Project Manual

U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2011

Team Canada
TRTL: Technological Residence, Traditional Living

Team Canada Solar Decathlon 2011
EVDS, Professional Faculties Building
University of Calgary
2500 University Drive NW
Calgary, Alberta, Canada
T2N 1N4

August 11, 2011

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Rules Compliance Checklist

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Rule 4-2	Construction Equipment	Specifications for heavy machinery	O-601 PM - Datasheets - Crane
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Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	NA
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that have been or will be stamped by the qualified, licensed design professional in the stamped structural submission; the stamped submission shall consist entirely of sheets that also appear in the drawings and project manual	S-001 through S-901
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Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	NA
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Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	NA
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Rule 8-4	Desiccant Systems	Specifications for desiccant system components	NA
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Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-001 till E-603
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Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. EDT or between 8 a.m. and 4 p.m. solar time on October 1	P-101 L-101

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Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	NA
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Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	Specifications 22 11 00
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Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-103

Detailed Water Budget

FUNCTION	WATER USE (GALLONS)	CALCULATIONS		NOTES
		GAL	EVENTS	
Hot Water Draws	240	15	16	Hot water draws as per contest criteria
Water Vaporization	2.4	0.6	4	Water evoparization events as per contest criteria
Dishwasher	20	4	5	Dishwasher events as per contest criteria
Clothes Washer	200	25	8	Clothes washer estimate as per contest criteria
Vegetation	60	-	-	Based on 1/4" of irrigation per ft^2 vegetation/week using low water intensity native plant species
Fire Protection	300			Fire protection system fill + 250 Gal in case of fire (estimated with hydraulics calculations method for required flow)
Testing	15			Testing of plumbing operational plumbing fixtures
Hydronics	15	-	-	Estimated Hydronic system volume
Safety Factor	85.24			10% safety factor
WATER REQUIRED	**937.64**	gallons		

Team provided liquids

Team intents to arrive on-site with fully charged heating and cooling system which includes:

- Approximately 15 US Gallons, water (heating/cooling fluid)
- 8.2 Lbs of refrigerant R-410A (air-source heat-pump)

Structural Calculations

TEAM CANADA 2011 SOLAR DECATHLON STRUCTURAL CALCULATIONS

Structural Calculations – Procedure

- Definition of design loads: dead, live, snow, wind, seismic
- Analysis of structural steel ribs
    - Tributary width calculations
    - Applied loads
    - SAP2000 model outputs
    - Check for lateral-torsional buckling of unsupported bottom flange
    - Deflections due to wind and seismic loads
    - Lateral support sizing
- SIP shear wall analysis
    - Applied loads
    - Force distribution analysis and required wall strength
    - Sizing of steel gauge plates
    - SIP connections
- Analysis of structural steel floor modules
    - Factored loads (beam strength)
    - Service loads (beam deflections)
    - Foundation bearing pressures, footing sizing
    - Foundation bracing sizing
    - Bracing connection design

LOAD CALCULATIONS

Note: all environmental loads used in design calculated for Alberta, Canada, using the worst case load factors specified in the Alberta Building Code 2006 (ABC 2006), as these values govern over loads calculated for Washington DC.

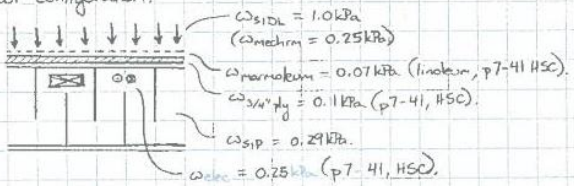
DEAD, LIVE AND SNOW LOADS

Dead Loads:

ω_{SIP} = 0.29 kPa (10.25" TCI panel, TCI tech specs).
$\omega_{roofing}$ = 0.15 kPa (3-ply asphalt, no gravel)
ω_{elec} = 0.15 kPa (minimal suspended wiring/ducts). } p 7-41, HSC
ω_{PV} = 0.25 kPa (panel wt. = 0.133 kPa)
ω_{window} = 0.70 kPa. (triple glazed, p586 0-86 wood design manual).

Roof/wall configurations: SIPs only → ω_D = 0.29 + 0.15 + 0.15 = 0.59 kPa.
PV only → ω_D = 0.25 kPa
SIP + PV → ω_D = 0.59 + 0.25 = 0.84 kPa.
Window → ω_D = 0.7 kPa.

Floor configuration:



Typical floor: ω_D = 1.0 + 0.07 + 0.11 + 0.29 + 0.25
= 1.72 kPa

Mech room: ω_D = 1.72 + 0.25 = 1.97 kPa.

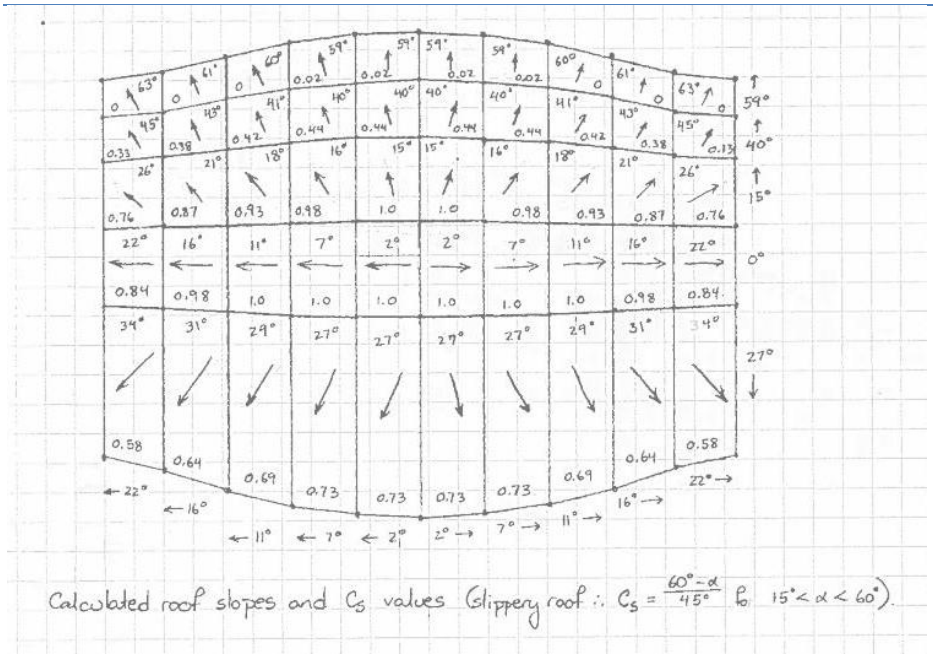
Live Loads:

ω_L = 2.4 kPa (house)
ω_L = 4.8 kPa (deck - means of egress).
ω_L = 1.0 kPa (roof minimum).

Snow Loads:

S_s = 2.9 kPa } Swan Hills, AB (Table C2, ABC 2006).
S_r = 0.1 kPa
I_s = 1.0 (Normal importance).
C_w = 1.0 (assumed sheltered → conservative).
C_b = 0.8 (l_c < 70m).
C_s = 1.0 (assumes no sliding snow).
C_a = 1.25 (assumes Case II loading, used for entire roof to account for drifting in all directions).

$S = I_s[S_s(C_b C_w C_s C_a) + S_r] = (1.0)[(2.9)(0.8)(1.0)(1.0)(1.25) + 1.0] = 3.0$ kPa.



UPDATES:

Note: Target Alberta location changed from Cardston ($q = 1.02$ kPa) to Calgary ($q = 0.50$ kPa)

$$P = I_w q C_e C_g C_p$$

$$C_e = 0.7 > 0.7\left(\frac{5.4}{12}\right)^{0.3} = 0.55 \text{ [Urban/Suburban Env.]}$$

$$P = P_0\left(\frac{C_e}{C_{e_0}}\right)\left(\frac{q}{q_0}\right) = P_0\left(\frac{0.7}{0.9}\right)\left(\frac{0.5}{1.02}\right) = 0.381P_0$$

$$P_{net} = 1.61(0.381) = 0.613 \text{ kPa}$$

$$P_{net,E} = 2.02(0.381) = 0.770 \text{ kPa}$$

Base Shears

$$V_w(EW) = (A - A_E)P_{net} + A_E P_{net,E} = (39.9 - 6)(0.613) + (6)(0.770) = 25.4 \text{ kN}$$

$$V_w(NS) = (A - A_E)P_{net} + A_E P_{net,E} = (52.2 - 17.5)(0.613) + (17.5)(0.770) = 34.75 \text{ kN}$$

Wind Loads:

$I_w = 1.0$ (Normal importance)

$q_{1/50} = 1.02 kPa$ (Cardston, AB, Table C2, ABC 2006).

$C_e = \left(\frac{h}{10}\right)^{0.2} \geq 0.9 = \left(\frac{54m}{10}\right)^{0.2} = 0.884 < 0.9 \therefore C_e = 0.9.$

$C_g C_p = f(\alpha) \rightarrow$ assumed in-plane with ridge.

	Wind blowing North.		Wind blowing South	
α	Central	End Zone	Central	End Zone
90° (S)	1.05	1.30	-0.70	-0.90
27° (S)	0.40	0.50	-0.83	-1.08
0° (U)	-1.30	-2.00	-1.30	-2.00
15° (N)	-0.90	-1.30	0.60	0.75
40° (N)	-0.90	-1.30	0.60	0.75
59° (N)	-0.90	-1.30	0.60	0.75
90° (N)	-0.70	-0.90	1.05	1.30

$P = I_w q C_e C_g C_p$ (kPa).

	Wind blowing N		Wind blowing S.	
α	Central	End Zone	Central	End Zone
90° (S)	0.964	1.193	-0.643	-0.826
27° (S)	0.367	0.459	-0.762	-0.991
0° (U)	-1.193	-1.863	-1.193	-1.863
15° (N)	-0.826	-1.193	0.551	0.689
40° (N)	-0.826	-1.193	0.551	0.689
59° (N)	-0.826	-1.193	0.551	0.689.
90° (N)	-0.643	-0.826	0.964	1.193

Vertical projection:

Central: $p_{net} = 0.964 kPa + 0.643 kPa = 1.61 kPa$

End Zone: $p_{net,E} = 1.193 kPa + 0.826 kPa = 2.02 kP.$

Horizontal projection:

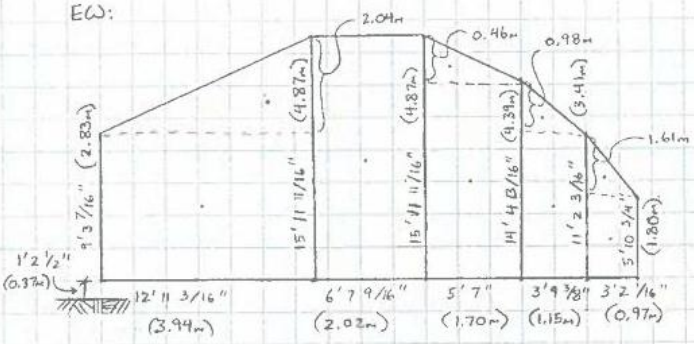
Central: $p = -1.193 kPa$

End Zone: $p = -1.863 kPa.$

Wind base shear + overturning moment

Projected areas + centroids:

EW:



$z \leq 0.1\omega = 0.1(9.855m) = 0.99m$

$\leq 0.4H = 0.4(5.49m) = 2.2m$

$\geq 0.04\omega = 0.04(9.855m) = 0.4m$

$\geq 1m \therefore z = 1m$

$A_E = (1.0)(2.83m) + \frac{(1.0)}{(3.94)}(2.04)(1.0) + \frac{1}{2}(1.0)(1.8+3.41)$

$= 6m^2$

$A = \frac{1}{2}\left[(3.94)(2.83+4.87) + (2.02)(4.87)(2) + (1.7)(4.87+4.39) + (1.15)(3.41+4.39) + (0.97)(3.41+1.80)\right] = 39.9m^2$

$\bar{x} = \left[\frac{1}{2}(3.94)^2(2.83) + \frac{1}{2}(3.94)^2\left(\frac{2}{3}\right)(4.87-2.83) + (2.02)(4.87)(3.94+1.01) + (1.7)(4.39)\left(3.94+2.02+\frac{1.7}{2}\right) + (1.15)(3.41)\left(3.94+2.02+1.7+\frac{1.15}{2}\right)\right.$

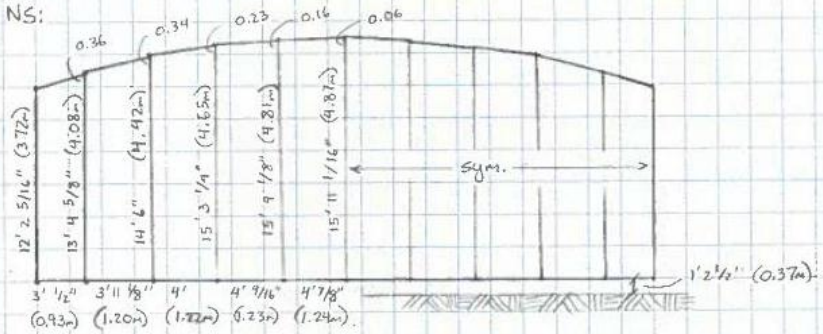
$\left. + (0.97)(1.8)\left(3.94+2.02+1.7+1.15+\frac{0.97}{2}\right) + (1.7)(4.87-4.39)\left(3.94+2.02+\frac{1.7}{3}\right) + (1.15)(4.39-3.41)\left(3.94+2.02+1.7+\frac{1.15}{3}\right)\right.$

$\left. + (0.97)(3.41-1.8)\left(3.94+2.02+1.7+1.15+\frac{0.97}{3}\right)\right] \times \frac{1}{79.8} = 5.24m$

$\bar{y} = \left[\frac{1}{2}(3.94)(2.83)^2 + \frac{1}{2}(2.02)(4.87)^2 + \frac{1}{2}(1.7)(4.39)^2 + \frac{1}{2}(1.15)(3.41)^2 + \frac{1}{2}(0.97)(1.80)^2 + \frac{1}{2}(3.94)(2.04)\left(2.83+\frac{2.04}{3}\right)\right.$

$\left. + \frac{1}{2}(1.7)(0.46)\left(4.39+\frac{0.46}{3}\right) + \frac{1}{2}(1.15)(0.98)\left(3.41+\frac{0.98}{2}\right) + \frac{1}{2}(0.97)(1.61)\left(1.80+\frac{1.61}{3}\right)\right] \times \frac{1}{79.8} = 2.12m.$

NS:



$A = (0.93)(3.72+4.08) + (1.2)(4.08+4.42) + (1.22)(4.42+4.65) + (1.23)(4.65+4.81) + (1.24)(4.81+4.87) = 52.2m^2$

$\bar{y} = \left[\frac{1}{2}(0.93)(3.72)^2 + \frac{1}{2}(1.2)(4.08)^2 + \frac{1}{2}(1.22)(4.42)^2 + \frac{1}{2}(1.23)(4.65)^2 + \frac{1}{2}(1.24)(4.81)^2 + \frac{1}{2}(0.93)(0.36)\left(3.72+\frac{0.36}{3}\right) + \frac{1}{2}(1.2)(0.34)\left(4.08+\frac{0.34}{3}\right)\right.$

$\left. + \frac{1}{2}(1.22)(0.23)\left(4.42+\frac{0.23}{3}\right) + \frac{1}{2}(1.23)(0.16)\left(4.65+\frac{0.16}{3}\right) + \frac{1}{2}(1.24)(0.06)\left(4.81+\frac{0.06}{3}\right)\right] \times \frac{2}{52.2} = 2.25m.$

$A_E = (0.93)(3.72+4.08) + (1.2)(4.08+4.42) = 17.5m^2$

Base shear (EW): $V_w = (A - A_E)p_{net} + A_E p_{net,E} = (39.9 - 6)(1.61) + (6)(2.02) = 66.7\,kN$

$V_{f_w} = 1.4V_w = 1.4(66.7\,kN) = 93.4\,kN$

$M_{f_w} = (93.4\,kN)(2.12m + 0.37m) = 233\,kN\cdot m$ (overturning moment).

Base shear (NS): $V_w = (A - A_E)p_{net} + A_E p_{net,E} = (52.2 - 17.5)(1.61) + (17.5)(2.02) = 91.1\,kN$

$V_{f_w} = 1.4V_w = 1.4(91.1\,kN) = 127.54\,kN$

$M_{f_w} = (127.54\,kN)(2.25m + 0.37m) = 334.2\,kN\cdot m$. (overturning moment).

Dead loads: Roof/walls/ribs → 157.7 kN

Floor system → 221 kN

Total D = 157.7kN + 221 kN = 378.7kN ; $D_f = 0.9D = 0.9(378.7) = 340.8\,kN$

$M_{f_D} = (340.8\,kN)\left(\frac{9.78m}{2}\right) = 1666\,kN\cdot m > 2M_{f_w} = 2(334.2) = 668.4\,kN\cdot m$.

∴ tie downs not required to resist overturning due to wind.

Total unfactored uplift force due to wind = 177.6kN ↑ $\quad W_{f,uplift} = 1.4(177.6) = 248.6\,kN$

$D_f = 340.8\,kN \leq 2W_{f,uplift} = 2(248.6kN) = 497.2\,kN$ ∴ tie downs required to resist (497.2 - 340.8) 156.4kN of uplift due to wind.

Max factored uplift force at column: $P_f = 14.10\,kN \uparrow$ (assured at midspan).

Max joist span: $3.5816m = \ell$

$M_{max} = \frac{P\ell}{2} = \frac{(14.10\,kN)(3.5816m)}{2} = -25.25\,kN\cdot m$ (assuming no reduction due to joist S.W. or floor loads).

for $L_u = 3.5816m$, $M_r'_{(W150\times18)} = \left(\frac{3.5816-3.5}{4-3.5}\right)(21.6-25.5) + 25.5 = 24.86\,kN\cdot m$

Joist self wt. $\omega_{S.W.} = 0.176\,kN/m$

$M_{SW} = \frac{\omega_{SW}\ell^2}{4} \times 0.9 = \frac{(0.176)(3.5816)^2}{4}(0.9) = 0.507\,kN\cdot m$

$M_{net} = M_{max} + M_{SW} = -25.25\,kN\cdot m + 0.507\,kN\cdot m = -24.74\,kN\cdot m \rightarrow 24.74\,kN\cdot m \leq 24.86\,kN\cdot m$
$\therefore$ adequate resistance.

Max factored moment in joist for downward loads $\sim 34\,kN\cdot m \leq M_{r(W150\times18)} = 42.2\,kN\cdot m$

$\rightarrow$ Therefore, joists in north and south modules can be W150×18.

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For central module, M_f in joists $\leq 32.0\,kN\cdot m$, no uplift $\therefore$ can use W150×14.

NORTH-SOUTH DIRECTION (MAIN LLRS IS STEEL RIB STRUCTURE)

Seismic Loads

$I_E = 1.0$ (Normal importance, ULS)
Soil bearing capacity, $S_U = 71.8$kPa (SD2511 Building Code)
→ Site class D assumed ($50\text{kPa} < S_U < 100\text{kPa}$), also conservative assumption of site conditions.

$S_a(0.2) = 0.2$, $S_a(0.5) = 0.12$, $S_a(1.0) = 0.06$, $S_a(2.0) = 0.03$, PBA = 0.1 (Cowley, AB, Table C2 ABC 2006)

$F_a = 1.3$ (Site class D, $S_a(0.2) = 0.2 < 0.25$)
$F_v = 1.4$ (Site class D, $S_a(1.0) = 0.06 < 0.1$)

$I_E F_a S_a(0.2) = (1.0)(1.3)(0.2) = 0.26 < 0.35$ ∴ Equivalent Static Force Procedure may be used

Assume conventional construction of moment frames, braced frames, or shear walls for steel structures designed and detailed according to CAN/CSA-S16.

$R_d = 1.5$, $R_o = 1.3$ } Table 4.1.8.9, ABC 2006.

Fundamental lateral period (steel moment frames): $T_a = 0.085 (h_n)^{3/4}$

$h_n = 18\text{ft} \approx 6\text{m}$
$T_a = 0.085 (6\text{m})^{3/4} = 0.3266$ ∴ $M_v = 1.0$ ($T_a < 1.0$)

$S(T_{0.5}) \geq F_v S_a(0.5) = (1.4)(0.12) = 0.168$
$\leq F_a S_a(0.2) = (1.3)(0.2) = 0.26$ } $S(T_{0.5}) = 0.168$

$S(T_{0.2}) = F_a S_a(0.2) = 0.26$

$S(T_a) = S(T_{0.3265}) = \frac{(0.3265 - 0.25)}{(0.5 - 0.25)}(0.168 - 0.26) + 0.26 = 0.2214$

$V = S(T_a) M_v I_E W / (R_d R_o) = (0.2214)(1.0)(1.0)W/(1.5 \times 1.3) = 0.114W$
$V \geq S(2.0) M_v I_E W / (R_d R_o) = (0.03)(1.0)(1.0)W/(1.5 \times 1.3) = 0.0154W$
$R_d \geq 1.5$ ∴ $V \leq \frac{2}{3} S(0.2) I_E W / (R_d R_o) = \frac{2}{3}(0.2)(1.0)(W)/(1.5 \times 1.3) = \boxed{0.0684W}$

EAST-WEST DIRECTION

Main LLRS is Titan Wall structural insulated panels. Therefore: Rd = 1.0, Ro = 1.0
V = S(Ta)MvIeW/(RdRo) = (0.2214)(1.0)(1.0)W/(1.0)(1.0) = 0.2214W

STRUCTURAL RIBS

Table 1: Structural Rib Geometry

Parameter	Structural Rib					
	RIB 1	**RIB 2**	**RIB 3**	**RIB 4**	**RIB 5**	**RIB 6**
Total length (m)	11.92	12.41	13.53	14.35	14.85	15.01
Horizontal projected length (m)	9.04	9.19	9.72	10.12	10.33	10.41
Overhang length (m)	0.70	1.48	1.21	0.99	0.85	0.73
Window height (m)	2.07	2.07	2.24	2.36	2.44	2.46
Trib Area – Left (m^2)	0.00	7.01	8.60	9.15	9.50	9.65
Trib Width – Left (m)	0.00	0.57	0.64	0.64	0.64	0.64
Trib Area – Right (m^2)	6.88	8.26	8.90	9.35	9.60	9.65
Trib Width – Right (m)	0.58	0.67	0.66	0.65	0.65	0.64
Trib Area – Total (m^2)	6.88	15.27	17.50	18.49	19.10	19.30
Trib Width - Average Total (m)	0.58	1.23	1.29	1.29	1.29	1.29

Table 2: Summary of Loads on Structural Steel Ribs

Parameter	Factor	RIB 1	RIB 2	RIB 3	RIB 4	RIB 5	RIB 6
Rib Geometry							
Total Rib Length (m)		11.92	12.41	13.53	14.35	14.85	15.01
Horizontal Proj (m)		9.04	9.19	9.72	10.12	10.33	10.41
Overhang (m)		0.70	1.48	1.21	0.99	0.85	0.73
Window height (m)		2.07	2.07	2.24	2.36	2.44	2.46
Tributary Width (m)		0.58	1.23	1.29	1.29	1.29	1.29
Window factor		0.00	0.00	0.50	1.00	1.00	1.00
Dead Loads							
Typical wall (kN/m)	0.59	0.34	0.54	0.76	0.76	0.76	0.76
PV + wall (kN/m)	0.84	0.48	0.85	1.09	1.08	1.08	1.08
PV only (kN/m)	0.25	0.14	0.31	0.32	0.32	0.32	0.32
Windows (kN/m)	0.70	0.40	0.86	0.91	0.90	0.90	0.90
South wall (kN/m)	weighted	0.17	0.54	0.83	0.90	0.90	0.90
Flat roof (kN/m)	weighted	0.17	0.54	0.76	0.76	0.76	0.76
Ribs (kN/m)		0.18	0.22	0.22	0.22	0.22	0.22
Live Loads							
Live load (kN/m)	1	0.58	1.23	1.29	1.29	1.29	1.29
Snow Loads							
Snow load (kN/m)	3	1.30	3.24	3.88	3.87	3.86	3.86
Wind Loads							
CgCp overhang		-7.00	-5.60	-4.20	-4.20	-4.20	-4.20
Overhang wind (kN/m)	0.918	-3.71	-6.33	-4.99	-4.97	-4.96	-4.96
CgCp uplift		-2.00	-2.00	-1.65	-1.30	-1.30	-1.30
Wind uplift (kN/m)	0.918	-1.06	-2.26	-1.96	-1.54	-1.53	-1.53
Total uplift (kN)		-9.58	-20.77	-19.04	-15.56	-15.85	-15.97
Seismic Loads							
D (kN)		5.23	12.14	16.15	16.91	17.38	17.50
S (kN)		11.74	29.77	37.70	39.12	39.85	40.15
W (kN)		8.16	19.58	25.57	26.70	27.35	27.54
V (kN) NS	0.0684	0.56	1.34	1.75	1.83	1.87	1.88
V (kN) EW	0.26	2.12	5.09	6.65	6.94	7.11	7.16

Table 3: Detailed Summary of Snow Loads on Structural Ribs

Cs Factors							
		Bay 1	**Bay 2**	**Bay 3**	**Bay 4**	**Bay 5**	
90	**S**	0.00	0.00	0.00	0.00	0.00	
27	**S**	0.56	0.64	0.69	0.71	0.73	
0	**U**	0.84	0.98	1.00	1.00	1.00	
15	**N**	0.74	0.85	0.92	0.97	1.00	
40	**N**	0.32	0.38	0.41	0.43	0.44	
59	**N**	0.00	0.00	0.00	0.01	0.02	
90	**N**	0.00	0.00	0.00	0.00	0.00	
		22	**16**	**11**	**7**	**2**	
Net Pressures (kPa)							
		Bay 1	**Bay 2**	**Bay 3**	**Bay 4**	**Bay 5**	
90	**S**	0.00	0.00	0.00	0.00	0.00	
27	**S**	1.72	1.94	2.09	2.17	2.22	
0	**U**	2.55	2.94	3.00	3.00	3.00	
15	**N**	2.25	2.55	2.77	2.90	2.99	
40	**N**	1.02	1.19	1.29	1.35	1.39	
59	**N**	0.10	0.10	0.10	0.14	0.16	
90	**N**	0.00	0.00	0.00	0.00	0.00	
UDLs (kN/m)							
		Rib 1	**Rib 2**	**Rib 3**	**Rib 4**	**Rib 5**	**Rib 6**
90	**S**	0.00	0.00	0.00	0.00	0.00	0.00
27	**S**	0.99	2.27	2.61	2.74	2.82	2.86
0	**U**	1.47	3.39	3.84	3.87	3.86	3.86
15	**N**	1.30	2.97	3.44	3.65	3.79	3.85
40	**N**	0.59	1.37	1.61	1.70	1.76	1.78
59	**N**	0.06	0.12	0.13	0.15	0.19	0.21
90	**N**	0.00	0.00	0.00	0.00	0.00	0.00

Table 4: Detailed Summary of Wind Loads on Structural Ribs

CgCp Factors			Wind blowing N		Wind blowing S			
			Central	End Zone*	Central	End Zone*		
	90	S	1.05	1.30	-0.70	-0.90	*End Zone includes Bays 1, 2, 9, and 10	
	27	S	0.40	0.50	-0.83	-1.08		
	0	U	-1.30	-2.00	-1.30	-2.00		
	15	N	-0.90	-1.30	0.60	0.75		
	40	N	-0.90	-1.30	0.60	0.75		
	59	N	-0.90	-1.30	0.60	0.75		
	90	N	-0.70	-0.90	1.05	1.30		
Net Pressures (kPa)								
			Bay 1	**Bay 2**	**Bay 3**	**Bay 4**	**Bay 5**	
Wind blowing North (Wind1)	90	S	1.193	1.193	0.964	0.964	0.964	
	27	S	0.459	0.459	0.367	0.367	0.367	
	0	U	-1.836	-1.836	-1.193	-1.193	-1.193	
	15	N	-1.193	-1.193	-0.826	-0.826	-0.826	
	40	N	-1.193	-1.193	-0.826	-0.826	-0.826	
	59	N	-1.193	-1.193	-0.826	-0.826	-0.826	
	90	N	-0.826	-0.826	-0.643	-0.643	-0.643	
Wind blowing South (Wind2)	90	S	-0.826	-0.826	-0.643	-0.643	-0.643	
	27	S	-0.991	-0.991	-0.762	-0.762	-0.762	
	0	U	-1.836	-1.836	-1.193	-1.193	-1.193	
	15	N	0.689	0.689	0.551	0.551	0.551	
	40	N	0.689	0.689	0.551	0.551	0.551	
	59	N	0.689	0.689	0.551	0.551	0.551	
	90	N	1.193	1.193	0.964	0.964	0.964	
UDLs (kN/m)								
			Rib 1	**Rib 2**	**Rib 3**	**Rib 4**	**Rib 5**	**Rib 6**
Wind1	90	S	0.69	1.47	1.39	1.24	1.24	1.24
	27	S	0.26	0.56	0.53	0.47	0.47	0.47
	0	U	-1.06	-2.26	-1.95	-1.54	-1.53	-1.53
	15	N	-0.69	-1.47	-1.30	-1.06	-1.06	-1.06
	40	N	-0.69	-1.47	-1.30	-1.06	-1.06	-1.06
	59	N	-0.69	-1.47	-1.30	-1.06	-1.06	-1.06
	90	N	-0.48	-1.02	-0.95	-0.83	-0.83	-0.83
Wind2	90	S	-0.48	-1.02	-0.95	-0.83	-0.83	-0.83
	27	S	-0.57	-1.22	-1.13	-0.98	-0.98	-0.98
	0	U	-1.06	-2.26	-1.95	-1.54	-1.53	-1.53
	15	N	0.40	0.85	0.80	0.71	0.71	0.71
	40	N	0.40	0.85	0.80	0.71	0.71	0.71
	59	N	0.40	0.85	0.80	0.71	0.71	0.71
	90	N	0.69	1.47	1.39	1.24	1.24	1.24

TYPICAL LOAD APPLICATION IN SAP2000 (ALL LOADS IN KN/M)

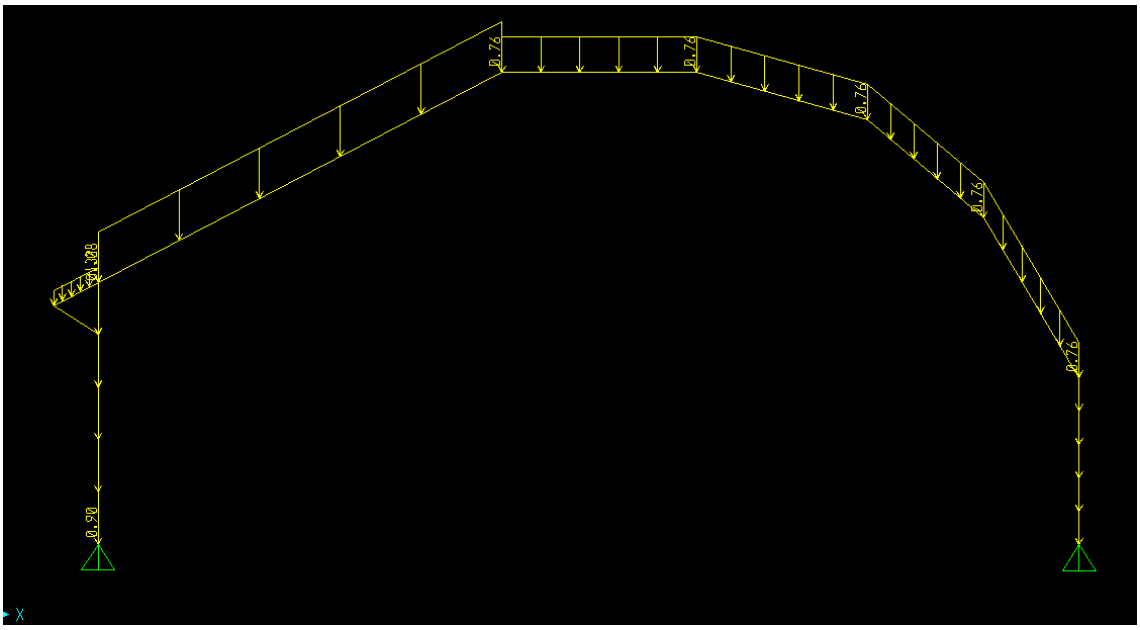


Figure 1: Superimposed Dead Loads on Rib 6

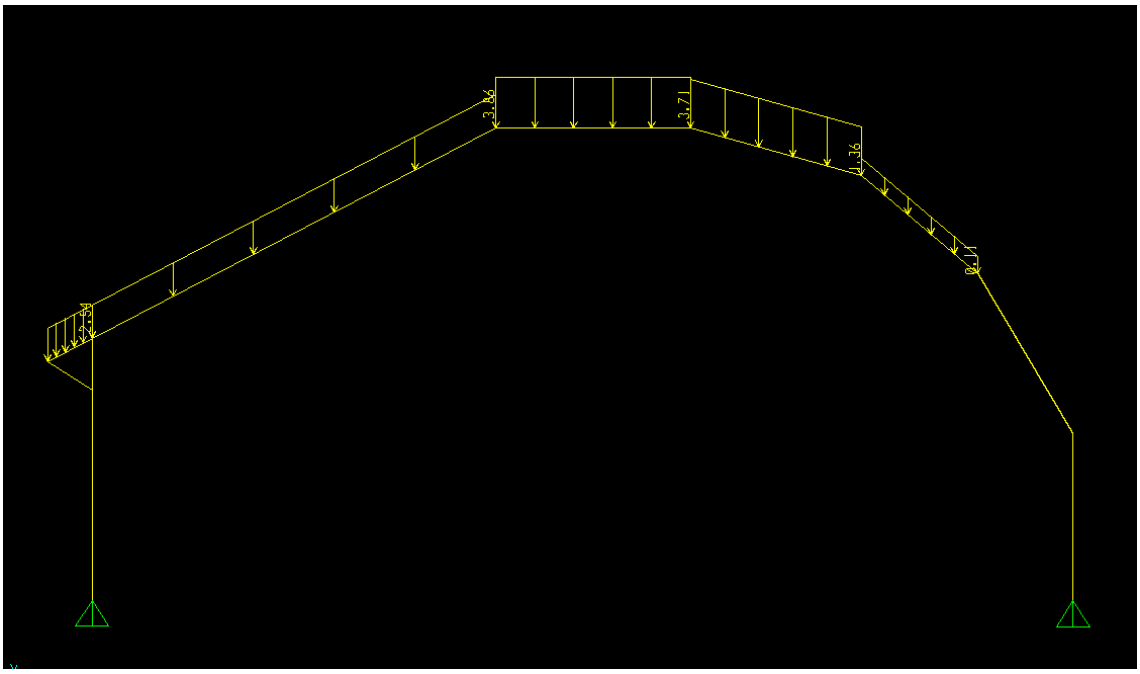


Figure 2: Snow Loads on Rib 6 (Snow1)

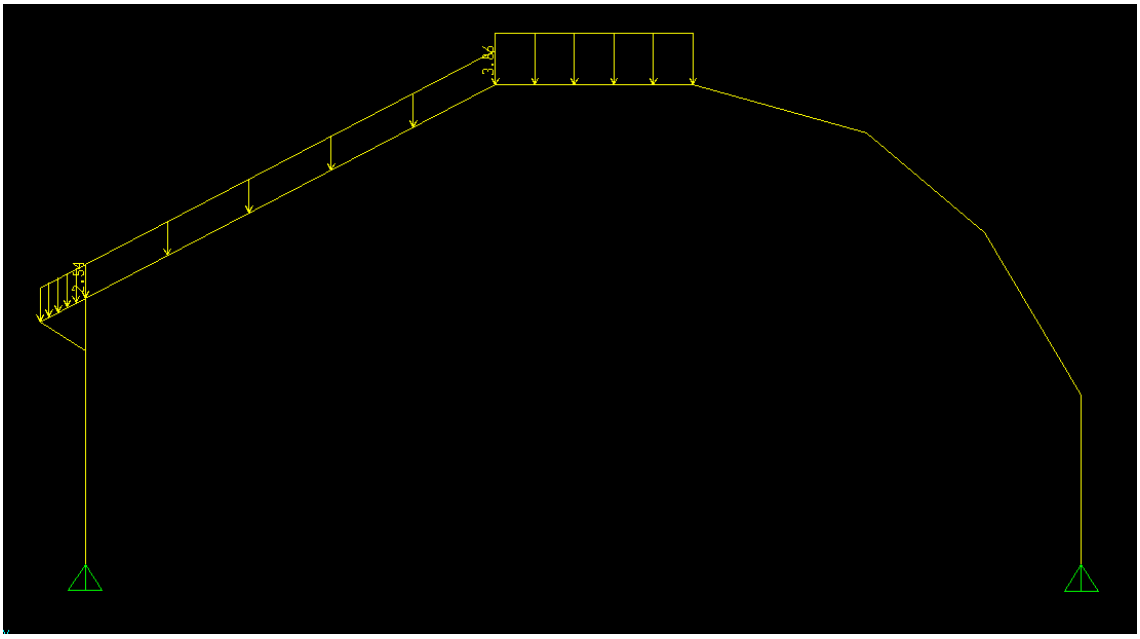


Figure 3: Unbalanced Snow Loads on Rib 6 (Snow2)

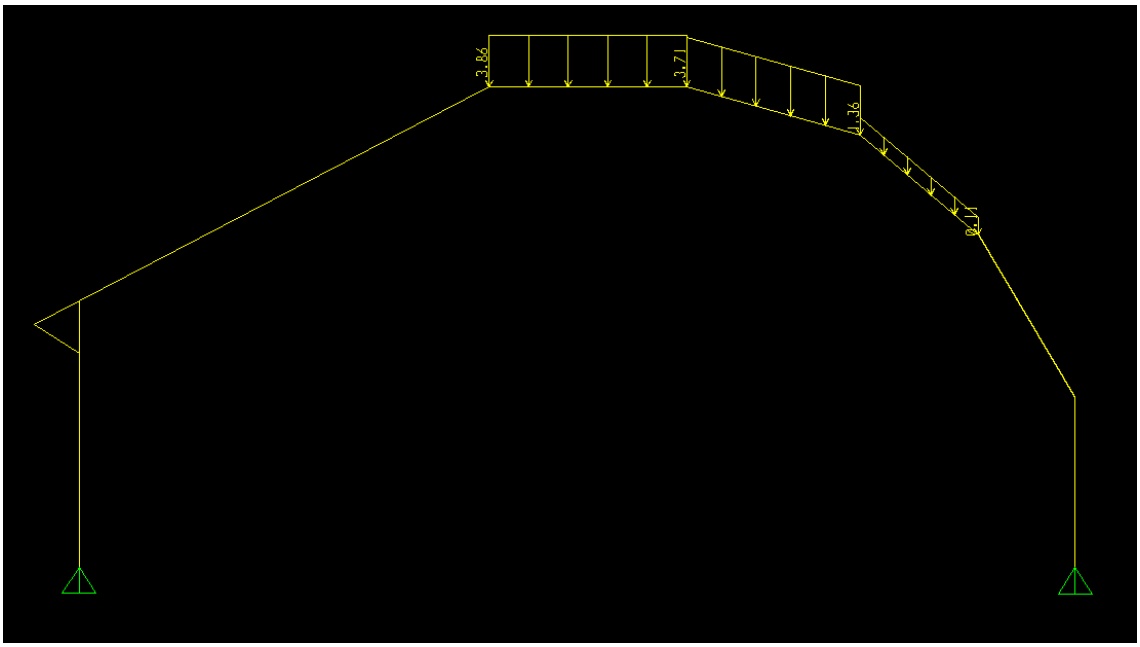


Figure 4: Unbalanced Snow Loads on Rib 6 (Snow3)

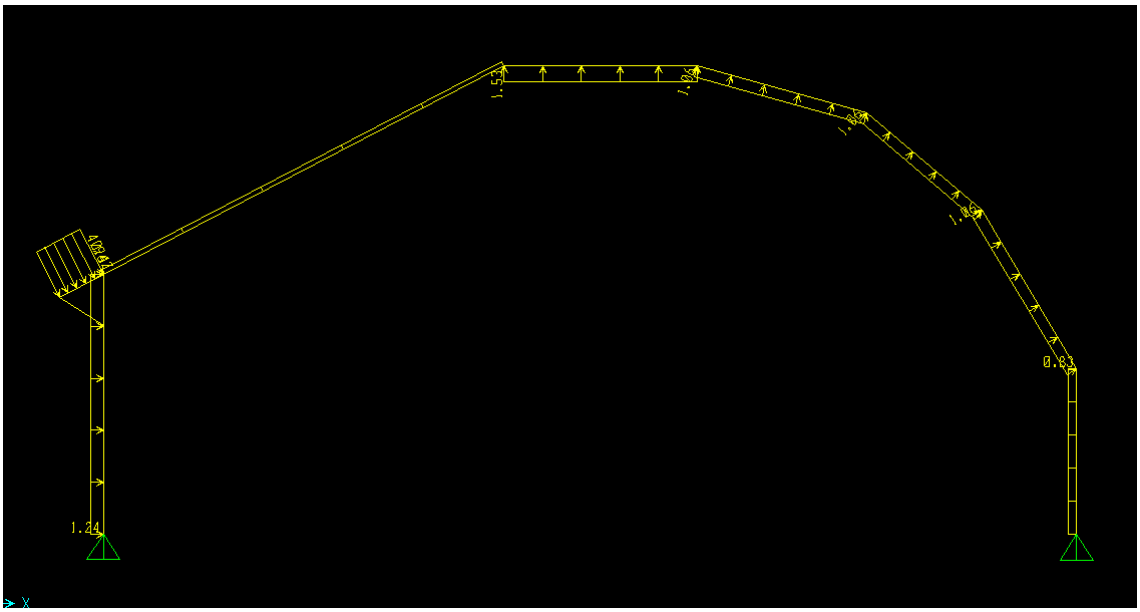


Figure 5: Wind Loads on Rib 6 - Wind Blowing North (Wind1)

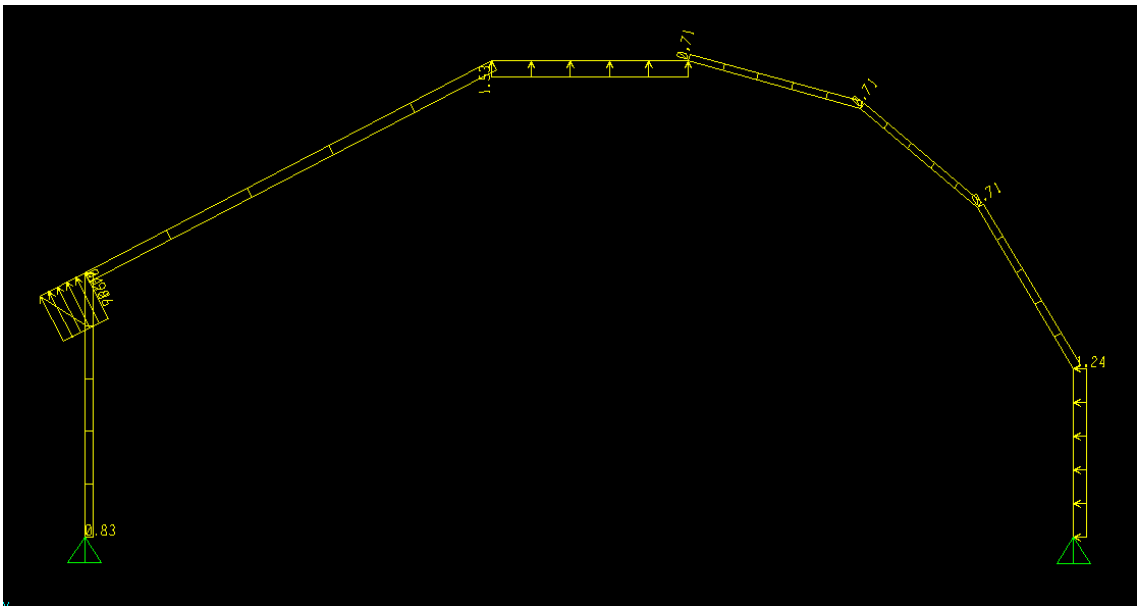


Figure 6: Wind Loads on Rib 6 - Wind Blowing South (Wind2)

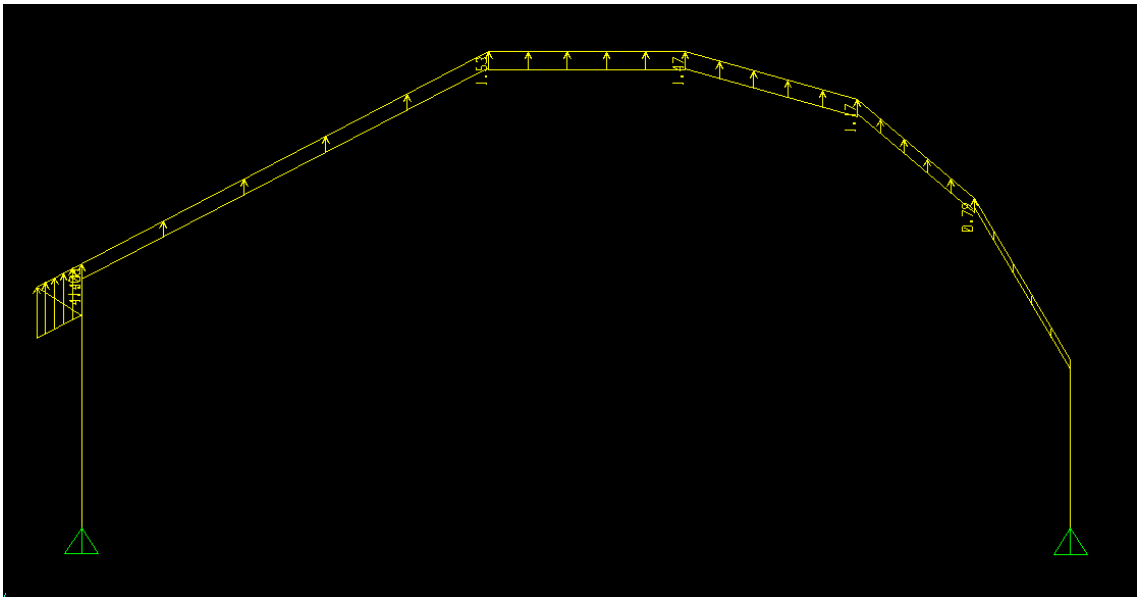


Figure 7: Wind Loads on Rib 6 - Wind Uplift (Wind3)

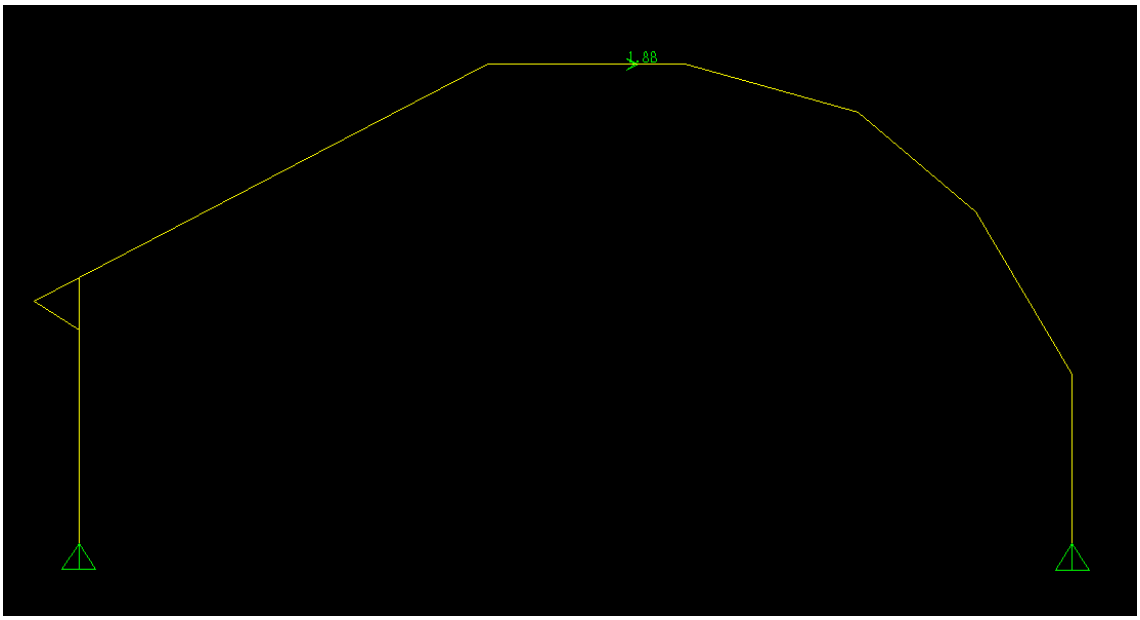


Figure 8: Seismic Loads on Rib 6 (Seismic1)

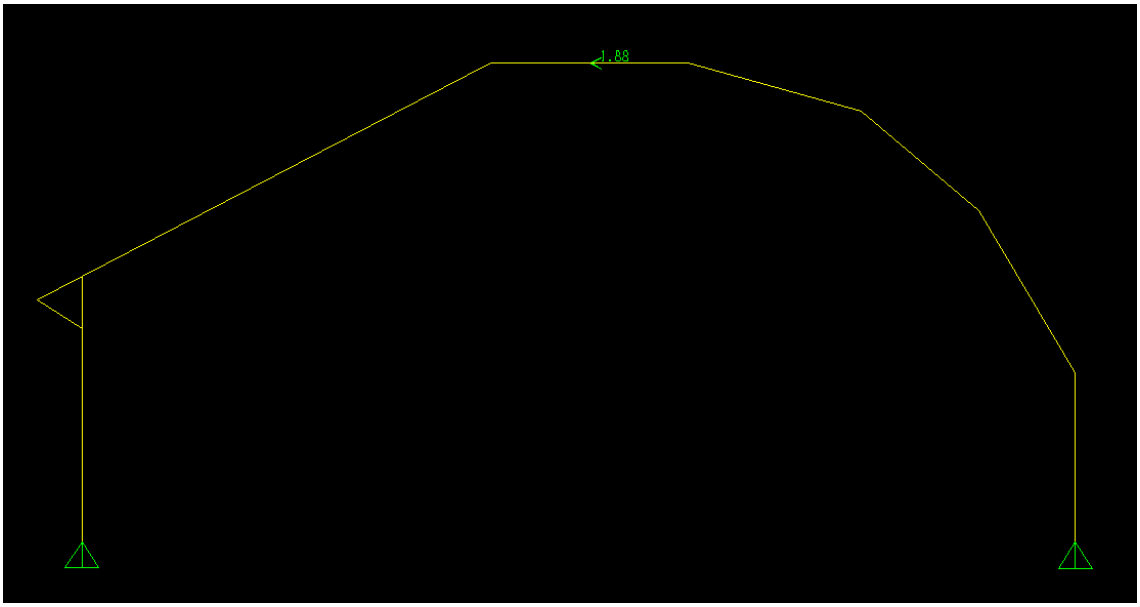


Figure 9: Seismic Loads on Rib 6 (Seismic2)

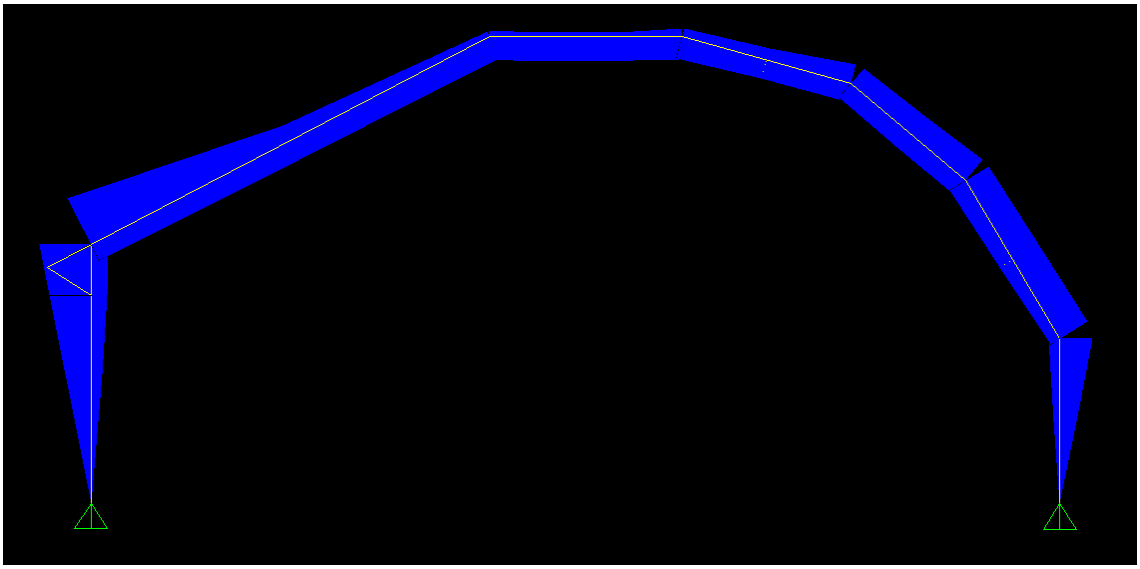


Figure 10: Bending Moment Envelope for Rib 6

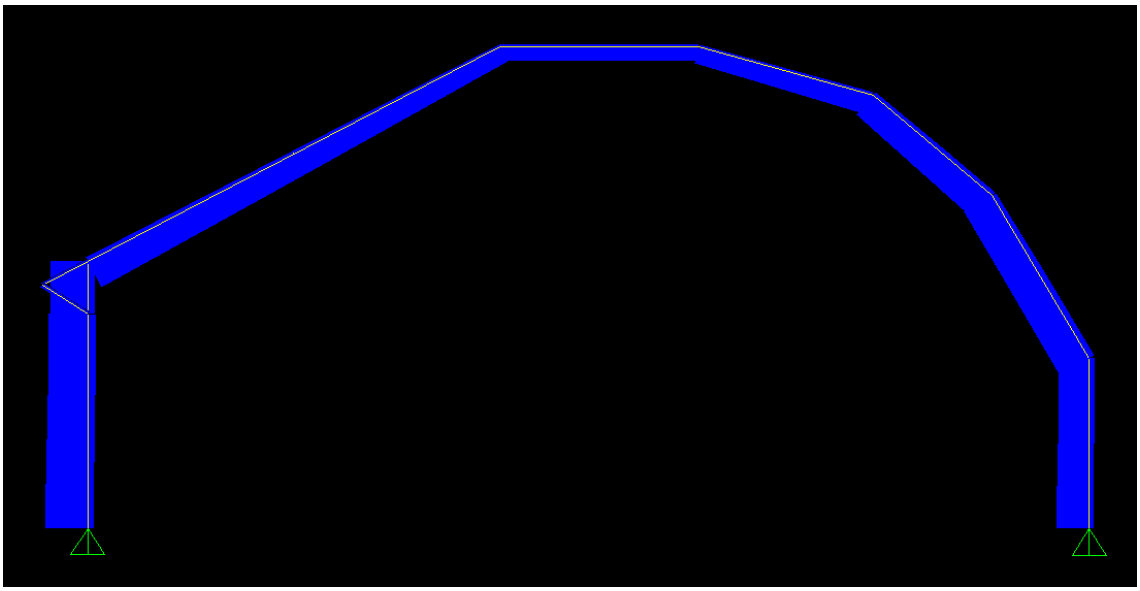


Figure 11: Axial Force Diagram for Rib 6

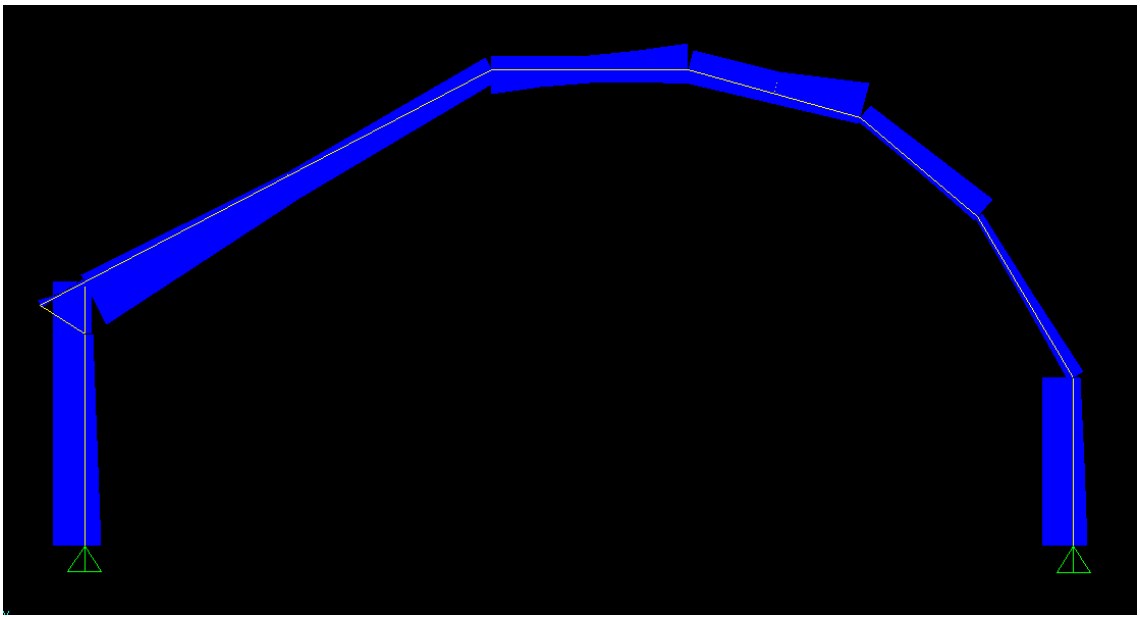


Figure 12: Shear Force Diagram for Rib 6

Table 5 – Summary of Factored Rib Design Forces by Frame

Rib	Frame	Length (m)	Max M3 (kN-m)	Min M3 (kN-m)	Max P (kN)	Min P (kN)	Max V2 (kN)	Min V2 (kN)
1	10	2.02	8.29	-6.64	11.36	-13.34	7.09	-6.89
	11	3.17	6.64	-8.29	2.56	-6.26	3.72	-6.03
	12	1.47	3.77	-2.46	0.61	-2.78	3.02	-3.00
	13	1.32	4.00	-3.80	1.27	-3.96	3.88	-2.61
	14	1.06	4.32	-4.44	1.96	-5.98	2.77	-1.46
	15	1.34	4.32	-4.44	2.84	-7.10	1.76	-1.40
	16	1.29	3.06	-4.12	2.98	-7.17	2.99	-3.32
	17	1.68	2.03	-1.77	3.35	-5.60	4.85	-4.85
	18	1.77	0.01	0.00	4.87	-7.63	0.03	-1.00
2	1	2.00	18.49	-11.65	17.04	-26.52	11.25	-11.41
	2	3.37	11.65	-18.49	6.32	-15.17	6.59	-13.59
	3	1.50	8.71	-5.31	2.58	-7.22	7.36	-6.83
	4	1.35	9.27	-9.53	3.65	-10.09	9.41	-5.78
	5	1.09	9.99	-11.03	6.01	-14.86	6.40	-3.11
	6	1.40	9.99	-11.03	7.82	-17.38	4.02	-3.24
	7	1.29	6.90	-10.51	7.58	-17.16	6.69	-8.44
	8	1.21	1.86	-1.58	4.36	-6.55	6.14	-6.14
	9	1.28	0.00	0.00	6.00	-7.11	0.02	-0.02
3	1	2.16	24.56	-11.23	11.32	-31.74	8.93	-11.72
	2	3.73	11.45	-24.56	5.09	-19.76	5.90	-17.15
	3	1.62	11.85	-5.23	2.33	-9.64	9.32	-8.47
	4	1.46	10.26	-10.86	3.24	-13.33	12.09	-5.60
	5	1.22	10.40	-13.28	5.13	-19.56	8.18	-2.47
	6	1.54	10.40	-14.61	6.36	-22.90	4.58	-2.90
	7	1.38	6.66	-14.61	6.02	-22.61	6.18	-10.88
	8	0.99	1.02	-0.81	3.34	-4.15	4.14	-4.14
	9	1.04	0.00	0.00	3.81	-4.80	0.01	-0.01
4	1	2.36	29.90	-11.01	8.69	-34.28	7.81	-12.98
	2	4.09	12.28	-29.90	3.69	-22.36	5.73	-18.95
	3	1.76	13.33	-4.80	1.76	-11.13	10.28	-9.42
	4	1.59	11.76	-11.57	2.43	-15.23	13.44	-5.20
	5	1.36	10.48	-15.44	3.82	-22.15	8.96	-1.79
	6	1.72	10.38	-17.70	4.57	-25.78	4.61	-2.51
	7	1.47	6.30	-17.70	4.28	-25.19	5.57	-12.31
	8	0.85	0.75	-0.60	2.97	-3.55	3.56	-3.56
	9	0.89	0.00	0.00	3.26	-4.13	0.01	-0.01
5	1	2.44	31.78	-11.28	8.02	-35.33	7.53	-13.28
	2	4.24	13.68	-31.78	3.66	-23.31	5.96	-19.49
	3	1.82	14.70	-5.28	1.78	-11.13	10.81	-9.85
	4	1.65	13.54	-12.43	2.47	-15.70	14.28	-5.31

Table 5 – Summary of Factored Rib Design Forces by Frame

Rib	Frame	Length (m)	Max M3 (kN-m)	Min M3 (kN-m)	Max P (kN)	Min P (kN)	Max V2 (kN)	Min V2 (kN)
	5	1.42	11.38	-16.40	3.87	-23.21	9.45	-1.82
	6	1.77	11.15	-19.22	4.58	-27.04	4.92	-2.60
	7	1.52	6.71	-19.22	4.28	-26.00	5.72	-12.86
	8	0.73	0.56	-0.45	2.62	-3.06	3.09	-3.09
	9	0.77	0.00	0.00	2.81	-3.58	0.01	-0.01
6	1	2.41	30.43	-10.40	6.56	-33.46	6.72	-12.95
	2	4.18	13.45	-30.43	3.65	-23.18	5.79	-19.33
	3	1.79	14.31	-4.90	1.85	-11.05	10.77	-9.68
	4	1.63	13.18	-11.89	2.56	-15.62	14.29	-5.17
	5	1.40	10.71	-16.37	3.95	-23.12	9.48	-1.81
	6	1.71	10.51	-19.19	4.65	-26.92	4.76	-2.46
	7	1.54	6.43	-19.19	4.31	-25.94	5.52	-12.75
	8	0.46	0.22	-0.18	1.66	-1.92	1.94	-1.94
	9	0.48	0.00	0.00	1.77	-2.25	0.01	-0.01

Table 6: Summary of Factored Rib Design Forces

Rib	Max M3 (kN-m)	Min M3 (kN-m)	Max P (kN)	Min P (kN)	Max V2 (kN)	Min V2 (kN)
1	8.29	-8.29	11.36	-13.34	7.09	-6.89
2	18.49	-18.49	17.04	-26.52	11.25	-13.59
3	24.56	-24.56	11.32	-31.74	12.09	-17.15
4	29.90	-29.90	8.69	-34.28	13.44	-18.95
5	31.78	-31.78	8.02	-35.33	14.28	-19.49
6	30.43	-30.43	6.56	-33.46	14.29	-19.33

Table 7: Lateral Torsional Buckling Check - Rib 6

Load Case No.	M_{fmax} (L)	Lu (L)	Mr'	%	M_{fmax} (R)	Lu (R)	Mr'	%
1.1	7.59	1.79	63.0	12%	4.81	3.44	36.9	13%
4.1	0.00	0.00	68.9	0%	10.75	5.89	18.0	60%
4.2	12.41	5.15	21.2	59%	0.00	0.00	68.9	0%
4.3	2.58	5.42	19.8	13%	0.00	0.00	68.9	0%
5.1	3.10	1.16	68.9	5%	4.84	4.19	28.5	17%
5.6	7.74	2.69	47.4	16%	2.02	1.95	60.2	3%
3.1	23.91	1.70	64.8	37%	19.19	3.59	35.0	55%
3.2	30.43	2.09	57.5	53%	15.05	3.08	41.7	36%
3.3	25.45	1.91	60.8	42%	16.08	3.36	37.8	43%
4.6	0.00	0.00	68.9	0%	15.23	4.95	22.4	68%
4.10	21.48	4.06	29.8	72%	0.00	0.00	68.9	0%
4.14	4.05	1.70	64.8	6%	2.85	3.59	34.9	8%
5.2	6.69	1.48	68.7	10%	7.09	3.81	32.5	22%

5.7	11.32	2.30	53.8	21%	4.27	2.61	48.7	9%
3.6	17.11	1.37	68.9	25%	15.68	4.22	28.2	56%
3.7	23.63	1.87	61.5	38%	10.72	3.69	33.8	32%
3.8	18.65	1.60	66.8	28%	12.06	4.03	30.1	40%
4.7	0.00	0.00	68.9	0%	15.00	5.18	21.0	71%
4.11	19.21	4.01	30.3	63%	0.00	0.00	68.9	0%
4.15	1.79	0.95	68.9	3%	2.24	4.86	23.0	10%
5.3	5.55	1.31	68.9	8%	6.37	4.18	28.6	22%
5.8	10.19	2.04	58.4	17%	3.55	3.11	41.2	9%
3.11	16.79	2.29	54.0	31%	14.88	3.19	40.1	37%
3.12	23.31	3.26	39.2	59%	10.74	2.31	53.6	20%
3.13	18.33	2.86	44.9	41%	11.76	2.77	46.1	25%
4.8	0.00	0.00	68.9	0%	13.37	4.93	22.5	59%
4.12	19.10	4.39	26.7	72%	0.00	0.00	68.9	0%
4.16	1.68	3.56	35.4	5%	1.41	2.39	52.3	3%
5.4	5.50	1.65	65.8	8%	6.37	3.67	34.0	19%
5.9	10.13	2.90	44.3	23%	3.55	2.21	55.4	6%

For all applied load cases, Mr' > M_{fmax} therefore Rib 6 is adequate to resist lateral torsional buckling with bracing at tops of north and south columns. Mr' calculated for W8x15 section.

Table 8: Check of Critical L-T Buckling Cases for Rib 5

Rib	Load Case No.	Mmax	Lu	Mr'	%
5	4.6	15.77	5.09	21.5	73%
5	4.10	22.83	4.12	29.2	78%
5	4.7	15.57	5.32	20.3	77%
5	4.11	20.53	4.07	29.7	69%
5	4.12	20.30	4.43	26.3	77%

Table 9: Base Reactions of Structural Ribs

Rib	Joint	Factored Envelope				Service Envelope			
		Max F1	Min F1	Max F3	Min F3	Max F1	Min F1	Max F3	Min F3
1	11	6.89	-7.09	13.34	-11.26	3.50	-4.07	7.75	-7.38
	18	2.99	-3.32	7.17	-2.58	1.87	-1.81	4.81	-2.37
2	1	11.41	-11.25	26.52	-16.53	5.59	-6.69	16.57	-11.70
	8	6.69	-8.44	17.16	-6.70	4.25	-4.68	11.46	-5.85
3	1	11.44	-8.93	31.74	-10.15	6.28	-5.74	20.80	-9.38
	8	6.18	-10.88	22.61	-4.81	4.26	-6.28	15.22	-5.75
4	1	12.79	-7.81	34.28	-7.18	7.22	-5.23	22.51	-8.03
	8	5.57	-12.31	25.19	-2.98	4.03	-7.22	16.87	-4.99
5	1	13.22	-7.53	35.33	-6.32	7.54	-5.13	23.37	-7.75
	8	5.72	-12.86	26.00	-2.93	4.16	-7.54	17.94	-5.17
6	2	5.52	-12.75	25.94	-2.96	4.04	-7.50	17.89	-5.14
	3	12.95	-6.72	33.46	-4.61	7.50	-4.68	22.45	-6.73

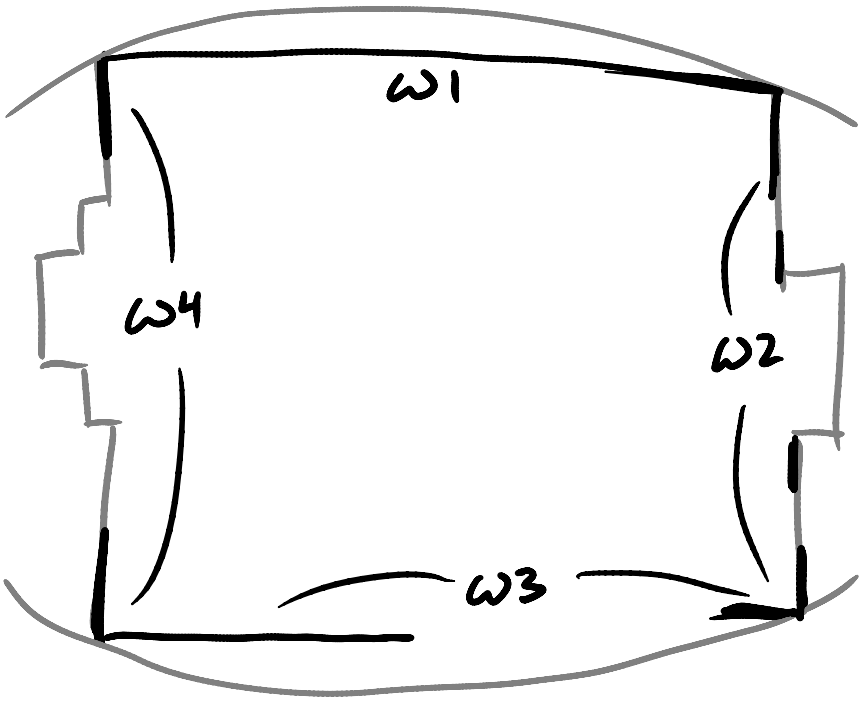


Figure 13: Shear Wall Layout for Calculations

Table 10: Shear Wall Force Distribution Calculations

Trial 1:		T =	84.2	Vx =	0	Vy =	127.54	
Wall	**Length**	**Parallel**	**x**	**y**	**d**	**Sd^2**	**P**	**kN/m**
1	9.6	x	-	7.89	2.61	65.5	6.08	0.63
2	3.76	y	9.6	-	4.14	64.4	68.78	18.29
3	4.75	x	-	0	-5.28	132.3	-6.08	-1.28
4	2.85	y	0	-	-5.46	85.0	58.76	20.62
			5.46	5.28		347.2		
Trial 2:		**T =**	**227.2**	**Vx =**	**0**	**Vy =**	**71**	
Wall	**Length**	**Parallel**	**x**	**y**	**d**	**Sd^2**	**P**	**kN/m**
1	9.6	x	-	7.89	2.61	65.5	16.41	1.71
2	3.76	y	9.6	-	4.14	64.4	30.20	8.03
3	4.75	x	-	0	-5.28	132.3	-16.41	-3.45
4	2.85	y	0	-	-5.46	85.0	40.80	14.31
			5.46	5.28		347.2		
Trial 3:		**T =**	**-3.73**	**Vx =**	**93.2**	**Vy =**	**0**	
Wall	**Length**	**Parallel**	**x**	**y**	**d**	**Sd^2**	**P**	**kN/m**
1	9.6	x	-	7.89	2.61	65.5	62.11	6.47
2	3.76	y	9.6	-	4.14	64.4	0.17	0.04
3	4.75	x	-	0	-5.28	132.3	31.13	6.55
4	2.85	y	0	-	-5.46	85.0	-0.17	-0.06
			5.46	5.28		347.2		
Trial 4:		**T =**	**65.95**	**Vx =**	**-70**	**Vy =**	**95.7**	
Wall	**Length**	**Parallel**	**x**	**y**	**d**	**Sd^2**	**P**	**kN/m**
1	9.6	x	-	7.89	2.61	65.5	-42.00	-4.38
2	3.76	y	9.6	-	4.14	64.4	51.48	13.69
3	4.75	x	-	0	-5.28	132.3	-27.90	-5.87
4	2.85	y	0	-	-5.46	85.0	44.22	15.52
			5.46	5.28		347.2		

Maximum Factored Shear = 20.62kN/m; Shear Strength of TW Panel = 30.89kN/m; therefore 1.5 FS

Table 11: Floor Module Factored Design Forces

Exterior Deck to Rib Distance and Tributary Width (metres)							
	RIB 1	**RIB 2**	**RIB 3**	**RIB 4**	**RIB 5**	**RIB 6**	
South	1.51	1.28	0.89	0.62	0.44	0.39	
North	1.25	1.14	0.81	0.60	0.44	0.41	
TW	0.48	1.07	1.19	1.21	1.22	1.21	
Factored Rib Reaction Forces (kN)							
South	13.3	26.5	31.7	34.3	35.3	33.5	
North	7.2	17.2	22.6	25.2	26.0	25.9	
Factored Module Reaction Forces (kN)							
S	13.2	28.6	36.6	41.3	44.0	42.8	
SC	15.0	29.6	30.0	28.5	27.1	26.3	
NC	12.0	25.6	27.3	26.9	26.0	25.7	
N	10.1	23.4	30.4	34.0	35.9	36.1	
Internal Moments of Joists (kN-m)							
S	16.58	32.28	32.66	29.22	25.45	23.21	
C	2.60	5.55	6.12	6.22	6.26	6.25	
N	10.82	23.92	25.79	24.50	22.03	21.31	
Internal Moments of Beams (kN-m)							
S	0.0	11.1	-12.8	12.4	-12.8	13.3	**13.3**
SC	0.0	12.4	-11.3	7.8	-7.7	8.3	**12.4**
NC	0.0	10.6	-10.1	7.5	-7.6	8.1	**10.6**
N	0.0	9.0	-10.4	10.2	-10.7	11.3	**11.3**
Base Reactions (kN)							
S	13.2	28.6	36.6	41.3	44.0	42.8	
SC	25.2	-	65.1	-	53.0	-	
NC	20.6	-	58.7	-	51.3	-	
NC	10.1	23.4	30.4	34.0	35.9	36.1	

Module Deck Length (m)		
3.63	North	
2.57	Centre	
3.61	South	

Applied Loads		
5.75	kPa	Factored Dist Load on N/S Modules
6.06	kPa	Factored Dist Load on Centre Module
0.22	kN/m	Unit mass of joists

Table 12: Floor Module Service Design Forces

Service Rib Reaction Forces (kN)						
South	7.8	16.6	20.8	22.5	23.4	22.5
North	4.8	11.5	15.2	16.9	17.9	17.9
Service Module Reaction Forces (kN)						
S	8.4	19.0	24.8	27.9	29.8	29.4
SC	10.1	20.4	21.1	20.1	19.3	18.7
NC	8.5	18.2	19.5	19.2	18.7	18.4
N	7.1	16.2	21.0	23.4	25.2	25.2
Internal Moments of Joists (kN-m)						
S	10.32	21.15	22.13	19.91	17.51	16.14
C	1.89	4.01	4.42	4.50	4.53	4.52
N	7.51	16.52	17.90	16.99	15.55	15.04
Internal Moments of Beams (kN-m)						
S	0.0	7.3	-8.5	8.4	-8.8	9.1
SC	0.0	8.5	-7.9	5.6	-5.5	5.9
NC	0.0	7.5	-7.2	5.4	-5.4	5.8
N	0.0	6.3	-7.2	6.9	-7.5	7.9
Base Reactions (kN)						
S	8.4	19.0	24.8	27.9	29.8	29.4
SC	17.1	-	45.6	-	37.7	-
NC	14.7	-	41.8	-	36.7	-
N	7.1	16.2	21.0	23.4	25.2	25.2

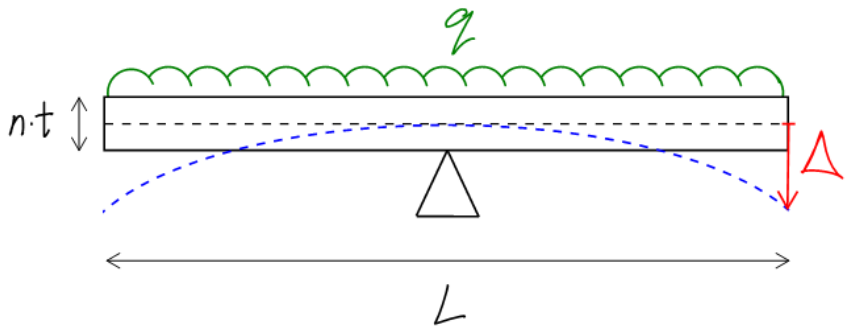
FOUNDATION FOOTING SIZING

Table 13: Footing Sizing Based on Service Design Forces

	RIB 1	**RIB 2**	**RIB 3**	**RIB 4**	**RIB 5**	**RIB 6**
Minimum Reaction Pad Side Length (in) – Based on 71.8kPa Bearing Pressure						
N	12.38	18.70	21.29	22.48	23.32	23.32
NC	17.81	-	30.04	-	28.15	-
SC	19.21	-	31.38	-	28.53	-
S	13.47	20.25	23.14	24.54	25.36	25.19
Maximum Reaction Pad Side Length (in) – Based on 47.9kPa Bearing Pressure						
N	15.16	22.90	26.07	27.52	28.56	28.56
NC	21.81	-	36.78	-	34.46	-
SC	23.52	-	38.41	-	34.93	-
S	16.49	24.80	28.33	30.05	31.05	30.84
Selected Reaction Pad Side Length (in)						
N	15	20	24	24	24	24
NC	21.5	-	32	-	30	-
SC	21.5	-	32	-	30	-
S	15	24	24	30	30	30

FOOTING PAD THICKNESSES

Deflection Model:



$$\Delta = \frac{qL^4}{96EI}$$

$$\Delta_{max} = \frac{L}{240}$$

$$I = \frac{L(n \cdot t)^3}{12}$$

$$\Delta_{\max} \geq \Delta$$

$$\frac{L}{240} = \frac{qL^4}{96E\left(\frac{L(nt)^3}{12}\right)}$$

$$n = \sqrt[3]{\frac{30\ qL^2}{b\ E\ t^3}}$$

Plywood Data		
t	3/4	in
	19.05	mm
E	1.10E+06	psi
	7.584	MPa

Drawing Keynote		**159**	**158**	**157**	**156A**	**156**	**155A**
L	*In*	32	30	24	21.5	20	15
L	*mm*	812.8	762	609.6	546.1	508	381
I	*mm4*	1.26E+07	1.19E+07	9.48E+06	8.49E+06	7.90E+06	1.76E+06
P	*kN*	45.6	37.7	25.2	17.1	17.1	8.4
q	*kPa*	69.0	64.9	67.8	57.3	66.3	57.9
n		2.97	2.78	2.43	2.14	2.14	1.69
Minimum Number of Layers		**3**	**3**	**3**	**3**	**3**	**2**
Δ	*mm*	3.27	2.54	1.36	0.82	0.77	0.95
Δ(max)	*mm*	3.39	3.18	2.54	2.28	2.12	1.59

CROSS BRACING DESIGN

BRACING BAY SIZES AND LOADS

East-West Bays

$$H_B(EW) = T = \frac{55.6}{8} = 6.95 \text{ kN} \qquad P = \frac{H_B}{\cos\alpha} \qquad V = H_B \tan\alpha$$

	Minimum	Maximum
Width, b	5'6" = 66"	10'5" = 125"
Height, h	9 3/4" = 9.75"	2'3 3/4" = 27.75"
Angle, α	4.46 deg	22.8 deg
Cable Tension, P	6.97 kN	7.54 kN
Shear, V	0.54 kN	2.92 kN

North-South Bays

$$H_B(Ns) = T = \frac{48.65}{6} = 8.11 \text{ kN} \qquad P = \frac{H_B}{\cos\alpha} \qquad V = H_B \tan\alpha$$

	Minimum	Maximum
Width, b	7'2 1/2" = 86.5"	10' 3/8" = 120.375"
Height, h	9 3/4" = 9.75"	2'3 3/4" = 27.75"
Angle, α	4.63 deg	17.79 deg
Cable Tension, P	8.14 kN	8.51 kN
Shear, V	0.66 kN	2.60 kN

CABLE SIZING

Maximum cable tension = 8.51 kN = 1915 lbs

Available Cables

A FS of 3 or more is recommended by many wire rope manufacturers and distributors.

7x19 Galvanized Aircraft Cable (GAC)

Table 14: 7x19 GAC Available Diameters and Ultimate Strengths[1]

Diameter(Inches)	Breaking Strength (lbs)
3/32	1,000
1/8	2,000
5/32	2,800
3/16	4,200
7/32	5,600
1/4	**7,000**
9/32	8,000
5/16	9,800
3/8	14,400

[1] http://www.lexcocable.com/7x19_aircraft_cable.html (June 6, 2011)

$$T_f = 3T_{max} = 5745 \text{ lbf}$$

∴ 1/4" 7x19 GAC is required

$$\Rightarrow FS = \frac{7000}{1915} = 3.66$$

BRAICNG CONNECTIONS

WOOD BLOCKING BOLTS

- ½" A325 bolts
- 4x6 Treated SPF
- 4 layers of untreated spruce plywood. (Countersunk through one layer)

BOLT BEARING

The following is based on the steps in the 1995 Wood Design Manual. The tabulated values for Q_r' are based on using A307 (Carriage) bolts. Stronger A325 bolts are to be used in this design.

$$Q_r = Q_r' n_s n_F K' J_R$$

$$Q_r' = 2.52 \text{ (38mm side plate)}$$

$$Q_r' = 3.44 \text{ (38mm side plate)}$$

$$Q_r' = 2.86$$

$$n_s = 1$$

$$n_F = 4$$

$$J_R = 1 \text{ (1 bolt per row)}$$

$$K' = K_D K_{SF} K_T$$

$$K_D = 1.15 \text{ (Short term load: wind/seismic)}$$

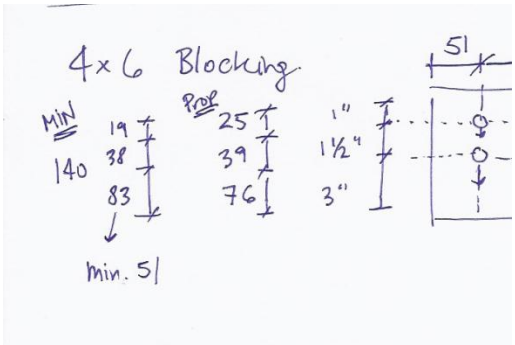
$$K_{SF} = 0.67 \text{ (other arrangements, wet)}$$

$$K_T = 1.0 \text{ (not treated with fire retardant)}$$

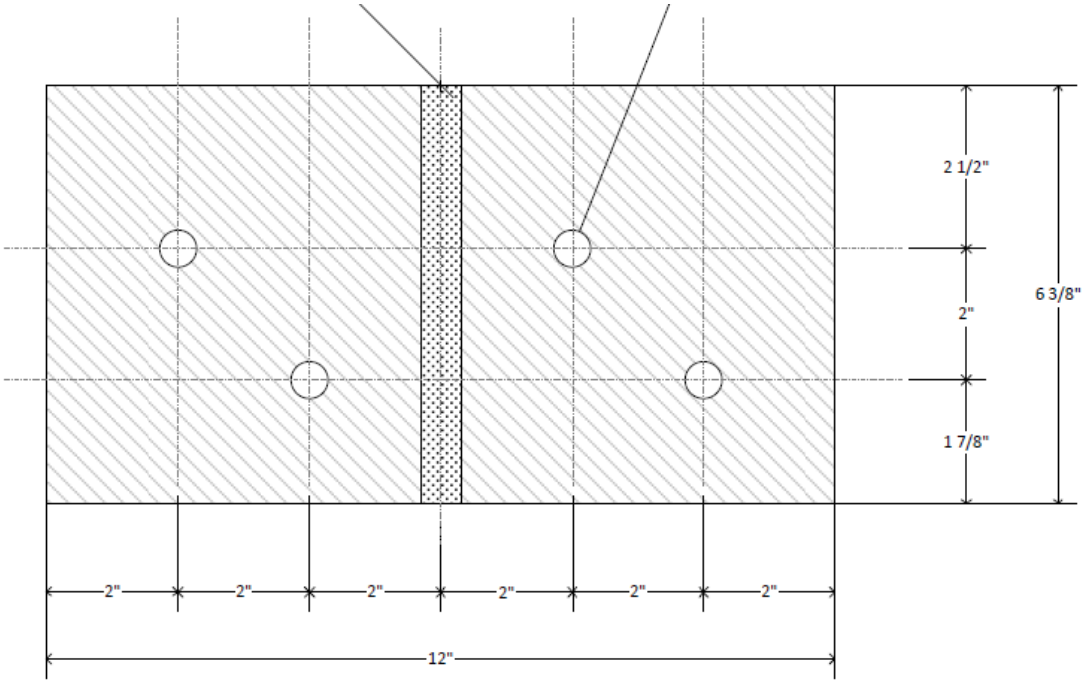
$$K' = (1.15)(0.67)(1.0) = 0.7705$$

$$Q_r = (2.863)(1)(4)(0.7705)(1) = 8.82 \text{ kN} > P_f = R_f = 8.11 \text{ kN}$$

REQUIRED SPACING



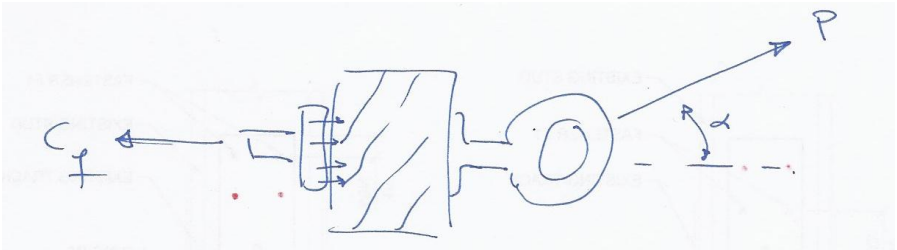
Bolts to be staggered as shown:



EYE BOLTS

Eye bolts connected to 4x6 lumber which is connected to plywood foundation pads.

BEARING



$$C_f = \frac{P}{\cos\alpha} = H_B = 8.11 \text{ kN}$$

7/8" nominal round washers: (OD = 2 1/4", ID = 15/16")

$$A_b = \frac{\pi}{4}\left(\left(2\frac{1}{4}\right)^2 - \left(\frac{15}{16}\right)^2\right) = 3.289 \text{ in}^2 = 2119 \text{ mm}^2$$

$$Q_r = \phi F_{cp} A_b K_B K_{Zcp} > C_f$$

SPF 89mm No.1/No.2

$f_{cp} = 5.3$

$K_D = 1.15$ [wind or seismic load; short term]

$K_{Scp} = 0.67$ [wet]

$K_T = 1.0$ [preserv., incised, greater than 89mm]

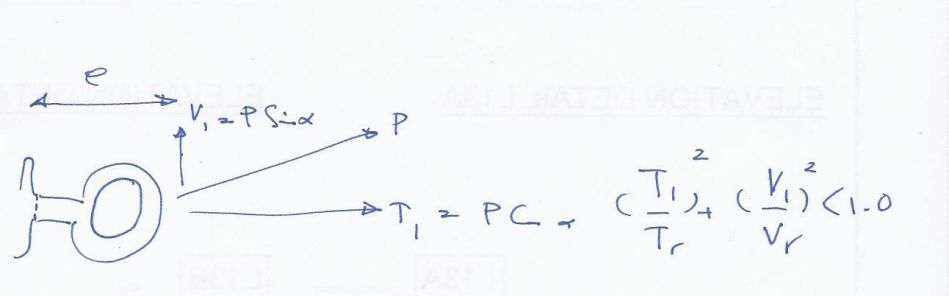
$F_{cp} = f_{cp} K_D K_{S_{cp}} K_T = (5.3)(1.15)(0.67)(1.0) = 4.08$ MPa

K_B
$= 1.19$ [57 mm bearing length; more than 75mm from end of member; bending stress minimized by short span]
$K_{Z_{cp}} = 1.08 \left(\frac{b}{d} = \frac{6}{4} = 1.5\right)$

$$Q_r = 0.8(4.08)(2119)(1.19)(1.08) = 8.88 \text{ kN} > C_f = 8.11 \text{ kN}$$

So config. meets bearing req.

SHEAR AND TENSION



For 5/8" Eye bolt (ASTM 489, $F_u = 448$ MPa (min), $F_y = 207$ MPa)

$$A_b = \frac{\pi}{4(15.9)^2} = 197.9 \text{ mm}^2$$

$$T_{f1} = T_{f2} = 8.11 \text{ kN}$$

$$V_{f1} = 3.10 \text{ kN}$$

$$V_{f2} = 1.10 \text{ kN}$$

$$T_r = 0.75\phi_b A_b F_u = (0.75)(0.8)(197.9)(448) = 52.30 \text{ kN}$$

$$V_r = 0.6\phi_b nmA_b F_u = (0.6)(0.8)(1)(1)(197.9)(448) = 42.55 \text{ kN}$$

$$\left(\frac{T_f}{T_r}\right)^2 + \left(\frac{V_f}{V_r}\right)^2 \leq 1$$

Since $T_{f1} = T_{f2}$ and $V_{f1} > V_{f2}$ only consider Case 1:

$$\left(\frac{8.11}{52.30}\right)^2 + \left(\frac{3.10}{42.55}\right)^2 = 0.0294 < 1$$

TENSION AND BENDING

It is unlikely that 18" of elevation change will occur between two jacks. Determine for what height a 5/8" eye bolt can be used. e=1"=25.4mm.

$$M_{f_{max}} = V_{max} e$$

$$M_r = \phi M_n = (0.9)S_e F_y = (0.9)\left(\frac{\pi d^3}{32}\right)(207) = 18.29(15.87)^3 = 0.07317 \text{ kN-m}$$

$$\frac{T_f}{T_r} + \frac{M_f}{M_r} \leq 1$$

$$\frac{8.11}{53.20} + \frac{V_{max}(0.0254)}{0.07317} = 1$$

$$V_{max} = 2.44 \text{ kN}$$

$$\alpha_{limit} = \arctan\frac{V_{max}}{H_B} = \arctan\frac{2.44}{8.11} = 16.7°$$

$$h_{limit} = b_{min} \tan \alpha_{limit} = 86.5'' \tan 16.7° = 26.0''$$
$$\Delta h_{NS} = 26'' - 9\ 3/4'' = 16\ 1/4''$$

Check East-West Bays:

$$\frac{6.95}{53.20} + \frac{V_{max}(0.0254)}{0.07317} = 1$$
$$V_{max} = 2.504 \text{ kN}$$
$$\alpha_{limit} = \arctan \frac{V_{max}}{H_B} = \arctan \frac{2.504}{6.95} = 19.81°$$
$$h_{limit} = b_{min} \tan \alpha_{limit} = 66'' \tan 19.81° = 23.78''$$
$$\Delta h_{EW} = 23.78'' - 9\ 3/4'' \cong 14''$$

In the longer bays (b_{max}),

North-South

$$h'_{limit} = b_{max} \tan \alpha_{limit} = 120.375 \tan 16.7 = 36.1''$$

East-West

$$h'_{limit} = b_{max} \tan \alpha_{limit} = 125 \tan 19.81 = 45.0''$$

Therefore, 5/8" eye bolts are acceptable up to a 14" change in elevation between adjacent screw jacks. If this is exceeded, blocking must be used on the lower jack to meet this condition.

TURNBUCKLESAND WIRE CLIPS

Turnbuckels – Jaw type[2]

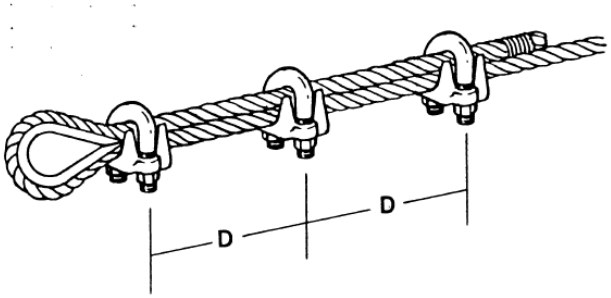
Needs to resist $T_{max} = 1925$ lbf

1/2" Jaw-Jaw Turnbuckle $T_r = 2200$ lbf $(FS = 5:1)$

Clips ⇒ 1/4" (Galvanized)

Number required[3] $= 3$

Spacing $= 6D = 6(5/16'') = 1(7/8)''$



D=6 times rope diameter
Clip Spacing

[2] http://lexco.stage.thomasnet-navigator.com/Asset/TURNBUCKLES_FAQ.pdf
[3] http://www.usbr.gov/ssle/safety/RSHS/appD.pdf

STEEL ANGLES

L2x2x1/4 – 4" length

For 5/8" hole:

Minimum end distance: 28 mm

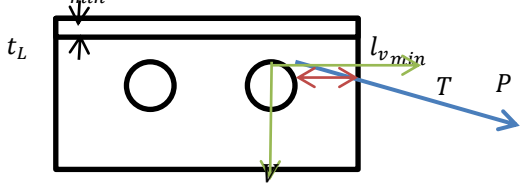
Minimum edge distance: 22 mm

Allow for 1 ¼" = 31.75 mm for both end and edge distance as shown. Minimums satisfied.

Pull-out

$t_L = 0.25'' = 6.35\text{mm}$

$l_{v_{min}} = 1.25'' = 31.75\text{ mm}$ (Pullout distance will always be greater than this)



Consider Tf as the maximum factored tensile load in the cable.

$$T_f = P_{max} = 8.51\text{ kN}$$

$$V_f = 2.92\text{ kN}$$

$$A_{n_t} = t_{cable} * t_L = (6.35\text{ mm})^2 = 40.32\text{ mm}^2$$

$$A_{n_v} = l_V * t_L = (31.75)(6.35) = 201.61\text{ mm}^2$$

$$T_r = \phi A_n F_y = (0.9)(40.32)(300) = 10.9\text{ kN}$$

$$T_r = \phi_u \left[U_t A_n F_u + \frac{0.6A_{gv}(F_y + F_u)}{2}\right]$$

$$= 0.75\left[(0.6)(40.32)(450) + \frac{(0.6)(201.61)(300+450)}{2}\right]$$

$$= 42.2\text{ kN}$$

$$T_r = 10.9\text{kN} > T_f = 8.51\text{ kN } OK$$

$$V_r = 0.66\phi A_v F_y = (0.66)(0.9)(201.61)(350) = 41.91\text{ kN}$$

$$V_r > V_f\ OK$$

∴ Section and design layout are adequate.

Bolts

Threads intercepted. Try ½" bolt A325. From CISC Table 3-4:

$$T_{f_b} = 2.92\text{ kN}$$

$$V_{f_b} = 8.11\text{ kN}$$

$$\frac{T_r}{n} = 62.9\text{ kN}$$

$$\frac{V_r}{n} = 50.3\text{ kN}$$

$n = 1$. Use two ½" A325 bolts.

With two bolts:

$$T_r = 2(62.9) = 125.8\text{ kN}$$

$$V_r = 2(50.3) = 100.6\text{ kN}$$

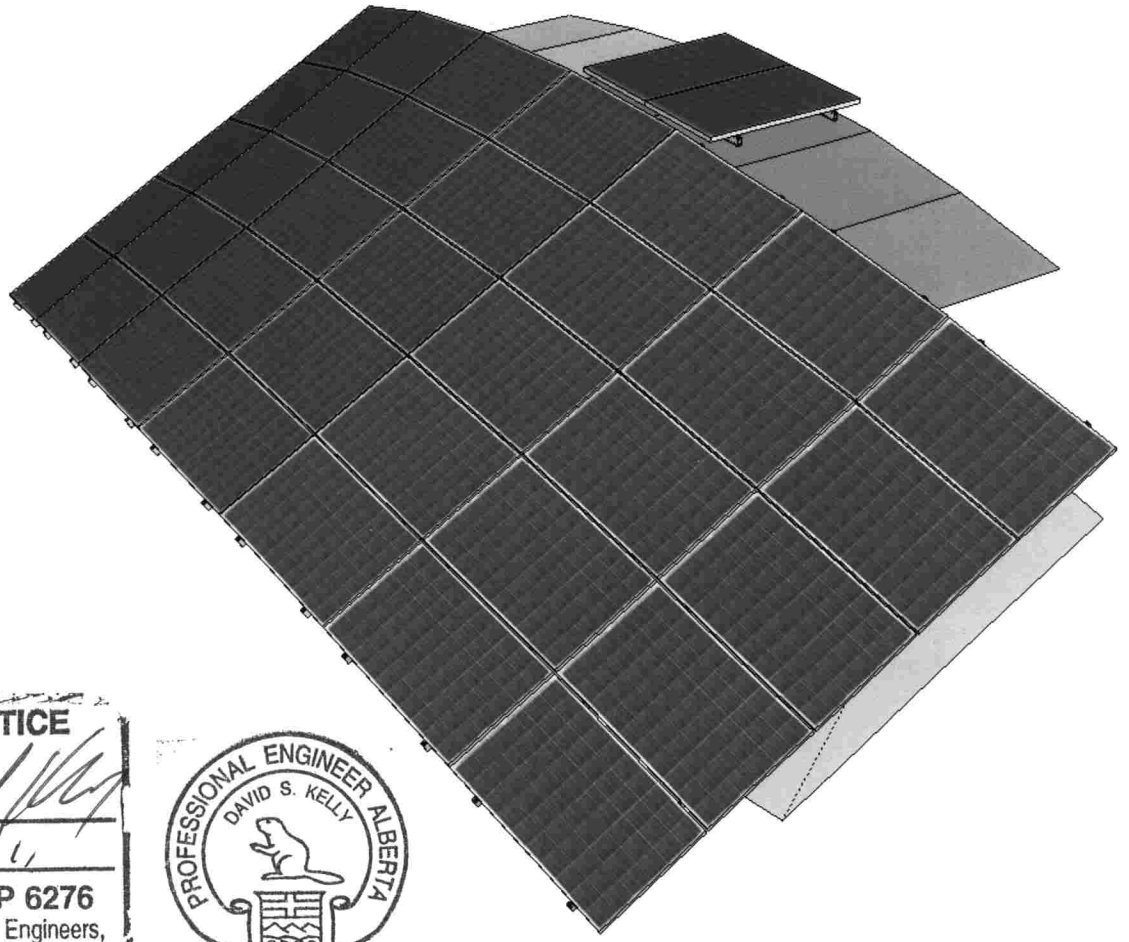
Combined shear and tension

$$\left(\frac{8.11}{100.6}\right)^2 + \left(\frac{2.92}{125.80}\right)^2 = 0.007 < 1\ OK$$

End spacing is 1 ¼”

Edge spacing is 1”

Satisfies minimums set for 5/8” bolt.



PERMIT TO PRACTICE
SEDMEK INC.
Signature
Date July 25/11
PERMIT NUMBER: P 6276
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER ALBERTA
DAVID S. KELLY

SkyFireEnergy
Solar Energy Systems

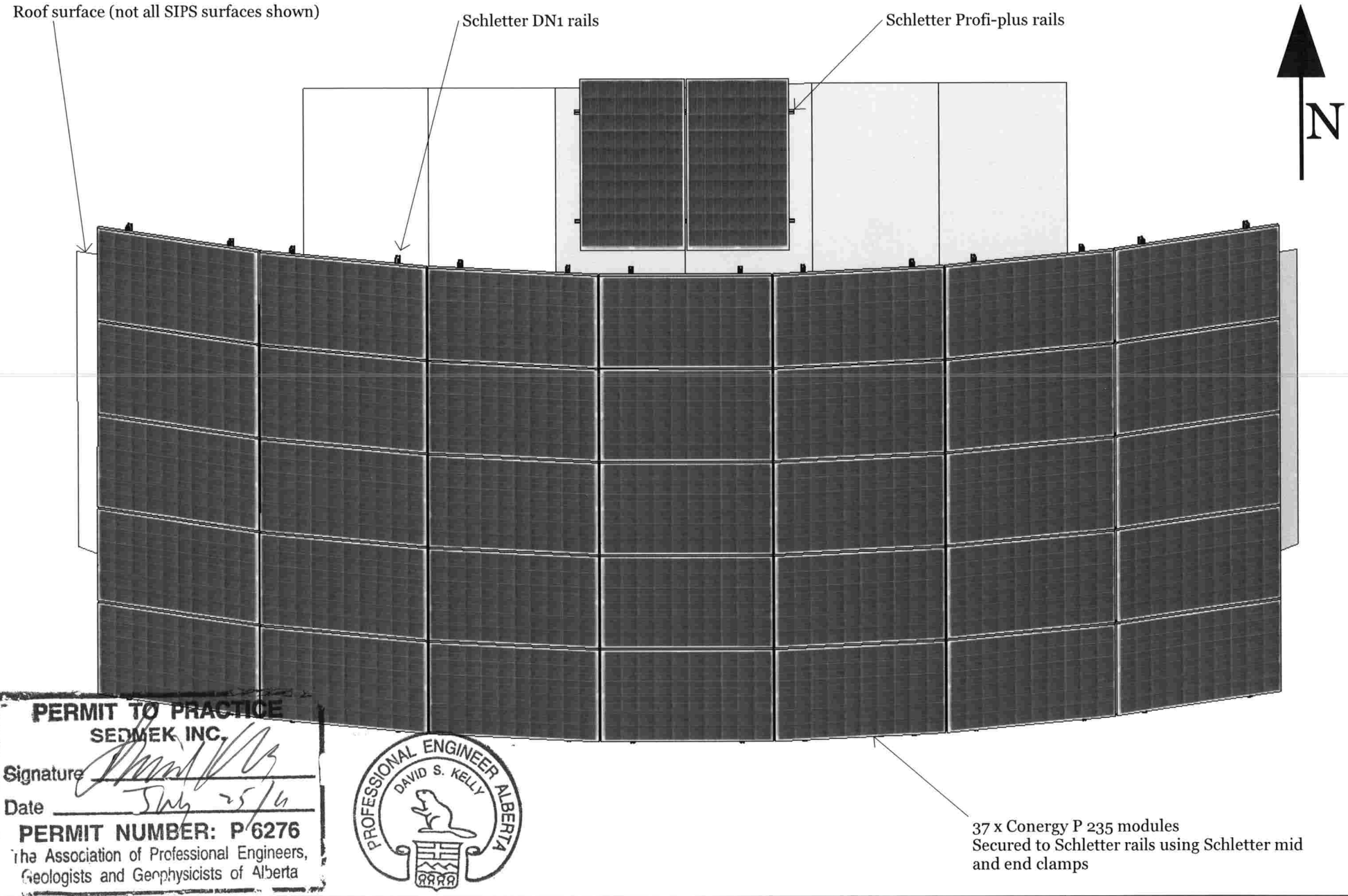
Project Name: Team Canada Solar Decathlon

PERSPECTIVE VIEW

37 x Conergy P 235 modules

SkyFire Energy Inc.

Drawing Date: July 14, 2011	Drawn By: DAV	
SCALE: NOT TO SCALE	DWG: 1	REV: 1



PERMIT TO PRACTICE
SEDMEK INC.
Signature
Date
PERMIT NUMBER: P 6276
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER ALBERTA
DAVID S. KELLY

SkyFireEnergy
Solar Energy Systems

Project Name: Team Canada Solar Decathlon

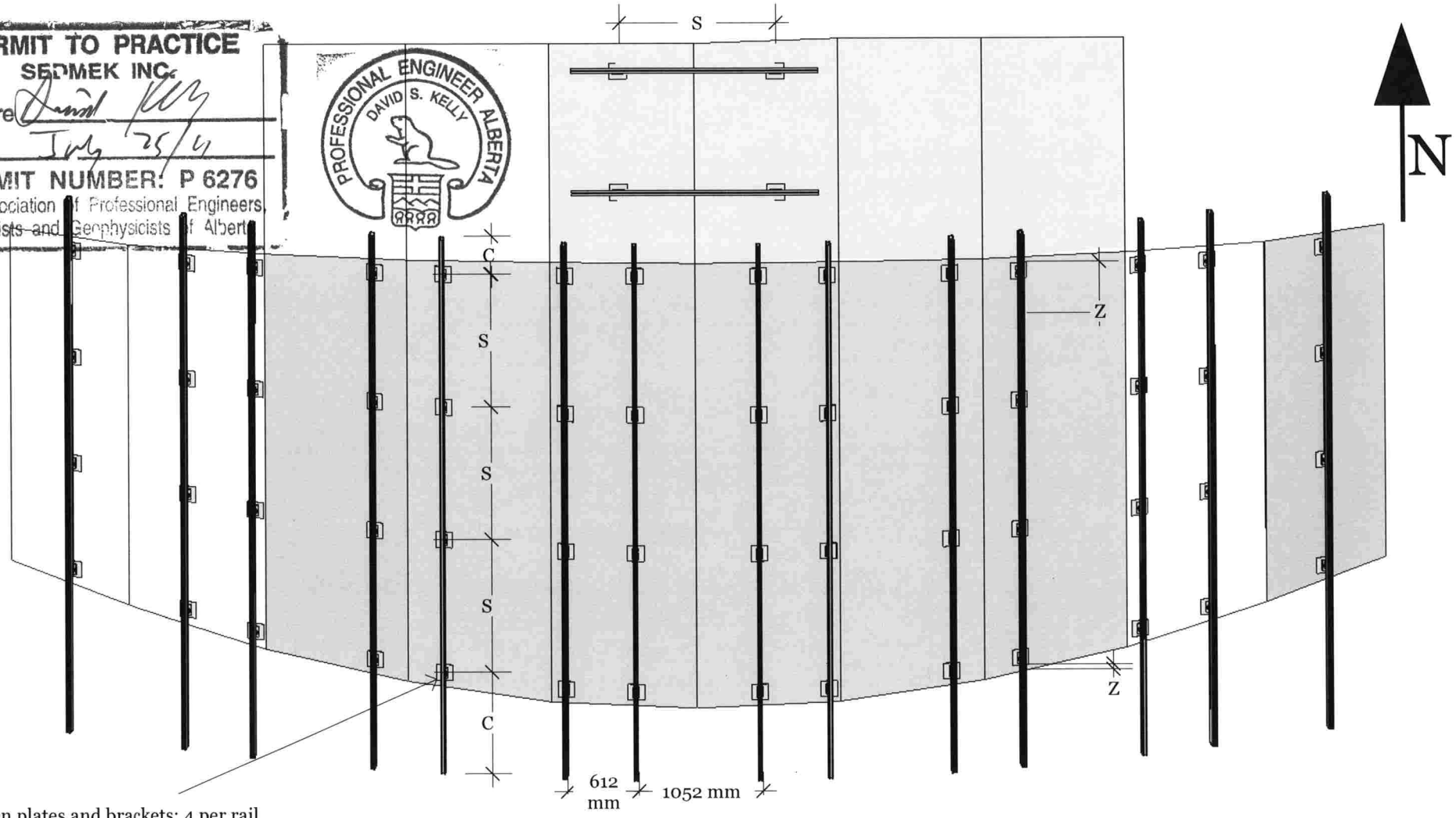
TOP VIEW - SOLAR MODULES

SkyFire Energy Inc.

Drawing Date: July 14, 2011	Drawn By: DAV	
SCALE: NOT TO SCALE	DWG: 2	REV: 1

PERMIT TO PRACTICE
SEDMEK INC.
Signature
Date July 25/11
PERMIT NUMBER: P 6276
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER ALBERTA
DAVID S. KELLY



Ecofasten plates and brackets; 4 per rail
See drawing 4 for connection detail
Rails tilted East/West as required to compensate for changing roof angles

*NOTE: This design reliant on calulations by Schletter Inc. and Jade Engineers Inc. See "Schletter Inc. PV Racking Structural Report" (J504) (15/06/2011), "Schletter Design Calculation Sheet Annex 5: Fixing Fix T" (06/06/2011) and "Schletter Design Profile Calculation 1: Profile DN1 (400065)" (20/06/2011)
**NOTE: Screw pull out strenth for Titanwall SIPS from Acuren Group Inc. (07/06/ 2011)

FOR ALL RAILS:
MAX span between ecofasten connections (S) = 1.5m
MAX cantilever from last rail connection (C) = 1.6m
MIN distance from edge of SIP to edge of ecofasten bracket (Z) = 50mm

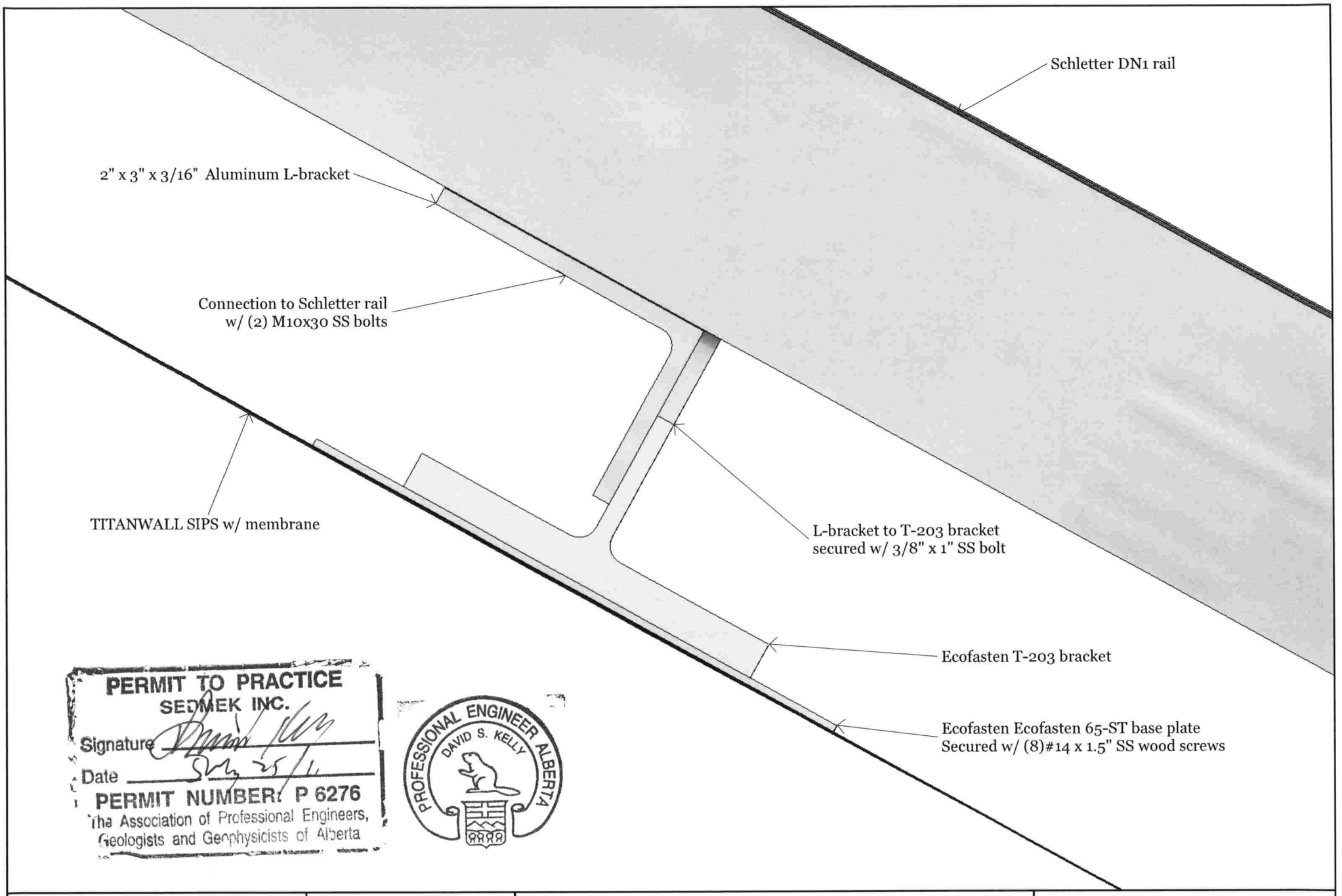
SkyFireEnergy Solar Energy Systems

Project Name: Team Canada Solar Decathlon

TOP VIEW - RAILS

SkyFire Energy Inc.

Drawing Date: July 14, 2011	Drawn By: DAV	
SCALE: NOT TO SCALE	DWG: 3	REV: 1



PERMIT TO PRACTICE
SEDMEK INC.
Signature
Date
PERMIT NUMBER: P 6276
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER ALBERTA
DAVID S. KELLY

SkyFireEnergy
Solar Energy Systems

Project Name: Team Canada Solar Decathlon

Ecofasten brackets and rail connection

SkyFire Energy Inc.

Drawing Date: July 14, 2011	Drawn By: DAV	
SCALE: NOT TO SCALE	DWG: 4	REV: 1

JADE Engineers Inc.

www.jadeengineers.com

81 Broadway, Tillsonburg, ON N4G 3P5
p. 519.842.9500 f. 877.766.0591

SCHLETTER INC. PV RACKING STRUCTURAL REPORT

Date: June 15, 2011
Project: Solar Decathalon
Client: Skyfire Energy
Product: Fix T size 2+3, timber M10 Fastening Kit
Profile DN1

No. Pages: 2
Work Order: J504

400878-2 bzw. -3
400065

Background:
JADE Engineers Inc. has been retained by Schletter Canada Inc. to conduct a structural review of the above described project and product(s).

Overview:
JADE Engineers conducted a structural review of the above described product(s) and reviewed the calculations by Schletter Canada Inc. The structural review was conducted as per the Section 4 of the 2006 Ontario Building Code and the 2005 National Building of Canada, 2009 Edition of the International Building Code and CSA S157.01-05, Strength Design in Aluminum.

Racking Material:
The racking is fabricated with extruded 6105-T5 alloy aluminum. 6105-T5 alloy has yield strength of 240 MPa and an ultimate strength of 260 MPa. The racking has no welded components and all components are assembled with stainless steel fasteners with the appropriate shear resistances.

Climatic Data and Design Loads:

Climatic Data (NBC)	
Location:	Calgary, Alberta
Snow:	S_s = 1.10 kPa
	S_r = 0.1 kPa
Wind:	$q_{1/50}$ = 0.50 kPa
Terrain:	Intermediate Exposure
Is = Iw:	1.0

Climatic Data (IBC/ASCE)	
Location:	- Calgary, Alberta
Snow:	15 psf
Wind:	90 MPH,
q(z):	0.72 kPa
Wind Gust:	3 seconds
Importance:	1.0

Responsibility of Owner
It is the responsibility of the property owner or contractor to verify, with a qualified structural engineer, that the existing roof structure is adequate to support the additional loads resulting from the installation of solar panels, racking, and ballast. Additional loads include snow accumulation due to solar PV panel heights.

Final Assembly:
The racking to be assembled as per Schletter Canada Inc. installation procedures and generally accepted work methods. Contractor must read this report, the above listed drawing(s) in conjunction with all related contract documents.

Contractor shall verify all conditions and measurements at the site and report to Schletter Canada Inc. any discrepancies or unsatisfactory conditions that will affect the installation of the racking system. Discrepancies include insufficient and incorrect material.

The construction documents;

1) Represent the finished structure.
2) They do not indicate the method of construction or installation.
3) Contractor shall be responsible for and provide all measures necessary to protect the structure during construction. Such measures shall include but not limited to; bracing, shoring of loads due to construction, etc.
4) The health and safety of the contractor and its employees is the responsibility of the owner and the contractor.
5) JADE Engineers Inc. is not responsible for the contractor's means, methods, work methods or procedures.
6) JADE Engineers Inc. is neither responsible nor obligated to conduct site inspections to verify installation of final assembly. JADE Engineers can be retained by the contractor.

Referenced Documentation
The following documentation is attached to this report as appendices and completes this certification document.

- Schletter Design Calculation Sheet Annex 5: Fixing Fix T, drawn up 06/06/2011
- Schletter Design Profile Calculation 1: Profile DN1 (400065), drawn up 20/06/2011

Conclusion:
The above described product(s) is structurally adequate and meets the requirements of Section 4 of the 2006 Ontario Building Code and 2005 National Building Code of Canada, 2009 Edition of the International Building Code and CSA S157.01-05, Strength in Aluminum Design.

Prepared By:

André Brisson, P. Eng.

Calculation sheet annex 5: Fixing

Date	06/06/2011
Version	2

FixT size 2+3, timber M10
(400878-2 bzw. -3)

Solar Mounting Systems SCHLETTER Canada Inc.

recommendations

The design calculations are obtained for installations in midland areas with regular conditions. In coastal areas and exposed locations (camber and sag) the consideration of higher wind loads is required. In these cases is the consultation of an specialized engineer required.

client: Skyfire Energy
project: Solar Decathalon

☐ imperial

ZIP Code: T1X 1E1 Calgary
51.035 ° northern width
-113.828 ° eastern length

					coast distance
tilt	α	30.0	°		
element weight	γ	19.8	kg	19.8 kg	
module height	h	1.65	m	1.65 m	
width of element	b	1.00	m	1 m	
height above sea level	H	10	m	10 m	
total height	z	10.00	m	10 m	
span width central	a1	1.50	m	1.50 m	
span width edge	a2	1.50	m	1.50 m	
span width corner	a3	1.50	m	1.50 m	
cantilever	a_{kr}	1.60	m	1.6 m	
span width b	b	1.65	m	1.65 m	
rebated distance	b_r	0.25	m	0.25 m	
rip wide of the trapeze	h_r	0.051	m	0.05 m	

Purlin thickness:
Thickness of Z-purlin(center): 6.500 in (165.1 mm)
Thickness of Z-purlin(edge): 6.500 in (165.1 mm)

statical system: monoslope
fixing typ: FixT size 2+3, timber M10

two span ☐ landscape orientation

Load assumptions concerning DIN 1055

dead load	g	0.12	kN/m²	0.12 kN/m²
snow load	s	0.69	kN/m²	0.69 kN/m²
Importance Iw		II		

terrain category

terrain category: 2.00 (adjacent pictures)
special wind/snow? none
wind: mph
snow: psf

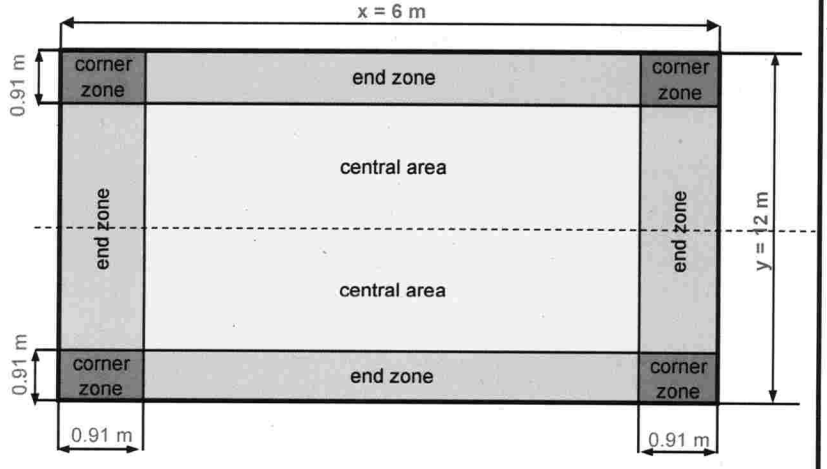
open terrain with scattered obstructions having heights generally less than 30 ft. (flat open country, grasslands an water surfaces in hurricane prone regions)

peak velocity pressure q **0.49** kN/m² 0.49 kN/m² Based on #

utilization ratio

		rebated distance		
edge △ center △ center △ edge	central area	end zone	corner zone
utilization ratio	center	68.1 %	68.1 %	68.1 %
failure criterion:	screw	screw	screw
anchoring depth	(40< t<60mm)		60 mm
			60.00 mm

roof dimensions in a plan view
x = 6.00 m
y = 12.00 m



confirmation of the fixing system — FixT size 2+3, timber M10 — (400878-2 bzw.

Used for **roof installation** **monoslope**

client: Skyfire Energy
project: Solar Decathalon

tilt	α	30	°
snow load	s	0.69	KN/m²
mean roof height	z	10.00	m
module height	h	1.65	m
module weight	g	0.12	KN/m²

sin = 0.500	cos =	0.866
peak velocity pressure	0.5	KN/m²
span width	1.50	m
cantilever	1.60	m
GC_{p+} = 1.45	GC_{p-} =	-1.90

load assumption per m² roof area

selfweight of modules

gv = 0.12 · 1.00 x 1.00 = 0.12 KN/m²
gz = 0.12 · 0.866 = 0.10 KN/m²
gy = 0.12 · 0.500 = 0.06 KN/m²

snow load

Sv = 0.7 · 1.00 x 0.866 = 0.6 KN/m²
Sz = 0.6 · 0.866 = 0.5 KN/m²
Sy = 0.6 · 0.500 = 0.3 KN/m²

wind pressure wdz = 0.5 · 1.45 = 0.71 KN/m²
uplift wsz = 0.5 · -1.90 = -0.92 KN/m²

Factors for determination of initial forces for single span, two span and three span beams

n	force factors A_{full}	$A_{partial}$	B_{full}	$B_{partial}$
1	0.500	0.500	0.000	0.000
2	0.375	0.438	1.250	1.250
3	0.400	0.450	1.100	1.200
4	0.393	0.446	1.143	1.223

load combinations

LC1 $\gamma_g \cdot g + \gamma_q \cdot s + \psi_{0,w} \cdot \gamma_q \cdot w$
LC2 $\gamma_g \cdot g + \psi_{0,s} \cdot \gamma_q \cdot s + \gamma_q \cdot w$
LC3 $0.9 \cdot g + \gamma_q \cdot w$

γ_g = 1.25
γ_q = 1.4
$\psi_{0,w}$ = 0.357
$\psi_{0,s}$ = 0.285

central roof area

n	LC1 vertical A	LC1 vertical B	LC1 horizontal A	LC1 horizontal B	LC2 vertical A	LC2 vertical B	LC2 horizontal A	LC2 horizontal B	LC3 vertical A	LC3 vertical B	LC3 horizontal A	LC3 horizontal B
1	2.33	2.33	0.95	0.95	2.56	2.56	0.37	0.37	-2.3	-2.3	0.10	0.10
2	2.23	1.86	0.91	0.76	2.45	2.05	0.35	0.30	-2.2	-1.9	0.09	0.08
3	2.25	1.77	0.92	0.72	2.47	1.95	0.36	0.28	-2.3	-1.8	0.10	0.07
4	2.24	1.81	0.91	0.73	2.47	1.99	0.35	0.28	-2.3	-1.8	0.10	0.07

composition of the proper combinations (two span)

	LC 1	LC 2	LC 3	
A_V	2.2	2.5	-2.2	KN
A_H	0.9	0.4	0.1	KN
B_V	2	2.0	-1.9	KN
B_H	0.8	0.3	0.1	KN

	center		edge		allocation Load	
pressure force	N_D =	2.05 KN	N_D =	2.45 KN	P =	2.05 KN
lateral load capacity	N_H =	0.76 KN	N_H =	0.91 KN	H =	0.76 KN
Tension force	N_Z =	-1.86 KN	N_Z =	-2.25 KN	P =	2.45 KN
lateral load capacity	N_H =	0.08 KN	N_H =	0.09 KN	H =	0.91 KN

confirmation allocation Load

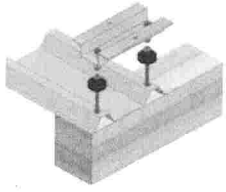
section modulus W = 8.30 cm³

	center		edge	
$M_d = P \cdot c/4$	=	12.8 KNcm	$M_d = P \cdot c/4$	= 15.3 KNcm
$\sigma = M_d/W$	=	1.5 KN/cm²	$\sigma = M_d/W$	= 1.8 KN/cm²
η = 0.045	=	**4.5 %**	η = 0.054	= **5.4 %**

confirmation of the connection screwstimber roof beamlateral brace supportprofiled sheeting

selected: other fixation according to experimental examinations n = 2 screw

load capacity according to expertise Nr. Z-515, Prof. Dr.-Ing. K. Berner, 30.08.2005, valid for sandwich panel Fischer type DL 70 according to permission Z-10.4-179 or equivalent



	center	edge
screw in depth	sg = 40.00 mm	40.0 mm
only roof beam, without	min 40	mm
	max 60	mm

acceptable screw load	max N_z =	1.80 KN	1.80 KN
required end distance		30.00 mm	30.00 mm
and vertical to the fiber		50.00 mm	50.00 mm
utilization ratio axial	η =	0.568 < 1	0.681 < 1

The screws are with 0,7x ds =7 mm Pre-drill holes!

to built with gasket kit for M10!

attention ! load transmitting of lateral acting downhill-slope force occurs by bearing stress against top crimping of theprofiled sheetingenough reliability without a confirmation

load transfer of the lateral support force in theprofiled sheeting has to be provided by the fixations of the profiled sheeting at the main force structure. Site specific verification is required

It is furthermore required to prove the load bearing capacity of the roof and building structure (i.e. components and cladding, etc.). The installation can only be realized with adequate load bearing reserves.

Profile Calculation 1:

DN1
(400065)

Solar Mounting Systems
SCHLETTER
Canada Inc.

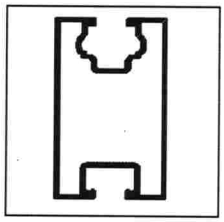
Date	20/06/2011
Version	1.5

recommendations

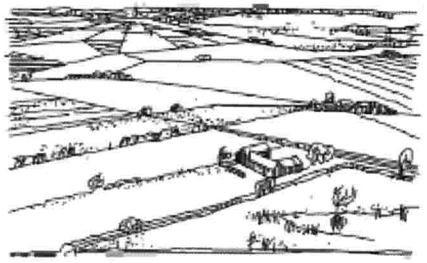
The design calculations are obtained for installations in midland areas with regular conditions. In coastal areas and exposed locations (camber and sag) the consideration of higher wind loads is required. In these cases is the consultation of a specialized engineer recommended.

client	Skyfire Energy		
project	Solar Decatholan	☐ imperial	
postal codes	T1X 1E1	Calgary	
51.0346	° northern width	-113.828	° western length
module area	A_N	1.65	m^2
module tilt	α	30.0	°
element weight	γ	22.0	kg
height of the element	h	1.65	m
width of element	b	1.00	m
cantilever	a_{kr}	1.60	m
height above sea level	H	172	m
ridge height	z	5.00	m
coast distance			

95.3%



terrain category 2



design system — **profil**

mono slope roof — DN1

☐ **Landscape** ☐ edge mounted

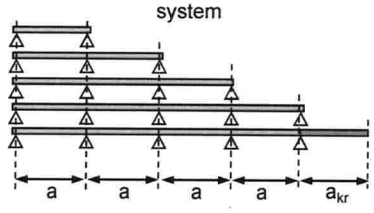
load assumptions according to OBC 2006

element weight	g	0.13	kN/m²
snow load	s	0.69	kN/m²
Importance Iw		II	
terrain category		2.00	
special wind/snow?	wind:		mph
none	snow:		psf

open terrain with scattered obstructions having heights generally less than 30 ft. (flat open country, grasslands an water surfaces in hurricane prone regions)

peak velocity pressure q **0.42** kN/m² Based on #

admissible spans in the different roof zone areas

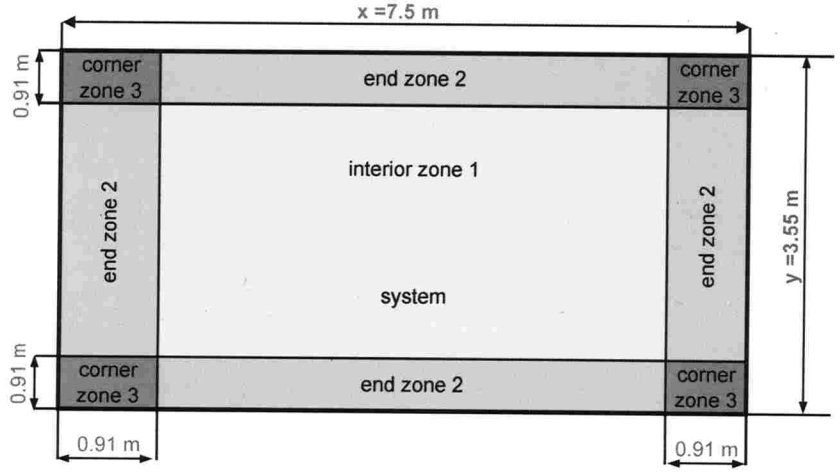


interior zone 1	end zone 2	corner zone 3
3.359 m	3.359 m	3.359 m
3.359 m	3.359 m	3.359 m
3.509 m	3.509 m	3.509 m
3.443 m	3.443 m	3.443 m
1.680 m	1.680 m	1.680 m

roof dimensions in a plan view

x = **7.50** m

y = **3.55** m



design calculations for determination of span width of profile DN1 (400065)

use for roof installation end zone 2

module tilt	α	30	°
snow load	s	0.69	kN/m²
height	z	5.00	m
modul height	h	1.65	m
modul weight	g	0.13	kN/m²

sin = 0.500	cos = 0.866
GC_{p+} = 1.45	GC_{p-} = -1.90
dynamic pressure	0.42 kN/m²

client: Skyfire Energy
project: Solar Decatholan

load assembly

dead load	g_v	= 0.13 · 1.00 · 1.00		= 0.13 kN/m²
modules	g_z	= 0.13 · 0.866		= 0.11 kN/m²
	g_y	= 0.13 · 0.500		= 0.07 kN/m²
snow load	S_v	= 0.69 · 1.00 · 0.866		= 0.59 kN/m²
	S_z	= 0.59 · 0.866		= 0.52 kN/m²
	S_y	= 0.59 · 0.500		= 0.30 kN/m²
wind pressure	w_{dz}	= 0.42 · 1.45	= 0.61 kN/m²	W_{dz} = 0.61 · 1.65 / 2 = 0.5 kN/m
	w_{sz}	= 0.42 · -1.90	= -0.79 kN/m²	W_{sz} = -0.79 · 1.65 / 2 = -0.65 kN/m

section properties

cross section area	A = 6.25	cm²
moment of resistance	S_y = 13.00	cm³
moment of resistance	S_z = 7.00	cm³

section force factors for single- and multiple span beams

n	$M_{1,total}$	$M_{1,partial}$	$M_{2,total}$	$M_{2,partial}$	$M_{B,total}$	$M_{B,partial}$	A_{total}	$A_{partial}$	B_{total}	$B_{partial}$	Q_{total}	$Q_{partial}$
1	0.125	0.125	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000	0.500	0.500
2	0.070	0.096	0.000	0.000	-0.125	-0.125	0.375	0.438	1.250	1.250	0.625	0.625
3	0.080	0.101	0.025	0.075	-0.100	-0.117	0.400	0.450	1.100	1.200	0.600	0.617
4	0.077	0.100	0.036	0.080	-0.107	-0.121	0.393	0.446	1.143	1.223	0.607	0.621

section forces vertical

	load combination 1				load combination 2				load combination 3			
n	$M_{z\text{-span}}$	$M_{z\text{-support}}$	$M_{z\text{-cantilever}}$	A	$M_{z\text{-span}}$	$M_{z\text{-support}}$	$M_{z\text{-cantilever}}$	A	$M_{z\text{-span}}$	$M_{z\text{-suppoert}}$	$M_{z\text{-cantilever}}$	A
1	0.114	0.00	-1.17	1.92	0.129	0.00	-1.32	2.16	-0.10	0.00	1.07	-1.75
2	0.085	-0.11	-1.17	1.85	0.096	-0.13	-1.32	2.09	-0.08	0.10	1.07	-1.70
3	0.090	-0.10	-1.17	1.86	0.101	-0.12	-1.32	2.10	-0.09	0.10	1.07	-1.71
4	0.089	-0.11	-1.17	1.86	0.100	-0.12	-1.32	2.10	-0.09	0.10	1.07	-1.71

section forces horizontal

	load combination 1				load combination 2				load combination 3			
n	$M_{y\text{-span}}$	$M_{y\text{-support}}$	$M_{y\text{-cantilever}}$	A	$M_{y\text{-span}}$	$M_{y\text{-support}}$	$M_{y\text{-cantilever}}$	A	$M_{y\text{-span}}$	$M_{y\text{-suppoert}}$	$M_{y\text{-cantilever}}$	A
1	0.051	0.000	-0.53	0.86	0.02	0.00	-0.24	0.40	0.01	0.000	-0.06	0.10
2	0.038	-0.051	-0.53	0.83	0.02	-0.02	-0.24	0.40	0.00	-0.01	-0.06	0.10
3	0.040	-0.047	-0.53	0.84	0.02	-0.02	-0.24	0.36	0.00	0.00	-0.06	0.10
4	0.040	-0.049	-0.53	0.84	0.02	-0.02	-0.24	0.36	0.00	-0.01	-0.06	0.10

summarization

	stresses midspan sections				stresses support sections			
n	LK1	LK2	LK3	**max**	LK1	LK2	LK3	**max**
1	1.61	1.33	-0.71	**1.61**	0.00	0.00	0.00	**0.00**
2	1.19	0.97	-0.58	**1.19**	-1.61	-1.33	0.71	**1.61**
3	1.26	1.03	-0.61	**1.26**	-1.48	-1.21	0.69	**1.48**
4	1.25	1.02	-0.60	**1.25**	-1.53	-1.26	0.71	**1.53**
	stresses cantilever section				16.50	13.61	9.09	**16.50**

admissible spans [m]

single field beam	**a =**	**3.36 m**
double field beam	**a =**	**3.36 m**
triple field beam	**a =**	**3.51 m**
multi field beam	**a =**	**3.44 m**
cantilever length	**a_{kr} =**	**1.68 m**

Summary of Unlisted Components

All electrical components carry an approved testing agency's listing per Section 6-7 of the SD2011 Building Code.

The team will be using Structurally Insulated Panels provided by Titanwall Inc. These panels have been approved by Tom Meyers according to IRC section R104.11. Please find attached a copy of this approved letter in Appendix A.

Summary of Reconfigurable Features

There are no reconfigurable features in the design.

Interconnection Application Form

_____*Team Canada, Lot* 105_____

Team Name and Lot Number

PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
Conergy	37 PV Modules (P-235PA) w/ Micro-Inverters on two circuits.	8.695kW

Total DC power of all arrays is _____8.7_____ kW (in tenths)

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
Enphase	D380	240	0.380 kW	19

Total AC power of all inverters is ___7.22___ kVA or kW (in whole numbers)

The following information must be included in the project manual or construction documents. If located in the construction documents, list the drawing locations in this section of the project manual. (Example: B3/E-201)

1. One-Line Electrical schematic – the loads do not have to be detailed.
2. Calculations of service/feeder net computer load and neutral load (NCE 220)
3. Plan view of the lot showing the house, decks, ramps, tour paths, the service point and the distribution panel or load center.

Provide the Team's "Electrical Engineer" contact in the "Team Officer Contact Info" database on the Yahoo Group as required per Rule 3-2.

Please see the "SD2011_Microgrid_Interconnection_Process_v1" file located the Files/Rules/Team Interconnection Process section of the Yahoo Group for more details on the interconnection process.

Energy Analysis Results and Discussion

This chapter discusses the energy analysis conducted by Team Canada, upon which most significant engineering design decisions were based.

The Role of Energy Simulation

The holy grail of design is optimization. In building design there is infrequently any individual aim that, when pursued on its own, presents significant difficulty. Challenge develops as project criteria lengthen; difficult challenges arise when some of the criteria are diametrically opposed. From the outset, Team Canada firmly set the lofty goal of achieving a design with an *optimized* balance between utility, aesthetics, affordability and energy performance, within the context of a First Nation client and, of course, the contest. Achievement of this goal is only possible with the use of energy simulation models. Quite often optimization is compartmentalized within the various disciplines. Total system optimization can only be achieved when the effects of manipulation in any sub-system are continuously viewed as they relate to the whole system. Sometimes the 'best' option for a specific sub-system has to be rejected because the consequences it bears on other sub-systems, or with respect to overall criteria, is unacceptable. For example, incredibly reduced energy consumption at high cost might be okay but, depending on criteria, laudable energy reduction for very low cost might be better. The process of optimization entails the identification of all acceptable system combinations in general terms, followed by a quantitative assessment and comparison of the overall effects of varying sub-system parameters, often one-by-one; and ultimately results in discovery of which arrangement has the overall greatest merit with respect to the end goal.

There will always be some areas of building design that remain mostly, if not entirely, subjective, such as aesthetics; however, there is no small number of building parameters whose properties, when varied, allow for assessment of the variance based on the quantitative result. Thankfully the energy simulation process does begin with a reasonable amount of knowns, typically provided by the architectural discipline. Assigning a dollar value to characteristics such as fire resistance and durability can be difficult; however, the decision to address these aspects simply because they solve human problems creates a starting point from which to go forward. Although the permutation and analysis process is long it is inherently thorough. As part of an integrated design process, this method proves to be very successful at increasing the number of decisions that are deliberate and truly informed; this includes, but is not limited to, decisions regarding:

1. R-value selection for walls, ceiling, and floor
2. Glazing type, quantity, and orientation
3. HVAC system selection
4. The inclusion and/or scale of renewable energy technologies (PV, solar thermal etc.)
5. Equipment selection and operational modification/optimization (electrical & mechanical)

Key decisions concerning these aspects were ultimately made by applying a Net Present Value (NPV) comparison method to the system permutations being considered. Capital cost for envelope and active systems, predicted total system energy consumption through time, current and predicted cost of energy & maintenance, and an estimated 75 and 25 year life cycle for the envelope and active systems respectively, were all accounted for using the NPV method. In

this fashion, the building design was based on what was found to be the most economical (lowest NPV) means of achieving a net-zero design fitting all the criteria applied to the home.

Energy Simulation Controls

Energy simulation programs are powerful tools but it must be acknowledged that output is only as reliable as the relevant input. In order to address this issue, the energy modeling results yielded was vetted through various methods throughout the design phase by:

- Completing models with multiple software packages and comparing the results.
- Completing multiple independent models.
- Identifying the sensitivity of the results to key inputs to help estimate the confidence range of the results.

Each major set of results were critically assessed and discussed with the rest of the engineering team. The rest of the team questioned the modelers' assumptions and inputs. Additional review was sought and provided by industry professionals to confirm that the results being generated were reasonable.

Energy Simulation Tools

A number of programs were utilized to complete the simulations. Each tool had its own unique set of strengths and weaknesses.

Hot2000

Hot2000 was developed by Natural Resources Canada and is globally available, free of charge. The program allows the user to enter the building data in a tabular form. The program has limited flexibility when it comes to modeling the home but is also relatively easy to use, especially when compared to more complicated programs such as TRNSYS. The program was used during the preliminary design phase in order to produce initial results in a timely manner and to test the accuracy of the TRNSYS model.

TRNSYS

TRNSYS is a commercial software package that was developed by the University of Wisconsin and is now distributed by the engineering consulting company Thermal Energy System Specialists. The program gives the user extensive control over the simulation, the ability to model a wide variety of systems, and provision of outputs as refined as sub-hourly, which can be exported to a spreadsheet for detailed analysis. However, high level control and output come at a price since the program is difficult to learn and complex simulations take an intensive investment of time and effort.

Excel

Hourly heating and cooling loads were exported from TRNSYS into Excel. Within Excel, the bulk loads from TRNSYS were treated to find the effects of varying system parameters. The spreadsheet was the key tool for assessing the effects of varying system parameters.

Building Energy Load Analysis

The initial analysis of the building's heating and cooling energy loads was assessed using Hot2000 and TRNSYS. Figures 1 and 2 shows a comparison between the heating and cooling loads produced by TRNSYS and Hot2000.

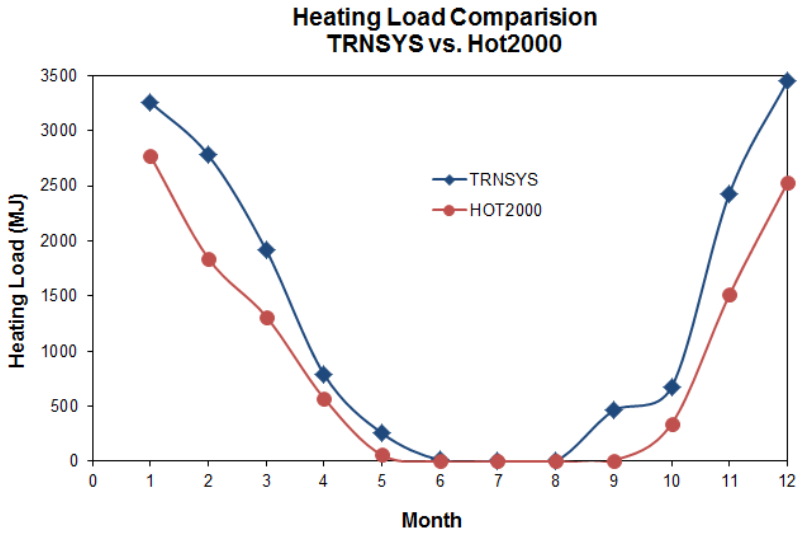


Figure 1 - Preliminary Heating Load Comparison between TRNSYS and Hot2000

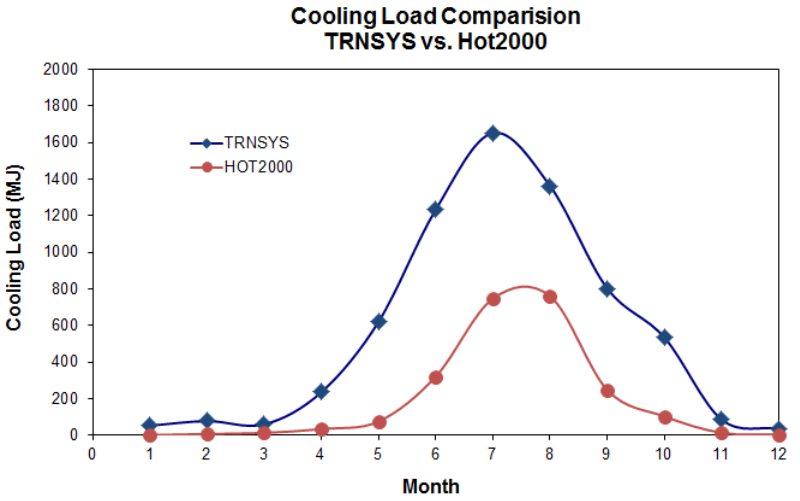


Figure 2 - Preliminary Cooling Load Comparison between TRNSYS and Hot2000

During the preliminary simulations, the heating loads calculated from the two programs were fairly consistent. However, the cooling loads differed considerably. This was due to the fact that the TRNSYS results did not included the effect of free cooling. This was accounted for in Excel, drastically reducing the cooling load shown in Figure 2. It is believed that the Hot2000 results had already accounted for a certain degree of free cooling but the exact control strategy is unknown.

While the results from the models differed, the need to make design decisions meant that a model had to be selected and developed as our basis for decision making. The TRNSYS model was chosen as our primary model due to a number of factors.

With Hot2000, there are a number of assumptions and formulas working in the background of the program that the user is unaware of and has no control over. Hot2000 is akin to a black box: The user supplies inputs and the software generates outputs. The user has little understanding of what happens in-between the two steps and the results are difficult to troubleshoot.

TRNSYS, on the other hand, is more customizable, provides the user with a greater understanding of the calculation methodology, most or all of which have been extensively validated. Additionally, TRNSYS allows the user to output and analyze almost any variable within the program on an hour by hour basis. This allows one to investigate the details of the simulation and ensure that the model's outputs are consistent with fundamental principles. In TRNSYS the user has complete control over the control strategy and develops the logic controlling the simulation.

Key Assumptions

Several key assumptions were made during the modeling process. It has been assumed that:

1. The house is very airtight - Blower door tests on TitanWall and other SIP-constructed homes (the DOE's Oak Ridge National Laboratory has done extensive SIP construction tightness testing) show that SIPs can produce remarkably airtight constructions. Using blower door data from a previously completed TitanWall project, an infiltration rate of 0.2 ACH at 50 Pa was assumed. However, it is acknowledged that 'tightness' is dependent on the individual design and construction process and it will be important to ensure the envelope is properly sealed. The energy model assumed a constant infiltration rate of 0.087 ACH; this rate was calculated based on infiltration studies which correlate design infiltration rates to the annual average. Upon final assembly the home will be blower door tested.
2. The effective R-value of the house will well approximate the estimates completed; there were some thermal bridges that were difficult to analyze but were nonetheless treated according to practices recommended by ASHRAE and Natural Resources Canada.
3. Lifecycle cost of *mechanical equipment and PV array* is 25 years.

Simulation & Analysis Findings

This section discusses the simulations performed according to the assumption discussed above. This section focuses on the home's heating approach, R-value optimization, glazing placement, domestic hot water (DHW) heating, an estimate of the electrical loads and a discussion on the PV system design.

PV Only versus PV & Heat Pump

Some Calgary net-zero home proponents suggest that a super-insulated home with electrical resistance heating is the best net-zero solution based on the cost and complexity of heat pumps, the price of PV and insulation, and the negligible cooling load that can be designed into a Calgary home.

However, to be competitive in the comfort contest in Washington, cooling equipment is required and, with respect to heating, a PV based resistance heating system is limited by a coefficient of performance (COP) of 1. The team decided to investigate the possibility of using an air source heat pump in hopes that the much higher COP of such a system would result in a lower system NPV. The team was able to locate a heat pump with exceptional performance at low ambient

temperatures and a variable frequency drive on the compressor cycle that eliminates part load inefficiencies. The disadvantages of the heat pump are the added noise and potential for requiring a specialized technician to complete repairs.

Building Envelope R-value & Mechanical HVAC System Selection

Since the type of envelope selected, an EPS insulated SIP with magnesium-oxide based sheathing, was adopted based upon architectural and client based criteria, the modeling team only sought to find the optimal variance of that selected technology; other envelope systems were not considered. While it is known that increasing the insulation of the envelope would decrease the energy load, it was not known if this was the most economical solution for reaching net-zero. NPV analysis was applied to identify the envelope R-value that would result in the lowest overall life cycle system cost. The analysis was completed over a range of R-values from R-15 to R-60. As mentioned previously, the NPV method was applied in a whole system context; this included cases for 3 unique mechanical systems: air-to-air heat pump, air–to-water heat pump with radiant floor heating and forced air cooling, and air-to-water heat pump with fan coil for an all-air conditioning system. Each combination of envelope R-value and mechanical system was considered over a 75 year life cycle. The 75 year life cycle analysis considered the following:

- Two full active system replacements (25 year life expectancies).
- The annual heating and cooling loads of the building and the associated cost of energy.
- The cost of the insulation at a given thickness.
- The cost of the mechanical system and annual maintenance costs.
- The cost of the required PV array and annual maintenance costs.

Recently an electrical resistance heating concept net-zero design approach has found acceptance as unique solution regardless of criteria. However, preliminary cost and PV array size results, excluded this approach immediately, which was a surprise to some and an important lesson taken away from this analysis.

Calculations indicated that when using TitanWall panels, the optimal R-value was surprisingly low –approximately R-25 as shown in Figure 3.

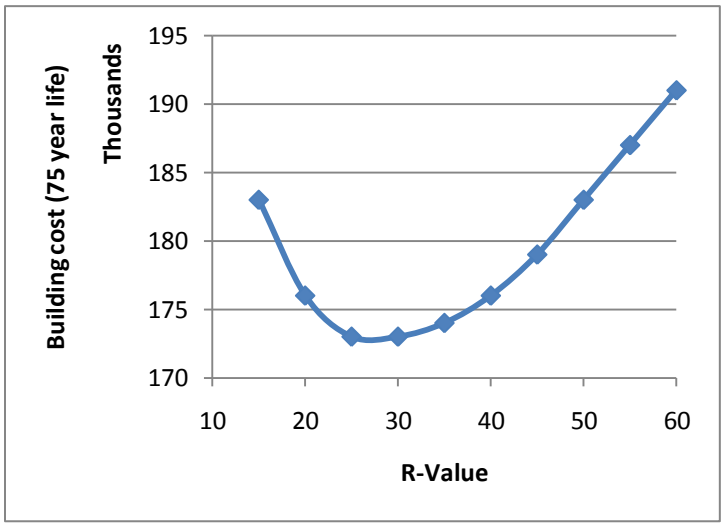


Figure 3 - Building cost as a function of R-value for an Air to Water Heat Pump system.

Out of the three mechanical system options, the most economical solution was found to be the air to water heat pump with a fan coil. The results listed in Table 1 are only for this case.

Table 1 - Comparison of Costs at Different R-values Based Upon the Air to Water Heat Pump System with a Fan Coil

Evalope Insulation	Cost of Building, Mechanical & PV Systems (75 year life)	Average COP of Heat Pump While Heating	Peak PV to Meet HVAC Load	Peak PV to Meet HVAC & Appliance Loads	Number of PV Panels to Meet HVAC & Appliance Load	PV Area (HVAC & Appl.)	Building Cost
(R-Value)	($ CAN)	(-)	(kWp)	(kWp)	(-)	(m2)	($ CAN)
15	183,742	1.51	7.5	10.5	45	74.3	26,576
20	176,371	1.49	6.2	9.2	40	66.1	35,435
25	173,461	1.47	5.4	8.4	36	59.5	43,053
30	173,661	1.46	4.9	7.9	34	56.2	49,173
35	174,515	1.45	4.6	7.6	33	54.5	54,638
40	176,658	1.44	4.3	7.3	32	52.9	60,104
45	179,635	1.43	4.1	7.1	31	51.2	65,569
50	183,273	1.43	4.0	7.0	30	49.6	71,035
55	187,003	1.42	3.8	6.8	30	49.6	76,501
60	191,287	1.42	3.8	6.8	29	47.9	81,966

Note: The values in Table 1 are based on an earlier design of the building and so vary from other final numbers documented.

As the result contradicts commonly perpetuated net-zero design philosophies in Alberta, reasonable explanations were sought to account for the discrepancy. A broad analysis of historical net-zero pricing forecasts could suggest that PV prices were projected to drop more rapidly than they have and that the capacity for significant advancements in heat pump technology was underestimated. Also, it is likely that the cost premium paid on the selected wall material, deemed acceptable for its fire and mould resistant properties, creates a total system cost function that differs from conventional construction methods. Whereas the base cost for TitanWall is high but the incremental cost for additional R-value is linear, the base cost for a cellulose wall is medium and the incremental cost for additional R-value is low.

Practical aspects also must be taken into account when selecting the R-value. The Alberta Building Code requires that the minimum R-value for the ceiling to be R-34, and our continuous ceiling/wall structure forced the need for a continuous R-value throughout ceiling/wall component. The roof area available for PV was limited and thus the solution had to be altered to satisfy this constraint. Based on a compromise between building loads, PV array size, and building code requirements, R-40 insulation is used throughout the wall, ceiling and floor.

Glazing Placement

Glazing not only provides occupants with a view of the outside world, but also allows daylight to illuminate the interior space and can provide heat load offsetting direct radiation. The main disadvantage of glazing is its relatively low thermal resistance and the resulting thermal losses. However, these losses can be minimized by intelligent placement of the glazing that maximizes the solar gain through the glazing while meeting the architectural requirements of the design.

Glazing on the northern side of the home was eliminated entirely as it would provide little daylight or solar gains to the interior space. Eliminating the northern glazing reduced the heat loss in the winter time. Based on heating and cooling loads alone, it would be preferable to eliminate glazing on the east and west walls as well. However, a compromise was made to accommodate aesthetics and provide a more consistent amount of day light throughout the space. South glazing with an overhang provides the most net energy gains to a house in Calgary's climate. The optimal south glazing area for our house was found to be approximately 6 m^2 based on the TRNSYS model (approximately 6% of total square footage of the home) , subject to uncertainties in the actual window performance, building thermal massing effects, tradeoffs between heating and cooling loads and other modeling factors. Furthermore, ignoring these uncertainties for a moment, the TRNSYS model showed very little difference in annual energy usage over a wide range of south glazing area values. Therefore, the actual area chosen is largely driven by aesthetics and day lighting preferences.

Radiant Floor versus Forced Air

It is generally accepted that radiant floor systems are more efficient than forced air systems largely due to the lower fluid delivery temperatures and lower distribution power requirements. Further energy savings may be achieved because equivalent operative room temperatures can be achieved with radiant floors with slightly lower supply air temperatures. Radiant floors offer more stable room temperature distributions and thus higher levels of comfort.

However, there are several characteristics of the competition that put radiant floors at the disadvantage.

First, the dry bulb temperature, not operative temperature, is being measure during the contest so it is advantageous to have a system that can respond quickly to that measurement method.

Second, during the touring portion of the competition, the heat stored in the floor would be lost to the ambient air as the building was over ventilated. When transitioning from the public tour to the comfort contest, a rapid reconditioning of the house will be required. The thermal mass of the radiant slab would slow this process.

Third, the use of a radiant floor was found to present additional construction complexities that would increase the effort required to reconstruct the house. The client is looking for a simple and robust solution. An air delivery system is a mandatory part of the design as it is required to provide air conditioning. The use of a radiant floor system could only be seen as 'extra' component.

Finally, radiant floor systems come at a significant capital cost premium and this is not consistent with the desires of our client. As with the wall thickness cost assessment, decreased PV costs and heat pump improvements may place common assumptions under scrutiny. NPV analysis concluded that a capital purchase of additional PV to offset the higher operational costs of the forced air system is more economical than a capital purchase of a lower energy distribution radiant floor.

For reasons related to response time, cost, and construction logistics, the forced air system was chosen in favor of the radiant floor system.

Solar Thermal Heating

The optimal tilt angle for solar thermal panels, on an annual basis, is approximately equal to the geographical latitude of the location of the install. To justify inclusion of a relatively expensive technology in a building system, annual utilization must be considered. The inherent problem with using solar thermal panels for heating in the Alberta climate is that they yield the least energy (or nothing at all) when they are needed the most. In order to 'address' this problem, some proponents of solar thermal heating subsequently advocate modifying installation tilt angles (towards the vertical) so that yields will be greater in the winter. While this strategy achieves the intended effect, it also devalues what is already an expensive installation as the total annual system output is intentionally reduced. Cost analysis quickly ruled out the use of solar thermal heating in general, let alone its implementation at reduced effectiveness.

Solar Thermal versus PV Heat Pump System for Water Heating

As opposed to fluctuating space heating loads, a home's domestic hot water load is essentially constant year round. Thus, solar thermal was considered as a valid candidate for hot water heating; however, the heat pump (which had already been cost justified and chosen for the HVAC scope) was also available for water heating with only incremental cost. The team completed a subsidiary life cycle cost comparison between implementation of a solar thermal water heating strategy and use of the air source heat pump, in conjunction with the varying amounts of PV panels required to meet zero in either case. NPV analysis showed that the two solutions were incredibly close in terms of economics as shown in Figure 4.

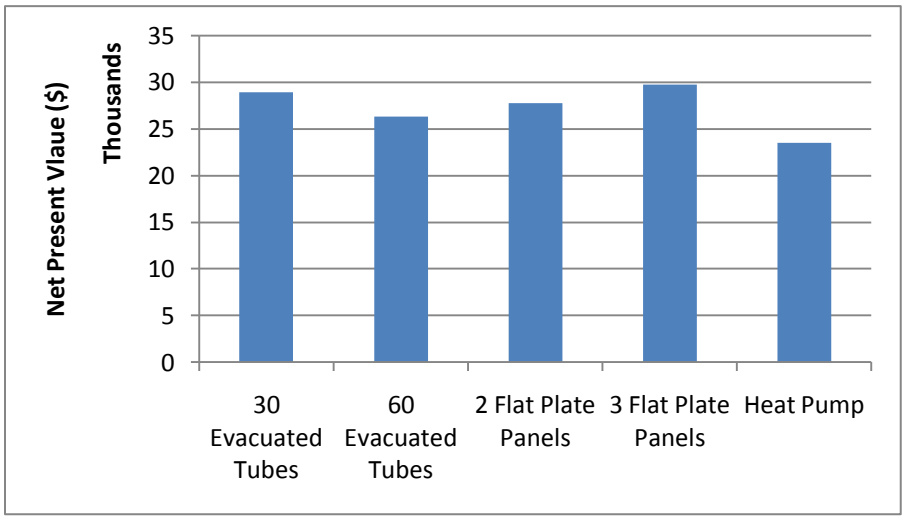


Figure 4 - NPV comparison Solar Thermal and Heat Pump DHW heating.

The PV/Heat pump solution was selected due to a number of reasons. Installation and maintenance is reduced on the scale of one whole system. The heat pump will be installed for heating regardless, so the added complexity of one extra tank and extra PV is limited. For solar thermal, on the other, plumbing would have to be provided to the exterior of the house. In the Alberta climate, exterior plumbing adds the requisite of supplying freeze protection and is an additional maintenance item. The exclusion of solar thermal reduces engineering time and frees up some mechanical room space. Aesthetic appeal was another factor in the decision; in discussions with the design team, an all PV system was identified as the preferable option.

Electrical Loads

Internal appliance and other electronic loads consume a significant amount of electrical power while also producing significant internal gains, heating up the internal space. These loads were estimated based upon average ENERGY STAR values and Building America's Benchmark analysis spreadsheet. The total annual electrical load, predicted to be 10,770 kWh, can be categorized as shown below.

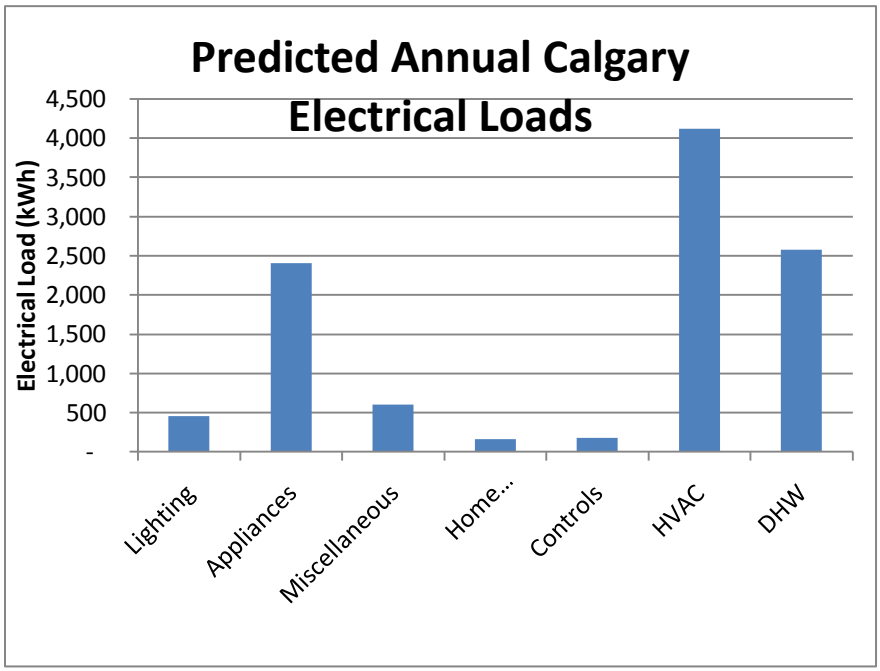


Figure 5 - Predicted Annual Calgary Loads

PV System Design

Many solar home designs utilize the flat south facing roof as the base for their systems. However, the cultural considerations of our client resulted in a design that challenged the engineering team with a curved roof surface. It is well known that any deviation from the optimal tilt angle (approximately 44° in Calgary) or the azimuth of 0° would result in a loss of PV production. However, in order to produce an aesthetic design that meets competition dimensional restrictions, an analysis was completed to determine the sensitivity of the PV production to the tilt and azimuth of the solar panels. NREL's System Advisor Model (SAM) was used in this analysis.

The array consists of 35 modules mounted at 27.4° tilt and 2 modules mounted horizontally on the roof. The curvature of the roof results in an average azimuth of 9.5 degrees. As shown in Figure 5, there are minimal efficiency losses, less than 4%, for the 35 modules mounted at 27.4°. The total efficiency of the PV system compared to a system at optimal tilt and azimuth angle is 95% which the team feels is a reasonable compromise between the cultural and aesthetic considerations of the home and the requirements for the PV system.

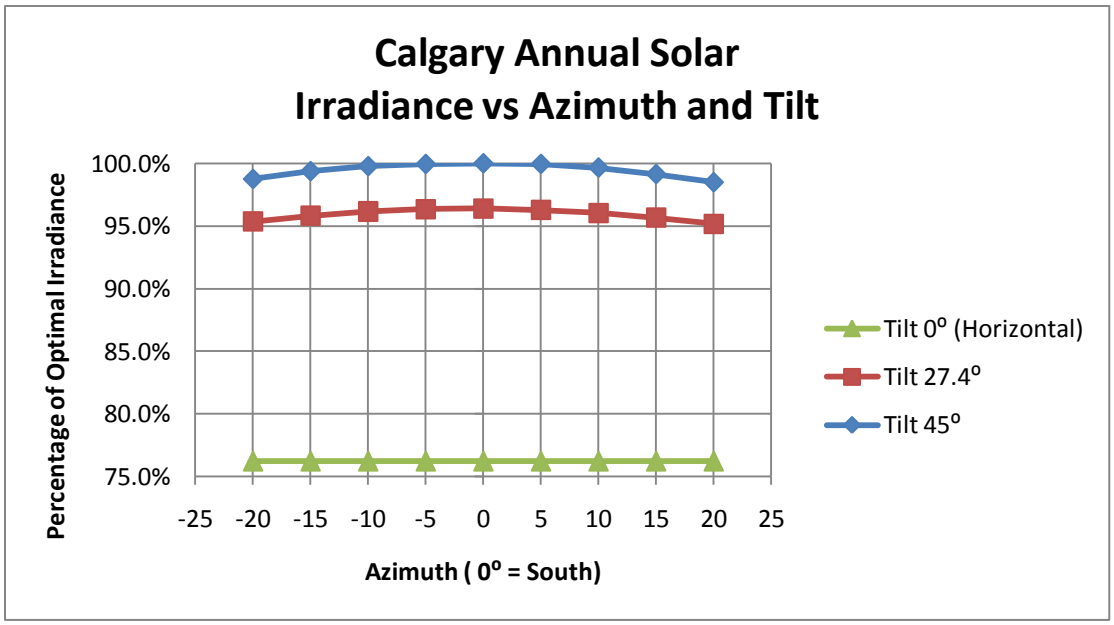


Figure 6 - Solar Resource Losses Based on Azimuth and Tilt

The team decided to utilize a micro inverter system that would provide a number of benefits:

- Prevent losses from a single panel from affecting a string of panels (including losses due to soiling, snow-cover, shading or non-uniform ageing)
- Allows PV module performance tracking on a per-module basis, to quickly and easily identify any issues with individual modules in the array.
- Eliminates string losses that would have otherwise resulted from the non-uniform panel outputs due to the placement of the array on the curved roof of the house.
- Micro inverters boast a longer lifespan than typical central inverters. The standard 15-yr warranty is 50% longer than the 10-yr warranty offered with typical central inverters. This extra lifespan goes a long way in justifying the price premium of micro inverters.

A more detailed discussion on the merits of micro inverters can be found in Appendix C. In the connection scheme discussed above, each module has its own MPPT inverter, with two inverters being housed in each D380 enclosure.

A simulation of the 8.7 kW array in SAM predicted the array would produce 10,865 kWh in the first year, with a 1% annual degradation thereafter based on the worst case of the manufacturer's power warranty. This equates to 1249 kWh/kWp which falls in line with estimates by professional installers based on empirical data from many installed systems in the region.

For comparison purposes, an analysis of the PV array was also performed in PVSyst, an industry-leading PV simulation software tool developed at the University of Geneva, Switzerland. The results were very close to those generated by SAM, predicting an annual output of 10872 kWh. The detailed results of this analysis can be found in Appendix D. Please note the soiling losses of 10% includes expected losses due to snow cover. Also note the 230W version of the PV module is used because the 235W version was not available in the database, therefore it would be reasonable to add 2.2% to the predicted output.

Appendix A: Approved Titanwall SIP panels - R104.11 Letter

APPROVED
By Tom Mevers at 4:13 pm, Apr 28, 2011

April 11, 2011

Tom Mevers
Building Official
2011 Solar Decathlon

Dear Mr. Mevers,

The Canada Solar Decathlon 2011 team is requesting to use Structural Insulated Panels (SIPs) manufactured by Titanwall Inc. for floor, wall and roof applications as an alternate building material according to IRC Section R104.11. This product meets the intent of the code due to the following reasons:

- Comparable structural capacity to materials prescribed within the code for an application in which all gravity loads are borne by a steel substructure and the SIPs are only required to transfer transverse shear loads.
- Its ability to perform as an air and vapor barrier to ensure continuous envelope
- Superior performance for thermal protection compared with materials prescribed in the code
- Durability comparable to materials prescribed in the code
- Comparable fire rating to gypsum board sheathing allowing the use of SIP as internal finish.

Please see the attached information from Titanwall Inc. for supporting evidence that these panels meet the intent of the code.

If you have any further questions, please don't hesitate to contact me.

Regards,

Frank Jansen
Engineering Lead
Team Canada Solar Decathlon 2011
fajansen@ucalgary.ca
(403) 829 - 9981

Appendix B: Fire Protection Hydraulic Calculations and Equipment Specifications

See next page.

VSC CORPORATION
10343-B SLIDING HILL ROAD
ASHLAND,VA 23005

HYDRAULIC CALCULATIONS

FOR

SOLAR DECATHLOM
TEAM CANADA
UNIVERSITY OF CALGARY

FILE NUMBER: SOLAR DECATHLON
DATE: **APR 29, 2011**

-DESIGN DATA-

OCCUPANCY CLASSIFICATION:	13D
DENSITY:	13 GPM (END / REMOTE HEAD)
AREA OF APPLICATION:	2 HEAD CALC
COVERAGE PER SPRINKLER:	225 SQ FT
NUMBER OF SPRINKLERS CALCULATED:	**2** sprinklers
TOTAL SPRINKLER WATER FLOW REQUIRED:	**27.1** gpm
TOTAL WATER REQUIRED (including hose):	**27.1** gpm
FLOW AND PRESSURE (@ PUMP):	27.1 gpm @ 23.7 psi
SAFETY FACTOR:	11.2 PSI
SPRINKLER ORIFICE SIZE:	1/2 inch

NAME OF CONTRACTOR: UNIVERSITY OF CALGARY

DESIGN/LAYOUT BY: J MACKLE

AUTHORITY HAVING JURISDICTION:

CONTRACTOR CERTIFICATION NUMBER:

CALCULATIONS BY HASS COMPUTER PROGRAM (LICENSE # 38091471)
HRS SYSTEMS, INC.
TUCKER, GA 30084

DATE: 4/29/2011 S:\CAD\COMMERCIAL\BC0600\BC0626\HASS\SOLAR DECATHLON.SDF
JOB TITLE: solar decathlon

WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. @ (PSI)	FLOW (GPM)	AVAIL. PRESS. @ (PSI)	TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
PUMP	35.0	34.9	35.0	34.9	27.1	23.7

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	27.1 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	0.0 GPM
OTHER HOSE STREAM ALLOWANCES	0.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	27.1 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)
S1	8.1	K= 4.90	8.2	14.1
S2	11.8	K= 4.90	7.0	13.0
1	11.0	- - - -	9.1	- - -
2	10.0	- - - -	13.8	- - -
3	10.0	- - - -	14.4	- - -
4	1.0	- - - -	19.4	- - -
PUMP	2.0	SOURCE	23.7	27.1

PIPE DATA

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)	PRESS. SUM. (PSI)
Pipe: 1					-14.1	1.101 PL	11.17 PF	0.4
S1	8.1	4.9	8.2	14.1	4.7	150 FTG	---- PE	-1.6
S2	11.8	4.9	7.0	13.0		0.035 TL	11.17 PV	
Pipe: 2					-27.1	1.101 PL	4.50 PF	1.7
S2	11.8	4.9	7.0	13.0	9.1	150 FTG	ET PE	0.3
1	11.0	0.0	9.1	0.0		0.119 TL	14.50 PV	
Pipe: 3					-27.1	1.101 PL	17.67 PF	4.2
1	11.0	0.0	9.1	0.0	9.1	150 FTG	2E3RT PE	0.4
2	10.0	0.0	13.8	0.0		0.119 TL	35.67 PV	
Pipe: 4					-27.1	1.101 PL	0.75 PF	0.7
2	10.0	0.0	13.8	0.0	9.1	150 FTG	E PE	0.0
3	10.0	0.0	14.4	0.0		0.119 TL	5.75 PV	
Pipe: 5					-27.1	1.380 PL	11.67 PF	1.1
3	10.0	0.0	14.4	0.0	5.8	120 FTG	2E PE	3.9
4	1.0	0.0	19.4	0.0		0.060 TL	17.67 PV	
Pipe: 6					-27.1	1.380 PL	60.75 PF	4.7
4	1.0	0.0	19.4	0.0	5.8	120 FTG	6E PE	-0.4
PUMP	2.0	SRCE	23.7	(N/A)		0.060 TL	78.75 PV	

NOTES (HASS):

(1) Calculations were performed by the HASS 8.1 computer program under license no. 38091471 granted by
HRS Systems, Inc.
208 South Public Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average imbalance at each node of 0.004 gpm and a maximum imbalance at any node of 0.025 gpm.

(3) Total pressure at each node is used in balancing the system. Maximum water velocity is 9.1 ft/sec at pipe 3.

(4) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(5) PIPE FITTINGS TABLE

Pipe Table Name: STANDARD.PIP

DATE: 4/29/2011 S:\CAD\COMMERCIAL\BC0600\BC0626\HASS\SOLAR DECATHLON.SDF
JOB TITLE: solar decathlon

PAGE: A MATERIAL: S40 HWC: 120

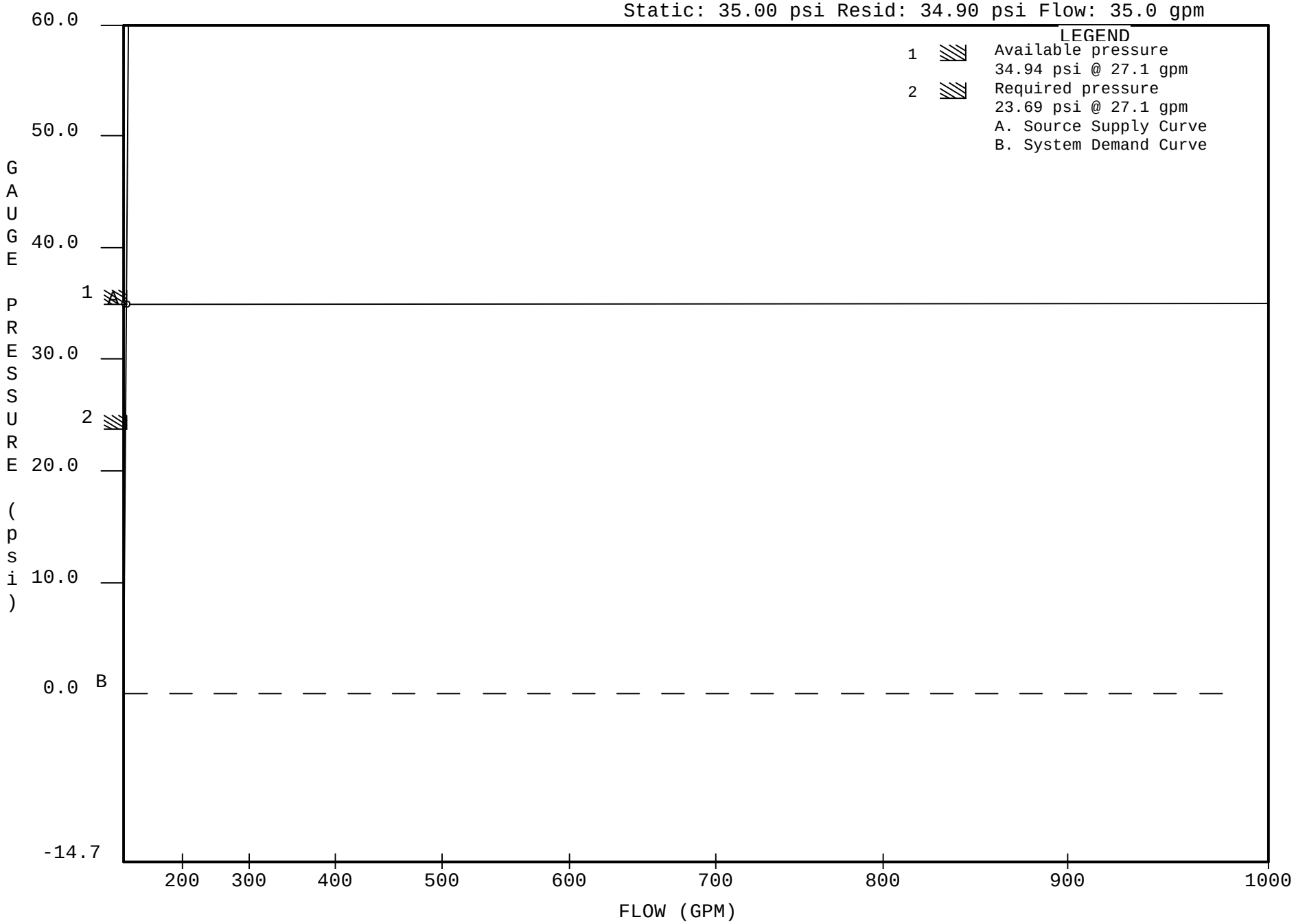
Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	N NPtee
	F F45Ell								
1.380	3.00 1.50	6.00	2.00	7.00	4.00	1.00	10.00	10.00	6.00

PAGE: F MATERIAL: CPVC-T HWC: 150

Diameter (in)	Equivalent Fitting Lengths in Feet						
	E Ell	T Tee	F 45 Tee	R Run	C Couplg	S SwgChk	G GatVal
1.101	5.00	5.00	1.00	1.00	1.00	4.50	0.00

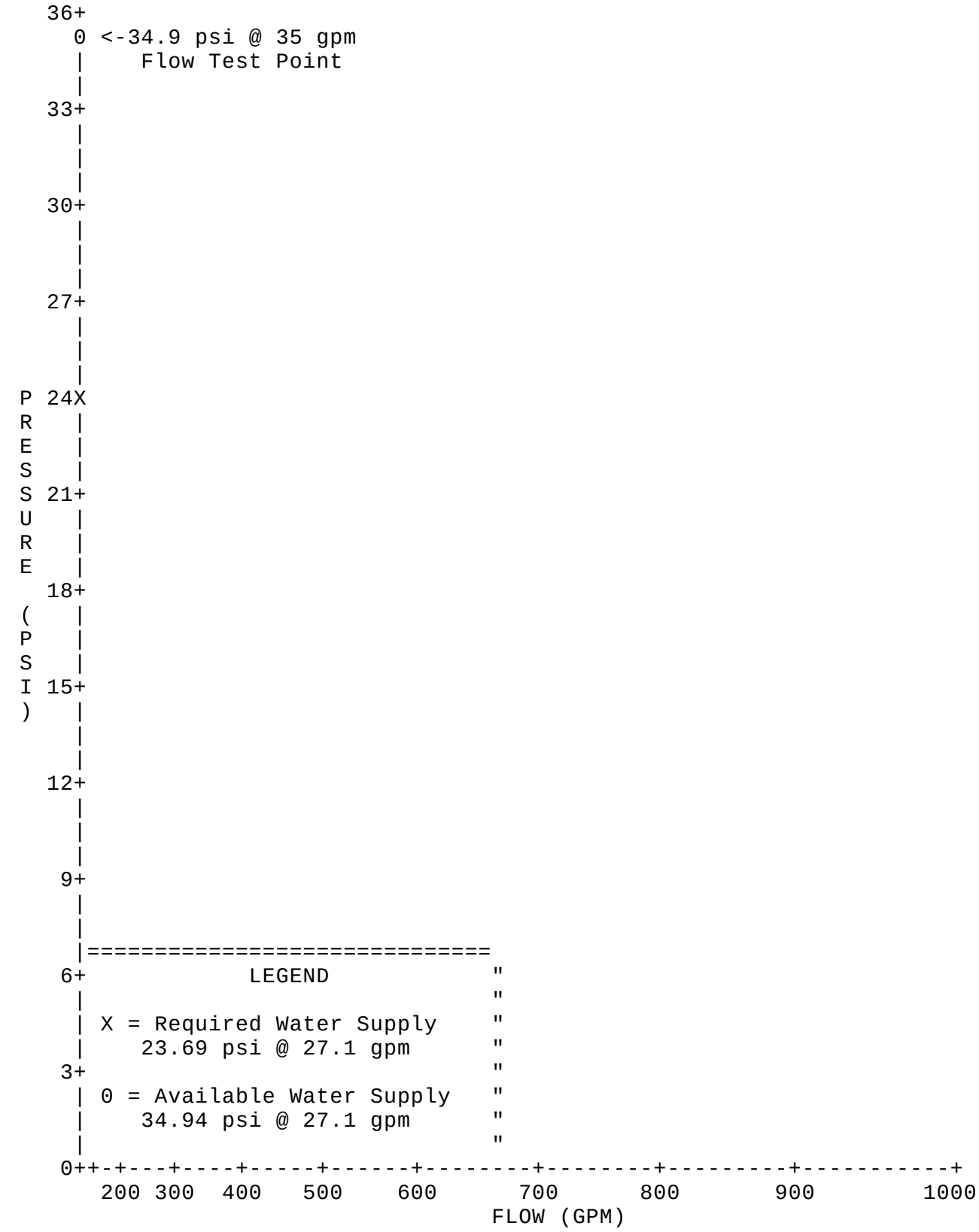
WATER SUPPLY ANALYSIS

Static: 35.00 psi Resid: 34.90 psi Flow: 35.0 gpm



DATE: 4/29/2011 S:\CAD\COMMERCIAL\BC0600\BC0626\HASS\SOLAR DECATHLON.SDF
JOB TITLE: solar decathlon

WATER SUPPLY CURVE



Appendix C: Micro Inverter Justification

See next page.

PV Module “Right-Sizing” for Microinverters

Marv Dargatz, Director of Engineering 01/19/2009

INTRODUCTION

This paper summarizes a discussion of the necessary choices and tradeoffs when matching PV module and microinverter power ratings. We will demonstrate examples of these tradeoffs using simulations based on real-world modules and historical weather data for three U.S. locations.

Solar Advisor Module, the NREL-developed program, was used to generate corrected irradiance levels and cell temperatures based on historical weather data. The data flow is shown in Appendix A.

If long-term energy production is a priority and real-world conditions are considered, a PV module power rating of up to 125 percent of inverter power rating is often the optimum match. In some cases, percentages of up to 140 percent can be justified. It is also clear that site installation specifics such as module tilt and local weather and soiling conditions play a significant role in appropriate inverter/module matching.

TWO THEORIES

The correct way to pair PV modules and inverters has been debated at length. There are two basic schools of thought, which apply to both microinverter and traditional string/central inverter systems; however, there are fewer variables with microinverters, and the result of those considerations is more deterministic.

Several factors should be considered. Appendix B contains a detailed list of factors, along with a brief summary and discussion of each factor. Depending on the application (e.g., a small residential system vs. a large commercial/utility PPA), the weighting of these factors varies considerably.

201 1st Street, Suite 300, Petaluma, CA 94952 707 763 4784 f 707.763.0784
enphaseenergy.com

The two schools of thought can be summarized as follows:

1) The PV module(s) should be sized so that the inverter never limits its output power.

2) The PV module should be sized so that the inverter limits its output power frequently, possibly every clear-sky day.

The two theories represent extremes, and the appropriate course of action will almost always lie somewhere between the two. Regardless of the application, the factors listed in Appendix B will apply.

TEST CASES

Our discussion will be limited to a microinverter application, and we will consider only a fixed array with a due south orientation. Several tilt angles will be considered. We will analyze a specific case in which a decision must be made between Sharp 216W and 235W modules, which will be used with an Enphase M190 Microinverter. The principles discussed here are also applicable to other module/inverter combinations. For string configurations, there are several considerations not discussed here.

Three test cases were modeled using the NREL Solar Advisor Model, along with manufacturers' data for the PV module and inverter. For the simulation, the actual AC output power limit for the inverter was 195W, which is several watts below the actual observed power limits. Irradiance profiles and temperature data were generated using actual measured data from Denver, CO; Palm Springs, CA; and Phoenix, AZ. In all cases, a 5 percent loss of power production was assumed for dirty modules. Module power production was degraded by 1 percent per year to account for module aging. This degradation was compounded annually, and the resulting module production factor is labeled "Module Power Factor" in the data tables in appendix C, D, and E. All arrays faced due south.

Two module power ratings were used. The first module is rated 216W. The second module is rated at 235W. Note that these power ratings are Standard Test Condition (STC) nameplate ratings. The actual output of most modules under real-world conditions is approximately 10-12 percent less than the STC rating. A more realistic rating is obtained under PV-USA Test Conditions (PTC). The CEC website list of eligible modules (http://www.gosolarcalifornia.org/equipment/pvmodule.html) confirms this. The 216W and 235W modules used here are PTC rated at 190.4W and

211.7W, respectively. As a general rule, most modules have a PTC rating of 90 percent of the STC (nameplate) rating.

Table 1 shows the percentage of harvested energy based on the theoretical maximum for three locations at three different array-tilt angles for the two different module power ratings. In all cases the modules were connected to an Enphase M190 Microinverter.

20 year lifetime
Realized energy harvest (% of possible)

		Clean		Dirty	
Module STC Power (watts)		216	235	216	235
	Roof Pitch				
Denver	3:12	99.99%	99.87%	100.00%	99.96%
	6:12	99.94%	99.67%	99.99%	99.88%
	12:12	99.87%	99.39%	99.97%	99.74%
Palm Springs	3:12	100.00%	99.99%	100.00%	100.00%
	6:12	100.00%	99.97%	100.00%	100.00%
	12:12	100.00%	99.94%	100.00%	99.99%
Phoenix	3:12	100.00%	99.94%	100.00%	99.99%
	6:12	99.99%	99.90%	100.00%	99.98%
	12:12	99.99%	99.82%	100.00%	99.96%

TABLE 1

As indicated in Table 1, the worst-case loss of energy harvest occurs in Denver, CO, with a 45 degree roof pitch. In this case, a 216W module will fail to produce 0.13 percent of possible energy over a 20-year period if the modules are washed frequently (e.g. once per week.) Under the same conditions, a 235W module will fail to produce 0.61 percent of potential energy. If the modules are washed only a few times per year—a far more likely scenario—these figures fall to 0.03 percent (216W module) and 0.26 percent (235W module).

Nearly all of the lost harvest occurs within the first three years for the 216W modules, and within the first seven years for the 235W modules. Lost energy harvest is also concentrated in the fall and spring seasons, when irradiance is high and temperatures are low. Test data for Denver is in Appendix C.

For Palm Springs and Phoenix, the 235W module is a perfect match for the 190W inverter. The 235W module produces 8.79 percent (235/216=1.0879) more energy than the 216W module. Over a 30-year inverter life, it is likely

that a module sized up to 245W may be a good match. Appendix D includes data for Palm Springs, and the Phoenix data appears in Appendix E.

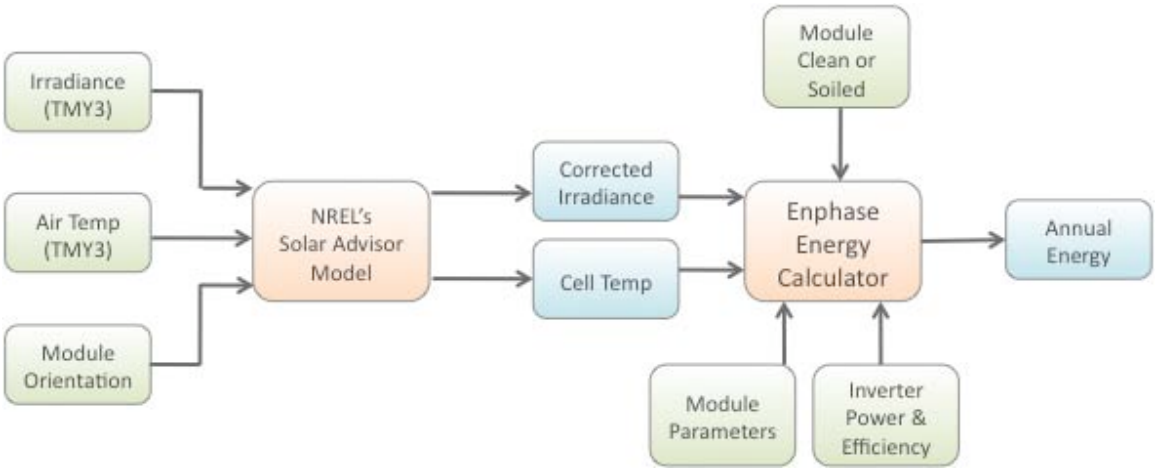
The loss of energy harvest in any of these scenarios pales in comparison to the lost energy of a string or central inverter, which suffers from inferior harvest due to module mismatch, shading, soiling, etc.

CONCLUSION

For a microinverter application, optimal energy harvest will generally result by selecting a module rated up to 125 percent of the maximum inverter power rating. The warmer the climate, the higher this percentage should be, assuming optimal tilt of the PV array. If the array is mounted on a horizontal surface, the module power rating will be substantially higher. In some cases, a module with an STC power rating of up to 140 percent of the inverter rating is justified. No consideration is given here to monetary factors such as annual electric rate schedules, time-of-use metering, or rebate structures.

APPENDIX A

Solar Advisor Module, the NREL-developed program, was used to generate corrected irradiance levels and cell temperatures based on historical weather data. The data flow is shown below:



APPENDIX B

1. Inverter power rating
2. Inverter power limit (actual)
3. Inverter efficiency
4. PV module actual vs. specified power output
5. PV module aging characteristics
6. PV module pricing
7. Site latitude
8. Site elevation
9. Site annual irradiance profile
10. Site annual temperature extremes and profiles
11. Site soiling conditions
12. Tracking vs. fixed array
13. If tracking – single or dual axis tracking
14. If fixed – tilt of array
15. If fixed – azimuth
16. Site maintenance practices
17. Financial rebate structure
18. Metering type – net metered vs. TOU
19. For string – module mismatch
20. For string – differential soiling
21. For string – module shading
22. Wind

First we will generalize the effects of the factors mentioned above and discuss some interrelationships. No inference is made as to the importance of any factor in a particular situation.

Items 1-4 above are related. The inverter power rating is a rating only. UL1741, the standard for Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources, requires that inverter output power be limited to within 10 percent of the nameplate rating. However, inverters that qualify for the California Incentive Program have been tested in addition to UL1741 certification to meet a guaranteed minimum output power.

The CEC-rated power refers to the lowest output power during a three-hour test, or the nameplate rating, whichever is less. This power rating is used in calculating rebate dollars. For this reason, most inverters limit their output power to some value just above the nameplate rating. Similarly, a CEC conversion efficiency test is performed and the weighted average efficiency is used in the rebate calculation. Modules are also tested for their actual power output. Unlike most inverters, most modules are CEC-rated at a lower power level than their nameplate rating.

For this analysis we used the Sharp 216 (ND-U216C1) and 235 (NU-U235F1) modules. The nameplate ratings are 216W and 235W, respectively; however the

PTC ratings on the CEC module list are 190.4W (88.15 percent of nameplate) and 211.7W (90.08 percent of nameplate), respectively.

Inverter efficiencies vary, but they are generally around 95 percent efficient. We assumed 95 percent. Obviously, the higher the efficiency of the inverter, the greater the amount of energy delivered to the utility over the life of the system.

Item 5: PV Module aging – PV module power output degrades over time. Several mechanisms contribute to the degradation, and degree of degradation varies between module technologies. Also, the rate of degradation changes over time. It is beyond the scope of this paper to discuss factors impacting power output degradation. We assumed 1 percent degradation per year; this value is commonly used in the PV industry.

Item 6: PV Module pricing – While financial considerations will almost certainly drive final decisions regarding module/inverter pairing, we leave it to the reader to apply their financial requirements to their particular situation.

Item 7: Site Latitude – Latitude and longitude determine many of the other factors that must be considered. Elevation, irradiance, temperature, soiling, tilt, and shading are all location specific. For our discussion, we chose three locations with dissimilar environmental factors; Denver, CO; Palm Springs, CA; and Phoenix, AZ.

Item 8: Site elevation – Elevation affects several other aspects of the site. Higher elevations can be subject to greater swings in temperature, and they often receive higher levels of peak irradiance.

Item 9: Irradiance profile – Irradiance, the amount of light in Watts/Meter^2 impinging on a surface, determines PV power production. Assuming all other factors are stable, power output increases linearly with increased irradiance once the irradiance exceeds approximately 100 Watts/Meter^2. Instantaneous irradiance is important, but the word “profile” was used here because it is important to recognize that a given irradiance will produce varying power levels depending on the simultaneous values of other factors such as temperature and wind.

Item 10: Temperature – Temperature plays a significant role in PV power production. Ambient temperature, wind speed and direction, array orientation, irradiance, and sun angle all contribute to PV cell temperature. Modules are rated at STC conditions of 1000W/Meter^2 and 25^{O}C. The following is useful as a general rule: Every 1^{O}C increase in cell temperature will result in a 0.5 percent decrease in power output. It is not uncommon for cell temperatures to reach 90^{O}C in some environments, which would result in a power output reduction of 32.5 percent. Hence, the module would produce only 67.5 percent of its rated power.

Item 11: Soiling conditions – Soiling is generally defined as normal atmospheric contamination that adheres to the module surface—e.g., dust, pollen, and ash—and

reduces power output. Regular module cleaning is recommended for maximum energy harvest. Many experts recommend cleaning PV modules at least four times per year. Depending on site-specific conditions, power production can be increased 6 percent or more by cleaning the module surface.

Items 12 and 13: Tracking vs. fixed and single vs. dual axis – Trackers can increase energy harvest substantially. For the purposes of this discussion, we will assume a fixed array.

Item 14: Tilt – This refers to the angle of the module relative to a horizontal surface, with the angle measured along the azimuth line.

Item 15: Azimuth – This is the orientation of the array relative to true north. In the Northern Hemisphere, a true south azimuth is generally preferred, but other orientations may be preferable due to factors such as time-of-use rebate structures and local load time-of-day profiles.

Item 16: Maintenance – For the purpose of this discussion, only cleaning of modules is considered.

Item 17: Financial rebates – We do not consider rebates as part of this discussion, but they will obviously be considered by the end user. For example, some rebates are limited based on the module and inverter ratings. In the past, some rebates were calculated based on module STC ratings. Today, many rebates use the more practical PTC rating.

Item 18: Metering type – This refers to the rate schedule, typically chosen by the system owner. Electric services are usually “net metered” or have a feed-in tariff. For net-metered accounts, the PV system owner can usually choose between time-of-use and non-time-of-use.

Items 19, 20, and 21: Module mismatch, differential soiling, and shading – These factors apply primarily to string/central inverter configurations and are not considered here.

Item 22: Wind – Wind speed and direction can impact PV module power production significantly. Wind cools the module, and the cooler the module, the greater the power produced.

APPENDIX C

State: CO
Latitude: 39.833 Longitude: -104.650
Elevation: 1650m

		Modules cleaned a few times per year. 5% degradation in power production.											
		3:12 array tilt				6:12 array tilt				12:12 array tilt			
	Module	216	216	235	235	216	216	235	235	216	216	235	235
year	Power Factor	unclipped	195	unclipped	195	unclipped	195	unclipped	195	unclipped	195	unclipped	195
1	1	351,254	351,213	382,152	381,481	369,863	369,604	402,397	400,571	373,009	372,349	405,820	402,254
2	0.99	347,742	347,717	378,330	377,801	366,165	365,983	398,373	396,836	369,279	368,772	401,762	398,733
3	0.98	344,265	344,253	374,547	374,136	362,503	362,382	394,390	393,106	365,587	365,208	397,745	395,192
4	0.97	340,822	340,819	370,802	370,490	358,878	358,800	390,446	389,389	361,931	361,659	393,767	391,634
5	0.961	337,414	337,413	367,094	366,865	355,289	355,240	386,541	385,682	358,311	358,122	389,830	388,060
6	0.951	334,040	334,040	363,423	363,258	351,736	351,706	382,676	381,987	354,728	354,606	385,931	384,484
7	0.941	330,699	330,699	359,788	359,672	348,219	348,202	378,849	378,312	351,181	351,114	382,072	380,911
8	0.932	327,392	327,392	356,191	356,110	344,737	344,728	375,061	374,656	347,669	347,637	378,251	377,327
9	0.923	324,118	324,118	352,629	352,579	341,289	341,287	371,310	371,014	344,193	344,180	374,469	373,741
10	0.914	320,877	320,877	349,102	349,071	337,876	337,876	367,597	367,388	340,751	340,747	370,724	370,159
11	0.904	317,668	317,668	345,611	345,595	334,498	334,498	363,921	363,779	337,343	337,342	367,017	366,592
12	0.895	314,492	314,492	342,155	342,149	331,153	331,153	360,282	360,190	333,970	333,970	363,347	363,036
13	0.886	311,347	311,347	338,734	338,732	327,841	327,841	356,679	356,620	330,630	330,630	359,713	359,495
14	0.878	308,233	308,233	335,346	335,346	324,563	324,563	353,112	353,076	327,324	327,324	356,116	355,969
15	0.869	305,151	305,151	331,993	331,993	321,317	321,317	349,581	349,560	324,050	324,050	352,555	352,469
16	0.86	302,099	302,099	328,673	328,673	318,104	318,104	346,085	346,074	320,810	320,810	349,029	348,985
17	0.851	299,078	299,078	325,386	325,386	314,923	314,923	342,624	342,620	317,602	317,602	345,539	345,521
18	0.843	296,088	296,088	322,132	322,132	311,774	311,774	339,198	339,197	314,426	314,426	342,084	342,077
19	0.835	293,127	293,127	318,911	318,911	308,656	308,656	335,806	335,806	311,282	311,282	338,663	338,661
20	0.826	290,195	290,195	315,722	315,722	305,569	305,569	332,448	332,448	308,169	308,169	335,276	335,276
		6,396,101	6,396,019	6,958,721	6,956,102	6,734,953	6,734,206	7,327,376	7,318,311	6,792,245	6,789,999	7,389,710	7,370,576
Total Lost Energy (Wh)			82		2,619		747		9,065		2,246		19,134
235W module gain over 216W module					8.76%				8.67%				8.55%

APPENDIX D

State: CA
Latitude: 33.633 Longitude: -116.167
Elevation: -34m

		Modules cleaned a few times per year. 5% degradation in power production.											
	Module	3:12 array tilt				6:12 array tilt				12:12 array tilt			
	Power	216	216	235	235	216	216	235	235	216	216	235	235
year	Factor	unclipped	195	unclipped	195	unclipped	195	unclipped	195	unclipped	195	unclipped	195
1	1	400,015	400,015	435,201	435,191	414,797	414,797	451,284	451,214	409,000	409,000	444,977	444,767
2	0.99	396,015	396,015	430,849	430,843	410,649	410,649	446,771	446,736	404,910	404,910	440,527	440,393
3	0.98	392,055	392,055	426,541	426,539	406,542	406,542	442,303	442,288	400,861	400,861	436,121	436,044
4	0.97	388,134	388,134	422,275	422,275	402,477	402,477	437,880	437,876	396,852	396,852	431,760	431,714
5	0.961	384,253	384,253	418,053	418,053	398,452	398,452	433,501	433,501	392,883	392,883	427,443	427,417
6	0.951	380,410	380,410	413,872	413,872	394,468	394,468	429,166	429,166	388,955	388,955	423,168	423,157
7	0.941	376,606	376,606	409,733	409,733	390,523	390,523	424,875	424,875	385,065	385,065	418,937	418,932
8	0.932	372,840	372,840	405,636	405,636	386,618	386,618	420,626	420,626	381,214	381,214	414,747	414,744
9	0.923	369,112	369,112	401,580	401,580	382,752	382,752	416,420	416,420	377,402	377,402	410,600	410,599
10	0.914	365,420	365,420	397,564	397,564	378,924	378,924	412,255	412,255	373,628	373,628	406,494	406,494
11	0.904	361,766	361,766	393,588	393,588	375,135	375,135	408,133	408,133	369,892	369,892	402,429	402,429
12	0.895	358,149	358,149	389,652	389,652	371,384	371,384	404,052	404,052	366,193	366,193	398,404	398,404
13	0.886	354,567	354,567	385,756	385,756	367,670	367,670	400,011	400,011	362,531	362,531	394,420	394,420
14	0.878	351,021	351,021	381,898	381,898	363,993	363,993	396,011	396,011	358,906	358,906	390,476	390,476
15	0.869	347,511	347,511	378,079	378,079	360,353	360,353	392,051	392,051	355,317	355,317	386,571	386,571
16	0.86	344,036	344,036	374,299	374,299	356,750	356,750	388,130	388,130	351,764	351,764	382,706	382,706
17	0.851	340,596	340,596	370,556	370,556	353,182	353,182	384,249	384,249	348,246	348,246	378,879	378,879
18	0.843	337,190	337,190	366,850	366,850	349,650	349,650	380,406	380,406	344,764	344,764	375,090	375,090
19	0.835	333,818	333,818	363,181	363,181	346,154	346,154	376,602	376,602	341,316	341,316	371,339	371,339
20	0.826	330,480	330,480	359,550	359,550	342,692	342,692	372,836	372,836	337,903	337,903	367,626	367,626
		7,283,994	7,283,994	7,924,713	7,924,695	7,553,165	7,553,165	8,217,562	8,217,438	7,447,602	7,447,602	8,102,714	8,102,201
Total Lost Energy (Wh)			0		18		0		124		0		513
235W module gain over 216W module					8.80%				8.79%				8.79%

APPENDIX E

State: AZ
Latitude: 33.450 Longitude: -111.983
Elevation: 337m

		Modules cleaned a few times per year. 5% degradation in power production.											
	Module	3:12 array tilt				6:12 array tilt				12:12 array tilt			
	Power	216	216	235	235	216	216	235	235	216	216	235	235
year	Factor	unclipped	195	unclipped	195	unclipped	195	unclipped	195	unclipped	195	unclipped	195
1	1	401,228	401,227	436,521	436,270	415,438	415,420	451,981	451,445	409,356	409,346	445,364	444,355
2	0.99	397,216	397,216	432,156	431,978	411,284	411,273	447,461	447,085	405,263	405,258	440,911	440,180
3	0.98	393,244	393,244	427,834	427,712	407,171	407,166	442,987	442,730	401,210	401,209	436,501	435,987
4	0.97	389,311	389,311	423,556	423,478	403,099	403,098	438,557	438,383	397,198	397,198	432,136	431,793
5	0.961	385,418	385,418	419,320	419,274	399,068	399,068	434,171	434,053	393,226	393,226	427,815	427,595
6	0.951	381,564	381,564	415,127	415,102	395,077	395,077	429,829	429,750	389,294	389,294	423,537	423,406
7	0.941	377,748	377,748	410,976	410,962	391,127	391,127	425,531	425,478	385,401	385,401	419,302	419,226
8	0.932	373,971	373,971	406,866	406,860	387,215	387,215	421,276	421,240	381,547	381,547	415,109	415,071
9	0.923	370,231	370,231	402,798	402,795	383,343	383,343	417,063	417,041	377,731	377,731	410,957	410,944
10	0.914	366,529	366,529	398,770	398,770	379,510	379,510	412,892	412,880	373,954	373,954	406,848	406,841
11	0.904	362,863	362,863	394,782	394,782	375,715	375,715	408,764	408,757	370,214	370,214	402,779	402,777
12	0.895	359,235	359,235	390,834	390,834	371,957	371,957	404,676	404,673	366,512	366,512	398,752	398,752
13	0.886	355,642	355,642	386,926	386,926	368,238	368,238	400,629	400,629	362,847	362,847	394,764	394,764
14	0.878	352,086	352,086	383,056	383,056	364,555	364,555	396,623	396,623	359,219	359,219	390,816	390,816
15	0.869	348,565	348,565	379,226	379,226	360,910	360,910	392,657	392,657	355,626	355,626	386,908	386,908
16	0.86	345,079	345,079	375,434	375,434	357,301	357,301	388,730	388,730	352,070	352,070	383,039	383,039
17	0.851	341,629	341,629	371,679	371,679	353,728	353,728	384,843	384,843	348,549	348,549	379,209	379,209
18	0.843	338,212	338,212	367,963	367,963	350,191	350,191	380,994	380,994	345,064	345,064	375,417	375,417
19	0.835	334,830	334,830	364,283	364,283	346,689	346,689	377,184	377,184	341,613	341,613	371,663	371,663
20	0.826	331,482	331,482	360,640	360,640	343,222	343,222	373,413	373,413	338,197	338,197	367,946	367,946
		7,306,083	7,306,082	7,948,747	7,948,024	7,564,838	7,564,803	8,230,261	8,228,588	7,454,091	7,454,075	8,109,773	8,106,689
Total Lost Energy (Wh)			1		723		35		1,673		16		3,084
235W module gain over 216W module					8.79%				8.77%				8.76%

201 1st Street, Suite 300, Petaluma, CA 94952 707 763 4784 f 707.763.0784
enphaseenergy.com

Appendix D: PV Simulation Results

See next page.

Grid-Connected System: Simulation parameters

Project : **SD2011**

Geographical Site	**Calgary Int'l**		**Country**	**Canada**
Situation	Latitude	51.1°N	Longitude	114.0°W
Time defined as	Legal Time	Time zone UT-7	Altitude	1084 m
	Albedo	0.20		

Meteo data : Calgary Int'l, Canada EPW

Simulation variant : **Ken1**

Simulation date 11/08/11 08h03

Simulation parameters

Heterogeneous field, double orientation

			Proportion af array #1	95 %
	Array#1 tilt	27°	Array#1 azimut	9°
	Array#2 tilt	0°	Array#2 azimut	0°

Horizon Free Horizon

Near Shadings No Shadings

PV Arrays Characteristics (2 kinds of array defined)

PV module Si-poly — Model **P 230PA**, Manufacturer Conergy

Array#1:	Number of PV modules	In series	1 modules	In parallel	35 strings
Total number of PV modules		Nb. modules	35	Unit Nom. Power	230 Wp
Array global power		Nominal (STC)	**8.1 kWp**	At operating cond.	7.2 kWp (50°C)
Array operating characteristics (50°C)		U mpp	27 V	I mpp	269 A
Array#2:	Number of PV modules	In series	1 modules	In parallel	2 strings
Total number of PV modules		Nb. modules	2	Unit Nom. Power	230 Wp
Array global power		Nominal (STC)	**460 Wp**	At operating cond.	413 Wp (50°C)
Array operating characteristics (50°C)		U mpp	27 V	I mpp	15 A
Total	Arrays global power	Nominal (STC)	**9 kWp**	Total	37 modules
		Module area	**61.1 m²**		

Inverter Model **M 190 72 240**, Manufacturer Enphase

Operating Voltage	22-40 V	Unit Nom. Power	0.190 kW AC	
Array#1:	Number of Inverter	35	Total Power	6.7 kW AC
Array#2:	Number of Inverter	2	Total Power	0.38 kW AC
Total	Number of Inverter	37	Total Power	7 kW AC

PV Array loss factors

Thermal Loss factor	Uc (const)	25.0 W/m²K	Uv (wind)	1.2 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind velocity = 1m/s.)			NOCT	47 °C
Wiring Ohmic Loss	Array#1	1.7 mOhm	Loss Fraction	1.5 % at STC
	Array#2	29 mOhm	Loss Fraction	1.5 % at STC
	Global		Loss Fraction	1.5 % at STC

Grid-Connected System: Simulation parameters (continued)

Array Soiling Losses			Loss Fraction	10.0 %
Module Quality Loss			Loss Fraction	2.0 %
Module Mismatch Losses			Loss Fraction	0.5 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs : Unlimited load (grid)

Grid-Connected System: Main results

Project : **SD2011**

Simulation variant : **Ken1**

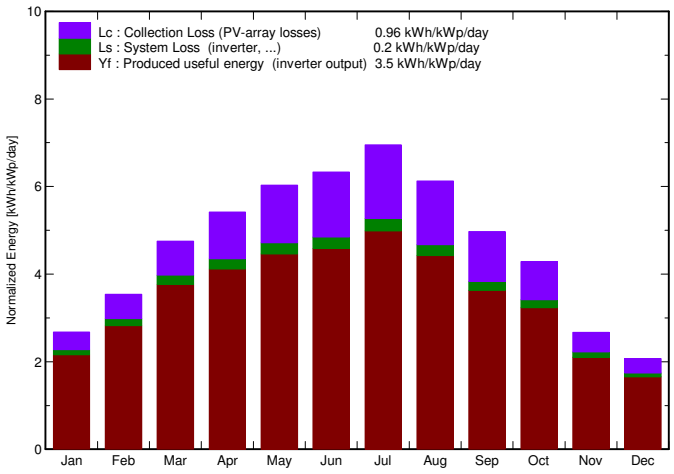
Main system parameters		System type	**Grid-Connected**		
PV Field Orientation	double orientation/ field #1(95 %	tilt27°, azimuth9°		field #2	tilt0°, azimuth0°
PV modules		Model	P 230PA	Pnom	230 Wp
PV Array		Nb. of modules	37	Pnom total	**8.5 kWp**
Inverter		Model	M 190 72 240	Pnom	190 W ac
Inverter pack		Nb. of units	37.0	Pnom total	**7.0 kW ac**
User's needs		Unlimited load (grid)			

Main simulation results

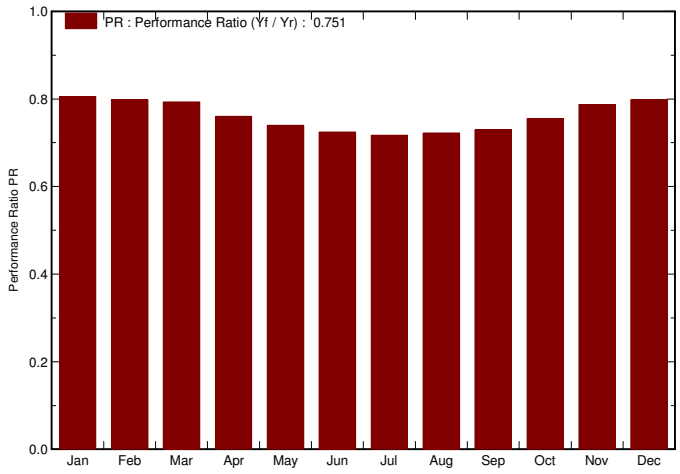
System Production — **Produced Energy** **10.87 MWh/year** Specific prod. 1278 kWh/kWp/year

Performance Ratio PR 75.1 %

Normalized productions (per installed kWp): Nominal power 8.5 kWp



Performance Ratio PR



Ken1

Balances and main results

	GlobHor kWh/m²	T Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	40.8	-8.16	82.9	79.7	601	569	11.85	11.22
February	63.0	-6.44	99.0	95.5	711	673	11.74	11.12
March	109.9	-3.78	147.3	142.3	1050	994	11.67	11.04
April	141.2	4.27	162.6	157.2	1111	1052	11.18	10.58
May	179.8	9.38	186.9	180.3	1245	1177	10.89	10.30
June	188.5	14.60	190.0	183.0	1238	1171	10.66	10.09
July	209.2	16.85	215.5	208.2	1390	1316	10.55	9.99
August	168.9	16.05	189.9	184.1	1234	1168	10.63	10.06
September	117.0	10.21	149.1	144.2	979	926	10.74	10.16
October	85.3	5.87	132.9	128.1	901	854	11.10	10.51
November	45.2	-3.61	80.1	77.0	568	537	11.59	10.96
December	32.8	-7.85	64.2	61.6	461	436	11.74	11.11
Year	1381.6	4.01	1700.5	1641.4	11488	10872	11.05	10.46

Legends:

GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
T Amb	Ambient Temperature	E_Grid	Energy injected into grid
GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

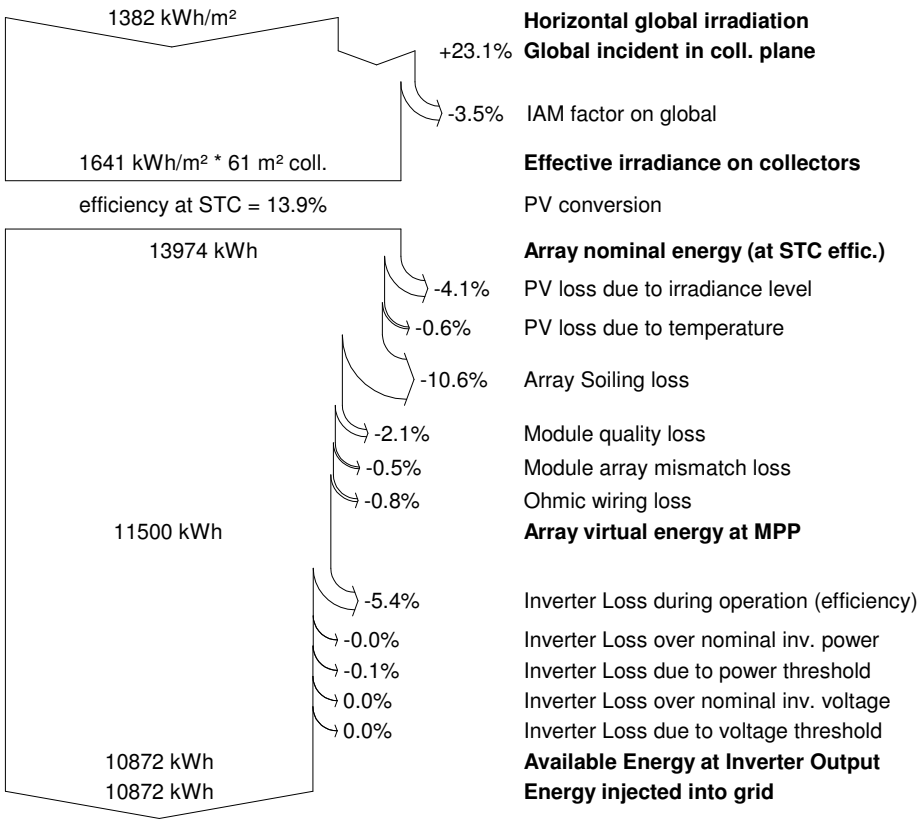
Grid-Connected System: Loss diagram

Project : **SD2011**

Simulation variant : **Ken1**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	double orientation/ field #1(95 %	tilt27°, azimuth9°	field #2	tilt0°, azimuth0°
PV modules	Model	P 230PA	Pnom	230 Wp
PV Array	Nb. of modules	37	Pnom total	**8.5 kWp**
Inverter	Model	M 190 72 240	Pnom	190 W ac
Inverter pack	Nb. of units	37.0	Pnom total	**7.0 kW ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Appendix E: Datasheets

See next page.

DMT300RFS

Built-in Dishwasher with Hard Food Disposer

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Where to buy

$899.99

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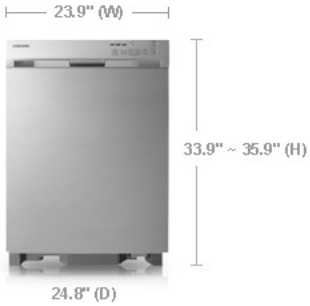
Product dimensions



Bullet view Table view

Full specs

Option	**Number of Option**	3
	Sanitize	Yes
	Cancel & Drain Button	Yes
	Child Lock	Yes
Dimensions	**Net Height**	33.9" ~ 35.9"
	Net Width	23.9"
	Net Depth	24.8"
Features	**Place Settings**	14
	Tub Material	Stainless Steel
	Drying System	Air vent
	Heater Position	Hidden (Tub bottom)
	Sound Level(Lw) Acoustic Power (dBA)	51
	NSF Certified for sanitize	Yes
	Leakage Sensor	Yes
	Wash Arm	3 (Upper, Middle, Lower)
	Food Disposer	Yes
	Water Filtration System (Soft Water)	Double Filtration

Weight	**Net Weight**	52.2 kg
	Gross Weight	54.9 kg
Design	**Colour / Material**	Stainless Steel
	Control Panel Style	Front
	Control Type	Tact button
Performance	**Wash Perfomance**	86%
	Dry Performance	90%
	Energy Performance	1.36 kw h/cycle
Cycle	**Normal**	Yes
	Number of Wash Cycle	4
	Heavy-Pots & Pans	Yes
	Delicate - China	Yes
	Quick wash	Yes
Interior	**Rack Coated**	Nylon 12
	Ball Tipped Tines	Yes
Upper Rack	**Adjustable**	Yes (tw o step)
	Adjustable Height	2"
	Cup Clip	Yes (2)
Lower Rack	**# of Removable Tine**	1
	Silverware Basket	2 pieces

Features and specifications are subject to change w ithout prior notification.

DV210AES

7.3 cu. ft. Front Load Dryer

Like

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Where to buy

$699.99

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Product dimensions

Bullet view Table view

Full specs

Features	**Matching Washer**	WF210ANS/XAC
	Capacity	7.3 cu.ft.
	Power resource	Electric
	Colour	Imperial Silver
	Door Trim	Imperial Silver
	Display Type	LED
	Display Color (LED)	Red
	Drum Material	Painted Coating
	Drum Light	Yes
	Reversible Door	Yes
	Drying Rack	No
	Door Safety	Yes
	Vent Exhaust	4 Way
Electrical Ratings	**Heating Element (KW)**	5300 W
	Cycle Time (AHAM 8lbs)	45 min ↓
	DOE Energy Factor	3.01 (lb / kWh)
	Voltage / Frequency	120 / 240 V / 60 Hz
Standard Dry Cycle	**Number of dry cycle**	7
	Normal	Yes

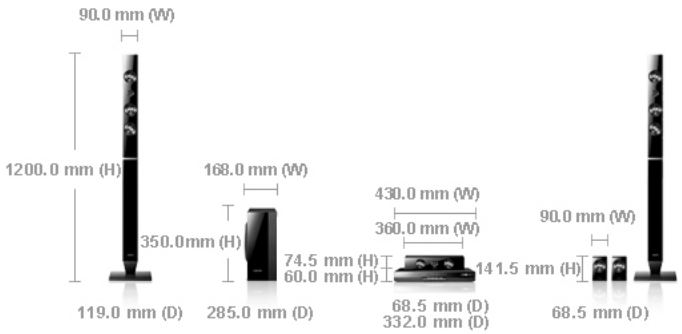
	Heavy Duty	Yes
	Perm Press	Yes
	Delicates	Yes
	Time Dry	Yes (Quick Dry)
	Wrinkle Release	Yes
	Air Fluff	Yes
Option	**Number of Option**	2
	Wrinkle Prevent	Yes
	Child Lock	Yes
Temp Level	**Number of temp level**	4
	High	Yes
	Medium	Yes
	Low	Yes
	Extra Low	Yes
Dryness level	**Number of dryness level**	4
	More Dry	Yes
	Normal Dry	Yes
	Less Dry	Yes
	Damp Dry	Yes
Others	**Signal Level**	On / Off
	Adjust Time	Yes
Weight	**Net Weight**	55.1 kg
Dimensions	**Net Height**	38.0" (15.0" pedestal sold separately)
	Net Width	27.0"
	Net Depth	31.1"

Features and specifications are subject to change without prior notification.

HT-D6530

Smart Wi-Fi 3D Blu-ray Home Theatre

Product dimensions



Bullet view Table view

Full specs

General	**Total Power**	1000 W
	Deck Type	Slot-in
	Number of Channel	5.1
	Disc Capacity	1
Playable Disc Type	**3D Blu-ray**	Yes
	Blu-ray Video	Yes
	DVD-Video / DVD±R / DVD ±RW	Yes
	CD DA / CD-R / CD-RW	Yes
Decoding Format	**AVCHD**	Yes
	DivX(including XviD), DivX HD	Yes
	LPCM	Yes
	AAC	Yes
	MP3	Yes
	MKV	Yes
	WMA, WMV(1/2/3/7/9)	Yes
	JPEG, PNG, GIF	JPEG
	HD JPEG	Yes
Video Feature	**BD Wise**	Yes
	BD Profile	2.0
	3D Converter (2D->3D)	Yes
	Video Up-Scale (DVD)	Yes

Audio Processing	Dolby Digital	Yes
	Dolby Pro Logic II	Yes
	Dolby Digital Plus	Yes
	Dolby True HD	Yes
	DTS	Yes
	DTS 96/24	Yes
	DTS-HD	Yes
	Wideband	Yes
	3D Depth Sound	Yes
	Smart Volume	Yes
	MP3 Enhancer	Yes
	Power Bass	Yes
	Virtual Surround (7.1 / 5.1)	Yes (virtual 7.1)
	EQ	Yes
	# of Sound Modes (DSP)	8
	Auto Sound Calibration (ASC)	Yes
Connectivity	Anynet+ (HDMI-CEC)	Yes
	All Share	Yes
	USB HOST	Yes
	Wireless LAN	Built-In
	Wireless Speaker Ready	Yes
	Made for iPod/iPhone	Yes
	iPod/iPhone over USB	Yes
	iPod Dock Cradle included	Yes
	ARC (Audio Return Channel)	Yes
AV input/output	HDMI Out	Yes
	Composite Output	Yes
	Component Output	Yes
	# of HDMI Input	2
	# of Audio Input	1
	# of Optical Input	1
Tuner	FM	Yes
Special Feature	Local Storage (Memory Built-in)	Yes (2 GB)
	Crystal Amplifier Plus	Yes
	Network Service	Widget
Speaker	Type (Tallboy/Satellite/Swivel)	2 Tallboy
	Sub Woofer	Normal
	Front	DT4
	Center	DC2
	Surround	DS2
Dimensions & Weight	Set Net Weight (Kg)	3.90
	Spk (sub woofer) Net Weight (Kg)	3.78
	Spk (front) Net Weight (Kg)	2.90
	Spk (center) Net Weight (Kg)	0.59
	Spk (surround) Net Weight (Kg)	0.57

	Set Net Dimension(W*H*D)	430.0 x 60.0 x 332.0 mm
	Spk (sub woofer) Net Dimension(W*H*D)	168.0 x 350.0 x 285.0 mm
	Spk (front) Net Dimension(W*H*D)	90.0 x 1200.0 x 119.0 mm (Stand: 250 x 250 mm)
	Spk (center) Net Dimension(W*H*D)	360.0 x 74.5 x 68.5 mm
	Spk (surround) Net Dimension (WxHxD)	90.0 x 141.5 x 68.5 mm
	Gross Weight: One Packing	8.5 lbs / 3.9 kg
	Gross Dimension (WxHxD) : One Packing	706.0 x 446.0 x 384.0 mm
Accessory	**Composite Cable**	Yes
	ASC MIC	Yes
	Antenna	Yes
	Cloth	Yes

Features and specifications are subject to change without prior notification.

FE-R400SX

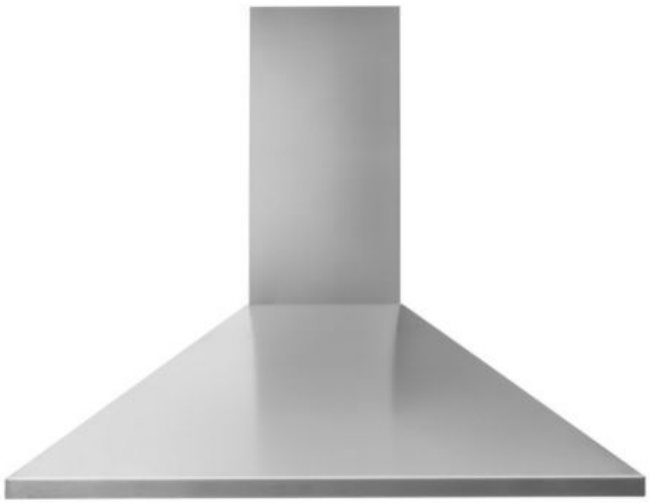
5.9 cu. ft. Freestanding Electric Range

Product dimensions

Bullet view | Table view

Full specs

Basic	**Capacity (cu. ft.)**	5.9
	Drawer	1.1
Control	**Control method (oven)**	Membrane
	Control method (cooktop)	Polypropylene Knob
	Cleaning	Self, Steam
	Display Type	Digital LED
	Child Safety Lock	Yes
Cooktop	**Type**	Electric Ceramic
	Number of Burners	5
	Hot surface Indicator	Yes
	Warming Zone	Yes
Oven	**Hidden Bake Elements**	Yes
	Sabbath Mode	Yes
Door	**Number Glass layers**	4
Dimensions	**Cavity (W*H*D)**	25.0" x 20.7" x 18.9"
	Outside (W*H*D)	29.9" x 47.1" x 25.7"
	Gross (W*H*D)	32.9" x 50.4" x 30.1"
Weight	**Net (Kg)**	43.5



LUFTIG HOO C50 S

Exhaust hood, Stainless steel

$399.00

Article Number: 500.920.16

2 dishwasher-safe grease filters included; easily removable for cleaning. Read more

1

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Choose Ok

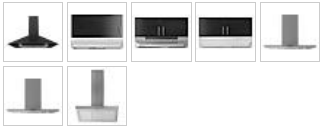
Store selection may vary and prices may differ from those online.

Matching Products

Product information

NYTTIG FIL 3
charcoal filter
$24.99

More Extractor hoods



Go to Extractor hoods

RB194ACRS

18 cu. ft. Bottom Mount Refrigerator with Side Swing Freezer Door.

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$1,199.99

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Product dimensions

Bullet view | Table view

Specs

Capacity

- 17.9 cu.ft Total Capacity
- 5.7 Cu ft Net Freezer Capacity
- 12.2 Cu ft Net Refrigerator Capacity

Refrigerator Features

- LED Interior Lighting
- Humidity Control
- 6 Door Pockets
- 3 Shelves
- 2 Fruit and Vegetable Drawers
- Tempered Glass Shelves available
- Chill Compartment available

Exterior Features

- Blue LED Display
- FF / FZ Indented Handle
- Stainless Steel

Weight

- 99 kg (218.26 lbs) Net Weight

Dimensions

- 32.17" Net Width
- 70.00" Net Case Height with Hinge
- 68.88" Net Case Height without Hinge
- 28.15" Net Depth with Door Handle
- 27.88" Net Depth without Door Handle
- 24.38" Net Depth without Door

Freezer Features

- 2 Freezer Drawers
- LED Interior Light

Others

- Door Alarm (2 min)
- R134a Refrigerant
- Cyclopentane Insulation

Cooling Features

- Twin Cooling
- No frost
- Multi Flow

Loading Quantity

- 18 / 39 / 39 Loading Quantity

Category

- Bottom Mount Freezer

UN40C5000

Samsung LED TV Series 5 has arrived.

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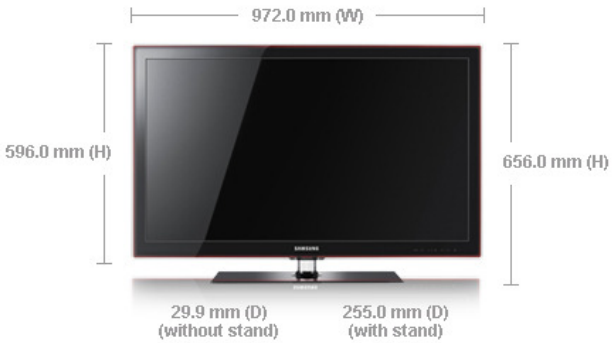
Product dimensions



Bullet view | Table view

Download PDF

Specs

Series

Series 5

Audio

Dolby Digital Plus, Dolby Pulse
DTS 2.0 + Digital Out
10Watts X 2 Sound Output (RMS)
Audio (Woofer) available

Input & Output

Audio Out (Mini Jack)
Component In (Y/Pb/Pr)
Component In (Y/Pb/Pr) 1 (Common Use for Component Y)
Digital Audio Out (Optical) x 1 (Side)
DVI Audio In (Mini Jack) x 1 (Common Use for PC)
Ethernet (LAN)
HDMI x 4 (Side)
PC Audio In (Mini Jack)
PC In (D-sub)
RF In

Display

Ultra Clear Panel available

Feature

AnyNet+ (HDMI-CEC) available
Auto Channel Search available
Auto Power Off available
Auto Volume Leveler available
Captions (Subtitle) available
Clock and On/Off Timer available
AllShare (Powered by DNLA)
EPG available
Games Mode available
OSD Languages : English, French, Spanish
Picture-in-Picture (1 Tuner PIP)
Sleep Timer available
USB (Movie)
WiFi Adaptor Support included
V-Chip available

Design

Slim Design

Video

40" Screen Size
1920 x 1080 Resolution
HyperReal Engine
Wide Color Enhancer Plus available

System

DTV Reception (ATSC)
DTV Tuner Built-in available

Power

Eco Mark (Energy Star 4.0)
Eco Sensor available
Power Supply AC100 - 240V 50 / 60 Hz

Accessory

Batteries included
Instruction Book available
Power Cable available
Remote Controller Model TM1060
Ultra Slim Wall Mount Support available

WF210ANS

4.0 cu. ft. High Efficiency Front Load Washer

Compare

Add to wishlist

Where to buy

$ 799.99

Find similar products

Like Be the first of your friends to like this.

Product dimensions

Bullet view | Table view

Specs

Features

- 4.0 Cu ft Load Capacity
- Vibration Reduction Technology
- Imperial Silver
- Imperial Silver Door Trim
- Direct Drive Motor
- 18:88 LED Display
- Red Display Color
- 1100 rpm Max. Spin Speed

Option

- 5 Options
- 19 Hours Delay Start
- My Cycle
- Extra rinse Option
- Add Garment Option
- Child Lock

Soil Level

- 3 Soil Levels
- Heavy Soil Level available
- Normal Soil Level available

Energy Efficiency

- MEF 2.4
- 3.7 L Water Consumption per Wash
- 140 kWh/yr Energy Consumption

Temp setting

- 4 Temperature Settings
- Hot / Cold Temperature Setting available
- Warm / Warm Temperature Setting available
- Warm / Cold Temperature Setting available
- Cold / Cold Temperature Setting available

Detergent Dispenser

- 3 Tray Detergent Dispensers
- Main Detergent Dispenser
- Softner Detergent Dispenser
- Bleach Detergent Dispenser

Dimensions

- 965mm Net Height
- 27" Net Width

Standard Wash Cycle

- 6 Wash Cycles
- Heavy duty program
- Normal program
- Delicates and Hand Wash program
- Perm Press program
- Rinse + Spin program
- Quick Wash program

Spin Speed

- 4 Spin Speeds
- High Spin Speed available
- Medium Spin Speed available
- Low Spin Speed available
- No Spin function

Others

- On/Off Signal Level

Layher AllroundScaffolding®
Erection Manual
09/2005

The universal system
for everyday and
complicated tasks in scaffolding

Certification according to
DIN ISO 9001/EN 29 001
by TÜV-CERT

Erection Manual

Layher®

More Possibilities. The Scaffolding System.

Important information

These instructions for assembly and use are only for general information. Some provisions may not apply to all applications. Never take chances! If you have questions regarding specific applications contact Layher.
Layher expects all users to be familiar with Layher Safety Guidelines, this Erection Manual, all Federal, State and local regulations governing scaffold construction and use before erecting scaffold.

⚠ WARNING

Serious INJURY or DEATH can result from your failure to follow all applicable safety requirements of OSHA, federal, state and local regulations, the Layher Safety Guidelines and this erection manual before erecting, using or dismantling this scaffold.

These instructions for assembly and use govern only the erection of this scaffold with original Layher components. Should components other than those originating from Layher be used we accept no liability for any damages which may occur as a result of their use.

All equipment must be inspected prior to erection to see that it is in good condition and is servicable. Damaged or deteriorated equipment must not be used. REMOVE it from the job site.

Inspect all Layher „Robust Decks" prior to erection especially for mechanical damages, deformation and rot or other deterioration.
Layher Allround must be erected, moved, altered or dismantled only under supervision and direction of a competent person[1]. Hard hats and appropriate clothing must be worn by all persons erecting, moving, dismantling or using Layher Allround.

The metric dimensions in this manual are the exact dimensions. Imperial sizes are only approximate.

For information regarding the load bearing capacity of the components refer also to Layher Allround Engineering Manual and Layher Allround Technical Manual.

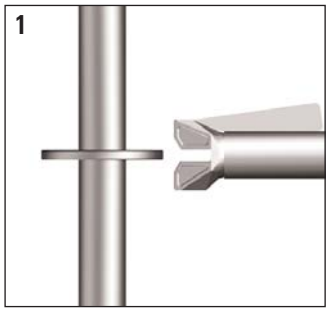
Key definitions according to OSHA (29 CFR 1926.450[b])

[1] **Competent person:**
OSHA defines „competent person" for this purpose as „one who is capable of identifying existing and predictable hazards in the surrounding or working conditions which are unsanitary, hazardous or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them".

Contents of this manual:

Function principle of the wedge head connection and flexibility

1

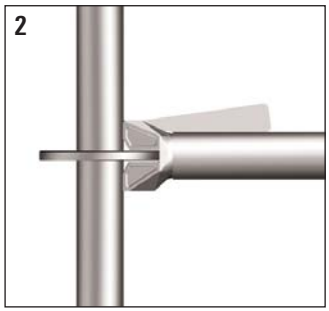


Lead the component to the standard,

⚠ WARNING

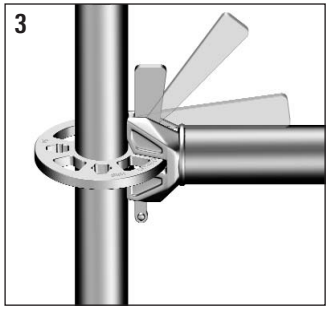
Wedges that are not fully seated or couplers that are not fully tightened will not support design loads. Failure to FULLY KNOCK HOME WEDGES OR TIGHTEN COUPLERS could cause serious INJURY or DEATH.

2



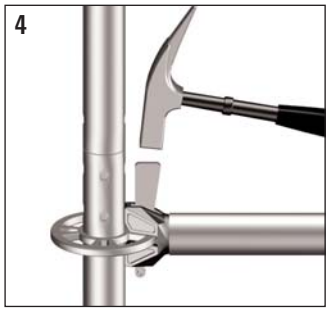
Until the wedge head touches the standard.

3



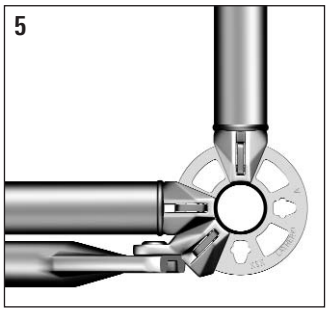
Lift the wedge and for rectangular assemblies insert it into the small hole of the perforated disk.

4



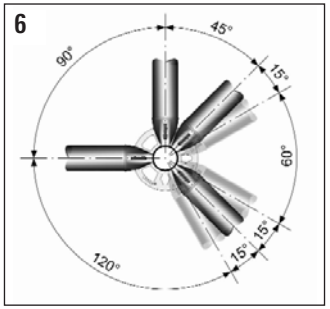
Drive the wedge with a 500 g (24 oz.) hammer home.

5



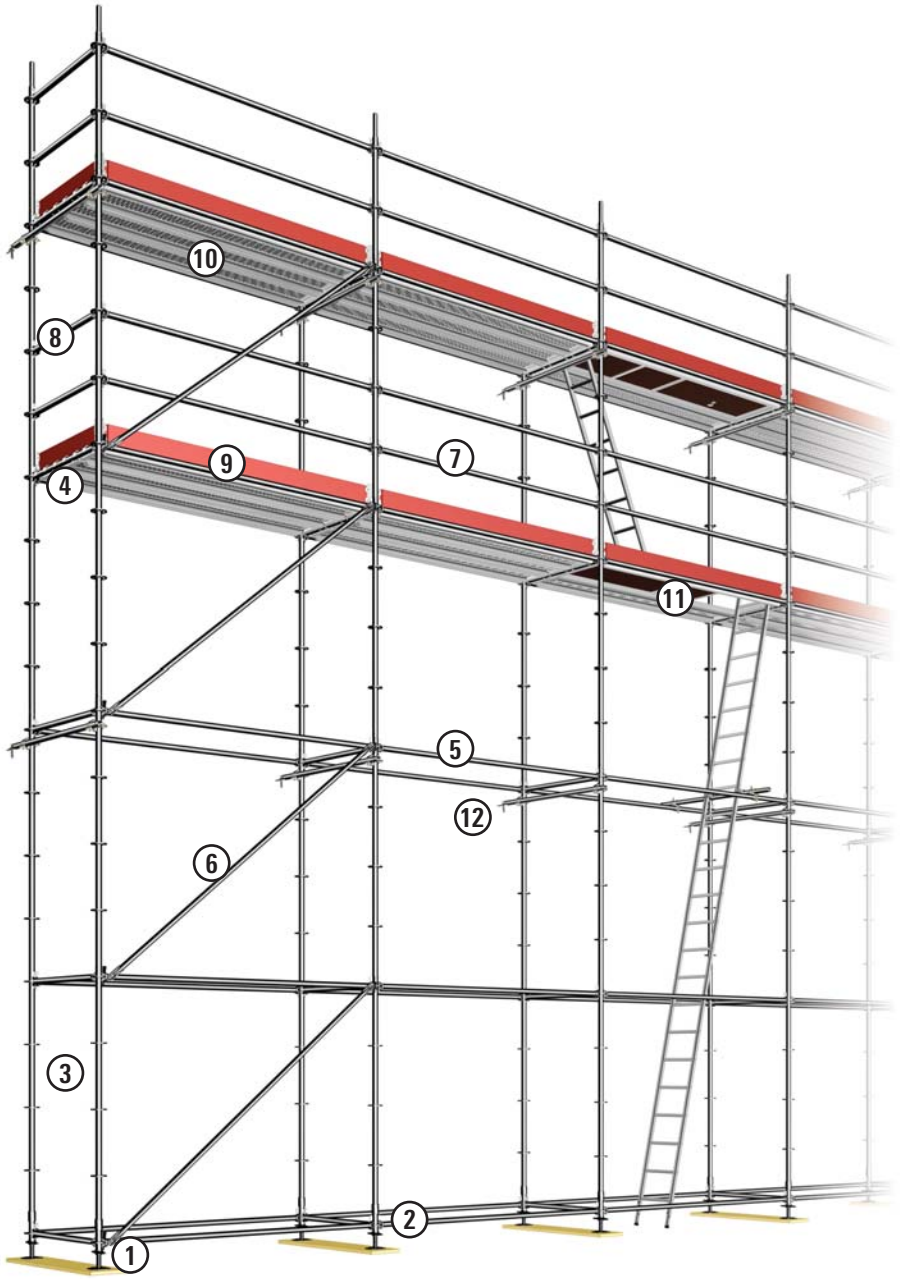
The 4 narrow openings in the rosette automatically center the ledgers at right angles – the 4 wide openings permit the alignment of the ledgers and diagonal braces at the required angle. Up to 8 components can be connected to one rosette.

6



For round scaffolds or non rectangular scaffols all angles larger than 45° can be set.

Overview of the main components of the AR-Scaffolding



NOTE: Internal means of access are most safe. Access shown is one out of more means of access Layher offers.

NOTE: Working or building surfaces are omitted for clarity in all pictures shown in this manual. DO NOT EXCEED maximum allowed distance between scaffold and working surface.

1 Screw jack . . . . . .(Item-No. 400x.xxx) resp. Allround adjustable base plate

2 Base colllar . . . . . .(Item-No. 2602.000)

3 Vertical standard . .(Item-No. 2603.xxx)

4 Bearer . . . . . .(Item-No. 2607.xxx) resp. Allround ledger

5 Runner . . . . . .(Item-No. 2607.xxx) resp. Allround ledger

6 Diagonal . . . . . .(Item-No. 2620.xxx)

7 Guardrail . . . . . .(= Runner)

8 End guardrail . . . . .(= Bearer)

9 Toeboard . . . . . .(Item-No. 2640.xxx)

10 Deck . . . . . .(Item-No. 38xx.xxx)

11 Access deck . . . . . .(Item-No. 38xx.xxx)

12 Anchor . . . . . .(Item-No. 2639.080)

Identification of basic components

The horizontal components and Layher fabricated decks listed below are shown with item numbers for tubular support.
All horizontal components and Layher fabricated decks (for the installation at Speedyscaf system) **are also available for/with claws that connect to U-Transoms**.

Adjustable base plate 60,
Item-No.4001.060

Adjustable base plate 80,
Item-No. 4001.080

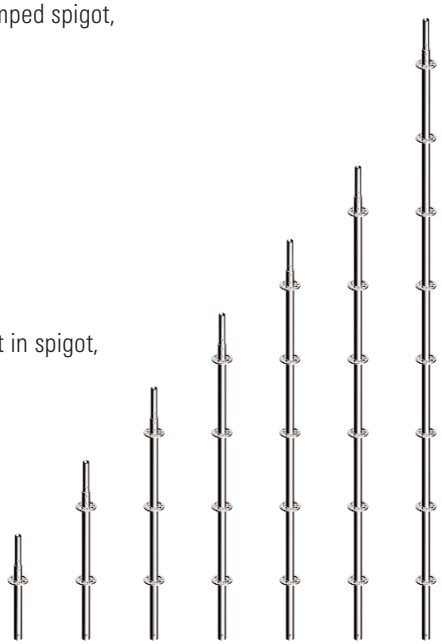
Adjustable base plate 60,
swivelling, Item-No. 4003.000

Base collar,
Item-No. 2602.000

Standard, with crimped spigot,
Item-No. 2603.xxx

0.50 m	1´ – 6˝
1.00 m	3´ – 3˝
1.50 m	4´ –11˝
2.00 m	6´ – 6˝
2.50 m	8´ – 2˝
3.00 m	9´ – 9˝
4.00 m	13´ – 2˝

Standard, with bolt in spigot,
Item-No. 2604.xxx



Ledger, Item-No. 2607.xxx

0.73 m	2´ – 6˝
1.09 m	3´ – 7˝
1.29 m	4´ – 3˝
1.40 m	4´ – 7˝
1.57 m	5´ – 2˝
2.07 m	6´ – 9˝
2.57 m	8´ – 5˝
3.07 m	10´ – 1˝
4.14 m	13´ – 6˝

Diagonal, Item-No. 2620.xxx

0.73 x 2.00 m	2´ – 5˝ x 6´ – 6˝
1.09 x 2.00 m	3´ – 7˝ x 6´ – 6˝
1.40 x 2.00 m	4´ – 7˝ x 6´ – 6˝
1.57 x 2.00 m	5´ – 2˝ x 6´ – 6˝
2.07 x 2.00 m	6´ – 9˝ x 6´ – 6˝
2.57 x 2.00 m	8´ – 5˝ x 6´ – 6˝
3.07 x 2.00 m	10´ – 1˝ x 6´ – 6˝

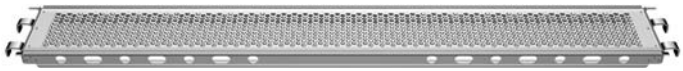
Ledger, reinforced,
Item-No. 2611.xxx

1.09 m	3´-7˝
1.29 m	4´-3˝

Tube bridging ledger,
Item-No. 2625.xxx

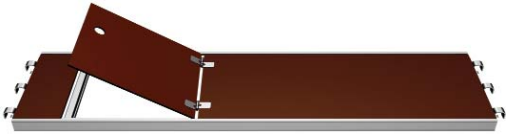
1.57 m	5´ – 2˝
2.07 m	6´ – 9˝
2.57 m	8´ – 5˝
3.07 m	10´ – 1˝

Identification of basic components



Steel deck, Item-No. 3861.xxx

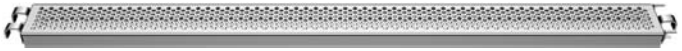
0.32 m x 0.73 m	1´ x 2´ – 5˝
0.32 m x 1.09 m	1´ x 3´ – 7˝
0.32 m x 1.57 m	1´ x 5´ – 2˝
0.32 m x 2.07 m	1´ x 6´ – 9˝
0.32 m x 2.57 m	1´ x 8´ – 5˝
0.32 m x 3.07 m	1´ x 10´ – 1˝



Robust access deck, shifted trapdoor

Item-No. 0718.373

0.61 x 3.07 m	6´ x 10´ – 1˝

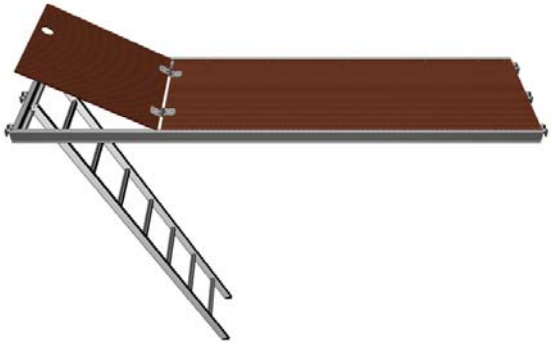


Steel deck, Item-No. 3848.xxx

0.19 m x 1.09 m	6˝ x 3´ – 7˝
0.19 m x 1.57 m	6˝ x 5´ – 2˝
0.19 m x 2.07 m	6˝ x 6´ – 9˝
0.19 m x 2.57 m	6˝ x 8´ – 5˝
0.19 m x 3.07 m	6˝ x 10´ – 1˝

Steel plank, Item-No. 3880.xxx, 45mm high

0.32 m x 1.00 m	1´ x 3´ – 3˝
0.32 m x 1.50 m	1´ x 4´ –11˝
0.32 m x 2.00 m	1´ x 6´ – 6˝
0.32 m x 2.50 m	1´ x 8´ – 2˝



Robust access deck, with integrated access ladder

Item-No.

3855.257	0.61 m x 2.57 m	2´x 8´– 5˝
3855.307	0.61 m x 3.07 m	2´x 10´– 1˝

Wooden Toeboard, Item-No. 2642.xxx

0.15 x 0.73 m	5˝ x 2' – 5˝
0.15 x 1.09 m	5˝ x 3´ – 7˝
0.15 x 1.57 m	5˝ x 5´ – 2˝
0.15 x 2.07 m	5˝ x 6´ – 9˝
0.15 x 2.57 m	5˝ x 8´ – 5˝
0.15 x 3.07 m	5˝ x 10´ – 1˝

Identification of basic components

Board bearer, Item-No. 2615.xxx

0.73 m	2′ – 5″
1.09 m	3′ – 7″
1.57 m	5′ – 2″
2.07 m	6′ – 9″
2.57 m	8′ – 5″
3.07 m	10′ – 1″

Board bearer
connecting to two decks

Item-No. 2614.070 0.64 m
2′-1″ 2 Steel decks

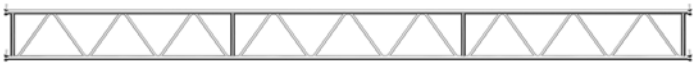
Item-No. 0702.238 0.96 m
3′-1″ 3 Steel decks

Board bearer
connecting to ledger and deck

Item-No. 0702.235 0.64m
2′-1″ 2 Steel decks

Item-No. 0702.237 0.96m
3′-1″ 3 Steel decks

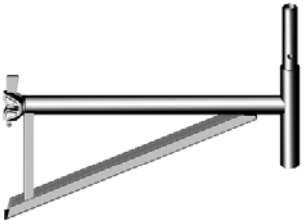
Brace for console bracket
Item-No. 2631.205



Lattice girder, Item-No. 2659.xxx

0.50 m x 5.14 m	1′-6″ x 16′-9″
0.50 m x 6.14 m	1′-6″ x 20′-1″
0.50 m x 7.71 m	1′-6″ x 25′-3″

Console bracket,
Item-No. 2631.039
0.39 m 1′-3″
1 steel deck



Console bracket,
Item-No. 2631.073
0.73 m 2′-5″
2 steel decks

Console with 2 hooks

Item-No. 0715.913
0.73 m 2′-5″ 2 Steel decks

Item-No. 0715.912
0.36 m 1′-2″ 1 Steel deck

Spigot with half coupler,
Item-No. 4706.022

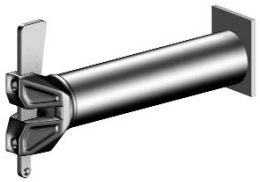
Identification of basic components

Rosette, clampable
Item-No. 2603.0xx

Rigid wedge coupler
Item-No. 2628.0xx

Swivel wedge coupler
Item-No. 2629.0xx

Twin wedge coupler
Item-No. 2628.000



Ledger 0,27 m
Item-No. 0716.307

Guardrail standard, cranked
Item-No. 2606.170

Swinggate, with toeboard
Item-No. 0714.584

Swinggate,
Item-No. 2627.004 0,73 m 2'-5"
Item-No. 2627.005 1,09 m 3'-7"

Identification of basic components

Ladder, galvanized steel
Item-No. 4104.002 1,83 m 6´
Item-No. 0714.923 1,52 m 5´
Item-No. 4104.001 0,90 m 3´

Aluminium platform stairs
Item-No. 2602.100 0.64 x 2.57 m
Item-No. 0700.269 0.64 x 3.07 m

Stairway guardrail
Item-No. 2638.257
2.57 m 8´-5˝
Item-No. 2638.307
3.07 m 10´-1˝

Access Ladder,
Item-No. 4005.007

Internal stairway guardrail
Item-No. 1752.000

Stairway guardrail bracket
Item-No. 2637.000

Stairway stringer, 10 steps

Item-No. 0712.147
2.57 m 8´-5˝

Ladder bracket with half wedge clamp, Item-No. 0714.756

Ladder bracket with half clamp, Item-No. 4104.003 (w/o picture)

Typical erection sequence 1

NOTE: OSHA requires that the employer shall have a competent person determine the feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffolds. Employers are required to provide fall protection for employees erecting or dismantling supported scaffolds where the installation and use of such protection is feasible and does not create a greater hazard.

⚠ WARNING

Fall arrest equipment attached to scaffold MAY NOT prevent serious INJURY or DEATH if a fall occurs.

Refer to OSHA or local regulations for the maximum distance allowed between platform and working surface.

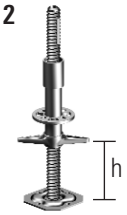
1

Lay out longitudinal ledgers (Item-No. 2607.xxx) in one row in accordance to the required bay length.

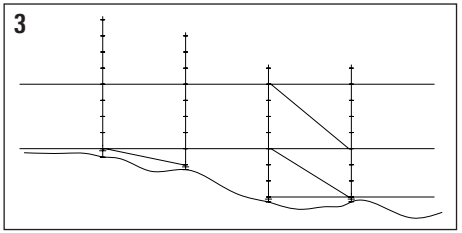
Lay out load distributing sills at the ends of the ledgers.

Put adjustable base plates (Item-No. 4001.xxx) on the sills, then place the base collars (Item-No. 2602.000), with the thinner tube downwards, onto the adjustable base plates (s. detail **2**).
The recommended height for the extension of the adjustable base plate h (s. pic. **2**) is approximately 20 cm (6˝).

2



3



Start the erection at the highest point of the ground, resp. take this point into consideration.

4

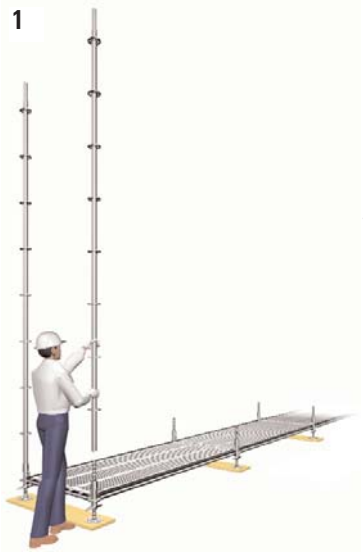
In the first bay connect the transversal ledgers (bearers) and longitudinal ledgers (runners) (Item-No. 2607.xxx) to the small holes of the base collars, according to pic. **5**, page 3.

Level out the assembled frame with a level horizontally, only then drive the wedge home.

Install bay per bay the longitudinal and transversal ledgers and level out the assembled bays.

Typical erection sequence 2

1



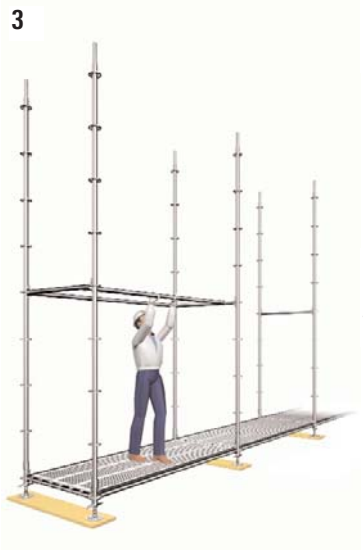
For a more simple and safer erection, lay out the first level of ledgers with steel decks or wooden planks.
Then put the vertical standards over the adjustable base plates onto the base collars.

2

Starting from the first bay, install the transversal ledgers at a height of 2 m (4 rosette spacings). The installation can be carried out savely from the first decked level.

As a result of the installation of the transversal ledgers (bearers), the rosettes of the vertical standards are automatically adjusted the way, that the longitudinal ledgers can be installed without adjusting the standards.

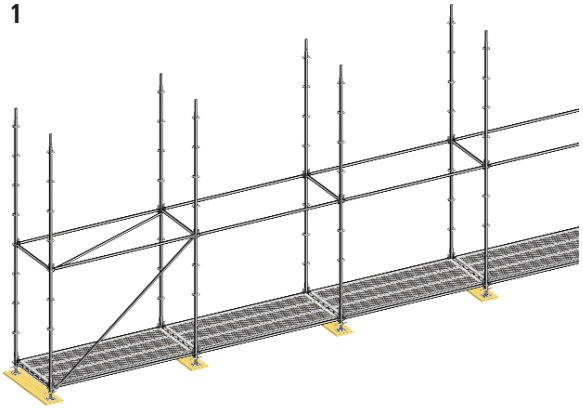
3



Standing safe on the platform level, the longitudinal ledgers are then installed bay by bay at a height of 2 m (6´-6˝).
The assembly can be carried out by one person for all ledger lengths .

Typical erection sequence 3

1



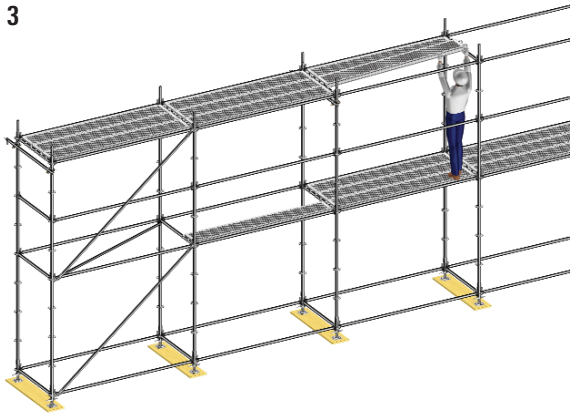
For decking the next platform level, the decks from the lower platform level can be used. If Layher fabricated decks with lift off locks are used no longitudinal ledgers are required at board level.

If wooden planks are used as platforms, ensure that the overlapping of the planks is sufficient according to your local standard and that the planks are secured against tipping.

NOTE: If the decks are moved during the erection progress, a competent person has to determine the feasibility and safety of providing fall protection for the erectors.

NOTE: In some cases structural analysis asks for longitudinal ledgers at boardlevel.

3



After the installation of the longitudinal and transversal ledgers, the vertical diagonals (Item-No. 2620.xxx) and, if required, the plan bracing (Item-No. 2608.xxx or 2622.xxx) must be installed.

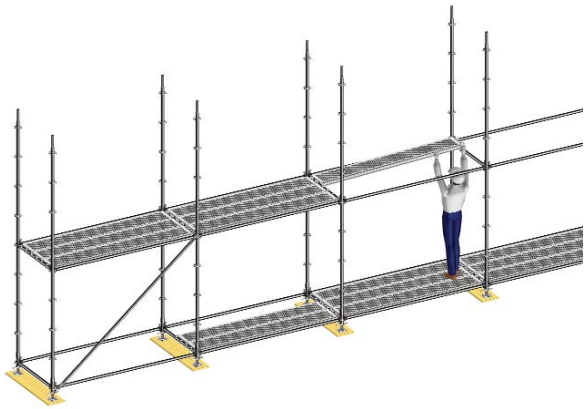
Tubes and couplers can also be used for the installation of plan bracing.

NOTE: In case wooden planks are used for the erection of the platforms, a horizontal diagonal must be installed every fifth bay, according to picture 1.

The minimum requirement for all diagonals is: 1 diagonal for every 5th bay.

The erection continues as shown in picture **2**.

2



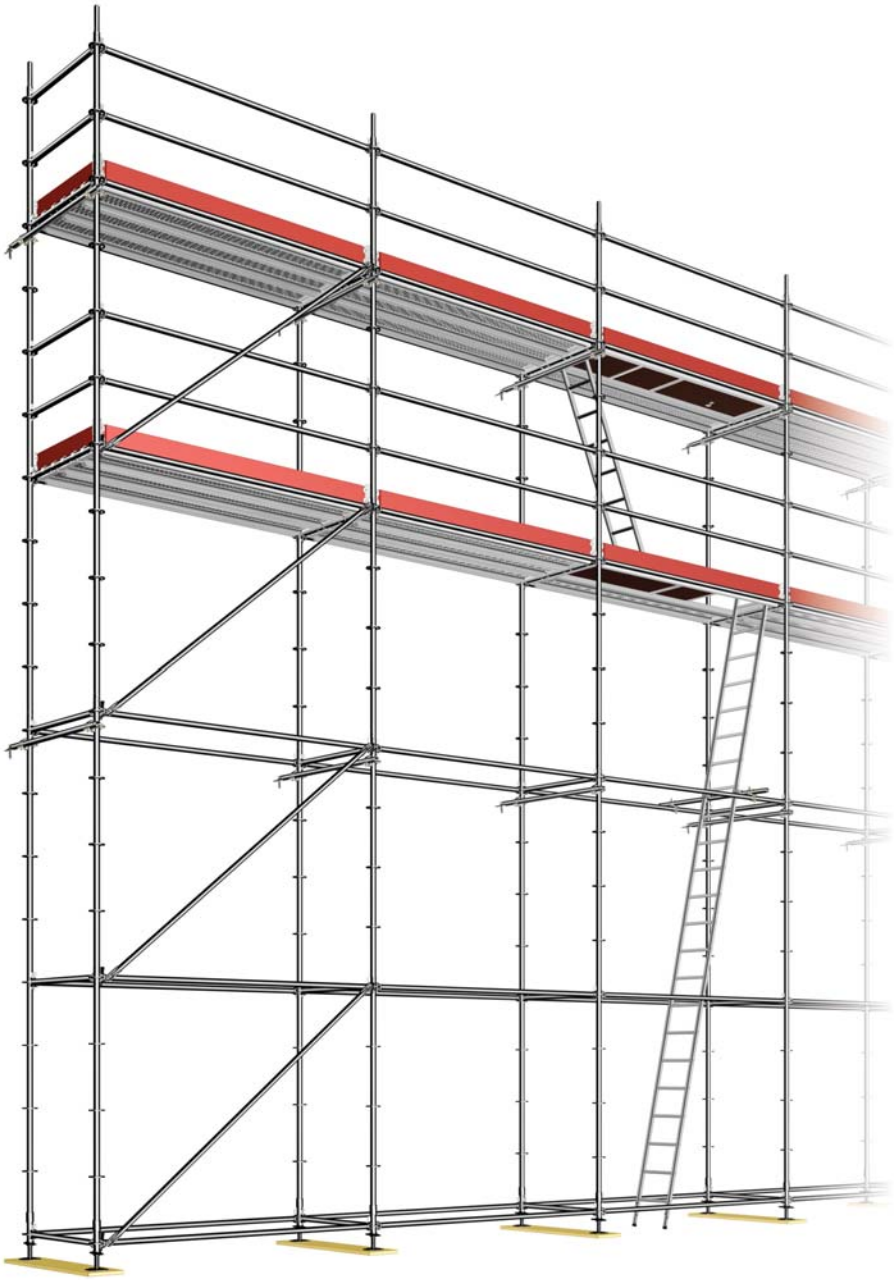
After the installation of the 3 part lateral fall protection (Toprail + midrail + toeboard) on the completed platform level, install the diagonals, then the longitudinal and transversal ledgers of the following level.

From the first platform level the required anchorages must be installed as shown on page 25.

NOTE: Anchorages are one of the most important requirements for the stability of the scaffolding, during erection, use and dismantling.

The decks can now be moved from the first to the second level unless all levels are to remain decked.

Typical erection sequence 4

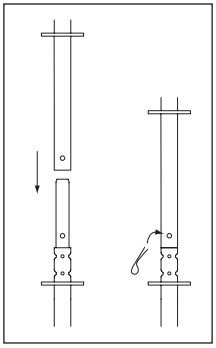


Repeat the assembling steps according to picture **2** + **3**, page 12, until the required height of the scaffolding is reached.

The vertical standards must extend at least 1 m (2 rosette spacings) over the highest working level, that the 3 part lateral protection – existing of toprail, midrail and toeboard – can be installed on the outside face and the ends.

NOTE: The 3 part lateral protection must be installed on all working levels.

NOTE: The top platform level must be anchored in every axis of the vertical standards.



TIP: When putting the standards on top of each other, turn the standards the way that, if necessary, the standards can be connected one to each other by locking pins.

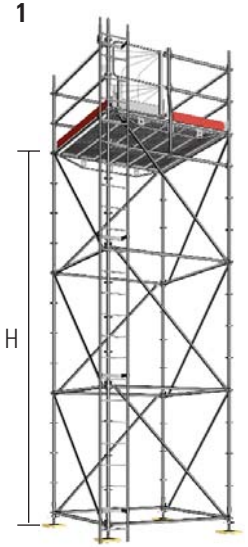
Tower scaffold

NOTE: The maximum distance between the platform levels must be observed according to local regulations.

NOTE: Safety will be considerably increased when scaffolding ladders and access decks are installed inside of the tower.

NOTE: The scaffolding must be tied or guyed, if the maximum ratios of height to minimum width of the scaffolding are exceeded per applicable regulations.

1



1 The scaffolding can be erected without tying or guying when the following ratios are observed:

Basic rules for erection recommended by Layher		
In the open	$\frac{H}{a}$ $\frac{3}{1}$	$H_{max.}$ = 12 m (39'-4")
In closed areas	$\frac{H}{a}$ $\frac{4}{1}$	$H_{max.}$ = 20 m (65'-7")

Pay attention to local regulations.

a = minimum base dimension
Plan view

2

2 Lay out ledgers (Item-No. 2607.xxx) in a way according to the required dimensions.

Then put the adjustable base plates onto the sills and place the base collars on the adjustable base plates.

Connect the ledgers to the small holes of the rosettes.

Level out the assembled rectangle.

3

3 Put the vertical standards onto the base collars and install at a height of 2 m (6'-6") the next level of ledgers .
Install diagonals on all four sides of the tower scaffold, then knock home the wedges of the ledgers and the diagonals.

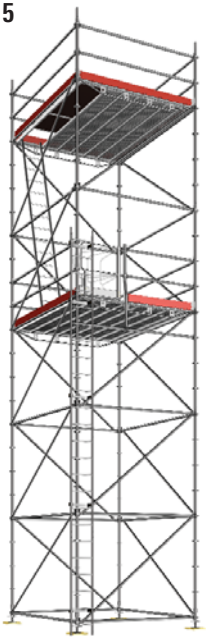
4

4 Connect the ladder bracket (Item-No. 4104.003) and the ladder (Item-No. 41044.xxx), to the scaffolding as option for access, also during the erection of the scaffolding.

NOTE: Secure the splices of the ladders where necessary with safety clips or pins.

After the installation of temporary platforms for the erection on the second level, install the bridging ledgers, the ledgers and the diagonals of the next level.
Next the working platforms have to be installed from the 2nd level. With the installation of the guardrail post, the 3 part lateral protection and the installation of the swinggate the assembly is completed.

5

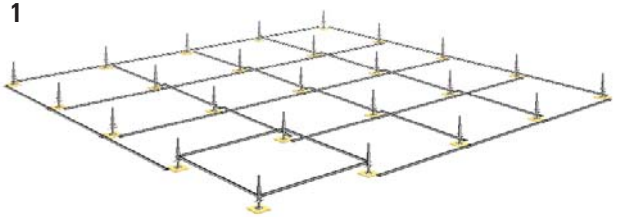


5 Erection up to the first platform level according to picture **2**,**3** and **4**.

Starting from the first platform level, vertical standards, ledgers and diagonals are installed. Installation of temporary platforms for the erection at a height of 2 m and installation of ledgers and diagonals indicated until the design height of the tower is

Birdcage scaffolds

1

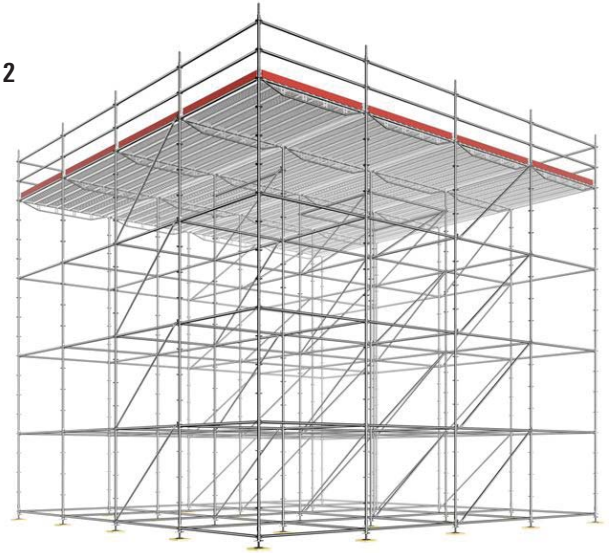


1 Lay out ledgers (Item-No. 2607.xxx) according to the chosen plan view.

Lay out sills, put on them the adjustable base plates and place base collars. Commencing at the highest point of the ground , install the ledgers (insert wedges into small holes of the rosette) in one bay.

Level out the bay, then repeat these steps bay by bay.

2

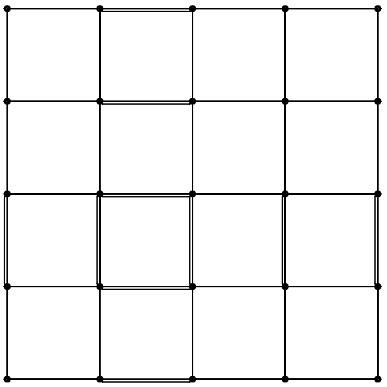


2 Place the vertical standards on the base collars and install the ledgers at a height of 2 m (6'-6'').
Install diagonal bracing to all 4 sides in at least 1 bay, then knock home the wedges of the ledgers and the diagonals.

After the installation of temporary platforms at the second level for the further erection , install the ledgers and the diagonals of the following level.
Repeat these erection steps until the required height of the scaffolding is reached.

Install the bridging ledgers, the decks and the 3 part lateral protection.

3



3 Install diagonals in at least one bay .

A line of diagonals must be installed every 5th bay.

NOTE: Bracing recommendations are minimum requirements. More braces may be necessary depending on the load applied.

Rolling towers

⚠ WARNING

Serious INJURY or DEATH can result from climbing or working on a rolling tower on which the CASTERS ARE NOT LOCKED.

DO NOT ride a rolling tower while it is being moved.

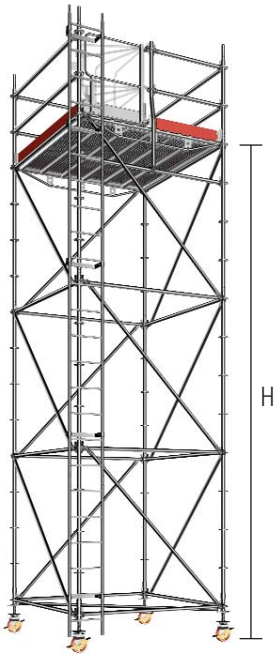
a = minimum base dimension
Plan view

Maximum ratios for untied Rolling towers.

Basic rules for erection recommended by Layher		
In the open	$\frac{H}{a}$ $\frac{3}{1}$	$H_{max.}$ = 12 m (39'-4'')
In closed areas	$\frac{H}{a}$ $\frac{4}{1}$	$H_{max.}$ = 20 m (65'-7'')

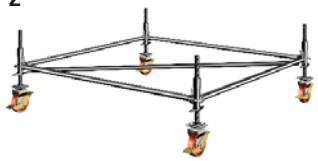
Pay attention to local regulations.

4



1

2



1 Lay out ledgers (Item-No. 2607.xxx) in a rectangle according to the chosen dimensions.

NOTE: The brakes of the castors must be locked

Place the base collars on the adjustable base of the castors then connect the first two ledgers to one base collar. Connect the next castors and the base collars to the firts two ledgers, then mount the remaining ledgers and the castor.

2 The horizontal bracing is achieved by ledgers (Item-No. 2607.xxx)

NOTE: Rolling towers must be braced at the bottom level!

Level out the assembled frame.

3

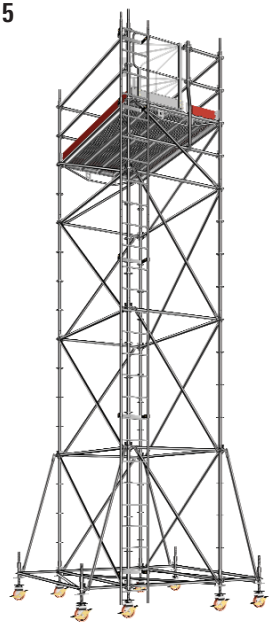
3 Put the vertical standards onto the base collars and install at a height of 2 m (6'-6'') the next level of ledgers (according to picture **3**).
Install diagonals on all four sides of the rolling tower, then knock home the wedges of the ledgers and the diagonals.
Connect the ladder bracket (Item-No. 4103.003) and the ladder (Item-No. 4104.xxx) to the scaffolding as access and also to aid the erection of the scaffolding.

NOTE: Secure the splices of the ladders where necessary with safety clips or pins.

4 After the installation of temporary platforms for the erection on the following level, install the ledgers and the diagonals of the next level.

From the last temporary level install the ledgers, the bridging ledgers and the decks of the working level.After the installation of the cranked guardrail standard, the 3 part lateral protection and the swinggate the assembly is completed.

5



Openings in working levels

Openings in working levels of tower, birdcage or rolling scaffolds, can be considered during erection, but can also, due to the components Layher offers, be installed into the platform levels after the assembly is completed.

NOTE: Observe your local regulations regarding maximum distance between edge of opening and penetrating element.

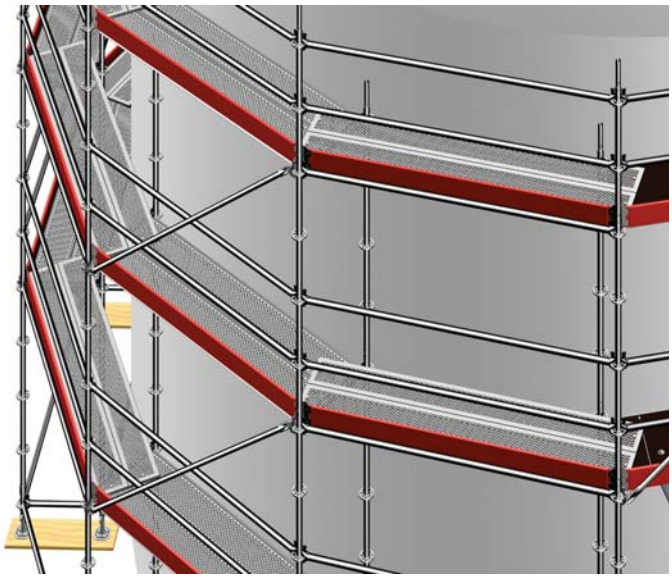
Special bearer for an opening at the perimeter of the working platform

Item-No.	2614.070	0.64 m	2´-1˝	for two steel decks
	0702.238	0.96 m	3´-1˝	for three steel decks

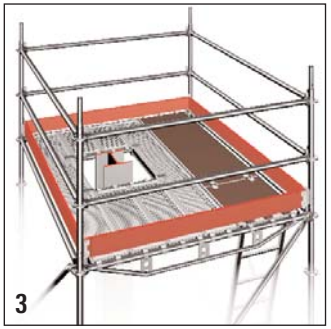
NOTE: DO NOT exceed load bearing capacity of board bearers.

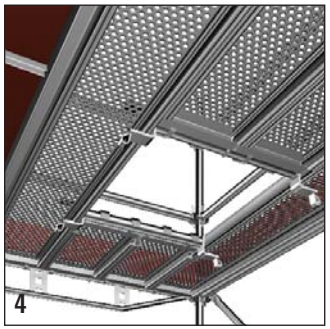
Special bearer for an opening inside of the working platform

Item-No.	0702.235	0.64 m	2´-1˝	for two steel decks
	0702.237	0.96 m	3´-1˝	for three steel decks



Special bearers have to be installed at the required places, then the remaining area to the bridging ledgers has to be planked with Layher fabricated decks.

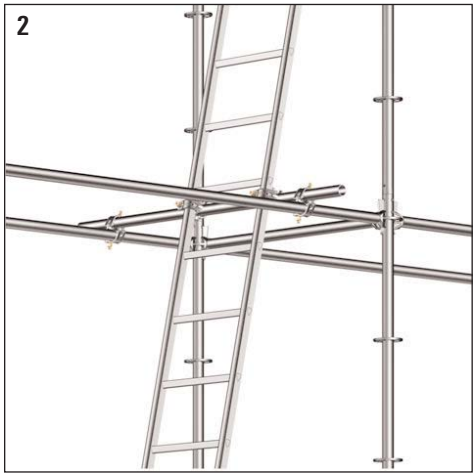




Layher steel planks (Item-No. 3880.xxx) are used at intermediate bays, for adjusting differences in length or for example at round scaffolds. Bolts or special plastic dowels must be used to secure the planks against movement.

Means of access

As means of access to the working platforms Layher offers scaffolding ladders, access decks with or without integrated ladder, platform stair towers and external means of access with swinggate.



1 Internal access by ladders with an angled scaffolding ladder (Item-No. 4104.xxx), for a distance between the working platforms > 2 m (6'-6'') and access ladder (Item-No. 4005.007) for a distance between the working areas of 2 m (6'-6'').

The scaffolding ladder (Item-No. 4104.xxx) is secured by a coupler and a transversal tube, as shown in picture **2**. or by connecting the ladder with a coupler to a longitudinal ledger (runner).

Means of access

NOTE: Drive home the wedge from the main platform NOT from the console platform.

Shore the console bracket with an Allround brace for console brackets (Item-No. 2631.205).

Stair towers are also available with opposite stairways.

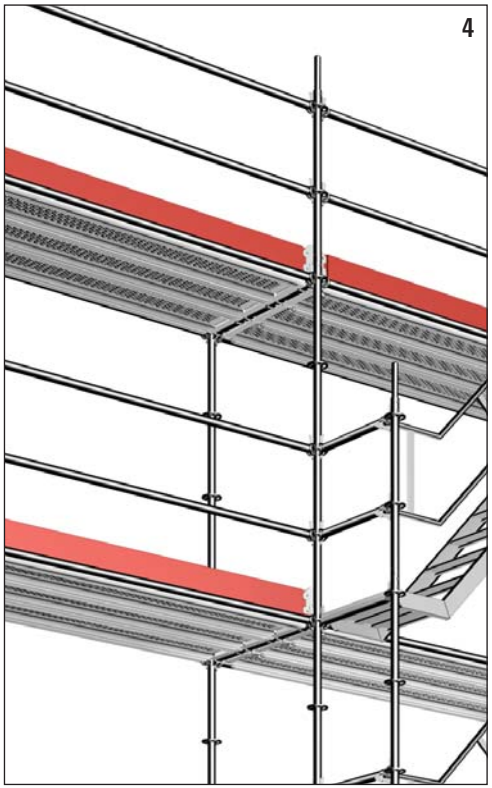
3 Internal access using access ladders (Item-No. 4005.007) or by access decks with integrated access ladders.

The access bay must be equipped with a 3 part lateral protection to 3 sides.

4 Platform stair towers

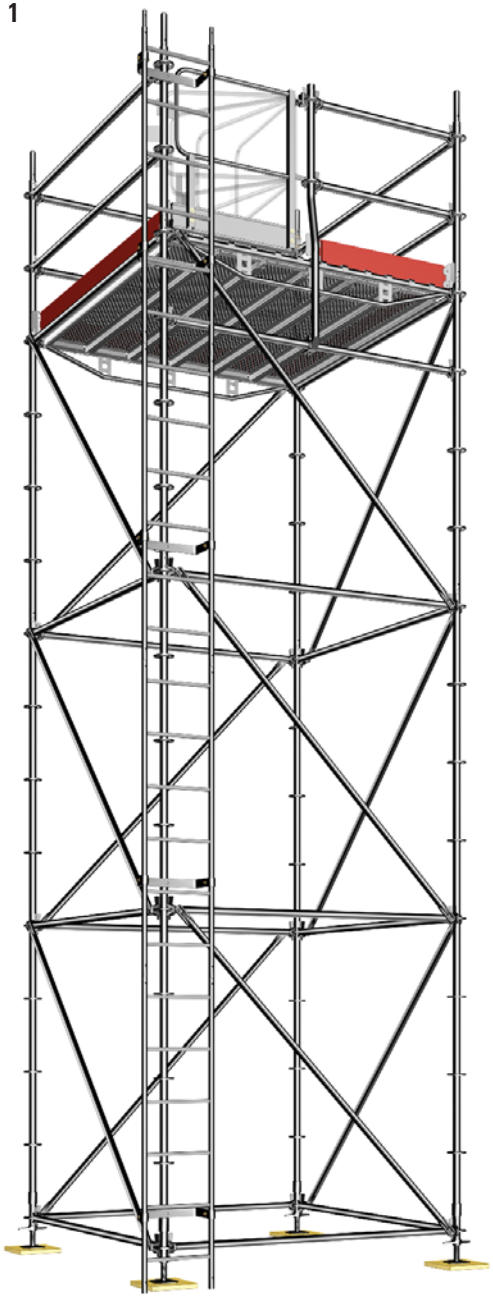
Install decks in the access bay and equip this bay in transversal direction with the 3 part lateral protection. Commencing from the ground an additional bay (in transversal direction, width of 0.73 m, 2'-5'') has to be erected. Connect the platform stair (Item-No. 2602.100) to the ledgers of the additional bay (Item-No. 2607.073) and mount the guardrail (Item-No. 2638.xxx). For the first guardrail 2 guardrail brackets (Item-No. 2637.000) are required. Install in the area of the stair platforms the required 3 part lateral protection.

Mount a console bracket (Item-No. 2630.073) on the top level on the adjacent bay, install the decks and the 3 part lateral protection at the side and end.

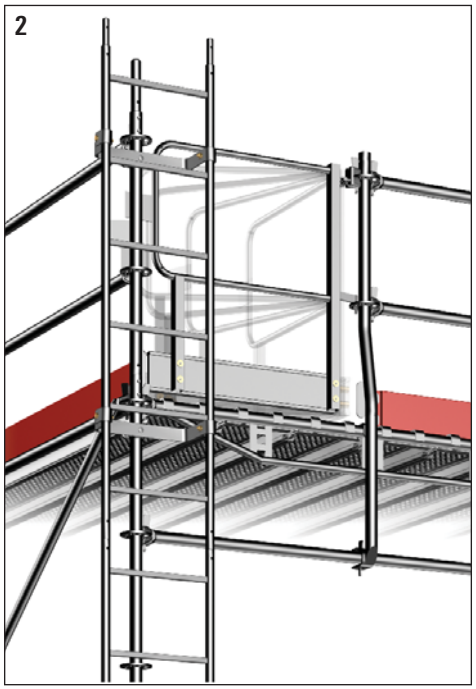


Means of access

1



2



External vertical ladder access with swinggate

Connect during the erection progress ladder brackets every 2 m (6'-6'') to the vertical standard next to the chosen area of access. Extend then ladder (Item-No. 4104.xxx) accordingly.

Mount at this side of the scaffold a ledger 0.5 m (1'-6'') below the working level. Connect the cranked guardrail standard (Item-No. 2606.170) to the ledger at board level and the ledger below.

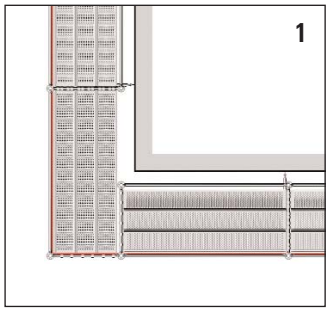
Connect the swinggate (Item-No. 0714.584 or 2627.xxx) to the guardrail standard the way, that the gate opens to the inside of the scaffold.

Corner Solutions

Scaffoldings, where workers are required to work in the corner areas, must be erected, so that the whole width of the scaffolding is also available in this area.

NOTE: Pay attention to the allowable maximum spans, the maximum working loads and the minimum overlapping of the planks.

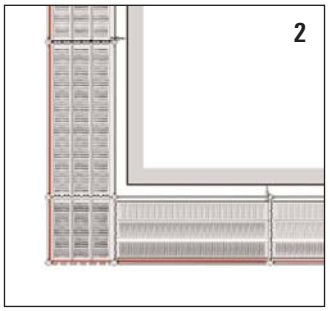
NOTE: Secure the wooden planks against uplift or movement.



Corner with the use of 3 standards:

Extend one scaffold bay over the corner until the other scaffolding bay can be connected directly to this bay.

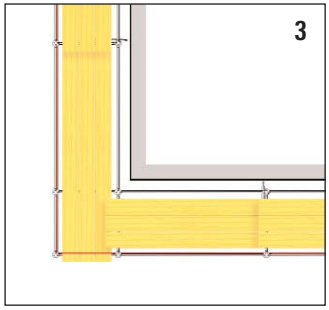
NOTE: Do not exceed the maximum distance between scaffolding and working surface.



Corner formation with 4 standards:

Extend the scaffolding bays over the corner until they meet at the internal vertical standard.

Use decks at the corner area which correspond to the bay width. This measure guarantees that the full width of the scaffolding is also available in the corner area.



Corner formation with 4 standards and wooden planks:

Extend the scaffolding bays over the corner until they meet at the internal vertical standard.

Fully deck the scaffolding bays with planks

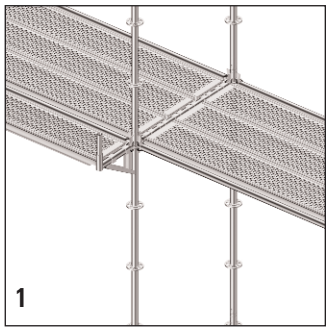
Console brackets

For widening working levels of single scaffold bays or over the whole length of the scaffolding, console brackets, ledgers (Item-No. 2607.xxx) and vertical standards (Item-No. 2603.xxx) can be used.

NOTE: Drive home the wedge from the main platform NOT from the console platform.

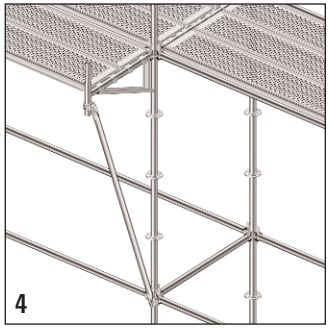
Install a ledger (Item-No. 2607.xxx) at the required height of the console bracket connection/the ledger connection.

NOTE: In many cases console platforms cause uplift forces in the vertical standards which must be compensated for.



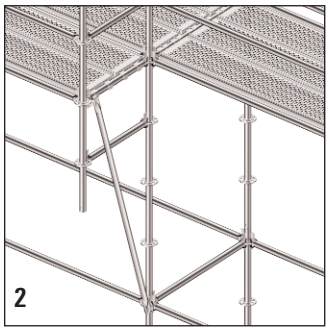
Console bracket 0.28 m (11'', item-No. 2630.019) for a deck with 0.19 m (7'') width or console bracket 0.39 m (1'-3'', item-No. 2631.039) for a deck with a width of 0.32 m (1'-11'').

A support for the console bracket is not required.



Console bracket 0.73 m (2'-5'', item-No. 2631.073) for two decks 0.32 m (1'-11'') or one deck 0.61 m (2'-0'').

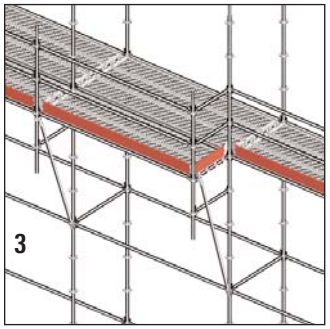
The console bracket must be supported with an Allround console brace (Item-No. 2631.205). Alternatively, this support can be made from tubes and couplers.



Consoles using ledgers, standards and diagonals.

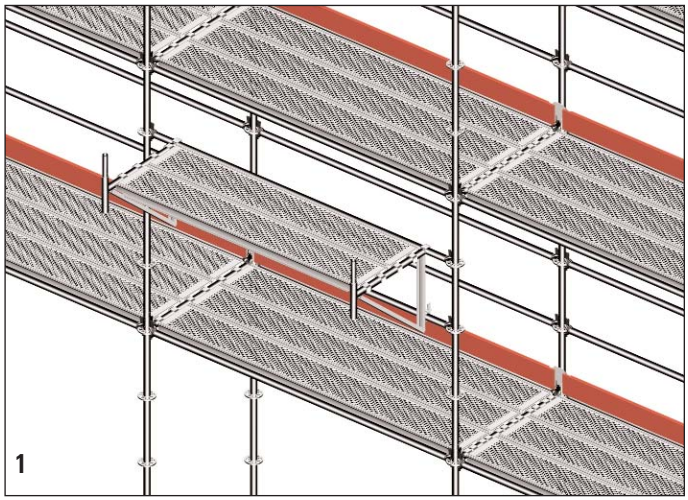
Install ledgers (Item-No. 2607.xxx) at the height of the working platform and 0.5 m (1'-6'') below. Connect a vertical post (Item-No. 2603.xxx) to the ledgers, then install the diagonal (Item-No. 2620.xxx) or a support using tubes and couplers.

NOTE: The support of the console is absolutely necessary in all arrangements.



Consoles using ledgers, vertical standards and Allround brace (Item-No. 2631.205).

Console brackets



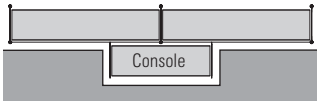
Niche console with 2 hooks (Item-No. 0715.912).

Installation at a height between two decking levels: This arrangement can be used within a baylength or across 2 bays.

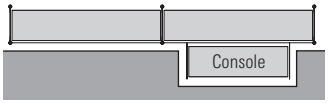
The place of use e.g. at building niches is independent from the chosen bay length.

Install ledgers (Item-No. 2607.xxx) at the required decking height and 0.5 m below. Then hang the console onto these ledgers. Drive home the wedge of the lower connection.

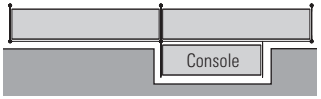
1a



1b



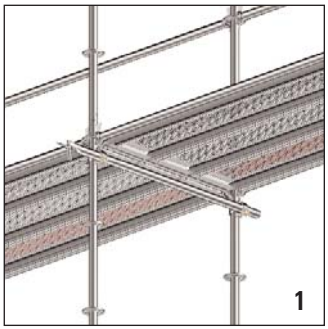
1c



Working surface

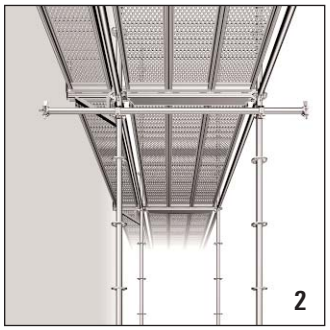
Scaffold anchorage

NOTE: Check if the load bearing capacity of the anchors is sufficient to cope with the forces applied to it. The anchoring of the scaffold is one of the most important requirements for the stability of the scaffold; therefore the structure where the scaffolding is tied to, or the supporting components must be verified in any case.



1 The anchoring or tying of the scaffold to the wall or a facade can be made by Allround wall ties (Item-No. 1754.xxx) and plastic inserts.
The Allround wall tie must be connected by couplers to both vertical standards .

The kind of plastic inserts required depend upon the structure of the wall and upon the anchor forces.



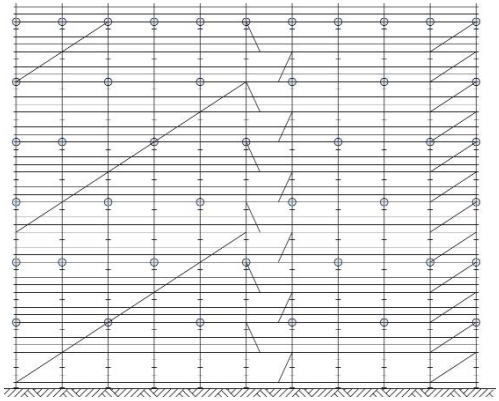
2 Alternatively, the tying to the eye bolt can be made using a ledger (Item-No. 2607.xxx).
The wedge head has to be moved centrally over the eye bolt and the wedge, comparable to the connection to a rosette, must then be inserted into the eye of the bolt.

3 Tying of the scaffold, independent from the assembly, to horizontal elements (e.g. beams) can be achieved by a clamp construction using tubes and couplers.
Alternatively the connection can be made using a tube and a clamp coupler (Item-No. 4716.xxx).
If forces have to be transmitted in the longitudinal direction of the horizontal elements, the connection has to be secured against movement in this direction.

For tying to vertical members (Posts or columns) of steel or concrete, use clamp couplers (Item-No. 4716.xxx) or tubes and couplers as shown in picture **5**.

Scaffold anchorage

1



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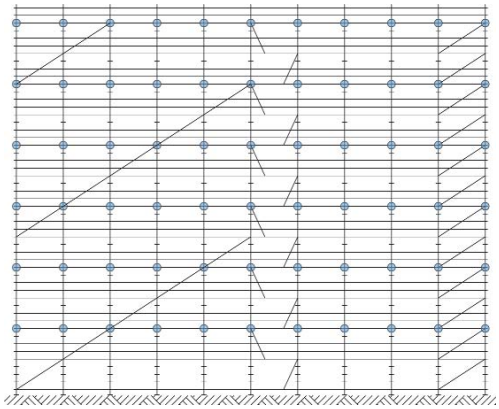
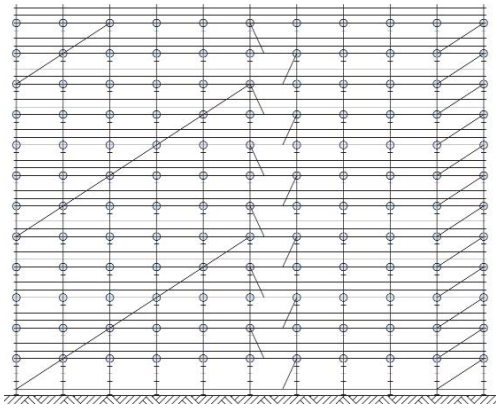


3



Scaffold anchorage

Scaffoldings must be tied to walls or other structures with sufficient load bearing capacity. Facade scaffolds or similar scaffolds are anchored by eye bolts and plastic inserts.
Three anchor patterns are available. The anchor pattern which has to be used depends upon the post spacing, the height of the scaffolding and if the scaffold is going to be clad by debris nets or tarpaulins.
The anchor forces have to be calculated according to your local codes or regulations and depend especially on the wind forces applied to the scaffolding.

1 Anchor pattern 8 m (26'-4'').

The external standards have to be tied every 4 m (13'-2''). The internal standards have to be anchored as shown in picture 1 every 8 m (26'-4'') whereas the adjacent axis of the standards has to be anchored staggered 4 m (13'-2'') in height.

2 Anchor pattern 4 m (13'-2'') in every axis of the standards

The scaffolding has to be anchored every 4 m (13'-2'') in every axis of the standards.

3 Anchor pattern 2 m (6'-6'') in every axis of the standards

When the scaffolding is clad by tarpaulins huge forces develop at the anchors and must be lead safe to the supporting structure. These forces can be reduced by using a tight anchor pattern.

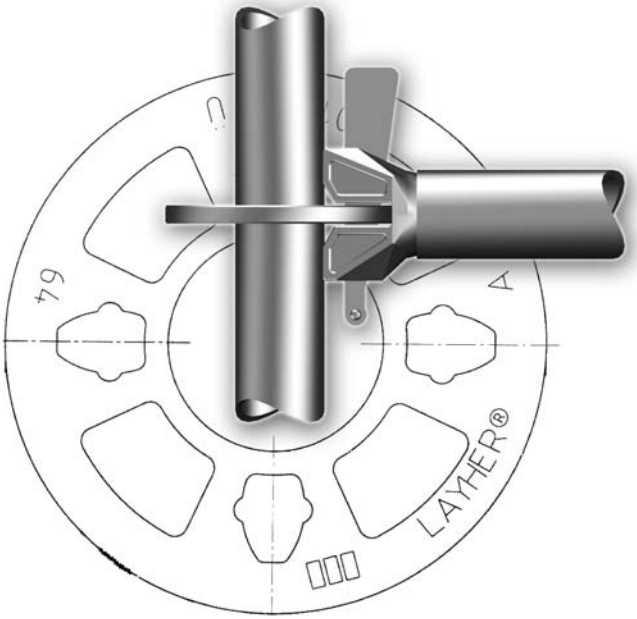
Load bearing capacities of main components

⚠ WARNING

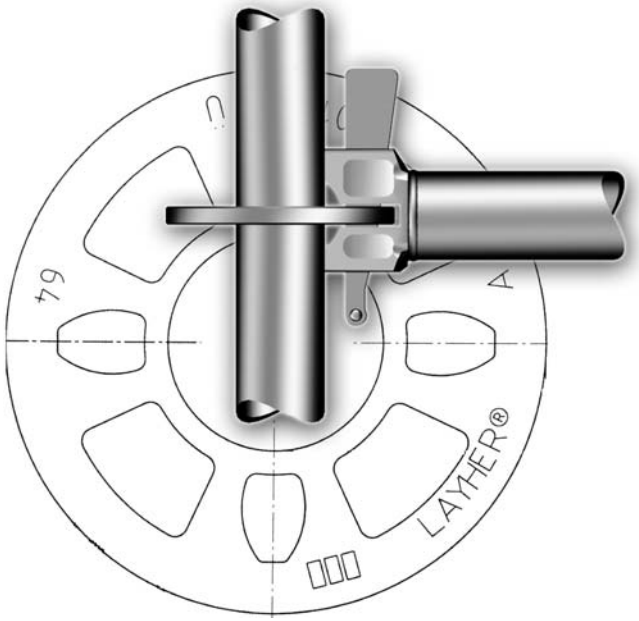
The use of these tables by unqualified persons can cause serious INJURY or DEATH.

Load bearing capacities depend on the Allround version being used. Distinguish between Allround System Variant II (fabricated from 1990 to 1999) and Allround K 2000+ (fabricated since 1999).

K 2000+



Variant II

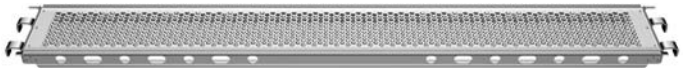


⚠ WARNING

If components of Allround Variant II and Allround K 2000+ are being mixed in one structure ONLY LOAD BEARING CAPACITIES OF VARIANT II CAN BE USED FOR STRUCTURAL ANALYSIS.

Allowable loading of decks

Steel decks that connect to tubular ledgers resp. bearers



Item-No.	Bay Length		Scaffolding Group	Uniformly Distr. Load	
	Metric (m)	Imperial		kN/m²	lbs/ft²
3861.307	3.07	10'-1"	Heavy Duty	3.6	75
3861.257	2.57	8'-5"	Heavy Duty	3.6	75
3861.207	2.07	6'-9"	Heavy Duty	3.6	75
3861.157	1.57	5'-2"	Heavy Duty	3.6	75
3861.109	1.09	3'-7"	Heavy Duty	3.6	75
3861.073	0.73	2'-5"	Heavy Duty	3.6	75

Steel decks that connect to U-Transoms

Item-No.	Bay Length		Scaffolding Group	Uniformly Distr. Load	
	Metric (m)	Imperial		kN/m²	lbs/ft²
3812.307	3.07	10'-1"	Heavy Duty	3.6	75
3812.257	2.57	8'-5"	Heavy Duty	3.6	75
3812.207	2.07	6'-9"	Heavy Duty	3.6	75
3812.157	1.57	5'-2"	Heavy Duty	3.6	75
3812.140	1.40	4'-7"	Heavy Duty	3.6	75
3812.109	1.09	3'-7"	Heavy Duty	3.6	75
3812.073	0.73	2'-5"	Heavy Duty	3.6	75

Robust decks with a width of 0.32 m (1'-1'')

Item-No.	Bay Length		Scaffolding Group	Uniformly Distr. Load	
	Metric (m)	Imperial		kN/m²	lbs/ft²
3836.307	3.07	10'-1"	Heavy Duty	3.6	75
3836.257	2.57	8'-5"	Heavy Duty	3.6	75
3836.207	2.07	6'-9"	Heavy Duty	3.6	75
3836.157	1.57	5'-2"	Heavy Duty	3.6	75

NOTE: Robust decks can NOT be connected to tubular bearers.

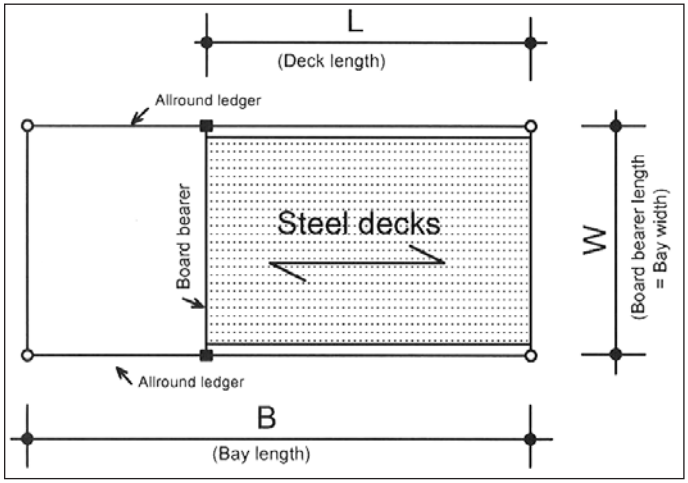
Robust decks with a width of 0.61 m (2'-0'')

Item-No.	Bay Length		Scaffolding Group	Uniformly Distr. Load	
	Metric (m)	Imperial		kN/m²	lbs/ft²
3835.307	3.07	10'-1"	Medium	2.4	50
3835.257	2.57	8'-5"	Medium	2.4	50
3835.207	2.07	6'-9"	Medium	2.4	50
3835.157	1.57	5'-2"	Medium	2.4	50
3835.109	1.09	3'-7"	Medium	2.4	50
3835.073	0.73	2'-7"	Medium	2.4	50

DO NOT EXCEED THE ALLOWABLE LOADINGS SHOWN IN THE ABOVE TABLES.

Allowable loading of board bearers

AR Board Bearer: Item-No. 2615.xxx



Safety 4:1 **Live load: 25 lbs/ft² (light duty)**

Length of Board Bearer W	Maximum allowable deck length L	Maximum allowable bay length B
0.73 m (2'-5")	2.57 m (8'-5")	3.07 m (10'-1")
1.09 m (3'-7")		
1.40 m (4'-7")		
1.57 m (5'-2")		
2.07 m (6'-9")	1.57 m (5'-2")	
2.57 m (8'-5")	1.09 m (3'-7")	
3.07 m (10'-1")	0.73 m (2'-5")	

Deck to deck board bearer

Deck Deck

A. Tube Board Bearer

Item-No. 0705.892 for 1 steel deck
Item-No. 2614.070 for 2 steel decks
Item-No. 0702.238 for 3 steel decks

B. U-Profile Board Bearer

Item-No. 0701.978 for 1 steel deck
Item-No. 2614.073 for 2 steel decks
Item-No. 2614.109 for 3 steel decks

Ledger to deck board bearer

Ledger Deck

A. Tube Board Bearer

Item-No. 0707.682 for 1 steel deck
Item-No. 0702.235 for 2 steel decks
Item-No. 0702.237 for 3 steel decks

B. U-Profile Board Bearer

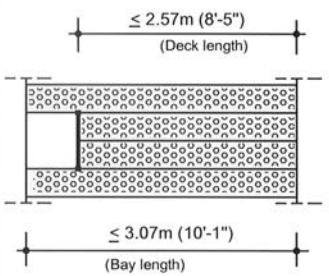
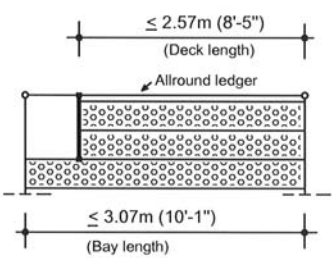
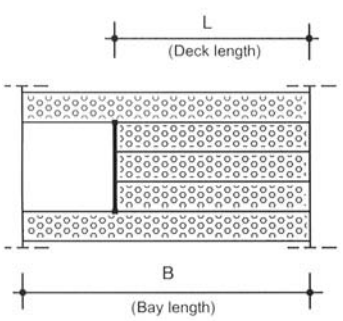
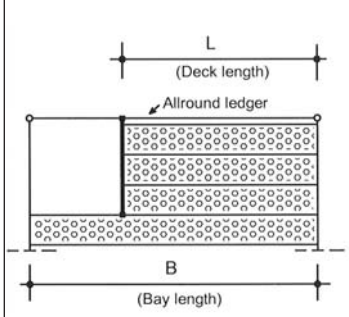
Item-No. 0701.979 for 1 steel deck
Item-No. 0701.635 for 2 steel decks
Item-No. 0701.637 for 3 steel decks

DO NOT EXCEED THE ALLOWABLE LOADINGS SHOWN IN THE ABOVE TABLES.

Allowable loading of board bearers

Allowable arrangements for board bearers

Safety 4:1 **Live load: 25 lbs/ft² (light duty) on all decks**

<table>
<tr><th colspan="2">Board Bearers for 2 decks
Arrangements can also be used accordingly for Board bearers for 1 steel deck.</th><th colspan="2">Board Bearers for 3 decks</th></tr>
<tr><th>Deck-to-deck board bearer</th><th>Ledger-to-deck board bearer</th><th>Deck-to-deck board bearer</th><th>Ledger-to-deck board bearer</th></tr>
<tr><td> 
</td><td> 
</td><td> 
</td><td> 
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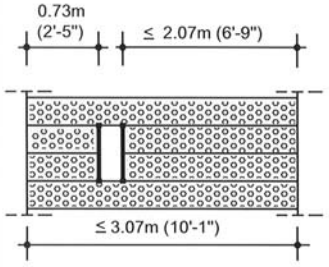
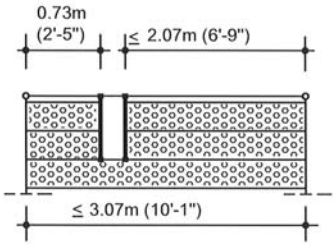
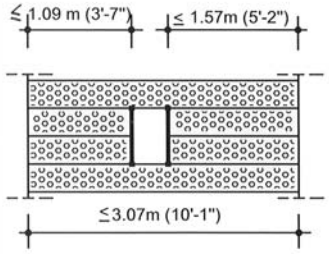
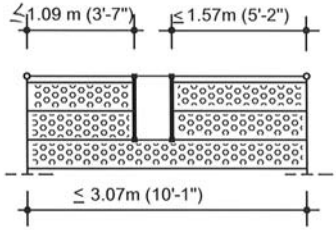
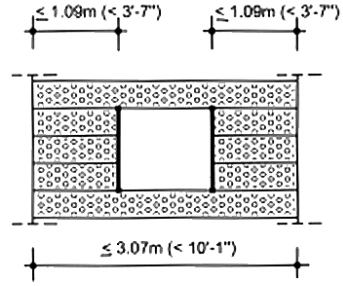
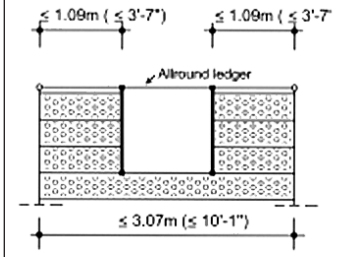
<tr><td> 
</td><td> 
</td><td>Maximum allowable bay length B</td><td>Maximum allowable deck length L</td></tr>
<tr><td rowspan="2">3.07 m (10'-1'')</td><td>2.57 m (8'-5'')</td></tr>
<tr><td>1.57 m (5'-2'')</td></tr>
<tr><td> 
</td><td> 
</td><td>2.57 m (8'-5'')</td><td>2.07 m (6'-9'')</td></tr>
<tr><td> 
</td><td> 
</td></tr>
</table>

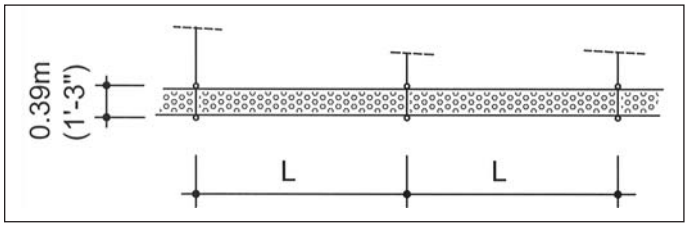
DO NOT EXCEED THE ALLOWABLE LOADINGS SHOWN IN THE ABOVE TABLES.

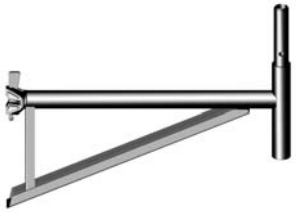
Allowable loading of console brackets

Allround console bracket 0.39 m (1'-3'') or 1 steel deck wide. Item-No. 2631.039

Note: For steel decks with claws that connect to tubular bearers

Bay length L		Scaffolding group
Metric	Imperial	
3.07m	10'-1'	Medium Duty
2.57m	8'-5''	
2.02m	6'-9''	Heavy Duty
1.57m	5'-2''	

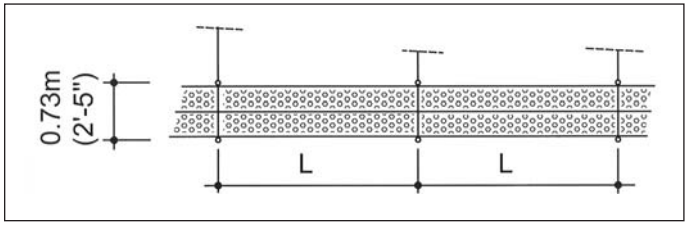




Allround console bracket 0.73 m (2'-5'') or 2 steel decks wide. Item-No. 2631.073

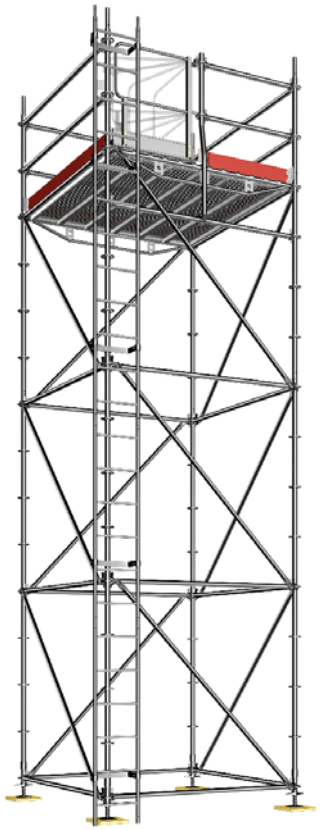
Note: For steel decks with claws that connect to tubular bearers

Bay length L		Scaffolding group
Metric	Imperial	
3.07m	10'-1'	Light Duty
2.57m	8'-5''	
2.02m	6'-9''	
1.57m	5'-2''	Medium Duty



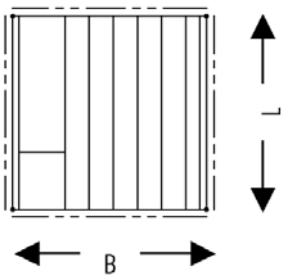
DO NOT EXCEED THE ALLOWABLE LOADINGS SHOWN IN THE ABOVE TABLES.

Allowable loading of tower scaffolds



Additional measures like anchorage, ballast or guying can be necessary, depending on the dimensions and the use of the tower scaffold.

Plan View:



Light Duty	25 lbs/ft²	1.2 kN/m²
Medium Duty	50 lbs/ft²	2.4 kN/m²
Heavy Duty	75 lbs/ft²	3.6 kN/m²

Tower scaffold with decks that connect to tubular bearers

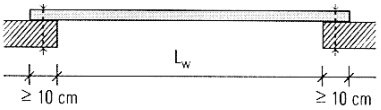
Bearing Ledger	Ledger Length B	Allowable scaffold load class of the deck, Length L			
		1.57 m (5'-2")	2.07 m (6'-9")	2.57 m (8'-5")	3.07 m (10'-1")
Tubular Ledger K 2000+	0.73 m (2'-5")	heavy duty	heavy duty	heavy duty	heavy duty
	1.09 m (3'-7")	heavy duty	heavy duty	heavy duty	heavy duty
	1.40 m (4'-7")	heavy duty	heavy duty	heavy duty	medium duty
	1.57 m (5'-2")	heavy duty	heavy duty	medium duty	medium duty
	2.07 m (6'-9")	medium duty	light duty	light duty	light duty
	2.57 m (8'-5")	light duty	light duty	—	—
Tubular Ledger Variant II	0.73 m (2'-5")	heavy duty	heavy duty	heavy duty	heavy duty
	1.09 m (3'-7")	heavy duty	heavy duty	heavy duty	heavy duty
	1.40 m (4'-7")	heavy duty	heavy duty	medium duty	medium duty
	1.57 m (5'-2")	heavy duty	medium duty	light duty	light duty
	2.07 m (6'-9")	light duty	light duty	light duty	—
	2.57 m (8'-5")	light duty	—	—	—
Tube Bridging Ledger K 2000+ and Variant II	1.57 m (5'-2")	heavy duty	heavy duty	heavy duty	heavy duty
	2.07 m (6'-9")	heavy duty	heavy duty	heavy duty	heavy duty
	2.57 m (8'-5")	heavy duty	heavy duty	heavy duty	heavy duty
	3.07 m (10'-1")	heavy duty	medium duty	medium duty	light duty

DO NOT EXCEED THE ALLOWABLE LOADINGS SHOWN IN THE ABOVE TABLES.

Allowable loading of steel planks

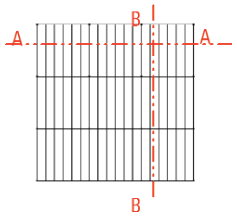
Reference No.	Component	
3.880.100	Steel plank 1.00 x 0.32 m, 45 mm high	(3'-3'' x 1'-1'', 2'' high)
3.880.150	Steel plank 1.50 x 0.32 m, 45 mm high	(4'-11'' x 1'-1'', 2'' high)
3.880.200	Steel plank 2.00 x 0.32 m, 45 mm high	(6'-6'' x 1'-1'', 2'' high)
3.880.250	Steel plank 2.50 x 0.32 m, 45 mm high	(8'-3'' x 1'-1'', 2'' high)
4.905.065	Bolt ∅ 12 x 65 mm	
4.905.000	Locking pin 2.8 mm	

Steel plank	Clear span	Load class	Safe working load
3880.100; L = 1.0 m (3'-3'')	L_w 0.8 m (2'-7'')	Heavy duty	75 psf
3880.150; L = 1.5 m (4'-11'')	L_w 1.3 m (4'-3'')		
3880.200; L = 2.0 m (6'-6'')	L_w 1.8 m (5'-11'')		
3800.250; L = 2.5 m (8'-2'')	2.3 m L_w>2.16 m (7'-6'' L_w>7'-1'')	Light duty	25 psf
	2.16 m L_w>1.8 m (7'-1'' L_w>5'-11'')	Medium duty	50 psf
	L_w 1.8 m (5'-11'')	Heavy duty	75 psf

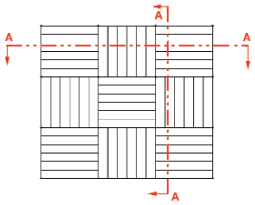


Allowable loading of birdcage scaffolds

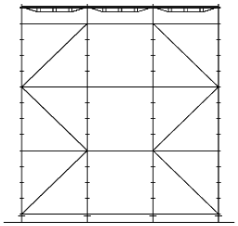
Variant A:
Decks span in same direction



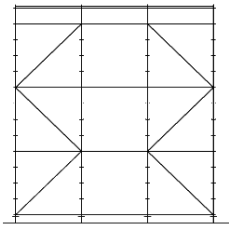
Variant B:
Decks span in alternating direction



Cross section A-A



Cross section B-B



All birdcage scaffolds shown in this table can be erected up to a height of 38 m (125') when the following conditions are observed:

1. Top level is planked with platforms and is working level.
   Other levels NOT planked.
2. 1 Diagonal for 5 bays in every axis.
3. Maximum lift height is 2 m (6'-7'') except**
   Max lift height is 1.5 m (4'-11')

DO NOT EXCEED THE ALLOWABLE LOADINGS SHOWN IN THE ABOVE TABLES.

Allowable loading of birdcage scaffolds

Load class	Allowable load	Allround variant	Size of bay	Transverse ledgers resp. transoms or bearers	Longitudinal ledgers or runners	Erection arrangement
Light duty	1.2 kN/m² (25 lbs/ft²)	K 2000+ and Variant II	3.07 m x 3.07 m (10'-1''x 10'-1'')	Tube bridging ledger 3.07 m (Tube bridging ledger 10'-1'')	Tube bridging ledger 3,07 m (Tube bridging ledger 10'-1'')	B
			3.07 m x 2.57 m (10'-1''x 8'-5'')	Tube bridging ledger 3.07 m (Tube bridging ledger 10'-1'')	Ledger 2.57 m (Ledger 8'-5'')	A
			2.57 m x 3.07 m (5'-2''x 10'-1'')	Tube bridging ledger 2.57 m (Tube bridging ledger 8'-5'')	Ledger 3.07 m (Ledger 10'-1'')	A
			2.07 m x 2.07 m (6'-9''x 6'-9'')	Ledger 2.07 m (Ledger 6'-9'')	Ledger 2.07 m (Ledger 6'-9'')	B
		K 2000+	1.57 m x 3.07 m (5'-2''x 10'-1'')	Ledger 1.57 m (Ledger 5'-2'')	Ledger 3.07 m (Ledger 10'-1'')	A
		Variant II	1.40 m x 2.57 m (4'-7''x 8'-5'')	Ledger 1.40 m (Ledger 4'-7'')	Ledger 2.57 m (Ledger 8'-5'')	A
			1.57 m x 2.07 m (5'-2''x 6'-9'')	Ledger 1.57 m (Ledger 5'-2'')	Ledger 2.07 m (Ledger 6'-9'')	A
Medium duty	2.4 kN/m² (50 lbs/ft²)	K 2000+ and Variant II	2.07 m x 3.07 m (6'-9''x 10'-1'')	Tube bridging ledger 2.07 m (Tube Bridging ledger 6'-9'')	Ledger 3.07 m (Ledger 10'-1'')	A
			2.57 m x 2.07 m (8'-5''x 6'-9'')	Tube bridging ledger 2.57 m (Tube bridging ledger 8'-5'')	Ledger 2.07 m (Ledger 6'-9'')	A
			2.57 m x 2.57 m (8'-5''x 8'-5'')	Tube bridging ledger 2.57 m (Tube bridging ledger 8'-5'')	Tube bridging ledger 2.57 m (Tube bridging ledger 8'-5'')	B
		K 2000+	1.57 m x 1.57 m (5'-2''x 5'-2'')	Ledger 1.57 m (Ledger 5'-2'')	Ledger 1.57 m (Ledger 5'-2'')	A
		Variant II	1.57 m x 1.57 m (5'-2''x 5'-2'')	Ledger 1.57 m (Ledger 5'-2'')	Ledger 1.57 m (Ledger 5'-2'')	B
Heavy duty	3.6 kN/m² (75 lbs/ft²)	K 2000+ and Variant II	1.57 m x 3.07 m (5'-2''x 10'-1'')	Tube bridging ledger 1.57 m (Tube bridging ledger 5'-2'')	Ledger 3.07 m (Ledger 10'-1'')	A
			2.07 m x 2.07 m (6'-9''x 6'-9'')	Tube bridging ledger 2.07 m (Tube bridging ledger 6'-9'')	Ledger 2.07 m (Ledger 6'-9'')	A
			2.57 m x 2.57 m** (8'-5''x 8'-5'')**	Tube bridging ledger 2.57 m** (Tube bridging ledger 8'-5'')**	Tube bridging ledger 2.57 m** (Tube bridging ledger 8'-5'')**	B**
			1.57 m x 1.57 m (5'-2''x 5'-2'')	Ledger 1.57 m (Ledger 5'-2'')	Ledger 1.57 m (Ledger 5'-2'')	B

DO NOT EXCEED THE ALLOWABLE LOADINGS SHOWN IN THE ABOVE TABLES.

Safety guidelines

This brochure is intended for general information only; some provisions may not apply to all applications. If you have questions regarding specific applications, contact Layher Inc.

POST THESE SCAFFOLDING SAFETY GUIDELINES in a conspicuous place and be sure that all persons who erect, dismantle or use the scaffolding are aware of them.

⚠ WARNING

Serious INJURY or DEATH can result from your failure to follow all applicable safety requirements of OSHA, federal, state and local regulations, and these Safety Guidelines before erecting, using or dismantling Layher scaffolding.

- Erection, use, maintenance and disassembly must conform to current Layher instructions as well as OSHA, and all other federal, state and local regulations.
- These Safety Guidelines are not intended to supersede any OSHA, federal, state, local statues or regulations.
- These Safety Guidelines apply to Layher Scaffolding's Allround and Speedyscaf products. For the erection of suspended scaffolds, additional precautions apply: please contact Layher Inc. and refer to OSHA and all other applicable federal, state and local regulations.

⚠ WARNING

DO NOT USE Layher Allround posts with crimped spigots for suspended scaffolds. Use only posts with bolt-in spigots for this application.

Layher's corresponding ERECTION MANUAL must be followed in erecting all Layher scaffolding. Erection Manuals are available from Layher Inc. without charge.

I. GENERAL GUIDELINES

- Layher Scaffoldings must be erected, moved, altered or dismantled only under the supervision and direction of a competent person[1]. Hard hats and appropriate clothing must be worn by all persons erecting, moving, dismantling or using Layher Scaffoldings.
  OSHA requires that the employer shall have a competent person[1] determine the feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffolds.
- DO NOT WORK ON SCAFFOLDS if you feel dizzy or unsteady in any way.
- DO NOT abuse or misuse the scaffold equipment.
- Never take chances! If you are in doubt regarding the safety or use of this scaffold, contact Layher Inc.
- Properly qualified personnel[2] MUST ANALYZE load-carrying members during design. Information about the component load capacity and weight is available from Layher Inc.
- The scaffold assembly must be designed to comply with local, state and federal requirements.

⚠ WARNING

Wedges that are not fully seated or couplers that are not fully tightened will not support design loads. Failure to FULLY KNOCK HOME WEDGES OR TIGHTEN COUPLERS could cause serious INJURY or DEATH.

[1] OSHA defines "competent person" for this purpose as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them." 29 CFR 1926.450 (b).

[2] OSHA defines "qualified" for this purpose as "one who, by possession of a recognized degree, certificate or professional standing, or who by extensive knowledge, training or experience, has successfully demonstrated his/her ability to solve or resolve problems related to the subject matter, the work, or the project." 29 CFR 1926.450 (b).

- SURVEY THE JOB SITE to determine ground conditions, strength of the supporting structure, proximity of electric power lines, overhead obstructions, wind conditions and the need for overhead or weather protection. These conditions must be evaluated and adequately provided for.
- DO NOT erect scaffolds near electrical power lines unless proper precautions are taken.
- Post/frame spacing and sill size can be determined only after the total loads to be imposed on the scaffold and the weight of the scaffold have been calculated.
- When uplift can occur, vertical members (frames or posts) must be pinned together. A qualified person has to determine if standards with bolt in spigots must be used.
- Any part of a building or structure used to support the scaffold must be capable of supporting the load to be applied. This analysis must be done by a qualified person.
- Stationary scaffolds over 125 feet in height must be designed by a professional engineer.
- All equipment must be inspected prior to erection to see that it is in good condition and is serviceable. Damaged or deteriorated equipment must not be used. REMOVE it from the job site.
- Inspect all Layher "Robust Decks" prior to erection, especially for mechanical damage, deformation and rot or other deterioration.
- Use only properly identified Layher components in erecting scaffolds with Layher instructions or guidelines.
- Rolling Towers over 60 feet in height must be designed by a professional engineer.

⚠ WARNING

Fall arrest equipment attached to scaffold MAY NOT prevent serious INJURY or DEATH if a fall occurs.

ERECTION OF FIXED SCAFFOLD

- Base plates must be used on all scaffolds, centered on the sills, and in firm contact with the sills. Base plates must also be in firm contact with other scaffold components, depending upon the scaffold design being followed. Be especially careful when scaffolding is to be erected on soft or frozen ground.
- Compensate for uneven ground by using screw jacks and base plates with sills. DO NOT USE unstable objects such as blocks, loose bricks etc.
- Use only tools recommended by Layher for erection and dismantling. Layher recommends a 500g (1.12 lbs.) hammer for knocking home the wedges.
- DO NOT stand, lean or put weight on horizontal members until the wedges are fully driven home and the couplers are tightened.

⚠ WARNING

FULLY KNOCK HOME WEDGES AND TIGHTEN COUPLERS IMMEDIATELY after placing member.

- Horizontal and/or vertical diagonal bracing, per Erection Manual, is required to maintain a square and plumb scaffold structure.
- Plumb and level the scaffold until proper fit can easily be made. DO NOT force members to fit. Be sure the scaffold stays plumb and level as erection progresses.
- Ties, guys, bracing and/or outriggers may be needed to assure a safe, stable scaffold assembly. The height of the scaffold in relation to the minimum base dimension (length or width), wind loads, the use of brackets or cantilevered platforms and imposed scaffold loads determine the need for sway and stability bracing.
- For detailed information regarding tying or guying of Layher Allround and Speedyscaf, the corresponding Erection Manual MUST BE USED or contact Layher Inc..
- Outrigger bays or outrigger units can be used to increase the minimum base width of freestanding towers. If used, they must be installed on both sides of the tower. The resulting base dimension, however, may no longer be the minimum (or limiting) base dimension.
- Work platforms must be fully decked with Layher platform units in sound condition. Individual grade wood planks MUST NOT be used with Layher Speedyscaf. Secure platform units against lift-off.

⚠ WARNING

USE ONLY LAYHER FABRICATED DECKS with LAYHER SPEEDYSCAF SYSTEM. Substitutions could cause a SCAFFOLD COLLAPSE.

- Guardrails must be used on all open sides and ends of scaffold platforms. Both top and midrails are required. Local codes specify heights above working surface and the platform height above ground when guardrails are required. Use at lower heights above ground if falls can cause injury. Watch out for local regulations!
- Toeboards must be installed whenever people are required to work or pass under a scaffold platform. Screening is required when materials are to be stacked higher than the toeboard.
- A means of access must be provided to all work platforms. If access is not available from the structure, access ladder units and swinggates, decks with built-in ladders or stairways must be provided. Attachable ladder units must extend at least 3 feet above platforms. Install access ladder units as scaffold erection progresses.
- Materials MUST NEVER be placed on cantilevered, side or end bracket platforms unless the assembly has been designed to support material loads by a qualified person. These types of platforms cause overturning and up-lift forces which must be compensated for.
- When uplift can occur, vertical members (frames or posts) must be pinned together. Consult a qualified person. The qualified person has to determine if a locking pin can be used or if standards with bolt in spigots must be used.
- DO NOT use Layher Bridging Ledgers without considering the loads to be supported. DO NOT cantilever Layher Bridging Ledgers. DO NOT cantilever Lattice Girders or other horizontal members without special design.

Safety guidelines

- Special care must be taken when Layher lattice girders or unit beams are used.
  - SpeedyScaf lattice girders must only be installed using special Layher girder couplers, with all bolts and nuts installed and tightened.
  - Trusses must overhang their supports by at least 6 inches.
  - Lateral bracing is required for all girders spans according to design
  - Lattice girders and unit beams used as side or end brackets require special mountings and special bracing. Consult a qualified person.
  - Always use lattice girder transoms and/or spigots to support platforms when planking or when installing frames above Allround lattice girders. Use SpeedyScaf intermediate transoms for SpeedyScaf lattice girders.
  - DO NOT connect unit beams together to form longer girders without assuring the longer girder and scaffold assembly will support all imposed loads. For connection use only unit beam spigots and pins. Consult a qualified person.
- DO NOT install platforms between free standing towers unless the assembly is designed by a qualified person.
- DO NOT MOUNT material hoists and derricks on a scaffold unless the scaffold is specifically designed for that purpose.
- DO NOT erect scaffold on wagons, trucks or other wheeled vehicles.
- CHECK THE ENTIRE SCAFFOLD ASSEMBLY BEFORE USE. Thoroughly inspect the completed assembly to see that it complies with the Erection Manual and all safety codes, that all wedges are driven home and all couplers tightened, that it is level and plumb, that work platforms are fully decked and guardrails are in place and that safe access is provided.

ERECTION OF ROLLING SCAFFOLDS

- Height of the rolling tower must not exceed 4 times its minimum base dimension (length or width). Watch out for local regulations.
- According to the type of Layher caster used, either check the nuts or bolts at the integrated adapter or secure the casters to the adapters with nuts and bolts.
- Screw jacks must not increase the height of the scaffold by more than 12 inches. Tower must be kept level and plumb at all times.
- Use horizontal diagonal near the bottom (above the casters) and at 20-foot (6 m) intervals measured from the lowest horizontal diagonal. Only Layher fabricated decks must be used on rolling towers. Secure the decks against lift-off with the Layher lock against lift-off.

USE OF FIXED SCAFFOLD

Before each work shift and after any occurrence which could affect the structural integrity of the scaffold, a competent person must inspect the scaffold assembly to be sure it is assembled correctly and has not been altered; that it is level and plumb; that the scaffold and all components are firm and secure; that safe access is provided; and that there are no overhead obstructions and no energized electric power lines within 10 feet of the scaffold assembly. Correct any deficiencies prior to use.

- Tag the scaffolding. Use only scaffolds that have been properly tagged. For further information about tagging refer to ANSI A 10.8-2001.
- Use only proper access. DO NOT climb any scaffold component unless it is specifically designed for that purpose. If safe access is not provided, insist that it be provided.
- Climb safely and only in access areas.
  - Face the rungs as you climb up or down.
  - Use both hands.
  - DO NOT try to carry materials while you climb.
  - Be sure of your footing and balance before you let go with your hands. Keep one hand firmly on ladder at all times.
  - Clean shoes and rungs to avoid slipping.
- DO NOT throw or do not let drop material on platforms.
- DO NOT jump onto planks or platforms.
- DO NOT work on slippery rungs or platforms.
- DO NOT overload platforms with materials. Special care must be taken when lattice girders are used.
- DO NOT use planked guardrails, boxes, ladders or other materials on top of scaffold platforms to increase working heights.
- DO NOT loosen, detach or remove any component of a scaffold assembly except under the supervision of a competent person. Components that have been removed must be replaced immediately.
- DO NOT stand on platform overhangs. Stand only within the platform area; do not try to extend work area by leaning out over guardrailing.

USE OF ROLLING TOWERS

- DO NOT RIDE a rolling tower. NO ONE MUST BE on a rolling tower WHILE it is being MOVED.
- Lock all casters before getting on a rolling tower. Casters must be locked at all times the scaffold is not being moved.
- DO NOT bridge between rolling towers without special design.
- Remove all materials from rolling tower before moving.
- Be sure floor surface is clear of debris, obstructions or holes before moving scaffold.
- Be sure there are no overhead obstructions or energized electric power lines in the path when moving a rolling tower.
- USE rolling towers ONLY on level surfaces.
- DO NOT PULL OR PUSH from the top. Move rolling towers from the base level only.

⚠ WARNING

Serious INJURY or DEATH can result from climbing or working on a rolling tower on which the CASTERS ARE NOT LOCKED.

DISMANTLING SCAFFOLDS

- BEFORE REMOVING OR LOOSENING any component, consider the effect of that action on the strength of the rest of the scaffold.
- Check to see if scaffold has been altered in any way which would make it unsafe. If so, reconstruct where necessary before commencing dismantling procedures. This includes all scaffold ties.
- Use only proper access. DO NOT climb braces, guardrails, or vertical members. DO NOT stand on platform overhangs.
- Visually inspect each plank or deck to be sure it is supported on both ends and is safe to stand or work on.
- DO NOT remove ties until scaffold above has been removed.
- Remove component immediately after loosening wedges or couplers.
- DO NOT accumulate removed components or equipment on the level being dismantled.
- Lower components in a safe manner as soon as dismantled. DO NOT throw components off scaffold.
- Stockpile dismantled equipment in an orderly manner.

⚠ WARNING

It may be NECESSARY TO ADD PARTS to a scaffold before it can be dismantled safely.

II. ADDITIONAL GUIDELINES FOR ALLROUND

PRIOR TO ERECTION

All wood planks used with Layher Allround must be inspected to see that they are graded for scaffold use, are sound and in good condition, and are free from saw cuts, cracks, notches, splits, delaminations and holes.

⚠ WARNING

NOT ALL SPECIES AND GRADES OF LUMBER CAN BE USED AS SCAFFOLD PLANK. Wood planks used for scaffolding must be graded by an approved grading agency or specifically manufactured for scaffold use.

ERECTION OF ALLROUND

- Layher fabricated scaffold decks.
  - If you use Layher scaffold decks with claws that connect to U-transoms, use the lock against lift-off provided by Layher to secure the deck.
  - If you use Layher fabricated decks which connect to tubular transoms, use the integrated lift-off lock to secure the deck against lift-off.
- If wood planks are being used for the scaffold platform, the platform must be fully planked or decked between the front upright and guardrail post. Work platforms and walkways must be at least 18 inches wide.
  - Each end of each plank must overlap its support by a minimum of 6 inches or be cleated.
  - Each end of each platform 10 feet long or less (longer than 10 feet) must overhang its supports by not more than 12 inches (18 inches). Larger overhangs must be guarded to prevent access to the overhang. Materials must not be stored on overhangs. DO NOT stand on platform overhangs.
  - Each plank on a continuous run scaffold must extend over its supports by at least 6 inches and overlap each other by at least 12 inches.
  - Spans of 2 inch by 10 inch nominal scaffold grade plank must never exceed 10 feet. No more than one person must stand on an individual plank at one time. Loads on planks must be evenly distributed and not exceed the allowable loads for type of plank being used.
- Use fabricated decks or cleated plank to minimize platform interference in access areas.

Understanding and following these Safety Guidelines will increase your personal safety and the safety of your fellow workers.

We're there for you.

Layher in the USA

Layher Inc.
4847 Timber Creek
Houston, Texas 77017
USA
Toll free: (+1) 866 300 0904
Fax: (+1) 713 947-1441
Web: www.layherscaf.com

Layher International

Subsidiaries:
Argentina, Australia, Austria, Chile, France, Great Britain, Hungary, Italy, New Zealand, Norway, Poland, Spain, Singapore, Sweden, Switzerland, The Netherlands, USA and Layher Bautechnik in Germany.

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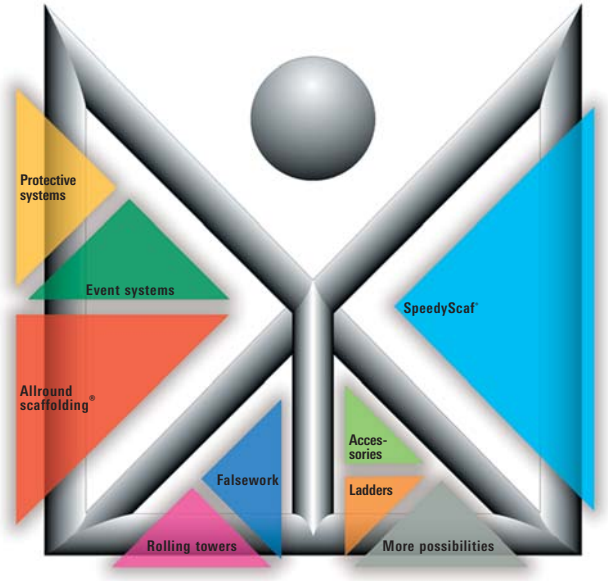
The Layher Product Range



All dimensions and weights are guideline values.
Subject to technical modifications.
We shall make delivery exclusively on the basis of our currently valid general terms of business.
Published by Layher Inc. USA

QO® and Homeline® Load Centers and Enclosures

Class 1100

Catalog
1100CT0501

2007

CONTENTS

a brand of Schneider Electric

SQUARE D

TABLE OF CONTENTS

NOTE: For information on Replacement Parts with specific part numbers, go to www.schneider-electric.us, click on Product FAQ's, enter the device catalog number, click SEARCH, then look for the information required.

PRODUCT DESCRIPTION

QO® Circuit Breaker Load Centers from Square D® are Underwriters Laboratories (UL) Listed panelboards. They are designed to meet residential, commercial, and industrial requirements to protect electrical systems, equipment, and people.

QO® Circuit Breaker Load Center

Features

- Single- or three-phase construction
- 30 400 A main lug or main circuit breaker ratings
- 2 4 2 circuit indoor or outdoor versions
- Flush or surface mounting
- Aluminum bus construction on fixed mains panels
- Service entrance equipment capable panels
- Straight-in wiring to minimize service cable installation
- Convertible mains to meet changing job site requirements
- Standard 22/10 k AIR series rating on main circuit breaker panels, increasing application capability
- 65 k AIR ratings for main lugs panels for industrial applications
- 65 k AIR rating with optional main circuit breaker on three-phase panels for industrial applications
- Shielded one-piece plated copper bus construction on convertible mains panels, an industry exclusive for protection and performance
- Single captive screw interior mounting on indoor panels to ease removal
- Split branch neutral for clutter-free wiring
- Top or bottom feed by rotating convertible mains panels 180 degrees
- Top or bottom feed for three-phase convertible panels by removing main circuit breaker and rotating panel 180 degrees
- Combination slot/square drive neutral, ground, and cover screws for positive drive and improved torque
- Three grounding bar mounting locations for ease of wiring
- Automatic flush adjustment cover to speed installation
- Tangential main service knockouts that eliminate offsets
- Equipment grounding bar included with main lug load centers
- Covers sold separately
- Provisions for door lock on convertible mains panel covers
- Two branch circuit breaker twistouts that are factory removed for easier installation of circuit breakers
- Side hinge doors on outdoor convertible main panels
- Outdoor panel covers lockable with padlock
- Manual and automatic transfer switch capability

QO® and Homeline® Load Centers and Enclosures
Catalog Number Description

CATALOG NUMBER DESCRIPTION

QO® Load Centers

Number Segment	Character	Description	QO®	1	3040	L	200	G	—	—
Load Center Family	QO®	UL and NOM Listed								
	CQO	CSA® Certified								
Phase	1	Blank or 1 = Single								
		3 = Three								
Spaces / Circuits	3040									
Mains Type	M	Main circuit breaker								
	MX	Main circuit breaker for Automatic Transfer Switch								
	L	Main lugs								
	U	Universal mains (studs only)								
Amperes										
Grounding Bar	Blank	Purchase separately								
	G	Included								
	N	Neutral installed								
	T	Factory-installed								
Cover	Blank	Purchase cover separately								
	C	Combination flush / surface indoor cover								
	DF	Flush cover with door								
	DS	Surface cover with door								
	F	Flush cover								
	R	Rainproof								
	RB	Rainproof for B hub								
	S	Surface cover								
Special Construction	CU	Copper bussing								
	FT	Feed-thru lugs								
	GP	Generator panel								
	NM	Non-metallic enclosure								
	R	Generator receptacle								
	WG	Wide gutter riser panel								

QO® Circuit Breakers

Number Segment	Character	Description	QO®	1	15	—
Brand	QO	Full Size				
	QOT	Tandem				
Number of Poles						
Amperes						
Device Name	Blank	10,000 AIR				
	EPD	30 mA equipment ground fault protection				
	GFI	Ground fault circuit interruption				
	HID	For use on high intensity discharge lighting systems				
	HM	High magnetic trip circuit breakers are recommended for applications where high initial inrush current may occur				
	K	Key operated				
	PL	Remote control switching capability				
	SWN	Switch neutral common trip				
	VH	22,000 AIR				
	AFI	Arc fault circuit interruption				
	CAFI	Combination arc fault circuit interruption				

GENERAL INFORMATION AND APPLICATION DATA

QO® Circuit Breaker Load Center

Circuit breaker load centers for use on electrical systems are UL Listed under File E-6294 (panelboards) and meet Federal Specifications W-P-115c, Type 1, Class 2 for use in government housing. Select from QO, QOT, QO-PL, QO-GFI (UL Class A ground fault protection), QO-AFI (arc fault circuit interrupter), QO-CAFI (combination arc fault interrupter), or QO-EPD (30 mA equipment ground fault protection) branch circuit breakers.

Service

- 120 Vac, 1ϕ2W
- 120/240 Vac, 1ϕ3W
- 240 Vac delta, 3ϕ3W
- 208Y/120 Vac, 3ϕ4W
- 240/120 Vac delta, 3ϕ4W
- 240 Vac corner grounded delta, 3ϕ3W
- 48 Vdc maximum (1ϕ convertible main lug 12 4 2 circuit only)

Ratings

	Main Lugs	Main Circuit Breaker
Single-Phase	30 400 A	100 4 00 A
Three-Phase	60 225 A	100 2 25 A

QO 1-Pole

QO 2-Pole

QO 3-Pole

QO-GFI 1-Pole

QO-GFI 2-Pole

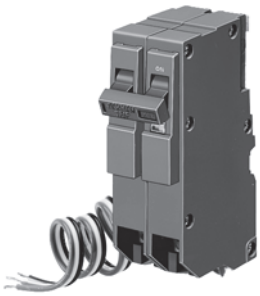
QO-AFI 1-Pole

QOK, 1-Pole

QO-SWN, 1-Pole

QO-EPD 1-Pole

QO-CAFI 1-Pole

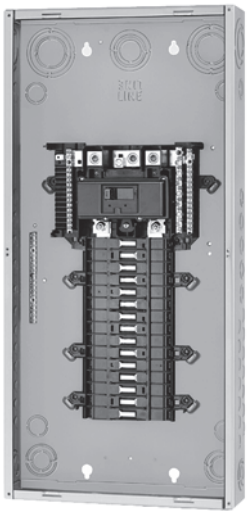


QO-PL 2-Pole

Branch Circuit Breakers

10,000 AIR	
QO	1-pole, 10 70 A
	2-pole, 10 12 5 A
	3-pole, 10 10 0 A
QOT	1-pole, 15 20 A
QO-EPD	1-pole, 15 30 A
	2-pole, 15 60 A
QO-GFI	1-pole, 15 30 A
	2-pole, 15 60 A
QO-AFI	1-pole, 15 20 A
QO-CAFI	1-pole, 15 20 A
QO-HID	1-pole, 15 50 A
	2-pole, 15 50 A
	3-pole, 15 30 A
QO-PL QO-PLILC	1-pole, 10 20 A, 30 A
	2-pole, 10 60 A
	3-pole, 15 60 A
QO-SWN	2-wire, 10 50 A
	3-wire, 10 50 A
QOK	1-pole, 10 30 A
22,000 AIR	
QO-VHGFI	1-pole, 15 30 A
QO-VH	1-pole, 15 30 A
	2-pole, 15 12 5 A
	3-pole, 15 10 0 A
QOB-VH	2-pole, 150 A [1]
	3-pole, 110 150 A [1]
42,000 AIR	
QOH	2-pole, 40 12 5 A
65,000 AIR	
QH	1-pole, 15 30 A
	2-pole, 15 30 A
	3-pole, 15 30 A

[1] For use with 300 A and 400 A load centers only. Requires PK3CA mounting kit, ordered separately.



QO130M150

Indoor Cover

QO140M200RB

Bolt-On Hubs

Indoor Enclosures (Type 1)

Welded sheet steel with knockouts at top, bottom, back, and sides

Finish: gray baked enamel, electrodeposited over cleaned, phosphatized steel

Most 100 225 A indoor enclosures are 14.25 in. (362 mm) wide (see Dimensions and Knockouts on page 26)

300 A and 400 A indoor enclosures are 20 in. (508 mm) wide

Top or bottom feed by rotating enclosure

Indoor Covers

Doors to cover circuit breaker handles, except on 2 4, 4 8, 6 12 , and 8 16 circuit models

Shutter-type twistouts

Flush and surface covers available, sold separately

Flush covers have automatic flush adjustment

Field-installed door lock provisions available on most covers

QOFP filler plates available for all covers

QOM1FP filler plates available for 100 1 25 A convertible load center covers

QOM2FP filler plates available for 150 2 25 A convertible load center covers

Q2FP filler plates available for 3-phase load center covers

Triple lead cover screws for fast cover installation

Rainproof Enclosures (Type 3R)

Complete enclosure includes interior trim and door

Welded, galvannealed steel

Finish: gray baked enamel, electrodeposited over cleaned, phosphatized, galvannealed steel

RB devices have provisions for interchangeable bolt-on hub

Top-centered rainproof mounting boss on the back of the enclosure simplifies installation and saves time

Stainless steel door latch on the enclosure provides secure closure and maximum durability

Convertible main panels are side-hinge door devices

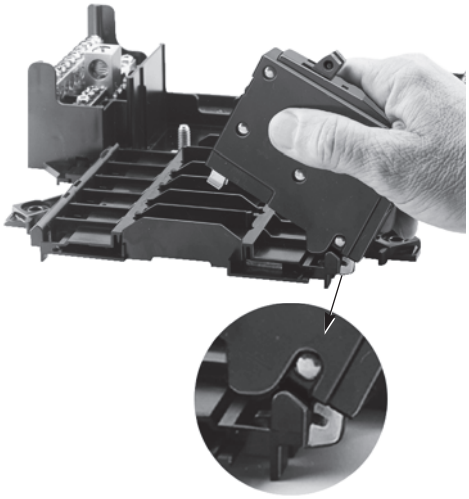
Allow 1.25 in. (32 mm) on the left side for the door to open

Side-hinged door provides full wiring access without door removal

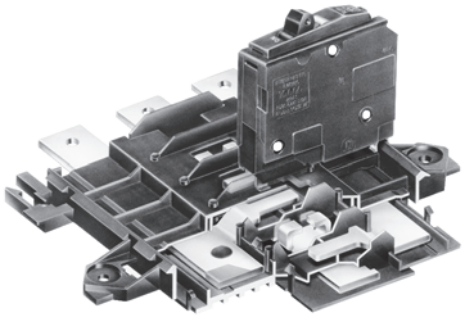
Bolt-On Hubs

Hubs available from 0.75 in. (19 mm) to 4 in. (102 mm) conduit size

No gasket required with hubs from 0.75 in. (19 mm) to 2.50 in. (64 mm) when used on RB type load centers



Tandem circuit breaker mounts on rails.



Branch Circuit Breaker

Class CTL

Class CTL load centers are UL Listed

Circuit breaker mounting rails have slots to accept tandem circuit breakers, on specified load centers

Meets paragraph 408.35 of the 2005 National Electrical Code® (NEC®)

Phasing

Load centers have distributed phase bussing

Most branch circuit breakers can be mounted in any position

Line Lugs

All lugs suitable for 75 °C copper or aluminum wires (see Main Lugs and Main Circuit Breaker Ratings on page 20)

Main lugs and main circuit breaker load centers have wire binding screw torque values on the wiring diagrams and circuit breaker labels

Neutral Assemblies

All lugs suitable for copper or aluminum wire (see Main Lugs and Main Circuit Breaker Ratings on page 20)

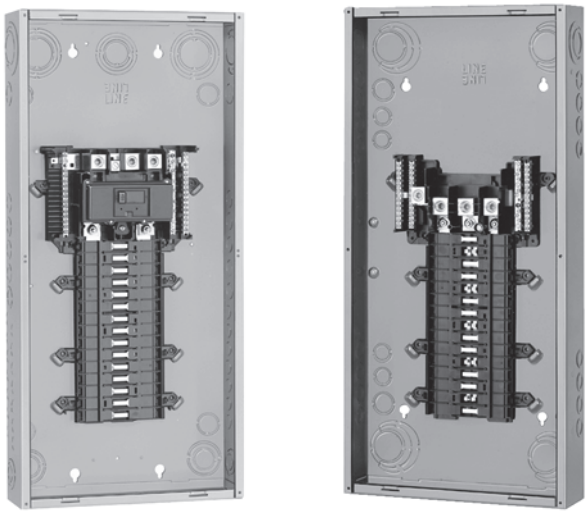
Branch neutral terminals suitable for one #14 #4 AWG copper or one #12 #4 AWG aluminum wire

Three #14 1/0 AWG copper or #14 #6 AWG aluminum terminals provided on 12 42 circuits, 100 225 A load centers

Suitable lugs provided on the neutrals for termination of the grounding conductor

All unused neutral terminals may be used to terminate bare or green equipment grounding conductors when the load center is used as service equipment:

- one or two #14 # 12 AWG copper
- one or two #12 # 10 AWG aluminum



Neutral assemblies accept copper or aluminum wire.

QO24L70S

QO816L100DS

QO148L125GF

Single Phase, 2–16 Circuits, 30–125 A, Fixed Mains

UL Listed

File E-6294

Suitable for use as service equipment

75 °C wire rating (see Technical Information on page 20)

Federal Specification W-P-115c, Type 1, Class 2

CSA Certified

File LL-89066-21

For other CSA certified load centers, see Supplemental Digest 174.

Short Circuit Current Rating

UL short circuit current rating depends on lowest interrupting rating of circuit breaker installed (see Technical Information on page 20)

Interior

Tin plated aluminum bus

Tin plated copper bus is an available option on 6 12 and 8 16 circuit load centers

Tin plated copper bus is standard on 4 8 circuit load centers

Mains

Factory-installed main lugs

Top mains positioning only

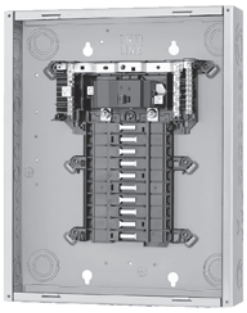
Top or bottom feed

A backfed main circuit breaker can be field-installed in 4 8 , 6 12 and 8 16 load centers using the PK2MB retaining kit

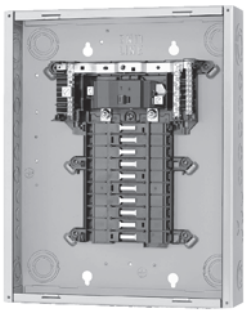
Cover

Flush- or surface-mounted cover included with load centers

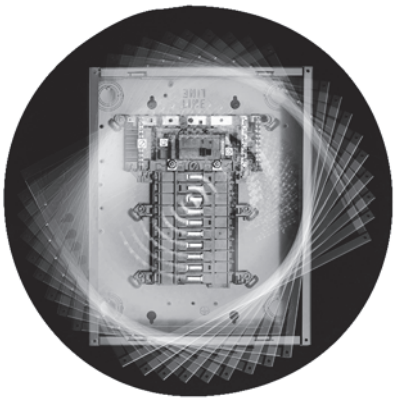
A cover with a door is an available option on 6 1 2 and 8 16 circuit load centers



Main Circuit Breaker



Main Lug



Top or bottom mains positioning. Rotate entire load center 180 degrees.

Single-Phase, 12–42 Circuits, 100–225 A, Convertible Mains

UL Listed

- File E-6294
- Federal Specification W-P-115c, Type 1, Class 2
- Suitable for use as service equipment
- 75 °C wire rating (see Technical Information on page 20)

Short Circuit Current Rating

- Main lugs: up to 65,000 AIR (depends on lowest interrupting rating of branch circuit breakers installed)
- Main circuit breaker: 22,000 AIR standard
- 22,000 AIR main circuit breaker kits (refer to page 10 and Technical Information on page 20)

Interior

- Shielded, one-piece tin plated copper bus
- Removable interior with single, captive mounting screw
- Split branch neutral with up to 50% more terminations than required
- Multiple mounting locations for equipment grounding bar kits: left, right, and bottom
- Main lugs load centers have equipment grounding bar kits included (not factory-installed)

Mains

Factory-installed main lugs convertible to main circuit breaker

Load Center Amperage	Main Circuit Breaker Kit Amperage
125	50 125
150	100 15 0
200	100 20 0
225	100 22 5

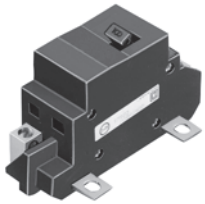
Factory-installed main circuit breaker convertible to main lugs

Main Circuit Breaker Amperage	Main Lug Kit Amperage	Load Center Amperage
100	125	100
125	125	125
150	225	150
200	225	200
225	225	225

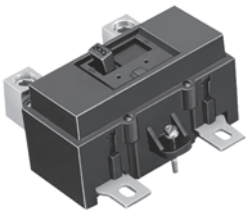
Cover

QOL125 Kit

QOL225 Kit



QOM1
Main Frame Size
50–125 A



QOM2
Main Frame Size
100–225 A

Single-Phase, 12–42 Circuits, 100–225 A, Convertible Mains, Continued

Covers

- Flush and surface covers sold separately
- Flush covers have spring-loaded interior trim for automatic flush adjustment
- Positive action, easy-open door latch

Main Lugs Kits

- Field-installable in main circuit breaker or main lugs load centers
- QOL125 kit for use in 100 125 A load centers
- QOL225 kit for use in 150 225 A load centers

Main Circuit Breaker Kits

- Field-installable in main lugs or main circuit breaker load centers
- 50 2 25 A main circuit breaker kit is 22,000 AIR series rated with 10,000 AIR branch circuit breakers

Field-Installable Main Circuit Breaker (Convertible Main Load Centers Only)

Main Circuit Breaker Ampere Rating [1]	Use with Convertible Load Center Mains Rating	22,000 AIR Main Circuit Breaker	Lug Wire Size [2] AWG/kcmil Al or Cu	Lug Torque lb-in. / N•m
QOM1 Frame Size				
50	100 125 A	QOM50VH	#12 2/0	50 lb-in. (6 N•m)
60	100 125 A	QOM60VH		
70	100 125 A	QOM70VH		
80	100 125 A	QOM80VH		
90	100 125 A	QOM90VH		
100	100 125 A	QOM100VH		
110	125 A	QOM110VH		
125	125 A	QOM125VH		
QOM2 Frame Size [3] [4]				
100	150 225 A	QOM2100VH	#4 30 0	250 lb-in. (28 N•m)
125	150 225 A	QOM2125VH		
150	150 225 A	QOM2150VH		
175	200 225 A	QOM2175VH		
200	200 225 A	QOM2200VH		
225	225 A	QOM2225VH		

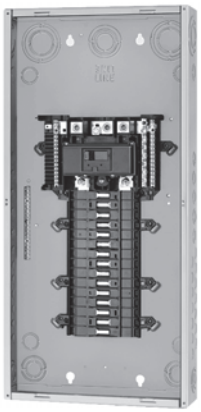
1 Do not exceed the load center mains rating.

2 Wire range listed for QOM circuit breaker kits is the wire range of that circuit breaker. To find out maximum wire size permitted in a particular load center per UL, see Main Wire Size AWG/kcmil on page 20.

3 Add suffix 1021 for shunt trip.

4 Add suffix 8041 for control wire taps.

QO2L30TTS



QO130M150

QO24L60NRNM

QO1816M200FTRB

Special Purpose

Recreational Vehicle and Manufactured Housing Load Centers

- UL Listed (File E-6294) and CSA Certified (LL89066-14)
- Single-phase, 2- and 3-wire
- Factory-installed equipment grounding bar
- Covers included with load centers

Load Centers with Covers

- Combination flush/surface cover included with load centers
- Equipment grounding bar included on main lug load centers
- Top or bottom feed on incoming service by rotating complete load center 180 degrees
- Convertible main load centers

Non-Metallic Load Center

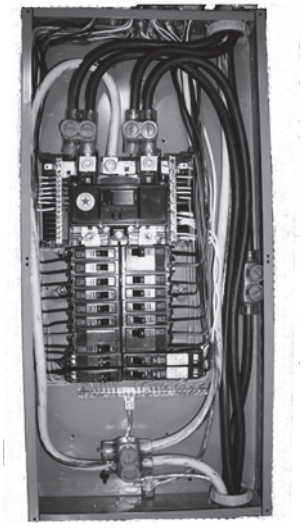
- UL Listed
- Suitable for use as service equipment
- Side-hinge door device
- 10,000 AIR rating
- Single-phase, 2- and 3-wire
- Factory-installed grounding bar
- Cover included with load center
- Knockouts in bottom endwall, side and back

Main Circuit Breaker with Feed-Thru Lugs

- Available rainproof enclosure only
- Side hinge door devices
- Allow 1.25 in. (32 mm) on the left side for the door to open
- 125, 150, and 200 A mains rating
- 125, 150, and 200 A feed-thru lugs
- Space for up to 8 single-pole circuit breakers

QO48M60DSGP

QO® Intelligent Load Center



Wide Gutter

Generator Panels

Generator Panel Manu al Transfer

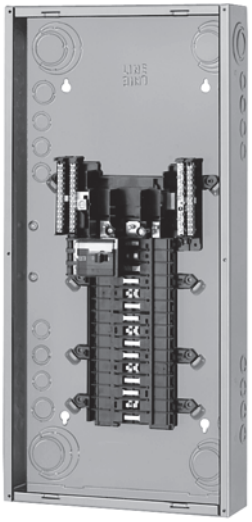
- Connects utility and standby power to installed branch circuits
- Includes two factory-installed 2-pole main circuit breakers tied together with a mechanical interlock
- 30 A and 60 A main circuit breaker versions
- Supply up to 8 branch circuits using tandem circuit breakers
- Available indoor enclosure only
- Cover with door included

Generator Panel Automatic Transfer

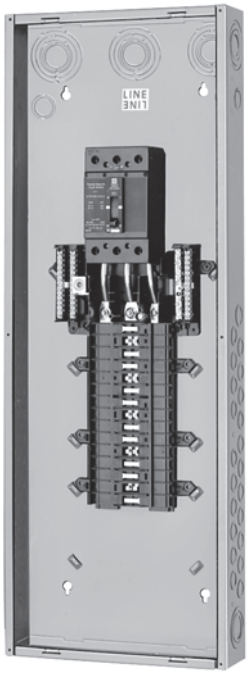
- QO® load center platform construction
- Automatic transfer from utility to back-up power source
- Transfer cycle less than 10 seconds
- Indoor and outdoor enclosures
- 120 / 240 Vac single-phase
- 150, 200 and 225 A main circuit breaker
- 42 circuit maximum construction, indoor, 28 circuit maximum outdoor
- 125 A maximum branch feeder connection to an alternative energy source
- Service entrance rated
- Manual override capability
- Easy removal of interior and transfer switch for rough in wiring
- 5-year limited warranty
- Compatible with standard load center field-installable accessories

Riser Panels

- Offset interior provides ample wire gutter space for high rise applications
- Factory-installed main lugs (125 A), convertible to main circuit breaker with standard QOC cover and optional Mono-Flat cover
- Factory-installed main lugs (200 A), convertible to main circuit breaker when used with QOC cover only
- Available in 12 to 40 circuits
- Indoor only
- Optional Mono-Flat® cover available for both 125 A and 200 A panels (sold separately)



QO330L200G



QO330MQ150

Three-Phase, 3–42 Circuits, 60–225 A, Convertible or Fixed Mains

UL Listed

- File E-6294
- Suitable for use as service equipment
- 75 °C wire rating (see Technical Information on page 19)

Short Circuit Current Rating

- Main lugs: up to 65,000 AIR (depends on lowest interrupting rating of branch circuit breakers installed)
- Main circuit breaker up to 225 A: 22,000 AIR standard; optional up to 65,000 AIR for 100 A to 225 A main circuit breakers

Mains

- Factory-installed main lugs or main circuit breaker
- Main neutral terminal located next to the phase terminals on 125 2 25 A main circuit breaker devices
- Top or bottom feed (see Technical Information on page 24)
- Fully convertible from main circuit breaker to main lugs (100 225 A)
- 100 A maximum back-fed main QO® circuit breaker; requires the use of retaining kit PK3MB

Cover

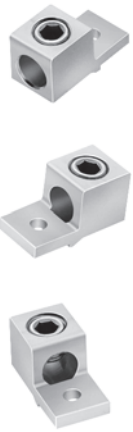
- Flush- and surface-mount covers sold separately
- Flush covers have spring-loaded interior trim for automatic flush adjustment
- Positive action, easy-to-open door latch

Interior

- Shielded one-piece plated copper bus on 100 2 25 A
- Removable interior with single, captive mounting screw on 100 22 5 A (indoor only)
- Main lugs load centers have equipment grounding bar kits included (not factory-installed)

Branch Neutral Termination

- Suitable for copper or aluminum wire
- Terminals suitable for one #14 #4 AWG coppe r or one #12 #4 AWG aluminum wire
- Positioned on both sides of the mains compartment
- Slot/square drive wire binding screws
- Three (3) #14 1 /0 AWG copper or #14 # 6 AWG aluminum terminations standard on 12 4 2 circuits, 100 22 5 A load centers



QOL3225
Main Lugs Kit

QDL Circuit Breaker
70–225 A

Three-Phase, 3–42 Circuits, 60–225 A, Convertible or Fixed Mains (Continued)

Main Lugs Kits

Field-installable in main circuit breaker or main lugs load centers

QOL3125 kit for use in 100 125 A load centers

QOL3225 kit for use in 150 225 A load centers

Main Circuit Breakers

Field-installable in main circuit breaker load centers

25,000 AIR QDL main circuit breakers series rated with 10,000 AIR QO® branch circuit breakers

100 225 A main circuit breakers are series rated up to 100,000 AIR (see table below) with 10,000 AIR branch circuit breakers in 30 circuit or larger main circuit breaker load centers with optional QJL main circuit breaker

Back-fed QO-VH (100 A maximum) main circuit breaker may be field installed in main lugs and main circuit breaker load centers (requires PK3MB retaining kit)

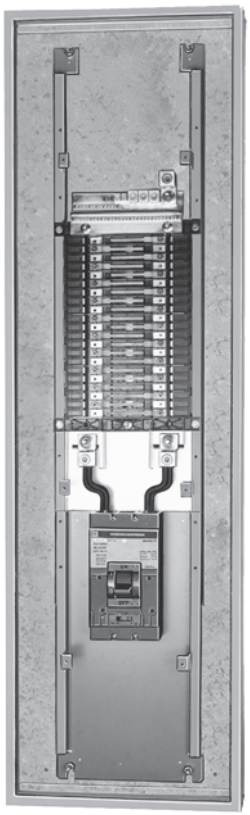
27 circuit, 100 A main circuit breaker load center includes factory-installed back-fed QO-VH main circuit breaker

Electrical accessories are not available on QDL, QGL, or QJL circuit breakers

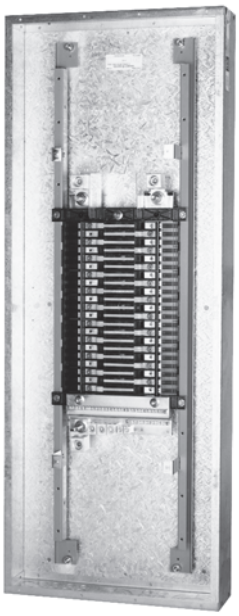
30 4 2 circuit, 125 22 5 A main circuit breaker load centers include integral QDL circuit breakers. Optional QGL and QJL circuit breakers available as shown:

Amperage	25,000 AIR	65,000 AIR	100,000 AIR [1]
70	QDL32070	QGL32070	QJL32070
80	QDL32080	QGL32080	QJL32080
90	QDL32090	QGL32090	QJL32090
100	QDL32100	QGL32100	QJL32100
110	QDL32110	QGL32110	QJL32110
125	QDL32125	QGL32125	QJL32125
150	QDL32150	QGL32150	QJL32150
175	QDL32175	QGL32175	QJL32175
200	QDL32200	QGL32200	QJL32200
225	QDL32225	QGL32225	QJL32225

[1] When these 3-pole circuit breakers are used as the main circuit breaker of a three-phase load center, the maximum AIR rating is 65,000 at 240 Vac and 100,000 at 208 Vac.



QON42MS400 and MH68



QON42LS400 and MH53

Single-Phase, 12–42 Circuits, 300–400 A, Fixed Mains

UL Listed

- File E-6294
- Suitable for use as service equipment
- 75 °C wire rating (see Technical Information on page 20)

Short Circuit Current Rating

- Main lugs: up to 65,000 AIR
- Main circuit breaker: 42,000 AIR fully rated (see Technical Information on page 20)

Mains

- Factory-installed main lugs and main circuit breaker
- Multiple wire terminals for phases and neutral
- Top or bottom mains positioning (see Technical Information on page 20)

Cover

- Flush- and surface-mount covers sold separately

Interior

- Available in single-phase construction
- Interiors accept QO® and QOB-VH 110 150 A maximum circuit breakers (QOB-VH circuit breakers require connector kit PK3CA)
- Tin plated aluminum bus
- Tin plated copper connector fingers
- Neutral assemblies positioned opposite the mains compartment

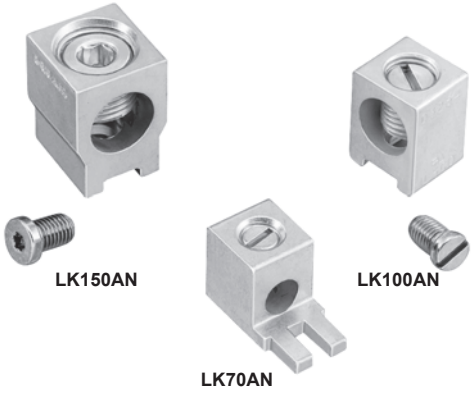
Enclosures

- 20 in. (508 mm) wide galvanized steel
- Embossed 0.25 in. (6 mm) standoffs
- End walls, one blank and one with knockouts, are standard; both are removable and interchangeable
- Embossed keyholes centered at both ends and in visual positioning
- Multiple grounding bar mounting locations
- Wire management braces

PG18GTA Grounding Bar Kit

PK6FL Flush Lock Kit

PK4FL Flush Lock Kit



LK150AN LK100AN LK70AN

Auxiliary Neutral Lugs

Accessories

Grounding Bar Kits

- Field-installable in all load centers
- Same wire size as terminals (see page 19)
- Suitable for copper or aluminum wire
- Available with #1 4/0 lug PK15GTA-L, PK18GTA-L, and PK23GTA-L (see page 19)

Flush Lock Kits

- Available for indoor load centers
- Two keys provided with each lock kit
- PK6FL for convertible 12 42 circuit load centers
- PK4FL for 300 and 400 A load centers

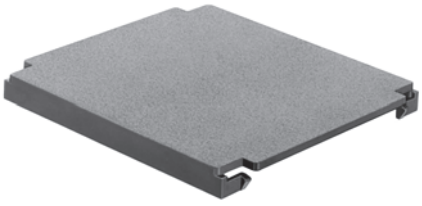
Auxiliary Neutral Lugs

- UL Listed for copper or aluminum wire
- Field-installable on neutral assembly
  - LK70AN:#12 # 2 AWG Al or #14 #4 AWG Cu
  - LK100AN:#6 2 /0 AWG (Al/Cu)
  - LK125AN:#14 2/0 AWG (Al/Cu)
  - LK150AN:#2 3 /0 AWG (Al/Cu)
  - LK225AN:#4 3 00 kcmil (Al/Cu), use ONLY in Series S, 150 22 5 A QO® or Homeline® load center

Cover Filler Plates

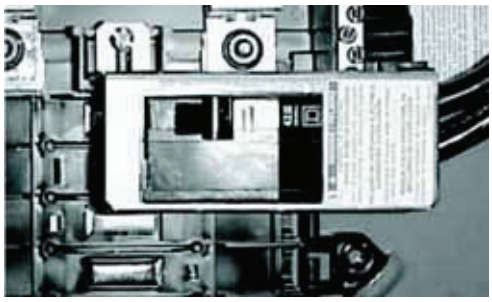
- Fast to install, snap-in type
- QOFP branch circuit
- QOM1FP for 70 125 A, single-phase, main circuit breakers
- QOM2FP for 150 22 5 A, single-phase, main circuit breakers
- Q2FP for 125 225 A, three-phase, main circuit breakers

QOFP Cover Filler Plate

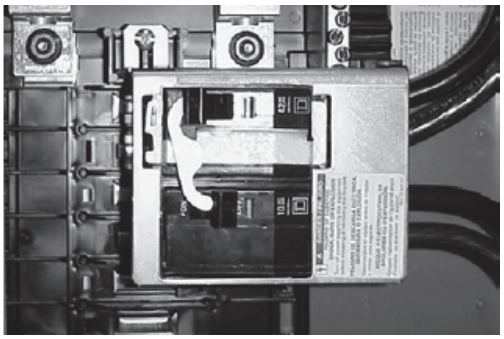


Q2FP Cover Filler Plate

QO2175SB



Back-fed Main Circuit Breaker Retaining Kit (PK4MB2LA)



QO Manual Transfer Equipment Kit (PK4DTIM4HA)

Generator Interlock Kit Installed

Accessories (Continued)

Surgebreaker® Secondary Surge Arrester

- QO2175SB UL Listed secondary surge arrester
- Easy plug-on installation for QO® load centers
- LED indicates operational status
- Plug-on design requires two pole spaces
- Designed to protect electrical service and major household appliances , excluding electronic devices

Back-Fed Main Circuit Breaker Retaining Kits

Back-fed main circuit breaker retaining kits secure 2-pole, 10 125 A circuit breakers to single-phase or three-phase mains interiors when used as back-fed main circuit breakers. Mounting of retaining kits is based on top-feed applications.

Catalog No.	Description
PK2MB	QO 6 1 2, 4 8, and 8 16 loa d centers
PK3MB	Three-phase load centers
PK4MB2LA	Mounts on the right side of QO single-phase, 100 125 A convertible main load center, series S01 and S02. Retains one 2-pole QO circuit breaker with or without electrical accessories.
PK4MB2HA	Mounts on the right side of QO single-phase, 150 225 A convertible main load center, series S01 and S02. Retains one 2-pole QO circuit breaker with or without electrical accessories.

UL Listed Manual Transfer Equipment Kits

Manual transfer equipment kits secure two 2-pole, 10 125 A circuit breakers.

Catalog No.	Description
QO2DTI	For interlocking the handles of two 2-pole or one 2-pole and one 1-pole QO and Q1 circuit breakers mounted side-by-side so that only one circuit breaker can be ON at a time.
QO2DTIM	QO2DTI mechanical interlock attachment with retaining kits for securing two adjacent back-fed circuit breakers in dual power supply applications. Can be used with two 2-pole or one 2-pole and one 1-pole QO circuit breakers in QO816L100 load centers.
PK4DTIM4LA	Mounts on the right side of QO single-phase, 100 125 A convertible main load center, series S01 and S02. Retains two 2-pole QO circuit breakers with a QO2DTI kit included for dual power supply applications.
PK4DTIM4HA	Mounts on the right side of QO single-phase, 150 225 A convertible main load center, series S01 and S02. Retains two 2-pole QO circuit breakers with a QO2DTI kit included for dual power supply applications.
PK4DTIM4LAL	Mounts on the left side of QO single-phase, 100 1 25 A convertible main load center, series S01 and S02. Retains two 2-pole QO circuit breakers with a QO2DTI kit included for dual power supply applications.

Generator Circuit Breaker Interlock Kit

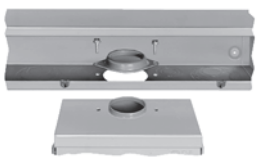
Catalog No.	Description
QOCRBGK1	For use on "G" and "S" Series NEMA Type 1 and "G", "S1" and "S2" Series NEMA Type 3R load centers. Interlocks a QOM1, 2-pole main circuit breaker of a load center (100-125 A) with a QO, 2-pole (15-125 A) branch circuit breaker. Includes a retaining kit.
QOCGK2	For use on G and S Series NEMA Type 1 and G and S1 Series NEMA Type 3R load centers. Interlocks a QOM2, 2-pole main circuit breaker of a load center (150 22 5 A) with a QO 2-pole (15 12 5 A) branch circuit breaker. Includes a retaining kit.
QORBGK2	For use on S2 Series NEMA Type 3R load centers. Interlocks a QOM2 2-pole main circuit breaker of a load center (150 225 A) with a QO 2-pole (15 1 25 A) branch circuit breaker. Includes a retaining kit.

SDAG26
With Tap Kits Installed

Tap Kit with Mechanical Lugs

Tap Kit for Crimp Lugs

RB Hub



BC200 Enclosure Coupling

Accessories (Continued)

Auxiliary Gutters and Tap Kits

Field-installable on the left or right side of load centers

Auxiliary gutters are 13.50 in. wide x 26.12 in. height x 3.75 in. deep

Conduit riser sizes: 1-3/4, 2, 2-1/2 or 3 in. (3 in. requires use of B300 bolt-on hubs)

Flush cover included with auxiliary gutter

Tap kits required for each riser wire to be tapped (see below for tap kits)

Wire range on tap kits is #4 AWG to 300 kcmil copper or aluminum

Tap kits include mechanical-type lugs or studs for crimp-type lugs

Crimp-type lugs not included in tap kits (order separately)

Auxiliary Gutter (SDAG26) to Load Center Catalog Number Reference

QO® Single-Phase	QO112L125G QO11224L125G QO112L125GC QO11224L125GC QO116L125G QO11624L125G QO120L125G QO12024L125G QO124L125G QO120L125GC	QO112M100 QO116M100 QO120M100 QO124M100 QO124M125 QO112M100C QO11220M100C QO116M100C QO120M100C
QO® Three-Phase	QO312L125G QO320L125G QO324L125G	

Tap Kits

UL Listed for Use with Auxiliary Gutter SDAG26				
Riser Wire			**Tap Off Wire**	
Catalog Number	**Lug Type**	**Wire Size**	**Lug Type**	**Wire Size**
SDGT30020	Mechanical	(2) #6 AWG 3 00 kcmil	Mechanical	(1) #6 AWG 2 /0 AWG
SDGT300300	Mechanical	(2) #6 AWG 3 00 kcmil	Mechanical	(1) #6 AWG 30 0 kcmil
SDGT300C10C	Crimp	(2) #4 AWG 3 00 kcmil	Crimp	(1) #8 AWG 1 /0 AWG
SDGT300C300C	Crimp	(2) #4 AWG 3 00 kcmil	Crimp	(1) #4 AWG 30 0 kcmil
QOGL20 (grounding lugs)	Mechanical	(2) #6 AWG 2/0 AWG		

Auxiliary Gutter **UL Listed for Use with Standard Load Centers for Riser Applications**								
	SDAG26	Flush	No	N/A	See Tap Kit			No

Bolt-On Hubs

Equipment with an RB suffix, meaning Rainproof Type 3R construction, uses the bolt-on hubs listed below. RB devices will accept 0.75 in. (19 mm) through 2.50 in. (64 mm) bolt-on hubs without the use of reducers. Off-center conduit thread openings and elongated mounting holes provide quick and easy adjustment to eliminate costly conduit offsets and bends. Hubs are suitable for use with conduit having ANSI standard taper pipe thread.

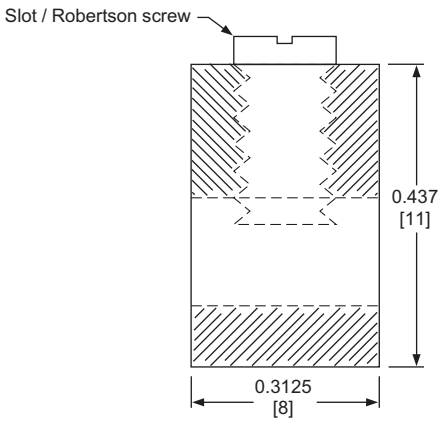
UL Listed Bolt-On Hubs for RB Devices

Conduit Size	0.75 in. 19 mm	1.00 in. 25 mm	1.25 in. 32 mm	1.50 in. 38 mm	2.00 in. 51 mm	2.50 in. 64 mm
Hub Cat. No.	B075	B100	B125	B150	B200	B250

NOTE: Closing cap (catalog number B-CAP) is provided factory-installed on each device having the RB suffix.

UL Listed Enclosure Coupling for RB Devices

Cat. No.	Designed for connecting wireway or other enclosures to units having RB bolt-on conduit provisions. Provides a bushed opening equal to 2 inch conduit. Eliminates the need for conduit nippling.
BC200	



Cross Section of Size 1 Ground Bar

Dimensions: in. [mm]

TECHNICAL INFORMATION

Grounding Bar Kits

All PK equipment grounding kits are supplied with mounting screws, necessary installation instructions, and an Equipment Grounding Terminal self-adhesive label.

Catalog Number	Total Qty.	Terminals						Approximate Overall Length		Distance Between Mounting Holes		Mounting
		Quantity Each Size See "Wire Range Table" below.										
		I	II	III	IV	V	VI	in.	mm	in.	mm	
PK0GTA2[1]	2						2	1.75	44	One hole	One hole	Top
PK0GTA6[2]	6					6		4.61	117	1.69	43	Top
PK3GTA1[3]	3	3						1.38	35	One hole	One hole	Top
PK4GTA[3]	4	4						1.63	41	One hole	One hole	Top
PK5GTA[4]	5	5						2.25	57	1.25	32	Top
PK7GTA[3]	7	7						2.88	73	1.25	32	Top or side
PK9GTA1[3]	9	9						3.25	83	One hole	One hole	Top
PK9GTA[3]	9	9						3.78	96	3.13	80	Top
PK12GTA[3]	12	12						4.70	119	3.13	80	Top
PK15GTA[3]	15	15						5.63	143	3.13	80	Top
PK15GTAL[5]	16	15	1					8.13	207	3.13	80	Top
PK15GTA6[6]	21	15			6			5.88	149	[7]	[7]	Top
PK18GTA[3]	18	18						6.56	167	3.13	80	Top
PK18GTAL[5]	19	18	1					8.81	224	3.13	80	Top
PK23GTA[3]	23	23						8.11	206	3.13	80	Top
PK23GTAL[5]	24	23	1					9.44	240	3.13	80	Top
PK27GTA[3][8]	27 or 26	27 26		1				9.36	238	3.13	80	Top

1 Mounting screw 40205-065-01 (one required).

2 Mounting screw 21922-18360 (two required).

3 Mounting screw 21594-14220 (two required).

4 Mounting screw 21594-14241 (two required).

5 Mounting screw 21594-14302 (two required).

6 Mounting screws 21594-14241(two required) and 21594-17121(two required).

7 3.13 in. (80 mm) on small terminals; 5.25 in. (133 mm) on large terminals.

8 PK27GTA includes one main grounding lug that mounts with two terminal screws and requires three terminals for mounting.

Size	Cu (AWG)	Al (AWG)
I	(1) #14 # 4 or (2) #14 or #12	(1) #12 #4 or (2) #12 or #10
II	(1) #1 4/ 0	(1) #1 4/0
III	(1) #6 2/ 0	(1) #6 2/0
IV	(1) #6 3/ 0	(1) #6 3/0
V	(1) #14 1 /0	(1) #14 1/0
VI	(1) #10 2/0	(1) #6 2 /0

QO® Circuit Breaker Load Centers—Class 1130
Technical Information
Main Lugs and Main Circuit Breaker Ratings

Single-Phase, Three-Wire, 120/240 Vac; Main Lugs Indoor

Mains Rating in Amps	Load Center Catalog Number	Load Center Cover Catalog Number	UL Listed Service Equipment (See notes)	Maximum UL Short Circuit Rating [1]	Main Wire Size AWG/kcmil Al/Cu	Enclosure No. (Page 26)	Top or Bottom Mains Position	UL Listed for Corner Grounded Delta Systems
Fixed Mains – Factory-Installed Main Lugs								
30	QO2L30S	Included	No	10,000 A	#12 10 Al #14 10 Cu	1	Top	No
70	QO24L70F/S	Included	B	10,000 A	#12 3 Al #14 4 Cu	2	Top	No
100	QO612L100F/S	Included	B, C	10,000 A	#8 1	4	Top	No
	QO612L100DF/S	Included	B, C	10,000 A	#8 1	4	Top	
	QO612L100DFCU/SCU	Included	B, C	10,000 A	#8 1	4	Top	
100	QO816L100F/S	Included	B, C	10,000 A	#8 1	4	Top	No
	QO816L100DF/S	Included	B, C	10,000 A	#8 1	4	Top	
	QO816L100DFCU/SCU	Included	B, C	10,000 A	#8 1	4	Top	
125	QO148L125GF/S	Included	B, C	10,000 A	#12 2 /0 Al #14 2/ 0 Cu	21	Top	No
Convertible Mains – Factory-Installed Main Lugs **QOM1 Main Frame Size – Convertible to Main Circuit Breaker – Copper Bus**								
125	QO112L125G	QOC16UF/S	B, C	65,000 A [2 3]	#6 2/ 0	6	Both	Yes
	QO11224L125G	QOC16UF/S	B, C	65,000 A [2 3]	#6 2/ 0	6	Both	
	QO116L125G	QOC24UF/S	B, C	65,000 A [2 3]	#6 2/ 0	7	Both	
	QO11624L125G	QOC24UF/S	B, C	65,000 A [2 3]	#6 2/ 0	7	Both	
	QO120L125G	QOC24UF/S	B	65,000 A [2 3]	#6 2/ 0	7	Both	
	QO12024L125G	QOC24UF/S	B	65,000 A [2 3]	#6 2/ 0	7	Both	
	QO124L125G	QOC24UF/S	B	65,000 A [2 3]	#6 2/ 0	7	Both	
	QO132L125G	QOC32UF/S	B	65,000 A [2 3]	#6 2/ 0	8	Both	
Convertible Mains – Factory-Installed Main Lugs **QOM2 Main Frame Size – Convertible to Main Circuit Breaker – Copper Bus**								
150	QO12030L125G	QOC30UF/S	B, C	65,000 A [2 3]	#6 25 0	9	Both	Yes
	QO124L150G	QOC30UF/S	B, C	65,000 A [2 3]	#6 25 0	9	Both	
	QO130L150G	QOC30UF/S	B, C	65,000 A [2 3]	#6 25 0	9	Both	
200	QO112L200G	QOC30UF/S	B, C	65,000 A [2 3]	#6 25 0	9	Both	Yes
	QO12436L200TFT	QOC40UF/S	B, C	65,000 A [2 3]	#6 25 0	10	Both	
	QO130L200G	QOC30UF/S	B, C	65,000 A [2 3]	#6 25 0	9	Both	
	QO13040L200G	QOC30UF/S	B, C	65,000 A [2 3]	#6 25 0	9	Both	
	QO140L200G	QOC40UF/S	B, C	65,000 A [2 3]	#6 25 0	10	Both	
225	QO142L225G	QOC42UF/S	B	65,000 A [2 3]	#6 30 0	11	Both	Yes
Fixed Mains – Factory-Installed Main Lugs								
400	QON12LS400 (Interior)	MHC50VF/S	C	65,000 A [4]	(1)1/0 750	15	Both	Yes
	MH50 (Enclosure)				(2)1/0 300			
	QON30LS400 (Interior)	MHC50QVF/S	No	65,000 A [4]	(1)1/0 750	15	Both	Yes
	MH50 (Enclosure)				(2)1/0 300			
	QON42LS400 (Interior)	MHC53QVF/S	No	65,000 A [4]	(1)1/0 750	17	Both	Yes
	MH53 (Enclosure)				(2)1/0 300			

1 Short circuit current rating depends on lowest AIR rating of main or branch circuit breaker installed.

2 UL Listed for 5000 A rms symmetrical short circuit rating when used in 3-phase, 240 Vac, corner grounded Delta systems, when used as main lugs load center **only**. Use 240 Vac circuit breakers only.

3 22,000 A rms symmetrical maximum when supplied by integral type QOM-VH main circuit breaker from Square D® with 22,000 A rms symmetrical minimum interrupting rating and when all installed QO® branch circuit breakers have 10,000 A rms symmetrical minimum interrupting rating.

4 UL Listed for 5000 A rms symmetrical short circuit rating when used on 3-phase, 240 Vac, corner grounded Delta systems. Use 240 Vac circuit breakers only.

B UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field-installed service disconnect.

C UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) when not more than six service disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard.

Single-Phase, Three-Wire, 120/240 Vac; Main Circuit Breaker Ind oor

Mains Rating in Amps	Load Center Catalog Number	Load Center Cover Catalog Number	UL Listed Service Equipment (See Notes)	Maximum UL Short Circuit Rating [1]	Main Wire Size AWG/kcmil Al/Cu	Enclosure No. (Page 26)	Top or Bottom Mains Position	UL Listed for Corner Grounded Delta Systems
Convertible Mains – Factory-Installed Main Circuit Breaker QOM1 Main Frame Size – Convertible to Main Lugs or Lower Amperage Main Circuit Breaker – Copper Bus								
100	QO112M100	QOC12UF/S	A, B	22,000 A [2]	#4 1	5	Both	No
	QO116M100	QOC20U100F/S	A, B	22,000 A [2]	#4 1	6	Both	
	QO120M100	QOC20U100F/S	A, B	22,000 A [2]	#4 1	6	Both	
	QO124M100	QOC24UF/S	A, B	22,000 A [2]	#4 1	7	Both	
	QO132M100	QOC32UF	A, B	22,000 A [2]	#4 1	8	Both	
125	QO124M125	QOC24UF/S	A, B	22,000 A [2]	#4 2/0	7	Both	No
	QO132M125	QOC32UF	A, B	22,000 A [2]	#4 2/0	8	Both	
Convertible Mains – Factory-Installed Main Circuit Breaker QOM2 Main Frame Size – Convertible to Main Lugs or Lower Amperage Main Circuit Breaker – Copper Bus								
150	QO12030M150	QOC30UF/S	A, B	22,000 A [2]	#4 250	9	Both	No
	QO124M150	QOC30UF/S	A, B	22,000 A [2]	#4 250	9	Both	
	QO130M150	QOC30UF/S	A, B	22,000 A [2]	#4 250	9	Both	
	QO132M150	QOC40UF/S	A, B	22,000 A [2]	#4 250	10	Both	
200	QO12040M200	QOC30UF/S	A, B	22,000 A [2]	#4 250	9	Both	No
	QO124M200	QOC30UF/S	A, B	22,000 A [2]	#4 250	9	Both	
	QO130M200	QOC30UF/S	A, B	22,000 A [2]	#4 250	9	Both	
	QO13040M200	QOC30UF/S	A, B	22,000 A [2]	#4 250	9	Both	
	QO140M200	QOC40UF/S	A, B	22,000 A [2]	#4 250	10	Both	
	QO142M200	QOC42UF/S	A, B	22,000 A [2]	#4 250	11	Both	
225	QO140M225	QOC42UF/S	A, B	22,000 A [2]	#4 300	11	Both	No
	QO142M225	QOC42UF/S	A, B	22,000 A [2]	#4 300	11	Both	
Fixed Mains – Factory-Installed Main Circuit Breaker								
300	QON42MS300	MHC68VF/S	A	42,000 A [3]	(1)#4 500	16	Both	Yes
	MH68 (Enclosure)				(2)#4 3 /0			
400	QON42MS400	MHC68VF/S	A	42,000 A [3]	(1)#4 600	16	Both	Yes
	MH68 (Enclosure)				(2)#4 250			

1 Short circuit current rating depends on lowest AIR rating of main or branch circuit breaker installed.

2 22,000 A rms symmetrical maximum when supplied by integral type QOM-VH main circuit breaker from Square D® with 22,000 A rms symmetrical minimum interrupting rating and when all installed QO® branch circuit breakers have 10,0000 A rms symmetrical minimum interrupting rating. 65,000 A rms symmetrical maximum when main lugs kits are installed.

3 UL Listed for 5000 A rms symmetrical short circuit current rating when used in 3-phase, 240 Vac, corner grounded Delta systems. Use 240 Vac circuit breakers only.

A UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with factory-installed service disconnect.

B UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field installed main lugs when not more than six disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See NEC Article for Lighting and Appliance Branch Circuit Panelboard.

QO® and Homeline® Load Centers and Enclosures
Technical Information

Single-Phase, Three-Wire, 120/240 Vac; Main Lugs Rainproof

Mains Rating in Amps	Load Center Catalog Number	Load Center Cover Catalog Number [1]	UL Listed Service Equipment (See Notes)	Maximum UL Short Circuit Rating [2]	Main Wire Size AWG/kcmil Al/Cu	Enclosure No. (Page 27)	Top or Bottom Mains Position	UL Listed for Corner Grounded Delta Systems
Fixed Mains – Factory-Installed Main Lugs								
40	QO2L40RB	Included	B	10,000 A	#12 6 #14 10	1R	Top	No
60	QO24L60NRNM	Included	B	10,000 A	#14 4	1NM	Top	No
70	QO24L70RB	Included	B	10,000 A	#12 3 #14 4	1R	Top	No
100	QO612L100RB	Included	B, C	10,000 A	#8 1	2R	Top	No
	QO612L100TRB	Included	B, C	10,000 A	#8 1	2R	Top	
	QO612L100RBCU	Included	B, C	10,000 A	#8 1	2R	Top	
100	QO816L100RB	Included	B, C	10,000 A	#8 1	2R	Top	No
	QO816L100RBCU	Included	B, C	10,000 A	#8 1	2R	Top	
125	QO148L125GRB	Included	B, C	10,000 A	#12 2/ 0 #14 2/ 0	15R	Top	No
Convertible Mains – Factory-Installed Main Lugs **QOM1 Main Frame Size – Convertible to Main Circuit Breaker – Copper Bus**								
125	QO112L125GRB	Included	B, C	65,000 A [3 4]	#6 2 /0	3R	Top	Yes
	QO11224L125GRB	Included	B, C	65,000 A [3 4]	#6 2 /0	3R	Top	
	QO11624L125GRB	Included	B, C	65,000 A [3 4]	#6 2 /0	4R	Top	
	QO124L125GRB	Included	B, C	65,000 A [3 4]	#6 2 /0	4R	Top	
Convertible Mains – Factory-Installed Main Lugs **QOM2 Main Frame Size – Convertible to Main Circuit Breaker – Copper Bus**								
150	QO130L150GRB	Included	B, C	65,000 A [3 4]	#6 250	6R	Top	Yes
200	QO112L200GRB	Included	B, C	65,000 A [3 4]	#6 250	5R	Top	Yes
	QO130L200GRB	Included	B, C	65,000 A [3 4]	#6 250	6R	Top	
	QO13040L200GRB	Included	B, C	65,000 A [3 4]	#6 250	6R	Top	
	QO140L200GRB	Included	B, C	65,000 A [3 4]	#6 250	7R	Top	Yes
225	QO142L225GRB	Included	B, C	65,000 A [3 4]	#6 300	8R	Top	Yes

1 Convertible mains load center has a side-hinge door. Allow 1.25 in. (32 mm) on the left side for the door to open.

2 Short circuit current rating depends on lowest AIR rating of main or branch circuit breaker installed.

3 UL Listed at 5000 A rms symmetrical short circuit current rating when used in 3-phase, corner grounded, Delta systems, when used as main lugs load center **only**. Use 240 Vac circuit breakers only.

4 22,000 A rms symmetrical maximum when supplied by integral type QOM-VH main circuit breaker from Square D® with 22,000 A rms symmetrical minimum interrupting rating and when all QO® installed branch circuit breakers have 10,000 A rms symmetrical minimum interrupting rating.

B UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field-installed service disconnect.

C UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) when not more than six service disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See NEC Article for Lighting and Appliance Branch Circuit Panelboard.

Single-Phase, Three-Wire, 120/240 Vac; Main Circuit Breaker Rainproof

Mains Rating in Amps	Load Center Catalog Number	Load Center Cover Catalog Number [1]	UL Listed Service Equipment (See Notes)	Maximum UL Short Circuit Rating [2]	Main Wire Size AWG/kcmil Al/Cu	Enclosure No. (Page 27)	Top or Bottom Mains Position	UL Listed for Corner Grounded Delta Systems
Convertible Mains – Factory-Installed Main Circuit Breaker QOM1 Main Frame Size – Convertible to Main Lugs or Lower Amperage Main Circuit Breaker – Copper Bus								
100	QO112M100RB	Included	A, D	22,000 A [3]	#6 2/0	3R	Top	No
	QO116M100RB	Included	A, D	22,000 A [3]	#6 2/0	4R	Top	
	QO120M100RB	Included	A, D	22,000 A [3]	#6 2/0	4R	Top	
125	QO124M125RB	Included	A, D	22,000 A [3]	#6 2/0	4R	Top	No
Convertible Mains – Factory-Installed Main Circuit Breaker QOM2 Main Frame Size – Convertible to Main Lugs or Lower Amperage Main Circuit Breaker – Copper Bus								
150	QO12030M150RB	Included	A, D	22,000 A [3]	#4 250	5R	Top	No
	QO130M150RB	Included	A, D	22,000 A [3]	#4 250	6R	Top	
200	QO12040M200RB	Included	A, D	22,000 A [3]	#4 250	5R	Top	No
	QO130M200RB	Included	A, D	22,000 A [3]	#4 250	6R	Top	
	QO140M200RB	Included	A, D	22,000 A [3]	#4 250	7R	Top	
Convertible Mains – Factory-Installed Main Circuit Breaker with Feed-Thru Lugs QOM1/QOM2 Frame Size – Convertible to Main Lugs or Lower Amperage Main Circuit Breaker – Copper Bus								
125	QO1612M125FTRB [4]	Included	A, D	22,000 A [3]	#4 2/0	3R	Top	No
150	QO1816M150FTRB [4]	Included	A, D	22,000 A [3]	#4 250	6R	Top	No
200	QO1816M200FTRB [4]	Included	A, D	22,000 A [3]	#4 250	6R	Top	No

1 Convertible mains load center has a side-hinge door. Allow 1.25 in. (32 mm) on the left side for the door to open.

2 Short circuit current rating depends on lowest AIR rating of main or branch circuit breaker installed.

3 22,000 A rms symmetrical maximum when supplied by integral type QOM-VH main circuit breaker from Square D® with 22,000 A rms symmetrical minimum interrupting rating and when all installed QO® branch circuit breakers have 10,000 A rms symmetrical minimum interrupting rating. 65,000 A rms symmetrical maximum when main lug kits installed.

4 QO1612M125FTRB provided with QOM1 frame main circuit breaker. QO1816M150/200FTRB provided with QOM2 frame main circuit breaker.

A UL Listed as suitable for use as service equipment (neutral bonded at time of installation) with factory-installed service disconnect.

D UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field-installed main lugs when not more than six service disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See NEC Article for Lighting and Appliance Branch Circuit Panelboard.

QO® Circuit Breaker Load Centers—Class 1130
Technical Information

3-Phase, 4-Wire, 208Y/120 Vac; 3-Phase, 4-Wire, 240/120 Vac, Delta;
3-Phase, 3-Wire, 240 Vac, Delta; Main Lugs, Main Circuit Breaker In door

Mains Rating in Amps	Load Center Catalog Number	Load Center Cover Catalog Number	UL Listed Service Equipment (See Notes)	Maximum UL Short Circuit Rating [1]	Main Wire Size AWG/kcmil Al/Cu		Enclosure No. (Page 26)	Top or Bottom Mains Position	UL Listed for Corner Grounded Delta Systems
Fixed Mains – Factory-Installed Main Lugs – Copper Bus									
60	QO403L60NF/S	Included	B	22,000 A [1]		#10-6	13	Top	No
125	QO312L125G [2]	QOC16UF/S	B, C	65,000 A [1]	#6 2 /0	#6 2/ 0	6	Both	No
	QO320L125G [2]	QOC24UF/S	B, C	65,000 A [1]	#6 2 /0	#6 2/ 0	7	Both	
	QO324L125G [2]	QOC24UF/S	B, C	65,000 A [1]	#6 2 /0	#6 2/ 0	7	Both	
200	QO318L200G [2]	QOC30UF/S	B, C	65,000 A [1]	#6 250	#6 2 50	9	Both	No
	QO330L200G [2]	QOC30UF/S	B, C	65,000 A [1]	#6 250	#6 2 50	9	Both	
225	QO342L225G [2]	QOC42UF/S	B	65,000 A [1]	#6 300	#6 3 00	11	Both	No
Convertible Mains – Factory-Installed QDL Main Circuit Breaker – Copper Bus									
100	QO327M100 [3]	QOC30UF/S	A, D	22,000 A	#4 2 /0	#4 2/ 0	9	Both	No
125	QO330MQ125 [2 4]	QOC342MQF/S	A, D	100,000 A [5 6]	#4 300	#4 3 00	12	H	No
150	QO330MQ150 [2 4]	QOC342MQF/S	A, D	100,000 A [5 6]	#4 300	#4 3 00	12	H	No
	QO342MQ150 [2 4]	QOC342MQF/S	A, D	100,000 A [5 6]	#4 300	#4 3 00	12	H	
200	QO330MQ200 [2 4]	QOC342MQF/S	A, D	100,000 A [5 6]	#4 300	#4 3 00	12	H	No
	QO342MQ200 [2 4]	QOC342MQF/S	A, D	100,000 A [5 6]	#4 300	#4 3 00	12	H	
225	QO342MQ225 [2 4]	QOC342MQF/S	A, D	100,000 A [5 6]	#4 300	#4 3 00	12	H	No

1 Short circuit current rating depends on lowest AIR rating of branch circuit breaker installed.

2 Certified to IEC 60439-1 for use on 415Y/240 Vac 3-phase 4-wire, 3,000 SCCR when QODX ... branch circuit breakers are used and 10,000 SCCR when QO...VS branch circuit breakers are used. CE marked.

3 Includes factory-installed back-fed QO3100VH main circuit breaker.

4 Mains positioning from top to bottom feed: first rotate the main circuit breaker 180 degrees, then rotate the complete load center 180 degrees.

5 100,000 A rms at 208 Vac symmetrical maximum when type QJL main circuit breaker from Square D® with 100,000 A rms minimum interrupting rating is installed and when all installed QO® and Q1 branch circuit breakers have 10,000 A rms symmetrical minimum interrupting rating.

6 25,000 A rms symmetrical maximum when supplied by integral type QDL main circuit breaker from Square D® with 25,000 A rms minimum interrupting rating and when all installed QO® and Q1 branch circuit breakers have 10,000 A rms symmetrical minimum interrupting rating.

A UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with factory-installed service disconnect.

B UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field-installed service disconnect.

C UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) when not more than six service disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See NEC Section 384-14.

D UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field-installed main lugs, when not more than six service disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See NEC Article for Lighting and Appliance Branch Circuit Panelboard.

Mains Rating in Amps	Load Center Catalog Number	Load Center Cover Catalog Number	UL Listed Service Equipment (See Notes)	Maximum UL Short Circuit Rating [1]	Main Wire Size AWG/kcmil Al/Cu	Enclosure No. (Pages 26 and 27)	Top or Bottom Mains Position	UL Listed for Corner Grounded Delta Systems
Load Center with Cover – 1-Phase, 3-Wire, 120/240 Vac – UL Listed; Complete QO® Load Center – Box, Interior and Combination Cover (in one package)								
Convertible Mains – Factory-Installed Main Lugs; QOM1 Main Frame Size – Convertible to Main Circuit Breaker – Copper Bus								
125	QO112L125GC	Included	B, C	65,000 A [2 3]	#4 2 /0	6	Both	Yes
	QO11224L125GC	Included	B, C	65,000 A [2 3]	#4 2 /0	6	Both	Yes
	QO120L125GC	Included	B, C	65,000 A [2 3]	#4 2 /0	7	Both	Yes
Convertible Mains – Factory-Installed Main Lugs; QOM2 Main Frame Size – Convertible to Main Circuit Breaker – Copper Bus								
150	QO130L150TC	Included	B, C	65,000 A [2 3]	#4 2 50	9	Both	Yes
200	QO13040L200GC	Included	B, C	65,000 A [2 3]	#4 2 50	9	Both	Yes
Convertible Mains – Factory-Installed Main Circuit Breaker – 22,000 RMS Symmetrical Amperes Short Circuit Current Rating QOM1 Main Frame Size – Convertible to Main Lugs – Copper Bus								
100	QO112M100C	Included	A, D	22,000 A [2]	#4-1/0	5	Both	Yes
	QO11220M100C	Included	A, D	22,000 A [2]	#4-1/0	5	Both	Yes
	QO116M100C	Included	A, D	22,000 A [2]	#4-1/0	6	Both	Yes
	QO120M100C	Included	A, D	22,000 A [2]	#4-1/0	6	Both	Yes
Convertible Mains – Factory-Installed Main Circuit Breaker – 22,000 RMS Sym. Amperes Short Circuit Current Rating QOM2 Main Frame Size – Convertible to Main Lugs – Copper Bus								
150	QO12030M150C	Included	A, D	22,000 A [2]	#4 2 50	9	Both	No
	QO130M150C	Included	A, D	22,000 A [2]	#4 2 50	9	Both	No
200 A	QO12040M200C	Included	A, D	22,000 A [2]	#4 2 50	9	Both	No
	QO130M200C	Included	A, D	22,000 A [2]	#4 2 50	9	Both	No
	QO13040M200C	Included	A, D	22,000 A [2]	#4 2 50	9	Both	No
	QO140M200C	Included	A, D	22,000 A [2]	#4 2 50	10	Both	No
Non-Metallic 1-Phase, 3-Wire, 120/240 Vac – Main Lugs Only								
60	QO24L60NRNM	Included	B, C	10,000 A	#14 4	1NM	Bottom	No
Riser , 1-Phase, 3-Wire, 120/240 Vac – Factory-Installed Main Lugs – Offset Interior Wide Gutter QOM1/QOM2 [4] Main Frame Size – Convertible to Main Circuit Breaker – Copper Bus [3]								
125	QO11224L125WG	QOC20UFWG	B, C	65,000 A [2]	#4 2 /0	14	Both	Yes
	QO12030L125WG		B	65,000 A [2]	#4 2 /0	14	Both	
200	QO13040L200WG	QOC30UFW	B, C	65,000 A	#4 2 50	23	Both	Yes
Generator Panel, 1-Phase, 3-Wire, 120/240 Vac – Factory-Installed Main Circuit Breakers with Mechanical Interlock								
30	QO48M30DSGP	Included	No	10,000 A	#14 8	4	Bottom	No
60	QO48M60DSGP		A	10,000 A	#8 2	4	Bottom	
Generator Panel - Use with Automatic Transfer Switch, 1-Phase, 3-Wire, 120 / 240 Vac, Factory- / Field-Installed Main Circuit Breaker – 22,000 RMS Sym. Amperes Short Circuit Current Rating [5]								
150	QO13842MX150	QOC38MXUF	A	22,000 A	#4-250	12	Both	No
200	QO13842MX200		A	22,000 A	#4-250	12	Both	No
225	QO13842MX225		A	22,000 A	#4-250	12	Both	No
	QO13842UX225		B	22,000 A	#4-250	12	Both	No
150	QO11428MX150FTRB[6]	Included	A	22,000 A	#4-250	7R	Both	No
200	QO11428MX200FTRB[6]	Included	A	22,000 A	#4-250	7R	Both	No
	QO11428UX200FTRB[6]	Included	B	22,000 A	#4-250	7R	Both	No

1 Short circuit current rating depends on lowest AIR rating of main or branch circuit breaker installed.

2 22,000 A rms symmetrical maximum when supplied by integral type QOM-VH main circuit breaker from Square D® with 22,000 A rms symmetrical minimum interrupting rating and when all installed QO® branch circuit breakers have 10,000 A rms symmetrical minimum interrupting rating.

3 UL Listed for 5000 A rms symmetrical short circuit rating when used in 3-phase, 240 Vac, corner grounded Delta systems, when used as main lugs load center **only**. Use QO-H 240 Vac circuit breakers only.

4 QOM2 Load Center is ONLY convertible to main circuit breaker when used with QOC cover.

5 One main circuit breaker is included with panel. Alternate source main circuit breaker (QO 125 A max.) must be ordered separately. Automatic transfer switch and generator kit for secondary power sources are ordered through a Kohler® authorized dealer or contractor.

6 Side-hinge door device allow 1.25 in. (32mm) on the left side for the door to open.

A UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with factory-installed service disconnect.

B UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field-installed service disconnect.

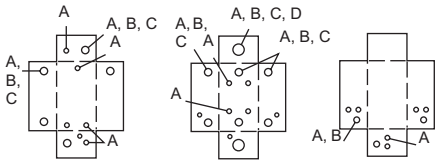
C UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) when not more than six service disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See NEC Article for Lighting and Appliance Branch Circuit Panelboard.

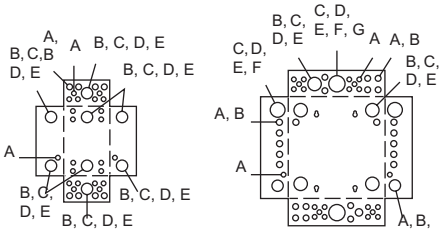
D UL Listed as suitable for use as service equipment (neutral bonded at the time of installation) with field-installed main lugs and not more than six service disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See NEC Article for Lighting and Appliance Branch Circuit Panelboard.

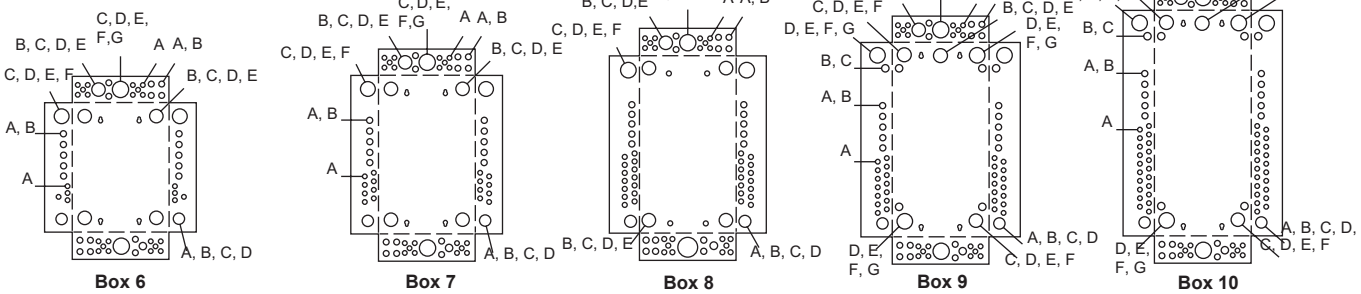
Indoor Dimensions						
Box No.	W		H		D	
	in.	mm	in.	mm	in.	mm
1	3.81	97	6.72	171	3.00	76
2	4.81	122	9.30	236	3.19	81
3	4.81	122	9.30	236	3.19	81
4	8.88	226	12.57	319	3.80	97
5	14.25	362	14.92	379	3.75	95
6	14.25	362	17.92	455	3.75	95
7	14.25	362	20.92	531	3.75	95
8	14.25	362	26.04	661	3.75	95
9	14.25	362	29.86	758	3.75	95
10	14.25	362	33.78	858	3.75	95
11	14.25	362	37.98	965	3.75	95
12	14.25	362	39.37	1000	3.75	95

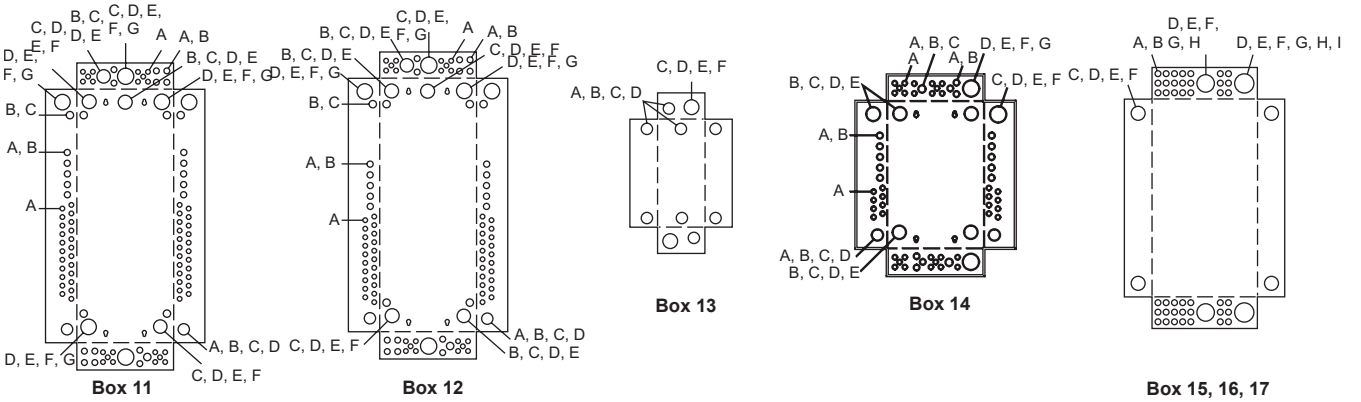
Indoor Dimensions						
Box No.	W		H		D	
	in.	mm	in.	mm	in.	mm
13	5.88	149	13.12	333	3.38	86
14	14.25	362	20.92	531	3.75	95
15	20.00	508	50.00	1270	5.75	146
16	20.00	508	68.00	1727	5.75	146
17	20.00	508	53.00	1346	5.75	146
18	5.88	149	16.12	409	3.38	86
19	7.56	192	23.12	587	4.25	108
20	9.62	244	26.12	663	4.75	121
21	8.88	226	14.80	376	3.80	97
22	8.55	217	23.92	608	3.95	100
23	14.25	362	29.86	758	3.75	95

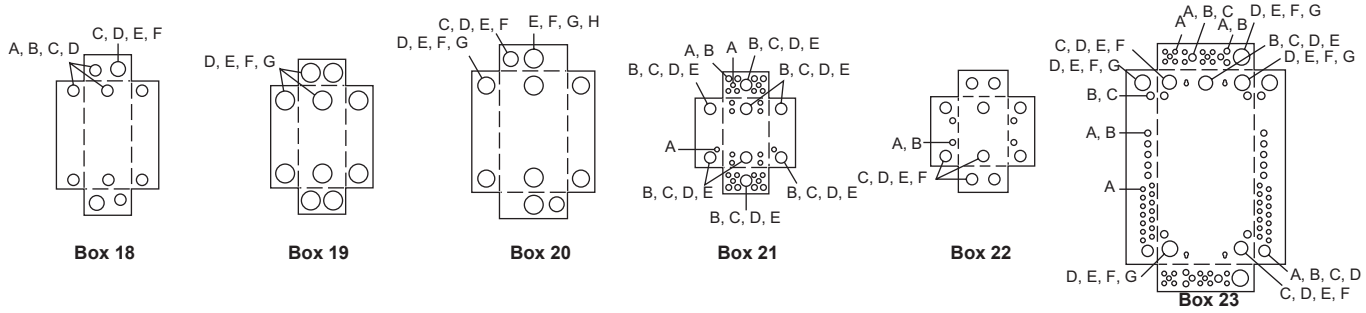
Knockouts									
Symbol	A	B	C	D	E	F	G	H	I
Conduit Size	0.50 in. 13 mm	0.75 in. 19 mm	1.00 in. 25 mm	1.25 in. 32 mm	1.50 in. 38 mm	2.00 in. 51 mm	2.50 in. 64 mm	3.00 in. 76 mm	3.50 in. 89 mm



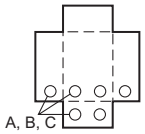




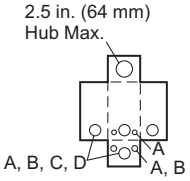




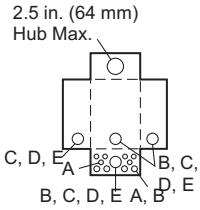
OUTDOOR DIMENSIONS AND KNOCKOUTS



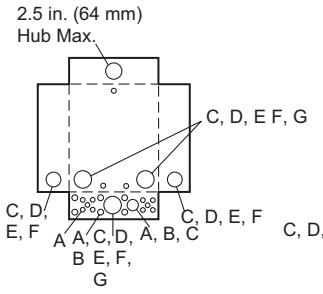
Box 1NM



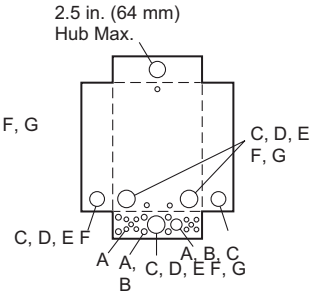
Box 1R



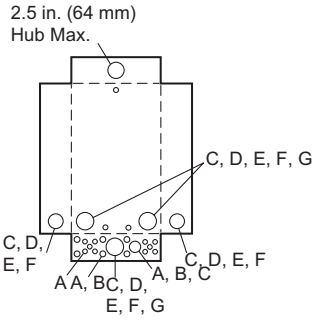
Box 2R



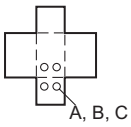
Box 3R, 4R



Box 5R



Box 6R, 7R, 8R



Box 9R

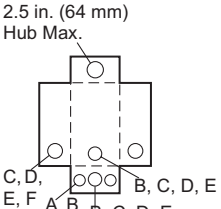
Box No.	W		H		D	
	in.	mm	in.	mm	in.	mm
1NM	6.52	166	8.79	223	3.90	99
1R[1]	4.88	124	9.38	238	4.00	102
2R	8.88	226	12.65	321	4.27	108
3R	14.75	375	18.92	481	4.52	115
4R	14.75	375	22.06	560	4.52	115
5R	14.75	375	26.04	661	4.52	115
6R	14.75	375	29.86	758	4.52	115
7R	14.75	375	33.78	858	4.52	115
8R	14.75	375	37.98	965	4.52	115
9R	4.56	116	6.50	165	3.88	99
10R	6.92	176	13.18	335	4.12	105
11R	7.56	192	192	590	4.75	121
12R	9.62	244	26.24	666	5.50	140
13R	6.92	176	16.18	411	4.12	105
14R	14.75	375	39.37	1000	4.52	115
15R	8.88	226	14.80	376	4.27	108
16R	8.55	217	24.75	629	4.16	106

Outdoor Dimensions

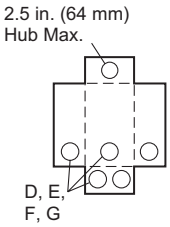
[1] HOME250SPA top endwall has no hub opening.

Symbol	A	B	C	D	E	F	G	H
Conduit Size	0.50 in. 13 mm	0.75 in. 19 mm	1.00 in. 25 mm	1.25 in. 32 mm	1.50 in. 38 mm	2.00 in. 51 mm	2.50 in. 64 mm	3.00 in. 76 mm

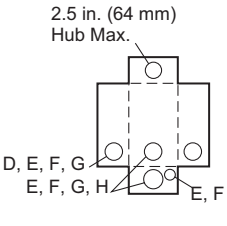
Knockouts



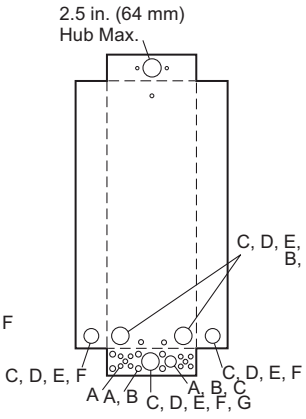
Box 10R, 13R



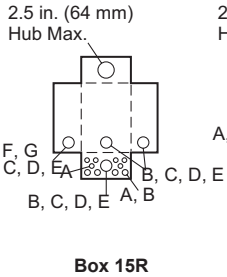
Box 11R



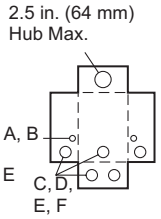
Box 12R



Box 14R



Box 15R



Box 16R

QO SINGLE-PHASE LABELS

The labels below represent typical labels. Information may not be applicable or may change without notice. See the actual label in the load center for the latest information.

QO Single-Phase Box Label Sample

Number of circuits maximum.
Enclosure catalog number.
Catalog number of covers; flush or surface.
See panelboard interior for the catalog number.
Voltage ratings.
Amperage rating.

Wire range for lug torque data table.

Short circuit ratings.
Short circuit ratings and additional of replacement circuit breakers.

UL Listing.

QO® LOAD CENTER

See Panelboard interior for Catalog No.
Box Cat. No. / Caja No. de Catalogo: BX18C
Use Cover Cat. No. /
Utilice la Cubierta No. de Catalogo: QOC16US or/or QOC16UF
Mains 125A max.
Lina principal de 125A maximo.
See main or service disconnect rating if installed.
240 V ~ Max. 1Ø, 50 / 60 Hz.
24 circuit max. / 24 circuitos maximo.
Type 1 Enclosure
Gabinete Tipo 1
For installation, repairs or alterations, Call an electrical contractor or electrician.

LUG TORQUE DATA

See circuit breakers and field installed units for wire binding screw torque

	Wire Range (AWG/kcmil)	Torque (in/lbs.)
Line Neutral Lug	4 - 2/0 CU/AL	50
Main Lug	6 - 2/0 CU/AL	50
Alternate Main Breaker	See Main Breaker	See Main Breaker

Branch Neutral and Equipment Ground Bar

Wire Range (AWG)	Torque (in./lbs.)		Bar with 1 screw size
	Bar with 2 screw sizes		
1/0 - 3 CU / AL	Large 50	Small	
4 CU / AL	Large 45	Small	35
6 CU / AL	Large 45	Small 25	35
8 CU / AL	Large 40	Small 10	25
10-14 CU, 10-12 AL	Large 35	Small 10	20

Equipment Ground Combinations

Two 14 or 12 CU, Two 12 AL	35	10	25
Two 10 AL	35		25

SHORT CIRCUIT RATING
RMS Symmetrical Amperes at 120 / 240 V ~ Maximum

Panel Rating	Remote Main	Integral Main	Branch (min.)/ Cat. prefix
*65,000	----	Lugs	65,000 / QH
*42,000	----	Lugs	42,000 / QOH
*22,000	----	Lugs	22,000 / OQ.VH
*10,000	----	Lugs	10,000 / OO, QOT & Q1
**5,000	----	Lugs	5,000 / QO...H (2 pole)
100,000	--100-200A,300V T Fuse	Lugs	10,000 / QO & QOT
42,0000	QOH	Lugs	10,000 / QO & QOT
22,000	Q2...H, KD, QO...VH	Lugs	10,000 / QO & QOT
65,000	KG	Lugs	10,000 / QO & QOT
22,000	----	QOM...VH	10,000 / QO, QOT & Q1

** 240 v ~ 3Ph. 3W. Grounded B" phase requires 240 V ~ branch breakers.
* The rating is equal to the lowest interrupting rating of any circuit breaker installed. Refer to branch breaker for individual ratings. Additional or replacement branch circuit breakers, main breaker, or service disconnect MUST have an interrupting rating equal to or greater than that of the circuit breaker with the lowest interrupting rating presently installed. See panelboard interior for breaker types.

Underwriter's Laboratories, Inc.®
LISTED
Electric
Cabinet Box
Issue No. V-2813

Install loose label with Spanish translation on back of cover.
Adhiera la etiqueta suelta con las traducciones en espanol en la parte posterior del frente.
Please read information before installing
Por favor lea la informacion antes de instalar.

SQUARE D COMPANY®

001021 15 40265-381-03

QO Single-Phase Wiring Diagram Sample

Service Equipment marking.
Use of unused neutral branch terminal for equipment grounding, service equipment application only.

Installation of back-fed main circuit breaker and required kit.
Alternate wiring diagram for main circuit breaker or main lug.

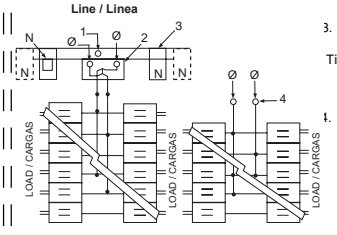
Type of circuit breakers from Square D that may be used in this panelboard.

Load center accessories.
Neutral lug for 1/0 AWG or larger wire.

Suitable for use with 75ºC Copper or Aluminum main conductors. See branch breakers for branch wire ratings.

* Suitable for use as service equipment when service disconnect (main breaker) is installed.
* Suitable for use as service equipment when not more than six main disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See Article 384-14 of the NEC.
* When used as service equipment, all unused neutral terminals may be used for terminating equipment ground wires.

1. Box bonding when required. / Conexion a la caja cuando fuese necesario.
2. Main breaker type: QOM1 or QOM1A. / Interruptor automatico principal tipo: QOM1 o QOM1A.



3. Service ground when required. / Tierra de acometida cuando fuese necesario
4. Main lugs kit no: QOL125. / No. de accesorio de las zapatas principales: QOL125.

Two single poles. One plug on space or may use one single pole. One two pole requires two spaces.
Torque Note: When main breaker or main lug connector mounting nuts are loosened or removed, retighten to 75 lbs./in. torque.

Equipment Grounding Terminals

Load Center Accessories - Kits

PK4MB2LA	Back-fed Main Cir. Brkr. Retaining
QO2175SB	Plug-0n Surge Arrestor *
SDSA1175	1 Phase Surge Arrestor
QOSAMK	SDSA1175 Mounting Bracket
QOL2125	1 Phase Plug-on Subfeed Lugs *
PK9--27GTA(L)	Equipment Ground Bar
PKGTAB	Equipment Ground Bar Insulator
LK70AN	70A Max. Neutral Lug
LK100AN	125A Max. Neutral Lug
QOL125	Main Lugs
PK6FL	Indoor Cover Lock

* May plug on two adjacent spaces.
Torque Note: When interior mounting screw is loosened or removed, retighten to 35 lbs./in.

SQUARE D COMPANY®

Made in U.S.A. 15 40265-668-02

QO THREE-PHASE LABEL SAMPLES

The labels below represent typical labels. Information may not be applicable or may change without notice. See the actual label in the load center for the latest information.

QO Three-Phase Box Label Sample

Number of circuits maximum.
Enclosure catalog number.
Catalog number of covers; flush or surface.
See panelboard interior for the catalog number.
Voltage ratings.
Amperage rating.

Wire range for lug torque data table.

Short circuit ratings.
Short circuit ratings and additional of replacement circuit breakers.

UL Listing.

QO® LOAD CENTER
See Panelboard interior for Catalog No.
Box Cat. No. / Caja No. de Catalogo:
BX338C
Use Cover Cat. No. /
Utilice la Cubierta No. de Catalogo:
QOC42US or/or QOC42UF
Mains 225A / Lina principal de 225A maximo.
See main or service disconnect rating if installed.
240 V ~ Max. 3Ø, 50 / 60 Hz.
42 circuit max. / 42 circuitos maximo.
Type 1 Enclosure
Gabinete Tipo 1
240V, 3PH, 3W: For this system neutral is not used and only breakers rated 240V are to be used.
240V, 3PH, 4W: When wired for delta system, phase "B" must be 208V to neutral. Breaker poles connected to phase "B" must be rated 240V.
1PH: Single pole breakers can not be connected to phase B.

LUG TORQUE DATA
See circuit breakers and field installed units for wire binding screw torque

	Wire Range (AWG/kcmil)	Torque (in/lbs.)
Line Neutral Lug	4 - 300 CU/AL	250
Main Lug	4 - 300 CU/AL	250
Alternate Main Breaker	See Main Breaker	See Main Breaker

Branch Neutral and Equipment Ground Bar

Wire Range (AWG)	Torque (in./lbs.) Bar with 2 screw sizes		Bar with 1 screw size
1/0 - 3 CU / AL	Large 50	Small	
4 CU / AL	Large 45	Small	35
6 CU / AL	Large 45	Small 25	35
8 CU / AL	Large 40	Small 10	25
10-14 CU, 10-12 AL	Large 35	Small 10	20

Equipment Ground Combinations

Two 14 or 12 CU, Two 12 AL	35	10	25
Two 10 AL	35		25

SHORT CIRCUIT RATING
RMS Symmetrical Amperes at 120 / 240 V ~ Maximum

Panel Rating	Remote Main	Integral Main	Branch (min.)/ Cat. prefix
*65,000	----	Lugs	65,000 / QH
*42,000	----	Lugs	42,000 / QOH
*22,000	----	Lugs	22,000 / OQ.VH
*10,000	----	Lugs	10,000 / OO&Q1,QO...H
**5,000	----	Lugs	5,000 / QO...H(2 POLE)
100,000	100-200A,300V T Fuse	Lugs	10,000 / QO
22,000	KD, QO...VH	Lugs	10,000 / QO
22,000	Q2...H	Lugs	10,000 / QO (10A-60A)
65,000	KG	Lugs	10,000 / QO
65,000	----	KG	10,000 QO&Q1
22,000	----	KD	10,000 QO&Q1
22,000	----	QO...VH	10,000 / QO

** 240 v ~ 3Ph. 3W. Grounded "B" phase requires 240 V ~ branch breakers.
* The rating is equal to the lowest interrupting rating of any circuit breaker installed. Refer to branch breaker for individual ratings. Additional or replacement branch circuit breakers, main breaker, or service disconnect MUST have an interrupting rating equal to or greater than that of the circuit breaker with the lowest interrupting rating presently installed. See panelboard interior for breaker types.

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Electric
Cabinet Box
Issue No. V-2813

For installation, repairs or alterations,
Call an electrical contractor or electrician.
Install loose label with Spanish translation on back of cover.
Adhiera la etiqueta sauelat con la traduccion en Español en la parte posterior de la cubierta.
Please read information before installing.
Por favor lea la informácion antes de instalor.

SQUARE D COMPANY®
001021 15 40265-381-03

QO Three-Phase Wiring Diagram Sample

Service Equipment marking.
Use of unused neutral branch terminal for equipment grounding, service equipment application only.

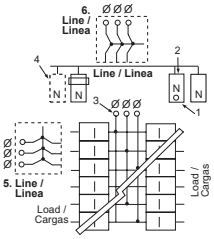
Alternate wiring diagram for main circuit breaker or main lug.
Installation of back-fed main circuit breaker and required kit.

Type of circuit breakers from Square D that may be used in this panelboard.

Load center accessories.
Neutral lug for 1/0 AWG or larger wire.

Suitable for use with 75ºC Copper or Aluminum main conductors. See branch breakers for branch wire ratings.

* Suitable for use as service equipment when service disconnect (main breaker) is installed.
* Suitable for use as service equipment when not more than six main disconnecting means are provided and when not used as a lighting and appliance branch circuit panelboard. See Article 384-14 of the NEC.
* When used as service equipment, all unused neutral terminals may be used for terminating equipment ground wires.



1. Box bonding when required. / Conexión a la caja cuando fuese necesario.
2. Service ground when required. / Tierra de acometida cuando fuese necesario
3. Main lugs kit no: QOL3225. / No. de accesorio de las zapatas principales: QOL3225.
4. Lug kit when installed. / Accesorio de la zapata, cuando se instala.
5. Back fed main circuit breaker when installed. / Interruptor automático principal de alimentación posterior, cuando se instala.
6. Integral main circuit breaker when installed. / Interruptor automático integral principal, cuando se instala.

One single pole. One plug on space. One two pole requires two plug on spaces. One three pole requires three plug on spaces.

Torque Note: When main breaker or main lug connector mounting nuts are loosened or removed, retighten to 75 lbs./in. torque.

Equipment Grounding Terminals

Load Center Accessories - Kits

PK3MB	Back-fed Main Cir. Brkr. Retaining
SDSA3650	3 Phase Surge Arrestor
QO60SL	1 Phase Plug-on Subfeed Lugs *
QO2125SL	1 Phase Plug-on Subfeed Lugs *
QO3125SL	3 Phase Plug-on Subfeed Lugs +
PK9-27GTA(L)	Equipment Ground Bar
PKGTAB	Equipment Ground Bar Insulator
LK100AN	125A Max. Neutral Lug
LK150AN	150A Max. Neutral Lug
QOL3225	Main Lugs
PK6FL	Indoor Cover Lock

* May plug on two adjacent spaces.
+ May plug on three adjacent spaces.

Torque Note: When interior or main breaker mounting screws are loosened or removed, retighten to 35 lbs./in.

SQUARE D COMPANY®
Made in U.S.A. 15 40265-545-01

WIRING DIAGRAMS

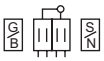
QO2L30S
QO2L40RB

QO2L30TTS

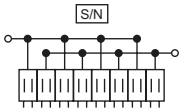
QO24L60NRNM

QO24L70F/S
QO24L70RB

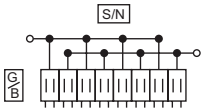
QO24L70TS



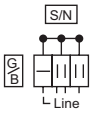
QO24L50TTS



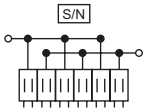
QO816L100F/S
QO816L100DF/S
QO816L100DFCU/SCU
QO816L100RB
QO816L100RBCU



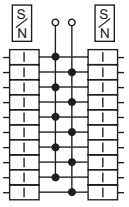
QO816L100TF/S
QO816L100DTF/S



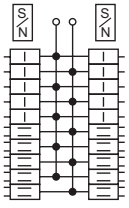
QO35FM30TTF/S



QO612L100F/S
QO612L100DF/S
QO612L100DFCU/SCU
QO612L100RB
QO612L100RBCU



QO120L125G
QO120L125GC



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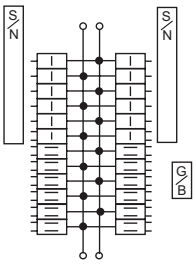

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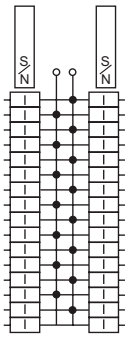

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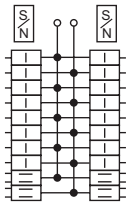

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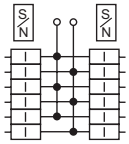

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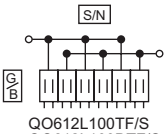

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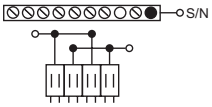
QO612L100TRB



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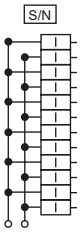

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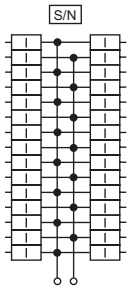

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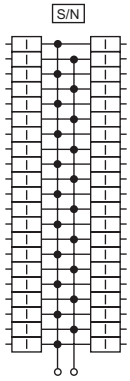

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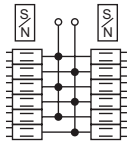

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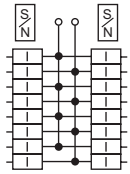

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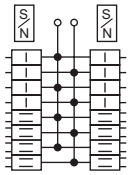

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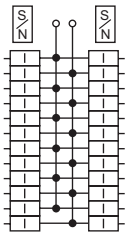

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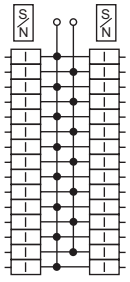

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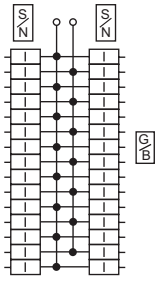

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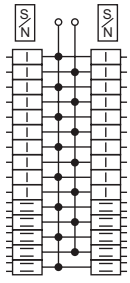

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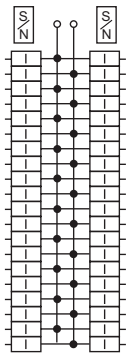

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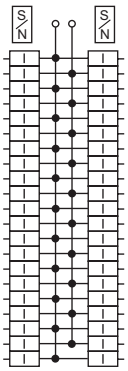

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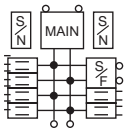
1-Phase, 3-Wire Main Lugs



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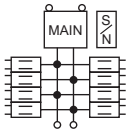

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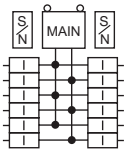

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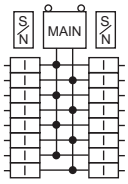

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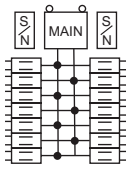

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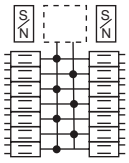

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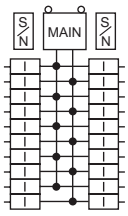

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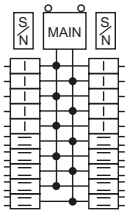

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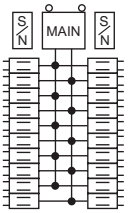

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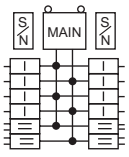

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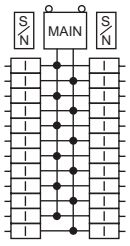

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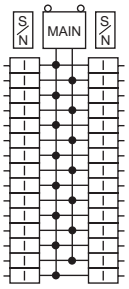

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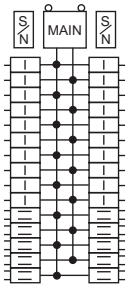

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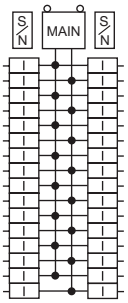

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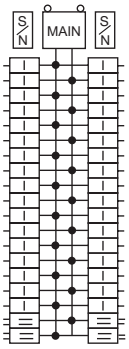

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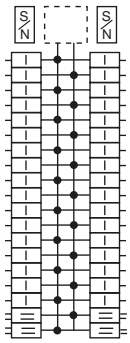

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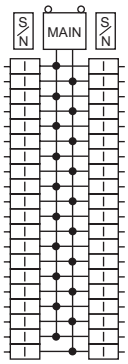

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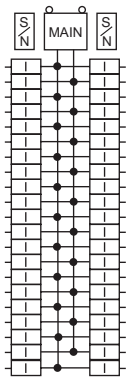

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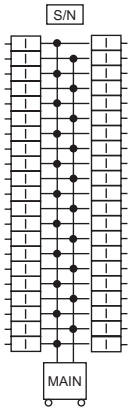

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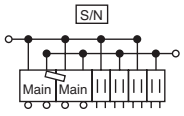

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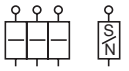
1-Phase, 3-Wire Main Circuit Breakers



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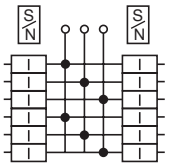

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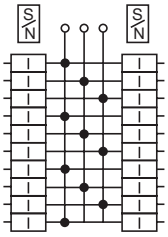

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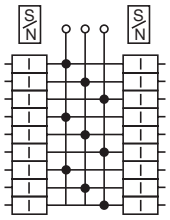

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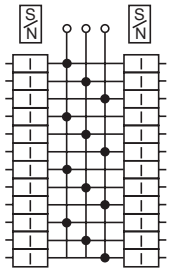

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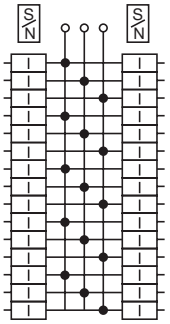

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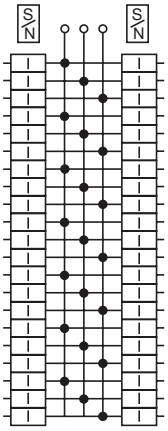

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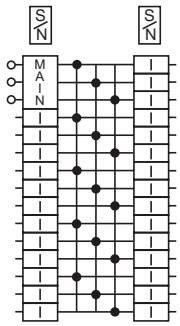
3-Phase, 4-Wire Main Lugs



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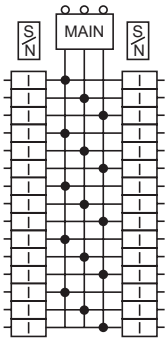

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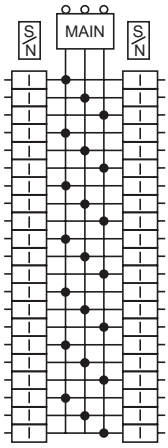
QO330MQ150
QO330MQ200
QO330MQ125RB
QO330MQ150RB
QO330MQ200RB



QO342MQ150
QO342MQ200
QO342MQ225
QO342MQ200RB
QO342MQ225RB

3-Phase, 4-Wire Main Circuit Breakers

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NOTE: For information on Replacement Parts with specific part numbers, go to www.schneider-electric.us, click on Product FAQ's, enter the device catalog number, click SEARCH, then look for the information required.

QO2100BNS

QO2100BNRB

QOM22225NRB

Q22200NS
With Cover Removed
(Order Q-Frame Circuit Breaker Separately)

GENERAL INFORMATION AND APPLICATION DATA

Type

Enclosed molded case circuit breakers are UL® Listed; File E136861, for enclosures and File E10027 for circuit breakers.

Molded case circuit breakers meet Federal Specifications W-C-375-B.

Enclosed molded case switches are UL Listed under File E59921.

Service

120/240 Vac, 1ϕ3W
240 Vac, 1ϕ2W
240 Vac, 1ϕ3W
240/120 Vac, 3ϕ4W
208Y/120 Vac, 3ϕ4W

Ratings

Enclosed Molded Case Circuit Breakers	
QO	10,000 A
QOM2	22,000 A
QB	10,000 A
QD	25,000 A
QG	65,000 A
QJ	65,000 A @ 240 V or 100,000 A @ 208Y / 120

Enclosure

Type 1 indoor general purpose

Welded sheet steel with knockouts at top, bottom, back and sides

Finish: gray baked enamel, electrodeposited over cleaned, phosphatized steel

Padlock provisions for locking circuit breaker handle in ON (I) or OFF (O) position

Flush or surface mount covers

Type 3R Rainproof

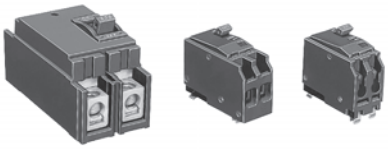
Welded, galvannealed sheet steel

Finish: gray baked enamel, electrodeposited over cleaned, phosphatized, galvannealed steel

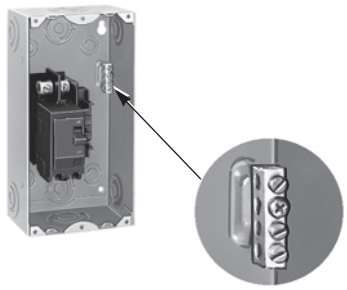
Provisions to padlock cover closed

RB devices have provisions for interchangeable bolt-on hubs

QOM2200VH



Circuit Breakers



Factory-installed equipment grounding bar.

PKOGTA2 field installed.

Circuit Breakers

Visi-Trip® indication (QO® circuit breakers)

Lugs suitable for aluminum or copper wire
(refer to catalog sections listed below:)

QO	Class 730
QB, QD, QG and QJ	Class 734
QOM2	Class 736
Molded-case switches	Class 601

Knockouts

Located in back, side and bottom of all devices

Equipment Grounding Bar

Field-installable PKOGTA2

Suitable for #6 AWG 2/0 aluminum or #10 AWG 2/0 AWG copper wire

Neutral Assemblies

Insulated, groundable (except QO2TR)

Suitable for aluminum or copper wire

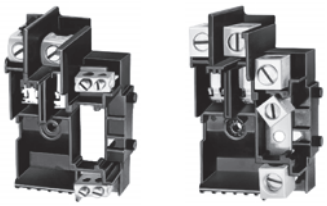
Grounding terminal provided

Bolt-On Hubs

Hubs available from 0.75 in. (19 mm) to 2.50 in. (64 mm) conduit size

Off-center thread openings keep conduit close to wall

No gasket required with hubs



QO Base Assemblies

QOM2 Base

Neutral Assemblies

Hubs

TECHNICAL INFORMATION

Enclosed Molded-Case Circuit Breaker Ratings

Service	Rating in Amperes	Enclosure		Enclosure No. (Page 37)	Circuit Breaker [1]			Neutral Assembly Terminal Wire Size AWG/kcmil	
		Type 1 Catalog Number	Type 3R Catalog Number		Catalog Number	UL® Listed Interrupting Rating in RMS Amps Symmetrical	Terminal Lug Wire Size AWG/kcmil	Neutral Terminals	Grounding Terminals
Enclosed Circuit Breaker Mounting Base									
 240 Vac	60 A [2]		QO2TR [3]	1R	QO210 to QO260	10,000 AIR	#14 4 Al or Cu [4]		#14 8 Al or Cu
Enclosed Circuit Breakers									
 120/240 Vac	100 A	QO2100BNF/S [5]	QO2100BNRB [5]	1, 2R	QO QO-PL QO-GFI	10,000 AIR	#12 1 Al or #14 1 Cu	#12 1 Al or #14 1 Cu	#12 2 Al or #14 2 Cu
					QO-VH	22,000 AIR			
	125 A	QO2125BNF/S [5]	QO2125BNRB [5]	2, 3R	QO QO-PL QO-GFI	10,000 AIR	#12 2/ 0 Al #14 2/0 Cu	#12 2/0 Al #14 2 /0 Cu	
					QO-VH	22,000 AIR			
	100-225 A	QOM22225NF/S [6]	QOM22225NRB [6]	6, 6R	QOM2-VH	22,000 AIR	4 - #4 2 50 kcmil Al/Cu	2 - #4 25 0 kcmil 4 - #14 2/ 0 Al or Cu	2 - #6 2 /0 Al 2 - #10 2/0 Cu
 240 Vac	100 A	QO3100BNF/S [5]	QO3100BNRB [5]	1, 2R	QO QO-PL QO-GFI	10,000 AIR	#12 1 Al or #14 1 Cu	#12 1 Al or #14 1 Cu	#12 2 Al or #14 2 Cu
					QO-VH	22,000 AIR			
 2-pole 240 Vac Max.	100-225 A	Q22200NS [7] [8]	Q22200NRB [7] [8]	3, 4R	QBL QDL QGL QJL	10,000 AIR 25,000 AIR 65,000 AIR 100,000 AIR	#4 300 Al or Cu	#4 2 50 Al or Cu	#12 1/ 0 Al or #14 1/0 Cu
		Q23225NF/S [8]	Q23225NRB [8]	4, 5R				#4 3 00 Al or Cu	
 3-pole 240 Vac	100-225 A	Q23225NF/S [8]	Q23225NRB [8]	4, 5R	QBL QDL QGL QJL	10,000 AIR 25,000 AIR 65,000 AIR 100,000 AIR [9]		#4 3 00 Al or Cu	

1 Order circuit breaker separately.

2 Not suitable for service equipment.

3 Top endwall has no hub opening; back and bottom feed only.

4 Load terminals use #6 maximum.

5 Enclosures will accept QO circuit breakers with factory-installed accessories.

6 Enclosure will accept QOM2 circuit breaker with factory-installed accessories.

7 Accepts 200 A maximum, 2-pole Q-frame circuit breakers.

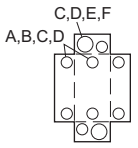
8 Equipment grounding kit factory-installed.

9 When these 3-pole circuit breakers are mounted in an enclosure, the maximum AIR rating is 65,000 at 240 Vac and 100,000 at 208 Vac.

DIMENSIONS AND KNOCKOUTS

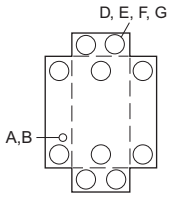
Dimensions						
Enclosure No.	W		H		D	
	in.	mm	in.	mm	in.	mm
1	5.88	149	13.12	333	3.38	86
2	5.88	149	16.12	409	3.38	86
1R	4.56	116	6.50	165	3.88	99
2R	6.92	176	13.12	333	4.12	105
3R	6.92	176	16.12	409	4.12	105
3	7.56	192	23.12	587	4.25	108
4	9.62	244	26.12	663	4.75	121
4R	7.56	192	23.24	590	4.75	121
5R	9.62	244	26.24	666	5.50	140
6	8.55	217	23.92	608	3.95	100
6R	8.55	217	24.75	629	4.16	106

Knockouts								
Symbol	A	B	C	D	E	F	G	H
Conduit Size	0.50 in. 13 mm	0.75 in. 19 mm	1.00 in. 25 mm	1.25 in. 32 mm	1.50 in. 38 mm	2.00 in. 51 mm	2.50 in. 64 mm	3.00 in. 76 mm

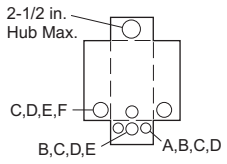


Box 1, 2

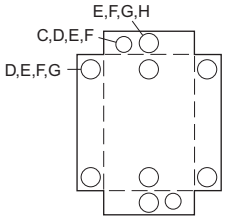
Box 1R



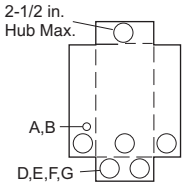
Box 3



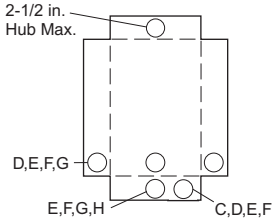
Box 2R, 3R



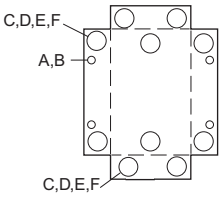
Box 4



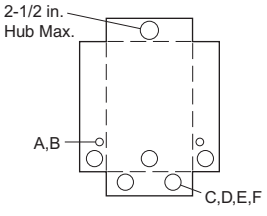
Box 4R



Box 5R



Box 6



Box 6R

Outdoor Dimensions and Knockouts

THERMOLEC

Certificate of Compliance

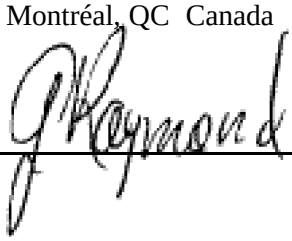
Certificate Number: LR 30551-1

Revision: LR 30551-35

Issued to: **THERMOLEC LTÉE/LTD**
2060 Place Thimens
St-Laurent, Québec
H4R 1L1

The products listed below are eligible to bear the CSA Mark
NOTE: The "NRTL/C" indicator also appears adjacent to the CSA Mark.

Issued by: G. Raymond, Eng.
Montréal, QC Canada

Signature: 

PRODUCTS

CLASS 2811 03 - HEATERS - Air - Stationary Type
CLASS 2811 83 - HEATERS - Air - Stationary Type - CERTIFIED TO U.S. STANDARDS

Open coil duct heaters for horizontal or vertical air flow, rated up to 600V, 60Hz, 1 or 3 phases, 1000KW and less: With temperature limiting controls, Series SC (slip-in) and FC(flanged); Without temperature Controls (construction evaluation only) Series FE and SE.

APPLICABLE STANDARDS

CSA Std C22.2	No.	155-M1986	-	Electric Duct Heaters
UL std. No.		1996	-	Electric Duct Heaters

*The "NRTL/C" indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

THERMOLEC

Certificate of Compliance

Certificate Number: LR 30551-27

Revision: LR 30551-35

Issued to: **THERMOLEC LTÉE/LTD**
2060 Place Thimens
St-Laurent, Québec
H4R 1L1

The products listed below are eligible to bear the CSA Mark
NOTE: The "NRTL/C" indicator also appears adjacent to the CSA Mark.

Issued by: G. Raymond, Eng.
Montréal, QC Canada

Signature: G. Raymond

PRODUCTS

CLASS 2811 03 - HEATERS - Air - Stationary Type
CLASS 2811 83 - HEATERS - Air - Stationary Type - CERTIFIED TO U.S. STANDARDS

Duct heaters with Sheathed Elements, for horizontal or vertical air flow, rated up to 600V, 60Hz, 1 or 3 phases, 1000KW and less: With temperature limiting controls, Series FT (flange mount) and ST (slip-in); without limit controls, series TFE (flange mount) and TSE (slip-in).

APPLICABLE STANDARDS

CSA Std C22.2	No.	155-M1986	-	Electric Duct Heaters
UL std. No.		1996	-	Electric Duct Heaters

*The "NRTL/C" indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

THERMOLEC FEATURES

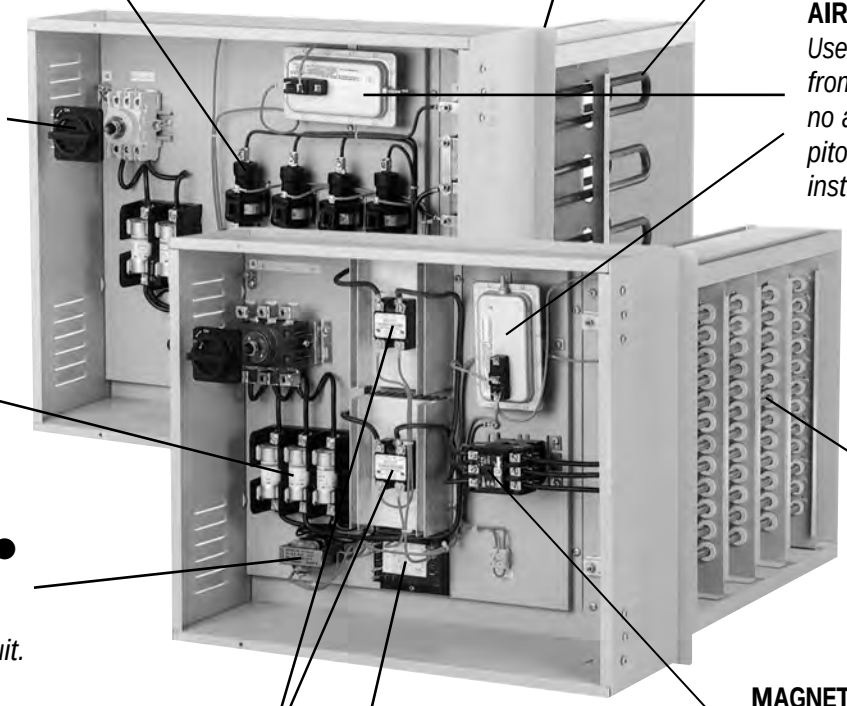
Standard ● *Optional* ❒

MERCURY CONTACTORS ❒
Used to power individual stages of heating. They allow a silent operation and are exceptionally reliable.

AUTOMATIC RESET CUT-OUT ●
The automatic reset thermal cut-out is a fail-safe, fixed temperature, disc type safety device that opens the circuit when it's set point is reached. It automatically resets and returns the heater to operating conditions.

TUBULAR INCOLOY ELEMENT ●

DISCONNECT SWITCH ❒
A built-in disconnect switch allows user to disconnect heaters individually in order to safely perform maintenance tasks.



AIRFLOW SWITCH ●
Used to prevent a heater from operating if there is no airflow. Provided with a pitot tube which, when installed into the duct, makes it sensitive to velocity pressure as well as to static pressure.

FUSES ❒
Used to protect the total load or individual stages.

HIGHEST GRADE OPEN COIL ●

TRANSFORMER ●
Built-in control transformer supplies 24 volts to the control circuit.

MAGNETIC CONTACTORS ●
Used to power individual stages of heating or as back-up for safety switches.

SOLID STATE RELAY ❒
Electronic contactor used to silently and proportionally control the heater in response to a pulsed signal.

All Thermolec Heaters are CSA and NRTL/C approved.

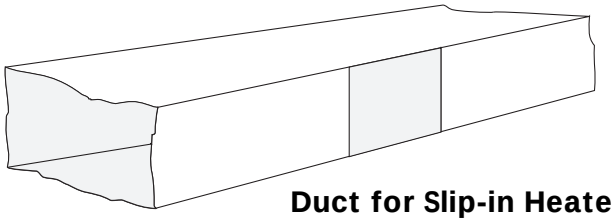
The NR TL/C indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

SCR CONTROLLER ❒
The SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand. It is compatible with thermistor thermostat (RT or DT), 0-10 Vdc, 4-20 mA, 0-135 ohms input signals.

MODELS

SLIP-IN TYPE DUCT HEATERS AND FLANGED TYPE DUCT HEATERS

SC Slip-in Open Coil ***(Fig. 1)***
ST Slip-in Tubular
FC Flanged Open Coil
FT Flanged Tubular ***(Fig. 2)***
RFC Round collar open coil ***(Fig. 3)***
RFT Round collar with Tubular elements



Duct for Slip-in Heater

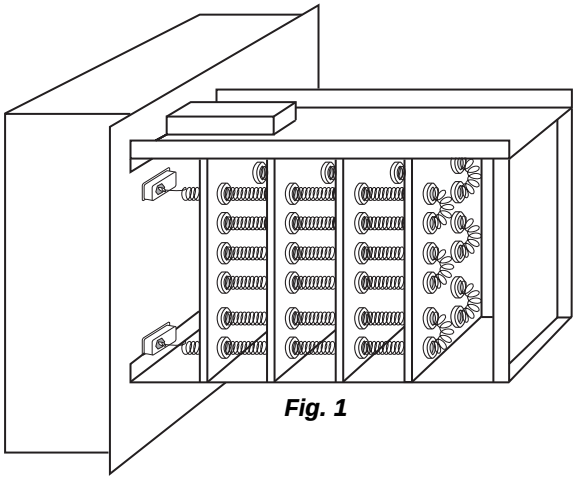
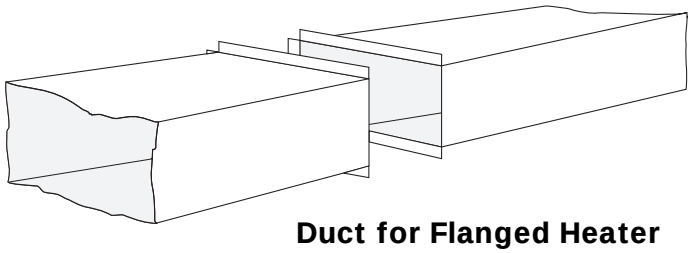


Fig. 1



Duct for Flanged Heater

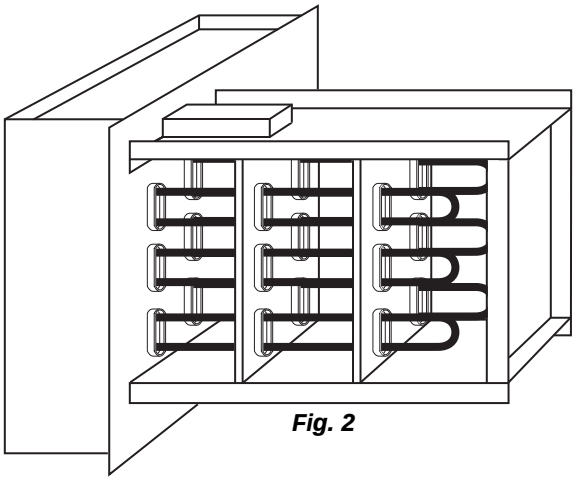


Fig. 2

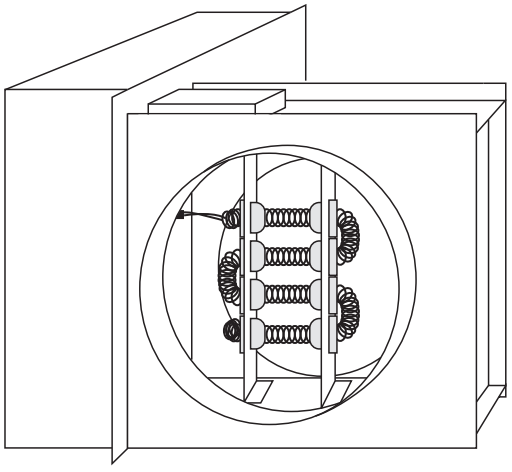


Fig. 3

All Thermolec heaters are CSA and NRTL/C approved

HOW TO SELECT AND SPECIFY IN THREE EASY STEPS

Selecting the heater for your application can be done in three easy steps:

1- Determine heater capacity, voltage and electrical components

2- Determine duct dimensions, air requirements and mechanical options

3- Determine method of control, then select control components

---

STEP 1 -

DETERMINE HEATER CAPACITY, VOLTAGE AND ELECTRICAL COMPONENTS

Heater capacity

Given CFM (volume of air in cubic feet per minute) and $\Delta^{o}T$ (temperature rise in ^{o} F), the KW capacity can be determined from the formulas:

$$KW^{**} = \frac{CFM \times \text{Temperature Rise, } ^{o}F^{*}}{3000}$$

$$\text{Temperature Rise, } ^{o}F = \frac{KW \times 3000}{CFM}$$

NOTE:
The above formulas are for standard air. Consult your Thermolec representative for non-standard air conditions.

* *Maximum air temperature rise for which the heater is designed*

** *This formula is for quick calculation and contains a loss allowance of 5%.*

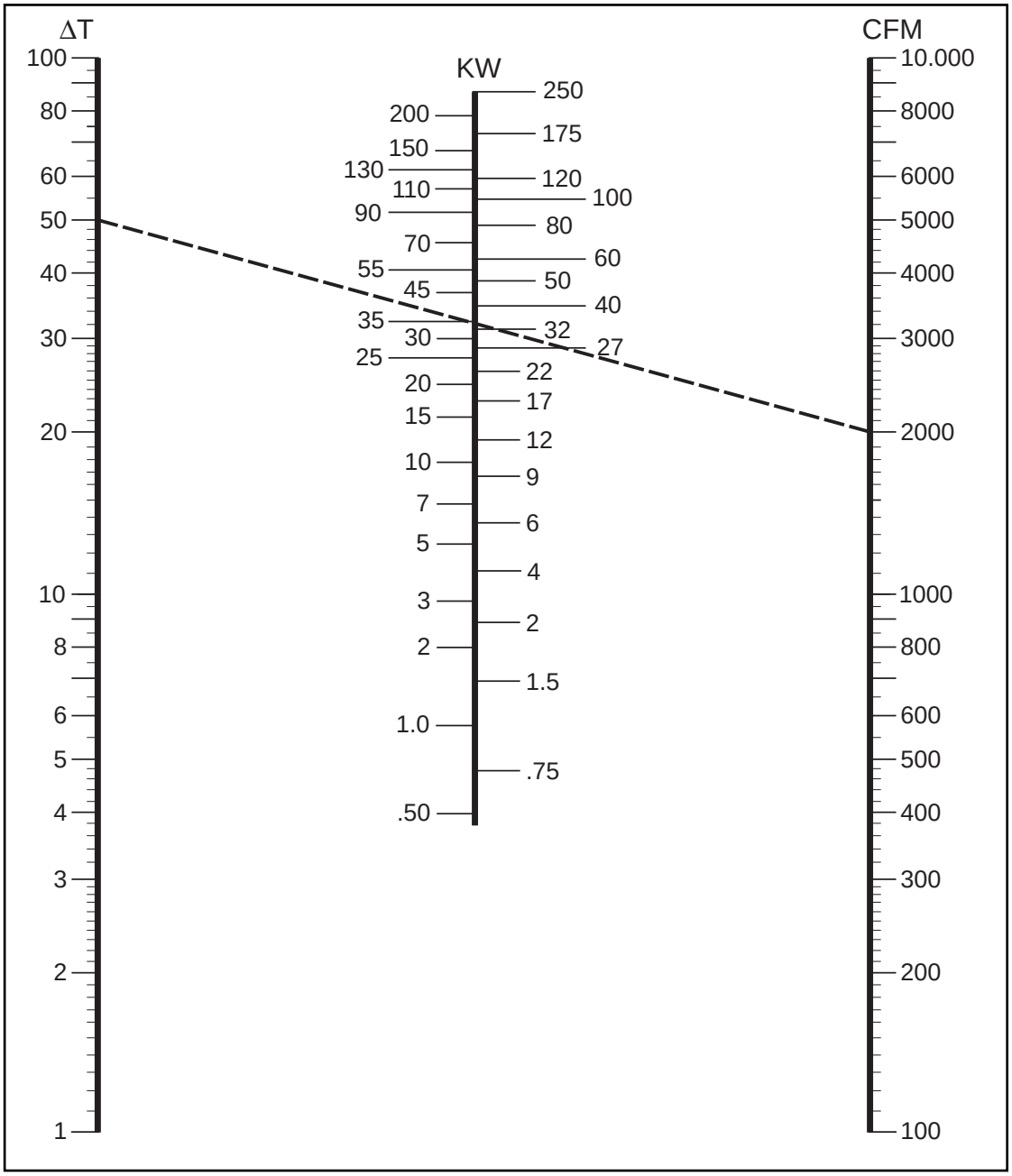


Chart to determine the required kilowatts

For a rough estimate, use the chart above.

Example:

Find the KW required to raise 2000 CFM from -10 to 40 ºF.

ΔT = 40 + 10 = 50 ºF.

Lay a straightedge across the chart from 50 on the ΔT scale to 2000 on the CFM scale.

Find the required KW where the straightedge intersects the KW scale.

For this example, the KW required is approximately 35 KW.
You may decide to add any safety factor or loss allowance.

Power and Voltage Requirements

Nominal and Standard Supply Voltages

While a utility's voltage may be referred to by means of a nominal figure, actual applied voltage may vary over a fairly wide range depending on factors like the system's power distribution lines, and many others. For instance, a nominal voltage of 575V / 3PH / 60Hz may variously be called 550V, 575V or 600V depending more on what the specification writer is accustomed to calling it than on the actual voltage supplied to the heater. Designing a heater for 550V when in fact 600V is supplied to it will result in almost 10% more current and 20% more KW capacity since current is proportional to the voltage and KW is proportional to the square of the voltage. Conversely, application of a lower voltage results in a corresponding under-performance of the heater. It is therefore of the utmost importance to ensure that the correct voltage is specified.

For safety reasons Thermolec standard supply voltages have been chosen to be the highest for each voltage range, as shown in the table below. Heaters designed for lower voltages in each range are available and will be supplied when customer expressly specifies a lower supply voltage.

Common Nominal Voltages	110 115 120	208		220	230 240		277	318 332 347	380		416		440 460 480		550 575 600	
Thermolec Standard Voltages	120 1 Ph	208 1 Ph	208 3 Ph	220 1 Ph	240 1 Ph	240 3 Ph	277 1 Ph	347 1 Ph	380 1 Ph	380 3 Ph	416 1 Ph	416 3 Ph	480 1 Ph	480 3 Ph	600 1 Ph	600 3 Ph

STANDARD VOLTAGES

This standardization reduces the risk of overheating due to a heater subjected to an overvoltage with the resulting nuisance tripping of high-temperature cut-outs.

Examples of risk:

Example 1:

A 575V/3 PH heater in a 600V/3PH installation would carry 5% more current and produce 10% more KW than it is designed for.

Example 2:

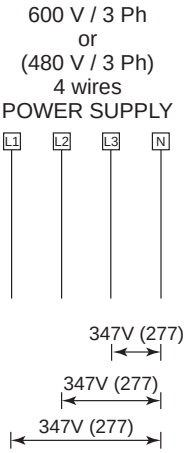
A 220V/1 PH heater in a 240V/1PH installation would carry 10% more current and produce 20% more KW than it is designed for.

Under such conditions, these heaters would overheat and thermal cut-outs would trip.
In order to avoid any risk of overheating, it would be advisable to verify the existing conditions on the job site.
In case of doubt about the required voltage, always specify one of the Thermolec Standard Voltages.

STEP 1 - (continued)

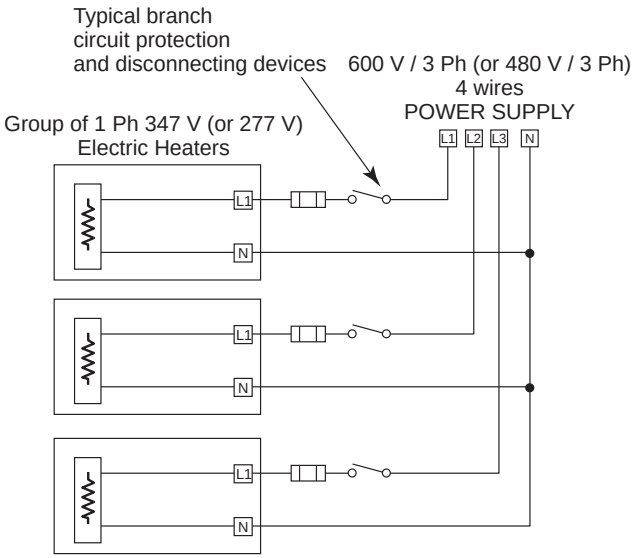
347 (277) V, Single Phase Power Supply

When capacities are below 7 KW at 277 V and 8 KW at 347 V Thermolec recommends the use of the following arrangements to obtain the most economical cost for heaters and electrical distribution.



347 / 600V
4 wire power supply
(also 277 / 480)

These voltages are generally derived from a 600 (480) volts - 3 phase - 4 wire power supply.
A group of 347 (277) volt - 1 phase heaters should be distributed as equally as practical over the three phases in order to keep current imbalance to a minimum.
Neutral conductor should not be broken by any switching or protective device, be it internal or external to the heater.



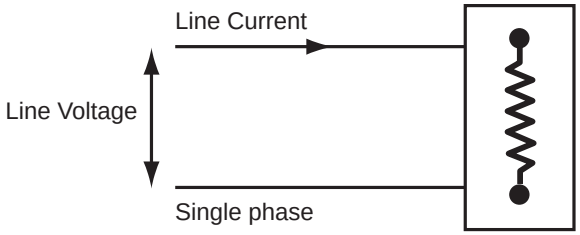
Equal distribution of heaters

Line Current

The table below shows line current per one KW capacity at various voltages. The following formulas apply:

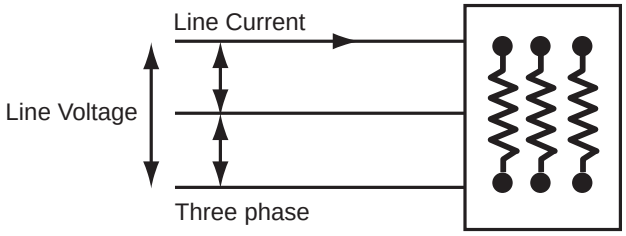
SINGLE PHASE

$$\text{Line Current in Amperes} = \frac{\text{Watts}}{\text{Line Voltage}}$$



THREE PHASE (Star or Delta loads)

$$\text{Line Current in Amperes} = \frac{\text{Watts}}{1.73 \times \text{Line Voltage}}$$



Thermolec Standard Voltages	120 1 Ph	208 1 Ph	208 3 Ph	220 1 Ph	240 1 Ph	240 3 Ph	277 1 Ph	347 1 Ph	380 1 Ph	380 3 Ph	416 1 Ph	416 3 Ph	480 1 Ph	480 3 Ph	600 1 Ph	600 3 Ph
Multiplier Amp./KW	8.33	4.81	2.78	4.55	4.17	2.41	3.61	2.88	2.63	1.52	2.40	1.39	2.08	1.20	1.67	0.96

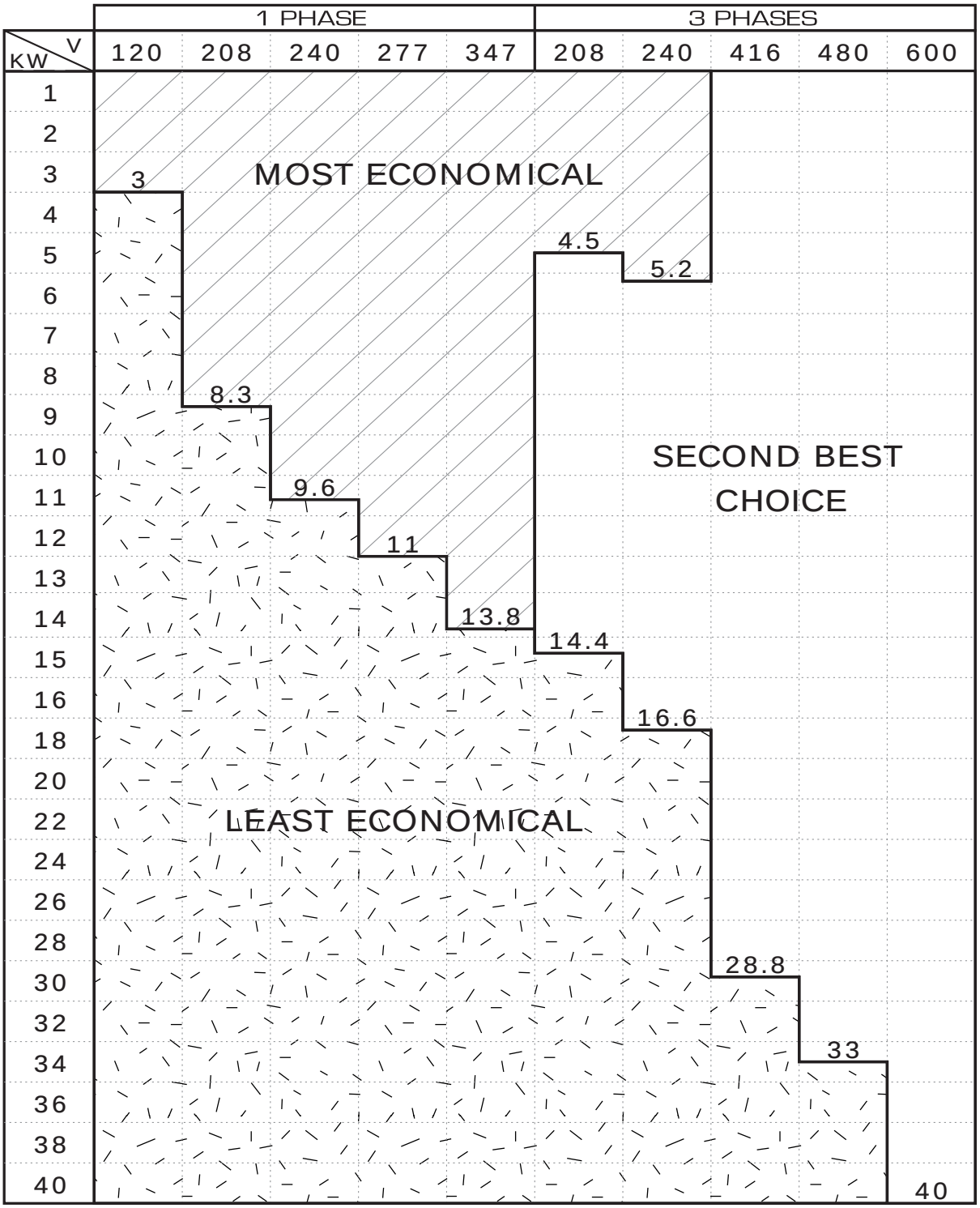
Multipliers to calculate Line Currents

(Line current in amperes = Multiplier x KW capacity)

Example: The Line current for a 40 KW / 600V / 3 phases heater is : 40 x 0.96 = 38.4 amperes.

STEP 1 - (continued)

Selection chart of most economical design for THERMOLEC modulating heaters KW/Voltage combination



STEP 1 - (continued)

FUSING

The National Canadian and Electrical Code requires that each power supply to a heater be individually protected by either fuses or circuit breakers external to the heater. Please see Pertinent Regulations.

Additional sub-circuit fusing within the heater (built-in load fuses) may be either mandatory or optional and if optional, may or may not be recommendable. The following table supplies the information necessary for decisions on built-in sub-circuit over-current protection.
As a general rule, built-in load fuses are rated 30 Amps for circuits up to 24 Amps and 60 Amps to protect one or more internal circuits totaling up to 48 Amps.

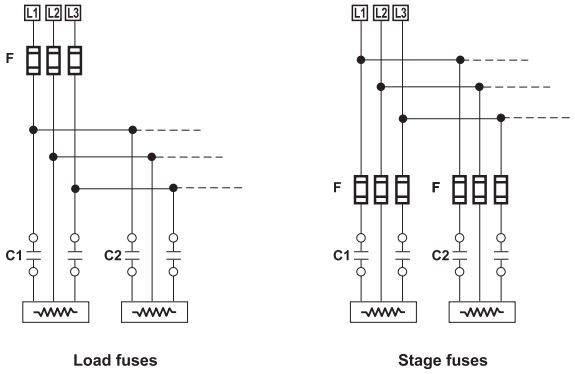
TABLE FOR LOAD FUSING

SUPPLY VOLTAGE & PHASE						HEATER RATED AMPS.	NEC ELECTRICAL CODE	INTERNAL LOAD FUSING MANDATORY	THERMOLEC RECOMMENDS BUILT-IN LOAD FUSES	THERMOLEC COMMENTS
240 / 1 PH	208 / 3 PH	277 / 1 PH	347 / 1 PH	480 / 3 PH	600 / 3 PH					
HEATER TOTAL KW * UP TO										
12	17	13	17	40	50	0 - 48	NO	NO	NO	OPTIONAL LOAD FUSES NOT RECOMMENDED - ONLY ONE POWER SUPPLY ECONOMICALLY JUSTIFIED.
38	57	44	55	133	166	49 - 160	YES	NO	YES	FUSES LIMIT EXTENT OF DAMAGE IN TERMINAL BOX IN CASE OF SHORT CIRCUIT.
39 & +	58 & +	45 & +	56 & +	134 & +	167 & +	161 & +	YES	YES	YES	MANDATORY IN CASE OF SHORT CIRCUIT.
* For higher KW capacities consult factory regarding the most economical number of power supplies.										

LOAD FUSES: The minimum required sets of 60 Amp fuses for proper protection (Option U1).
Example of load fusing: A one stage, three phase heater rated 40 amps will use one set (3 fuses of 60 Amps).

STAGE FUSES: Mostly optional, one or more sets of fuses per stage (Option U2).
Thermolec standard fuses are 30 Amps for circuits up to 24 Amps and 60 Amps for circuits up to 48 Amps.
Example of stage fusing: A three phase heater rated 48 amps will use one set (3 fuses of 60 Amps) if the heater is designed with one stage.
For two stages (24 Amps per stage), two sets (6 fuses of 30 Amps) will be used.
For three stages (16 Amps per stage), three sets (9 fuses of 30 Amps) will be used.

Because fuses require ventilation, the control box must be louvered. If the control box is specified as Nema 4 or 12, then the box must be oversized.



Typical sub-circuit fusing arrangements

For more detailed information, please refer to section 2 in brochure " Power supply and fusing considerations "

STEP 1 - (continued)

Contactors

Contactors are used to power individual stages of heat or as back-up for safety switches.

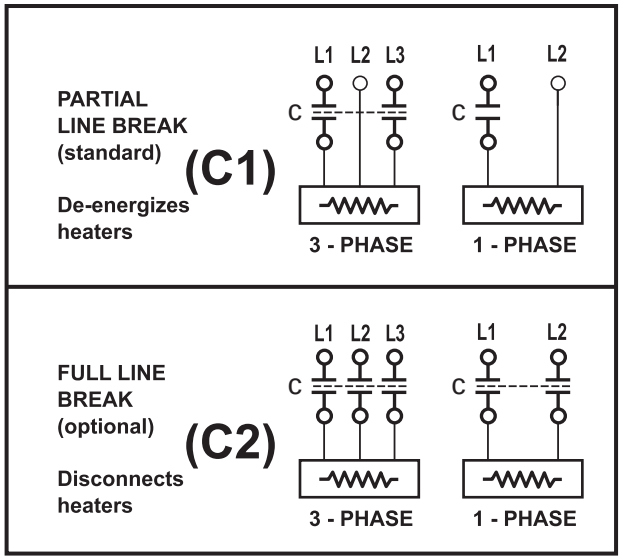
Contactors may be of two types:

Partial line-break (or de-energizing)

In the partial line-break arrangement the contactor opens the current path, thus de-energizing the heater.

Full line-break (or disconnecting)

The full line-break type contactor opens all ungrounded power lines in the heater. This may be ordered as an option (Request option C2).



Partial and Full Break Figures

Special power lugs

Heaters are supplied with power terminal blocks rated for copper conductors with 75 ºC insulation. Aluminum conductors are not recommended and the standard terminal blocks are not sized for aluminum. Please consult Thermolec if the use of aluminum conductors is considered.
For very high amperages, Thermolec can supply terminal blocks for two or more parallel conductors per phase.
For more detailed information, please refer to section 2 in brochure "Power supply and fusing considerations".

STEP 2 -

DETERMINE DUCT DIMENSIONS, AIR REQUIREMENT AND MECHANICAL OPTIONS

Air Flow requirements and Minimum Velocity

When there is a choice in heater face dimensions the specification writer has several good reasons for favoring the smaller rather than the larger heater face area: The smaller sized, higher velocity electric coil will perform better, weigh less and cost less per KW than an otherwise identical larger coil.

The main selection criteria are KW per square foot of face area (or duct size) and Design Velocity.

KW per Square Foot Range	COMMENTS
Less than 5	High cost per KW
5 to 12	Medium cost per KW
12 to 20	Low cost per KW
Over 20	Medium cost per KW

Kilowatts per square foot Table

Face velocity in Feet Per Minute (FPM)	COMMENTS
Less than 400	Requires derating of watts density on elements. Specify proportional control.
400 to 2000	Most economical range
Over 2000	Specify special coil supports

Design Velocity Table

Unlike hot water or steam coils, electric coils will generate 100% of the heating capacity (i.e. the heat output is constant as long as the heater is energized) regardless of the air flow. A drop in air flow through an electric coil below the minimum required FPM (feet per minute) will increase both the coil temperature and the exhausted air, which may result in high limit cut-outs tripping.
Another frequent cause of unnecessary cut-out tripping is the uneven distribution of air flow over the coil surface, resulting in "hot spots". In order to achieve trouble-free performance, provide adequate air flow as per "air flow requirement" chart (on page 14) and ensure even air flow distribution by following sound industry practice in design and installation of ductwork and equipment.

The Thermolec CSA NRTL/C listing is limited to 22.5 KW per square foot of duct area for open coil heaters and 13 KW per square foot of duct area for tubular element heaters.

Air flow requirements for ON-OFF Control

The minimum air flow required through a duct heater depends on the KW per square foot of face area for the highest capacity ON-OFF stage. In general **400 FPM** is adequate in most applications.

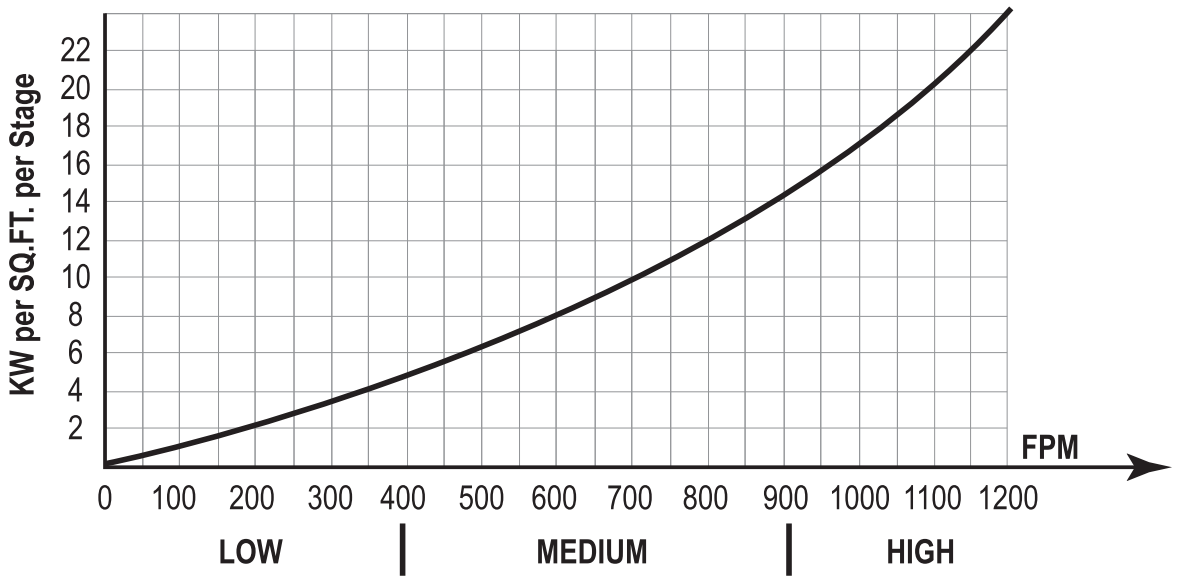
Air flow requirement for Full SCR control

An SCR controlled heater may be considered as having an "infinite" number of control stages, and consequently the air flow requirements of the chart (on page 14) for minimum air flow does not apply.
As a general rule, heaters equipped with FULL SCR will require an air velocity of at least **300 FPM**. For lower design velocities please consult factory.

Exclusive Feature:

The special Thermo-V unit for VAV applications allows the heater to perform down to **50 FPM**.
Please see pages ***25 and 26.***

STEP 2 - (continued)



Air Flow Requirement for Open Coil Heaters

Net FACE AREA = Duct width in inches x Duct Height in inches / 144
KW per SQ.FT. per STAGE = KW of the largest stage / net FACE AREA in SQ.FT.

Please refer to the table on page 16 for tubular elements.

Example:
Find the minimum air flow requirement for a 65 KW 1 stage heater in a 24” wide by 18” high duct.

Ⓐ Calculate duct area in square feet.

$$\text{Duct Area} = \frac{24\text{”} \times 18\text{”}}{144} = 3 \text{ square feet}$$

Ⓑ Calculate KW per square foot per stage.

$$\text{KW per square foot per stage} = \frac{65 \text{ KW}}{3 \text{ sq.ft.} \times 1 \text{ stage}} = 21.66$$

Ⓒ Using the Air flow requirement curve above, find 21.66 on the vertical scale.
Read the minimum velocity required on the horizontal axis, which is approx. 1150 FPM.

Ⓓ If it is a 2 stage heater then KW per square foot per stage $= \frac{65 \text{ KW}}{3 \text{ sq.ft.} \times 2 \text{ stages}} = 10.83$
In this case 750 FPM are required.

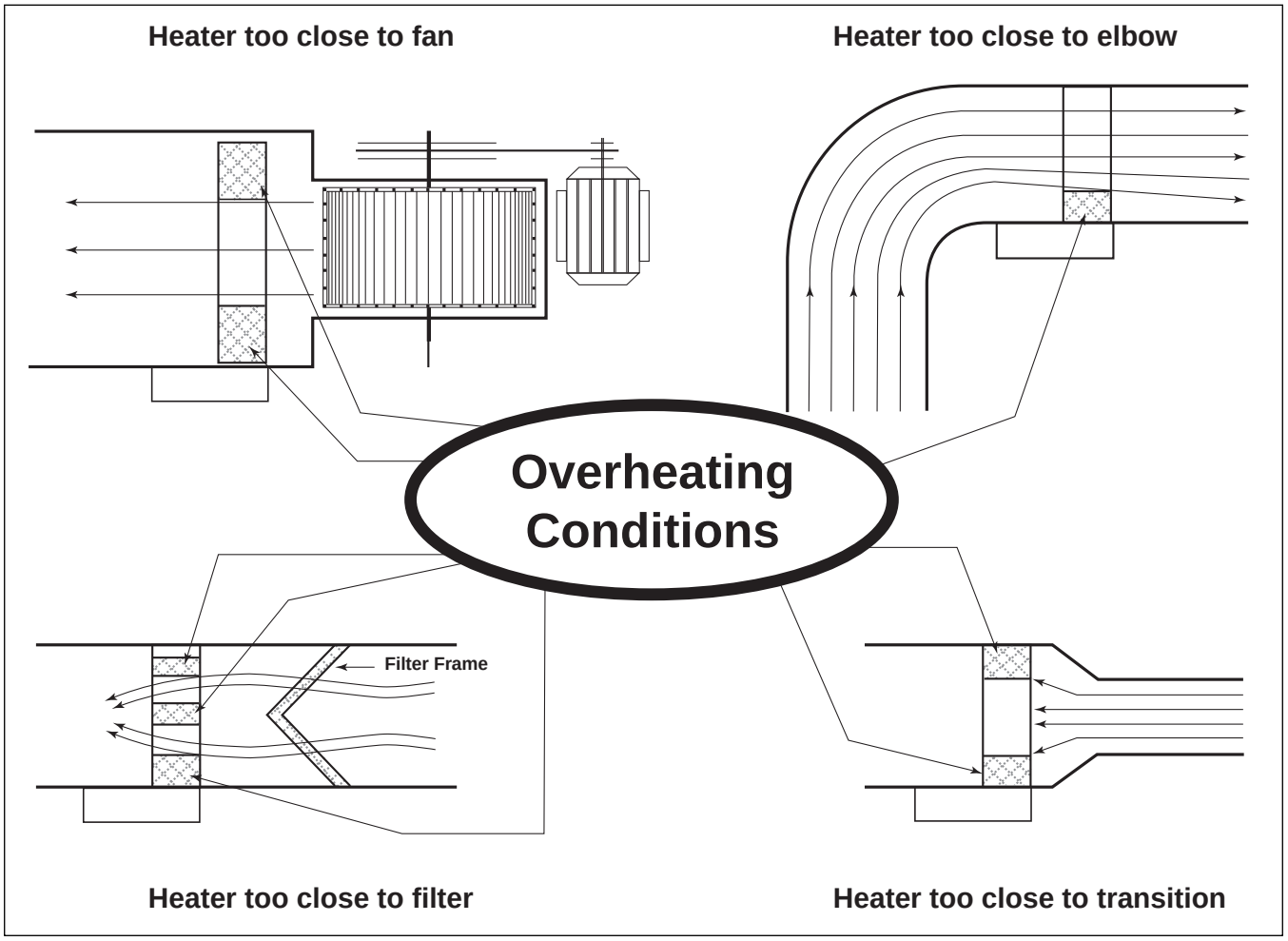
Ⓔ If it is an SCR Controlled heater then 300 FPM are required.

STEP 2 - (continued)

Airflow Uniformity

In order to prevent hot spots, the air flow must be uniformly distributed across the heater area. The following figures illustrate typical heater mis-application where the airflow is not uniform. An NEC article (please see below *) specifies that a heater should not be installed closer than 4 feet downstream or 2 feet upstream from a fan outlet, an abrupt transition, an elbow or any other kind of obstruction in the duct. If your application is such that one of the mentioned installations cannot be avoided, THERMOLEC can help you by designing around it.

* 1071 NEC Article 424-59:
"Means shall be provided to assure uniform and adequate airflow over the face of the heater. Heaters installed near (within 4 feet) a fan outlet, elbows, baffle plates or other obstruction in duct work may require turning vanes, pressure plates or other devices in the inlet side of the duct heater to assure an even distribution of air over the face of the heater".



STEP 2 - (continued)

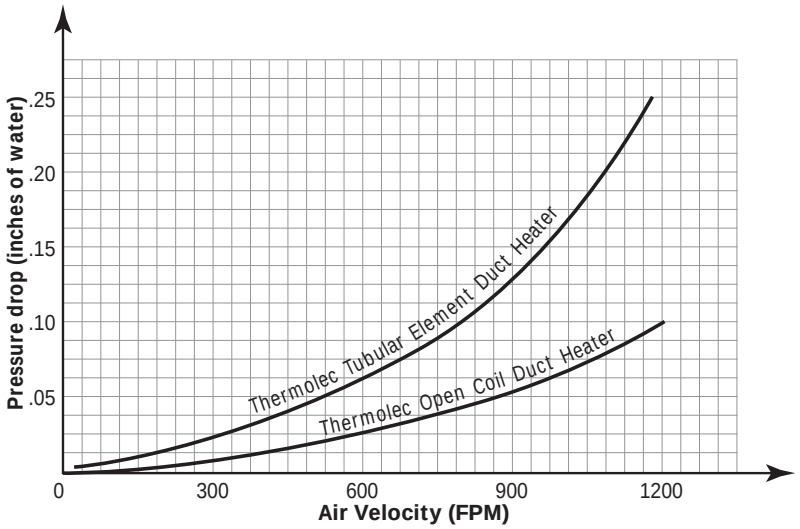
OPEN COIL vs TUBULAR elements

THERMOLEC manufactures both open coil and tubular duct heaters.

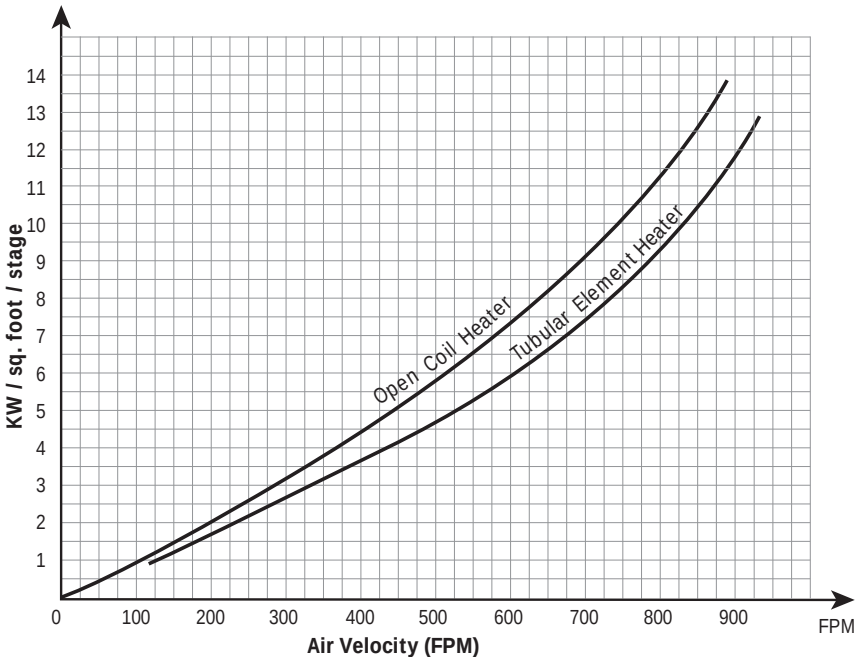
It is widely acknowledged that tubular elements find practical application under certain circumstances (service conditions include possible contact by personnel, presence of dust or particles in the air flows or atmospheric conditions).

But, where heating filtered air is the sole function, the open coil heater is superior for many reasons:

- Longer life
- More kilowatts per square foot
- Less stratification by equal distribution of the elements
- Lower wire surface temperature
- Less maintenance
- Greater serviceability
- Better heat distribution across heater face
- Less pressure drop
- Lighter weight
- Low shipping costs
- Less sensitivity to moisture
- More flexibility of size and capacity
- Cost effective
- Smaller size
- Large electrical clearance

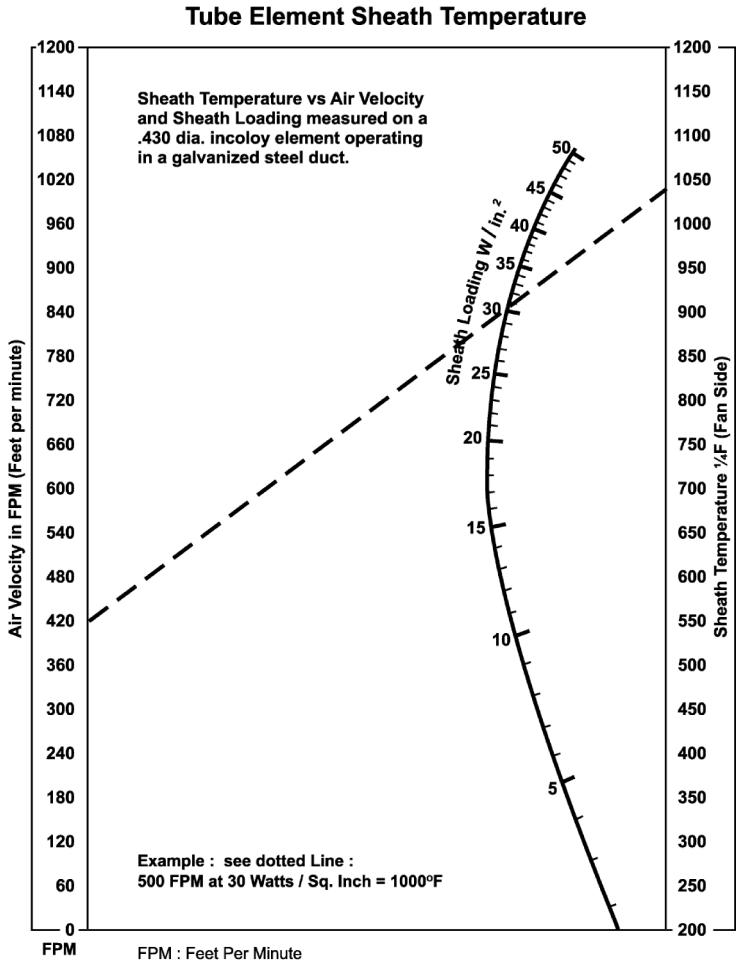


Pressure Drop for Tubes



Minimum Air Velocity for tubes

STEP 2 - (continued)



Exclusive Design advantage of the Thermolec Tubular heater construction

Thermolec Tubular elements can be removed through the control box, which avoids the need to remove the heater from the duct and thus reduces maintenance costs. However, precautions must be taken in terms of clearance when installing the heater in order to take advantage of this feature.

Please refer to SECTION 2 of this catalog for more detailed considerations about open coil and tubular elements.

STEP 2 - (continued)

Size Limitations

Although there are practically no limitations to the maximum size of Thermolec custom-built heaters, all CSA listed heaters must comply to the following minimum dimensions:

	Slip-in Type Open Coil	Flanged Type Open Coil	Slip-in Type Tubular	Flanged Type Tubular
Minimum Duct Width Dimension "W"	6"	5"	8"	7"
Minimum Duct Height Dimension "H"	5"	4"	6"	6"

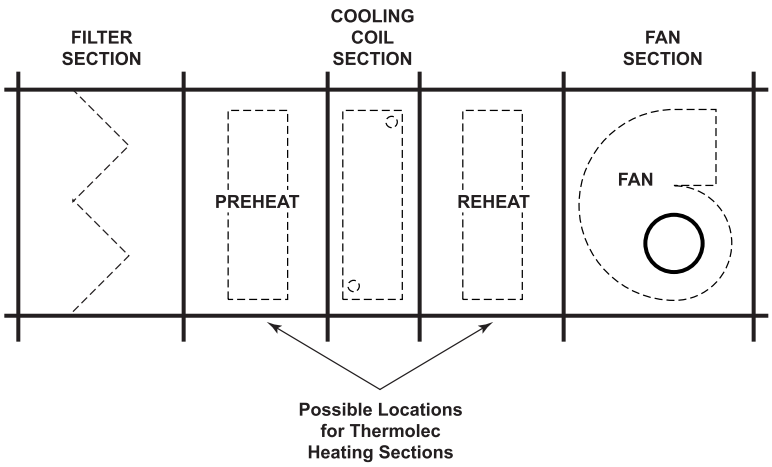
Size Limitation Table

CSA listed custom heaters are available in virtually any KW rating. However, Thermolec listing is restricted to a maximum KW density of 22.5 KW per square foot of heated area for open coil and 13 KW per square foot for tubular. For a quick approximation of the maximum KW available in a particular duct size, please use the following formulas:

Open Coil Type SC or FC	Maximum KW =	$\frac{22.5 \times \text{width in inches} \times \text{height in inches}}{144}$
Tubular Type ST or FT	Maximum KW =	$\frac{13 \times \text{width in inches} \times \text{height in inches}}{144}$

Modular Construction for Air Handling Units

Thermolec heaters can be part of large air handling units. In this case, a heater becomes a module of a bigger unit and is designed to match the other components: filter frames, fans, cooling coils, VAV boxes, etc. Flanged units can be bolted directly to adjacent sections or slip-in models are inserted into a bigger unit. Since there can be several special conditions in such big units, the heater has to be designed to accommodate them. Special features can be installed upon request: section with no heat, pressure plates to equalize air flow, buffer sections to space the heater away from other components, etc.



Modular Heating Sections

STEP 2 - (continued)

Variable Air Volume units (VAV)

The *"Thermo-V"* electric heater developed by Thermolec eliminates the common problems that are encountered in the application of an electric heater to a VAV box as described below:

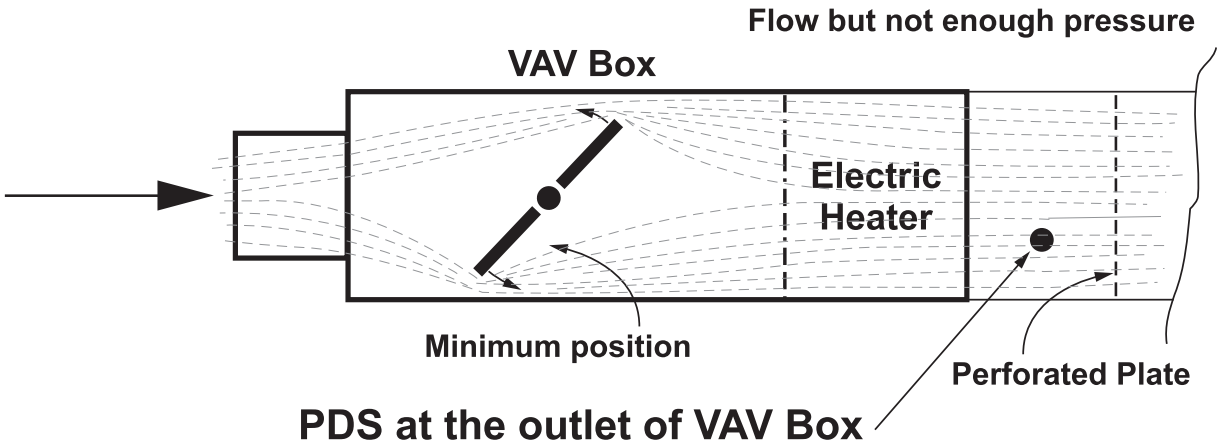
A. When the VAV Box is in the minimum opening position, the air flow is often below the minimum required to operate a standard electric heater, causing element overheating and possible tripping of the thermal cut-outs. The common solution is to increase the minimum ventilation air flow to accommodate the minimum air flow required to operate the heater which translates into energy waste.

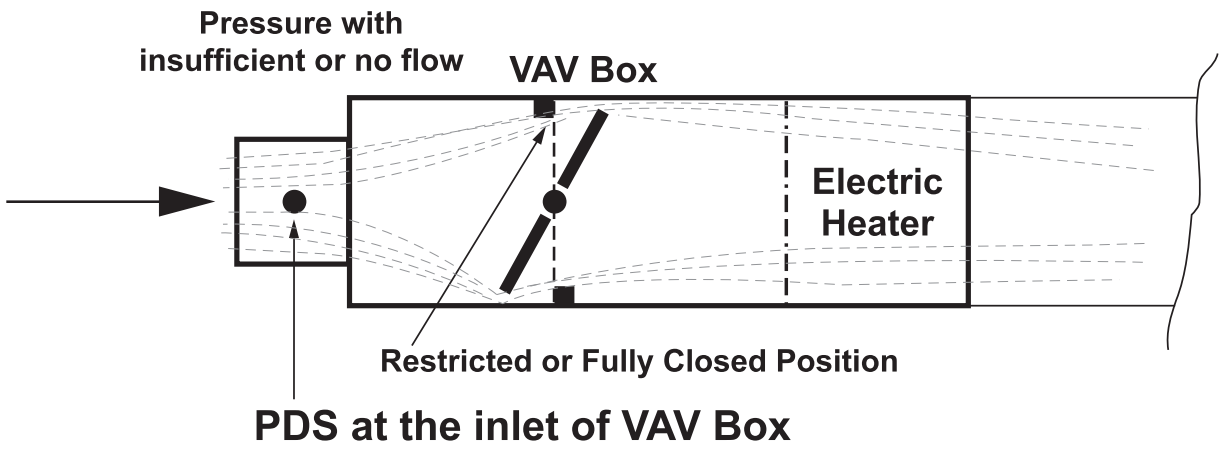
B. The static pressure in the duct downstream is so low that even the most sensitive pressure differential switch is unable to detect sufficient pressure to activate the electric heater. The common solutions are:

1. To create an artificial pressure by adding restrictions at the outlet (perforated plate), which creates a costly and unnecessary pressure loss when the box is in a fully open position.

2. To measure the pressure upstream of the VAV box, which could be dangerous, since, with a restricted or totally closed box, there is pressure without air flow. The electric heater will have to rely solely on it's safety thermal protections to shut off.

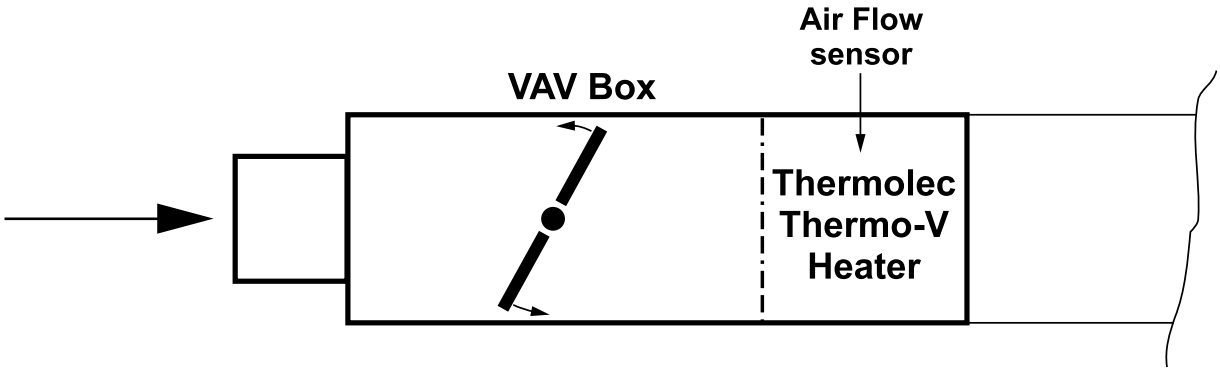
Common Problems Encountered





STEP 2 - (continued)

Thermolec has developed and patented an innovative solution to eliminate these problems:
The Proportional Electronic Air Flow Sensor.
The Air Flow Sensor responds to the radiant heat of the heating element which, in turn, is influenced by the air flowing through the heater to dissipate the heat.
The patented sensor and associated electronic controller modulate the power to the heater, adjusting the heater's capacity to accurately match the air flow available.
This unique concept allows the heater to respond exactly to the quantity of air flowing through it and safely shut down in case of a total loss of air flow.
The heater delivers maximum heating when needed with normal minimum air flow, reduced heating with lower than minimum air flow and stops heating with no air flow.



The Thermolec VAV Solution

The electronic controller also allows a proportional control of the heater, and is compatible with the following input signals:

1- Variable voltage signal 0 -10VDC.
2- Pulse Signal 24VAC or VDC.

Benefits of the Proportional Electronic Air Flow Sensor :

- The heater will operate with extremely low air flow. VAV boxes can then be set to minimum air to satisfy ventilation requirements rather than increased to accommodate conventional heater velocity requirements.
- Allows the heater to operate safely regardless of the duct static pressure.

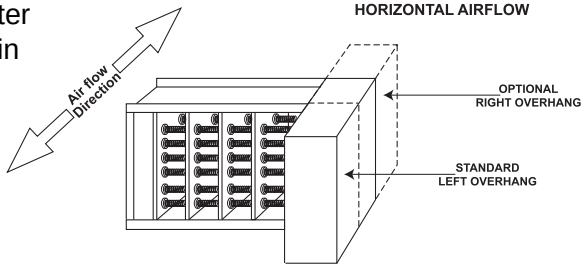
STANDARD CAPACITIES	STANDARD DIMENSIONS
up to 2 Kw 120V / 1Ph	
up to 5 Kw 208V / 1Ph	Round: from 6" to 12" dia.
up to 6 Kw 240V / 1Ph	
up to 7 Kw 277V / 1Ph	Rectangular: from 6" x 6" to 24" x 18"
up to 8 Kw 347V / 1Ph	
Other dimensions, capacities and voltages up to 40 KW and 600V / 3Ph a vailable upon request.	

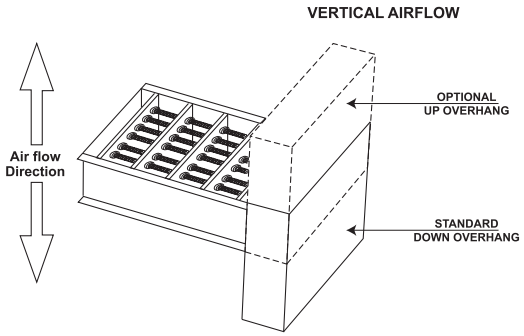
STEP 2 - (continued)

Universal mounting of Thermolec heaters

Unique feature

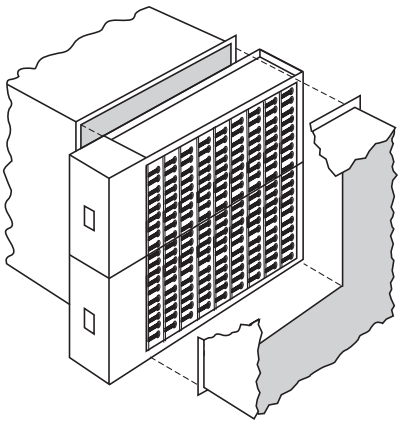
By design, all Thermolec heaters are made non-sensitive to air flow direction. The built-in high limit thermal cut-outs are located in such a way that the air flow could be in any direction without impairing safety and the same heater could be installed in a horizontal or vertical duct.





Multiple Heaters in a duct

Normally, electric heaters are not designed to be used in series in a heating installation. For very large heaters, manufacturing, shipping, field handling and installation, can be simplified by using two or more units specially designed for parallel installation. Each section has its own cut-outs and terminal blocks are provided to interconnect the controls in the field.

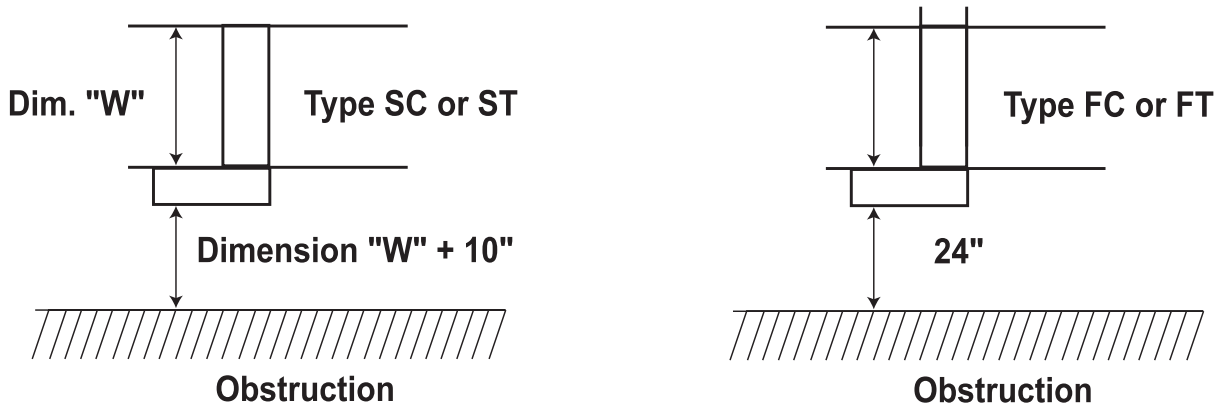


Two stacked sections in a duct

Clearance

Thermolec heaters are CSA and NRTL/C approved for zero clearance to combustible material. This means that there is no distance restrictions between the section of the duct housing the heater and combustible material. However, space should be provided to install and service the duct heater. Please see the minimum recommended installation clearances figures below.

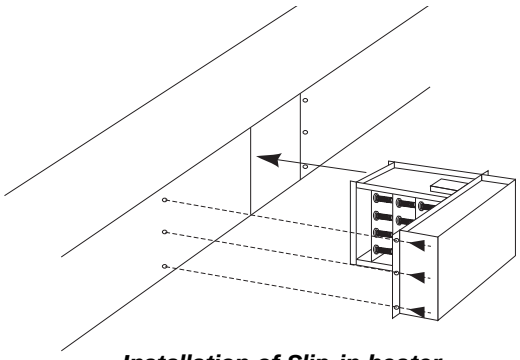
Minimum recommended distance for safety and service



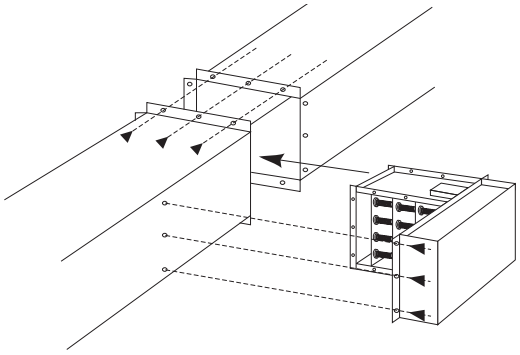
Installation clearances

STEP 2 - (continued)

Heater Installation

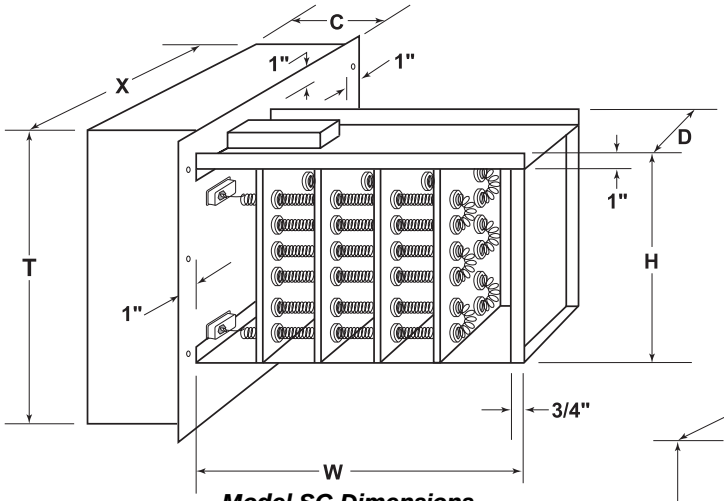


Installation of Slip-in heater

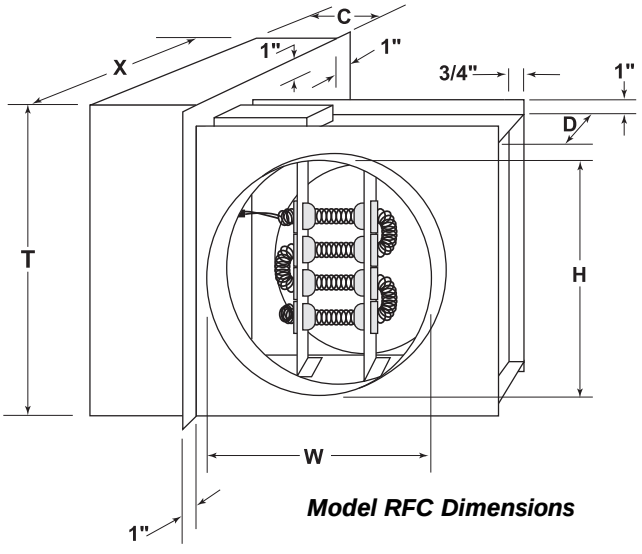


Installation of flanged heater

Details of the Thermolec Mechanical construction

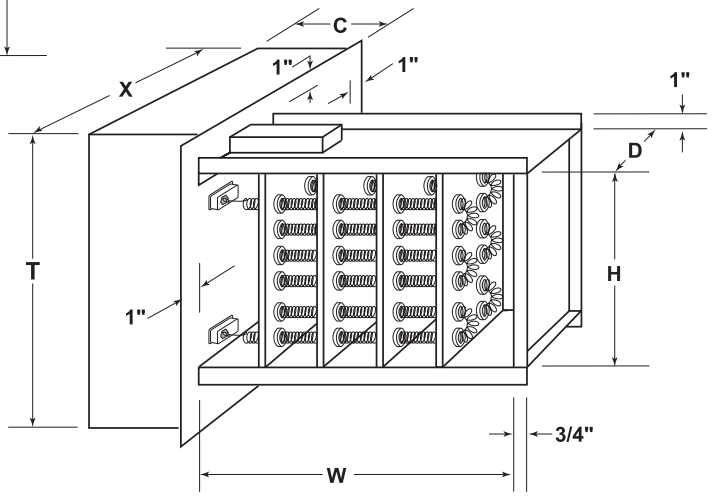


Model SC Dimensions



Model RFC Dimensions

Detailed dimensions:

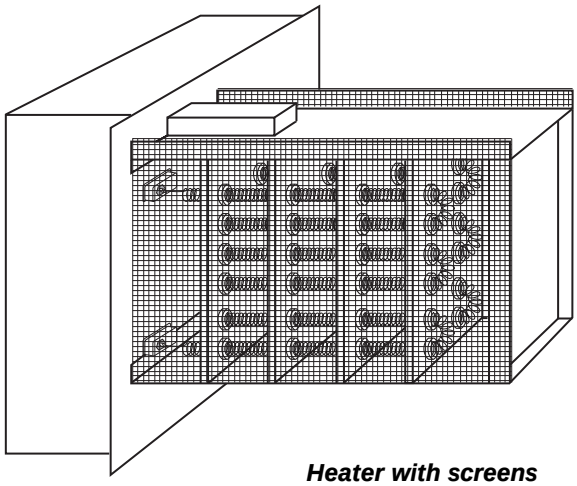


Model FC Dimensions

Conversion to metric
1” = 25.4 mm
3/4” = 19.05 mm

STEP 2 - (continued)

Protective screens

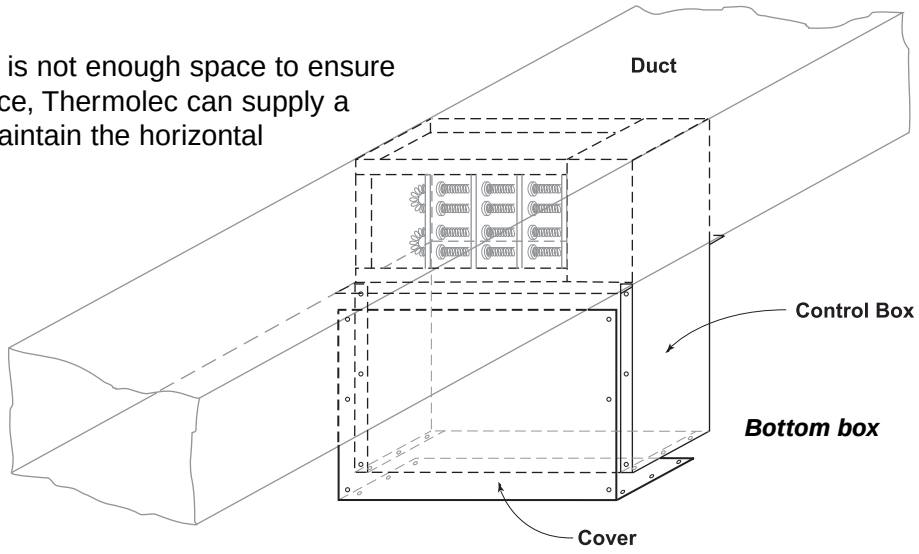


Heater with screens

Screens on both sides of the heater prevent any accidental contact by personnel or tools with electrically de-energized but still "live" coil elements.

Bottom control box

In special conditions, where there is not enough space to ensure proper installation and maintenance, Thermolec can supply a bottom control box designed to maintain the horizontal orientation of open coil elements.



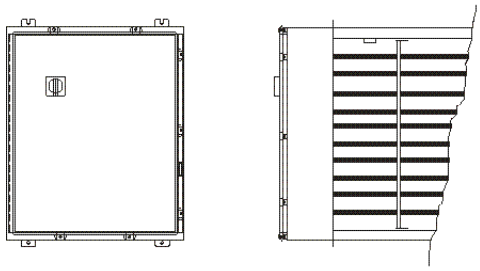
Dust-tight control box

Dust-tight Control Box

A dust-tight control box can be supplied by Thermolec when local codes require it. The control box has all the openings sealed and the cover is gasketed. When SCRs or fuses are installed in a gasketed control box, since there is no opening allowed for proper cooling, the box has to be oversized.

STEP 2 - (continued)

Nema 4 or Weatherproof control Box



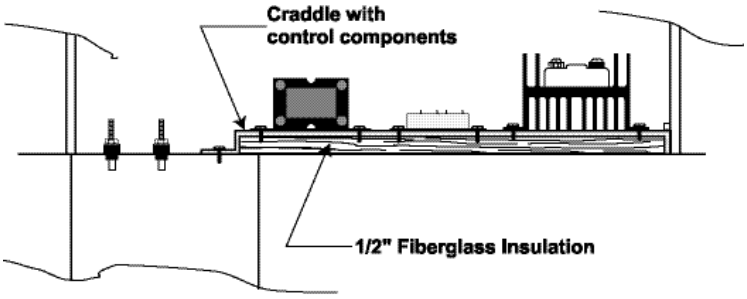
Weatherproof control box

NEMA 4 or Weatherproof oversized control panel

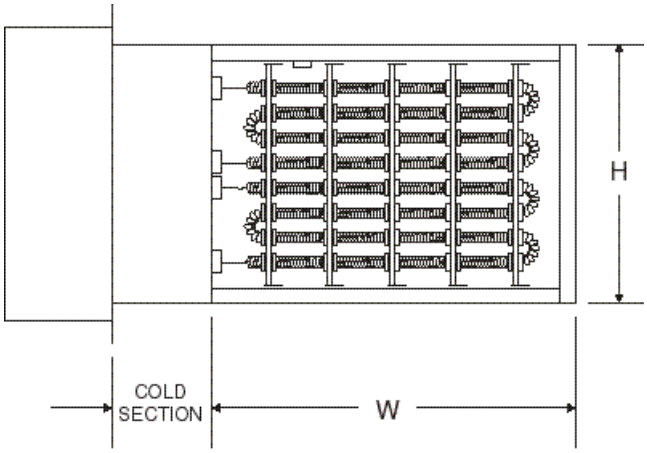
In locations subject to frequent washdowns (i.e. mines, food processing plants), the electric heaters must be supplied with a NEMA 4 control box. The terminal box is all welded, painted steel, with a hinged, gasketed cover and hold-down clamps. When required, the terminal box could be made in stainless steel (specify Nema 4X). The electrical contractor must install water-tight connectors for power supply and control wires.

Insulated Terminal Box

When there is a risk of condensation because of a high contrast between the duct temperature and the control box temperature, Thermolec recommends an insulated control box.



Insulated Terminal Box



Recessed Terminal Box

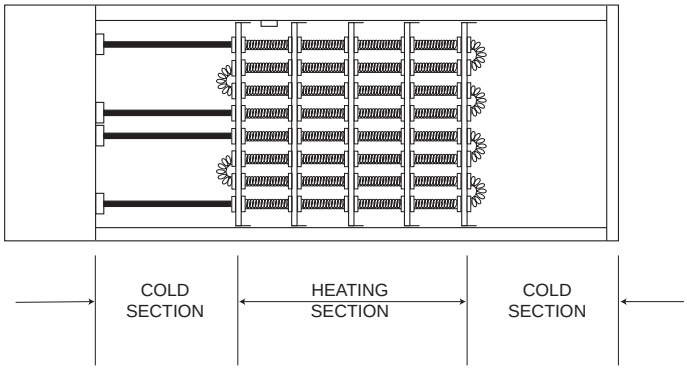
Recess Terminal Box

When heaters are installed in insulated ducts with more than 1” insulation or are inserted through an accoustic plenum, specify a recessed terminal box and indicate dimension of cold section.

STEP 2 - (continued)

Special Heaters

Thermolec manufactures heaters with special specifications to meet the needs of any OEM manufacturer.



Special Heater with no-heat sections

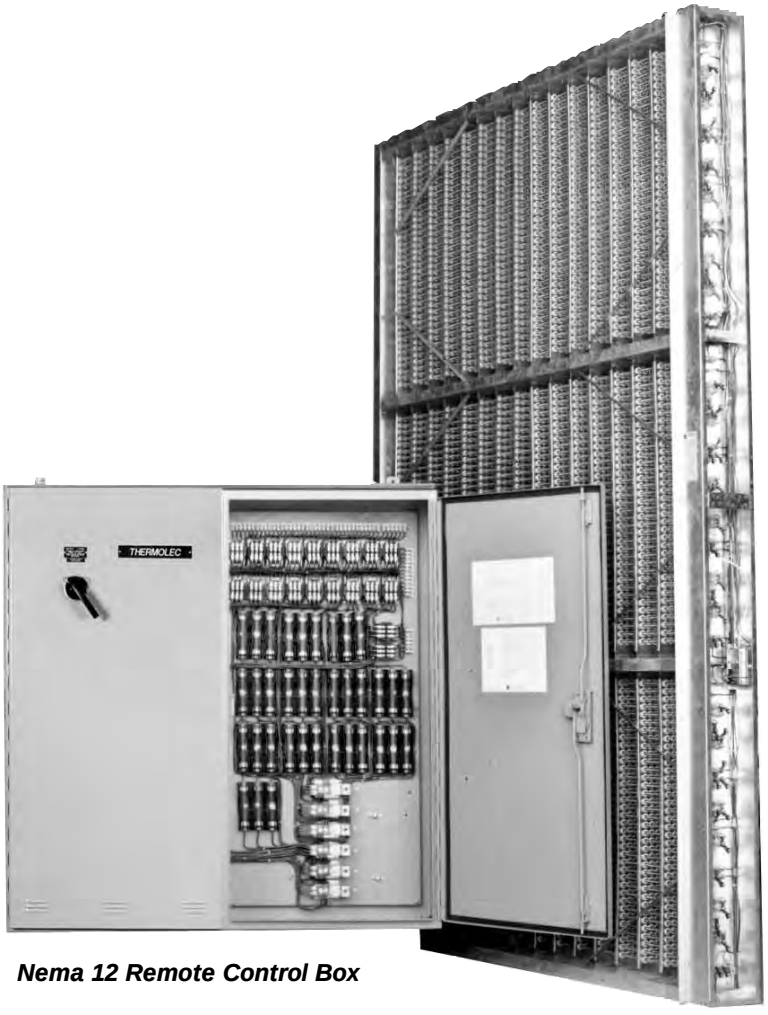
Stainless Steel Process Heater

Process Heaters

Thermolec manufactures process heaters for drying, curing, baking, etc...

Heater with remote control panel

Thermolec electric duct heaters are available in any size from 6" x 6" up to 144" x 96" and up to 1000 KW in one section.
Shown across is a 750 KW open coil heater with it's Nema 12 remote control panel.



Nema 12 Remote Control Box

STEP 3 - DETERMINE METHOD OF CONTROL AND SELECT CONTROL COMPONENTS

Temperature Control Modes and Staging

In selecting temperature controls the specification writer will generally wish to consider both control accuracy and cost.
To provide an acceptably close match of heater output to the system's varying demand for heat it is usually necessary to divide the total KW capacity into separately controlled increments or "control stages". Each stage accounts for part of the total temperature rise ΔT through the heater.
This temperature rise per stage (ΔT / stage) determines how accurately the temperature in the system can be controlled. For selection purposes Thermolec distinguishes FINE, MEDIUM, and COARSE control, which we arbitrarily define:

Temperature rise per control stage, ˚F	Temperature control accuracy
5 or less	FINE (SCR)
6 to 20	MEDIUM
over 21	COARSE

When a heater is controlled by an SCR, it can be considered as having an infinite number of stages and the accuracy is equivalent to FINE.
For a given accuracy and energy efficiency requirement, the number of control stages to be specified depends on the total design temperature rise through the heater.
The following table shows the Thermolec recommendations for control.

Recommended Number of Control ON/OFF stages or SCR Proportional Control

Heating Load		ΔT = 6°C 10°F	ΔT = 11°C 20°F	ΔT = 17°C 30°F	ΔT = 22°C 40°F	ΔT = 28°C 50°F	ΔT > 28°C 50°F
Temperature Control Options	Coarse	--	1 stage ON / OFF	2 stages ON / OFF	2 stages ON / OFF	2 stages ON / OFF	SCR
	Medium	1 stage ON / OFF	SCR	SCR	SCR	SCR	
	Fine	SCR	SCR	SCR	SCR	SCR	

Caution: It should be reminded that a coarse control puts an additional stress on the contactors since they have to cycle more often.

STEP 3 - (continued)

ON - OFF Control Mode

Air temperature is controlled by switching on and off selected control stages of the heater or, on single stage heaters, the entire heater. The ON / OFF mode is practical up to two control stages.
It is recommended for most COARSE control accuracy applications and is satisfactory up to a maximum of 25 ˚F ΔT temperature rise per stage.

CONTROL STAGES

A control stage is a "portion of the total KW capacity of a heater, wired to respond separately to temperature control". Contrary to a common misunderstanding, the number of control stages to be specified for an ON / OFF control system does **not** depend on total KW capacity nor on total amps of a heater.

With ON - OFF control, the temperature rise per control stage (ΔT/stage) determines the inherent temperature control accuracy of the duct heater. Therefore the correct number of control stages is a function of the total temperature rise of the heater and of the desired control accuracy.
For example, a 200 KW heater, handling 120,000 CFM for a design temperature rise of 5 ˚F will give FINE control accuracy with only one control stage. The temperature controller for this heater will be a 1 stage ON - OFF thermostat (if, for any reason, it is not desirable to switch 200 KW in a single step, several "power stages" can be used with automatic time delay).

On the other hand, with a 10 KW heater, handling 600 CFM for a design temperature rise of 50 ˚F, FINE temperature control requires FULL SCR control.

POWER STAGES

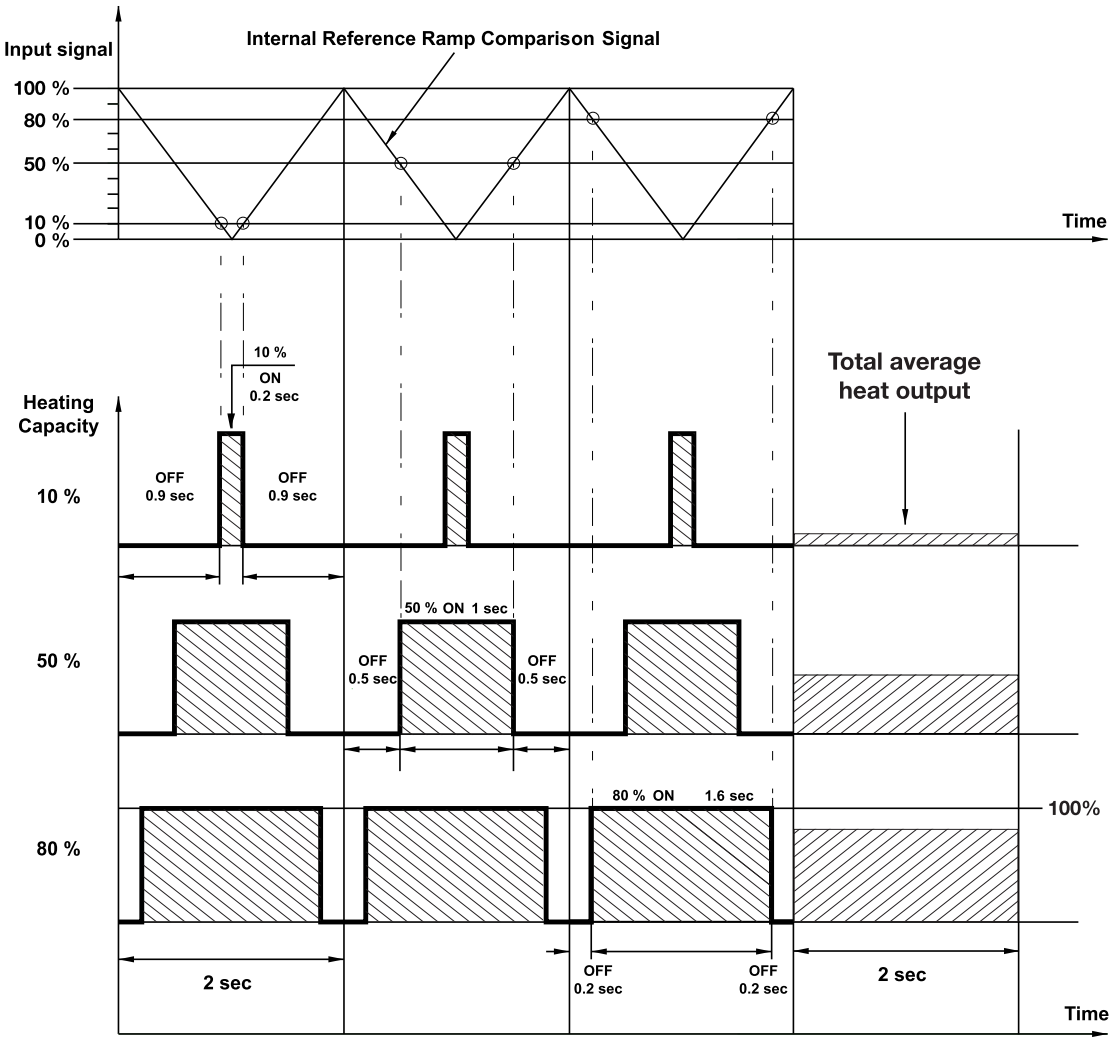
A power stage is a part of a control stage, wired for delayed switching ON. The need for and the capacity of power stages is determined, not by temperature control requirements, but by local codes and conditions governing the increments of capacity that may be brought on line at any moment without causing excessive voltage drop. When required, Thermolec will break down high amperage control stages into several power stages.

MODULATING CONTROL MODE

This method is also referred to as **"proportional"**. The heater is electronically controlled to deliver anywhere from zero to 100% of it's capacity, precisely and smoothly matching the heat demand of the system. This is achieved by means of an SCR controller connected to a proportioning thermostat which may be either a duct type for a Fresh Air make-up or a room type for zone heating.

The word proportional refers to the portion of a time period in which a heating element is turned ON and OFF (e.g. 10% ON and 90% OFF meaning 10% of the heating capacity).
According to the thermostat demand, the heater is pulsed in different proportion of ON time and OFF time to match the heating demand. The longer the element is turned ON, the more heat it is generating and vice versa. The heat produced during the ON period continues to dissipate during the OFF period, thus creating an average temperature output matching the thermostat set-point.

STEP 3 - (continued)



Pulse Width Modulation Diagram

In the above example:

10%	=	12 cycles ON, 108 cycles OFF	0.2 seconds of heating on 2 seconds
50%	=	60 cycles ON, 60 cycles OFF	1 second of heating on 2 seconds
80%	=	96 cycles ON, 24 cycles OFF	1.6 second of heating on 2 seconds
100%	=	120 cycles ON	2 seconds of heating on 2 seconds,

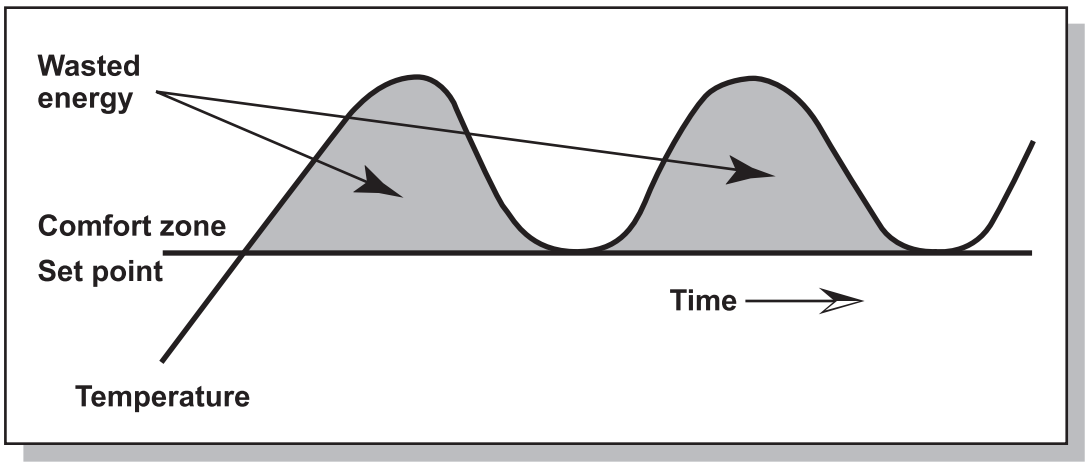
Principle of the Pulse Width Modulation (PWM)
The input signal is compared with an internally generated reference signal (triangle wave) that has a time base of 2 seconds (2 x 60 cycles or 120 cycles), and the controller activates the SCR output in a range of 0 to 100%. On this graphic, every time the horizontal line corresponding to the input (in the above example, 10%, 50% and 80%), crosses the reference signal, the heating elements are switched ON or OFF. The total heat output is an average between the ON and OFF periods, and for low heat demand, the heater is not "dimmed" but switched ON for very shorts periods.

STEP 3 - (continued)

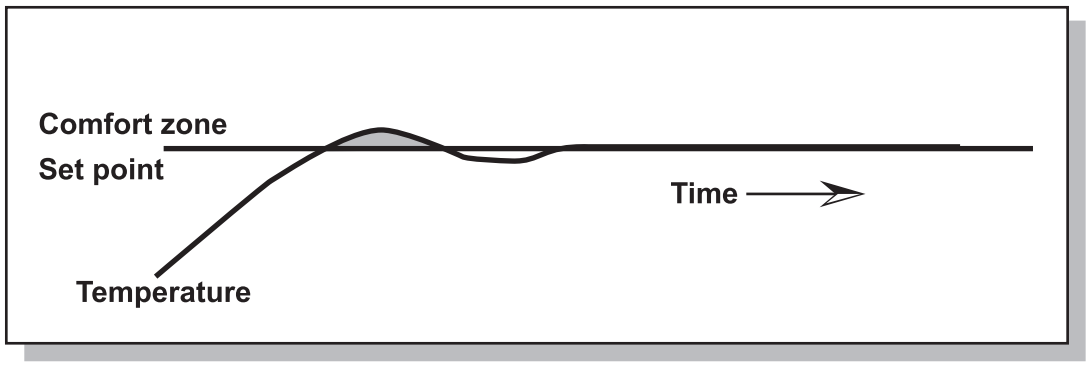
Comparison between ON/OFF and proportional control

Due to it's high differential, ON/OFF control mode wastes a lot of energy. The graphic below shows how the ON/OFF method creates high "overshoot" above the temperature set point while the electronic proportional method keeps the temperature close to the set point. The shaded areas correspond to wasted energy. A proportional control can thus maintain an accurate room or discharge temperature without the typical variations of the ON/OFF method. This represents an energy saving of approximately 15%.

Heating Cycle of ON / OFF Control Mode



Heating Cycle with Proportional Control (SCR)

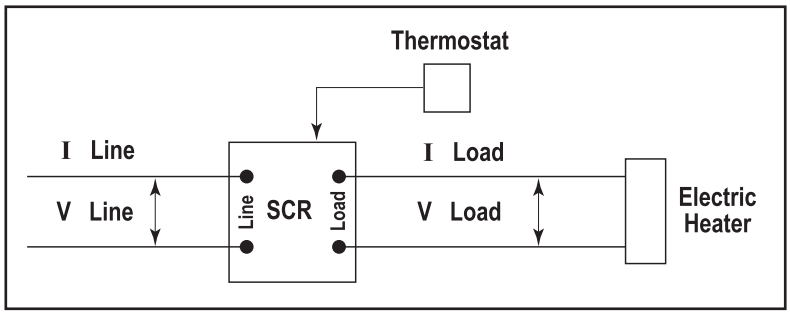


STEP 3 - (continued)

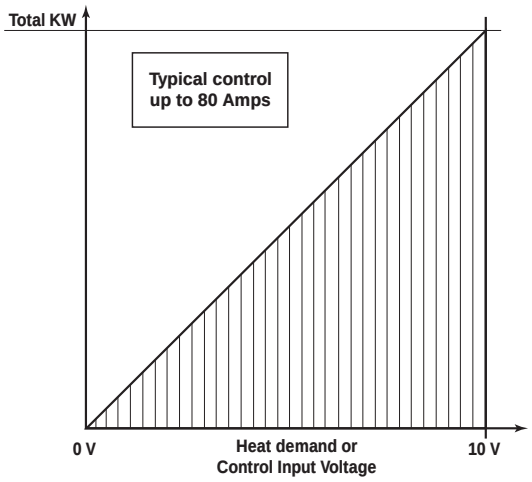
Thermolec strongly recommends the use of SCR proportioning controls for the best results in energy efficiency and maximum comfort.
When the output of the entire heater is being modulated in this manner, the control system is defined as **"FULL SCR".**
When one control stage only is controlled by a SCR while the balance of the heater stages are handled by ON - OFF control, the system is defined as **"HYBRID or VERNIER".**

FULL SCR

SCR is the abbreviation of Silicon Controlled Rectifier, also called current valve because of its ability to modulate the current supplied to, and consequently the capacity of, the heater. The example below sketches how a typical SCR modulates the heat output of a 15 KW / 600 V / 1 PH, electric heater.
As long as the temperature controller demands less than full heat, the SCR will switch the heater on and off repetitively on a very short cycle or period, typically 2 seconds. The net heat output is the product of the KW capacity of the heater multiplied by the ratio of the "ON" to "ON+OFF" or "period" time.
This ratio is determined by an electronic logic in the SCR according to a signal from a proportioning thermostat. Enough heat is stored in the electric elements so that there is an almost constant operating temperature corresponding to the demand.
FULL SCR control is recommended where FINE temperature control is required.



Full SCR Control Electric Diagram



Full SCR Load Diagram

Note: All Thermolec controllers are equipped with a zero-cross thyristor switching system that virtually eliminates all Electro-magnetic interference (EMI) et radio frequency interference (RFI).
The Light Emitting Diode (LED) on the controller indicates when the heating element is on.

STEP 3 - (continued)

HYBRID or VERNIER CONTROL - Principles

Where FINE control accuracy is required and the heater capacity is too high to be handled economically by "FULL SCR", (80 Amps max.), Thermolec recommends a combination of a smaller SCR and a step controller, both being controlled by the same input signal. In this system, the "SCR" is the modulating heating stage. The other heating stages are controlled by the Thermolec electronic step controller. **D46 (the Sequential mode).**

The SCR stage automatically fills the gaps between the step controlled stages, thus providing fully proportional control over the entire heater range.

In applications where the heated air is delivered to the space without proper mixing and stratification is a problem, it is preferable to use the sequential mode and specify "FULL FACE" staging (each stage covers the entire duct face area) when the heater capacity is below 12 KW/sq.ft. Otherwise the binary mode (more economical) is recommended above 12 KW/sq.ft.

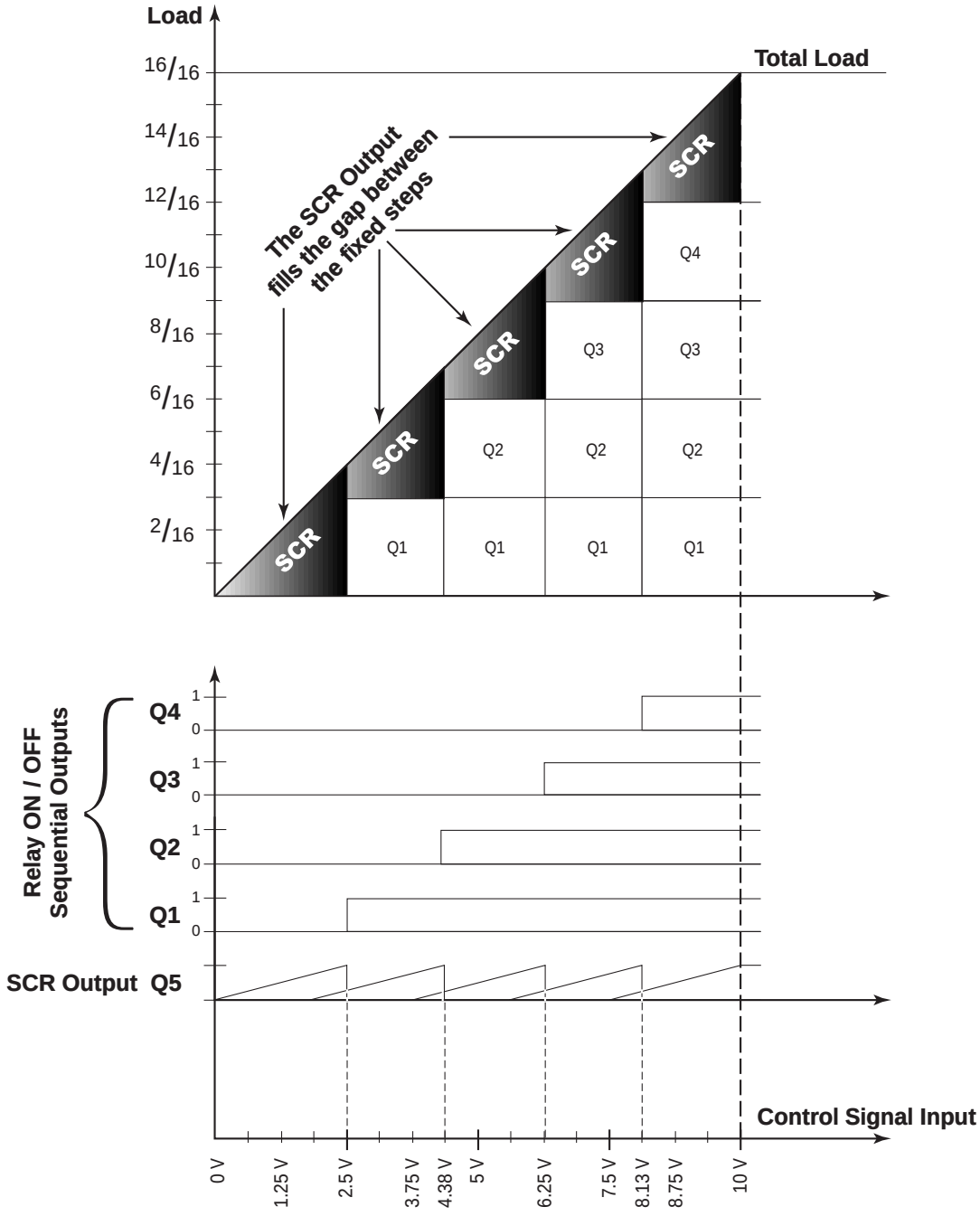
TYPICAL DIVISION OF STEPS - Hybrid control				
	Sequential mode	**Sequential staging for a 160 KW heater.**		
SCR Step	2/6	SCR Step	2/6	53.33 KW
Step 1	1/6	Step 1	1/6	26.66 KW
Step 2	1/6	Step 2	1/6	26.66 KW
Step 3	1/6	Step 3	1/6	26.66 KW
Step 4	1/6	Step 4	1/6	26.66 KW

Input voltage	KW output	Fixed steps “ON” and SCR
from 0 to 3.3 V	0 to 53.33 KW	The variable SCR step covers the heat demand
from 3.3 to 4.99 V	53.33 to 79.99 KW	step 1 + SCR (26.66 fixed + 53.33 SCR)
from 4.99 to 6.65 V	79.99 to 106.66 KW	step 1 + step 2 + SCR (53.33 fixed + 53.33 SCR)
from 6.65 to 7.81 V	106.66 to 133.32 KW	step 1 + step 2 + step 3 + SCR (79.99 fixed + 53.33 SCR)
from 7.81 to 10 V	133.32 to 160 KW	step 1 + step 2 + step 3 + step 4 + SCR (106.66 fixed + 53.33 SCR)

STEP 3 - (continued)

Since the SCR step is kept relatively small (53.3 Kw), it is still cost effective compared to a full SCR 160 KW.

In the following graphic, the sequential loads are switched ON and OFF to match the heat demand. Lay a straightedge vertically at any position of the control input voltage and find exactly which stages are ON or OFF. The SCR not only fill the gaps but overlaps the gaps between the fixed steps at all times.



Hybrid Sequential Load Diagram

STEP 3 - (continued)

HYBRID CONTROL - Binary Mode

Binary staging for a 160 KW heater.

SCR Step	1/16	10 KW
Step 1	1/16	10 KW
Step 2	2/16	20 KW
Step 3	4/16	40 KW
Step 4	8/16	80 KW

In this example, the control voltage 0-10 Volts DC is divided by 16 which gives an increment of 0.625 Volts per 10 KW step.

Here is how it works, in increments of 10 KW and .625 V input voltage:

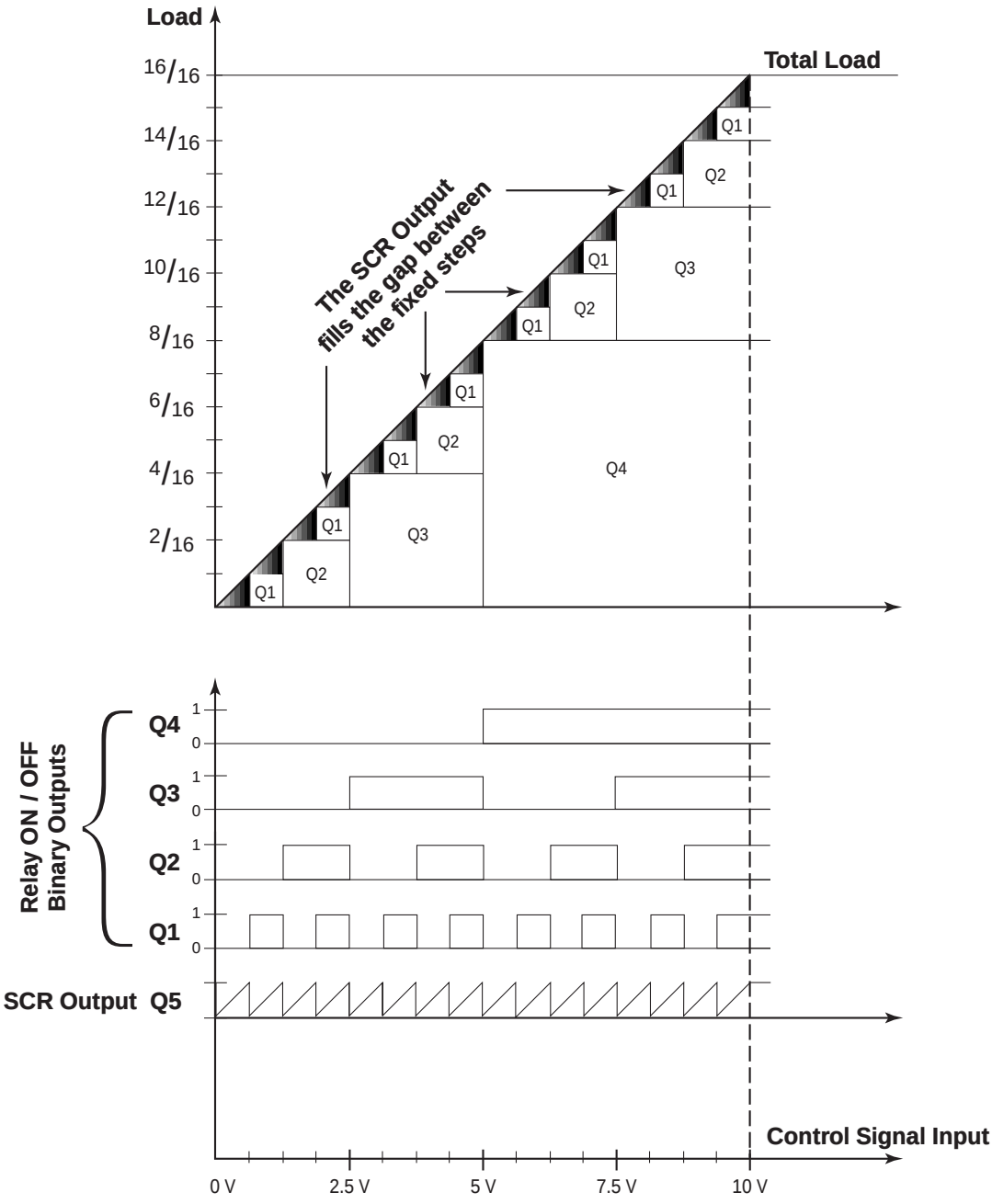
Input voltage	KW output	Fixed steps on and SCR
from 0 to .625 V	0 to 10 KW	The variable SCR step covers the heat demand
from .625 to 1.25 V	10 to 20 KW	step 1 + SCR (10 fixed + 10 SCR)
from 1.25 to 1.875 V	20 to 30 KW	step 2 + SCR (20 fixed + 10 SCR)
from 1.875 to 2.5 V	30 to 40 KW	step 1 + step 2 + SCR (30 fixed + 10 SCR)
from 2.5 to 3.125 V	40 to 50 KW	step 3 + SCR (40 fixed + 10 SCR)
from 3.125 to 3.75 V	50 to 60 KW	step 3 + step 1 + SCR (50 fixed + 10 SCR)
from 3.75 to 4.375 V	60 to 70 KW	step 3 + step 2 + SCR (60 fixed + 10 SCR)
from 4.375 to 5 V	70 to 80 KW	step 3 + step 2 + step 1+ SCR (70 fixed + 10 SCR)
from 5 to 5.625 V	80 to 90 KW	step 4 + SCR (80 fixed + 10 SCR)
from 5.625 to 6.25 V	90 to 100 KW	step 4 + step 1 + SCR (90 fixed + 10 SCR)
from 6.25 to 6.875 V	100 to 110 KW	step 4 + step 2 + SCR (100 fixed + 10 SCR)
from 6.875 to 7.5 V	110 to 120 KW	step 4 + step 2 + step 1 + SCR (110 fixed + 10 SCR)
from 7.5 to 8.125 V	120 to 130 KW	step 4 + step 3 + SCR (120 fixed + 10 SCR)
from 8.125 to 8.75 V	130 to 140 KW	step 4 + step 3 + step 1 + SCR (130 fixed + 10 SCR)
from 8.75 to 9.375 V	140 to 150 KW	step 4 + step 3 + step 2 + SCR (140 fixed + 10 SCR)
from 9.375 to 10 V	150 to 160 KW	step 4 + step 3 + step 2 + step 1 + SCR (150 fixed + 10 SCR)

Since the SCR step is kept small, it is cost effective compared to a full SCR 160 KW.

Hybrid Binary Load Diagram (Please see next page)

STEP 3 - (continued)

In the following graphic, the binary loads are switched ON and OFF to match the heat demand. Lay a straightedge vertically at any position of the control input voltage and find exactly which stages are ON or OFF. The SCR modulating step fills the gap between the fixed steps at all times.



Hybrid Binary Load Diagram

STEP 3 - (continued)

Summary of Temperature Control

1- Electric ON / OFF thermostats are available up to three stages for room or duct control and up to four stages for duct control only. Three and four stage thermostats are not recommended for FINE or MEDIUM temperature control because of their large differentials. However, they are suitable for COARSE control.

2- P.E. Switches with a pneumatic thermostat are recommended for up to four stages only and can be used for FINE as well as MEDIUM or COARSE control.

3- FULL SCRs are compatible with electronic or pneumatic signal. They are recommended where FINE temperature control and energy conservation is required. As a general guideline, it is economical to use Full SCR on heaters up to 70 Amps total load. Between 70 and 120 Amps, the cost is slightly more expensive and beyond 120 Amps Hybrid controllers are the best choice.

4- Hybrid controllers are compatible with electronic or pneumatic signal. They are recommended where FINE temperature control is required and where the heater capacity is too large to be controlled economically by a FULL SCR (over 120 Amps).

5- Thermolec is engaged in a countinuous effort of product development, hence, the following information is presented as a general overview of existing products and can be modified without further notice.

Notes:

a- Although ON/OFF stages can offer some economy, in most multi-stage (2 stages and over) applications up to 40 KW, SCR proportional control can be obtained at almost the same price. Please see selection of most economical KW / voltage combination on page 7.

b- In order to manage the energy resources properly and provide the best comfort, **Thermolec recommends specifying a proportional control at all times.**

ON/OFF Room Thermostats

24 volts wall thermostat, ON-OFF type with built-in thermometer and adjustable heat anticipator.

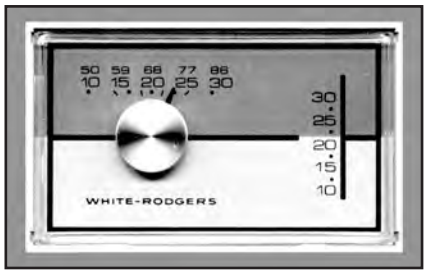
1 stage

T86 Honeywell

2 stages

T874 Honeywell

1 and 2 stages



1F30W-301 (1 stage) and 1F37-408 (2 stages) - White-Rodgers

STEP 3 - (continued)

Modulating Room Thermostats

RT

The Thermolec RT electronic modulating room thermostat is a thermistor proportional type that is compatible with all Thermolec electronic controls. ABS casing. Thermistor based, proportional control, two wire type, with built-in adjustable set point.
Standard range: 10 to 30 ˚C, (50 to 86 ˚F).

RT

RARS

RARS Remote (set point) **Adjuster + Room Sensor**
Similar to an RT but divided into a two controls: a room sensor without adjustment and a remote adjuster. Two wire sensor to be installed in the room (RS) in conjunction with a remote set point adjuster (RA) installed at customer is convenience.
Standard range: 10 to 30 ˚C, (50 to 86 ˚F).

ON/OFF Duct thermostats

Bulb thermostat

(Capillary type) with 5' capillary tube to be installed in the duct.
Designed for pilot duty service.
Available in 1 or 2 stages ON-OFF.
Standard range: -15 to + 35 ˚C (5 to 95 ˚F).

T678A Honeywell

1687-9 White-Rodgers

Bulb thermostat

(Capillary type) with 8' capillary tube to be installed in the duct.
Designed for pilot duty service.
Available in 1 stage ON-OFF.
Standard range: -34 to + 32 ˚C (-30 to 90 ˚F).

STEP 3 - (continued)

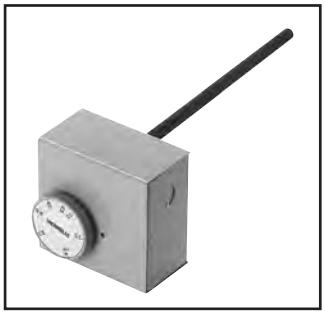
Modulating Duct Thermostats

DT

The Thermolec DT electronic modulating duct thermostat is a thermistor proportional type that is compatible with all Thermolec electronic controls. ABS casing for temperatures up to 65 ˚C. Metal casing for temperatures over 65 ˚C, two wire type, with built-in adjustable set point.

DT - ABS Casing

Model #	Range ˚C	˚F.
DT-1815	-18 - +15	0 - 59
DT-037	0 - 37	32 - 99
DT-1040	10 - 40	50 - 104
DT-3265	32 - 65	90 - 149
DT-6590	65 - 90	149 - 194
DT-80155	80 - 155	176 - 311

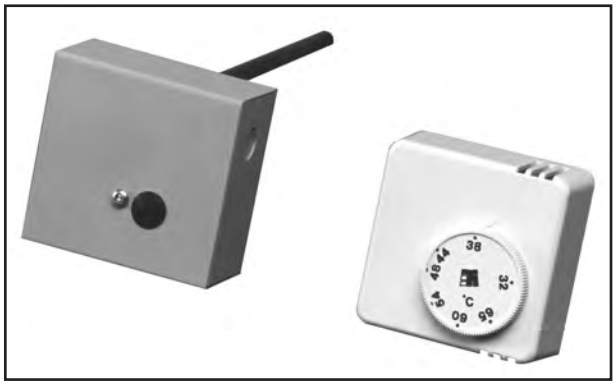


DT - Metal casing

RADS - ABS casing

RADS Remote (set point) **Adjuster + Duct Sensor**

Two wire sensor to be installed in the air duct (**DS**) in conjunction with a remote set point adjuster (**RA**) installed at customer's convenience.



RADS - Metal casing

Model #	Range ˚C	˚F.
RADS-1815	-18 - +15	0 - 59
RADS-037	0 - 37	32 - 99
RADS-1040	10 - 40	50 - 104
RADS-3265	32 - 65	90 - 149
RADS-6590	65 - 90	149 - 194
RADS-80155	80 - 155	176 - 311

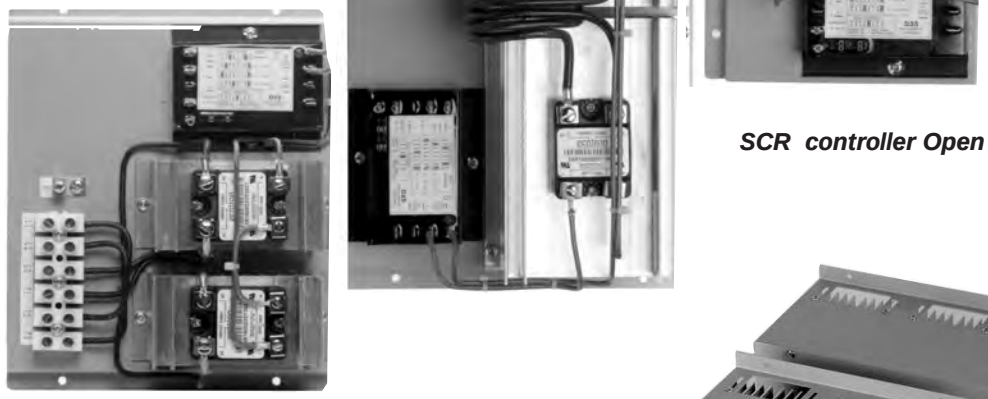
STEP 3 - (continued)

SCR Controller

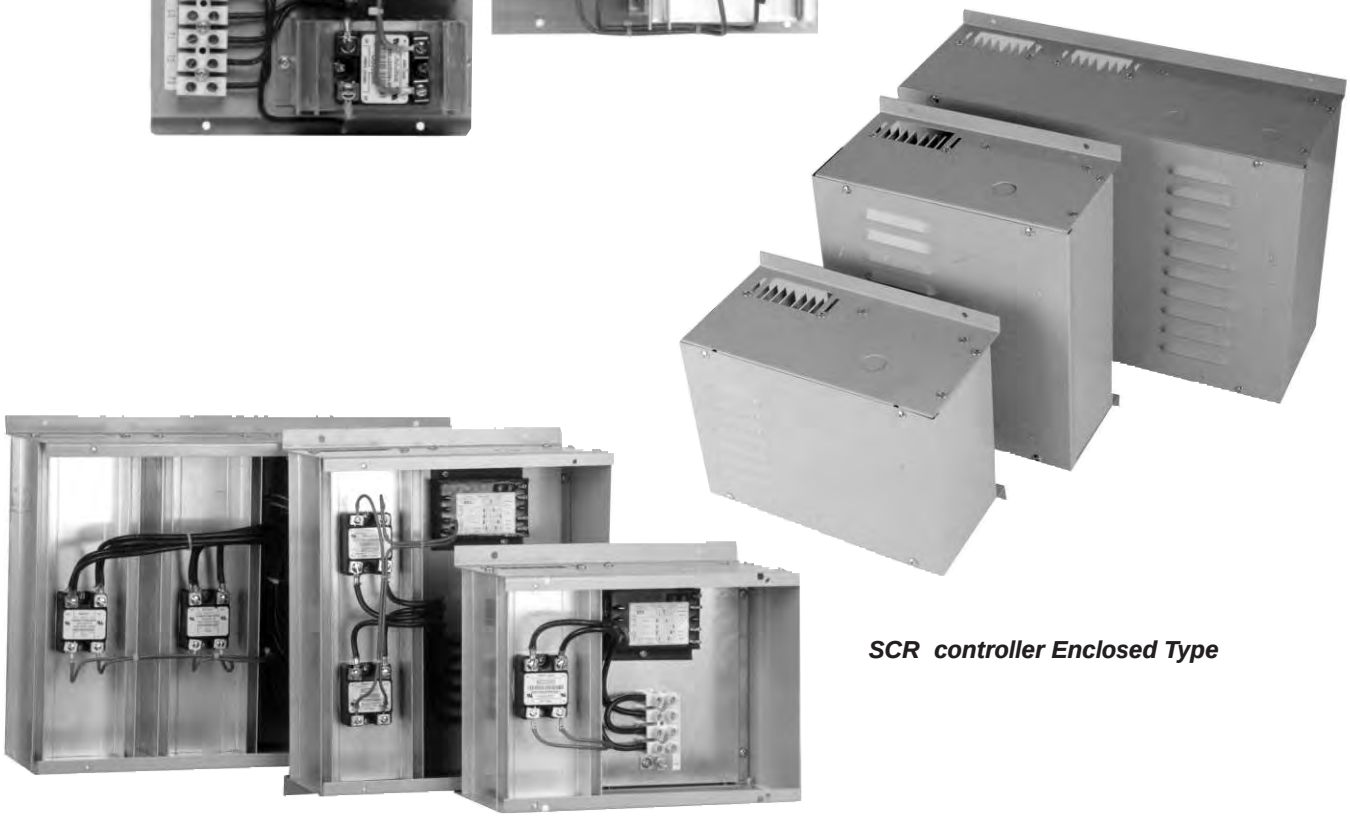
The SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand.

Input: Thermistor thermostat (RT or DT),
0 - 10 VDC, 4 - 20 mA, 0 - 135 Ohms.

Output: Single or three phases load,
20, 30, 40 and 80 Amps @ 600 V. max



SCR controller Open Type



SCR controller Enclosed Type

Warranty

1- Thermolec Ltd. guarantees their heater resistance elements and other built-in components against any defect in workmanship and material for a period of one year, effective date of shipment from it's factory.
Any claim under this guarantee will be considered only if the product has been installed and operated in accordance with Thermolec's instructions.

2- Thermolec's responsibility will be limited in any case to the replacement or repair, at its factory or in the field, by its own personnel or through others, at its option, of such heaters or parts thereof that shall prove to be defective within one year from shipment.

3- Misuse of this product, or repairs made by others without Thermolec's authorization, will void this warranty.

4- Thermolec shall not be held responsible for damage or delays and shall not be held liable for any charges resulting from the removal or replacement of the allegedly defective heater.

5- Thermolec shall not be held responsible for any incidental or consequential damage or delays due to workmanship or material. No additional charge will be accepted for repair, replacement or modification if prior written authorization was not obtained from Thermolec.

6- Any control device or accessory, supplied with the heater, to be mounted or connected remotely, will only be guaranteed by the manufacturer per conditions stated in clause 5.

SPECIFICATION FOR OPEN COIL HEATERS

Long Form

Supply where indicated in these specifications, or where shown on drawings, CSA (NRTL/C) approved open coil duct heaters as manufactured by THERMOLEC.

☛ 1- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
- Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
- Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.

☛ 2- SAFETY CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc-type thermal cut-out(s) located in the top frame component above the heating elements.
- In addition to the automatic reset cut-out, heaters of 30KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe manual reset disc-type thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA.
- The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.
- Cut-outs shall de-energize the heater in case of insufficient air flow.
- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location (option X1) and protective screens on both sides (option MS).
- Load fuses shall be supplied as recommended by NEC (National Electrical Code).
- When heaters are used in VAV systems, they should be modulating type ***"THERMO-V"*** equipped with an electronic air flow sensor as described in item #8.

☛ 3- AIR FLOW:

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.
- Heaters shall be CSA approved for zero clearance in horizontal ducts.

☛ 4- MOUNTING METHOD:

- Heaters shall be open coil model SC slip-in type or model FC flanged type, as shown on the plans or on the coil schedule.
- Slip-in heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side.
- Flanged heaters shall be suitable for attaching to matching flanges on the duct.
- Mounting flanges on both models shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phases, kilowatt and number of control stages shall be as per heater schedule.

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipping, heaters shall withstand tests as required by CSA.

Long Form (continued)

☛ 7- STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:

- High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

Additional options can be chosen from the following list:

- Mercury contactors
- Unfused disconnect switch
- SCR proportional controller
- HRC Form 1 load fuses
- Hybrid controller with SCR and binary steps
- Pressure Electric switches
- Pneumatically controlled SCR
- Pilot lights to indicate staging, power supply on, overheating, no air flow, heating on

Note: it is also possible to order a separate CEMA-1 remote control panels (option M6)* with the above options.
* Remote mounting control panel must include HRC Form 1 load fuses in order to provide over-current protection for each duct heater power circuit.

☛ 8- HEATERS FOR VAV SYSTEMS:

- **Duct heaters for VAV systems will be electronic modulating type "THERMO-V", equipped with a proportional controller to modulate the total heater load according to the temperature control signal and a proportional electronic air flow sensor (non pressure dependent type) to modulate the heater capacity according to the available air flow:**
  Maximum heating with normal air flow
  Reduced heating with low air flow
  No heating with no air flow

Please refer to the Thermo-V flyer and specification at the end of this section.

☛ 9- SPECIAL CONSTRUCTION:

- Heaters could be equipped with a bottom terminal box, weatherproof shroud or any other feature selected from the option list (see section 2).

☛ 10- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

Short Form

- Supply where indicated in these specifications CSA (NRTL/C when required) approved duct heaters as manufactured by THERMOLEC.

- Coils shall be of High Grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminal pins shall be stainless steel insulated by means of non-rotating ceramic bushings.

- Heaters shall be model SC slip-in type, as shown on the plans or on the heater schedule. Heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side. Mounting flanges shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

- All duct heaters shall be equipped with fail-safe, automatic reset and manual reset disc-type thermal cut-outs, as required by CSA.

- Cut-outs shall be shielded from accidental impact, and shall de-energize the heater in case of insufficient air flow.

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts. Heaters shall be CSA approved for zero clearance in horizontal ducts.

- Duct heaters shall be equipped with magnetic contactors as required, 24 volts transformer, airflow sensor, …(room thermostat, duct thermostat, SCR control, load fuses, solid state relays, mercury contactors, pilot lights, protective screens, etc).

- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location (option X1) and protective screens on both sides (option MS).

- Load fuses shall be supplied as required by local codes.

- **Duct heaters for VAV systems will be electronic modulating type “THERMO-V”, equipped with a proportional controller to modulate the total heater load according to the temperature control signal and a proportional electronic air flow sensor (non pressure dependent type) to modulate the heater capacity according to the available air flow:**
  Maximum heating with normal air flow
  Reduced heating with low air flow
  No heating with no air flow

THERMOLEC THERMOLEC 0PEN COIL HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH x HEIGHT		kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6	*Examples :*											
7	RH - 1	SC	1	12	10	5	600/3	1	600	25	24	1 - 2 - 3 - 17
8	RH - 2	SC	1	48	36	60	600/3	1	2000	90	24	1 - 2 - 3 - 7 - 18

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

➤ Required Options

1 ➤ Built-in disconnect switch
2 ➤ SCR proportional controller
3 ➤ Screens both sides
4 ➤ Pneumatically controlled SCR
5 ➤ Solid State Relay (TRIAC)
6 ➤ Hybrid controller (SCR + step controller)
7 ➤ Load fuses, HRC type
8 ➤ Mercury contactors
9 ➤ Pressure electric switch
10 ➤ Low watts density elements
11 ➤ Pilot lights
12 ➤ Full break contactors
13 ➤ Nema 4 control box
14 ➤ _____
15 ➤ _____
16 ➤ _____
17 ➤ Electronic room thermostat RT
18 ➤ Electronic duct thermostat DT
19 ➤ Remote adjustable duct sensor RADS
20 ➤ Remote adjustable room sensor RARS

SPECIFICATION FOR TUBULAR HEATERS

Long Form

Supply where indicated in these specifications CSA (NRTL/C) approved tubular duct heaters as manufactured by THERMOLEC.

☛ 1- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Heating elements shall be tubular type made of heavy gauge Incoloy 800 filled with compacted magnesium oxide insulating powder.
- Above 277 Volts or 30KW, each tube shall be of "U" type and shall be removable through the control box without removing the heater from its ductwork.

☛ 2- SAFETY CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc-type thermal cut-out(s) located in the top frame component above the heating elements.
- In addition to the automatic reset cut-out, heaters of 30 KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe manual reset disc-type thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA.
- The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.
- Cut-outs shall de-energize the heater in case of insufficient air flow.
- For maintenance and safety purposes, a built-in disconnect shall be supplied to switch the power off at the heater location.
- Load fuses shall be supplied as required by NEC (National Electrical Code).

☛ 3- AIR FLOW:

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts.

☛ 4- MOUNTING METHOD:

- Heaters shall be ST slip-in type or model FT flanged type, as shown on the plans or on the heater schedule.
- Slip-in heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side.
- Flanged heaters shall be suitable for attaching to matching flanges on the duct.
- Mounting flanges on both models shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phase kilowatt and number of control stages shall be as per heater schedule.

Long Form (continued)

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipping, heaters shall withstand tests as required by CSA.

☛ 7- STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:

- High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

Additional options can be chosen from the following list:

- Mercury contactors
- Unfused disconnect switch
- SCR proportional controller
- HRC Form 1 load fuses
- Hybrid controller with SCR and binary steps
- Pressure Electric switches
- Pneumatically controlled SCR
- Pilot lights to indicate staging, control voltage on, power supply on, overheating, no air flow, heating on

☛ 8- SPECIAL CONSTRUCTION:

- Heaters could be equipped with a bottom terminal box, weatherproof shroud or any other feature selected from the option list (see section 2).

☛ 9- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

SPECIFICATION FOR TUBULAR HEATERS

Short Form

- Supply where indicated in these specifications CSA (NRTL/C when required) approved duct heaters as manufactured by THERMOLEC.

- Heating elements shall be tubular type made of heavy gauge Incoloy 800 filled with compacted magnesium oxide insulating powder.
  Above 277 Volts or 30KW, each tube shall be of "U" type and shall be removable through the control box without removing the heater from its ductwork.

- Heaters shall be ST slip-in type, as shown on the plans or on the heater schedule.
  Heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side. Mounting flanges shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

- All duct heaters shall be equipped with fail-safe disc-type thermal cut-outs, automatic reset and manual reset as required by CSA.

- Cut-outs shall be shielded from accidental impact, and shall de-energize the heater in case of insufficient air flow.

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts.

- Duct heaters shall be equipped with magnetic contactors as required, 24 volts transformer, airflow sensor, …(room thermostat, duct thermostat, SCR control, load fuses, solid state relays, mercury contactors, pilot lights, protective screens, etc).

- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location.

- Load fuses shall be supplied as required by local codes.

THERMOLEC

THERMOLEC TUBULAR HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH	x HEIGHT	kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6	***Examples :***											
7	RH - 1	ST	1	12	10	5	600/3	1	600	25	24	1 - 2 - 17
8	RH - 2	ST	1	48	36	60	600/3	1	2000	90	24	1 - 2 - 7 - 18

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer and PDS as standard components.

➤ Required Options

1 ➤ Built-in disconnect switch
2 ➤ SCR proportional controller
3 ➤ Screens both sides
4 ➤ Pneumatically controlled SCR
5 ➤ Solid State Relay (TRIAC)
6 ➤ Hybrid controller (SCR + step controller)
7 ➤ Load fuses, HRC type
8 ➤ Mercury contactors
9 ➤ Pressure electric switch
10 ➤ Low watts density elements

11 ➤ Pilot lights
12 ➤ Full break contactors
13 ➤ Nema 4 control box
14 ➤ _____
15 ➤ _____
16 ➤ _____
17 ➤ Electronic room thermostat RT
18 ➤ Electronic duct thermostat DT
19 ➤ Remote adjustable duct sensor RADS
20 ➤ Remote adjustable room sensor RARS

THERMO-V SPECIFICATION

Supply where indicated in these specifications, or where shown on drawings, CSA (NRTL/C) approved THERMO-V type heaters specially designed for VAV boxes and manufactured by THERMOLEC.

☛ 1- AIR FLOW:

- The proportional electronic air flow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available air flow:
  The heaters shall deliver maximum heating when needed with normal minimum air flow, reduce heating with lower than minimum air flow and stop heating with no air flow.

☛ 2- CONTROL AND INPUT SIGNAL:

- Heaters shall be equipped with a proportional controller to modulate the heater load according to the temperature control signal.
  The electronic controller shall be compatible with the following input signals:
  - Variable voltage signal 0-10 VDC
  - Pulse with modulation AC or DC

☛ 3- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
- Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
- Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.
- Heaters shall be CSA approved for zero clearance in horizontal ducts.

☛ 4- SAFETY AND BUILT-IN CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc thermal cut-out.
- In addition, heaters of 30KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe disc type manual reset thermal cut-out as required by CSA.
- Cut-outs shall de-energize the heater in case of accidental over-heating.
- For maintenance and safety purposes, the heaters shall be equipped with a built-in disconnect to switch the power off at the heater location and protective screens on both sides.
- Load fuses shall be supplied as recommended by NEC (National Electrical Code).
- All duct heaters shall be complete with the following built-in controls : magnetic contactors as required, control transformer, proportional electronic controller and air flow sensor as standard components.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phase, kilowatts shall be as per the following schedule.

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipment, heaters shall withstand tests as required by CSA.

☛ 7- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

THERMOLEC

THERMO-V ELECTRIC HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH	x HEIGHT	kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13	***Example :***											
14	RH - 1	SC	1	12	10	5	600/3	1	600	25	24	1 - 2

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer, SCR proportional controller, built-in disconnect switch and air flow sensor as standard components

➤ Required Options

1 ➤ Screens both sides

2 ➤ Load fuses, HRC type

3 ➤ Pneumatically controlled SCR

4 ➤ _____

5 ➤ _____

6 ➤ _____

THERMOLEC

Application Notes

OPEN COIL AND TUBULAR ELEMENTS CONSIDERATIONS

2060 Lucien Thimens Street
St-Laurent, Quebec H4R 1L1
Tel.: (514) **336-9130**
Fax: (514) 336-3270

Open coil and tubular elements considerations

THERMOLEC manufactures both open coil and tubular duct heaters.
It is widely acknowledged that tubular elements find practical application under certain circumstances (service conditions include possible contact by personnel, presence of dust or particles in the air flow or atmospheric conditions). Where duct air heating is the sole function, the open coil heater is superior for the reasons shown in the following comparison:

1-ELEMENT LIFE EXPECTANCY

The life expectancy of the nickel/chromium resistance wire in both the open coil and tubular elements is directly related to the maximum wire surface temperature experienced during operation. In an open coil heater, the passing air in direct contact with the wire easily dissipates the heat, thus reducing this surface temperature. In the tubular element, the heat from the enclosed resistance wire must travel through electrically insulating compacted magnesium oxide powder surrounding the coil and through a steel sheath before dissipation. To further compound the wire surface temperature problem of the tubular element, the limited space inside the sheath necessitates the use of smaller gauge resistance wire wound on a smaller arbor; hence a much higher wattage density per square inch of resistance wire becomes a necessary design evil. For example, 200 watts per square inch may be required for enclosed elements compared to 40 to 50 watts per square inch for open coil elements. The net result is that the resistance wire of the enclosed element, with a higher operating temperature, a higher wattage density and double insulation, may not last as long as the open coil element.

2-SERVICE CONSIDERATION

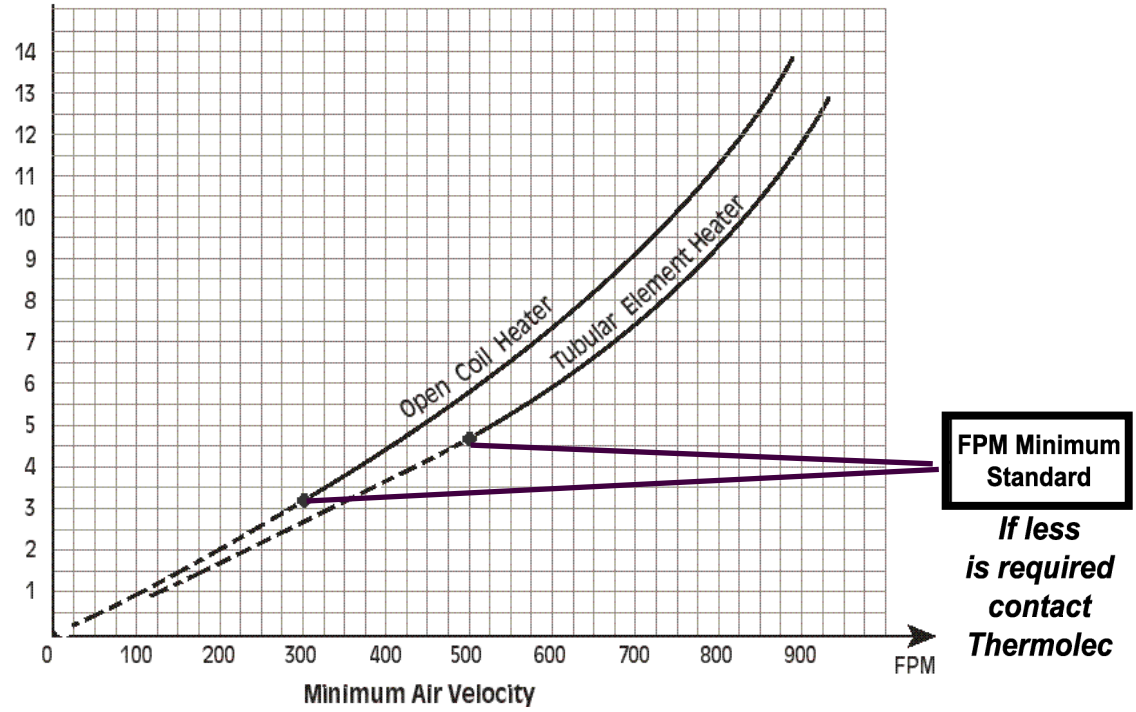
Contrary to common belief, the tubular element is not as robust and trouble-free as might be expected. Space limitations within the element casing require electrical clearances to be very small. This is a critical problem for elements with higher voltages, particularly if the insulating powder is not properly compacted. There always exists a danger that the magnesium oxide surrounding the element will absorb moisture, become conductive and short circuit the element to the sheath. Because of this problem, UL requirements have become much more stringent. A separate Standard (UL # 1030) on tubular elements was published containing strict requirements for the manufacturer of UL listed finned tubular elements. These requirements attempt to control the problems of magnesium oxide contamination and moisture absorption through frequently repeated tests. No such standards or tests are required for open coil elements.

3-SAFETY DEVICES

Should an open coil element overheat, a low mass, disc-type primary safety device immediately senses the higher temperature and switches the power off in a very short time. In the case of the tubular heater, there are multiple time delays. The thermal inertia of the coil, insulating material and sheath surface must be overcome. During the interim, the unsafe overheat conditions may damage or simply ruin the tubular element, making a tubular heater a less "forgiving" heating device.

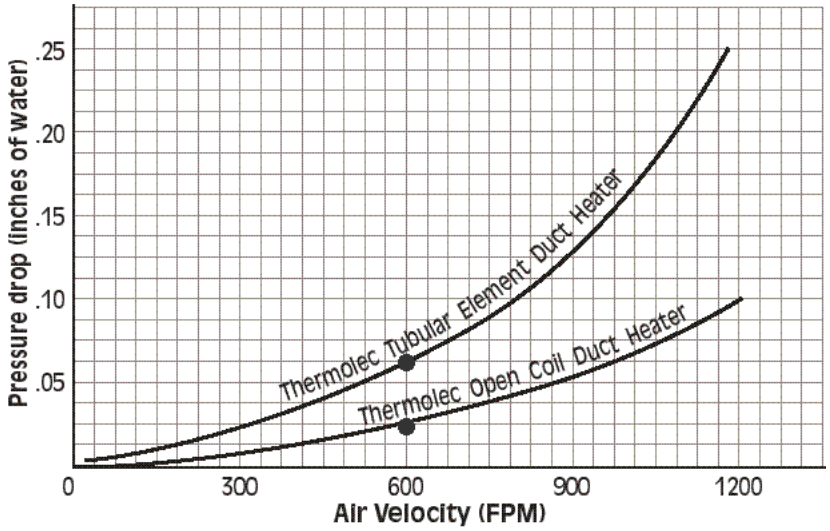
4-KILOWATTS PER SQUARE FOOT

Since tubular elements surface temperature lag behind the resistance wire temperature due to mass and insulation, and in order not to exceed the maximum temperatures allowed by UL, a tubular duct heater is not permitted to have the same concentration of wattage as an open coil heater. Thermolec open coil duct heaters have listing of 22.5 KW per square foot. For tubular duct heaters, the limitation is usually about 13KW per square foot.



5-PRESSURE DROP

Open coil heaters cause a smaller static pressure drop than do tubular heaters. This may permit the use of a smaller blower with resultant energy savings. A typical tubular heater with 600 feet/minute face velocity has .60 inches of water pressure drop, while the same size open coil heater with the same face velocity has only .03 inches of water pressure drop.



6-WEIGHT

Open coil duct heaters weigh considerably less than comparable tubular heaters, hence they offer additional cost savings in packing, shipping, installation and installation hardware.

7-WIRE SURFACE TEMPERATURE

A well-designed open coil element operates "in the black", at a temperature range of 750ºF to 900ºF. The tubular element is designed for a surface temperature of similar magnitude, but this requires the surface temperature of the inner coil portion to often exceed 1600ºF. Element durability is sacrificed in the normal design of the sheathed element.

8-SUSCEPTIBILITY TO MOISTURE

The structure which supports tubular elements must allow for the movement of the elements as they expand and contract from heating and cooling.
Moisture, when present, can easily be absorbed from the terminal end into the core of the element where it combines with the moisture-thirsty magnesium oxide powder into a conductive form of magnesium oxide. When this occurs, the enclosed element may develop an internal short and fail, becoming a hazard.
Open coil elements wire are electrically insulated by thick ceramic bushings which have five to ten times the electrical clearances of the typical tubular type element. The open coil element has been proven reliable in air with 100% relative humidity in laboratory tests, and in years of less-than-ideal field service conditions. Testing proved that a 600V open coil heater, after total immersion of the elements in water, functioned without fault.

9-PRICE

Heaters equipped with tubular elements are considerably more costly in materials, tooling and labor to produce than are comparable open coil heaters, hence they must be sold at a higher price. The only exception could be mass-produced heaters of standard wattage increments; however, such heaters do not give the design engineer the flexibility of choosing from an infinite variety of electrical ratings and dimensions as in the case of the open coil heater.

10-CONCLUSION

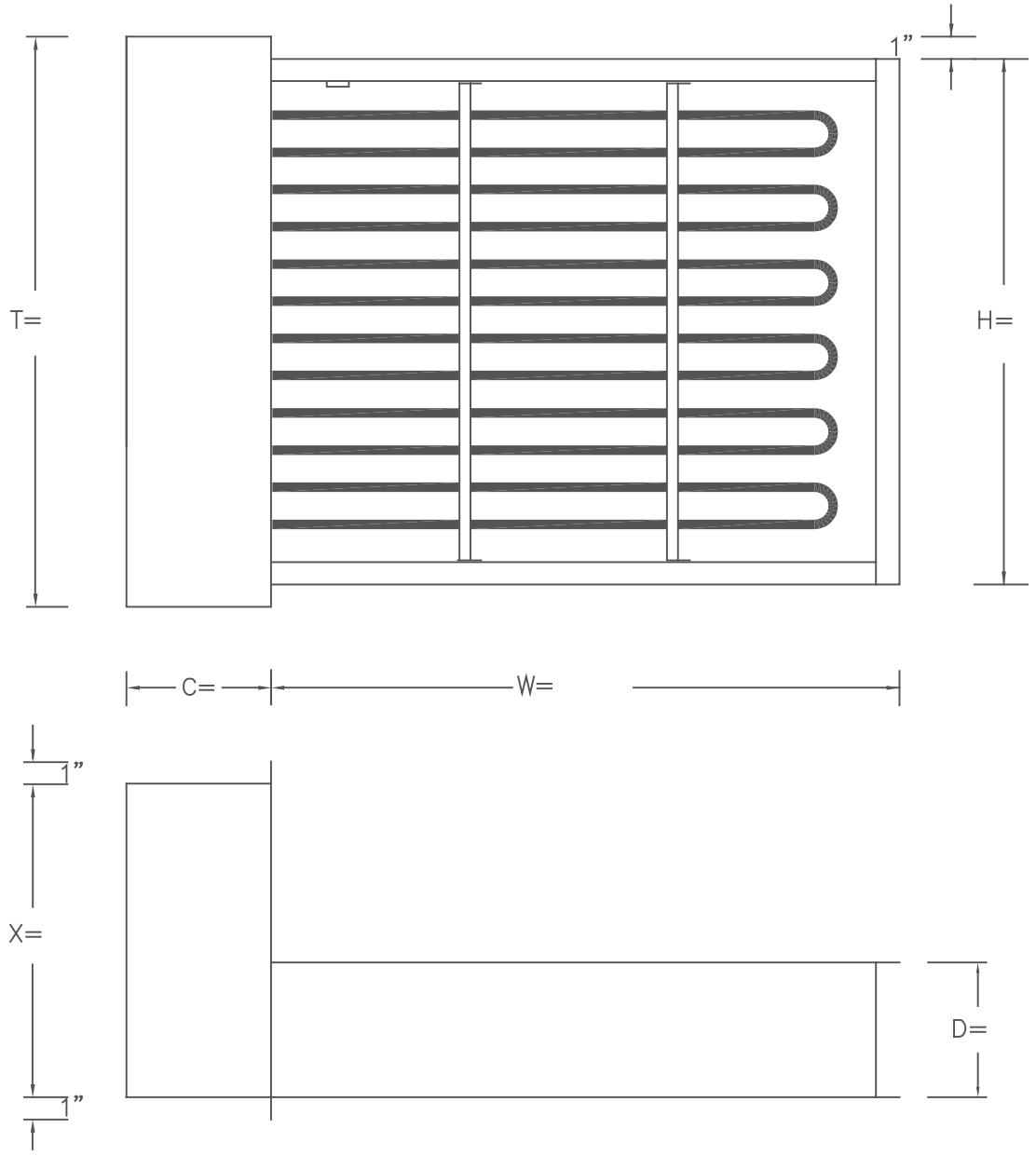
In summary, the advantages of the open coil heaters over the tubular element heaters for duct heating applications include:

- Longer life
- More kilowatts per square foot
- Lower wire surface temperature
- Less maintenance
- Increased safety and larger electrical clearances
- Less pressure drop
- Lighter weight
- Lower shipping costs
- Less sensitivity to moisture
- More flexibility in size and capacity
- Lower cost
- Smaller size

Selection guide for heating elements

Following are a few factors commonly used to determine the choice of construction.

FACTOR	OPEN COIL	TUBULAR	FINNED TUBULAR
COIL TEMPERATURES	Resistance coil, exposed directly to airstream, runs cooler than coils imbedded in sheathed elements.	Tubes run hotter than open coil or finned tubular. Temperatures are kept within safe limits by reducing watt densities.	Finned tubes run hotter than open coil, but cooler than tubular due to heat transfer effect of fins.
AIRFLOW UNIFORMITY	Airflow must be uniformly distributed to prevent hotspots. Pressure plates can help even out airflow.	Less susceptible to hotspots than open coil, but more susceptible than finned tubular.	Finned tubulars heaters are most tolerant of nonuniform airflow. Hotspots tend to be dissipated by sheath and fins.
PRESSURE DROPS	Lowest pressure drop due to large percentage of open space.	Highest pressure drop because of high percentage of space occupied by tubes.	Lower pressure drop than tubular, but higher than open coil.
ELECTRICAL CLEARANCES	Large clearances between live parts and ground enable open coil heaters to withstand severe applications.	Clearances between live parts and sheath are small, but filled with compacted insulation.	Clearances between live parts and sheath are small, but filled with compacted insulation.
AIR QUALITY	Use only with clean air free of conductive particles or water spray. To a certain extent humid air is acceptable.	Can be used with virtually any of atmospheric conditions.	Can be used with air containing water droplets or conductive particles unless particles are likely to build up between fins.
OUTLET AIR TEMPERATURE	1200ºF. maximum	1200ºF. maximum	600ºF. maximum
MECHANICAL STABILITY	Open coil heaters are-most susceptible to damage due to physical abuse.	Tubular heaters are least susceptible to damage due to physical abuse.	Finned tubular heaters can withstand more physical abuse than open coil.
CONTROLLABILITY	Open coil heaters respond quickly to step control because of low thermal inertia. This can produce temperature fluctuations if control system does not compensate.	Thermal inertia greater than open coil, but less than finned tubular.	Higher thermal inertia makes finned tubular heaters slower to respond, but can produce more uniform temperatures if control system is properly designed.
SAFETY	Since element is electrically live, it is advisable and safer to order protective screen at all times, if element may be touched by conductive material or accidentally by personnel.	Because the coil is enclosed in a grounded metal sheath, electrical shock hazard due to accidental contact does not exist.	Because the coil is enclosed in a grounded metal sheath, electrical shock hazard due to accidental contact does not exist.
COST	For most applications, open coil heaters are more economical because manufacturing operations are simpler.	Generally most expensive of the three because of conservative, high temperature design.	Generally more expensive than open coil, but less expensive than tubular because watt densities are higher.
WEIGHT	The lightest of all 3 types.	Heavier than open coil. Additional support required for horizontally mounted units, especially for extra long heaters.	Heavier than open coil. Additional support required for horizontally mounted units, especially for extra long heaters.



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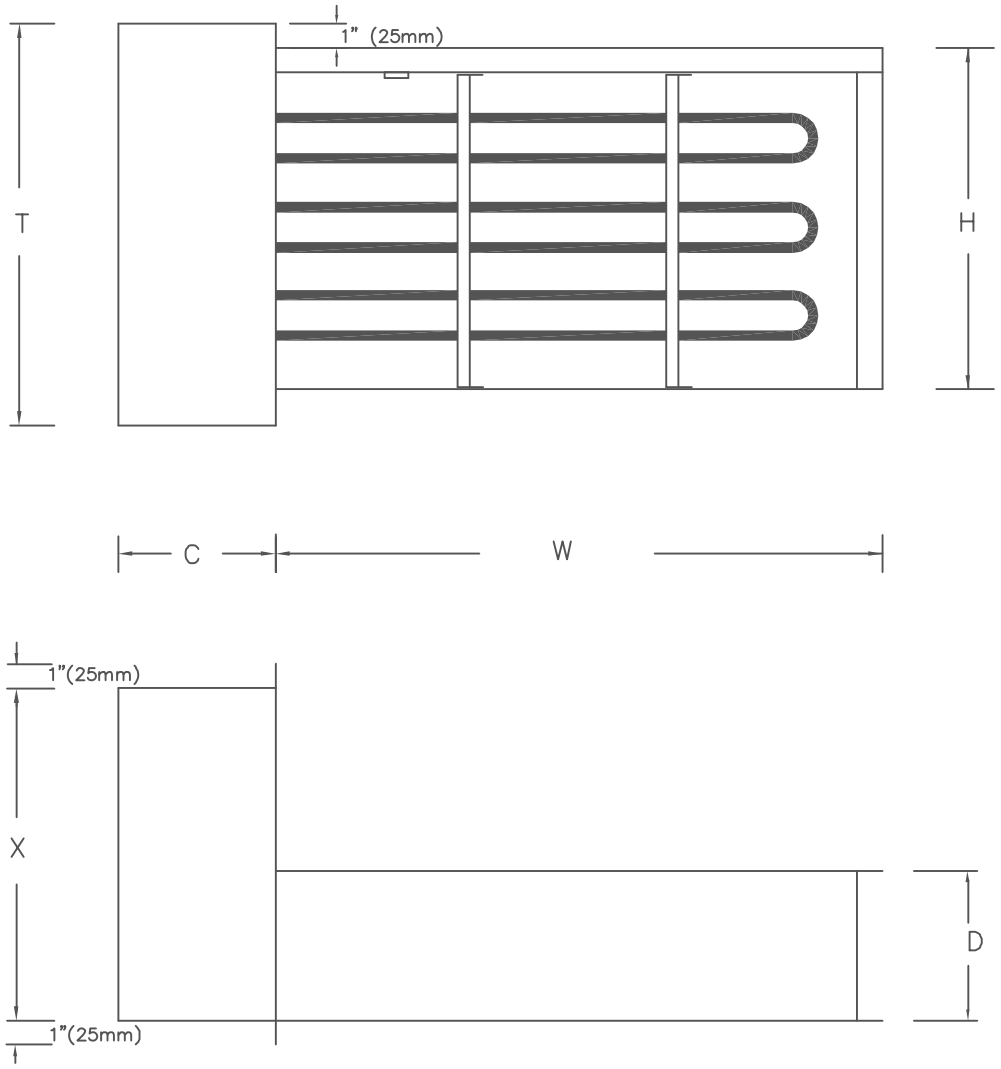
		DATE / PER



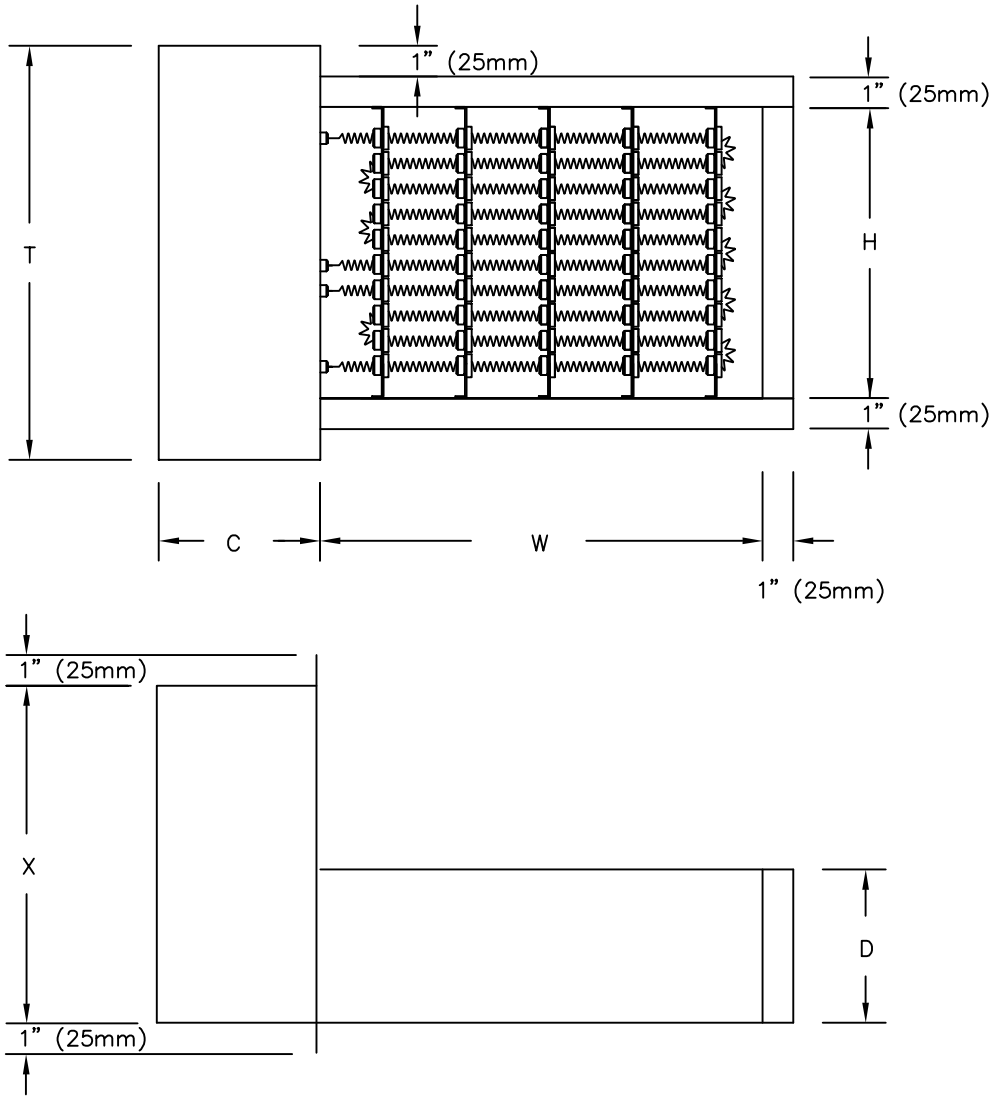
VUE DE HAUT
TOP VIEW

THERMOLEC

Title / Titre

Drawing number / Numéro de dessin

MST0



TOP VIEW
VUE DE HAUT

THERMOLEC

Title / Titre

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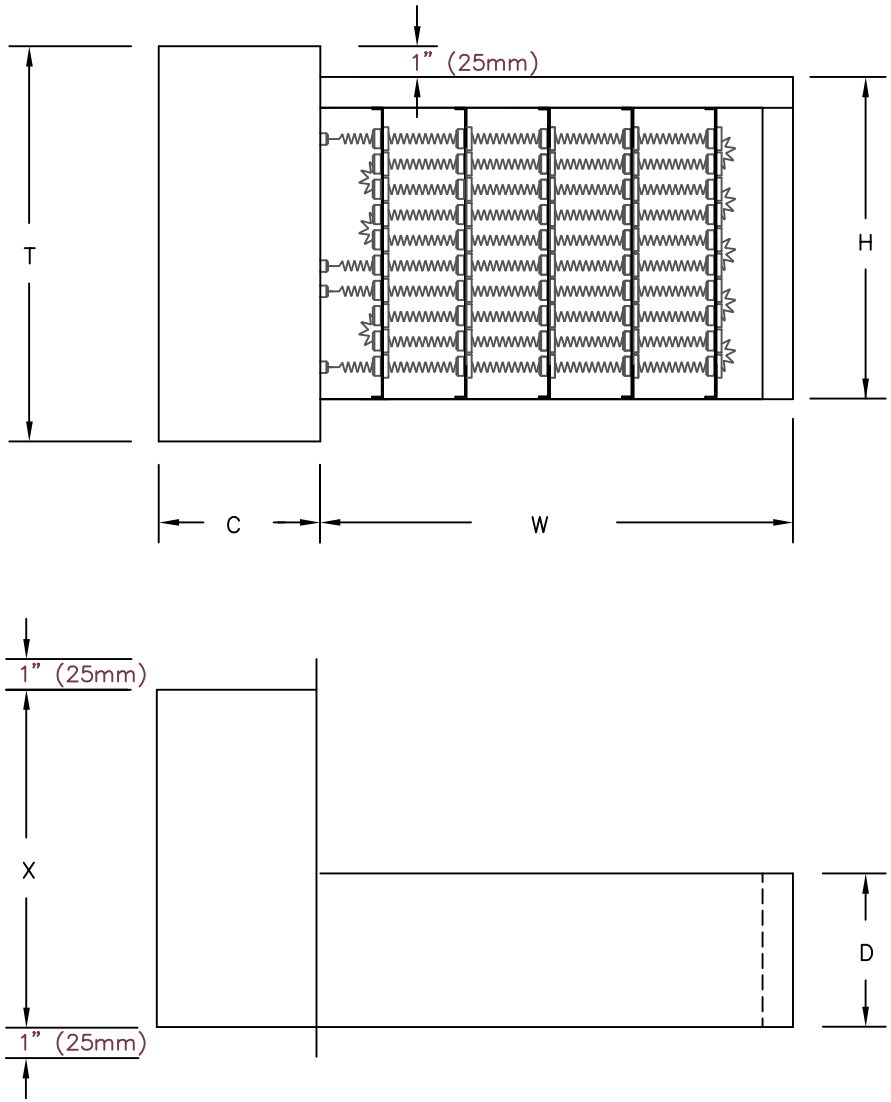

OP VIEW

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Title / Titre

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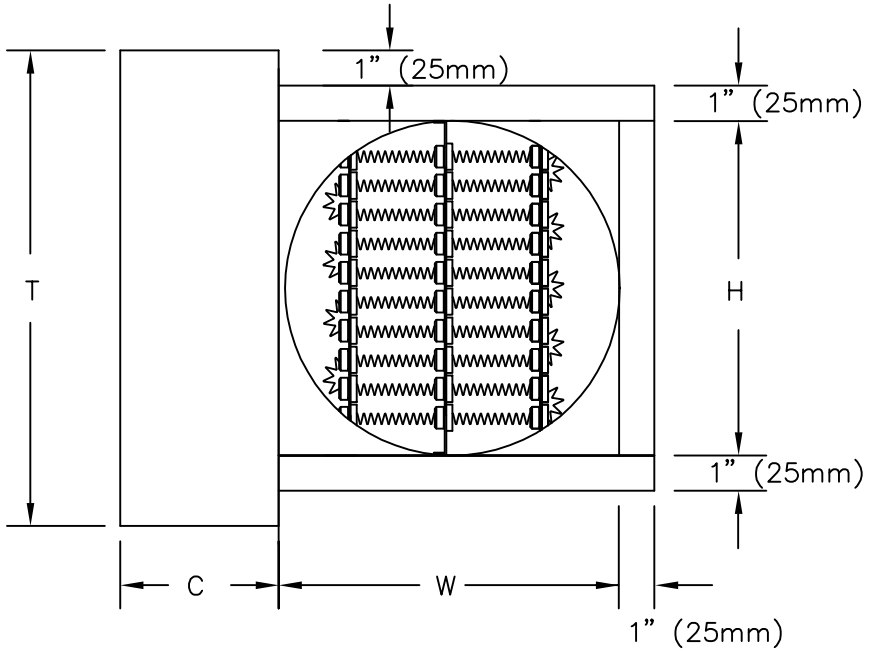
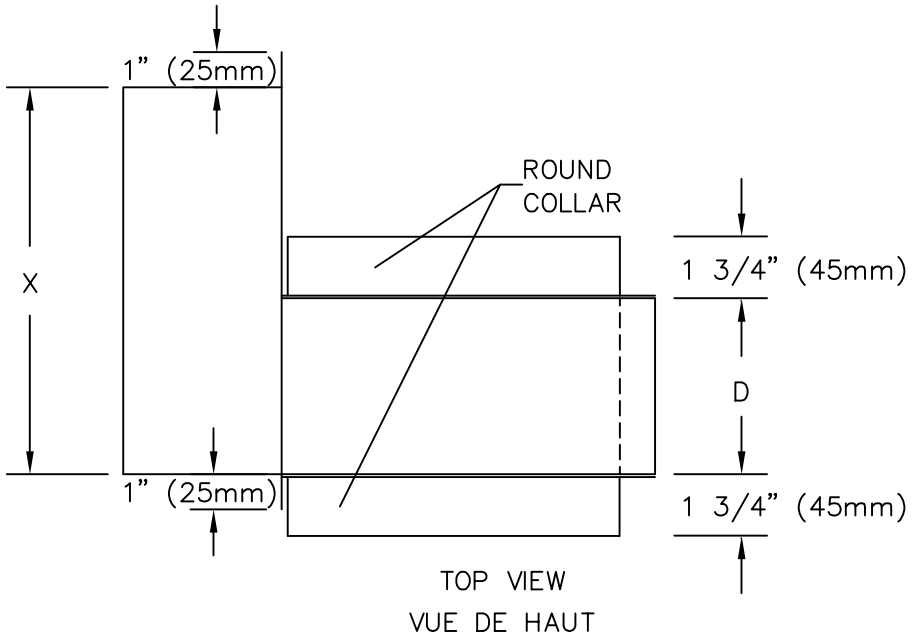




TOP VIEW
VUE DE HAUT

THERMOLEC

Title / Titre

Drawing number / Numéro de dessin

MRFC - 40LS - 0002 - 000G

THERMOLEC

2060, LUCIEN-THIMENS STREET,
MONTREAL, QUEBEC, CANADA,
H4R 1L1

TEL. : 1-800-336-9130
FAX : 1-800-336-3270
WEB : thermolec.com

ELECTRIC HEATING AND CONTROLS

Applications
and
Technical Notes
for

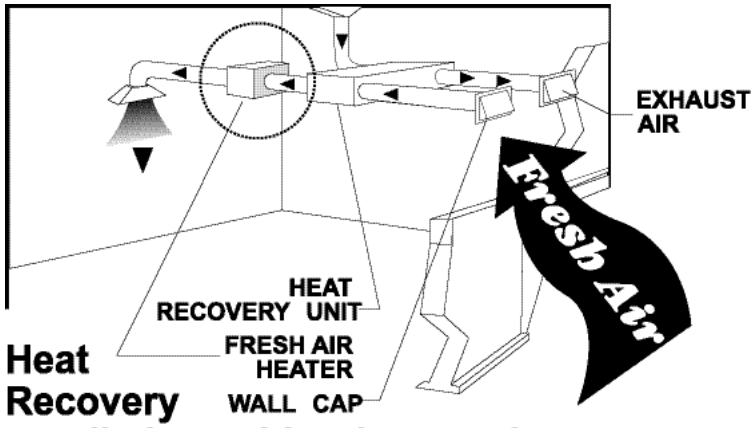
Thermo-Air **Fresh Air Heater**

Thermo-Zone **Zone Heater**

FRESH AIR HEATER

Application # 1

Thermo-Air complementing a heat recovery ventilation system.



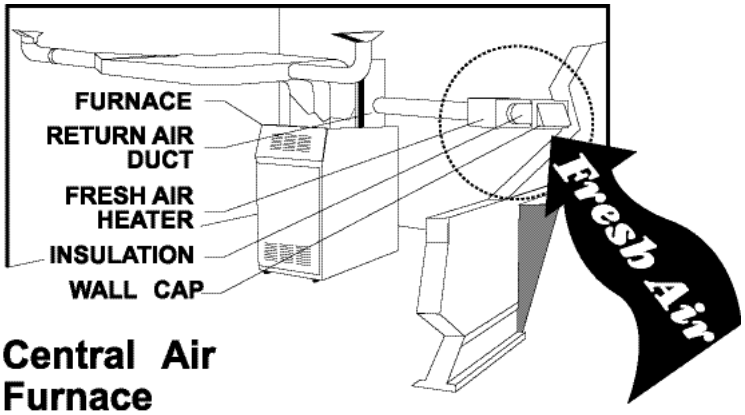
Heat Recovery Ventilation with Thermo-air

At low temperature, a heat recovery ventilation system cannot recover enough heat to pre-heat the incoming outside air to a comfortable level.
A ***THERMO-AIR*** heater is the ideal solution to restore efficiency to the system. It is equipped with an electronic controller that proportionally modulates the heating load to match the exact capacity required, thus minimizing operating cost. It's super-sensitive **air flow sensor**, monitors the quantity of air flowing through the heater, adjusts the heater's capacity to match the air flow available and shuts the heater down in case of a total loss of air.

Application # 2

Thermo-Air complementing a central forced-air heating system.

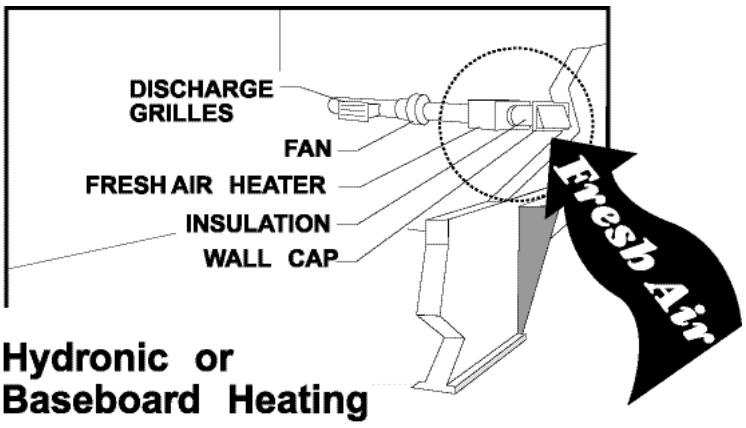
With an existing central forced-air heating system, the furnace fan can be used to bring new outside air into the system. Preheating that air at the source will improve the performance of the furnace and the life expectancy of the heat exchanger.
The ***THERMO-AIR*** heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.



Central Air Furnace

FRESH AIR HEATER

Application # 3
Fresh Air make-up.

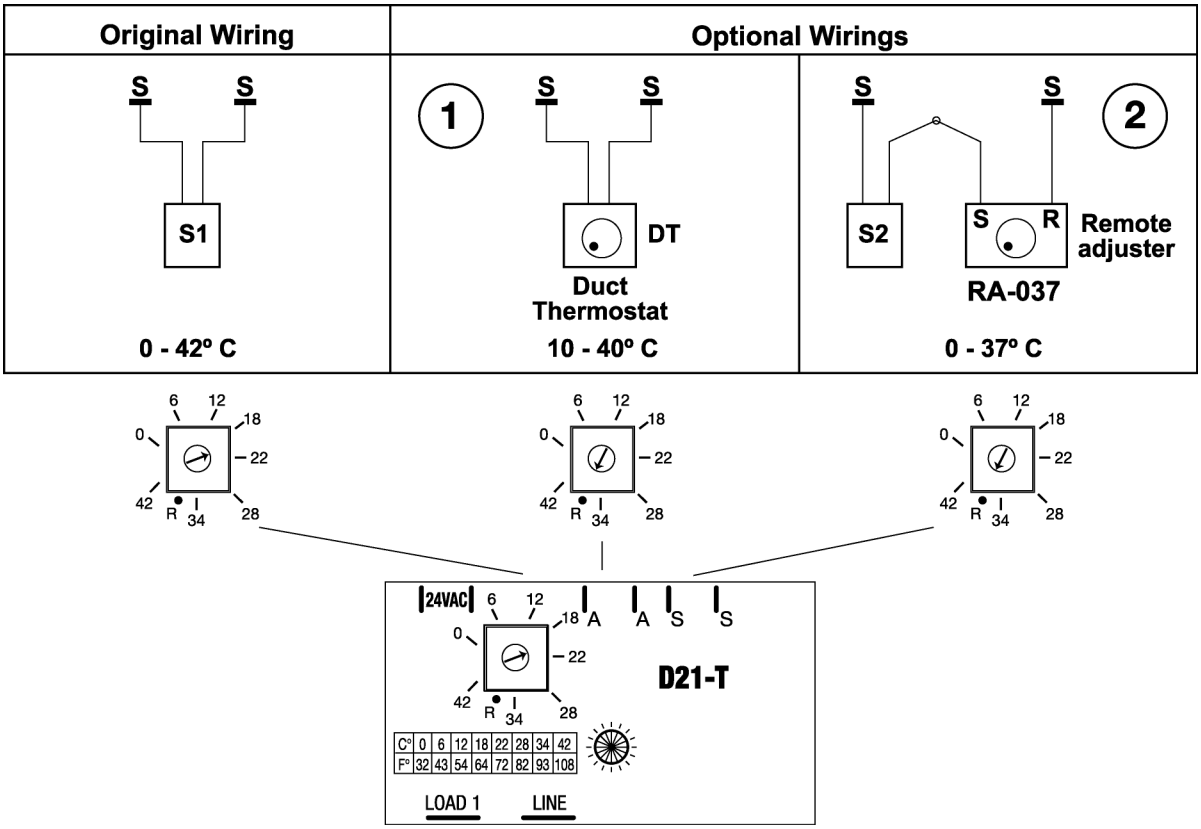


A ***THERMO-AIR*** heater combined with a small fan is all that it takes to create a low-cost, efficient and accurate air make-up.
This new heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.

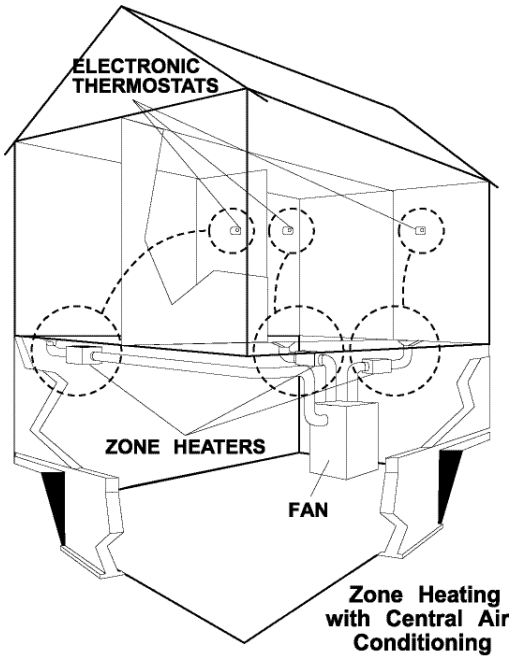
Remote set point adjustment option

Instead of adjusting the set-point on the electronic module inside the heater, it is possible to adjust it remotely by using
1- A remote duct thermostat (DT-1040) with a range of 10 to 40°C
or
2- A wall mount set-point adjuster with a range of 0 to 37°C (**RA-037**).

In both cases, it is necessary to set the potentiometer to the **"R"** position (for Remote Control).



ZONE HEATER

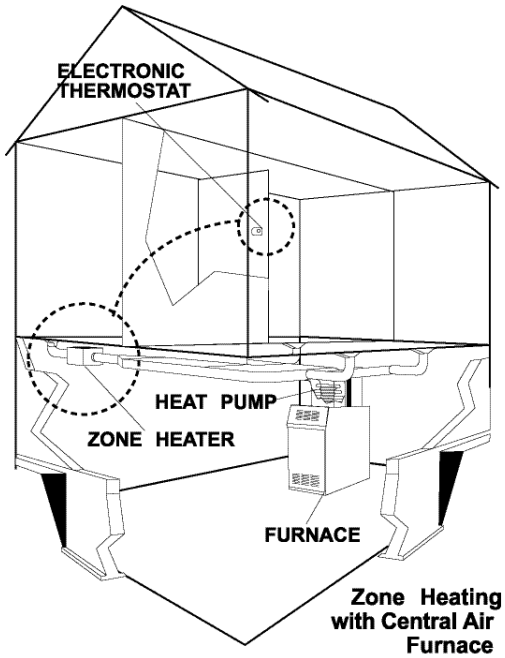


Application # 1

Central ventilation with zone heaters.

In this application, there is no furnace required but only a central blower that provides continuous ventilation. The heating of the forced air is done in each zone, controlled by an accurate electronic thermostat supplied with each heater.
Each thermostat controls it's heater in a proportional way, thus avoiding a waste of energy and providing maximum comfort. The super-sensitive **air flow sensor** permits the heater to operate only when the fan is running.

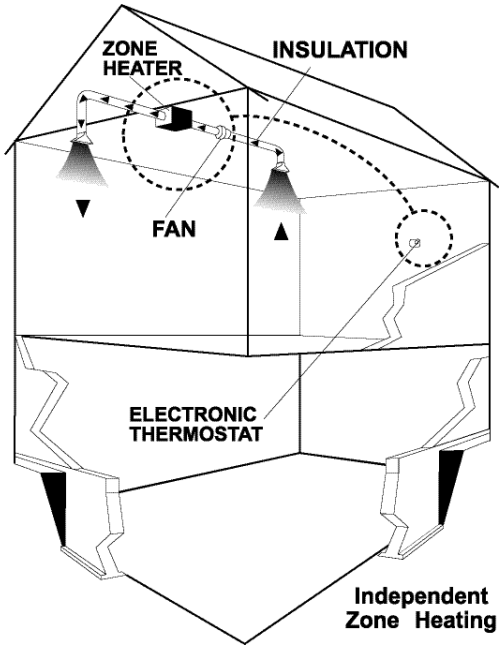
The central blower should be equipped with an air filter, a humidifier and a cooling coil if air conditioning is required.



Application # 2

Add-on heater for a cold room.

In a central heating system, it often happens that a room located at the end of a duct run is too cold and uncomfortable. This could also happen to a basement in mid-season. The ***THERMO-ZONE*** is a perfect, easy and low cost solution. Just insert the new heater in the duct supplying that cold room and enjoy new comfort.
This new heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.
This heater is supplied with an electronic wall thermostat to maximize comfort and savings.
It is recommended to keep the fan in continuous operation at low speed.

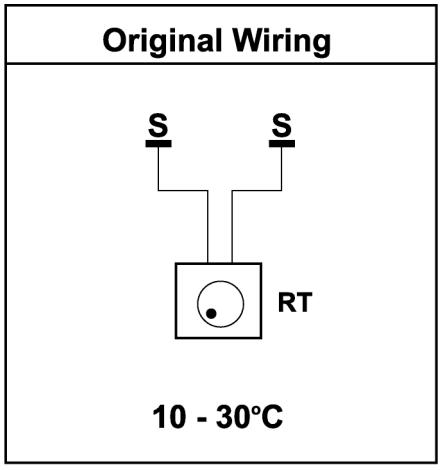


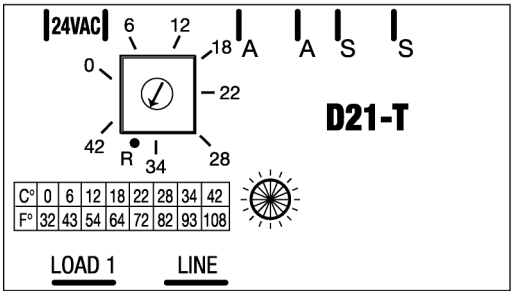
Application # 3

Stand alone heating system.

A ***THERMO-ZONE*** heater combined with a small ventilation unit and two grilles or diffusers is all that it takes to create a small, accurate and low-cost heating system. This new heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.

This heater is supplied with an electronic wall thermostat to maximize comfort and energy savings.





How to evaluate your heating requirement?

Considering today's insulation standards, an easy to remember rule of thumb is that the heating capacity should be equal to 8 watts per square foot. A 1 KW heater would then be sufficient to heat a surface of 1000 ÷ 8 = 125 square feet. Adding a safety factor would bring the surface to approximately 120 square feet, i.e. a 12' x 10' room.

We suggest:

Up to 120 sq. ft.	1 KW	
from 121 sq. ft. to 240 sq. ft.	2 KW	
from 241 sq. ft. to 360 sq. ft.	3 KW,	and so on.

A small excess of capacity is not a problem because the electronic controller will modulate this capacity in order to give only the heat required by the thermostat.

How to evaluate the ventilation requirements?

A ***THERMO-AIR*** or ***THERMO-ZONE*** requires a minimum of 30 CFM (cubic feet per minute) per Kilowatt to operate.
A lower air flow is not a problem for the heater since the electronic controller will automatically reduce the heating according to the air flow.

For a quick calculation, a 1 KW unit requires a minimum of 30 CFM,
a 2 KW unit requires a minimum of 60 CFM, and so on.

Electrical connections

We recommend not to exceed 2 KW at 120V, 5 KW at 208V, 6 KW at 240V, 7KW at 277V, 8KW at 347V.

Specifications and Safety Features

Heating capacity of 1 to 8 KW.
Standard voltages 120, 208, 240, 277 and 347.
Standard round collar dimension 6" and 8" for easy installation between the floor joists (or basement false ceiling). Other dimensions up to 12" diam. and 24"x18" duct also available. Please contact factory.

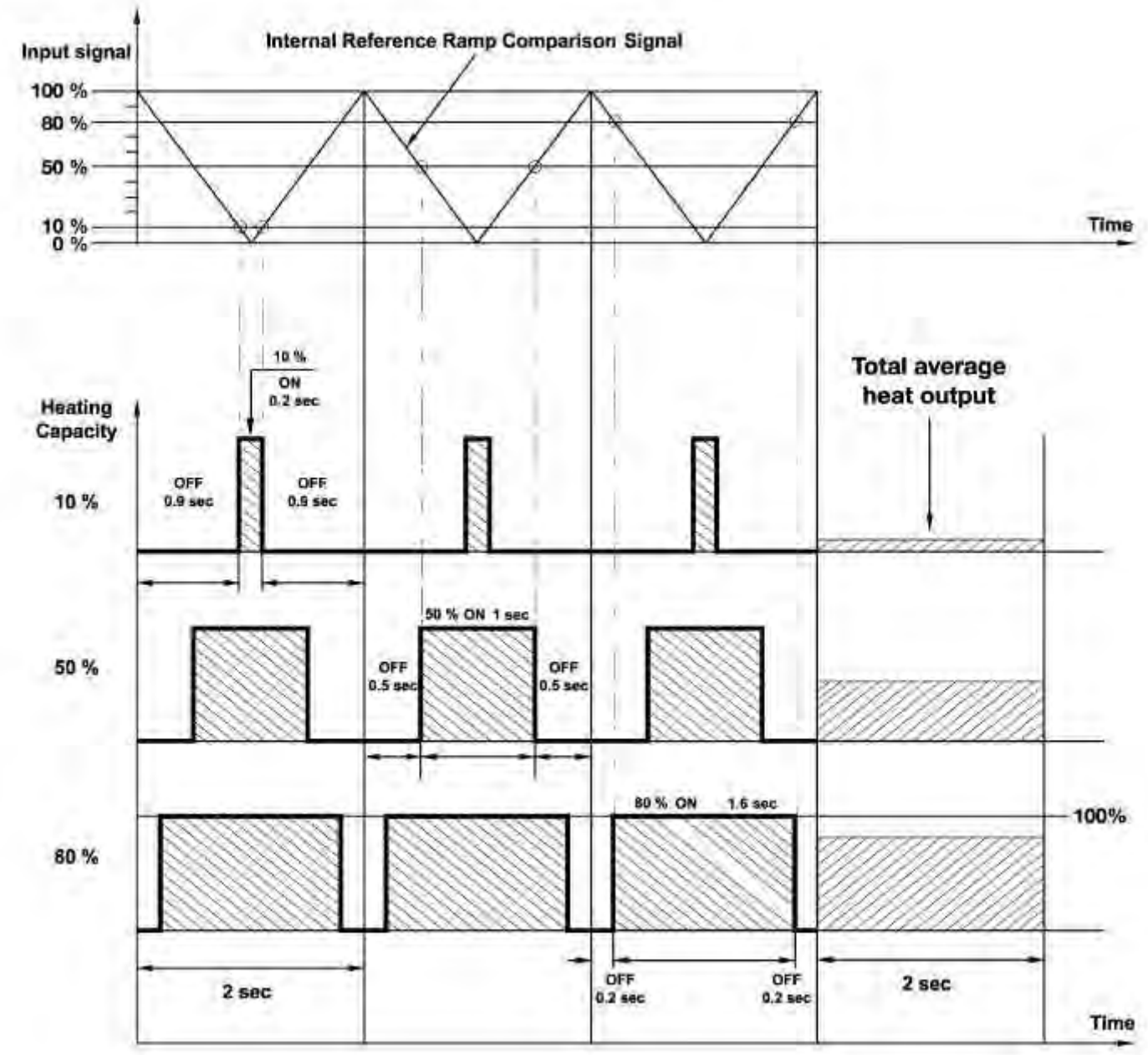
The unit operates at low temperature (60º**C** / 140º**F** max.) and has three levels of protection:
• one automatic reset cut-out calibrated at (51.6º**C** / 125º**F**),
• one manual reset cut-out calibrated at (93º**C** / 200º**F**) and
• one airflow sensor that protects the unit against air failure.
This proportional sensor reduces the heating capacity if the air flow is not sufficient, so that the discharge air temperature never exceeds 60º**C** / 140º**F**, and stops heating completely if the airflow stops.

A ***THERMO-AIR*** or a ***THERMO-ZONE*** unit can modulate it's heating capacity between 0 and 100 % according to the thermostat demand and/or the air flow going through the heater, which makes this heater self regulating.

What is proportional control?

The word proportional refers to the portion of a time period in which a heating element is turned ON and OFF (e.g. 10 % ON and 90 % OFF meaning 10 % of the heating capacity). According to the thermostat demand, the heater is pulsed in different proportions of ON time and OFF time to match the heating demand. The longer the element is turned ON, the more it is generating heat and vice versa. The heat produced during the ON period continues to dissipate during the OFF period, thus creating an average temperature output matching the thermostat set-point.

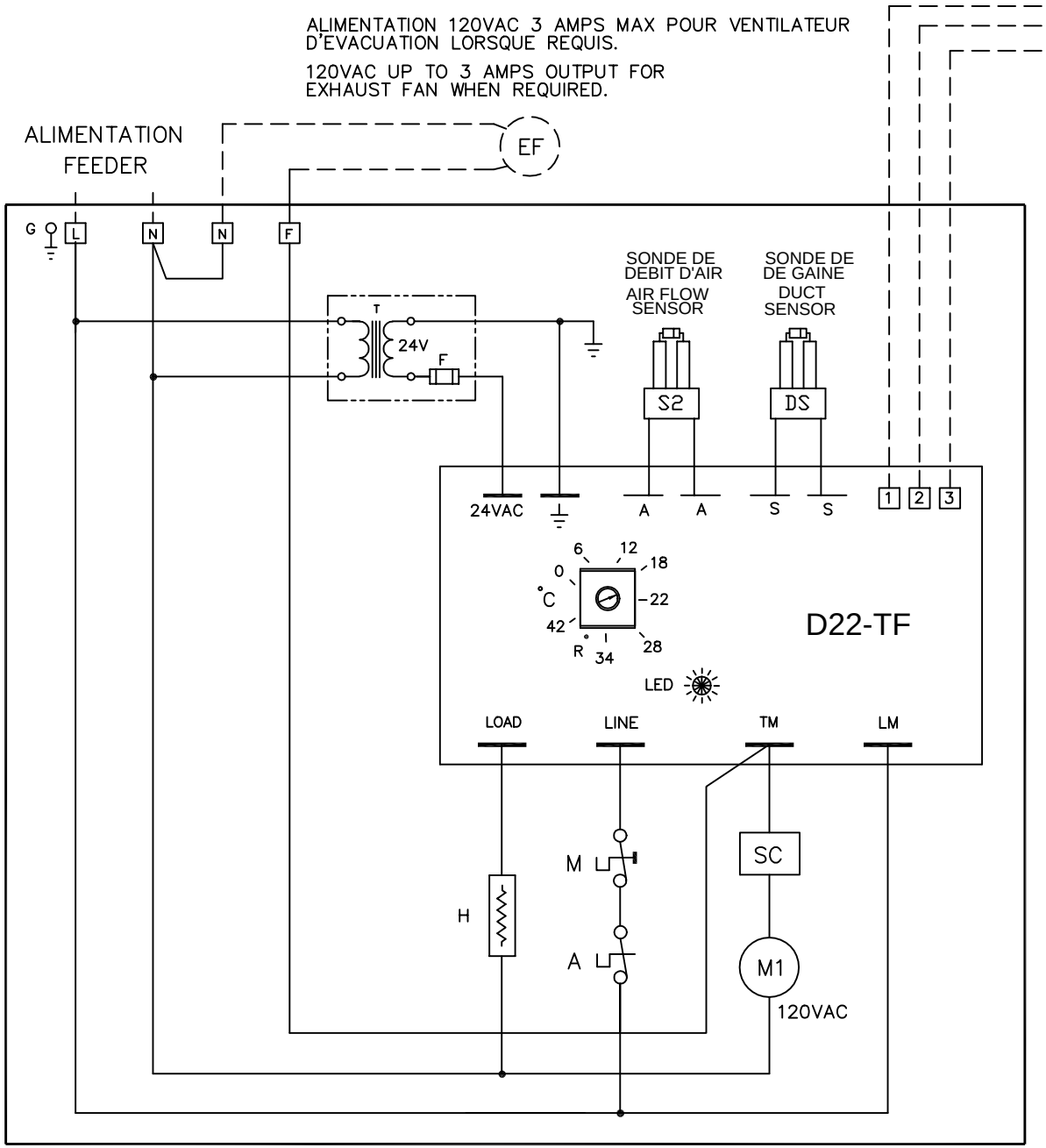
For a graphic description of the proportional control, please see next page.

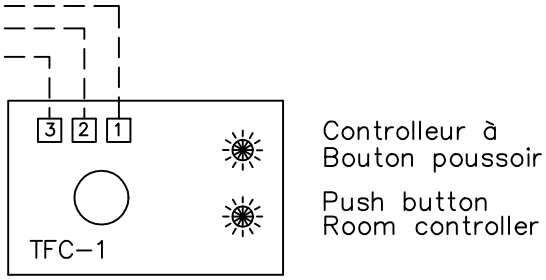


Graphic for proportional control

Proportional Control Diagram - Principle of the Pulse With Modulation

By comparing the input signal with an internally generated reference signal (triangle wave), the controller activates the SCR output in a range of 0 to 100%.
On this graphic, every time the horizontal line corresponding to the input (in this example, 10 %, 50 % and 80 %), crosses the reference signal, the heating elements are switched ON or OFF. The total heat output is an average between the ON and OFF periods. For low heat demand, the heater is not "dimmed" but switched ON for very short periods.
Note: All Thermolec controllers are equipped with a zero-cross thyristor switching circuitry that virtually eliminates all electro-magnetic interference (EMI) and radio frequency interference (RFI). The light emitting diode (LED) on the controller indicates when the heating element is on.





LEGENDE

A	SONDE THERMIQUE A REENCLENCHEMENT AUTOMATIQUE
M	SONDE THERMIQUE A REENCLENCHEMENT MANUEL
D22-TF	CONTROLEUR ELECTRONIQUE
H	ELEMENT CHAUFFANT
DS	SONDE DE GAINE
S2	SONDE DE DEBIT D'AIR
SC	REGULATION DE VITESSE
MI	MOTEUR DU VENTILATEUR 120VAC
T	TRANSFORMATEUR
TA	SELECTUR DE TEMPERATURE

LEGEND

A	AUTOMATIC RESET CUT-OUT
M	MANUAL RESET CUT-OUT
D22-TF	SOLID STATE CONTROLLER
H	HEATING ELEMENT
DS	DUCT SENSOR
S2	AIR FLOW SENSOR
T	TRANSFORMER
SC	SPEED CONTROLLER
M1	FAN MOTOR 120VAC
TA	TEMPERATURE SET POINT ADJUSTER

TITLE/TITRE

MINI FRESH AIR MAKE-UP W.D

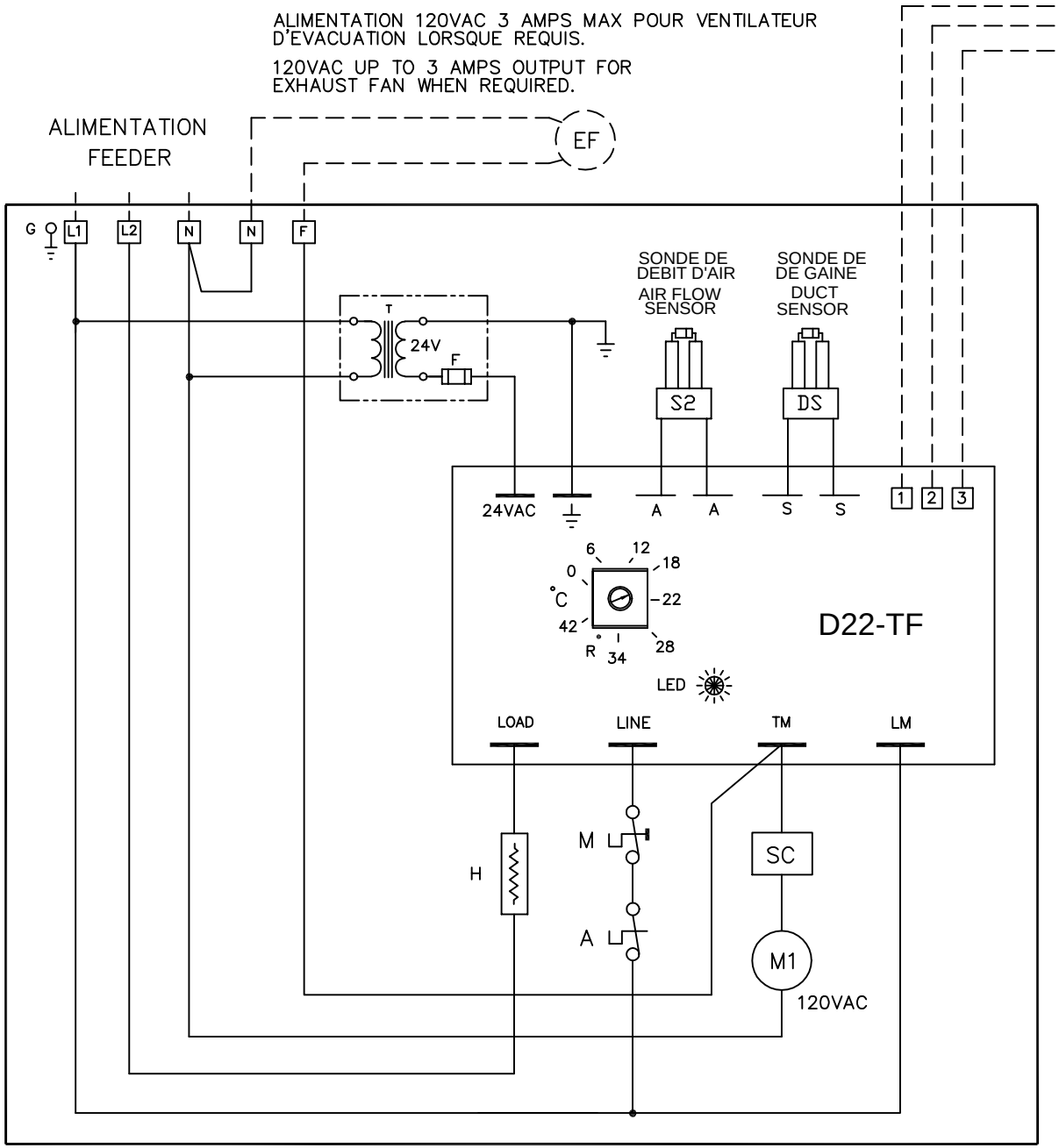
THERMOLEC

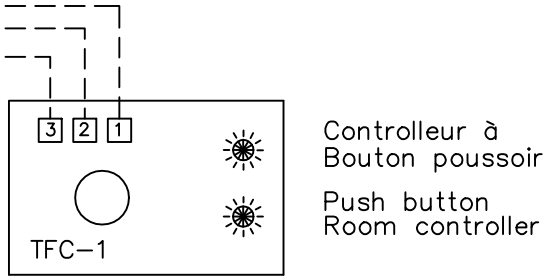
MONTREAL – CANADA

LTEE
LTD

DRAWING NO. FRESH MAKE-UP 120

DATE	PER	





Controlleur à
Bouton poussoir

Push button
Room controller

LEGENDE

A	SONDE THERMIQUE A REENCLENCHEMENT AUTOMATIQUE
M	SONDE THERMIQUE A REENCLENCHEMENT MANUEL
D22-TF	CONTROLEUR ELECTRONIQUE
H	ELEMENT CHAUFFANT
DS	SONDE DE GAINE
S2	SONDE DE DEBIT D'AIR
SC	REGULATION DE VITESSE
MI	MOTEUR DU VENTILATEUR 120VAC
T	TRANSFORMATEUR
TA	SELECTUR DE TEMPERATURE

LEGEND

A	AUTOMATIC RESET CUT-OUT
M	MANUAL RESET CUT-OUT
D22-TF	SOLID STATE CONTROLLER
H	HEATING ELEMENT
DS	DUCT SENSOR
S2	AIR FLOW SENSOR
T	TRANSFORMER
SC	SPEED CONTROLLER
M1	FAN MOTOR 120VAC
TA	TEMPERATURE SET POINT ADJUSTER

TITLE/TITRE

MINI FRESH AIR MAKE-UP W.D

THERMOLEC

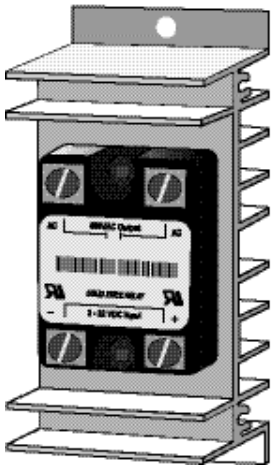
MONTREAL – CANADA

LTEE
LTD

DRAWING NO. FRESH MAKE-UP 240

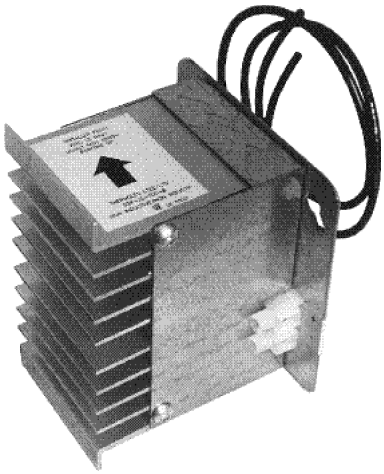
DATE	PER	

Specification sheet



Open Type

NRTL/C



Box Type

Description

Solid State Relays are designed for controlling large amounts of power with a Logic Input Signal.
The internal circuit features a dual SCR design for full wave capability and a Zero Crossing Detector.
An opto-coupler isolates the input signal from the power circuit.
All Thermolec's solid state relays are equipped with the **TransAX™** system that protects against transients even on 600V lines, therefore ensuring quality, reliability and superior performances.

- Up to 30 AMP
- Up to 600 VOLT
- Low voltage control 3-32 VDC (standard) (24 VAC also available)
- Exposed terminal block for control signal
- Fits a standard 4x4 box

THERMOLEC

TEL: 514-336-9130
FAX: 514-336-3270

Electric Heating and Controls
Chauffage électrique et contrôles

2060, Place Thimens, Montréal
Québec, Canada, H4R 1L1

Solid State Relay

TransAX™: A superior protection !

Usually there are two methods used to absorb transients: RC networks and Metal Oxyde Varistors (MOV). Both methods are unsufficient in certain cases.
The new **TransAX™** option eliminates the problems normally associated with RC networks and MOV's.
It is an active component that can quickly switch very high currents. Instead of absorbing excessive energy endlessly, at a predetermined programmable trip point it passes the energy back to the line. During normal operations the switch sits idle and is always ready to activate.

Typical Applications

- On/Off and proportional control of electric heating equipment
- Interfacing of microprocessor controls to AC loads such as baseboard heaters, duct heaters, etc.
- Replacement of electro-mechanical line contactor
- Industrial and process control

FEATURES

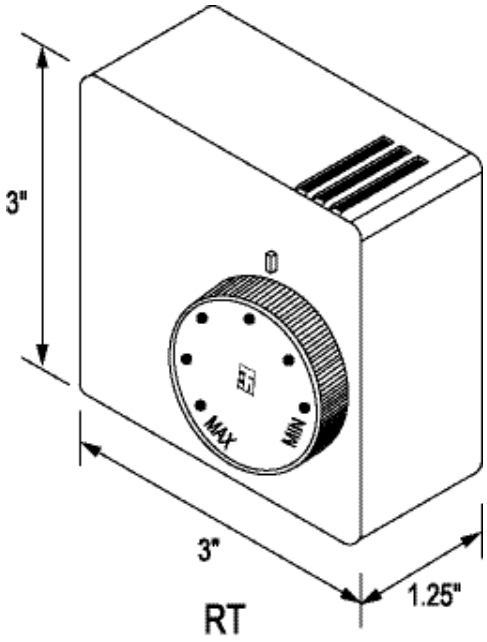
- Back to back thyristors output
- Zero crossfired units
- Generous heatsink for lower operating temperature
- Integrated triggering circuitry.
- CSA recognized
- Designed to comply with V.D.E. requirements

How to order :

SSR	—	20	—	1	—	AC	—	B
Solid **S**tate **R**elay		**20**= 20 Amp **30**= 30 Amp		**1**= 347V Max **6**= 600V Max		**DC**= 3-30 VDC **AC**= 24 VAC		**B** = Box type **O** = Open type

Example: SSR-30-6-DC-B
Solid State Relay, 30 Amps, 600V Max, DC, Box

Specification sheet



RT - Room thermostat (proportional)

- 2 wires
- Low voltage
- Adjustable set point
- Thermistor sensor
- White ABS housing
- Adjustment Range: 10 - 30° C (50 - 86° F)
- Special ranges available upon request

THERMOLEC

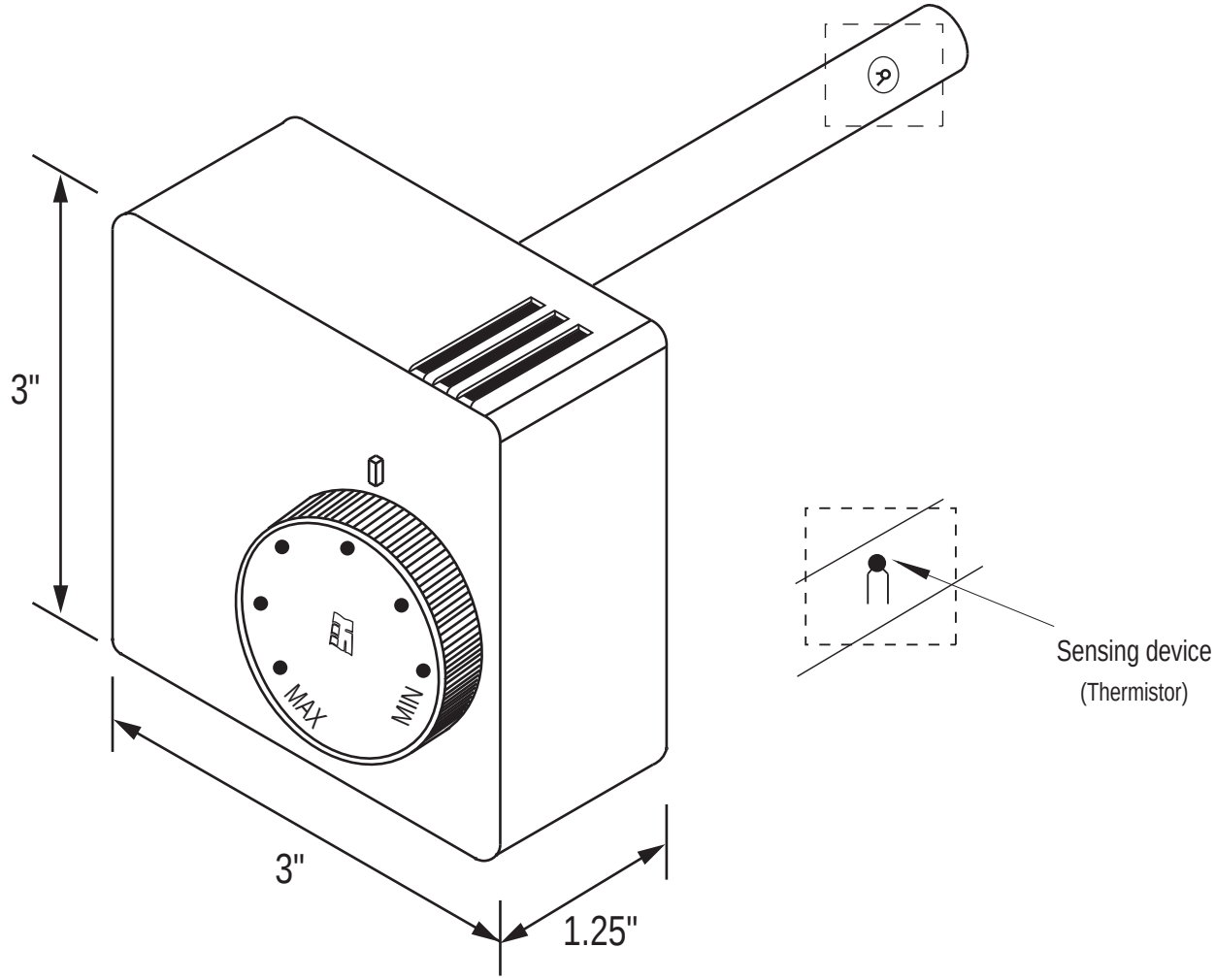
Electric Heating and Controls

TEL: 514-336-9130
FAX: 514-336-3270

2060, Rue Lucien-Thimens, Montréal
Québec, Canada, H4R 1L1

RT-1030

Specification sheet



DT - Duct thermostat (proportional)

- 2 wires
- Low voltage
- Adjustable set point
- Thermistor sensor
- White ABS housing
- Adjustment Range: 10 - 40° C (50 - 104° F)
- Special ranges available upon request

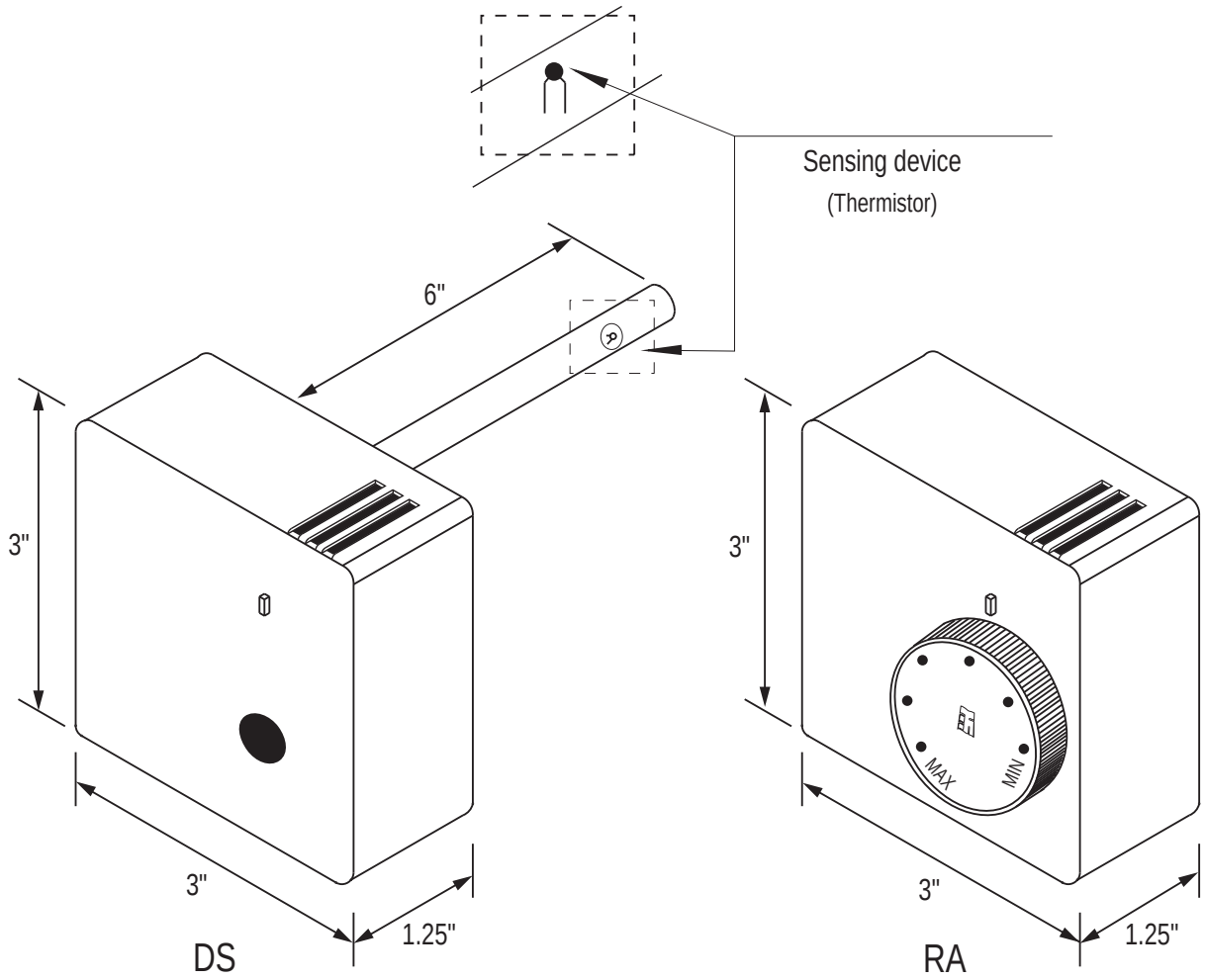
THERMOLEC
Electric Heating and Controls

TEL: 514-336-9130
FAX: 514-336-3270

2060, Rue Lucien Thimens, Montréal
Québec, Canada, H4R 1L1

DT-1040

Specification sheet



RA - Remote set-point Adjuster

- 2 wires
- Low voltage
- Adjustable set point
- White ABS housing
- Adjustment Range: 10-40° C (50-104° F)
- Special ranges available upon request

DS - Duct Sensor

- 2 wires
- Low voltage
- Thermistor sensor
- White ABS housing

THERMOLEC

Electric Heating and Controls

TEL: 514-336-9130
FAX: 514-336-3270

2060, Rue Lucien-Thimens, Montréal
Québec, Canada, H4R 1L1

RADS-1040

THERMOLEC

Certificate of Compliance

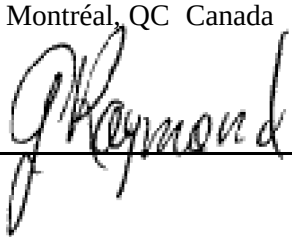
Certificate Number: LR 30551-1

Revision: LR 30551-35

Issued to: **THERMOLEC LTÉE/LTD**
2060 Place Thimens
St-Laurent, Québec
H4R 1L1

The products listed below are eligible to bear the CSA Mark
NOTE: The "NRTL/C" indicator also appears adjacent to the CSA Mark.

Issued by: G. Raymond, Eng.
Montréal, QC Canada

Signature: 

PRODUCTS

CLASS 2811 03 - HEATERS - Air - Stationary Type
CLASS 2811 83 - HEATERS - Air - Stationary Type - CERTIFIED TO U.S. STANDARDS

Open coil duct heaters for horizontal or vertical air flow, rated up to 600V, 60Hz, 1 or 3 phases, 1000KW and less: With temperature limiting controls, Series SC (slip-in) and FC(flanged); Without temperature Controls (construction evaluation only) Series FE and SE.

APPLICABLE STANDARDS

CSA Std C22.2	No.	155-M1986	-	Electric Duct Heaters
UL std. No.		1996	-	Electric Duct Heaters

*The "NRTL/C" indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

THERMOLEC

Certificate of Compliance

Certificate Number: LR 30551-27

Revision: LR 30551-35

Issued to: **THERMOLEC LTÉE/LTD**
2060 Place Thimens
St-Laurent, Québec
H4R 1L1

The products listed below are eligible to bear the CSA Mark
NOTE: The "NRTL/C" indicator also appears adjacent to the CSA Mark.

Issued by: G. Raymond, Eng.
Montréal, QC Canada

Signature: G. Raymond

PRODUCTS

CLASS 2811 03 - HEATERS - Air - Stationary Type
CLASS 2811 83 - HEATERS - Air - Stationary Type - CERTIFIED TO U.S. STANDARDS

Duct heaters with Sheathed Elements, for horizontal or vertical air flow, rated up to 600V, 60Hz, 1 or 3 phases, 1000KW and less: With temperature limiting controls, Series FT (flange mount) and ST (slip-in); without limit controls, series TFE (flange mount) and TSE (slip-in).

APPLICABLE STANDARDS

CSA Std C22.2	No.	155-M1986	-	Electric Duct Heaters
UL std. No.		1996	-	Electric Duct Heaters

*The "NRTL/C" indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

THERMOLEC FEATURES

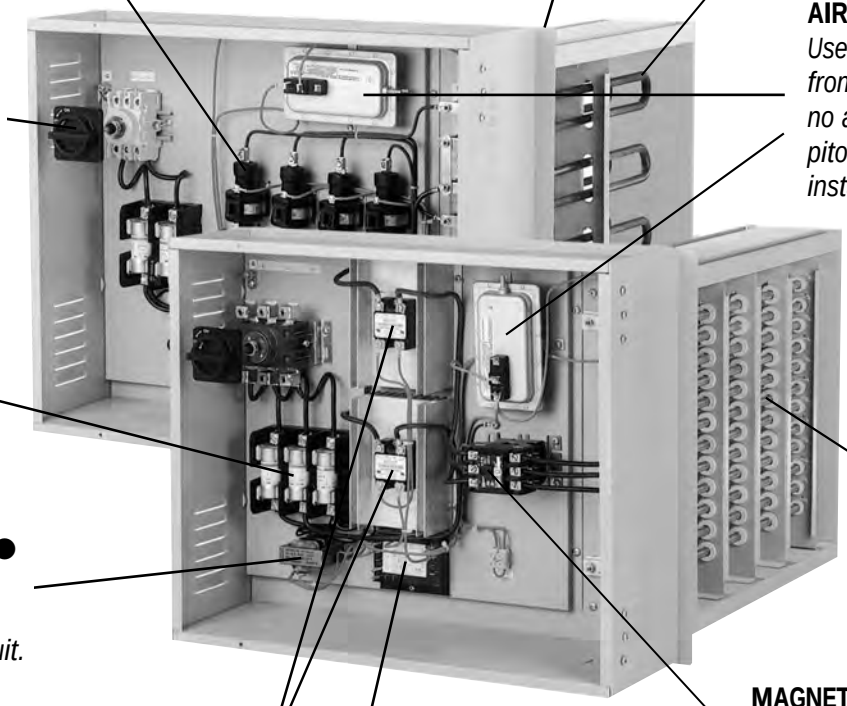
Standard ● *Optional* ❒

MERCURY CONTACTORS ❒
Used to power individual stages of heating. They allow a silent operation and are exceptionally reliable.

AUTOMATIC RESET CUT-OUT ●
The automatic reset thermal cut-out is a fail-safe, fixed temperature, disc type safety device that opens the circuit when it's set point is reached. It automatically resets and returns the heater to operating conditions.

TUBULAR INCOLOY ELEMENT ●

DISCONNECT SWITCH ❒
A built-in disconnect switch allows user to disconnect heaters individually in order to safely perform maintenance tasks.



AIRFLOW SWITCH ●
Used to prevent a heater from operating if there is no airflow. Provided with a pitot tube which, when installed into the duct, makes it sensitive to velocity pressure as well as to static pressure.

FUSES ❒
Used to protect the total load or individual stages.

HIGHEST GRADE OPEN COIL ●

TRANSFORMER ●
Built-in control transformer supplies 24 volts to the control circuit.

MAGNETIC CONTACTORS ●
Used to power individual stages of heating or as back-up for safety switches.

SOLID STATE RELAY ❒
Electronic contactor used to silently and proportionally control the heater in response to a pulsed signal.

All Thermolec Heaters are CSA and NRTL/C approved.

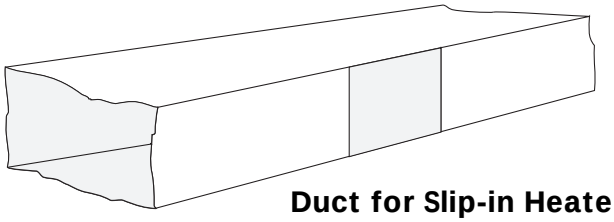
The NR TL/C indicator adjacent to the CSA Mark signifies that the product has been evaluated to the applicable ANSI/UL and CSA Standards, for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

SCR CONTROLLER ❒
The SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand. It is compatible with thermistor thermostat (RT or DT), 0-10 Vdc, 4-20 mA, 0-135 ohms input signals.

MODELS

SLIP-IN TYPE DUCT HEATERS AND FLANGED TYPE DUCT HEATERS

SC Slip-in Open Coil ***(Fig. 1)***
ST Slip-in Tubular
FC Flanged Open Coil
FT Flanged Tubular ***(Fig. 2)***
RFC Round collar open coil ***(Fig. 3)***
RFT Round collar with Tubular elements



Duct for Slip-in Heater

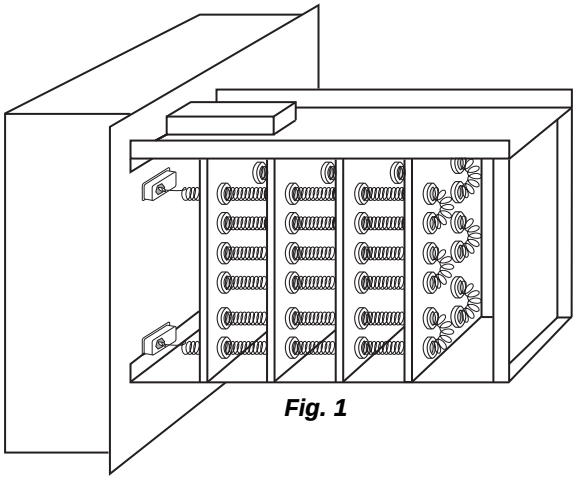
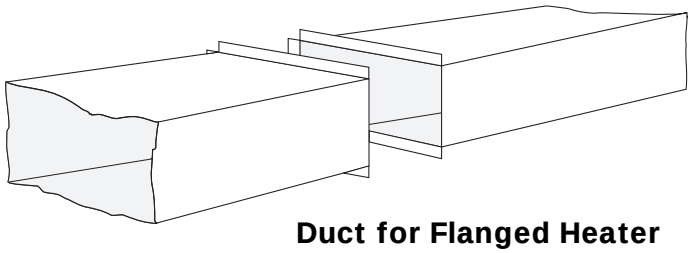


Fig. 1



Duct for Flanged Heater

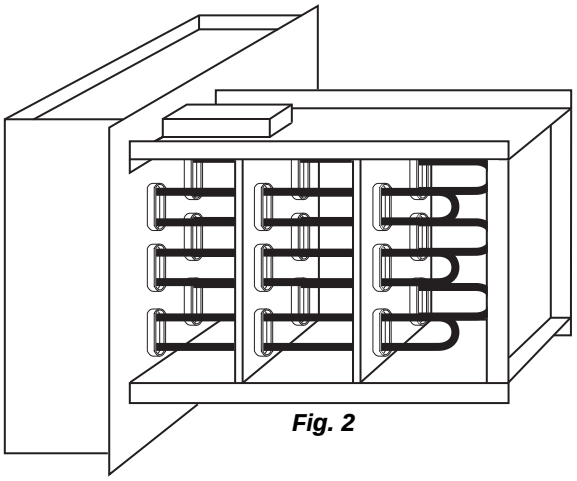


Fig. 2

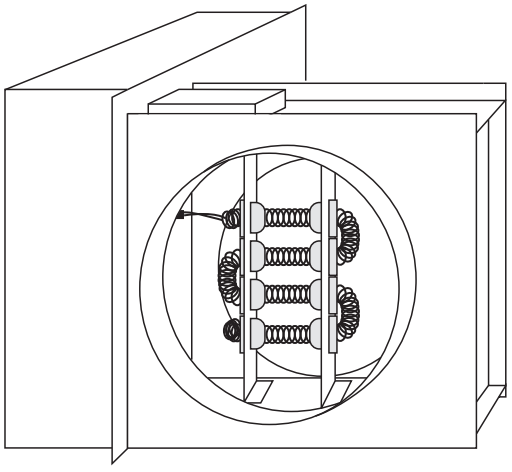


Fig. 3

All Thermolec heaters are CSA and NRTL/C approved

HOW TO SELECT AND SPECIFY IN THREE EASY STEPS

Selecting the heater for your application can be done in three easy steps:

1- Determine heater capacity, voltage and electrical components

2- Determine duct dimensions, air requirements and mechanical options

3- Determine method of control, then select control components

---

STEP 1 -

DETERMINE HEATER CAPACITY, VOLTAGE AND ELECTRICAL COMPONENTS

Heater capacity

Given CFM (volume of air in cubic feet per minute) and $\Delta^{o}T$ (temperature rise in ^{o} F), the KW capacity can be determined from the formulas:

$$KW^{**} = \frac{CFM \times \text{Temperature Rise, } ^{o}F^{*}}{3000}$$

$$\text{Temperature Rise, } ^{o}F = \frac{KW \times 3000}{CFM}$$

NOTE:
The above formulas are for standard air. Consult your Thermolec representative for non-standard air conditions.

* *Maximum air temperature rise for which the heater is designed*

** *This formula is for quick calculation and contains a loss allowance of 5%.*

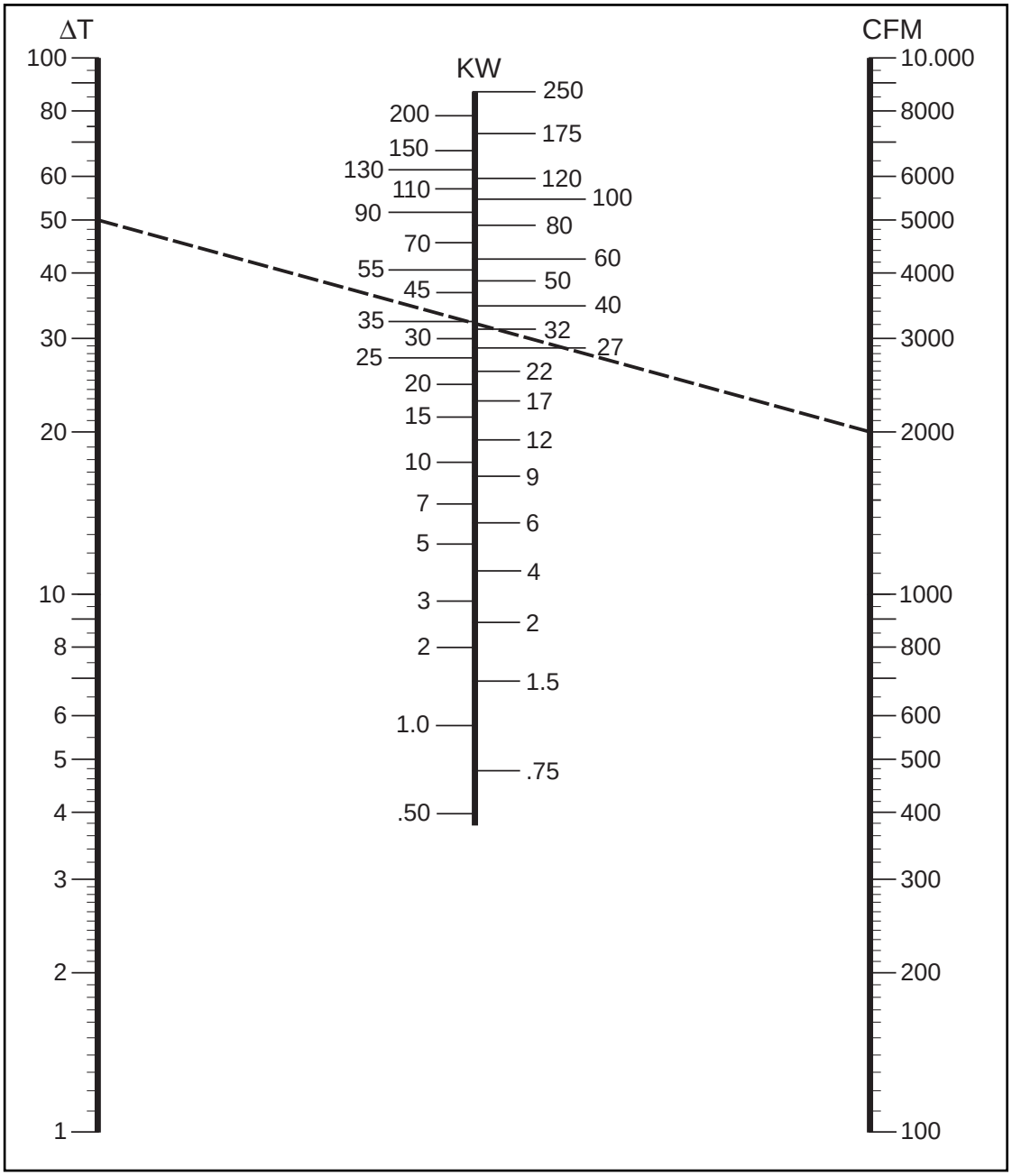


Chart to determine the required kilowatts

For a rough estimate, use the chart above.

Example:

Find the KW required to raise 2000 CFM from -10 to 40 ºF.

ΔT = 40 + 10 = 50 ºF.

Lay a straightedge across the chart from 50 on the ΔT scale to 2000 on the CFM scale.

Find the required KW where the straightedge intersects the KW scale.

For this example, the KW required is approximately 35 KW.
You may decide to add any safety factor or loss allowance.

Power and Voltage Requirements

Nominal and Standard Supply Voltages

While a utility's voltage may be referred to by means of a nominal figure, actual applied voltage may vary over a fairly wide range depending on factors like the system's power distribution lines, and many others. For instance, a nominal voltage of 575V / 3PH / 60Hz may variously be called 550V, 575V or 600V depending more on what the specification writer is accustomed to calling it than on the actual voltage supplied to the heater. Designing a heater for 550V when in fact 600V is supplied to it will result in almost 10% more current and 20% more KW capacity since current is proportional to the voltage and KW is proportional to the square of the voltage. Conversely, application of a lower voltage results in a corresponding under-performance of the heater. It is therefore of the utmost importance to ensure that the correct voltage is specified.

For safety reasons Thermolec standard supply voltages have been chosen to be the highest for each voltage range, as shown in the table below. Heaters designed for lower voltages in each range are available and will be supplied when customer expressly specifies a lower supply voltage.

Common Nominal Voltages	110 115 120	208		220	230 240		277	318 332 347	380		416		440 460 480		550 575 600	
Thermolec Standard Voltages	120 1 Ph	208 1 Ph	208 3 Ph	220 1 Ph	240 1 Ph	240 3 Ph	277 1 Ph	347 1 Ph	380 1 Ph	380 3 Ph	416 1 Ph	416 3 Ph	480 1 Ph	480 3 Ph	600 1 Ph	600 3 Ph

STANDARD VOLTAGES

This standardization reduces the risk of overheating due to a heater subjected to an overvoltage with the resulting nuisance tripping of high-temperature cut-outs.

Examples of risk:

Example 1:

A 575V/3 PH heater in a 600V/3PH installation would carry 5% more current and produce 10% more KW than it is designed for.

Example 2:

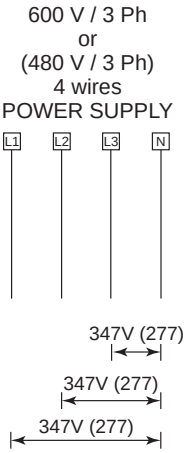
A 220V/1 PH heater in a 240V/1PH installation would carry 10% more current and produce 20% more KW than it is designed for.

Under such conditions, these heaters would overheat and thermal cut-outs would trip.
In order to avoid any risk of overheating, it would be advisable to verify the existing conditions on the job site.
In case of doubt about the required voltage, always specify one of the Thermolec Standard Voltages.

STEP 1 - (continued)

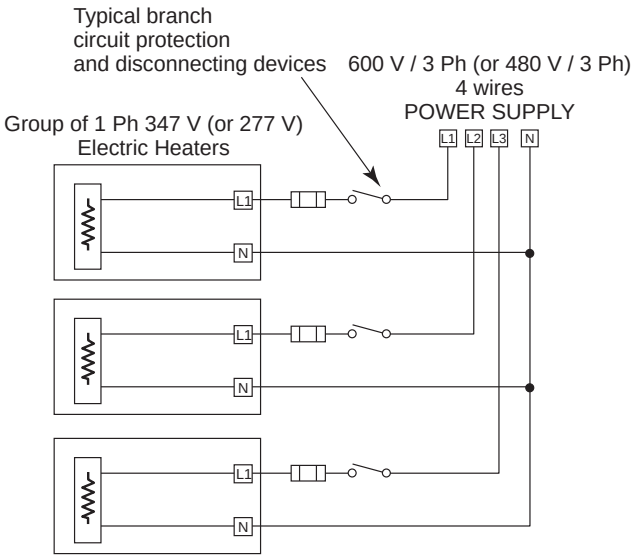
347 (277) V, Single Phase Power Supply

When capacities are below 7 KW at 277 V and 8 KW at 347 V Thermolec recommends the use of the following arrangements to obtain the most economical cost for heaters and electrical distribution.



347 / 600V
4 wire power supply
(also 277 / 480)

These voltages are generally derived from a 600 (480) volts - 3 phase - 4 wire power supply.
A group of 347 (277) volt - 1 phase heaters should be distributed as equally as practical over the three phases in order to keep current imbalance to a minimum.
Neutral conductor should not be broken by any switching or protective device, be it internal or external to the heater.



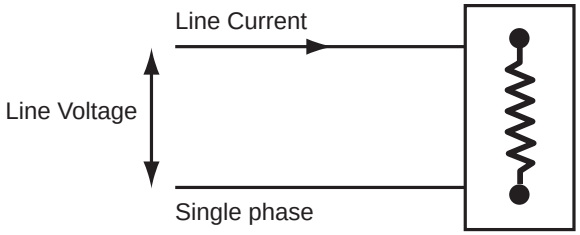
Equal distribution of heaters

Line Current

The table below shows line current per one KW capacity at various voltages. The following formulas apply:

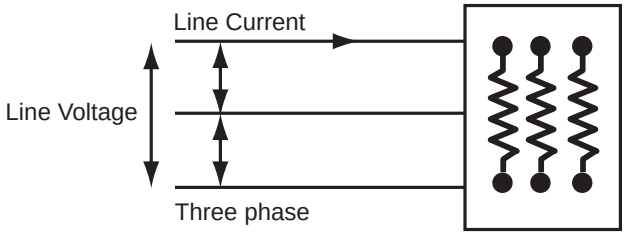
SINGLE PHASE

$$\text{Line Current in Amperes} = \frac{\text{Watts}}{\text{Line Voltage}}$$



THREE PHASE (Star or Delta loads)

$$\text{Line Current in Amperes} = \frac{\text{Watts}}{1.73 \times \text{Line Voltage}}$$



Thermolec Standard Voltages	120 1 Ph	208 1 Ph	208 3 Ph	220 1 Ph	240 1 Ph	240 3 Ph	277 1 Ph	347 1 Ph	380 1 Ph	380 3 Ph	416 1 Ph	416 3 Ph	480 1 Ph	480 3 Ph	600 1 Ph	600 3 Ph
Multiplier Amp./KW	8.33	4.81	2.78	4.55	4.17	2.41	3.61	2.88	2.63	1.52	2.40	1.39	2.08	1.20	1.67	0.96

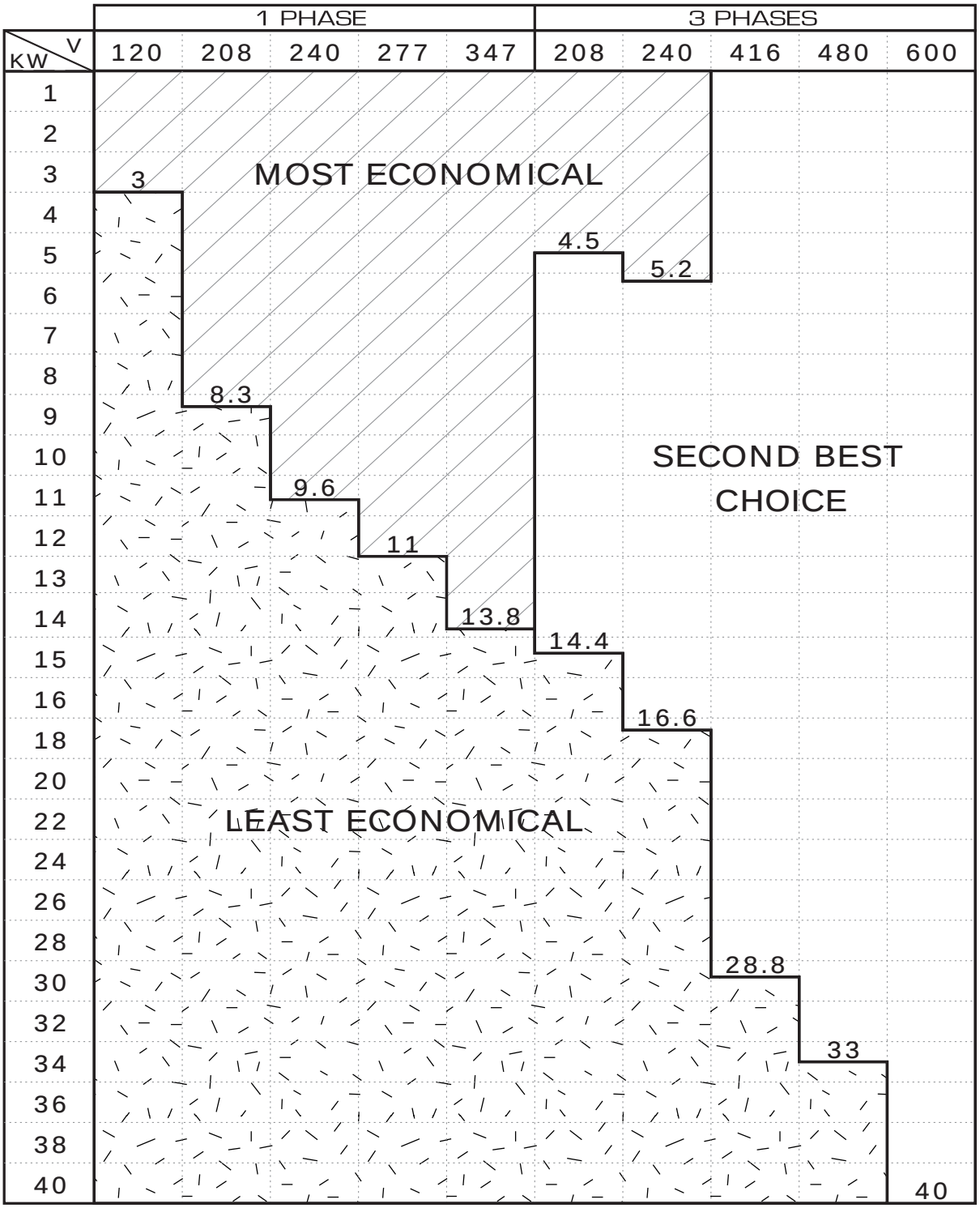
Multipliers to calculate Line Currents

(Line current in amperes = Multiplier x KW capacity)

Example: The Line current for a 40 KW / 600V / 3 phases heater is : 40 x 0.96 = 38.4 amperes.

STEP 1 - (continued)

Selection chart of most economical design for THERMOLEC modulating heaters KW/Voltage combination



STEP 1 - (continued)

FUSING

The National Canadian and Electrical Code requires that each power supply to a heater be individually protected by either fuses or circuit breakers external to the heater. Please see Pertinent Regulations.

Additional sub-circuit fusing within the heater (built-in load fuses) may be either mandatory or optional and if optional, may or may not be recommendable. The following table supplies the information necessary for decisions on built-in sub-circuit over-current protection.
As a general rule, built-in load fuses are rated 30 Amps for circuits up to 24 Amps and 60 Amps to protect one or more internal circuits totaling up to 48 Amps.

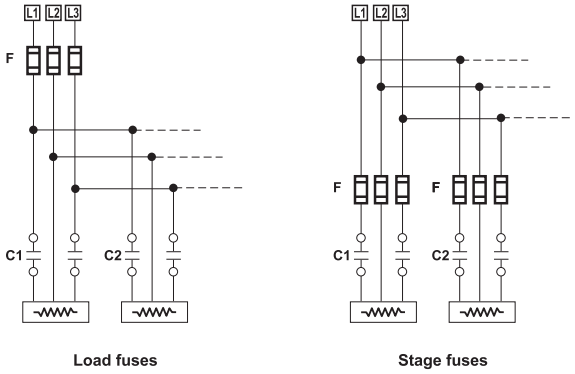
TABLE FOR LOAD FUSING

SUPPLY VOLTAGE & PHASE						HEATER RATED AMPS.	NEC ELECTRICAL CODE	INTERNAL LOAD FUSING MANDATORY	THERMOLEC RECOMMENDS BUILT-IN LOAD FUSES	THERMOLEC COMMENTS
240 / 1 PH	208 / 3 PH	277 / 1 PH	347 / 1 PH	480 / 3 PH	600 / 3 PH					
HEATER TOTAL KW * UP TO										
12	17	13	17	40	50	0 - 48	NO	NO	NO	OPTIONAL LOAD FUSES NOT RECOMMENDED - ONLY ONE POWER SUPPLY ECONOMICALLY JUSTIFIED.
38	57	44	55	133	166	49 - 160	YES	NO	YES	FUSES LIMIT EXTENT OF DAMAGE IN TERMINAL BOX IN CASE OF SHORT CIRCUIT.
39 & +	58 & +	45 & +	56 & +	134 & +	167 & +	161 & +	YES	YES	YES	MANDATORY IN CASE OF SHORT CIRCUIT.
* For higher KW capacities consult factory regarding the most economical number of power supplies.										

LOAD FUSES: The minimum required sets of 60 Amp fuses for proper protection (Option U1).
Example of load fusing: A one stage, three phase heater rated 40 amps will use one set (3 fuses of 60 Amps).

STAGE FUSES: Mostly optional, one or more sets of fuses per stage (Option U2).
Thermolec standard fuses are 30 Amps for circuits up to 24 Amps and 60 Amps for circuits up to 48 Amps.
Example of stage fusing: A three phase heater rated 48 amps will use one set (3 fuses of 60 Amps) if the heater is designed with one stage.
For two stages (24 Amps per stage), two sets (6 fuses of 30 Amps) will be used.
For three stages (16 Amps per stage), three sets (9 fuses of 30 Amps) will be used.

Because fuses require ventilation, the control box must be louvered. If the control box is specified as Nema 4 or 12, then the box must be oversized.



Typical sub-circuit fusing arrangements

For more detailed information, please refer to section 2 in brochure " Power supply and fusing considerations "

STEP 1 - (continued)

Contactors

Contactors are used to power individual stages of heat or as back-up for safety switches.

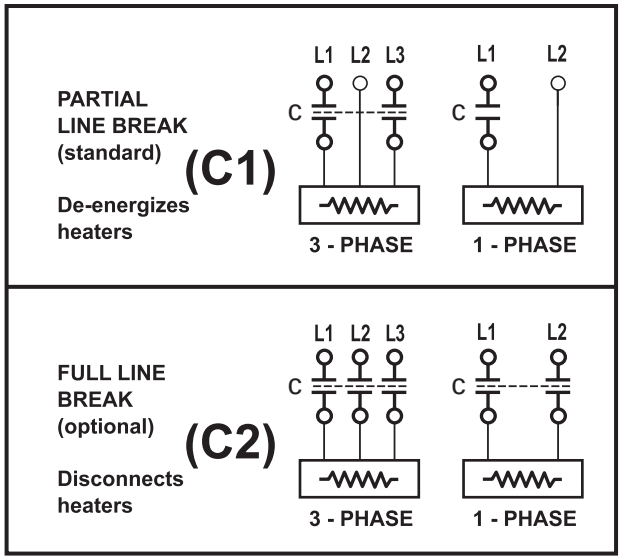
Contactors may be of two types:

Partial line-break (or de-energizing)

In the partial line-break arrangement the contactor opens the current path, thus de-energizing the heater.

Full line-break (or disconnecting)

The full line-break type contactor opens all ungrounded power lines in the heater. This may be ordered as an option (Request option C2).



Partial and Full Break Figures

Special power lugs

Heaters are supplied with power terminal blocks rated for copper conductors with 75 ºC insulation. Aluminum conductors are not recommended and the standard terminal blocks are not sized for aluminum. Please consult Thermolec if the use of aluminum conductors is considered.
For very high amperages, Thermolec can supply terminal blocks for two or more parallel conductors per phase.
For more detailed information, please refer to section 2 in brochure "Power supply and fusing considerations".

STEP 2 -

DETERMINE DUCT DIMENSIONS, AIR REQUIREMENT AND MECHANICAL OPTIONS

Air Flow requirements and Minimum Velocity

When there is a choice in heater face dimensions the specification writer has several good reasons for favoring the smaller rather than the larger heater face area: The smaller sized, higher velocity electric coil will perform better, weigh less and cost less per KW than an otherwise identical larger coil.

The main selection criteria are KW per square foot of face area (or duct size) and Design Velocity.

KW per Square Foot Range	COMMENTS
Less than 5	High cost per KW
5 to 12	Medium cost per KW
12 to 20	Low cost per KW
Over 20	Medium cost per KW

Kilowatts per square foot Table

Face velocity in Feet Per Minute (FPM)	COMMENTS
Less than 400	Requires derating of watts density on elements. Specify proportional control.
400 to 2000	Most economical range
Over 2000	Specify special coil supports

Design Velocity Table

Unlike hot water or steam coils, electric coils will generate 100% of the heating capacity (i.e. the heat output is constant as long as the heater is energized) regardless of the air flow. A drop in air flow through an electric coil below the minimum required FPM (feet per minute) will increase both the coil temperature and the exhausted air, which may result in high limit cut-outs tripping.
Another frequent cause of unnecessary cut-out tripping is the uneven distribution of air flow over the coil surface, resulting in "hot spots". In order to achieve trouble-free performance, provide adequate air flow as per "air flow requirement" chart (on page 14) and ensure even air flow distribution by following sound industry practice in design and installation of ductwork and equipment.

The Thermolec CSA NRTL/C listing is limited to 22.5 KW per square foot of duct area for open coil heaters and 13 KW per square foot of duct area for tubular element heaters.

Air flow requirements for ON-OFF Control

The minimum air flow required through a duct heater depends on the KW per square foot of face area for the highest capacity ON-OFF stage. In general **400 FPM** is adequate in most applications.

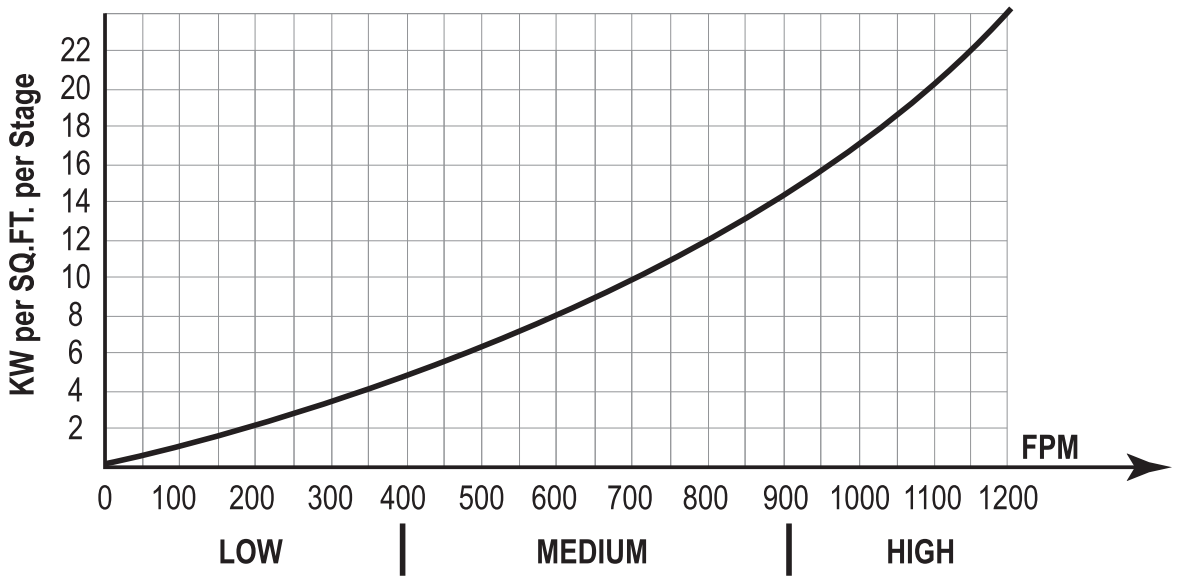
Air flow requirement for Full SCR control

An SCR controlled heater may be considered as having an "infinite" number of control stages, and consequently the air flow requirements of the chart (on page 14) for minimum air flow does not apply.
As a general rule, heaters equipped with FULL SCR will require an air velocity of at least **300 FPM**. For lower design velocities please consult factory.

Exclusive Feature:

The special Thermo-V unit for VAV applications allows the heater to perform down to **50 FPM**.
Please see pages ***25 and 26.***

STEP 2 - (continued)



Air Flow Requirement for Open Coil Heaters

Net FACE AREA = Duct width in inches x Duct Height in inches / 144
KW per SQ.FT. per STAGE = KW of the largest stage / net FACE AREA in SQ.FT.

Please refer to the table on page 16 for tubular elements.

Example:
Find the minimum air flow requirement for a 65 KW 1 stage heater in a 24” wide by 18” high duct.

Ⓐ Calculate duct area in square feet.

$$\text{Duct Area} = \frac{24\text{”} \times 18\text{”}}{144} = 3 \text{ square feet}$$

Ⓑ Calculate KW per square foot per stage.

$$\text{KW per square foot per stage} = \frac{65 \text{ KW}}{3 \text{ sq.ft.} \times 1 \text{ stage}} = 21.66$$

Ⓒ Using the Air flow requirement curve above, find 21.66 on the vertical scale.
Read the minimum velocity required on the horizontal axis, which is approx. 1150 FPM.

Ⓓ If it is a 2 stage heater then KW per square foot per stage $= \frac{65 \text{ KW}}{3 \text{ sq.ft.} \times 2 \text{ stages}} = 10.83$
In this case 750 FPM are required.

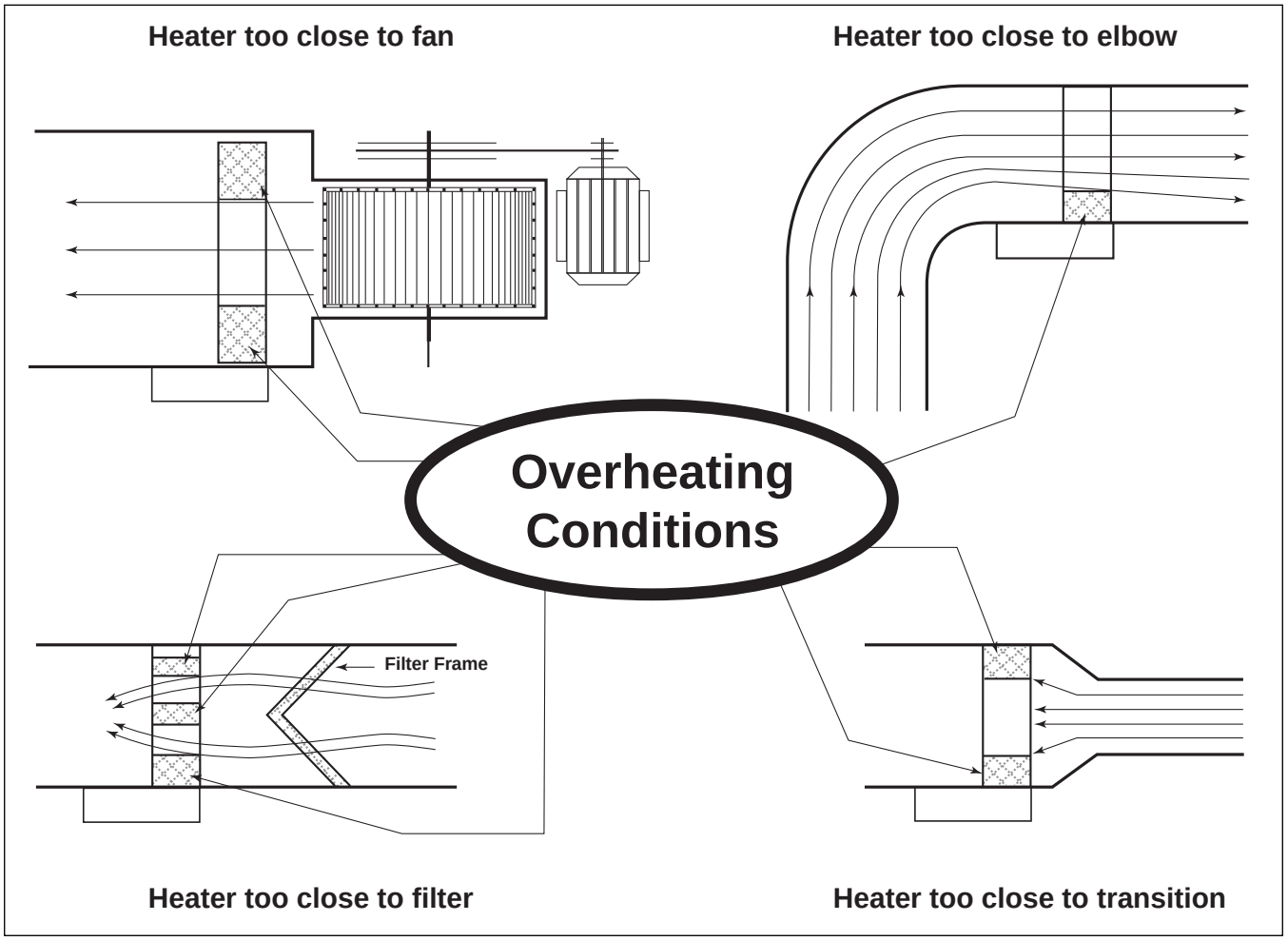
Ⓔ If it is an SCR Controlled heater then 300 FPM are required.

STEP 2 - (continued)

Airflow Uniformity

In order to prevent hot spots, the air flow must be uniformly distributed across the heater area. The following figures illustrate typical heater mis-application where the airflow is not uniform. An NEC article (please see below *) specifies that a heater should not be installed closer than 4 feet downstream or 2 feet upstream from a fan outlet, an abrupt transition, an elbow or any other kind of obstruction in the duct. If your application is such that one of the mentioned installations cannot be avoided, THERMOLEC can help you by designing around it.

* 1071 NEC Article 424-59:
"Means shall be provided to assure uniform and adequate airflow over the face of the heater. Heaters installed near (within 4 feet) a fan outlet, elbows, baffle plates or other obstruction in duct work may require turning vanes, pressure plates or other devices in the inlet side of the duct heater to assure an even distribution of air over the face of the heater".



STEP 2 - (continued)

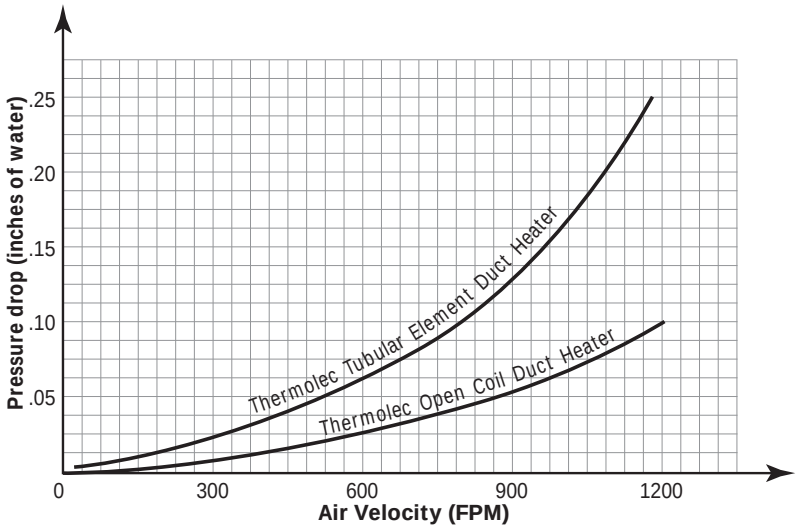
OPEN COIL vs TUBULAR elements

THERMOLEC manufactures both open coil and tubular duct heaters.

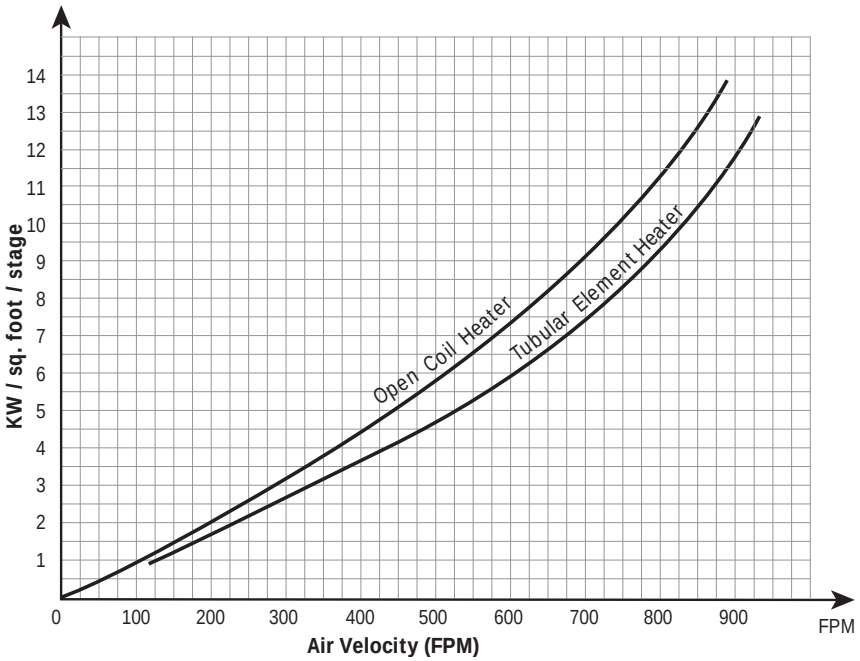
It is widely acknowledged that tubular elements find practical application under certain circumstances (service conditions include possible contact by personnel, presence of dust or particles in the air flows or atmospheric conditions).

But, where heating filtered air is the sole function, the open coil heater is superior for many reasons:

- Longer life
- More kilowatts per square foot
- Less stratification by equal distribution of the elements
- Lower wire surface temperature
- Less maintenance
- Greater serviceability
- Better heat distribution across heater face
- Less pressure drop
- Lighter weight
- Low shipping costs
- Less sensitivity to moisture
- More flexibility of size and capacity
- Cost effective
- Smaller size
- Large electrical clearance

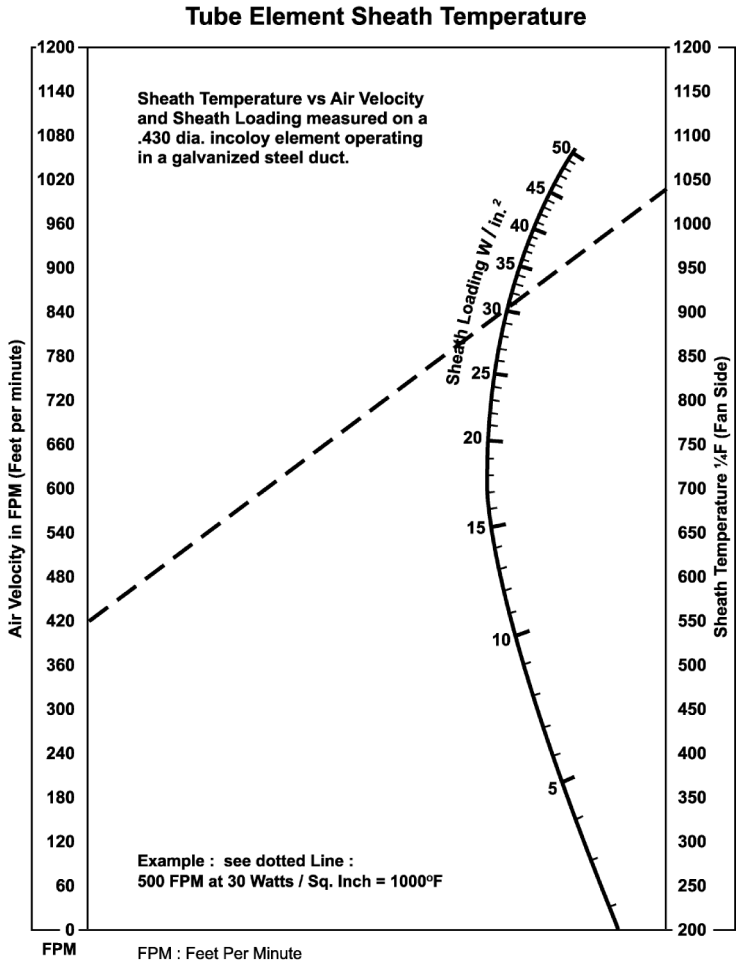


Pressure Drop for Tubes



Minimum Air Velocity for tubes

STEP 2 - (continued)



Exclusive Design advantage of the Thermolec Tubular heater construction

Thermolec Tubular elements can be removed through the control box, which avoids the need to remove the heater from the duct and thus reduces maintenance costs. However, precautions must be taken in terms of clearance when installing the heater in order to take advantage of this feature.

Please refer to SECTION 2 of this catalog for more detailed considerations about open coil and tubular elements.

STEP 2 - (continued)

Size Limitations

Although there are practically no limitations to the maximum size of Thermolec custom-built heaters, all CSA listed heaters must comply to the following minimum dimensions:

	Slip-in Type Open Coil	Flanged Type Open Coil	Slip-in Type Tubular	Flanged Type Tubular
Minimum Duct Width Dimension "W"	6"	5"	8"	7"
Minimum Duct Height Dimension "H"	5"	4"	6"	6"

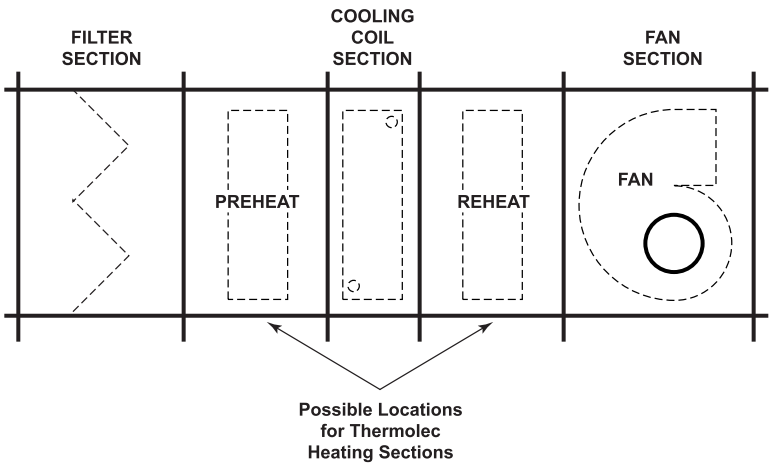
Size Limitation Table

CSA listed custom heaters are available in virtually any KW rating. However, Thermolec listing is restricted to a maximum KW density of 22.5 KW per square foot of heated area for open coil and 13 KW per square foot for tubular. For a quick approximation of the maximum KW available in a particular duct size, please use the following formulas:

Open Coil Type SC or FC	Maximum KW =	$\frac{22.5 \times \text{width in inches} \times \text{height in inches}}{144}$
Tubular Type ST or FT	Maximum KW =	$\frac{13 \times \text{width in inches} \times \text{height in inches}}{144}$

Modular Construction for Air Handling Units

Thermolec heaters can be part of large air handling units. In this case, a heater becomes a module of a bigger unit and is designed to match the other components: filter frames, fans, cooling coils, VAV boxes, etc. Flanged units can be bolted directly to adjacent sections or slip-in models are inserted into a bigger unit. Since there can be several special conditions in such big units, the heater has to be designed to accommodate them. Special features can be installed upon request: section with no heat, pressure plates to equalize air flow, buffer sections to space the heater away from other components, etc.



Modular Heating Sections

STEP 2 - (continued)

Variable Air Volume units (VAV)

The *"Thermo-V"* electric heater developed by Thermolec eliminates the common problems that are encountered in the application of an electric heater to a VAV box as described below:

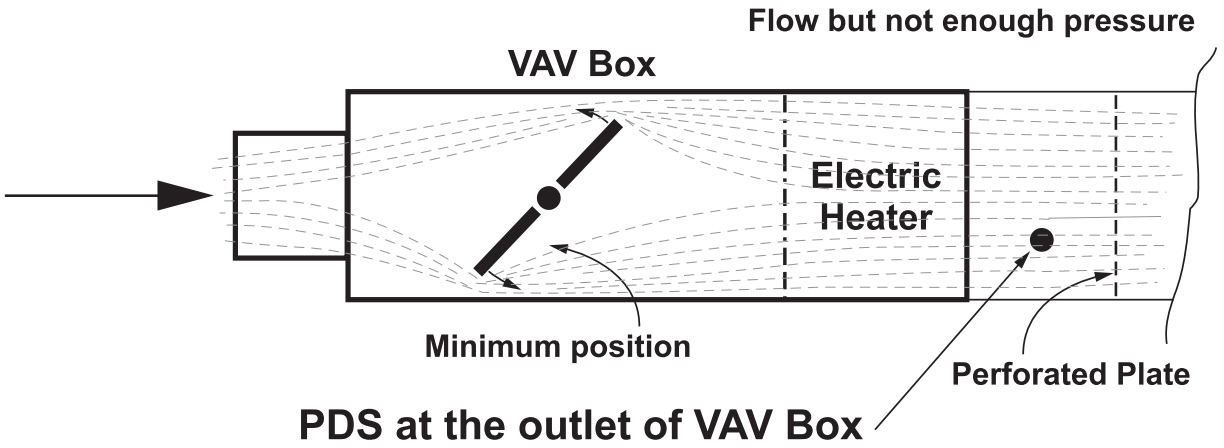
A. When the VAV Box is in the minimum opening position, the air flow is often below the minimum required to operate a standard electric heater, causing element overheating and possible tripping of the thermal cut-outs. The common solution is to increase the minimum ventilation air flow to accommodate the minimum air flow required to operate the heater which translates into energy waste.

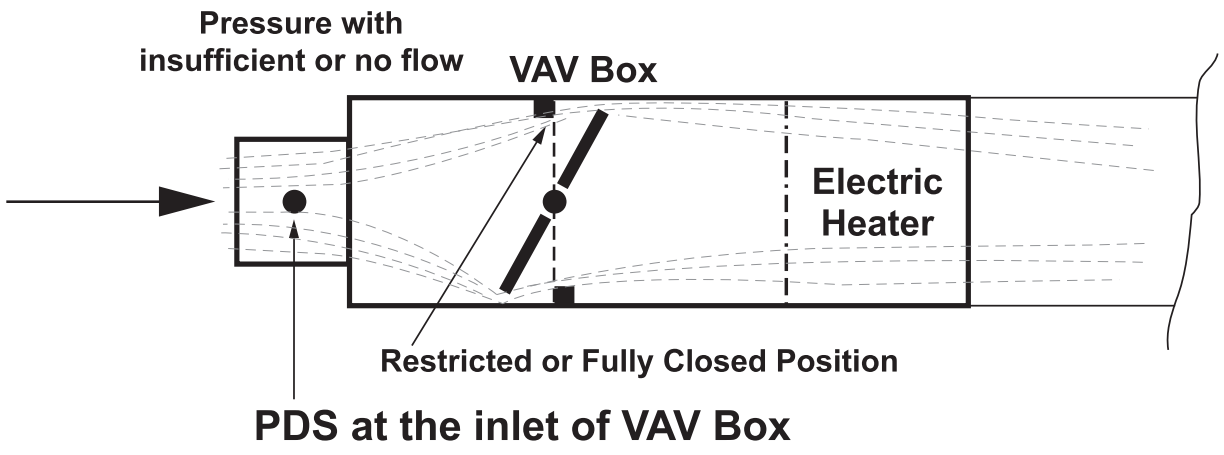
B. The static pressure in the duct downstream is so low that even the most sensitive pressure differential switch is unable to detect sufficient pressure to activate the electric heater. The common solutions are:

1. To create an artificial pressure by adding restrictions at the outlet (perforated plate), which creates a costly and unnecessary pressure loss when the box is in a fully open position.

2. To measure the pressure upstream of the VAV box, which could be dangerous, since, with a restricted or totally closed box, there is pressure without air flow. The electric heater will have to rely solely on it's safety thermal protections to shut off.

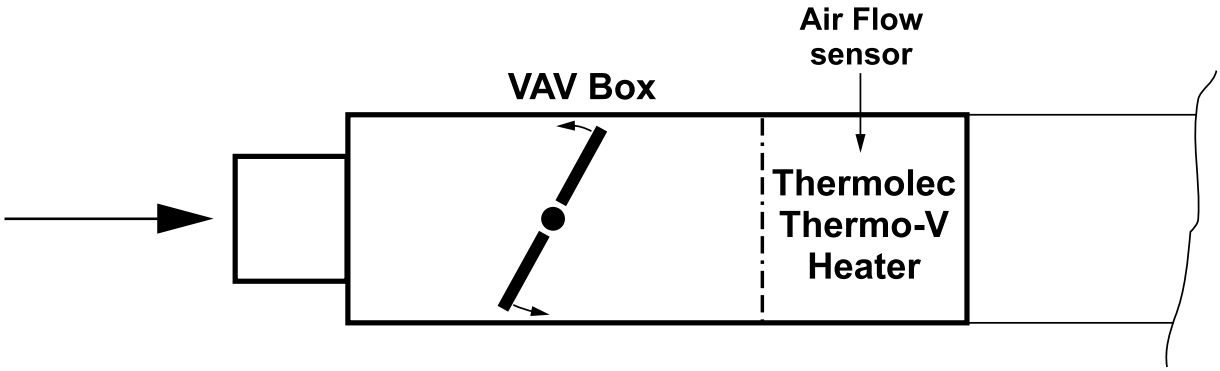
Common Problems Encountered





STEP 2 - (continued)

Thermolec has developed and patented an innovative solution to eliminate these problems:
The Proportional Electronic Air Flow Sensor.
The Air Flow Sensor responds to the radiant heat of the heating element which, in turn, is influenced by the air flowing through the heater to dissipate the heat.
The patented sensor and associated electronic controller modulate the power to the heater, adjusting the heater's capacity to accurately match the air flow available.
This unique concept allows the heater to respond exactly to the quantity of air flowing through it and safely shut down in case of a total loss of air flow.
The heater delivers maximum heating when needed with normal minimum air flow, reduced heating with lower than minimum air flow and stops heating with no air flow.



The Thermolec VAV Solution

The electronic controller also allows a proportional control of the heater, and is compatible with the following input signals:

1- Variable voltage signal 0 -10VDC.
2- Pulse Signal 24VAC or VDC.

Benefits of the Proportional Electronic Air Flow Sensor :

- The heater will operate with extremely low air flow. VAV boxes can then be set to minimum air to satisfy ventilation requirements rather than increased to accommodate conventional heater velocity requirements.
- Allows the heater to operate safely regardless of the duct static pressure.

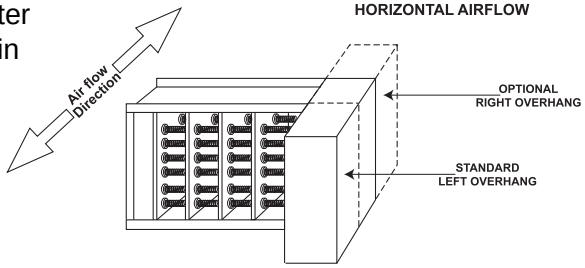
STANDARD CAPACITIES	STANDARD DIMENSIONS
up to 2 Kw 120V / 1Ph	
up to 5 Kw 208V / 1Ph	Round: from 6" to 12" dia.
up to 6 Kw 240V / 1Ph	
up to 7 Kw 277V / 1Ph	Rectangular: from 6" x 6" to 24" x 18"
up to 8 Kw 347V / 1Ph	
Other dimensions, capacities and voltages up to 40 KW and 600V / 3Ph a vailable upon request.	

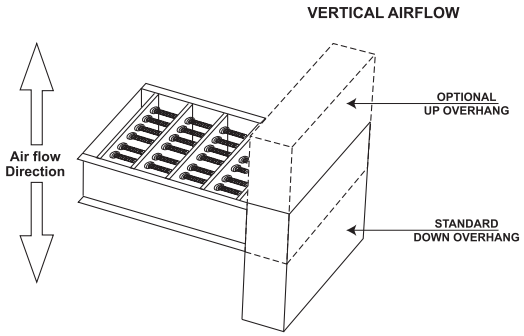
STEP 2 - (continued)

Universal mounting of Thermolec heaters

Unique feature

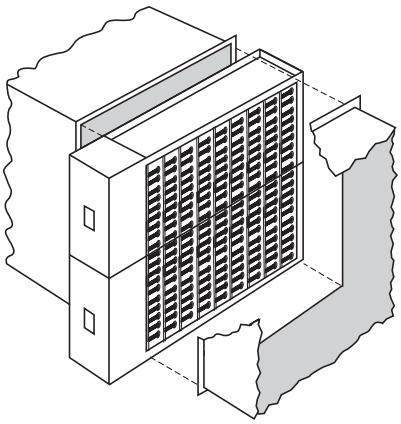
By design, all Thermolec heaters are made non-sensitive to air flow direction. The built-in high limit thermal cut-outs are located in such a way that the air flow could be in any direction without impairing safety and the same heater could be installed in a horizontal or vertical duct.





Multiple Heaters in a duct

Normally, electric heaters are not designed to be used in series in a heating installation. For very large heaters, manufacturing, shipping, field handling and installation, can be simplified by using two or more units specially designed for parallel installation. Each section has its own cut-outs and terminal blocks are provided to interconnect the controls in the field.

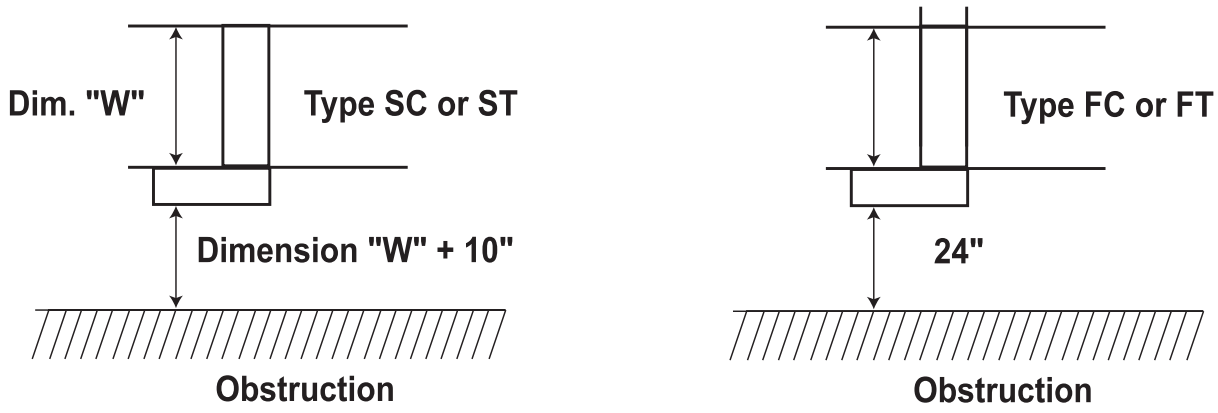


Two stacked sections in a duct

Clearance

Thermolec heaters are CSA and NRTL/C approved for zero clearance to combustible material. This means that there is no distance restrictions between the section of the duct housing the heater and combustible material. However, space should be provided to install and service the duct heater. Please see the minimum recommended installation clearances figures below.

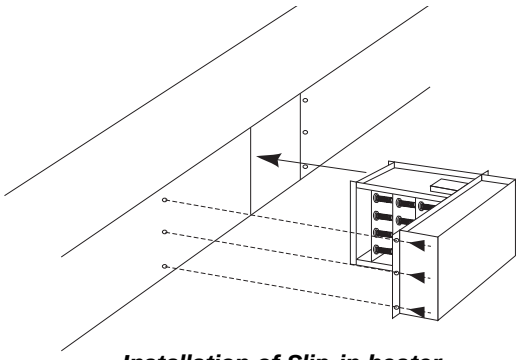
Minimum recommended distance for safety and service



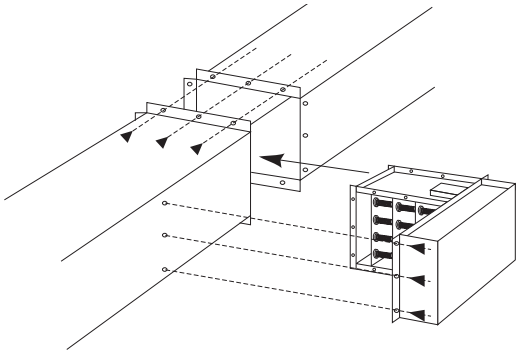
Installation clearances

STEP 2 - (continued)

Heater Installation

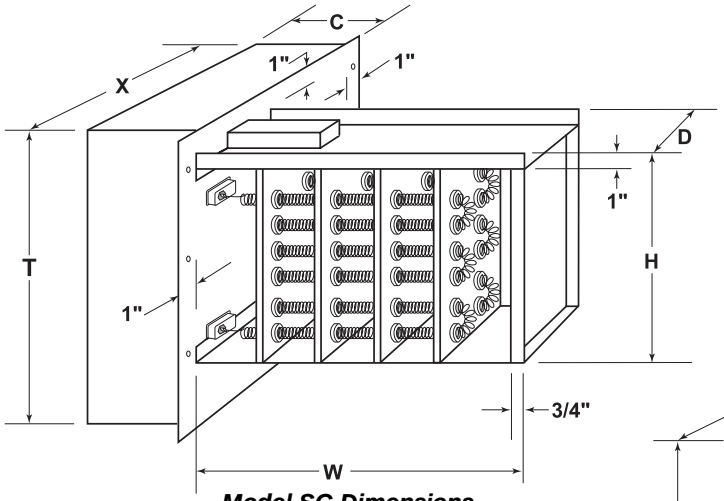


Installation of Slip-in heater

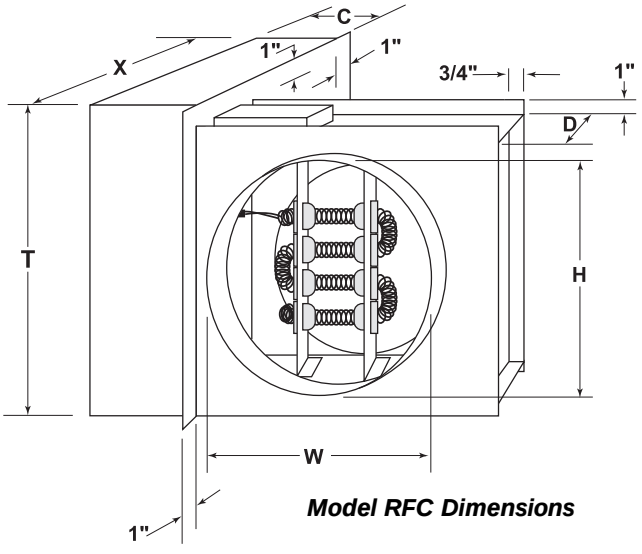


Installation of flanged heater

Details of the Thermolec Mechanical construction

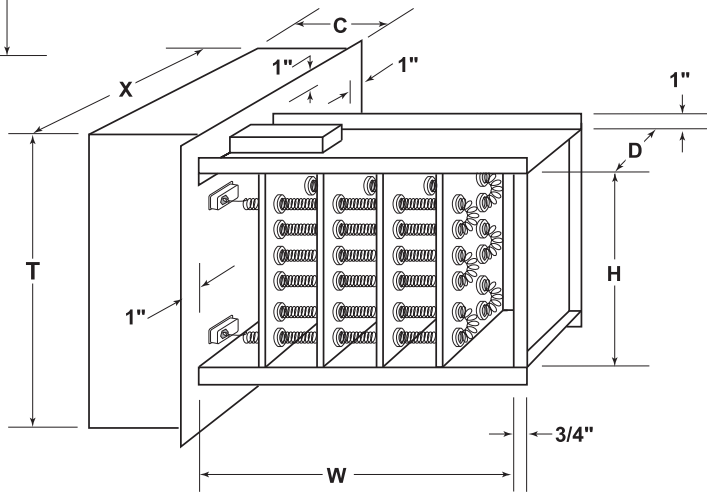


Model SC Dimensions



Model RFC Dimensions

Detailed dimensions:

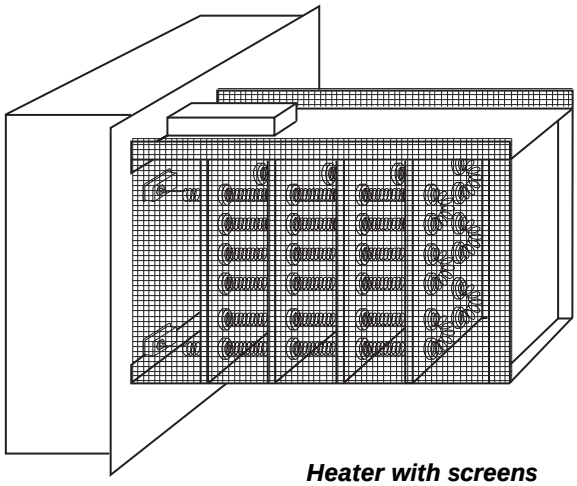


Model FC Dimensions

Conversion to metric
1” = 25.4 mm
3/4” = 19.05 mm

STEP 2 - (continued)

Protective screens

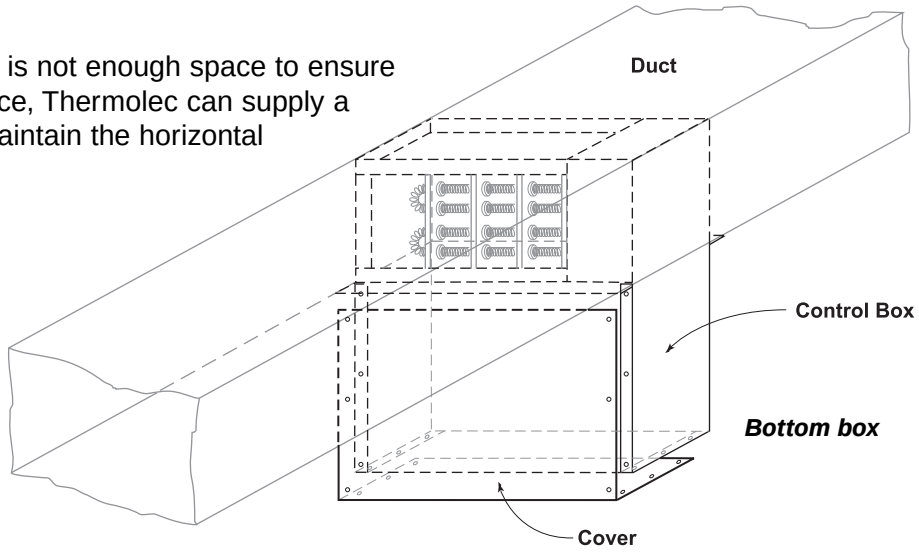


Heater with screens

Screens on both sides of the heater prevent any accidental contact by personnel or tools with electrically de-energized but still "live" coil elements.

Bottom control box

In special conditions, where there is not enough space to ensure proper installation and maintenance, Thermolec can supply a bottom control box designed to maintain the horizontal orientation of open coil elements.



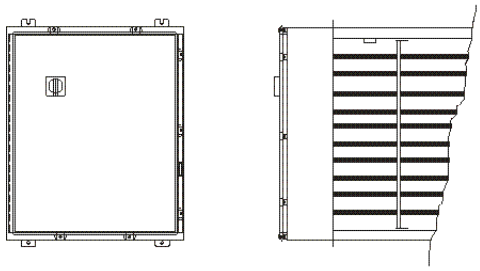
Dust-tight control box

Dust-tight Control Box

A dust-tight control box can be supplied by Thermolec when local codes require it. The control box has all the openings sealed and the cover is gasketed. When SCRs or fuses are installed in a gasketed control box, since there is no opening allowed for proper cooling, the box has to be oversized.

STEP 2 - (continued)

Nema 4 or Weatherproof control Box



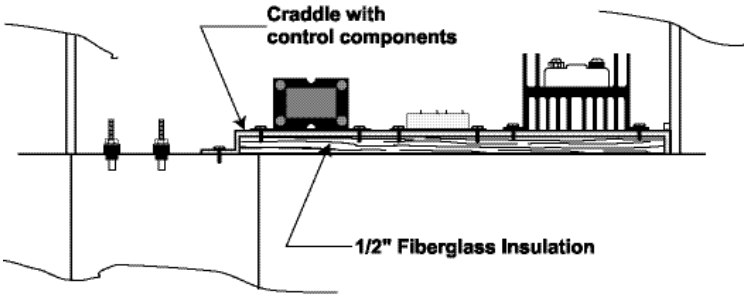
Weatherproof control box

NEMA 4 or Weatherproof oversized control panel

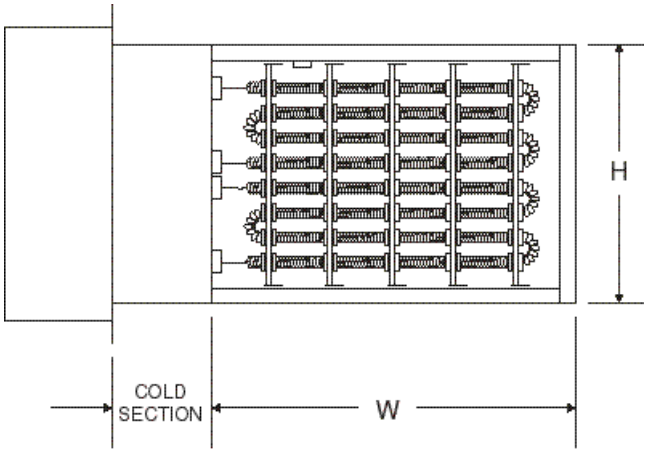
In locations subject to frequent washdowns (i.e. mines, food processing plants), the electric heaters must be supplied with a NEMA 4 control box. The terminal box is all welded, painted steel, with a hinged, gasketed cover and hold-down clamps. When required, the terminal box could be made in stainless steel (specify Nema 4X). The electrical contractor must install water-tight connectors for power supply and control wires.

Insulated Terminal Box

When there is a risk of condensation because of a high contrast between the duct temperature and the control box temperature, Thermolec recommends an insulated control box.



Insulated Terminal Box



Recessed Terminal Box

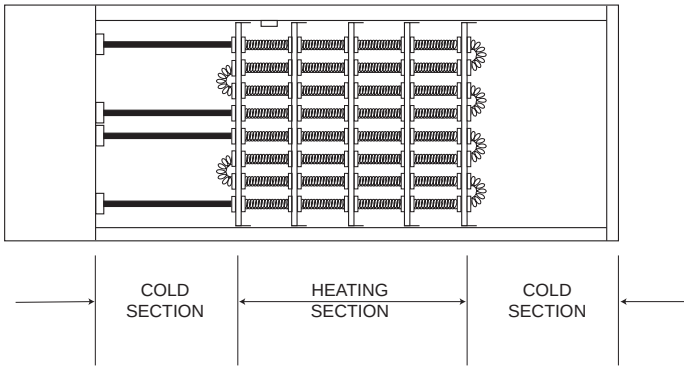
Recess Terminal Box

When heaters are installed in insulated ducts with more than 1” insulation or are inserted through an accoustic plenum, specify a recessed terminal box and indicate dimension of cold section.

STEP 2 - (continued)

Special Heaters

Thermolec manufactures heaters with special specifications to meet the needs of any OEM manufacturer.



Special Heater with no-heat sections

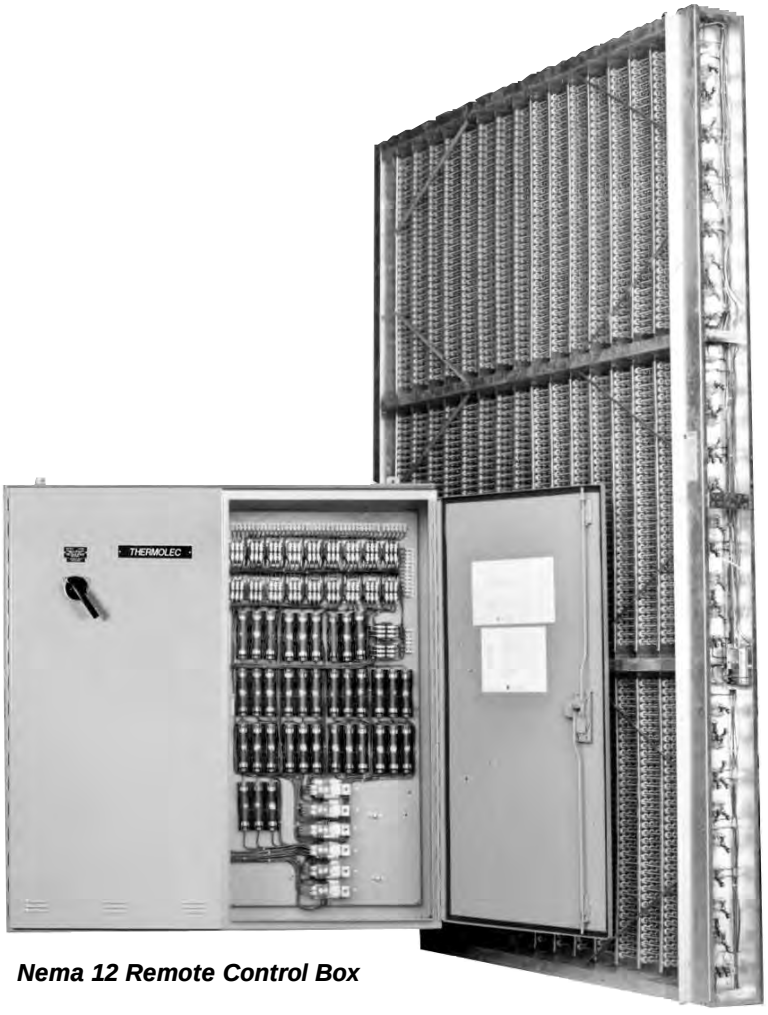
Stainless Steel Process Heater

Process Heaters

Thermolec manufactures process heaters for drying, curing, baking, etc...

Heater with remote control panel

Thermolec electric duct heaters are available in any size from 6" x 6" up to 144" x 96" and up to 1000 KW in one section.
Shown across is a 750 KW open coil heater with it's Nema 12 remote control panel.



Nema 12 Remote Control Box

STEP 3 - DETERMINE METHOD OF CONTROL AND SELECT CONTROL COMPONENTS

Temperature Control Modes and Staging

In selecting temperature controls the specification writer will generally wish to consider both control accuracy and cost.
To provide an acceptably close match of heater output to the system's varying demand for heat it is usually necessary to divide the total KW capacity into separately controlled increments or "control stages". Each stage accounts for part of the total temperature rise ΔT through the heater.
This temperature rise per stage (ΔT / stage) determines how accurately the temperature in the system can be controlled. For selection purposes Thermolec distinguishes FINE, MEDIUM, and COARSE control, which we arbitrarily define:

Temperature rise per control stage, ˚F	Temperature control accuracy
5 or less	FINE (SCR)
6 to 20	MEDIUM
over 21	COARSE

When a heater is controlled by an SCR, it can be considered as having an infinite number of stages and the accuracy is equivalent to FINE.
For a given accuracy and energy efficiency requirement, the number of control stages to be specified depends on the total design temperature rise through the heater.
The following table shows the Thermolec recommendations for control.

Recommended Number of Control ON/OFF stages or SCR Proportional Control

Heating Load		ΔT = 6°C 10°F	ΔT = 11°C 20°F	ΔT = 17°C 30°F	ΔT = 22°C 40°F	ΔT = 28°C 50°F	ΔT > 28°C 50°F
Temperature Control Options	Coarse	--	1 stage ON / OFF	2 stages ON / OFF	2 stages ON / OFF	2 stages ON / OFF	SCR
	Medium	1 stage ON / OFF	SCR	SCR	SCR	SCR	
	Fine	SCR	SCR	SCR	SCR	SCR	

Caution: It should be reminded that a coarse control puts an additional stress on the contactors since they have to cycle more often.

STEP 3 - (continued)

ON - OFF Control Mode

Air temperature is controlled by switching on and off selected control stages of the heater or, on single stage heaters, the entire heater. The ON / OFF mode is practical up to two control stages.
It is recommended for most COARSE control accuracy applications and is satisfactory up to a maximum of 25 ˚F ΔT temperature rise per stage.

CONTROL STAGES

A control stage is a "portion of the total KW capacity of a heater, wired to respond separately to temperature control". Contrary to a common misunderstanding, the number of control stages to be specified for an ON / OFF control system does **not** depend on total KW capacity nor on total amps of a heater.

With ON - OFF control, the temperature rise per control stage (ΔT/stage) determines the inherent temperature control accuracy of the duct heater. Therefore the correct number of control stages is a function of the total temperature rise of the heater and of the desired control accuracy.
For example, a 200 KW heater, handling 120,000 CFM for a design temperature rise of 5 ˚F will give FINE control accuracy with only one control stage. The temperature controller for this heater will be a 1 stage ON - OFF thermostat (if, for any reason, it is not desirable to switch 200 KW in a single step, several "power stages" can be used with automatic time delay).

On the other hand, with a 10 KW heater, handling 600 CFM for a design temperature rise of 50 ˚F, FINE temperature control requires FULL SCR control.

POWER STAGES

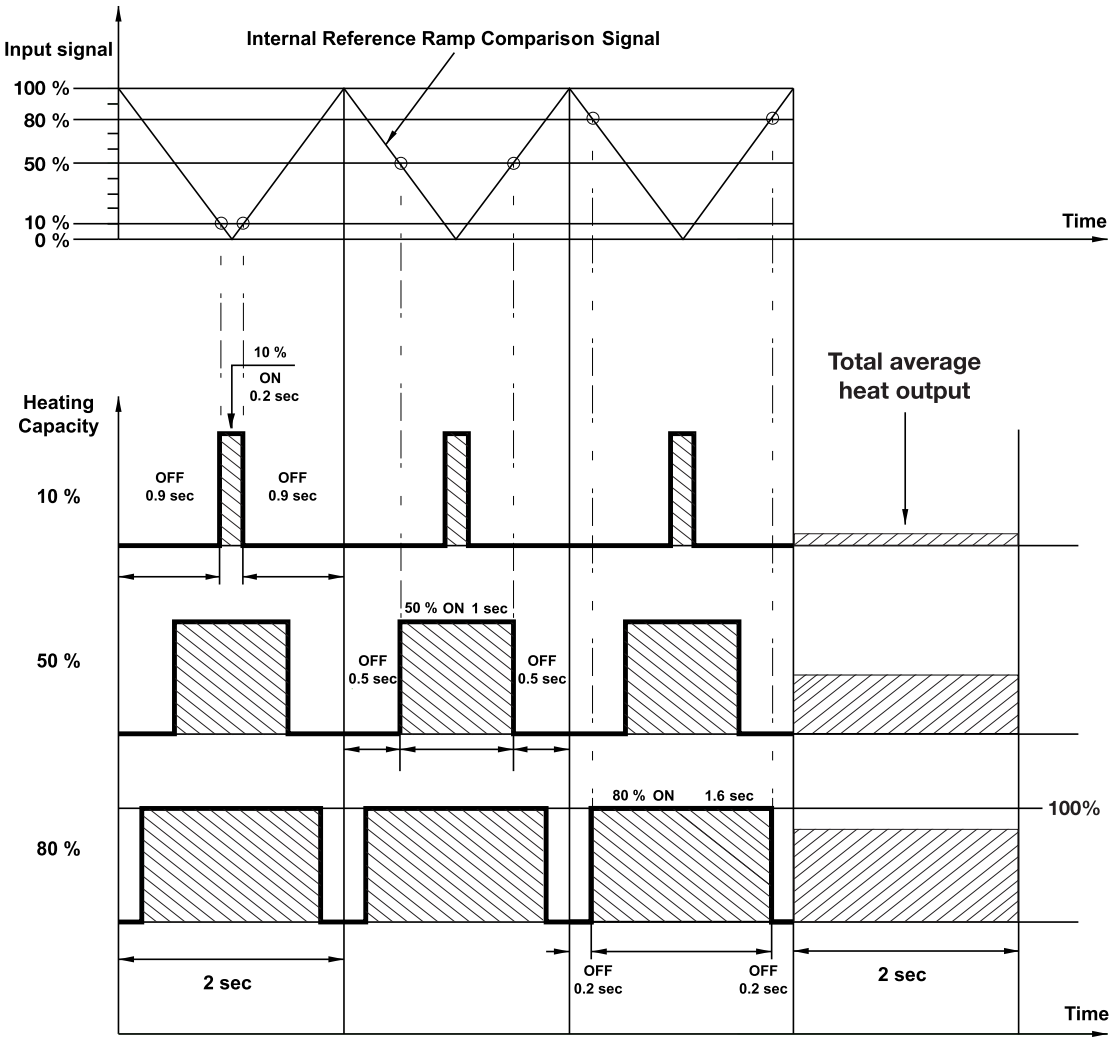
A power stage is a part of a control stage, wired for delayed switching ON. The need for and the capacity of power stages is determined, not by temperature control requirements, but by local codes and conditions governing the increments of capacity that may be brought on line at any moment without causing excessive voltage drop. When required, Thermolec will break down high amperage control stages into several power stages.

MODULATING CONTROL MODE

This method is also referred to as **"proportional"**. The heater is electronically controlled to deliver anywhere from zero to 100% of it's capacity, precisely and smoothly matching the heat demand of the system. This is achieved by means of an SCR controller connected to a proportioning thermostat which may be either a duct type for a Fresh Air make-up or a room type for zone heating.

The word proportional refers to the portion of a time period in which a heating element is turned ON and OFF (e.g. 10% ON and 90% OFF meaning 10% of the heating capacity).
According to the thermostat demand, the heater is pulsed in different proportion of ON time and OFF time to match the heating demand. The longer the element is turned ON, the more heat it is generating and vice versa. The heat produced during the ON period continues to dissipate during the OFF period, thus creating an average temperature output matching the thermostat set-point.

STEP 3 - (continued)



Pulse Width Modulation Diagram

In the above example:

10%	=	12 cycles ON, 108 cycles OFF	0.2 seconds of heating on 2 seconds
50%	=	60 cycles ON, 60 cycles OFF	1 second of heating on 2 seconds
80%	=	96 cycles ON, 24 cycles OFF	1.6 second of heating on 2 seconds
100%	=	120 cycles ON	2 seconds of heating on 2 seconds,

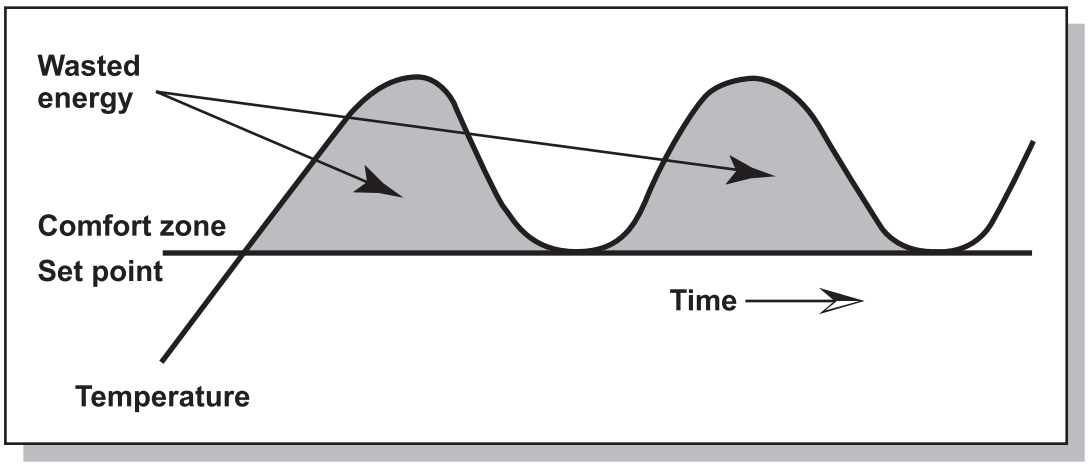
Principle of the Pulse Width Modulation (PWM)
The input signal is compared with an internally generated reference signal (triangle wave) that has a time base of 2 seconds (2 x 60 cycles or 120 cycles), and the controller activates the SCR output in a range of 0 to 100%. On this graphic, every time the horizontal line corresponding to the input (in the above example, 10%, 50% and 80%), crosses the reference signal, the heating elements are switched ON or OFF. The total heat output is an average between the ON and OFF periods, and for low heat demand, the heater is not "dimmed" but switched ON for very shorts periods.

STEP 3 - (continued)

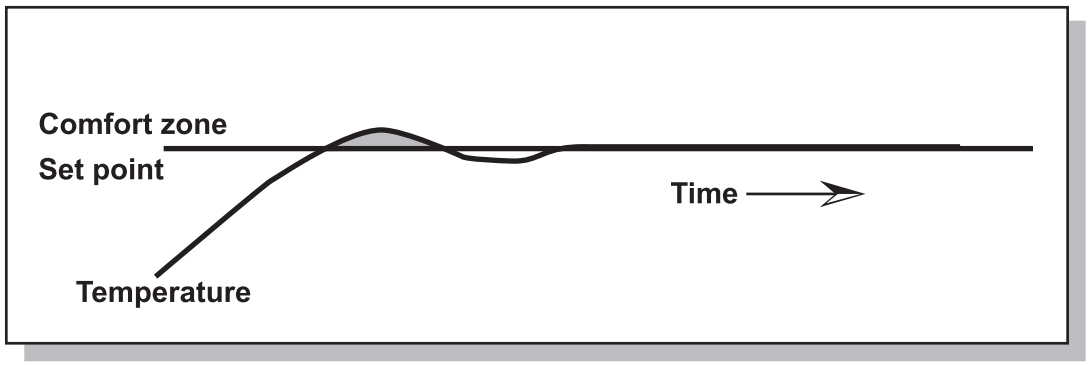
Comparison between ON/OFF and proportional control

Due to it's high differential, ON/OFF control mode wastes a lot of energy. The graphic below shows how the ON/OFF method creates high "overshoot" above the temperature set point while the electronic proportional method keeps the temperature close to the set point. The shaded areas correspond to wasted energy. A proportional control can thus maintain an accurate room or discharge temperature without the typical variations of the ON/OFF method. This represents an energy saving of approximately 15%.

Heating Cycle of ON / OFF Control Mode



Heating Cycle with Proportional Control (SCR)

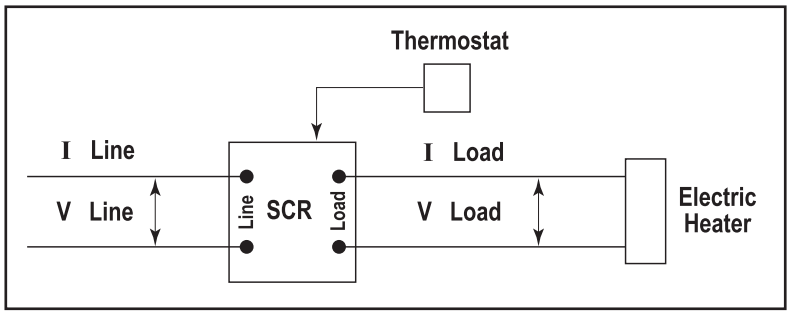


STEP 3 - (continued)

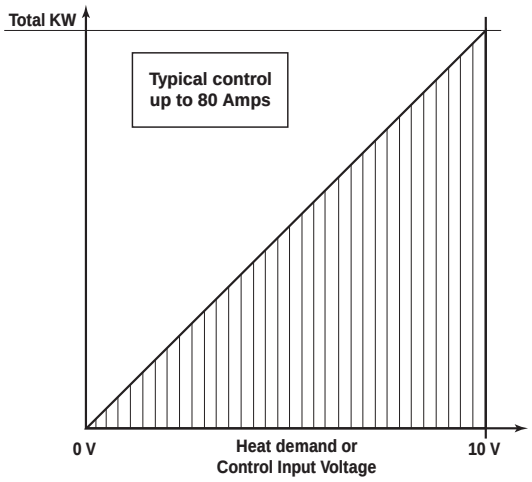
Thermolec strongly recommends the use of SCR proportioning controls for the best results in energy efficiency and maximum comfort.
When the output of the entire heater is being modulated in this manner, the control system is defined as **"FULL SCR".**
When one control stage only is controlled by a SCR while the balance of the heater stages are handled by ON - OFF control, the system is defined as **"HYBRID or VERNIER".**

FULL SCR

SCR is the abbreviation of Silicon Controlled Rectifier, also called current valve because of its ability to modulate the current supplied to, and consequently the capacity of, the heater. The example below sketches how a typical SCR modulates the heat output of a 15 KW / 600 V / 1 PH, electric heater.
As long as the temperature controller demands less than full heat, the SCR will switch the heater on and off repetitively on a very short cycle or period, typically 2 seconds. The net heat output is the product of the KW capacity of the heater multiplied by the ratio of the "ON" to "ON+OFF" or "period" time.
This ratio is determined by an electronic logic in the SCR according to a signal from a proportioning thermostat. Enough heat is stored in the electric elements so that there is an almost constant operating temperature corresponding to the demand.
FULL SCR control is recommended where FINE temperature control is required.



Full SCR Control Electric Diagram



Full SCR Load Diagram

Note: All Thermolec controllers are equipped with a zero-cross thyristor switching system that virtually eliminates all Electro-magnetic interference (EMI) et radio frequency interference (RFI).
The Light Emitting Diode (LED) on the controller indicates when the heating element is on.

STEP 3 - (continued)

HYBRID or VERNIER CONTROL - Principles

Where FINE control accuracy is required and the heater capacity is too high to be handled economically by "FULL SCR", (80 Amps max.), Thermolec recommends a combination of a smaller SCR and a step controller, both being controlled by the same input signal. In this system, the "SCR" is the modulating heating stage. The other heating stages are controlled by the Thermolec electronic step controller. **D46 (the Sequential mode).**

The SCR stage automatically fills the gaps between the step controlled stages, thus providing fully proportional control over the entire heater range.

In applications where the heated air is delivered to the space without proper mixing and stratification is a problem, it is preferable to use the sequential mode and specify "FULL FACE" staging (each stage covers the entire duct face area) when the heater capacity is below 12 KW/sq.ft. Otherwise the binary mode (more economical) is recommended above 12 KW/sq.ft.

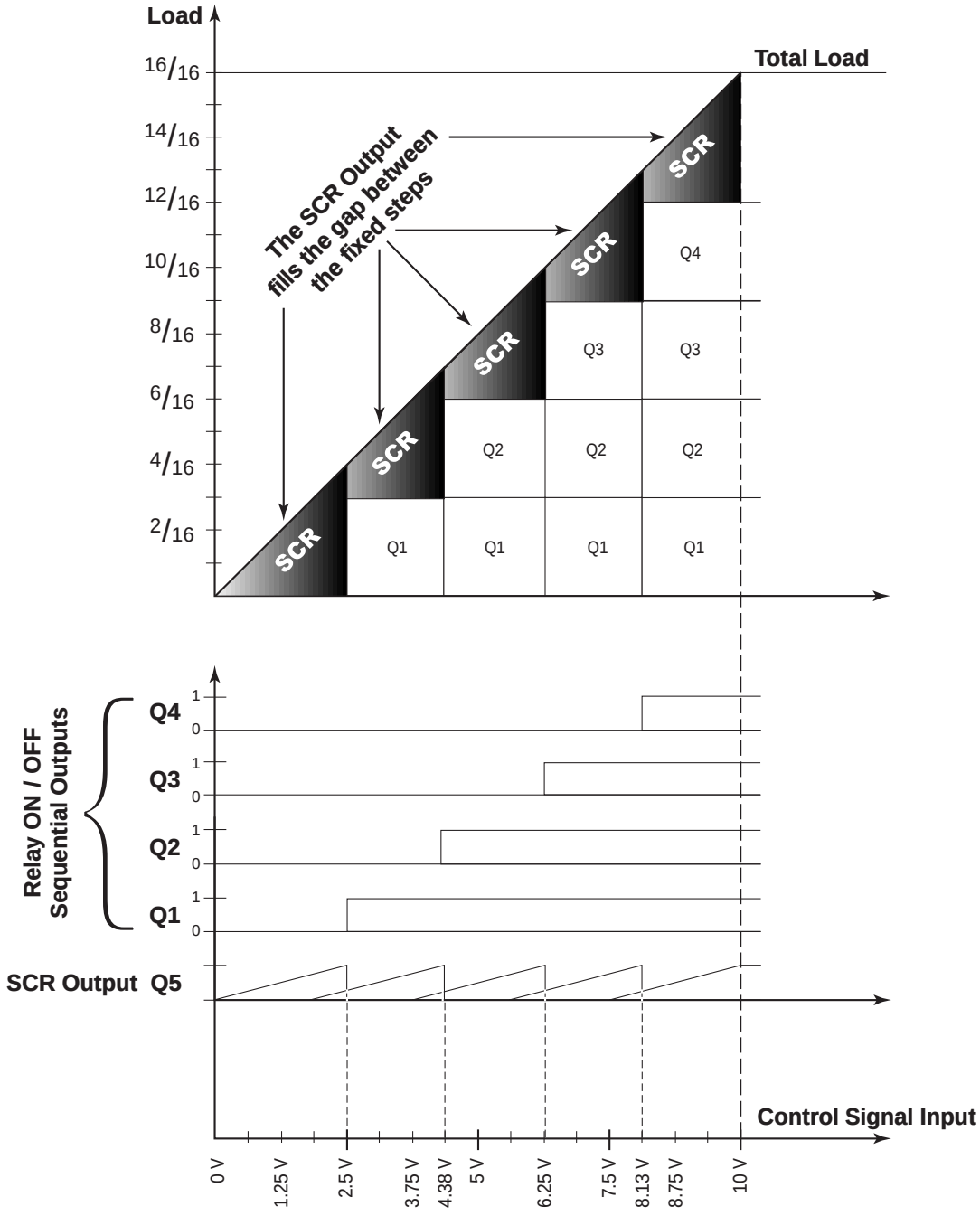
TYPICAL DIVISION OF STEPS - Hybrid control				
	Sequential mode	**Sequential staging for a 160 KW heater.**		
SCR Step	2/6	SCR Step	2/6	53.33 KW
Step 1	1/6	Step 1	1/6	26.66 KW
Step 2	1/6	Step 2	1/6	26.66 KW
Step 3	1/6	Step 3	1/6	26.66 KW
Step 4	1/6	Step 4	1/6	26.66 KW

Input voltage	KW output	Fixed steps “ON” and SCR
from 0 to 3.3 V	0 to 53.33 KW	The variable SCR step covers the heat demand
from 3.3 to 4.99 V	53.33 to 79.99 KW	step 1 + SCR (26.66 fixed + 53.33 SCR)
from 4.99 to 6.65 V	79.99 to 106.66 KW	step 1 + step 2 + SCR (53.33 fixed + 53.33 SCR)
from 6.65 to 7.81 V	106.66 to 133.32 KW	step 1 + step 2 + step 3 + SCR (79.99 fixed + 53.33 SCR)
from 7.81 to 10 V	133.32 to 160 KW	step 1 + step 2 + step 3 + step 4 + SCR (106.66 fixed + 53.33 SCR)

STEP 3 - (continued)

Since the SCR step is kept relatively small (53.3 Kw), it is still cost effective compared to a full SCR 160 KW.

In the following graphic, the sequential loads are switched ON and OFF to match the heat demand. Lay a straightedge vertically at any position of the control input voltage and find exactly which stages are ON or OFF. The SCR not only fill the gaps but overlaps the gaps between the fixed steps at all times.



Hybrid Sequential Load Diagram

STEP 3 - (continued)

HYBRID CONTROL - Binary Mode

Binary staging for a 160 KW heater.

SCR Step	1/16	10 KW
Step 1	1/16	10 KW
Step 2	2/16	20 KW
Step 3	4/16	40 KW
Step 4	8/16	80 KW

In this example, the control voltage 0-10 Volts DC is divided by 16 which gives an increment of 0.625 Volts per 10 KW step.

Here is how it works, in increments of 10 KW and .625 V input voltage:

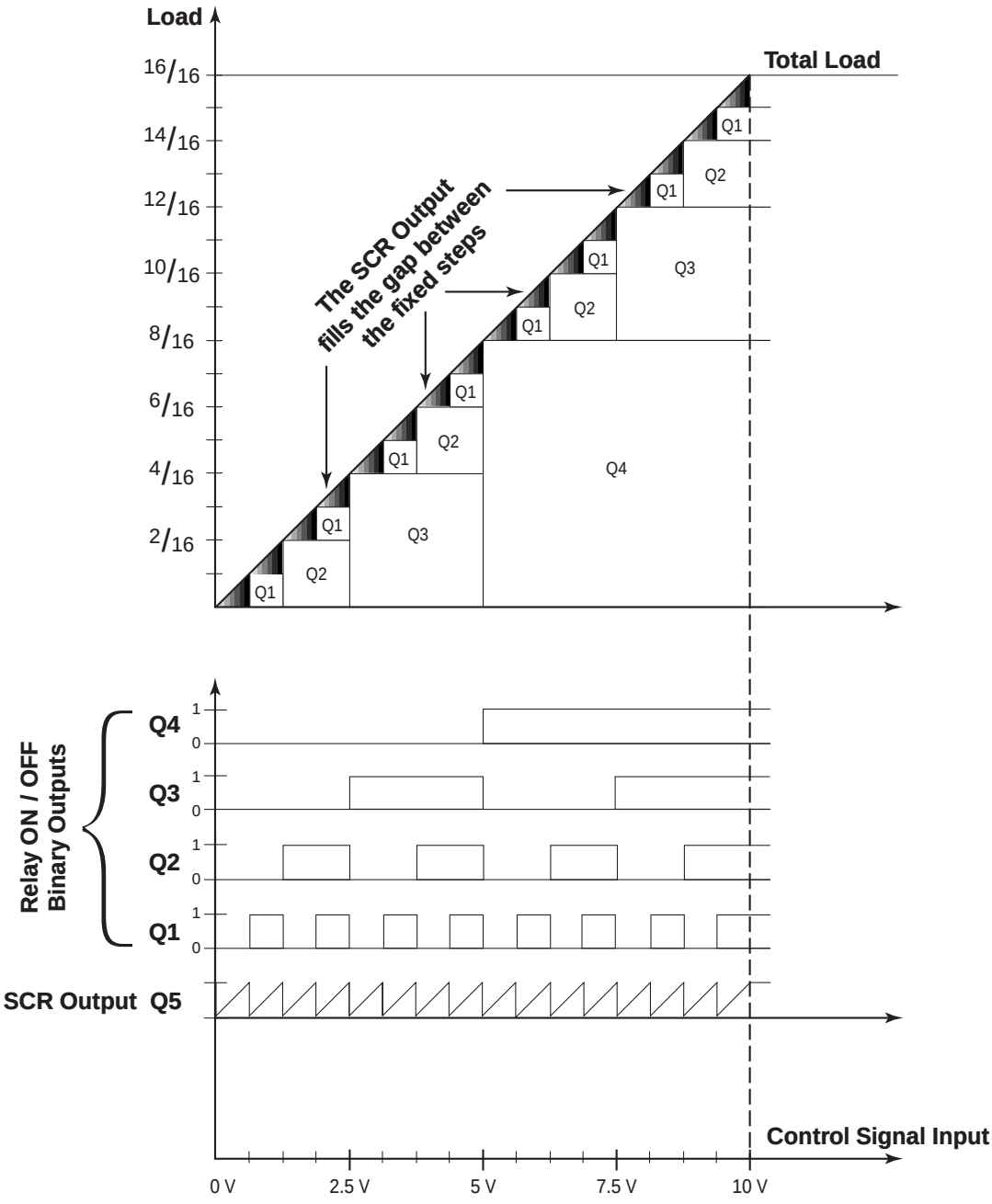
Input voltage	KW output	Fixed steps on and SCR
from 0 to .625 V	0 to 10 KW	The variable SCR step covers the heat demand
from .625 to 1.25 V	10 to 20 KW	step 1 + SCR (10 fixed + 10 SCR)
from 1.25 to 1.875 V	20 to 30 KW	step 2 + SCR (20 fixed + 10 SCR)
from 1.875 to 2.5 V	30 to 40 KW	step 1 + step 2 + SCR (30 fixed + 10 SCR)
from 2.5 to 3.125 V	40 to 50 KW	step 3 + SCR (40 fixed + 10 SCR)
from 3.125 to 3.75 V	50 to 60 KW	step 3 + step 1 + SCR (50 fixed + 10 SCR)
from 3.75 to 4.375 V	60 to 70 KW	step 3 + step 2 + SCR (60 fixed + 10 SCR)
from 4.375 to 5 V	70 to 80 KW	step 3 + step 2 + step 1+ SCR (70 fixed + 10 SCR)
from 5 to 5.625 V	80 to 90 KW	step 4 + SCR (80 fixed + 10 SCR)
from 5.625 to 6.25 V	90 to 100 KW	step 4 + step 1 + SCR (90 fixed + 10 SCR)
from 6.25 to 6.875 V	100 to 110 KW	step 4 + step 2 + SCR (100 fixed + 10 SCR)
from 6.875 to 7.5 V	110 to 120 KW	step 4 + step 2 + step 1 + SCR (110 fixed + 10 SCR)
from 7.5 to 8.125 V	120 to 130 KW	step 4 + step 3 + SCR (120 fixed + 10 SCR)
from 8.125 to 8.75 V	130 to 140 KW	step 4 + step 3 + step 1 + SCR (130 fixed + 10 SCR)
from 8.75 to 9.375 V	140 to 150 KW	step 4 + step 3 + step 2 + SCR (140 fixed + 10 SCR)
from 9.375 to 10 V	150 to 160 KW	step 4 + step 3 + step 2 + step 1 + SCR (150 fixed + 10 SCR)

Since the SCR step is kept small, it is cost effective compared to a full SCR 160 KW.

Hybrid Binary Load Diagram (Please see next page)

STEP 3 - (continued)

In the following graphic, the binary loads are switched ON and OFF to match the heat demand. Lay a straightedge vertically at any position of the control input voltage and find exactly which stages are ON or OFF. The SCR modulating step fills the gap between the fixed steps at all times.



Hybrid Binary Load Diagram

STEP 3 - (continued)

Summary of Temperature Control

1- Electric ON / OFF thermostats are available up to three stages for room or duct control and up to four stages for duct control only. Three and four stage thermostats are not recommended for FINE or MEDIUM temperature control because of their large differentials. However, they are suitable for COARSE control.

2- P.E. Switches with a pneumatic thermostat are recommended for up to four stages only and can be used for FINE as well as MEDIUM or COARSE control.

3- FULL SCRs are compatible with electronic or pneumatic signal. They are recommended where FINE temperature control and energy conservation is required. As a general guideline, it is economical to use Full SCR on heaters up to 70 Amps total load. Between 70 and 120 Amps, the cost is slightly more expensive and beyond 120 Amps Hybrid controllers are the best choice.

4- Hybrid controllers are compatible with electronic or pneumatic signal. They are recommended where FINE temperature control is required and where the heater capacity is too large to be controlled economically by a FULL SCR (over 120 Amps).

5- Thermolec is engaged in a countinuous effort of product development, hence, the following information is presented as a general overview of existing products and can be modified without further notice.

Notes:

a- Although ON/OFF stages can offer some economy, in most multi-stage (2 stages and over) applications up to 40 KW, SCR proportional control can be obtained at almost the same price. Please see selection of most economical KW / voltage combination on page 7.

b- In order to manage the energy resources properly and provide the best comfort, **Thermolec recommends specifying a proportional control at all times.**

ON/OFF Room Thermostats

24 volts wall thermostat, ON-OFF type with built-in thermometer and adjustable heat anticipator.

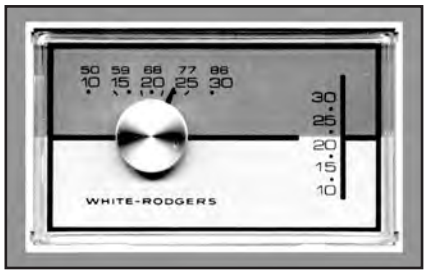
1 stage

T86 Honeywell

2 stages

T874 Honeywell

1 and 2 stages



1F30W-301 (1 stage) and 1F37-408 (2 stages) - White-Rodgers

STEP 3 - (continued)

Modulating Room Thermostats

RT

The Thermolec RT electronic modulating room thermostat is a thermistor proportional type that is compatible with all Thermolec electronic controls. ABS casing. Thermistor based, proportional control, two wire type, with built-in adjustable set point.
Standard range: 10 to 30 ˚C, (50 to 86 ˚F).

RT

RARS

RARS Remote (set point) **Adjuster + Room Sensor**
Similar to an RT but divided into a two controls: a room sensor without adjustment and a remote adjuster. Two wire sensor to be installed in the room (RS) in conjunction with a remote set point adjuster (RA) installed at customer is convenience.
Standard range: 10 to 30 ˚C, (50 to 86 ˚F).

ON/OFF Duct thermostats

Bulb thermostat

(Capillary type) with 5' capillary tube to be installed in the duct.
Designed for pilot duty service.
Available in 1 or 2 stages ON-OFF.
Standard range: -15 to + 35 ˚C (5 to 95 ˚F).

T678A Honeywell

1687-9 White-Rodgers

Bulb thermostat

(Capillary type) with 8' capillary tube to be installed in the duct.
Designed for pilot duty service.
Available in 1 stage ON-OFF.
Standard range: -34 to + 32 ˚C (-30 to 90 ˚F).

STEP 3 - (continued)

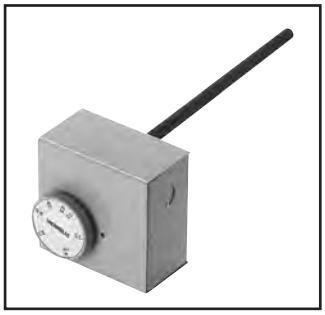
Modulating Duct Thermostats

DT

The Thermolec DT electronic modulating duct thermostat is a thermistor proportional type that is compatible with all Thermolec electronic controls. ABS casing for temperatures up to 65 ˚C. Metal casing for temperatures over 65 ˚C, two wire type, with built-in adjustable set point.

DT - ABS Casing

Model #	Range ˚C	˚F.
DT-1815	-18 - +15	0 - 59
DT-037	0 - 37	32 - 99
DT-1040	10 - 40	50 - 104
DT-3265	32 - 65	90 - 149
DT-6590	65 - 90	149 - 194
DT-80155	80 - 155	176 - 311

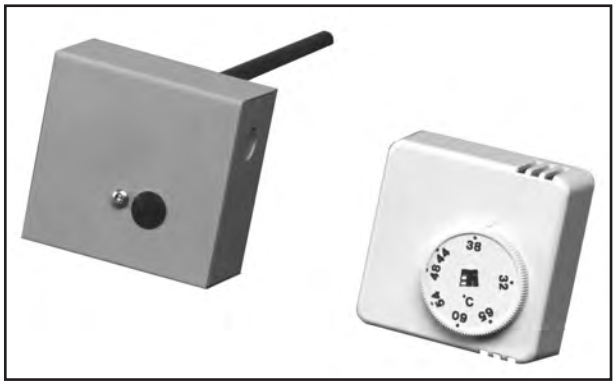


DT - Metal casing

RADS - ABS casing

RADS Remote (set point) **Adjuster + Duct Sensor**

Two wire sensor to be installed in the air duct (**DS**) in conjunction with a remote set point adjuster (**RA**) installed at customer's convenience.



RADS - Metal casing

Model #	Range ˚C	˚F.
RADS-1815	-18 - +15	0 - 59
RADS-037	0 - 37	32 - 99
RADS-1040	10 - 40	50 - 104
RADS-3265	32 - 65	90 - 149
RADS-6590	65 - 90	149 - 194
RADS-80155	80 - 155	176 - 311

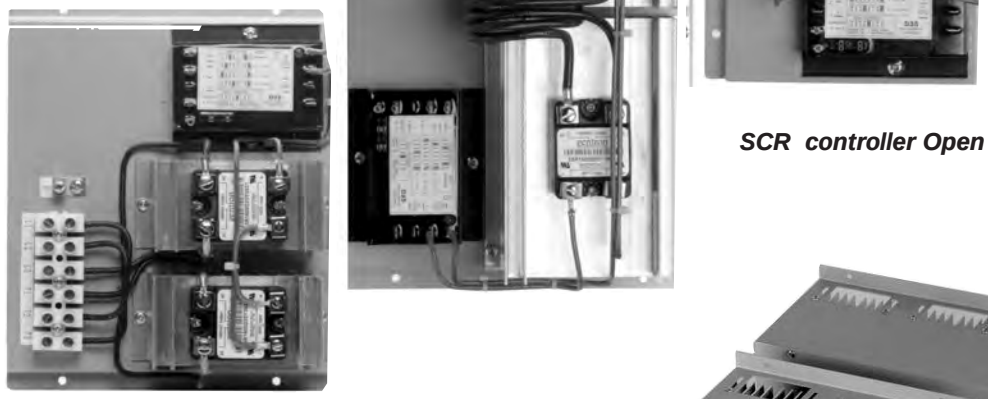
STEP 3 - (continued)

SCR Controller

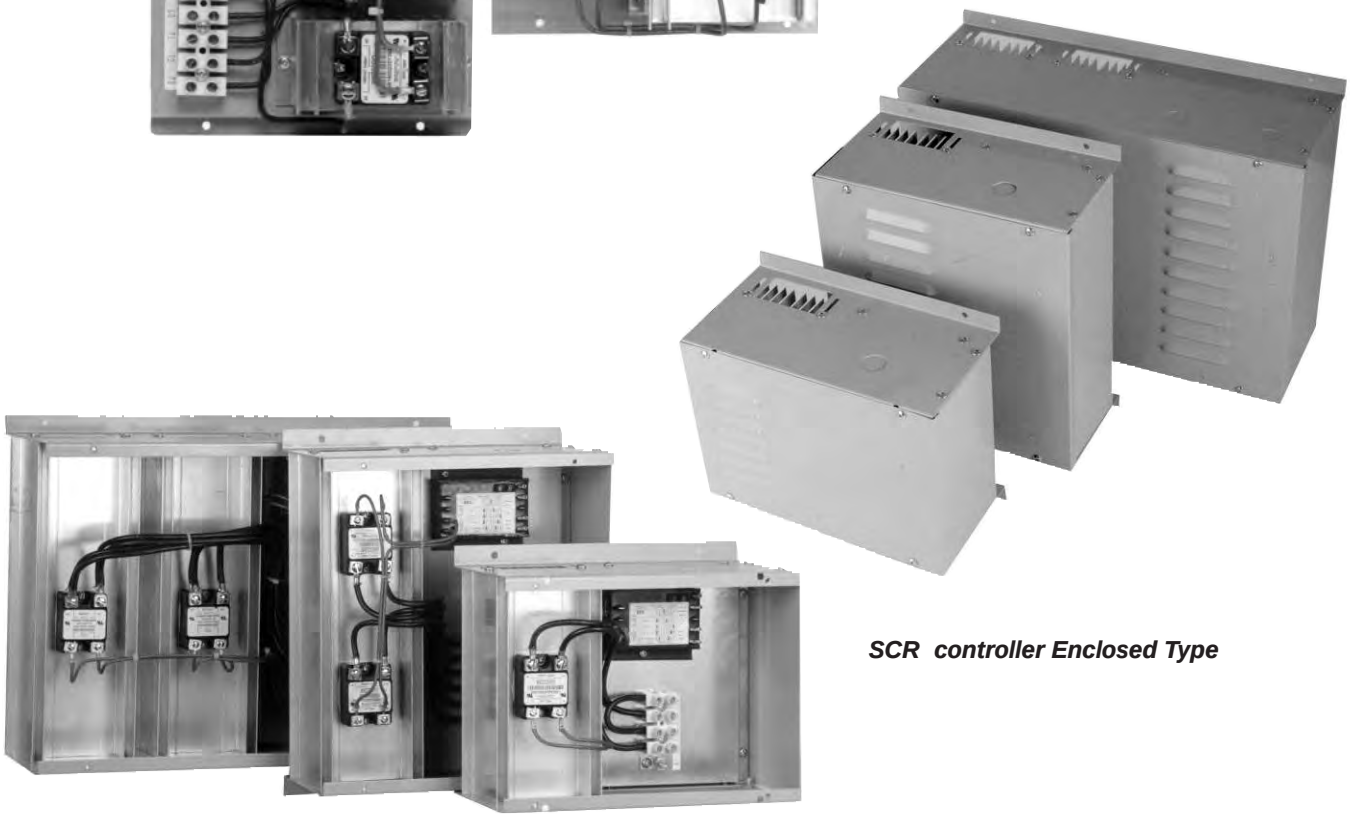
The SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand.

Input: Thermistor thermostat (RT or DT),
0 - 10 VDC, 4 - 20 mA, 0 - 135 Ohms.

Output: Single or three phases load,
20, 30, 40 and 80 Amps @ 600 V. max



SCR controller Open Type



SCR controller Enclosed Type

Warranty

1- Thermolec Ltd. guarantees their heater resistance elements and other built-in components against any defect in workmanship and material for a period of one year, effective date of shipment from it's factory.
Any claim under this guarantee will be considered only if the product has been installed and operated in accordance with Thermolec's instructions.

2- Thermolec's responsibility will be limited in any case to the replacement or repair, at its factory or in the field, by its own personnel or through others, at its option, of such heaters or parts thereof that shall prove to be defective within one year from shipment.

3- Misuse of this product, or repairs made by others without Thermolec's authorization, will void this warranty.

4- Thermolec shall not be held responsible for damage or delays and shall not be held liable for any charges resulting from the removal or replacement of the allegedly defective heater.

5- Thermolec shall not be held responsible for any incidental or consequential damage or delays due to workmanship or material. No additional charge will be accepted for repair, replacement or modification if prior written authorization was not obtained from Thermolec.

6- Any control device or accessory, supplied with the heater, to be mounted or connected remotely, will only be guaranteed by the manufacturer per conditions stated in clause 5.

SPECIFICATION FOR OPEN COIL HEATERS

Long Form

Supply where indicated in these specifications, or where shown on drawings, CSA (NRTL/C) approved open coil duct heaters as manufactured by THERMOLEC.

☛ 1- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
- Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
- Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.

☛ 2- SAFETY CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc-type thermal cut-out(s) located in the top frame component above the heating elements.
- In addition to the automatic reset cut-out, heaters of 30KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe manual reset disc-type thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA.
- The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.
- Cut-outs shall de-energize the heater in case of insufficient air flow.
- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location (option X1) and protective screens on both sides (option MS).
- Load fuses shall be supplied as recommended by NEC (National Electrical Code).
- When heaters are used in VAV systems, they should be modulating type ***"THERMO-V"*** equipped with an electronic air flow sensor as described in item #8.

☛ 3- AIR FLOW:

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.
- Heaters shall be CSA approved for zero clearance in horizontal ducts.

☛ 4- MOUNTING METHOD:

- Heaters shall be open coil model SC slip-in type or model FC flanged type, as shown on the plans or on the coil schedule.
- Slip-in heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side.
- Flanged heaters shall be suitable for attaching to matching flanges on the duct.
- Mounting flanges on both models shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phases, kilowatt and number of control stages shall be as per heater schedule.

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipping, heaters shall withstand tests as required by CSA.

Long Form (continued)

☛ 7- STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:

- High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

Additional options can be chosen from the following list:

- Mercury contactors
- Unfused disconnect switch
- SCR proportional controller
- HRC Form 1 load fuses
- Hybrid controller with SCR and binary steps
- Pressure Electric switches
- Pneumatically controlled SCR
- Pilot lights to indicate staging, power supply on, overheating, no air flow, heating on

Note: it is also possible to order a separate CEMA-1 remote control panels (option M6)* with the above options.
* Remote mounting control panel must include HRC Form 1 load fuses in order to provide over-current protection for each duct heater power circuit.

☛ 8- HEATERS FOR VAV SYSTEMS:

- **Duct heaters for VAV systems will be electronic modulating type "THERMO-V", equipped with a proportional controller to modulate the total heater load according to the temperature control signal and a proportional electronic air flow sensor (non pressure dependent type) to modulate the heater capacity according to the available air flow:**
  Maximum heating with normal air flow
  Reduced heating with low air flow
  No heating with no air flow

Please refer to the Thermo-V flyer and specification at the end of this section.

☛ 9- SPECIAL CONSTRUCTION:

- Heaters could be equipped with a bottom terminal box, weatherproof shroud or any other feature selected from the option list (see section 2).

☛ 10- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

Short Form

- Supply where indicated in these specifications CSA (NRTL/C when required) approved duct heaters as manufactured by THERMOLEC.

- Coils shall be of High Grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminal pins shall be stainless steel insulated by means of non-rotating ceramic bushings.

- Heaters shall be model SC slip-in type, as shown on the plans or on the heater schedule. Heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side. Mounting flanges shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

- All duct heaters shall be equipped with fail-safe, automatic reset and manual reset disc-type thermal cut-outs, as required by CSA.

- Cut-outs shall be shielded from accidental impact, and shall de-energize the heater in case of insufficient air flow.

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts. Heaters shall be CSA approved for zero clearance in horizontal ducts.

- Duct heaters shall be equipped with magnetic contactors as required, 24 volts transformer, airflow sensor, …(room thermostat, duct thermostat, SCR control, load fuses, solid state relays, mercury contactors, pilot lights, protective screens, etc).

- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location (option X1) and protective screens on both sides (option MS).

- Load fuses shall be supplied as required by local codes.

- **Duct heaters for VAV systems will be electronic modulating type “THERMO-V”, equipped with a proportional controller to modulate the total heater load according to the temperature control signal and a proportional electronic air flow sensor (non pressure dependent type) to modulate the heater capacity according to the available air flow:**
  Maximum heating with normal air flow
  Reduced heating with low air flow
  No heating with no air flow

THERMOLEC THERMOLEC 0PEN COIL HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH x HEIGHT		kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6	*Examples :*											
7	RH - 1	SC	1	12	10	5	600/3	1	600	25	24	1 - 2 - 3 - 17
8	RH - 2	SC	1	48	36	60	600/3	1	2000	90	24	1 - 2 - 3 - 7 - 18

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

➤ Required Options

1 ➤ Built-in disconnect switch
2 ➤ SCR proportional controller
3 ➤ Screens both sides
4 ➤ Pneumatically controlled SCR
5 ➤ Solid State Relay (TRIAC)
6 ➤ Hybrid controller (SCR + step controller)
7 ➤ Load fuses, HRC type
8 ➤ Mercury contactors
9 ➤ Pressure electric switch
10 ➤ Low watts density elements
11 ➤ Pilot lights
12 ➤ Full break contactors
13 ➤ Nema 4 control box
14 ➤ _____
15 ➤ _____
16 ➤ _____
17 ➤ Electronic room thermostat RT
18 ➤ Electronic duct thermostat DT
19 ➤ Remote adjustable duct sensor RADS
20 ➤ Remote adjustable room sensor RARS

SPECIFICATION FOR TUBULAR HEATERS

Long Form

Supply where indicated in these specifications CSA (NRTL/C) approved tubular duct heaters as manufactured by THERMOLEC.

☛ 1- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Heating elements shall be tubular type made of heavy gauge Incoloy 800 filled with compacted magnesium oxide insulating powder.
- Above 277 Volts or 30KW, each tube shall be of "U" type and shall be removable through the control box without removing the heater from its ductwork.

☛ 2- SAFETY CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc-type thermal cut-out(s) located in the top frame component above the heating elements.
- In addition to the automatic reset cut-out, heaters of 30 KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe manual reset disc-type thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA.
- The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.
- Cut-outs shall de-energize the heater in case of insufficient air flow.
- For maintenance and safety purposes, a built-in disconnect shall be supplied to switch the power off at the heater location.
- Load fuses shall be supplied as required by NEC (National Electrical Code).

☛ 3- AIR FLOW:

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts.

☛ 4- MOUNTING METHOD:

- Heaters shall be ST slip-in type or model FT flanged type, as shown on the plans or on the heater schedule.
- Slip-in heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side.
- Flanged heaters shall be suitable for attaching to matching flanges on the duct.
- Mounting flanges on both models shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phase kilowatt and number of control stages shall be as per heater schedule.

Long Form (continued)

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipping, heaters shall withstand tests as required by CSA.

☛ 7- STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:

- High limit cut-outs, magnetic contactors as required, control transformer and air flow sensor as standard components.

Additional options can be chosen from the following list:

- Mercury contactors
- Unfused disconnect switch
- SCR proportional controller
- HRC Form 1 load fuses
- Hybrid controller with SCR and binary steps
- Pressure Electric switches
- Pneumatically controlled SCR
- Pilot lights to indicate staging, control voltage on, power supply on, overheating, no air flow, heating on

☛ 8- SPECIAL CONSTRUCTION:

- Heaters could be equipped with a bottom terminal box, weatherproof shroud or any other feature selected from the option list (see section 2).

☛ 9- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

SPECIFICATION FOR TUBULAR HEATERS

Short Form

- Supply where indicated in these specifications CSA (NRTL/C when required) approved duct heaters as manufactured by THERMOLEC.

- Heating elements shall be tubular type made of heavy gauge Incoloy 800 filled with compacted magnesium oxide insulating powder.
  Above 277 Volts or 30KW, each tube shall be of "U" type and shall be removable through the control box without removing the heater from its ductwork.

- Heaters shall be ST slip-in type, as shown on the plans or on the heater schedule.
  Heaters shall be suitable for insertion into the duct through an opening on its side and shall have a flange for securing it to the duct side. Mounting flanges shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

- All duct heaters shall be equipped with fail-safe disc-type thermal cut-outs, automatic reset and manual reset as required by CSA.

- Cut-outs shall be shielded from accidental impact, and shall de-energize the heater in case of insufficient air flow.

- Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts.

- Duct heaters shall be equipped with magnetic contactors as required, 24 volts transformer, airflow sensor, …(room thermostat, duct thermostat, SCR control, load fuses, solid state relays, mercury contactors, pilot lights, protective screens, etc).

- For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location.

- Load fuses shall be supplied as required by local codes.

THERMOLEC

THERMOLEC TUBULAR HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH	x HEIGHT	kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6	***Examples :***											
7	RH - 1	ST	1	12	10	5	600/3	1	600	25	24	1 - 2 - 17
8	RH - 2	ST	1	48	36	60	600/3	1	2000	90	24	1 - 2 - 7 - 18

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer and PDS as standard components.

➤ Required Options

1 ➤ Built-in disconnect switch
2 ➤ SCR proportional controller
3 ➤ Screens both sides
4 ➤ Pneumatically controlled SCR
5 ➤ Solid State Relay (TRIAC)
6 ➤ Hybrid controller (SCR + step controller)
7 ➤ Load fuses, HRC type
8 ➤ Mercury contactors
9 ➤ Pressure electric switch
10 ➤ Low watts density elements

11 ➤ Pilot lights
12 ➤ Full break contactors
13 ➤ Nema 4 control box
14 ➤ _____
15 ➤ _____
16 ➤ _____
17 ➤ Electronic room thermostat RT
18 ➤ Electronic duct thermostat DT
19 ➤ Remote adjustable duct sensor RADS
20 ➤ Remote adjustable room sensor RARS

THERMO-V SPECIFICATION

Supply where indicated in these specifications, or where shown on drawings, CSA (NRTL/C) approved THERMO-V type heaters specially designed for VAV boxes and manufactured by THERMOLEC.

☛ 1- AIR FLOW:

- The proportional electronic air flow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available air flow:
  The heaters shall deliver maximum heating when needed with normal minimum air flow, reduce heating with lower than minimum air flow and stop heating with no air flow.

☛ 2- CONTROL AND INPUT SIGNAL:

- Heaters shall be equipped with a proportional controller to modulate the heater load according to the temperature control signal.
  The electronic controller shall be compatible with the following input signals:
  - Variable voltage signal 0-10 VDC
  - Pulse with modulation AC or DC

☛ 3- CONSTRUCTION:

- Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
- Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
- Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.
- Heaters shall be CSA approved for zero clearance in horizontal ducts.

☛ 4- SAFETY AND BUILT-IN CONTROLS:

- Heaters shall be equipped with fail-safe automatic reset disc thermal cut-out.
- In addition, heaters of 30KW and less, rated for voltages below 300 volts shall be equipped with a fail-safe disc type manual reset thermal cut-out as required by CSA.
- Cut-outs shall de-energize the heater in case of accidental over-heating.
- For maintenance and safety purposes, the heaters shall be equipped with a built-in disconnect to switch the power off at the heater location and protective screens on both sides.
- Load fuses shall be supplied as recommended by NEC (National Electrical Code).
- All duct heaters shall be complete with the following built-in controls : magnetic contactors as required, control transformer, proportional electronic controller and air flow sensor as standard components.

☛ 5- SIZE & CAPACITY:

- Heater size, volts, phase, kilowatts shall be as per the following schedule.

☛ 6- INTERNAL WIRING:

- All internal wiring shall terminate on clearly identified terminal blocks.
- A wiring diagram shall be installed on the control box cover.
- Prior to shipment, heaters shall withstand tests as required by CSA.

☛ 7- APPROVALS:

- Heaters data sheets, wiring diagrams and mechanical drawings shall be submitted to the consulting engineer for approval before manufacturing.

THERMOLEC

THERMO-V ELECTRIC HEATERS SCHEDULE

ID	SYSTEM / TAGS / HEATER	TYPE	QTY	DUCT DIMENSIONS IN. ☑ MM ☐ WIDTH	x HEIGHT	kW	VOLTS/ PHASES	STAGES	AIR FLOW CFM ☑ L/S ☐	ΔT TEMP F° ☑ C° ☐	CONT. VOLTS	OPTIONS
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13	***Example :***											
14	RH - 1	SC	1	12	10	5	600/3	1	600	25	24	1 - 2

STANDARD BUILT-IN CONTROLS:

All duct heaters shall be complete with the following built-in controls:
High limit cut-outs, magnetic contactors as required, control transformer, SCR proportional controller, built-in disconnect switch and air flow sensor as standard components

➤ Required Options

1 ➤ Screens both sides

2 ➤ Load fuses, HRC type

3 ➤ Pneumatically controlled SCR

4 ➤ _____

5 ➤ _____

6 ➤ _____

THERMOLEC

Application Notes

OPEN COIL AND TUBULAR ELEMENTS CONSIDERATIONS

2060 Lucien Thimens Street
St-Laurent, Quebec H4R 1L1
Tel.: (514) **336-9130**
Fax: (514) 336-3270

Open coil and tubular elements considerations

THERMOLEC manufactures both open coil and tubular duct heaters.
It is widely acknowledged that tubular elements find practical application under certain circumstances (service conditions include possible contact by personnel, presence of dust or particles in the air flow or atmospheric conditions). Where duct air heating is the sole function, the open coil heater is superior for the reasons shown in the following comparison:

1-ELEMENT LIFE EXPECTANCY

The life expectancy of the nickel/chromium resistance wire in both the open coil and tubular elements is directly related to the maximum wire surface temperature experienced during operation. In an open coil heater, the passing air in direct contact with the wire easily dissipates the heat, thus reducing this surface temperature. In the tubular element, the heat from the enclosed resistance wire must travel through electrically insulating compacted magnesium oxide powder surrounding the coil and through a steel sheath before dissipation. To further compound the wire surface temperature problem of the tubular element, the limited space inside the sheath necessitates the use of smaller gauge resistance wire wound on a smaller arbor; hence a much higher wattage density per square inch of resistance wire becomes a necessary design evil. For example, 200 watts per square inch may be required for enclosed elements compared to 40 to 50 watts per square inch for open coil elements. The net result is that the resistance wire of the enclosed element, with a higher operating temperature, a higher wattage density and double insulation, may not last as long as the open coil element.

2-SERVICE CONSIDERATION

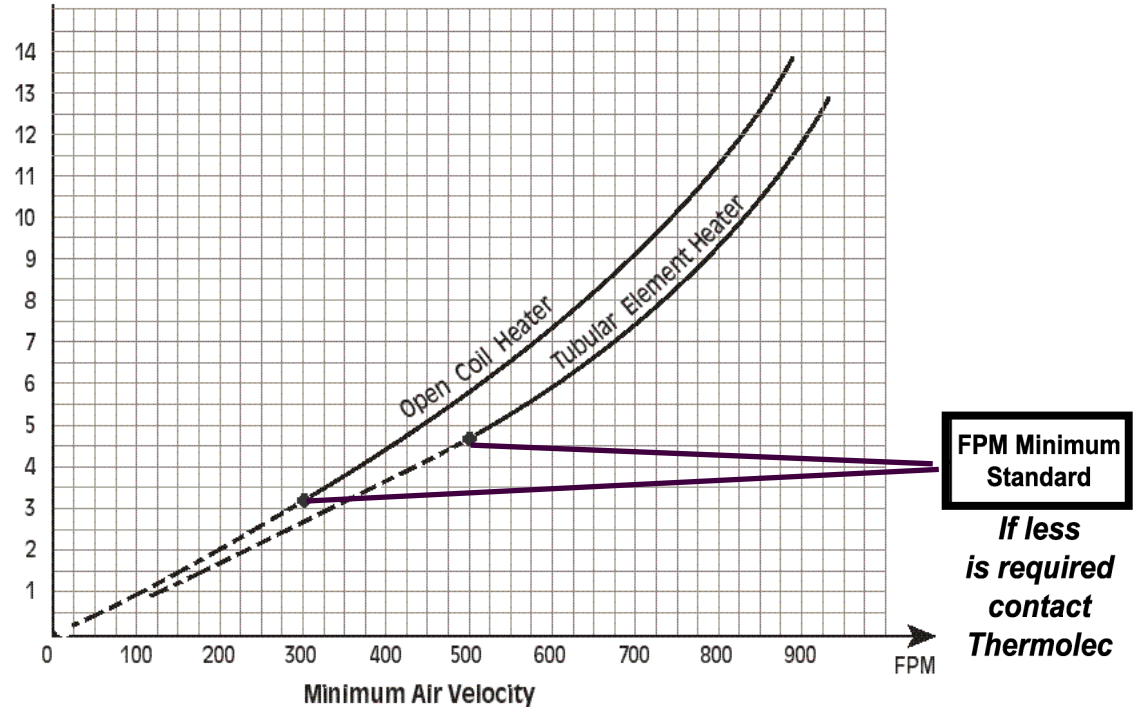
Contrary to common belief, the tubular element is not as robust and trouble-free as might be expected. Space limitations within the element casing require electrical clearances to be very small. This is a critical problem for elements with higher voltages, particularly if the insulating powder is not properly compacted. There always exists a danger that the magnesium oxide surrounding the element will absorb moisture, become conductive and short circuit the element to the sheath. Because of this problem, UL requirements have become much more stringent. A separate Standard (UL # 1030) on tubular elements was published containing strict requirements for the manufacturer of UL listed finned tubular elements. These requirements attempt to control the problems of magnesium oxide contamination and moisture absorption through frequently repeated tests. No such standards or tests are required for open coil elements.

3-SAFETY DEVICES

Should an open coil element overheat, a low mass, disc-type primary safety device immediately senses the higher temperature and switches the power off in a very short time. In the case of the tubular heater, there are multiple time delays. The thermal inertia of the coil, insulating material and sheath surface must be overcome. During the interim, the unsafe overheat conditions may damage or simply ruin the tubular element, making a tubular heater a less "forgiving" heating device.

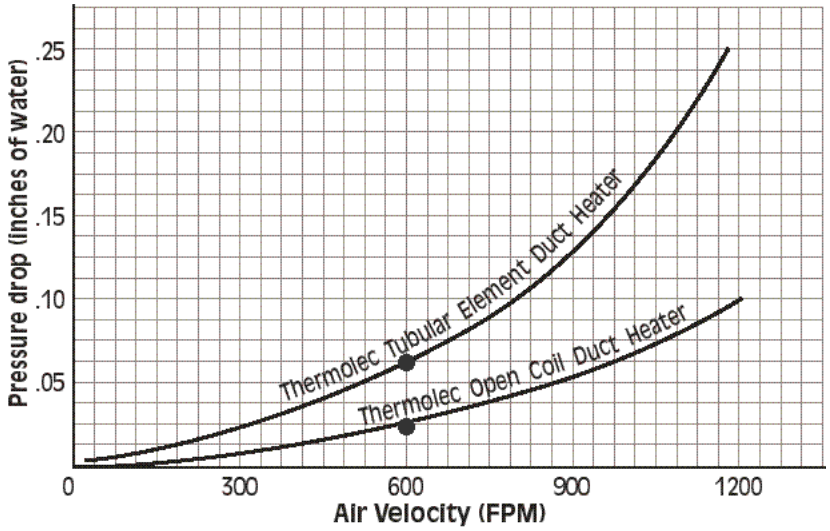
4-KILOWATTS PER SQUARE FOOT

Since tubular elements surface temperature lag behind the resistance wire temperature due to mass and insulation, and in order not to exceed the maximum temperatures allowed by UL, a tubular duct heater is not permitted to have the same concentration of wattage as an open coil heater. Thermolec open coil duct heaters have listing of 22.5 KW per square foot. For tubular duct heaters, the limitation is usually about 13KW per square foot.



5-PRESSURE DROP

Open coil heaters cause a smaller static pressure drop than do tubular heaters. This may permit the use of a smaller blower with resultant energy savings. A typical tubular heater with 600 feet/minute face velocity has .60 inches of water pressure drop, while the same size open coil heater with the same face velocity has only .03 inches of water pressure drop.



6-WEIGHT

Open coil duct heaters weigh considerably less than comparable tubular heaters, hence they offer additional cost savings in packing, shipping, installation and installation hardware.

7-WIRE SURFACE TEMPERATURE

A well-designed open coil element operates "in the black", at a temperature range of 750ºF to 900ºF. The tubular element is designed for a surface temperature of similar magnitude, but this requires the surface temperature of the inner coil portion to often exceed 1600ºF. Element durability is sacrificed in the normal design of the sheathed element.

8-SUSCEPTIBILITY TO MOISTURE

The structure which supports tubular elements must allow for the movement of the elements as they expand and contract from heating and cooling.
Moisture, when present, can easily be absorbed from the terminal end into the core of the element where it combines with the moisture-thirsty magnesium oxide powder into a conductive form of magnesium oxide. When this occurs, the enclosed element may develop an internal short and fail, becoming a hazard.
Open coil elements wire are electrically insulated by thick ceramic bushings which have five to ten times the electrical clearances of the typical tubular type element. The open coil element has been proven reliable in air with 100% relative humidity in laboratory tests, and in years of less-than-ideal field service conditions. Testing proved that a 600V open coil heater, after total immersion of the elements in water, functioned without fault.

9-PRICE

Heaters equipped with tubular elements are considerably more costly in materials, tooling and labor to produce than are comparable open coil heaters, hence they must be sold at a higher price. The only exception could be mass-produced heaters of standard wattage increments; however, such heaters do not give the design engineer the flexibility of choosing from an infinite variety of electrical ratings and dimensions as in the case of the open coil heater.

10-CONCLUSION

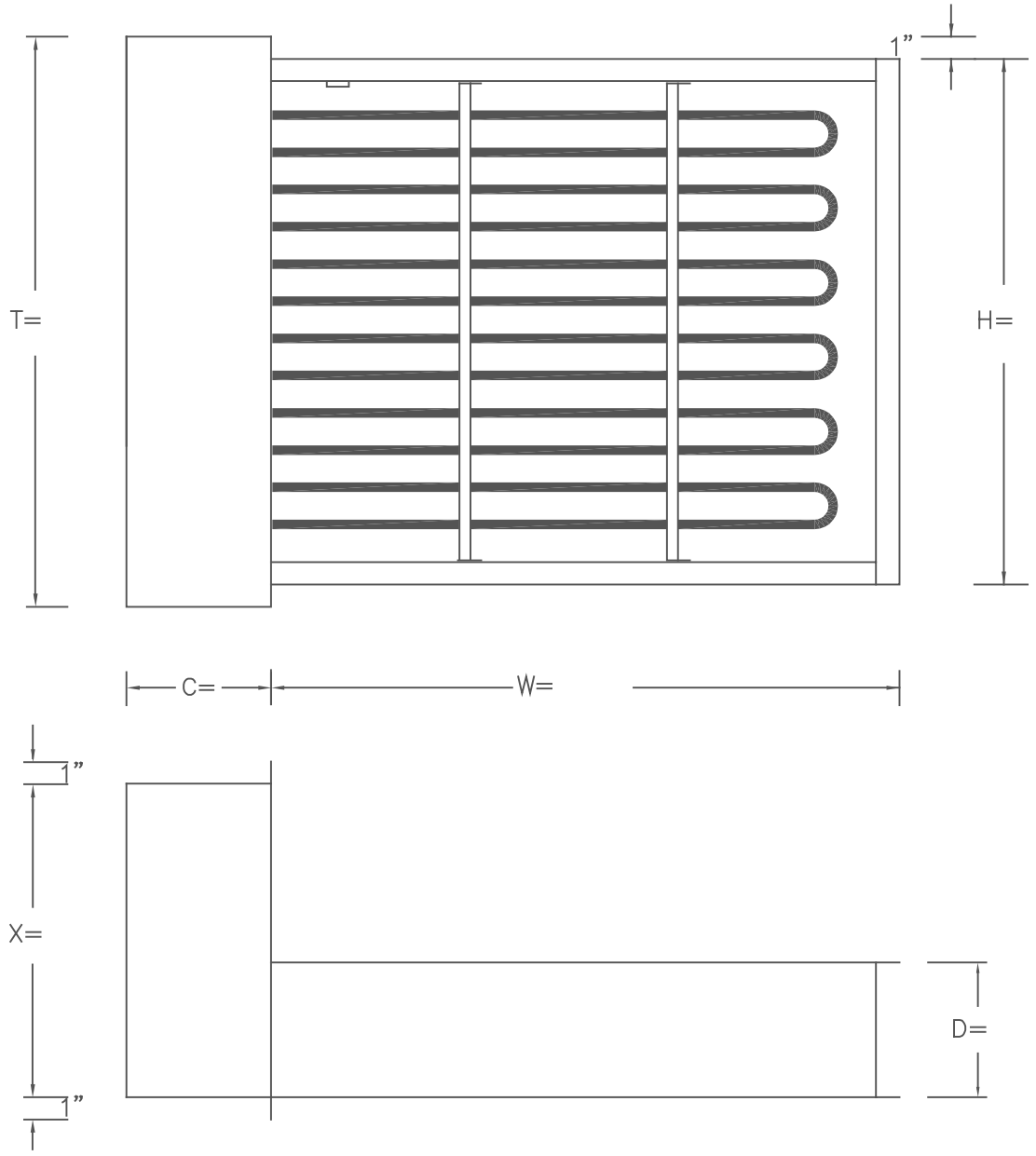
In summary, the advantages of the open coil heaters over the tubular element heaters for duct heating applications include:

- Longer life
- More kilowatts per square foot
- Lower wire surface temperature
- Less maintenance
- Increased safety and larger electrical clearances
- Less pressure drop
- Lighter weight
- Lower shipping costs
- Less sensitivity to moisture
- More flexibility in size and capacity
- Lower cost
- Smaller size

Selection guide for heating elements

Following are a few factors commonly used to determine the choice of construction.

FACTOR	OPEN COIL	TUBULAR	FINNED TUBULAR
COIL TEMPERATURES	Resistance coil, exposed directly to airstream, runs cooler than coils imbedded in sheathed elements.	Tubes run hotter than open coil or finned tubular. Temperatures are kept within safe limits by reducing watt densities.	Finned tubes run hotter than open coil, but cooler than tubular due to heat transfer effect of fins.
AIRFLOW UNIFORMITY	Airflow must be uniformly distributed to prevent hotspots. Pressure plates can help even out airflow.	Less susceptible to hotspots than open coil, but more susceptible than finned tubular.	Finned tubulars heaters are most tolerant of nonuniform airflow. Hotspots tend to be dissipated by sheath and fins.
PRESSURE DROPS	Lowest pressure drop due to large percentage of open space.	Highest pressure drop because of high percentage of space occupied by tubes.	Lower pressure drop than tubular, but higher than open coil.
ELECTRICAL CLEARANCES	Large clearances between live parts and ground enable open coil heaters to withstand severe applications.	Clearances between live parts and sheath are small, but filled with compacted insulation.	Clearances between live parts and sheath are small, but filled with compacted insulation.
AIR QUALITY	Use only with clean air free of conductive particles or water spray. To a certain extent humid air is acceptable.	Can be used with virtually any of atmospheric conditions.	Can be used with air containing water droplets or conductive particles unless particles are likely to build up between fins.
OUTLET AIR TEMPERATURE	1200ºF. maximum	1200ºF. maximum	600ºF. maximum
MECHANICAL STABILITY	Open coil heaters are-most susceptible to damage due to physical abuse.	Tubular heaters are least susceptible to damage due to physical abuse.	Finned tubular heaters can withstand more physical abuse than open coil.
CONTROLLABILITY	Open coil heaters respond quickly to step control because of low thermal inertia. This can produce temperature fluctuations if control system does not compensate.	Thermal inertia greater than open coil, but less than finned tubular.	Higher thermal inertia makes finned tubular heaters slower to respond, but can produce more uniform temperatures if control system is properly designed.
SAFETY	Since element is electrically live, it is advisable and safer to order protective screen at all times, if element may be touched by conductive material or accidentally by personnel.	Because the coil is enclosed in a grounded metal sheath, electrical shock hazard due to accidental contact does not exist.	Because the coil is enclosed in a grounded metal sheath, electrical shock hazard due to accidental contact does not exist.
COST	For most applications, open coil heaters are more economical because manufacturing operations are simpler.	Generally most expensive of the three because of conservative, high temperature design.	Generally more expensive than open coil, but less expensive than tubular because watt densities are higher.
WEIGHT	The lightest of all 3 types.	Heavier than open coil. Additional support required for horizontally mounted units, especially for extra long heaters.	Heavier than open coil. Additional support required for horizontally mounted units, especially for extra long heaters.



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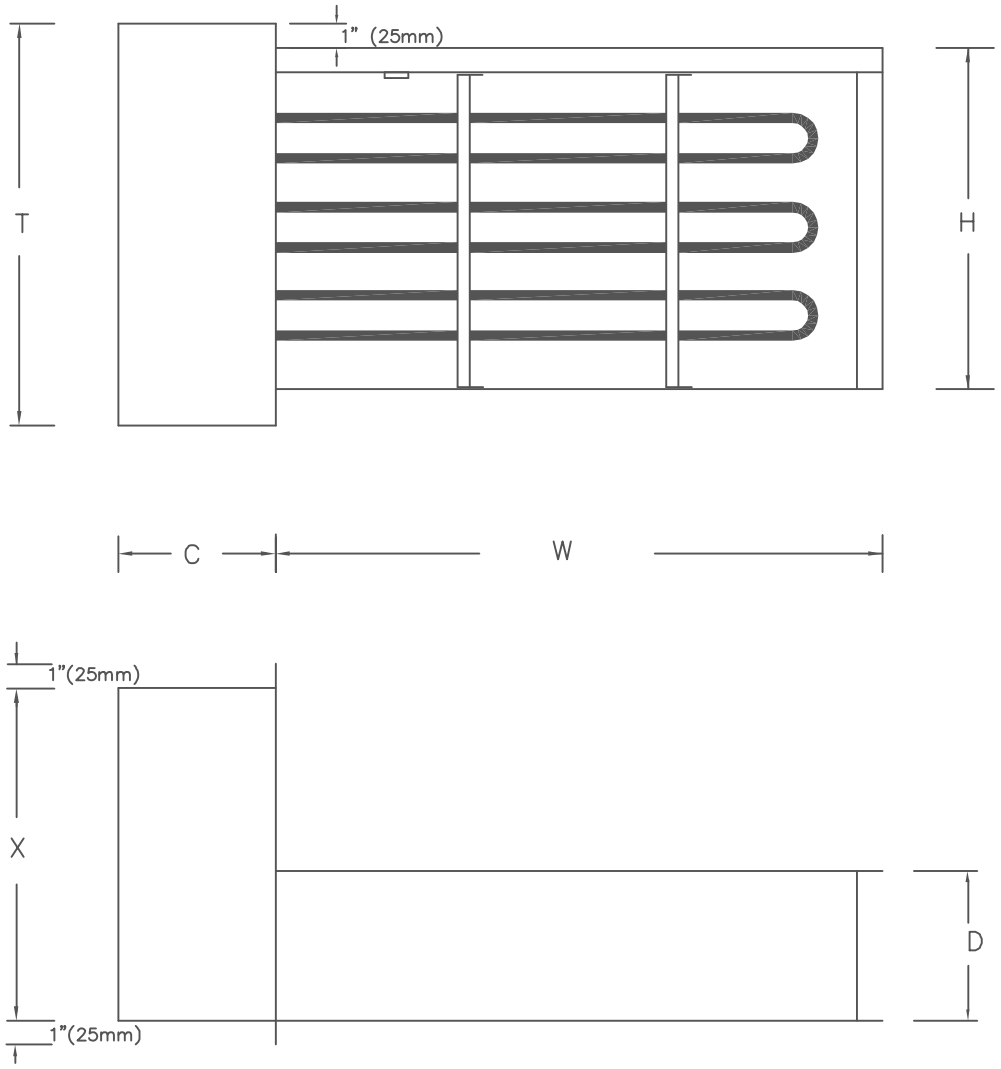
		DATE / PER



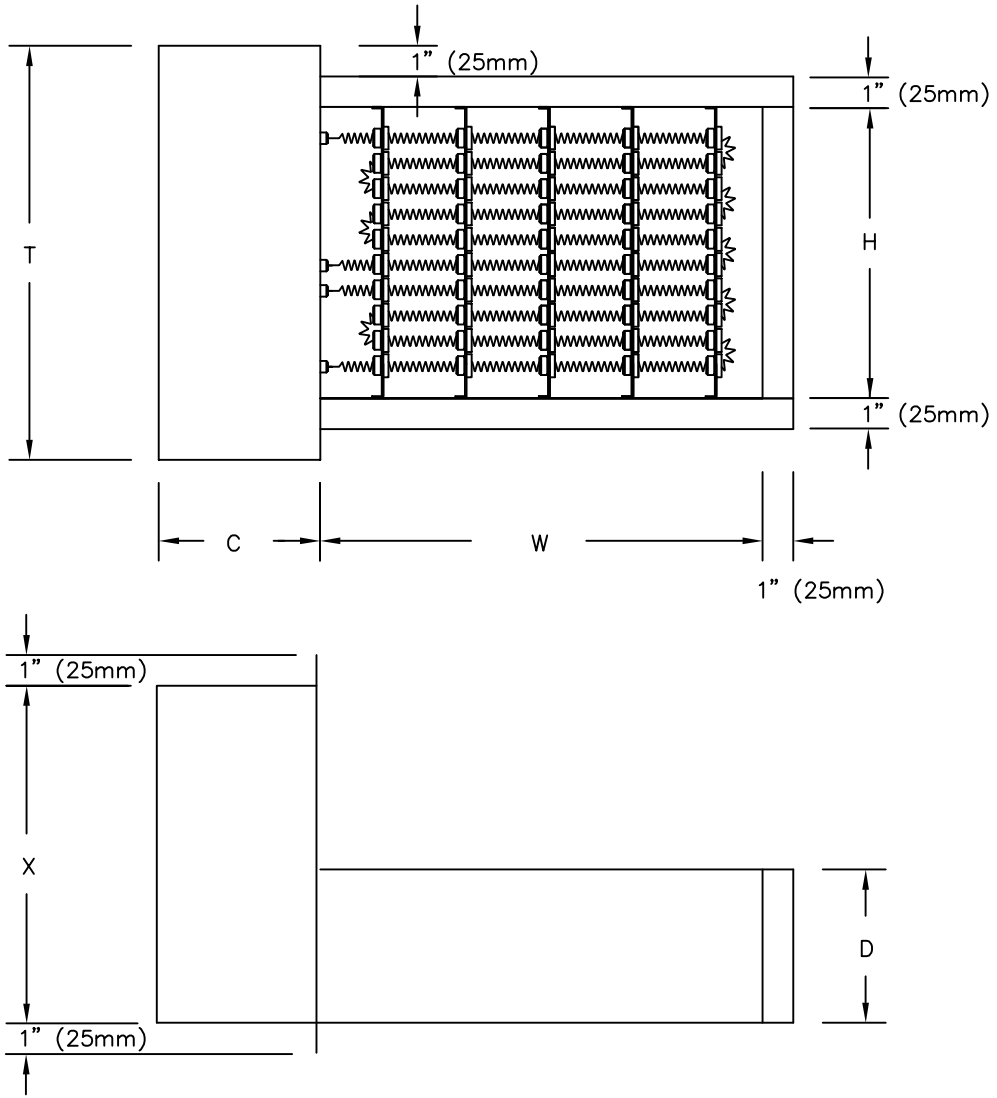
VUE DE HAUT
TOP VIEW

THERMOLEC

Title / Titre

Drawing number / Numéro de dessin

MST0



TOP VIEW
VUE DE HAUT

THERMOLEC

Title / Titre

Drawing number Numero de dessin

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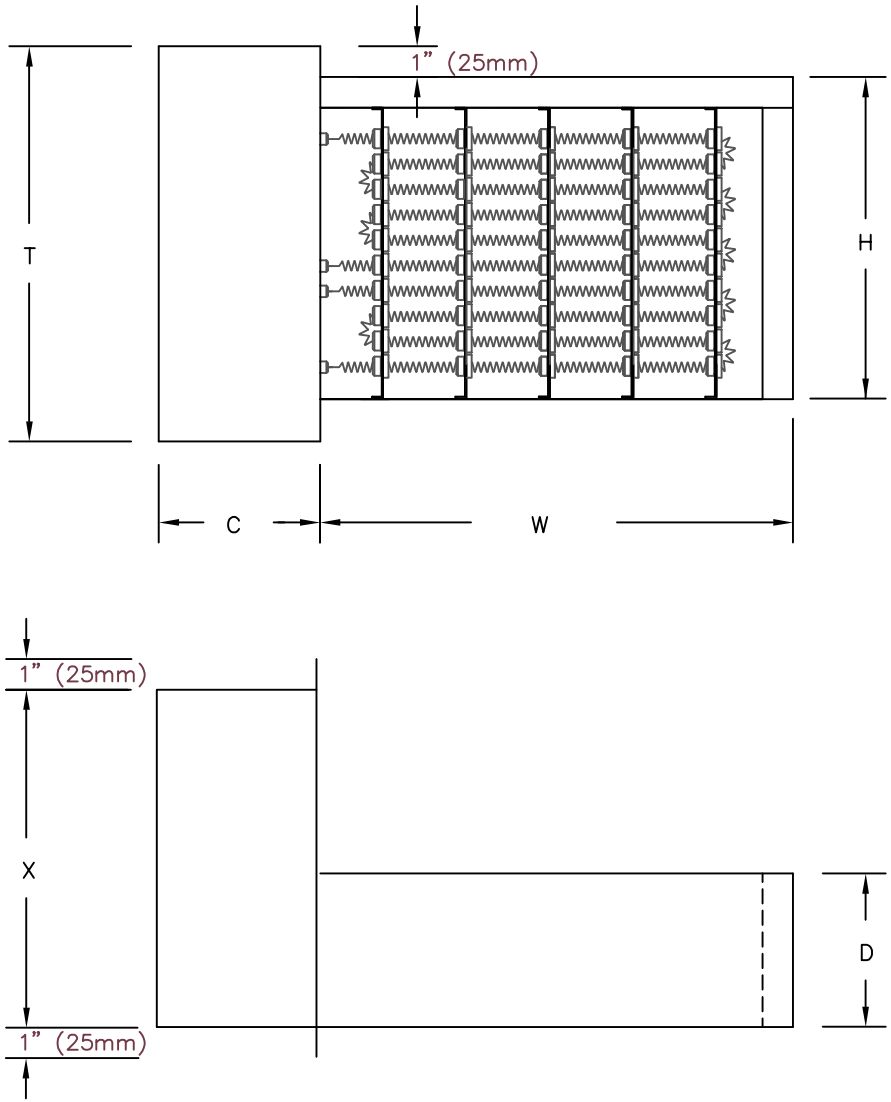

OP VIEW

THERMOLEC

Title / Titre

Drawing number / Numéro de dessin

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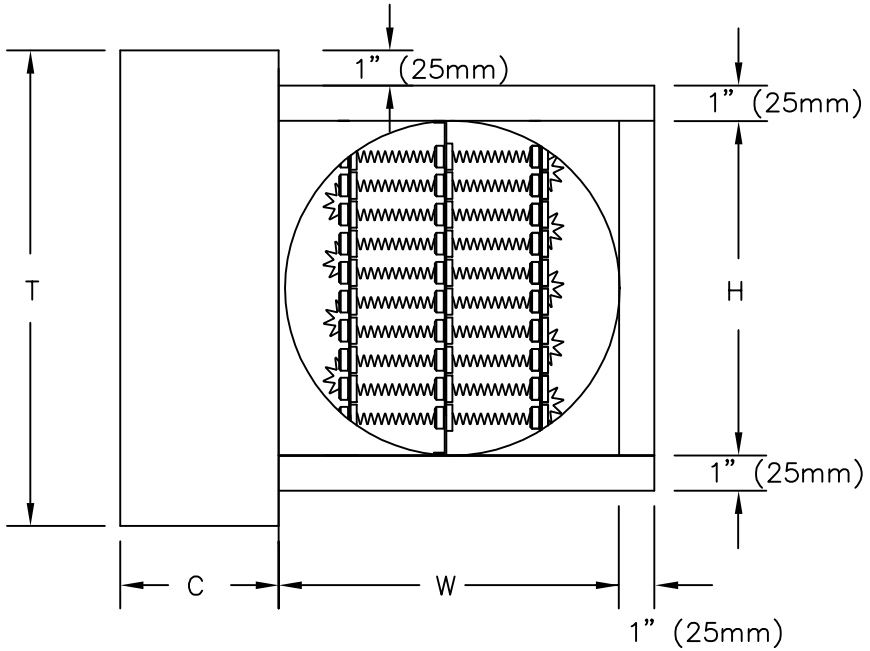
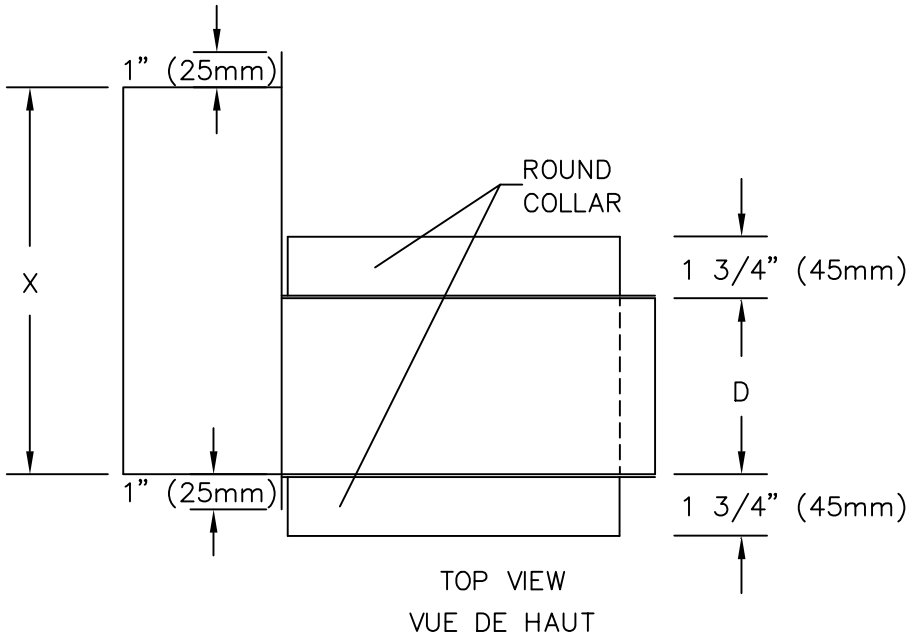




TOP VIEW
VUE DE HAUT

THERMOLEC

Title / Titre

Drawing number / Numéro de dessin

MRFC - 40LS - 0002 - 000G

THERMOLEC

2060, LUCIEN-THIMENS STREET,
MONTREAL, QUEBEC, CANADA,
H4R 1L1

TEL. : 1-800-336-9130
FAX : 1-800-336-3270
WEB : thermolec.com

ELECTRIC HEATING AND CONTROLS

Applications
and
Technical Notes
for

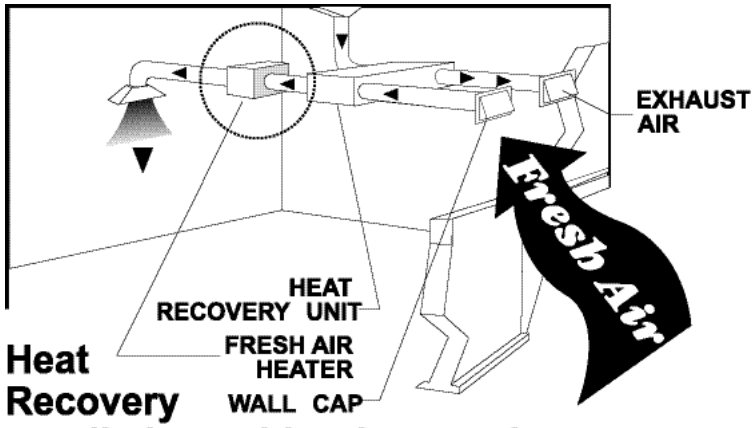
Thermo-Air **Fresh Air Heater**

Thermo-Zone **Zone Heater**

FRESH AIR HEATER

Application # 1

Thermo-Air complementing a heat recovery ventilation system.



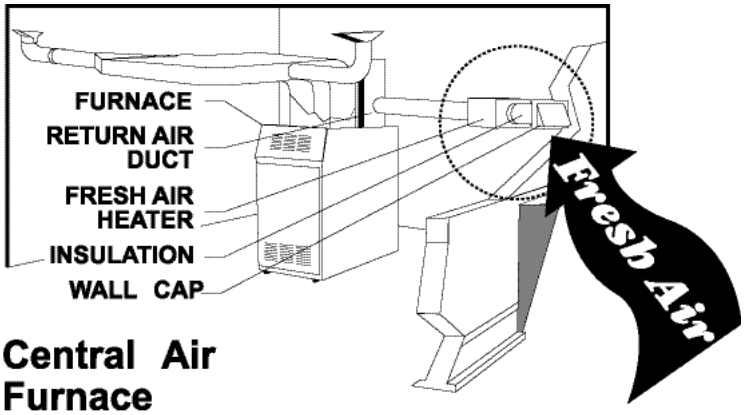
Heat Recovery Ventilation with Thermo-air

At low temperature, a heat recovery ventilation system cannot recover enough heat to pre-heat the incoming outside air to a comfortable level.
A ***THERMO-AIR*** heater is the ideal solution to restore efficiency to the system. It is equipped with an electronic controller that proportionally modulates the heating load to match the exact capacity required, thus minimizing operating cost. It's super-sensitive **air flow sensor**, monitors the quantity of air flowing through the heater, adjusts the heater's capacity to match the air flow available and shuts the heater down in case of a total loss of air.

Application # 2

Thermo-Air complementing a central forced-air heating system.

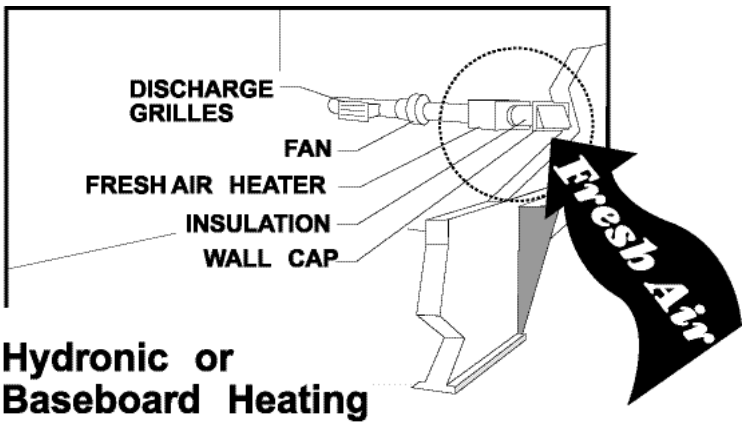
With an existing central forced-air heating system, the furnace fan can be used to bring new outside air into the system. Preheating that air at the source will improve the performance of the furnace and the life expectancy of the heat exchanger.
The ***THERMO-AIR*** heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.



Central Air Furnace

FRESH AIR HEATER

Application # 3
Fresh Air make-up.

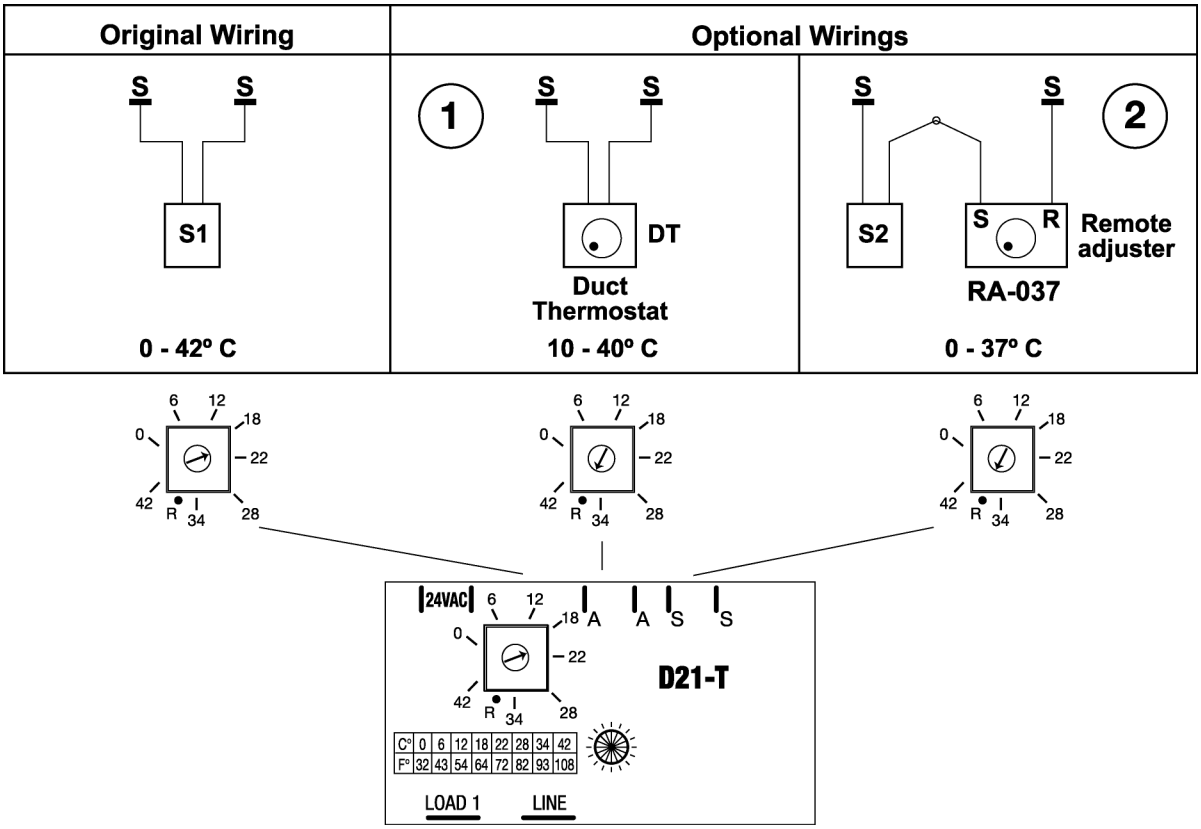


A ***THERMO-AIR*** heater combined with a small fan is all that it takes to create a low-cost, efficient and accurate air make-up.
This new heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.

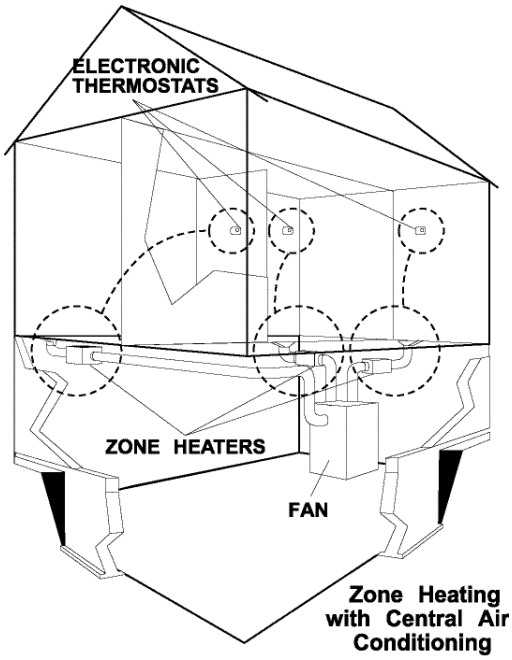
Remote set point adjustment option

Instead of adjusting the set-point on the electronic module inside the heater, it is possible to adjust it remotely by using
1- A remote duct thermostat (DT-1040) with a range of 10 to 40°C
or
2- A wall mount set-point adjuster with a range of 0 to 37°C (**RA-037**).

In both cases, it is necessary to set the potentiometer to the **"R"** position (for Remote Control).



ZONE HEATER

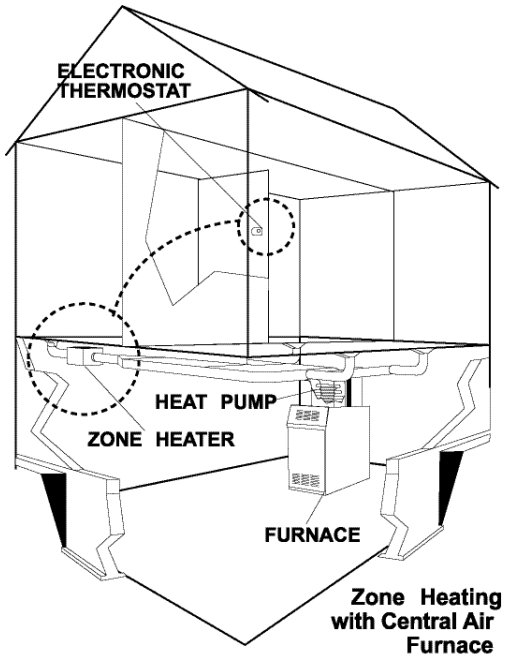


Application # 1

Central ventilation with zone heaters.

In this application, there is no furnace required but only a central blower that provides continuous ventilation. The heating of the forced air is done in each zone, controlled by an accurate electronic thermostat supplied with each heater.
Each thermostat controls it's heater in a proportional way, thus avoiding a waste of energy and providing maximum comfort. The super-sensitive **air flow sensor** permits the heater to operate only when the fan is running.

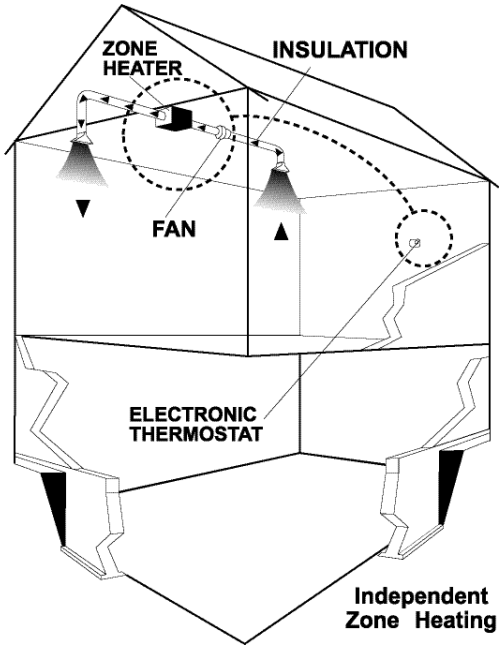
The central blower should be equipped with an air filter, a humidifier and a cooling coil if air conditioning is required.



Application # 2

Add-on heater for a cold room.

In a central heating system, it often happens that a room located at the end of a duct run is too cold and uncomfortable. This could also happen to a basement in mid-season. The ***THERMO-ZONE*** is a perfect, easy and low cost solution. Just insert the new heater in the duct supplying that cold room and enjoy new comfort.
This new heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.
This heater is supplied with an electronic wall thermostat to maximize comfort and savings.
It is recommended to keep the fan in continuous operation at low speed.

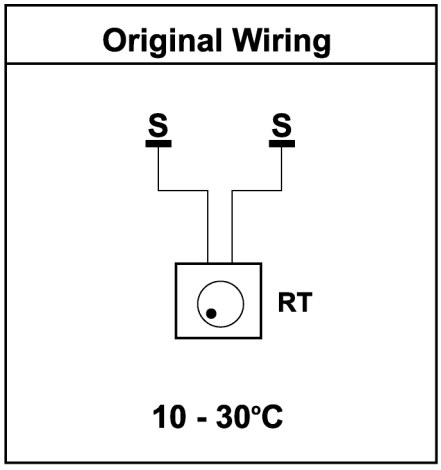


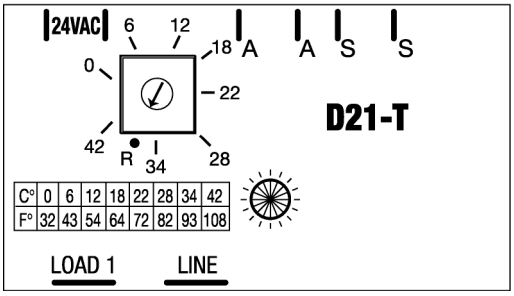
Application # 3

Stand alone heating system.

A ***THERMO-ZONE*** heater combined with a small ventilation unit and two grilles or diffusers is all that it takes to create a small, accurate and low-cost heating system. This new heater is equipped with a **modulating controller** which uses the minimum amount of energy, thus avoiding waste, and a super-sensitive **air flow sensor** which permits the heater to operate only when the fan is running.

This heater is supplied with an electronic wall thermostat to maximize comfort and energy savings.





How to evaluate your heating requirement?

Considering today's insulation standards, an easy to remember rule of thumb is that the heating capacity should be equal to 8 watts per square foot. A 1 KW heater would then be sufficient to heat a surface of 1000 ÷ 8 = 125 square feet. Adding a safety factor would bring the surface to approximately 120 square feet, i.e. a 12' x 10' room.

We suggest:

Up to 120 sq. ft.	1 KW	
from 121 sq. ft. to 240 sq. ft.	2 KW	
from 241 sq. ft. to 360 sq. ft.	3 KW,	and so on.

A small excess of capacity is not a problem because the electronic controller will modulate this capacity in order to give only the heat required by the thermostat.

How to evaluate the ventilation requirements?

A ***THERMO-AIR*** or ***THERMO-ZONE*** requires a minimum of 30 CFM (cubic feet per minute) per Kilowatt to operate.
A lower air flow is not a problem for the heater since the electronic controller will automatically reduce the heating according to the air flow.

For a quick calculation, a 1 KW unit requires a minimum of 30 CFM,
a 2 KW unit requires a minimum of 60 CFM, and so on.

Electrical connections

We recommend not to exceed 2 KW at 120V, 5 KW at 208V, 6 KW at 240V, 7KW at 277V, 8KW at 347V.

Specifications and Safety Features

Heating capacity of 1 to 8 KW.
Standard voltages 120, 208, 240, 277 and 347.
Standard round collar dimension 6" and 8" for easy installation between the floor joists (or basement false ceiling). Other dimensions up to 12" diam. and 24"x18" duct also available. Please contact factory.

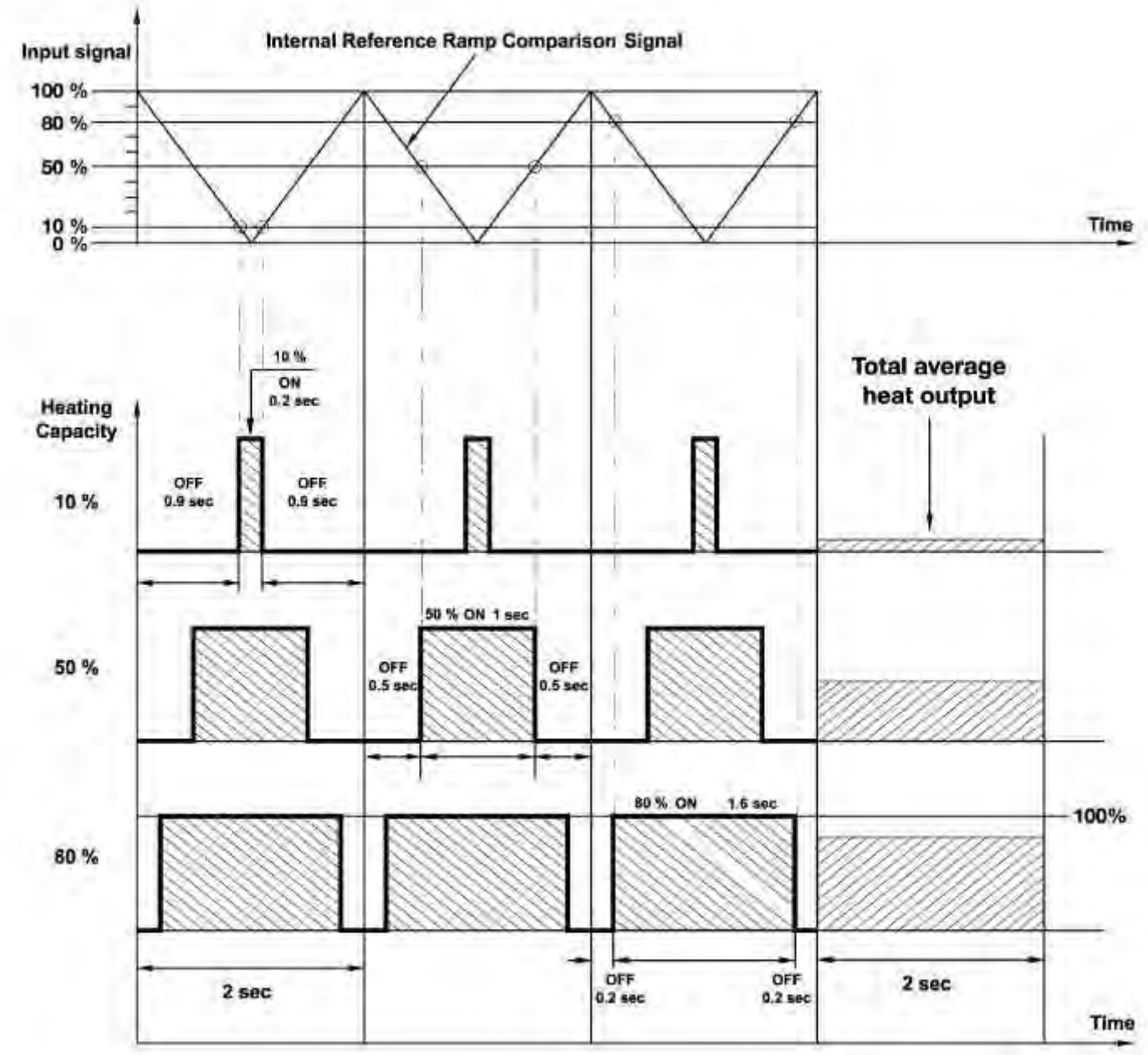
The unit operates at low temperature (60º**C** / 140º**F** max.) and has three levels of protection:
• one automatic reset cut-out calibrated at (51.6º**C** / 125º**F**),
• one manual reset cut-out calibrated at (93º**C** / 200º**F**) and
• one airflow sensor that protects the unit against air failure.
This proportional sensor reduces the heating capacity if the air flow is not sufficient, so that the discharge air temperature never exceeds 60º**C** / 140º**F**, and stops heating completely if the airflow stops.

A ***THERMO-AIR*** or a ***THERMO-ZONE*** unit can modulate it's heating capacity between 0 and 100 % according to the thermostat demand and/or the air flow going through the heater, which makes this heater self regulating.

What is proportional control?

The word proportional refers to the portion of a time period in which a heating element is turned ON and OFF (e.g. 10 % ON and 90 % OFF meaning 10 % of the heating capacity). According to the thermostat demand, the heater is pulsed in different proportions of ON time and OFF time to match the heating demand. The longer the element is turned ON, the more it is generating heat and vice versa. The heat produced during the ON period continues to dissipate during the OFF period, thus creating an average temperature output matching the thermostat set-point.

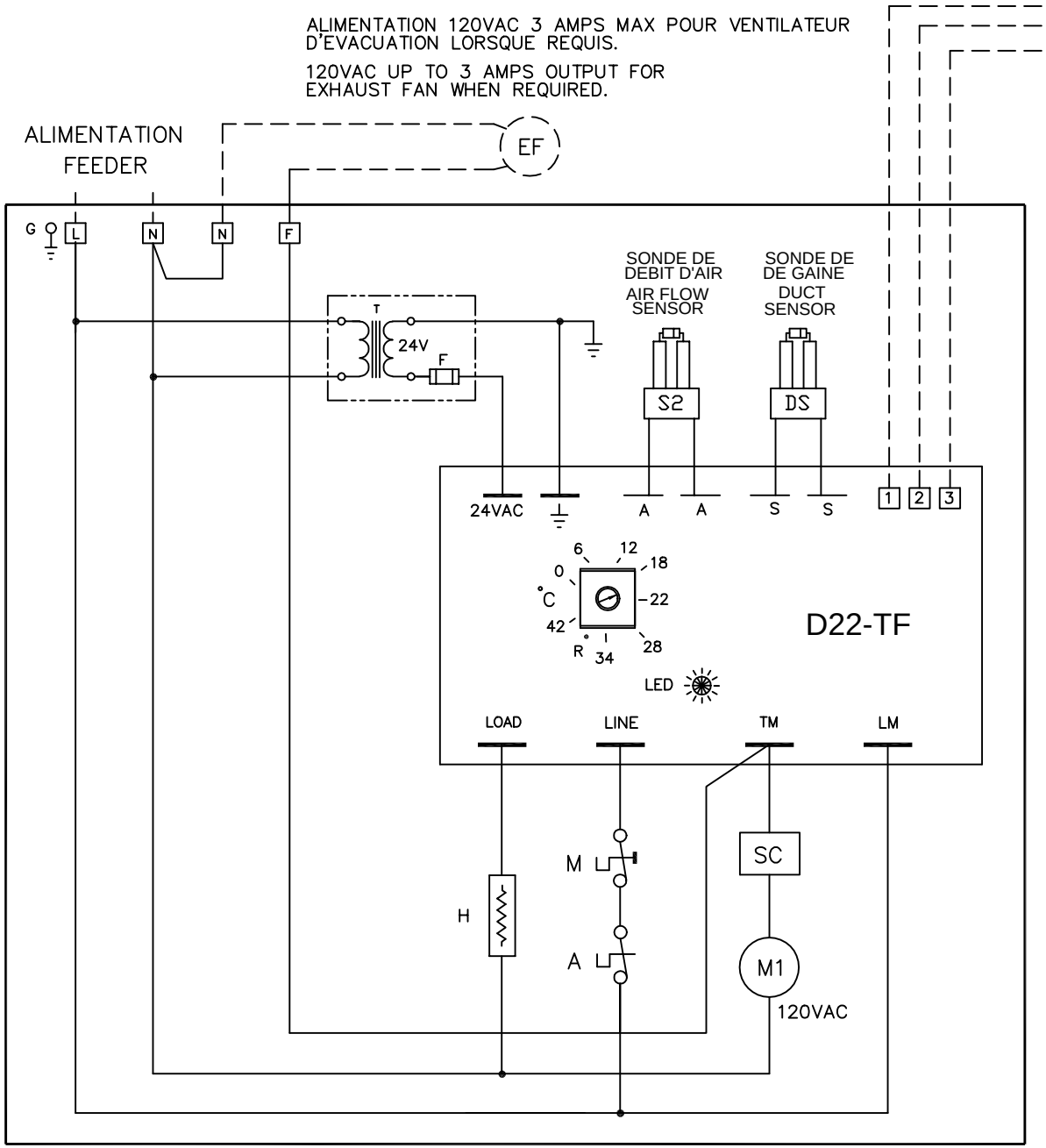
For a graphic description of the proportional control, please see next page.

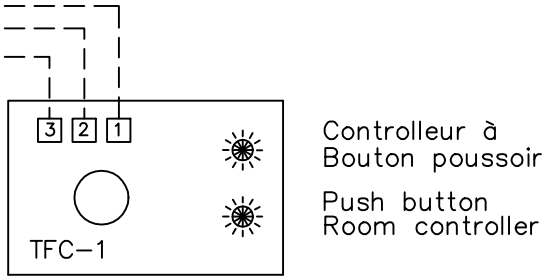


Graphic for proportional control

Proportional Control Diagram - Principle of the Pulse With Modulation

By comparing the input signal with an internally generated reference signal (triangle wave), the controller activates the SCR output in a range of 0 to 100%.
On this graphic, every time the horizontal line corresponding to the input (in this example, 10 %, 50 % and 80 %), crosses the reference signal, the heating elements are switched ON or OFF. The total heat output is an average between the ON and OFF periods. For low heat demand, the heater is not "dimmed" but switched ON for very short periods.
Note: All Thermolec controllers are equipped with a zero-cross thyristor switching circuitry that virtually eliminates all electro-magnetic interference (EMI) and radio frequency interference (RFI). The light emitting diode (LED) on the controller indicates when the heating element is on.





LEGENDE

A	SONDE THERMIQUE A REENCLENCHEMENT AUTOMATIQUE
M	SONDE THERMIQUE A REENCLENCHEMENT MANUEL
D22-TF	CONTROLEUR ELECTRONIQUE
H	ELEMENT CHAUFFANT
DS	SONDE DE GAINE
S2	SONDE DE DEBIT D'AIR
SC	REGULATION DE VITESSE
MI	MOTEUR DU VENTILATEUR 120VAC
T	TRANSFORMATEUR
TA	SELECTUR DE TEMPERATURE

LEGEND

A	AUTOMATIC RESET CUT-OUT
M	MANUAL RESET CUT-OUT
D22-TF	SOLID STATE CONTROLLER
H	HEATING ELEMENT
DS	DUCT SENSOR
S2	AIR FLOW SENSOR
T	TRANSFORMER
SC	SPEED CONTROLLER
M1	FAN MOTOR 120VAC
TA	TEMPERATURE SET POINT ADJUSTER

TITLE/TITRE

MINI FRESH AIR MAKE-UP W.D

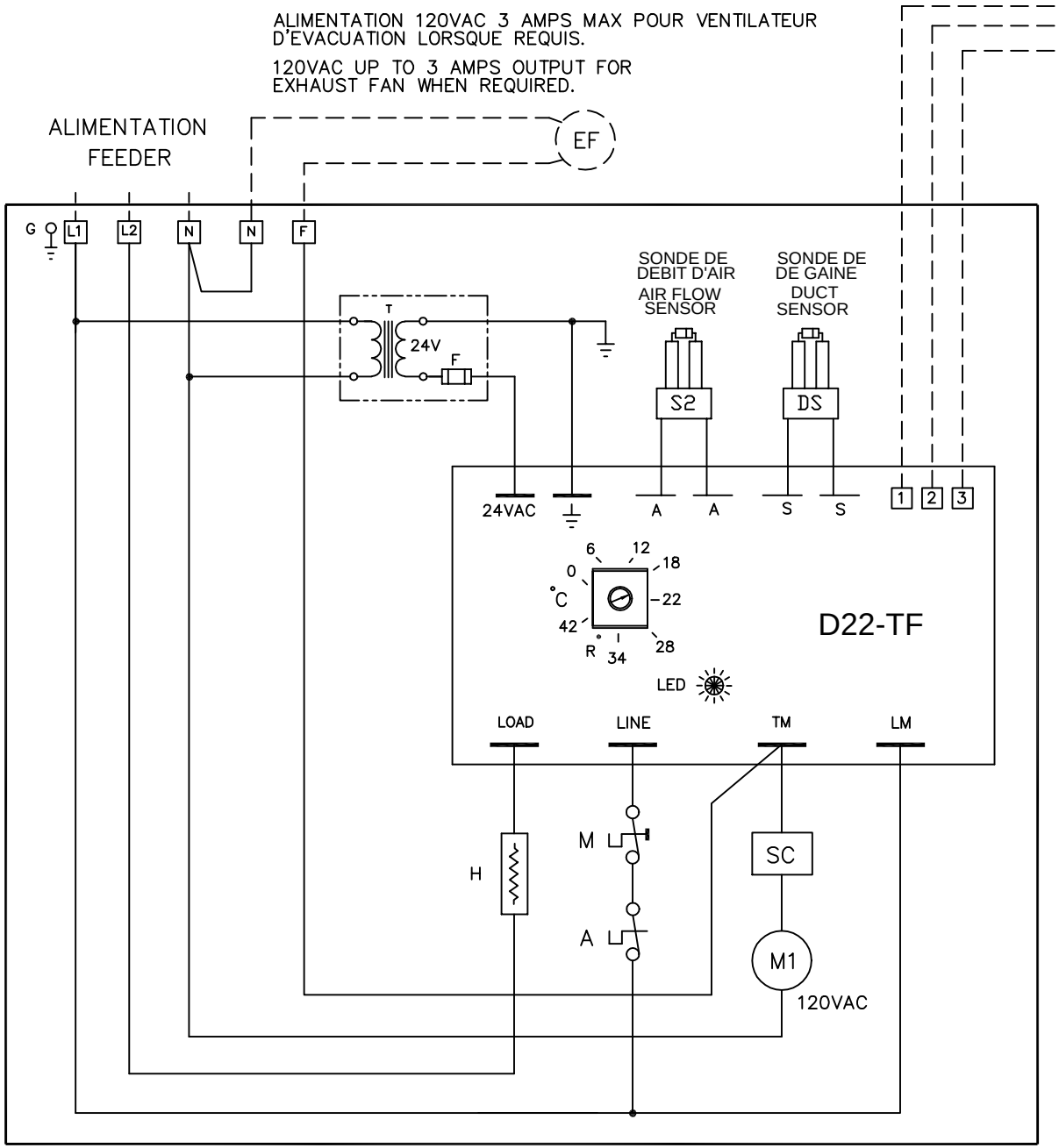
THERMOLEC

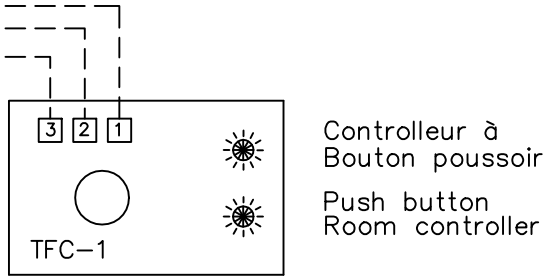
MONTREAL – CANADA

LTEE
LTD

DRAWING NO. FRESH MAKE-UP 120

DATE	PER	





Controlleur à
Bouton poussoir

Push button
Room controller

LEGENDE

A	SONDE THERMIQUE A REENCLENCHEMENT AUTOMATIQUE
M	SONDE THERMIQUE A REENCLENCHEMENT MANUEL
D22-TF	CONTROLEUR ELECTRONIQUE
H	ELEMENT CHAUFFANT
DS	SONDE DE GAINE
S2	SONDE DE DEBIT D'AIR
SC	REGULATION DE VITESSE
MI	MOTEUR DU VENTILATEUR 120VAC
T	TRANSFORMATEUR
TA	SELECTUR DE TEMPERATURE

LEGEND

A	AUTOMATIC RESET CUT-OUT
M	MANUAL RESET CUT-OUT
D22-TF	SOLID STATE CONTROLLER
H	HEATING ELEMENT
DS	DUCT SENSOR
S2	AIR FLOW SENSOR
T	TRANSFORMER
SC	SPEED CONTROLLER
M1	FAN MOTOR 120VAC
TA	TEMPERATURE SET POINT ADJUSTER

TITLE/TITRE

MINI FRESH AIR MAKE-UP W.D

THERMOLEC

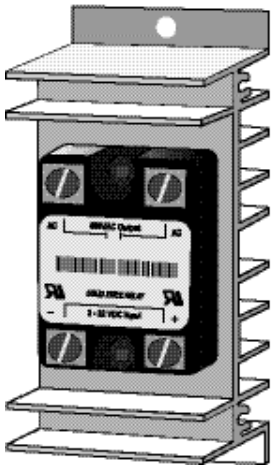
MONTREAL – CANADA

LTEE
LTD

DRAWING NO. FRESH MAKE-UP 240

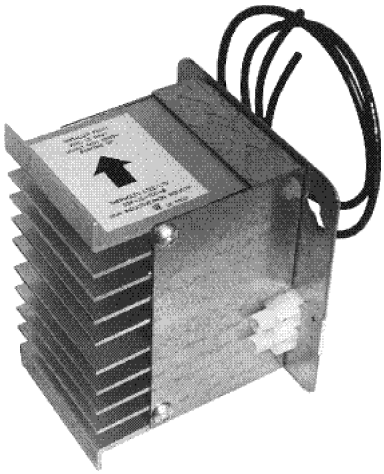
DATE	PER	

Specification sheet



Open Type

NRTL/C



Box Type

Description

Solid State Relays are designed for controlling large amounts of power with a Logic Input Signal.
The internal circuit features a dual SCR design for full wave capability and a Zero Crossing Detector.
An opto-coupler isolates the input signal from the power circuit.
All Thermolec's solid state relays are equipped with the **TransAX™** system that protects against transients even on 600V lines, therefore ensuring quality, reliability and superior performances.

- Up to 30 AMP
- Up to 600 VOLT
- Low voltage control 3-32 VDC (standard) (24 VAC also available)
- Exposed terminal block for control signal
- Fits a standard 4x4 box

THERMOLEC

TEL: 514-336-9130
FAX: 514-336-3270

Electric Heating and Controls
Chauffage électrique et contrôles

2060, Place Thimens, Montréal
Québec, Canada, H4R 1L1

Solid State Relay

TransAX™: A superior protection !

Usually there are two methods used to absorb transients: RC networks and Metal Oxyde Varistors (MOV). Both methods are unsufficient in certain cases.
The new **TransAX™** option eliminates the problems normally associated with RC networks and MOV's.
It is an active component that can quickly switch very high currents. Instead of absorbing excessive energy endlessly, at a predetermined programmable trip point it passes the energy back to the line. During normal operations the switch sits idle and is always ready to activate.

Typical Applications

- On/Off and proportional control of electric heating equipment
- Interfacing of microprocessor controls to AC loads such as baseboard heaters, duct heaters, etc.
- Replacement of electro-mechanical line contactor
- Industrial and process control

FEATURES

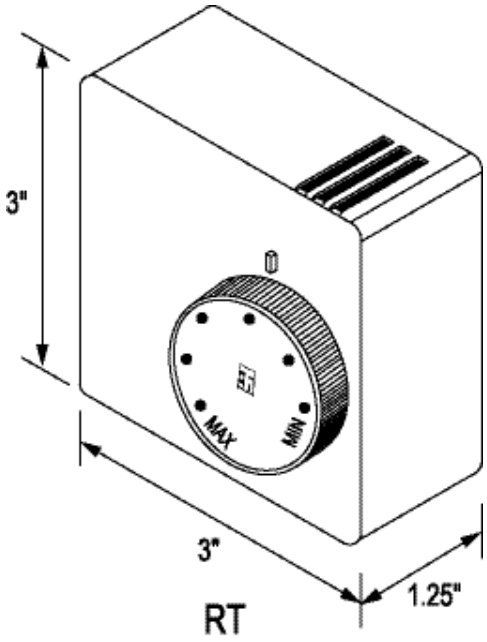
- Back to back thyristors output
- Zero crossfired units
- Generous heatsink for lower operating temperature
- Integrated triggering circuitry.
- CSA recognized
- Designed to comply with V.D.E. requirements

How to order :

SSR	—	20	—	1	—	AC	—	B
Solid **S**tate **R**elay		**20**= 20 Amp **30**= 30 Amp		**1**= 347V Max **6**= 600V Max		**DC**= 3-30 VDC **AC**= 24 VAC		**B** = Box type **O** = Open type

Example: SSR-30-6-DC-B
Solid State Relay, 30 Amps, 600V Max, DC, Box

Specification sheet



RT - Room thermostat (proportional)

- 2 wires
- Low voltage
- Adjustable set point
- Thermistor sensor
- White ABS housing
- Adjustment Range: 10 - 30° C (50 - 86° F)
- Special ranges available upon request

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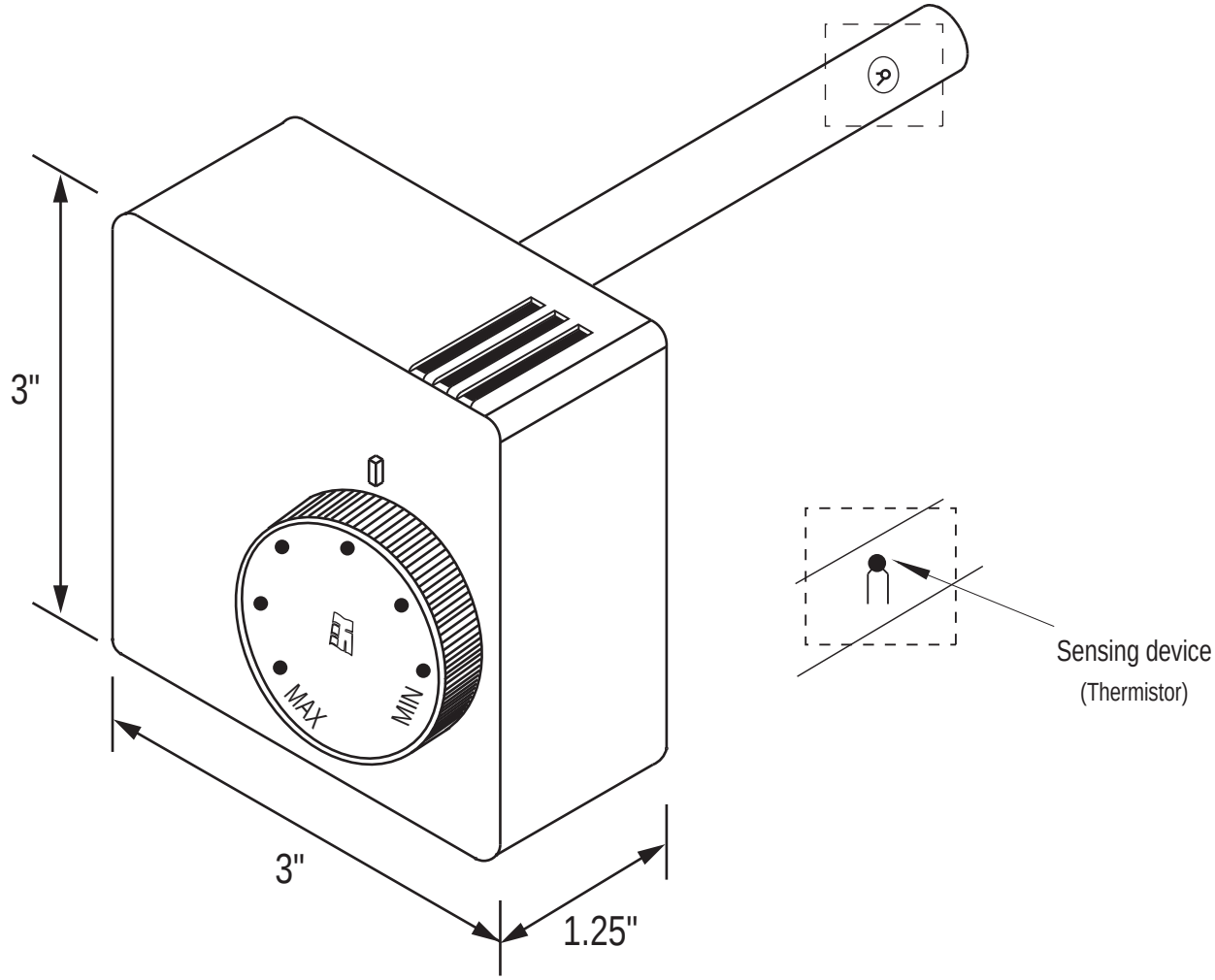
Québec, Canada, H4R 1L1

RT-1030

Specification sheet



DT - Duct thermostat (proportional)

- 2 wires
- Low voltage
- Adjustable set point
- Thermistor sensor
- White ABS housing
- Adjustment Range: 10 - 40° C (50 - 104° F)
- Special ranges available upon request

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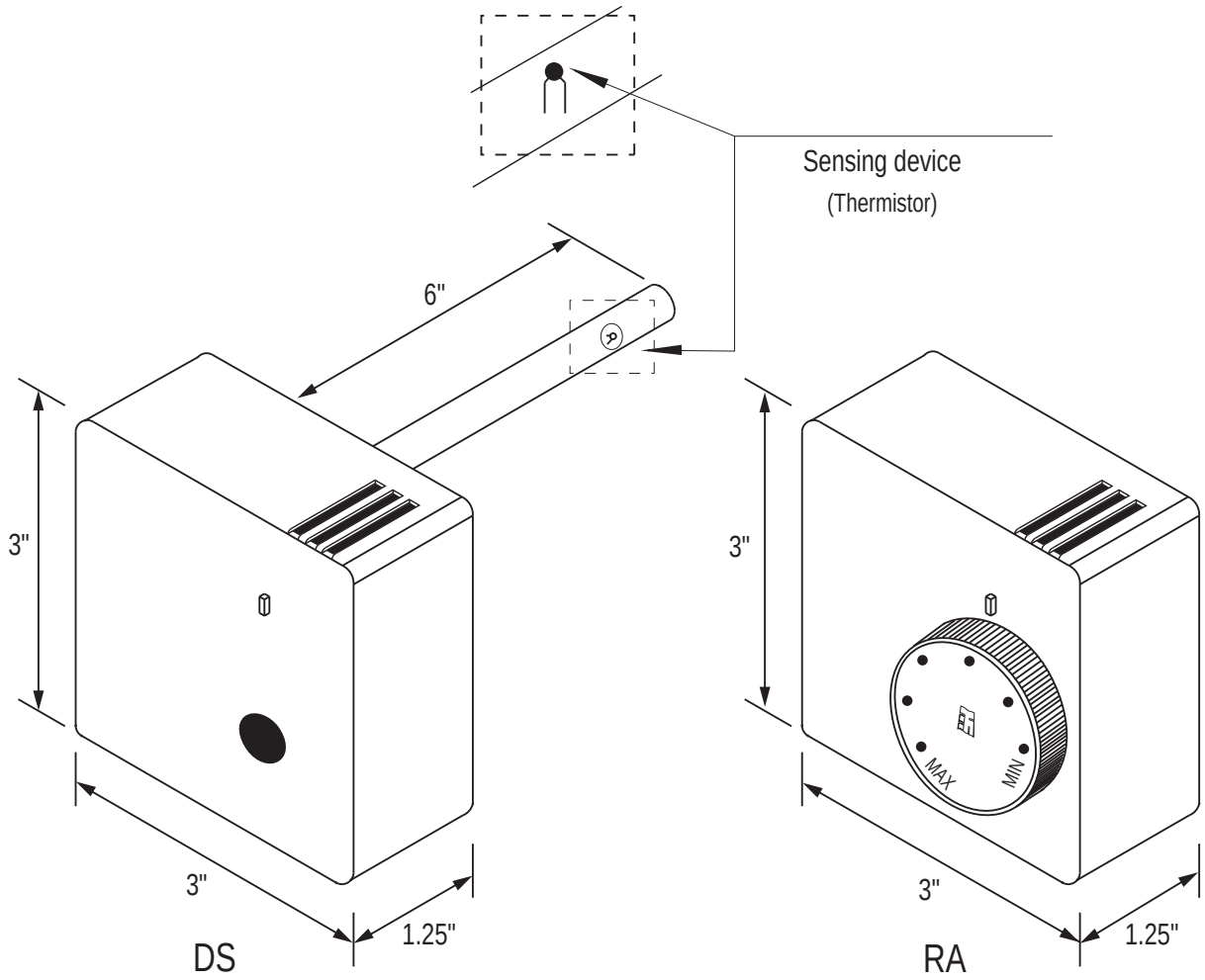
Electric Heating and Controls

TEL: 514-336-9130
FAX: 514-336-3270

2060, Rue Lucien Thimens, Montréal
Québec, Canada, H4R 1L1

DT-1040

Specification sheet



RA - Remote set-point Adjuster

- 2 wires
- Low voltage
- Adjustable set point
- White ABS housing
- Adjustment Range: 10-40° C (50-104° F)
- Special ranges available upon request

DS - Duct Sensor

- 2 wires
- Low voltage
- Thermistor sensor
- White ABS housing

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Québec, Canada, H4R 1L1

RADS-1040

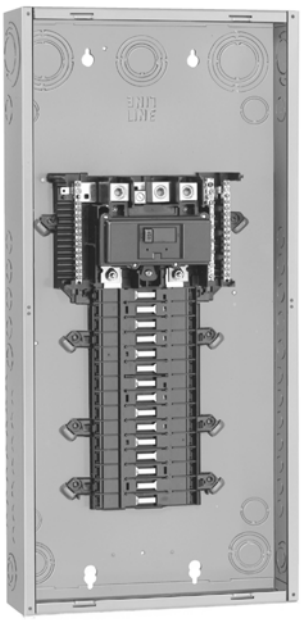
1Ø3W—120/240 Vac—UL Listed

Table 1.18: Indoor Main Circuit Breaker (Order QO, QOT, QO-EPD, QO-GFI, QO-AFI and QO-PL Branch Circuit Breakers from pages 1-2 and 1-3.)

Mains Rating	Spaces	Max. Single Pole Circuits▲	Max. Tandem Circuit Breakers	$ Price (Interior, Box and Cover)	Load Center Box and Interior Cat. No.	Load Center Box and Interior $ Price	Indoor Cover with Door (Order Separately) Flush Cat. No.	Indoor Cover with Door (Order Separately) Surface Cat. No.	Indoor Cover with Door (Order Separately) $ Price	Main Wire Size AWG/kcmil Al or Cu	Equipment Ground Bar Kit (Order Separately) Cat. No.	Equipment Ground Bar Kit (Order Separately) $ Price	Box No. See Page 1-17
Convertible Mains —Factory-installed Main Circuit Breaker, 22 kA Short Circuit Current Rating, Convertible to Main Lugs (see below) or Lower Amperage Main Circuit Breaker (See page 1-5),■ QOM1 Main Circuit Breaker Frame Size—Copper Bus													
	12	12	0	**339.70**	QO112M100	**302.00**	QOC12UF	QOC12US	**37.70**		PK9GTA	**13.40**	5
	16	16	0	**379.70**	QO116M100	**342.00**	QOC20U100F	QOC20U100S	**37.70**	6–1	PK12GTA	**15.80**	6
100 A	20	20	0	**433.70**	QO120M100	**396.00**	QOC20U100F	QOC20U100S	**37.70**		PK15GTA	**17.10**	6
	24	24	0	**553.70**	QO124M100	**516.00**	QOC24UF	QOC24US	**37.70**	6–2/0	PK15GTA	**17.10**	7
	32	32	0	**726.70**	QO132M100	**689.00**	QOC32UF	Use Flush	**37.70**		PK18GTA	**18.80**	8
125 A	24	24	0	**819.70**	QO124M125	**782.00**	QOC24UF	QOC24US	**37.70**	6–2/0	PK15GTA	**17.10**	7
	32	32	0	**1041.60**	QO132M125	**1002.00**	QOC32UF	Use Flush	**39.60**		PK18GTA	**18.80**	8
Convertible Mains —Factory-Installed Main Circuit Breaker, 22 kA Short Circuit Current Rating Convertible to Main Lugs (see below) or Lower Amperage Main Circuit Breaker (See page 1-5) ■ QOM2 Main Circuit Breaker Frame Size—Copper Bus													
	20	30	10	**821.00**	QO12030M150	**734.00**	QOC30UF	QOC30US	**87.00**		PK18GTA	**18.80**	9
150 A	24	24	0	**849.00**	QO124M150	**762.00**	QOC30UF	QOC30US	**87.00**	4–250	PK15GTA	**17.10**	9
	30	30	0	**854.00**	QO130M150	**767.00**	QOC30UF	QOC30US	**87.00**		PK18GTA	**18.80**	9
	32	32	0	**969.00**	QO132M150	**882.00**	QOC40UF	QOC40US	**87.00**		PK18GTA	**18.80**	10
	20	40	20	**821.00**	QO12040M200	**734.00**	QOC30UF	QOC30US	**87.00**		PK23GTA	**21.30**	9
	24	24	0	**866.00**	QO124M200	**779.00**	QOC30UF	QOC30US	**87.00**		PK15GTA	**17.10**	9
	24	36	12	**1287.00**	QO12436M200TFT◊	**1200.00**	QOC40UF	QOC40US	**87.00**		PK23GTA and LK100AN□		10
200 A	30	30	0	**879.00**	QO130M200	**792.00**	QOC30UF	QOC30US	**87.00**	4–250	PK18GTA	**18.80**	9
	30	40	10	**957.00**	QO13040M200	**870.00**	QOC30UF	QOC30US	**87.00**		PK23GTA	**21.30**	9
	40	40	0	**1121.00**	QO140M200	**1034.00**	QOC40UF	QOC40US	**87.00**		PK23GTA	**21.30**	10
	40	60	20	**1431.00**	QO14060M200	**1344.00**	QOC40UF	QOC40US	**87.00**		PK23GTA	**21.30**	10
New!	42	42	0	**1220.00**	QO142M200	**1109.00**	QOC42UF	QOC42US	**111.00**		PK23GTA	**21.30**	11
	42	52	10	**1382.00**	QO14252M200	**1271.00**	QOC42UF	QOC42US	**111.00**	4–300	PK23GTA	**21.30**	11
225 A	40	40	0	**1196.00**	QO140M225	**1085.00**	QOC42UF	QOC42US	**111.00**		PK23GTA	**21.30**	11
	42	42	0	**1253.00**	QO142M225	**1142.00**	QOC42UF	QOC42US	**111.00**		PK23GTA	**21.30**	11
Fixed Mains—Factory-installed LAL Main Circuit Breaker, 42 kA Short Circuit Current Rating♦													
300 A	42	42	0	**4909.00**	QONQ42MS300 (int)★ MH62 (box)△	**4243.00** **75.00**	NC62NQVF	NC62NQVS	**591.00**	(1) 4–500 or (2) 4–3/0	PK27GTA▼ or PK15GTA6	**33.80** **53.00**	16
400 A	42	42	0	**4909.00**	QONQ42MS400 (int)★ MH62 (box)△	**4243.00** **75.00**	NC62NQVF	NC62NQVS	**591.00**	(1) 4–500 or (2) 4–250	PK27GTA▼ or PK15GTA6	**33.80** **53.00**	16

Above listings through 200 A mains rating meet Federal Specification W-P-115c as Type 1, Class 2.

- ▲ Maximum single pole branch circuits utilizing QO and/or QOT circuit breakers.
- ■ 22 k AIR main circuit breaker UL Listed for use ahead of QO, QOT and QO-PL 10 k AIR branch circuit breakers to permit their application on systems with up to 22 kA available fault current.
- ♦ UL short circuit current rating depends on lowest interrupting rating of circuit breakers installed. Also, UL Listed 5000 A short circuit current for corner grounded Delta systems. Use QO-H circuit breakers only.
- ★ Interior only, order box separately.
- ▼ PK27GTA includes a 6–2/0 Al/Cu lug.
- △ PE1A Discount Schedule.
- □ Factory included.
- ◊ Supplied with feed-thru lugs.



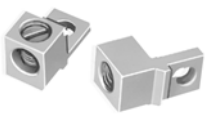
QO130M150

Main Lug Kits

Table 1.19: Field-Installed Main Lugs (Convertible Load Centers Only)

Main Lug Rating☆	Use on Convertible Load Center with Mains Rating	Cat. No.	$ Price	Lug Wire Size▽ AWG/kcmil Al or Cu
125 A	100–125 A	QOL125◒	**44.10**	6–2/0
225 A	150–225 A	QOL225◒	**104.00**	6–300

- ☆ Do not exceed the load center mains rating.
- ▽ Wire range listed for QOL lug kits is the wire range of that lug. To find out maximum wire size permitted in a particular load center per UL, see pages 1-5 through 1-11 under main wire size.
- ◒ If main circuit breaker knockout has been removed from the load center's trim, order appropriate filler plate from page 1-13.



QOL125

QOL225

QO® and QOB Miniature Circuit Breakers

Catalog
0730CT9801R1/08
2008
Class 730

CONTENTS

SQUARE D
by Schneider Electric

Schneider Electric

General Information

QO® and QOB Circuit Breakers

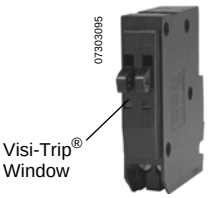
QO® (plug-on) and QOB (bolt-on) one-, two- and three-pole thermal-magnetic circuit breakers provide overcurrent protection and switching on ac and dc systems. Plug-on QO circuit breakers are for use in QO load centers, NQ and NQOD panelboards, OEM mounting bases, and Speed-D® switchboard distribution panels. Bolt-on QOB circuit breakers are for use in NQO and NQOD panelboards.

Operating mechanism

QO Circuit Breakers

QO and QOB circuit breakers have an overcenter, trip-free toggle mechanism with quick-make, quick-break action and positive handle indication. The tripping mechanisms in two-and three-pole circuit breakers operate such that an overcurrent on any pole of the circuit breaker will cause all poles of the circuit breaker to open simultaneously. Each pole has an individual thermal-magnetic trip element calibrated for 40°C ambient temperature.

Trip Indication



QO and QOB circuit breakers have Visi-Trip® trip indication, which provides a visual indication that the circuit breaker has tripped and interrupted the circuit. When the circuit breaker has tripped, the handle assumes a center position and the red Visi-Trip indicator appears in a window in the circuit breaker case. The Visi-Trip indicator is only visible when the circuit breaker has tripped. Trip indication immediately distinguishes the circuit from any other circuit which is merely in the on or off position. The circuit breaker can be reset by pushing the handle to OFF and then to ON.

Construction Standards

QO and QOB circuit breakers are built to comply with UL Standard 489, CSA 22.2 No. 5, NOM/ANCE and NEMA Standard AB1 and to meet Federal Specification W-C-375B/GEN. QO circuit breakers are UL Listed under UL File E84967 and are CSA Certified under CSA Master Contract 153555.

QO Circuit Breaker	UL Type
QO280–QO210	QOA, QOB
QO2110–QO2125	QOC, QOCB
QO2150–QO2200	QOC (no bolt-on version)

Ratings

When designing an electrical distribution system, overcurrent protective devices are generally selected based on performance requirements. Factors influencing this selection include system voltage, continuous current, interrupting rating, and frequency.

Voltage Rating

The circuit breaker must have a voltage rating greater than, or equal to, the system voltage. When a circuit breaker clears an overcurrent, it is done in two steps. First, the current sensing system identifies the overcurrent and releases the tripping mechanism. This results in a parting of the contacts. The circuit breaker must then extinguish the voltage arc across the contacts. If the circuit breaker has the correct voltage rating, it can efficiently extinguish this voltage arc. QO and QOB circuit breakers are rated for use in the following voltage systems:

- 120 Vac
- 208/120 Vac
- 120/240 Vac
- 240 Vac
- 48 Vdc (10–70 A for 1 and 2 pole circuit breakers, 10–60 A for 3 pole circuit breakers)

Continuous Current Rating

The continuous current rating of a circuit breaker is the maximum current in amperes (dc or rms ac at rated frequency) which a device will carry continuously without exceeding the specified allowable temperature rise. Sometimes referred to as the ampere rating or handle rating of the circuit breaker, the continuous current rating relates to the system current flow under normal conditions.

UL and CSA require that circuit breakers must be able to carry their continuous current rating indefinitely at 40°C in free air in order to achieve a UL Listing/CSA Certification. The National Electrical Code (NEC) and the Canadian Electrical Code (CEC) recognize that devices applied in end-use equipment can be affected by heat build up during normal operating conditions. For this reason, the codes require that circuit breakers be selected based on the characteristics of the load (particularly, the portion of the load which will be on continuously for three hours or more at a time).

Frequency Rating

The standard rated frequency for circuit breakers is 60 Hz. Circuit breakers are also rated for dc applications as shown in Table 1. Many Square D circuit breakers can also be applied on 50 Hz systems without derating. GFCI, AFCI and EPD devices are rated for 60 Hz operation only. Frequencies can affect the thermal, magnetic and short-circuit characteristics of circuit breakers. See Data Bulletin 0100DB0101 *Determining Current Carrying Capacity in Special Applications*. Contact the Field Sales office before applying circuit breakers on systems at frequencies other than 50/60 Hz.

Interrupting Rating

The interrupting rating of a circuit breaker is the highest current at rated voltage that the circuit breaker is intended to interrupt under standard test conditions. A circuit breaker must be chosen so that the interrupting rating is equal to or greater than the maximum available short-circuit current at the point where the circuit breaker is applied in the system.

Table 1: Interrupting Ratings

Circuit Breaker Type	Number of Poles	Ampere Rating	UL Listed Interrupting Rating[1]			
			120 Vac	120/240 Vac	240 Vac	48 Vdc[2]
QO	1	10–70 A	10 kA	10 kA	—	5 kA
	2	10–70 A	10 kA	10 kA	10 kA	5 kA
		80–100 A	10 kA	10 kA	10 kA	—
		110—200 A	10 kA	10 kA	—	—
	3	15–60 A	10 kA	10 kA	10 kA	5 kA
		70–100 A	10 kA	10 kA	10 kA	—
QOB	1	10–70 A	10 kA	10 kA	—	5 kA
	2	10–70 A	10 kA	10 kA	10 kA	5 kA
		80–100 A	10 kA	10 kA	10 kA	—
		110—125 A	10 kA	10 kA	—	—
	3	15–60 A	10 kA	10 kA	10 kA	5 kA
		70–100 A	10 kA	10 kA	10 kA	—
QO-H, QOB-H	2	15–100 A	10 kA[3]	10 kA[3]	10 kA[3]	—
QO-VH	1	15–30 A	22 kA	22 kA	—	—
	2	15–200 A	22 kA	22 kA	—	—
	3	15–100 A	22 kA	22 kA	22 kA	—
QOB-VH	1	15–30 A	22 kA	22 kA	—	—
	2	15–125 A	22 kA	22 kA	—	—
	3	15–150 A	22 kA	22 kA	22 kA	—
QOH	1	40–125 A	42 kA	42 kA	—	—
QH, QHB	1	15–30 A	65 kA	65 kA	—	—
	2	15–30 A	65 kA	65 kA	—	—
	3	15–30 A	65 kA	65 kA	65 kA	—
QO-GFI, QOB-GFI	1	15–30 A	10 kA	—	—	—
	2	15–60 A	10 kA	10 kA	—	—
QO-VHGFI, QOB-GFI	1	15–30 A	22 kA	—	—	—
QO-AFI, QOB-AFI	1	15–30 A	10 kA	—	—	—
QO-CAFI, QOB-CAFI	1	15–30 A	10 kA	—	—	—
QO-VHCAFI, QOB-VHCAFI	1	15–30 A	22 kA	—	—	—
QO-EPD, QOB-EPD	1	15–30 A	10 kA	—	—	—
	2	15–60 A	10 kA	10 kA	—	—
QO-PL	1	15–30 A	10 kA	10 kA	10 kA	—
	2	15–30 A	10 kA	10 kA	10 kA	—
	3	15–30 A	10 kA	10 kA	10 kA	—

1 10 kA and 5 kA are 1Ø-3Ø.

2 DC ratings do not apply to circuit breakers rated 10 A.

3 UL Listed 5,000 AIR on 3Ø grounded B-Phase Delta system.

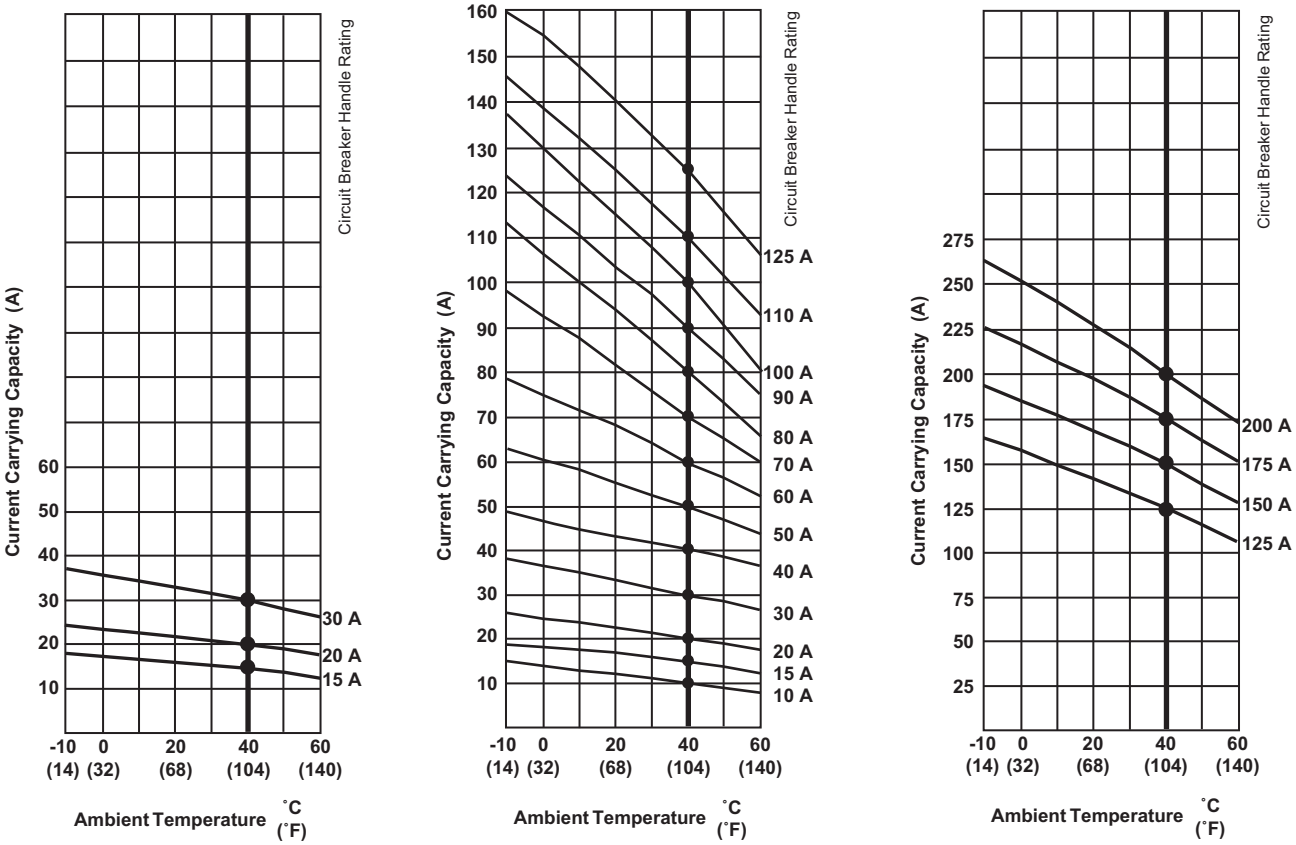
DC Voltage Rating

QO and QOB circuit breakers are available with a UL Listed 48 Vdc rating. See Table 1. Refer to Square D Data Bulletin 0601DB0401 for additional information on dc-rated circuit breakers.

Temperature Rating

To meet the requirements of Underwriters Laboratories Standard 489, molded case circuit breakers are designed, built, and calibrated for us on 60 Hz ac systems in 40°C (104°F) ambient temperature. When applied at ambient temperatures other than 40°C, the current-carrying capacity and/or trip charasteristics of the circuit breaker may vary.

Figure 1: Ambient Rerating Curves



QOT Circuit Breakers | QO, QOB Circuit Breakers | QE Circuit Breakers

IEC Rating

IEC rated QO circuit breakers are available. For further information contact the Field Sales office.

Terminology

HACR

HACR is a term used to designate circuit breakers which have been certified to be used on multi-motor and combination loads such as are found in heating, air conditioning and refrigeration equipment. QO circuit breakers meet the UL requirements for HACR circuit breakers and are suitable for group motor applications requiring HACR listing.

This means that QO and QOB circuit breakers meet the code requirements that HACR circuit breaker must be of the inverse time type and be approved for group installation. QO and QOB circuit breakers, except for GFI, AFI and EPD, are Listed with UL as HACR Type and are labeled accordingly.

Switching Duty (SWD) Circuit Breakers

QO and QOB circuit breakers are suitable for switching 120 Vac fluorescent lighting loads. The switching duty (SWD) listing applies only to one-pole 15 and 20 A circuit breakers rated at 347 Vac or less. The circuit breakers are subjected to specified temperature rise tests at predetermined periods during the endurance operations.

Terminations

The 10–30 A circuit breakers have pressure plate terminals suitable for single or two-wire terminations. Copper or aluminum conductors may be used as outlined in Table 2. QO-GFI 15–30 A and QO-AFI circuit breakers have pressure plate terminals suitable for single-wire terminations. These circuit breakers are suitable for use with 60°C or 75°C conductors.

The QO 35–200 A and all QO-PL and QOT tandem circuit breakers have box-type lugs suitable for single-wire terminations. These circuit breakers are suitable for use with 75°C conductors.

Table 2: Terminations

Circuit Breaker Types	Rating	Wire Size
QO, QOB, QO-VH, QOB-VH	10–30 A	(1) 14–8 AWG (1.5–3.3 mm^2) Al/Cu (2) 14–10 AWG (1.5–2.6 mm^2) Cu
	35–70 A	(1) 8–2 AWG (3.3–6.5 mm^2) Al/Cu
	80–125 A	(1) 4–2/0 AWG (5.2–9.3 mm^2) Al/Cu
QO, QOB, QO-VH	150–200 A	(1) 4 AWG–300 kcmil (5.2–50 mm^2) Al/Cu
QOB-VH	110–175 A	(1) 4 AWG–300 kcmil (5.2–50 mm^2) Al/Cu
QOT	15–20 A	(1) 12–8 AWG (2.0–3.3 mm^2) Al (1) 14–8 AWG (1.6–3.3 mm^2) Cu
QO-CAFI, QO-AFI, QO-GFI, QO-EPD, QOB-CAFI, QOB-AFI, QOB-GFI, QOB-EPD	15–30 A	(1) 12–8 AWG (2.0–3.3 mm^2) Al (1) 14–8 AWG (1.6–3.3 mm^2) Cu
QO-GFI, QO-EPD, QOB-GFI, QOB-EPD	40–60 A	(1) 12–4 AWG (2.0–4.1 mm^2) Al (1) 14–6 AWG (1.6–4.1 mm^2) Cu
QO-PL	10–60 A	(1) 12–2 AWG (2.0–6.5 mm^2) Al

Special Application Circuit Breakers

There are several special application circuit breakers in the QO family:

- QO-HM and QOB-HM High-Magnetic Circuit Breakers
- QO-HID and QOB-HID Circuit Breakers
- QO and QOB Miniature Switches
- QOK and QOBK Key-Operated Circuit Breakers
- QO-GFI and QOB-GFI Qwik-Gard® Circuit Breakers
- QO-EPD and QOB-EPD Equipment Protection Devices
- QO-SWN and QOB-SWN Switch Neutral Circuit Breakers
- QOT Tandem Circuit Breakers
- QO-PL and QOB-PL Powerlink® Circuit Breakers
- QO-AFI and QOB-AFI Branch Feeder Arc-Fault Circuit Interrupters (AFCI)
- QO-CAFI, QOB-CAFI Combination Arc-Fault Circuit Interrupters (AFCI)

This following sections describe the special application circuit breakers and provides application information for their use.

QO-HM and QOB-HM High Magnetic Circuit Breakers

QO-HM and QOB-HM high-magnetic circuit breakers are recommended for area lighting (such as athletic fields, parking lots, and outdoor signs), when using lamps of inherent high inrush current, individual dimmer applications or other applications where high inrush currents exceed standard tripping conditions. These circuit breakers are available in one-pole 15 and 20 A ratings only. QO-HM and QOB-HM circuit breakers are physically interchangeable with standard QO and QOB circuit breakers and accommodate the complete range of QO accessories.

QO-HM and QOB-HM circuit breakers are manufactured with the magnetic trip point calibrated at a much higher level than standard QO and QOB circuit beakers, as shown in Table 3.

Table 3: QO-HM and QOB-HM Circuit Breaker Magnetic Hold Levels

Continuous Current Rating	Maximum Full Cycle Magnetic Hold Level
15 A	315–525 A
20 A	322–537 A

QO-HID and QOB-HID High Intensity Discharge Circuit Breakers

QO-HID and QOB-HID circuit breakers are for use in high intensity discharge (HID) lighting systems, such as systems using mercury vapor, metal halide or high-pressure sodium lighting units. These circuit breakers are designed to handle the high inductive loads, harmonic currents and cycling which are inherent in HID lighting systems. QO-HID and QOB-HID circuit breakers are physically interchangeable with standard QO circuit breakers and accommodate the complete range of QO accessories.

QO-HID and QOB-HID circuit breakers are manufactured with larger contacts than standard QO and QOB circuit breakers to allow switching of high inductive loads. They also have magnetic characteristics similar to QO-HM and QOB-HM high-magnetic circuit breakers to allow the circuit breaker to hold in against the high starting inrush currents which are typical in HID lighting systems.

QO and QOB Miniature Switches

Miniature switches are intended for use as disconnecting devices only. They provide no overcurrent protection. QO and QOB switches are UL Certified for use on circuits capable of delivering not more than 10 kA when protected by an equivalent rated circuit breaker or fuse. These switches are available in 60 and 100 A rating.

QO and QOB switches are available with auxiliary switches only. (Shunt trip and bell alarm electrical accessories are not available on QO and QOB miniature switches.) QO and QOB switches are available with the complete range of handle accessories.

QOK and QOBK Key-Operated Circuit Breakers

1P QOK
Circuit Breaker

Key-operated QOK and QOBK circuit breakers provide an alternative means for turning a circuit breaker ON or OFF, as well as for resetting a tripped circuit breaker. The circuit breaker is turned on, off or reset with a special key included with the circuit breaker. Key-operated circuit breakers are available in one-pole construction only and can be mounted in any one-pole space which will accept a standard QO circuit breaker. These circuit breakers are available in 10–30 A ratings, with interrupting ratings of 10 kA at 120 Vac.

Replacement keys are available separately. Factory-installed or field-installable accessories are not available on key-operated circuit breakers.

1P QO-GFI
Circuit Breaker

2P QO-GFI
Circuit Breaker

QO-GFI and QOB-GFI Qwik-Gard® Ground-Fault Circuit Interrupters

Qwik-Gard® Ground-Fault Circuit Interrupters offer a means of providing ground-fault protection for people. Qwik-Gard "people protection" ground-fault circuit interrupters are built as Class A devices in accordance with UL Standard 489 and CSA C22.2 #144 for ground-fault circuit interrupters (GFCIs). Class A devices must trip at 6 milliamperes of ground-fault current and above, and hold below 4 milliamperes of ground-fault current.

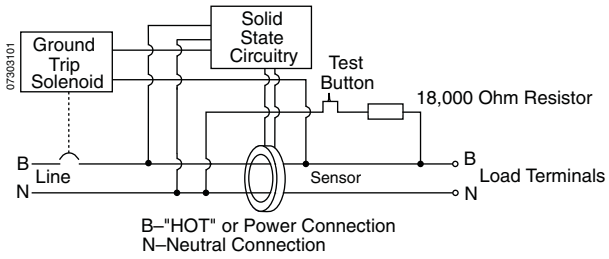
Qwik-Gard GFCIs provide the same branch circuit protection as standard QO circuit breakers. They are longer than standard QO circuit breakers, and thus require more gutter space. All QO electrical accessories except shunt trip and all QO mechanical accessories are available for QO-GFI and QOB-GFI circuit breakers.

Qwik-Gard circuit breakers are UL Listed and CSA Certified and available in both one- and two-pole constructions.

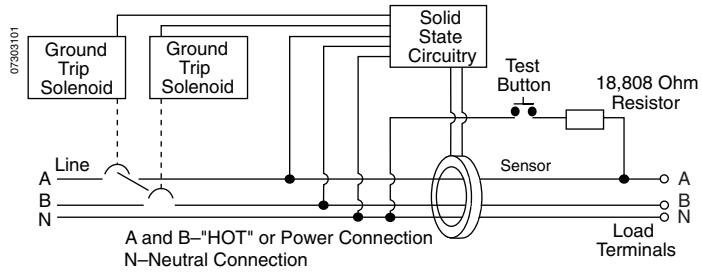
Qwik-Gard Ground-Fault Circuit Interrupter Operation

The ground-fault sensor in a Qwik-Gard GFCI continuously monitors the current flow in the load and neutral conductors. The sensor compares the current flow in all directions. If the current flowing back to the source is less than the current flowing out to the load, a ground fault exists. When the difference in current flow exceeds 6 milliamperes, the sensor sends a signal to trip the GFCI. The trip will be indicated by the Visi-Trip® indicator and the operating handle will move to the center tripped position.

Qwik-Gard Class A GFCIs include a self-contained means of testing the ground-fault circuitry. If the GFCI is connected correctly, with the pigtail connected to the neutral assembly in the load center or panelboard, pressing the test button will trip the GFCI and show a trip indication. UL requires that GFCIs must be operational at 85% of the rated voltage.



One-Pole Qwik-Gard Circuit Breaker



Two-Pole Qwik-Gard Circuit Breaker

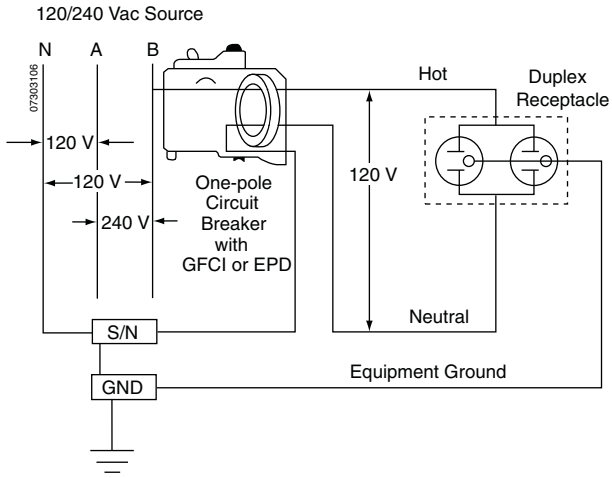
Proper Application of Qwik-Gard GFCIs

- Do not connect to swimming pool equipment installed before adoption of the 1965 National Electric Code
- Do not connect to electrical ranges or clothes dryers whose frames are grounded by a connection to the grounded circuit conductor.
- Do not use as a main circuit breaker in a panelboard or in reverse connected (backfed) applications.
- Do not megger, high-voltage or hi-pot test. Any voltage in excess of 240 Vac will damage the GFCI electronics so that the circuit breaker will not protect against low-level ground faults.
- Must be located no more than 250 ft. (76 m) from the load being served.
- RequiresS the same mounting space as standard QO circuit breakers.

One-Pole Qwik-Gard Ground-Fault Circuit Interrupters

One-pole Qwik-Gard GFCIs must be installed on independent circuits. Circuits which have a neutral common to more than one panel circuit conductor cannot be protected against ground faults by a one-pole GFCI because the current returning to the source through the neutral cannot be effectively split to prevent the Qwik-Gard GFCI from tripping under normal use.

Figure 2: Typical One-Pole Qwik-Gard GFCI Wiring

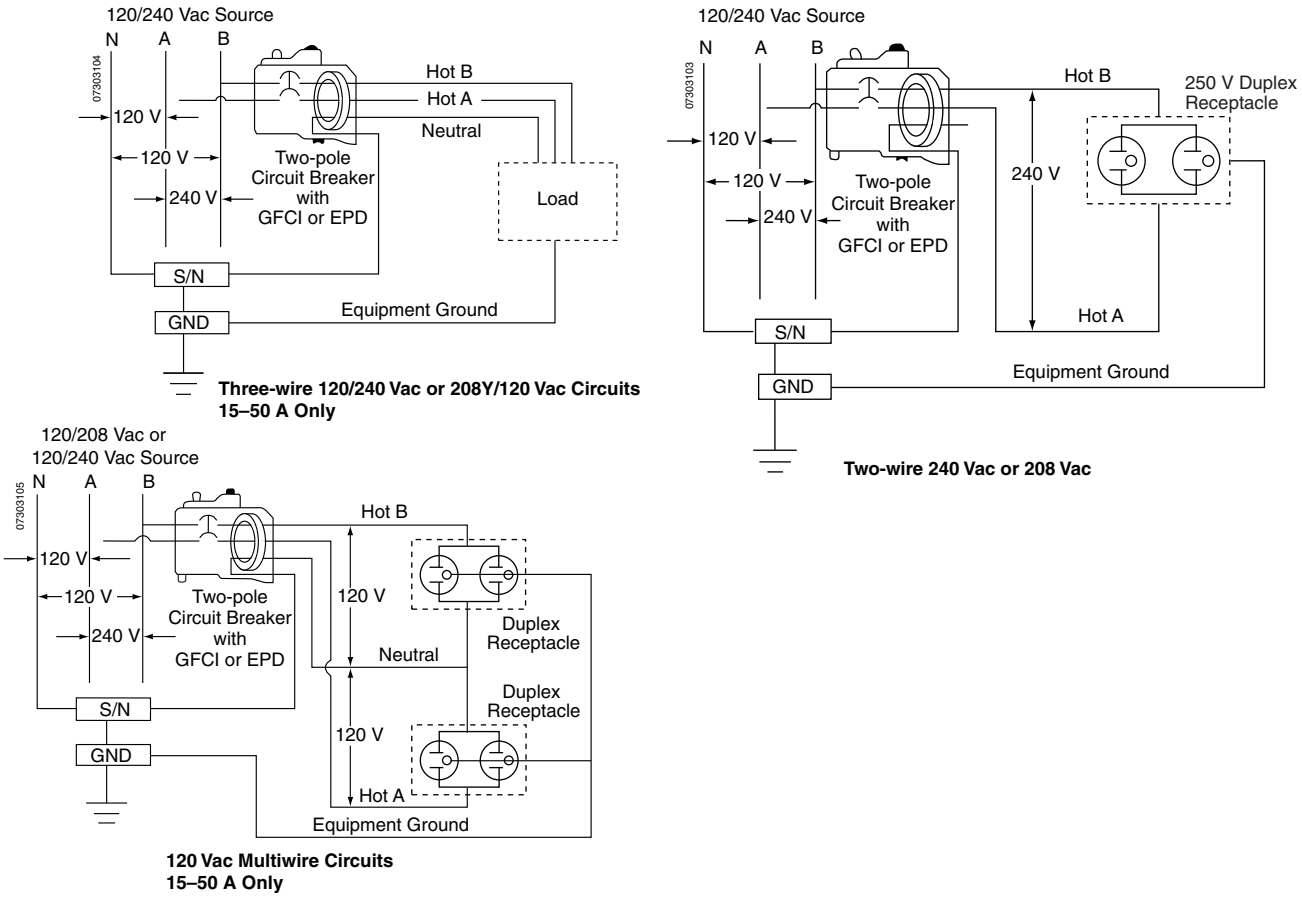


Two-Pole Qwik-Gard GFCIs

Two-pole Qwik-Gard GFCIs can be installed on a 120/240 Vac 1Ø3W system, the 120/240 Vac portion of a 120/240 Vac 3Ø4W system, or two phases and neutral of a 208Y/120 Vac 3Ø4W system. Regardless of the application, connections must be made to two “hot” busses and the panel neutral assembly. When installed on these systems, protection is provided for two-wire 240 Vac or 208 Vac circuit, three-wire 120/240 Vac or 208Y/120 Vac circuits and 120 Vac multiwire circuits.

The 60 A QO260GFI and QOB260GFI GFCIs are limited for use on 208 Vac and 240 Vac two-wire systems. These GFCIs require the panel neutral connection to provide the 120 Vac power necessary for testing the ground-fault circuitry.

Figure 3: Typical Two-Pole Qwik-Gard GFCI Wiring



QO-EPD and QOB-EPD Equipment Protection Devices

QO-EPD and QOB-EPD circuit breakers are one- and two-pole thermal-magnetic circuit breakers with integral **equipment** ground-fault protection. These circuit breakers are rated for use on 120/240 Vac and 120/208 Vac electrical systems to provide overcurrent protection, short-circuit protections and equipment ground-fault protection.

EPD circuit breakers are built in accordance with UL Standard 489. QO-EPD and QOB-EPD circuit breakers are not designed to protect people from the hazards of electrical shock. The ground-fault protection level is 30 milliamperes to protect electrical equipment such as heat trace tape.

QO-EPD and QOB-EPD circuit breakers include a self-contained means of testing the ground-fault circuitry. If the circuit breaker is connected correctly, with the pigtail connected to the neutral assembly in the load center or panelboard, pressing the test button will trip the circuit breaker and show a trip indication. EPD circuit breakers must be operational at 85% of the rated voltage.

EPD circuit breakers provide the same branch circuit protection as standard QO and QOB circuit breakers. They are longer than standard QO circuit breakers, and thus require more gutter space. All QO electrical accessories except shunt trip and all QO mechanical accessories are available for QO-EPD and QOB-EPD circuit breakers.

QO-SWN and QOB-SWN Switch Neutral Circuit Breakers

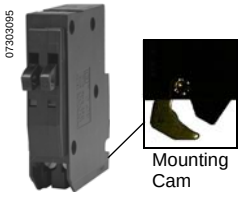
2 Wire and 3 Wire
QO-SWN Circuit Breaker

The QO-SWN and QOB-SWN switch neutral circuit breakers are designed to protect gas pump assemblies.These circuit breakers have provisions for switching the grounded conductor as outlined in the National Electrical Code.

The QO-SWN and QOB-SWN circuit breakers are designed to simultaneously open all grounded and ungrounded conductors. All branch circuit wiring is terminated on the load side of the circuit breaker. The panel neutral connection is made using the pigtail lead built into the circuit breaker. Two-wire circuit breakers require two pole spaces; three-wire circuit breaker require three pole spaces.

QO-SWN and QOB-SWN circuit breakers are available with the complete range of QO accessories.

QOT Tandem Circuit Breakers



1P QOT Tandem
Circuit Breaker

QOT tandem circuit breakers are manufactured so two one-pole, thermal-magnetic circuit breakers occupy only one QO pole space. They are used in applications where circuit loading is light and/or noncontinuous, as in residential applications. QOT circuit breakers are available in 15/15 ampere, 15/20 ampere and 20/20 ampere construction.

QOT circuit breakers have a mounting cam to limit their installation in QO load centers to only those positions having a mounting rail slot. This physically limits the total number of circuit beakers permitted in the panelboard for safe operation.

Each one-pole QOT circuit breaker provides individual switching and tripping action. Individual trip, two-pole circuit with common switching may be assembled by using a handle tie (kit QOTHT) between two adjacent QOT circuit breakers.

QO-PL and QOB-PL Powerlink® Remotely Operated CIrcuit Breakers

1P QO-PL
Circuit Breaker

2P QO-PL
Circuit Breaker

QOPLPS
Power Supply

QO-PL and QOB-PL circuit breakers combine overcurrent and short-circuit protection with remote switching. These circuit breakers are ideal for lighting loads or wherever power switching is required.

These circuit breakers are designed to be used with many types of control devices, from simple push buttons to programmable controllers and energy management systems. QO-PL and QOB-PL circuit breakers have all of the features of standard QO circuit breakers including Visi-Trip®, plus the added ability to be remotely switched on and off. They are rated for a minimum of 30,000 remote operations.

Remote switching is accomplished using a 24 Vdc power supply. Square D offers QOPLPS and QOBPLPS power supplies. These power supplies mount directly in any QO load center or NQ or NQOD panelboard just like a QO circuit breaker. They provide power to switch up to three QO-PL or QOB-PL circuit breakers simultaneously. A minimum of two seconds recharge time must be allowed between operation for non-simultaneous operations of circuit breakers being supplied by a power supply.

Table 4: Maximum Circuit Breakers per Power Supply

Voltage	Maximum QO-PL and QOB-PL Circuit Breakers Recommended per QOPLPS[1]
208Y/120 Vac	2
240 Vac	3

1 At ambient temperature of -25° through 40°C.

QO Arc-Fault Circuit Interrupter Circuit Breakers

1P QO-AFI
Circuit Breaker

QO arc-fault circuit interrupters (AFCI) quickly detects a wide range of arc-fault conditions, recognizes the nature and specific wave-form of an arc fault and trips the circuit breaker. Traditional circuit breakers and fuses are designed to detect overloads and short circuits. Arc-fault circuit breakers are designed to detect overloads, short circuits and arc faults.

An arc-fault circuit breaker opens the circuit and stops the arcing and high intensity heat before a fire is likely to ignite. It is designed with the same quick-open and Visi-Trip® features and reliability of other QO circuit breaker products, fits into most existing Square D load centers, and can generally be used as a direct replacement for a standard Square D circuit breakers. The AFCI overall size is larger than an equivalent QO circuit breaker.

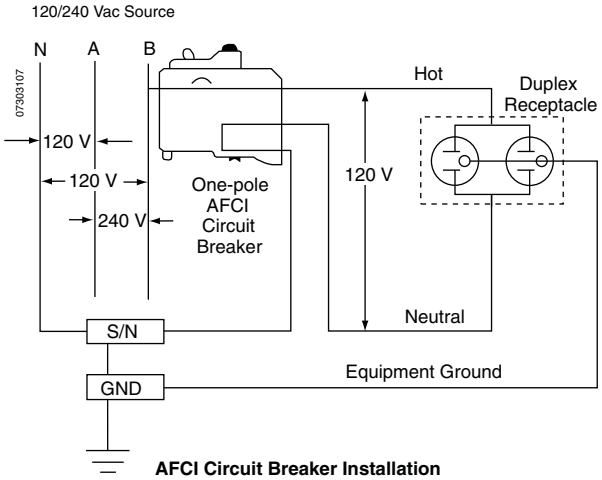
Arc-fault circuit breakers:

- Have special microprocessor-based arc identification to differentiate necessary operational arcs (associated with loads such as electric motors, switches and receptacles) from actual arc faults which can cause damage and fires.
- Differentiate true arc faults from chopped wave-forms associated with switched-mode power supplies on electrical appliances, computers and lamp dimmers.

QO AFCI's are available as Branch Feeder Type and Combination Type. Branch AFCI circuit breakers provide arc-fault protection of the branch circuit wiring. Combination AFCI circuit breakers provide arc-fault protection for the branch circuit and also provides protection of cord sets and power-supply cords.

The AFCI type required for an installation is generally governed by the installation codes which are adopted by local inspection authorities. Consult local building codes and inspection authorities to determine which type is required in your area.

Figure 4: Typical AFCI Circuit Breaker Installation



AFCI Circuit Breaker Installation

Accessories

Most QO and QOB circuit breakers can be supplied with electrical accessories factory-installed on one-, two- or three-pole circuit breakers. Electrical accessories are not available on AFCI circuit breakers.

Handle accessories are also available for field installation on QO and QOB circuit breakers. All field-installed handle accessories must be ordered separately.

Electrical Accessories

Only one electrical accessory can be installed per circuit breaker, and are factory-installed only. All electrical accessories occupy one additional pole space. The proper suffix number must be added to the circuit breaker catalog number to order an accessory. No field modification or field installation is possible on electrical accessories.

Table 5: Factory-Installed Electrical Accessory Suffix Numbers

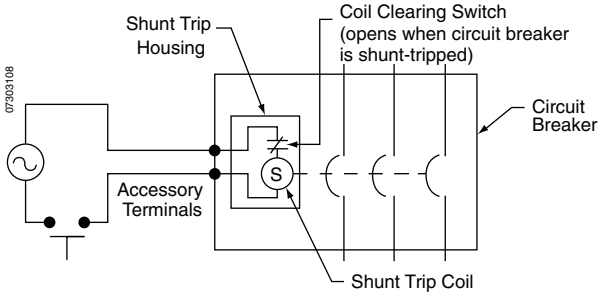
Accessory	Description	Voltage	Coil Burden	Max. Load	Catalog Suffix
Shunt Trip	Trips the circuit breaker from a remote location by means of a trip coil energized from a separate circuit. All shunt trips will operate at 75% or more of rated voltage. • For use with momentary or maintained push button. • Not available on QO-GF or QO-EPD circuit breakers. • Shunt trip terminals accept (2) 14–12 AWG Cu leads.	12 Vac/dc 24 Vac/dc	60 VA 168 VA	—	1042
		120 Vac 208 Vac 240 Vac	72 VA 228 VA 288 VA	—	1021
Auxiliary Switch “A” Contact	Circuit breaker open—One contact only, opens when circuit breaker is off or tripped. 5 A max at 120 Vac.	120 Vac	—	5 A	1200
Auxiliary Switch “B” Contact	Circuit breaker open—One contact only, closed when circuit breaker is off or tripped. 5 A max at 120 Vac.	120 Vac	—	5 A	1201
Alarm Switch	Used with control circuits and is actuated only when the circuit breaker has tripped. Standard construction includes a normally-open contact. • Alarm switch terminals accept (2) 14–12 AWG Cu leads.	120 Vac	—	5 A	2100

Shunt Trip

The shunt trip is used to trip the circuit breaker from a remote location by using a tripping coil energized from a separate circuit. When energized by a push-button or other pilot device, the shunt trip caused the circuit breaker to trip. The handle moves to the tripped position and the Visi-Trip® indicator appears. The trip coil has a coil clearing contact to break the coil circuit when the circuit breaker trips.

Shunt trips are available for QO and QOB circuit breakers only with standard control voltage ratings up to 240 Vac or 24 Vdc. (Shunt trips are not available on QO and QOB GFCI, AFCI, EPD and miniature switches.) Shunt trips operate at 75% or more of rated voltage.

Figure 5: Shunt Trip Wiring Diagram

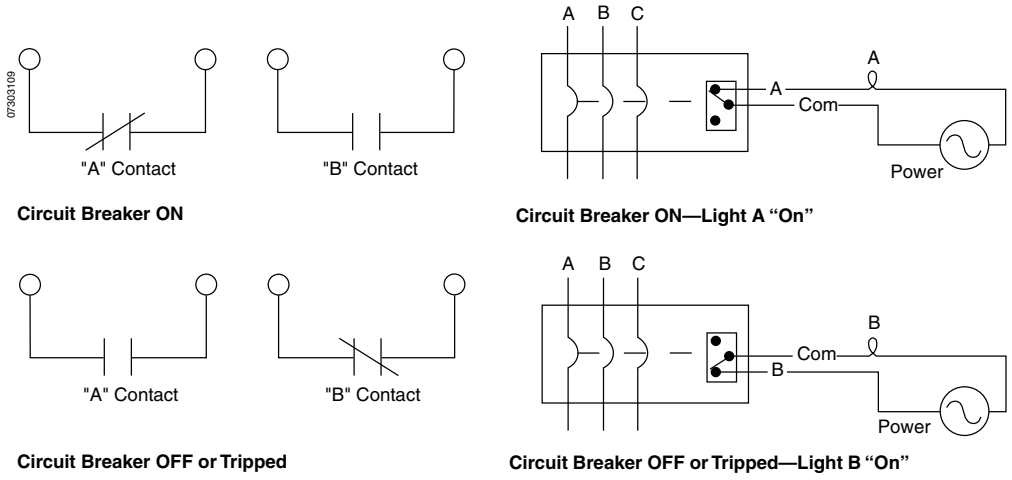


Auxiliary Switch

The auxiliary switch accessory monitors the circuit breaker contact status and provides a remote signal indicating whether the circuit breaker contacts are open or closed. When the circuit breaker is off or tripped, the auxiliary switch with an “A” contact is open and the auxiliary switch with a “B” contact is closed. When the circuit breaker is on, the auxiliary switch with an “A” contact is closed and the auxiliary switch with a “B” contact is open.

Auxiliary switches are available for QO and QOB circuit breakers and miniature switches. (Auxiliary switches are not available on QO and QOB AFI and CAFI products.)

Figure 6: Auxiliary Switch Wiring Diagrams



Circuit Breaker ON

Circuit Breaker ON—Light A “On”

Circuit Breaker OFF or Tripped

Circuit Breaker OFF or Tripped—Light B “On”

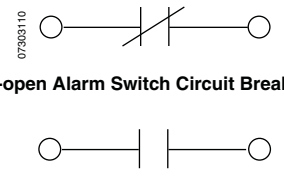
Alarm Switch

The alarm switch accessory monitors the circuit breaker trip status and is used to provide a remote warning signal indicating that the circuit breaker has tripped. This signal can be used in conjunction with a horn, pilot light, or some other indicator.

The contact on the standard alarm switch is open when the circuit breaker is in the off or on position and is closed when the circuit breaker is in the tripped position.

Alarm switches are actuated when the circuit breaker has tripped as a result of an overload, short circuit or shunt trip operation. Alarm switches are available for QO and QOB circuit breakers and miniature switches. (Alarm switches are not available on QO and QOB AFI and CAFI products.)

Figure 7: Alarm Switch Wiring Diagram



Normally-open Alarm Switch Circuit Breaker Tripped

Circuit Breaker OFF or ON

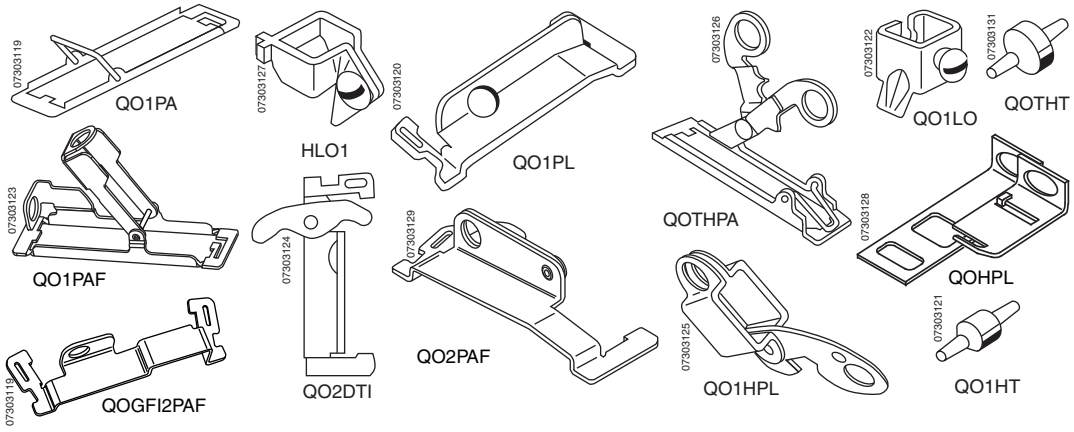
Handle Accessories

Field-installed handle accessories are also available.

Table 6: Field-Installable Handle Accessories

Accessory	Description	Catalog Number
Handle Tie	Converts any two adjacent 120/240 Vac 1P QO circuit breakers to independent trip 2P.	QO1HT
	Converts any two adjacent 120/240 Vac 1P side-by-side QOT circuit breakers to independent trip 2P.	QOTHT
Handle Clamp	Clamp for holding QO 1P handle in ON or OFF position.	QO1LO
	Clamp for holding QO or Q1 (1P, 2P, or 3P) circuit breaker handle in ON or OFF position.	HLO1
Handle Padlock Attachment for Padlocking in ON or OFF Position	Loose attachment for padlocking 1P QO circuit breaker in ON or OFF position.	QOHPL
	Fixed attachment for padlocking 1P QO circuit breaker in ON or OFF position.	QO1PA
	Attachment for padlocking 1P side-by-side QOT circuit breaker in ON or OFF position.	QOTHPA
	Fixed attachment for padlocking 2P QO-GFI circuit breaker in ON or OFF position.	GF12PA
	Loose attachment for padlocking 2P and 3P standard QO circuit breaker in ON or OFF position.	QO1HPL
	Fixed attachment for padlocking 2P and 3P standard QO circuit breaker in ON or OFF position.	QO1PL
Handle Padlock Attachment for Padlocking in OFF Position	Fixed attachment for padlocking 1P QO circuit breaker in OFF position only.	QO1PAF
	Fixed attachment for padlocking 2P and 3P QO circuit breakers in OFF position only.	QO2PAF
	Fixed attachment for padlocking 1P QO-GFI, QO-AFCI and QO-EPD circuit breakers in OFF position only.	QOGFI1PAF
	Fixed attachment for padlocking 2P QO-GFI and QO-EPD circuit breakers in OFF position only.	QOGFI12PAF
Sub-Feed Lugs	60 A 2P plug-on—2 spaces required (6–2 Al/Cu)	QO60SL
	125 A 2P plug-on—2 spaces required (12–2/0 Al/Cu)	QO2125SL
	225 A 2P plug-on—4 spaces required (4–300 Al/Cu)	QO2225SL
	125 A 3P plug-on—3 spaces required (12–2/0 Al/Cu)	QO3125SL
Mechanical Interlock Attachment	For interlocking the handles of two 2P or one 2P and one 1P QO and Q1 circuit breaker mounted side-by-side so that only one circuit breaker can be ON at a time (Not for QOU)	QO2DTI
Mechanical Interlock with Retaining Kit	For securing two adjacent back-fed circuit breakers in dual power supply applications. Can be used with two 2P or one 2P and one 1P QO circuit breaker in QO816L100 load center.	QO2DTIM

Figure 8: Handle Accessories



Handle Tie

The handle tie accessory converts any two adjacent one-pole QO circuit breakers to one independent trip multi-pole circuit breaker.

Handle Lock-Off (Clamp)

The handle lock-off accessories fasten the handle in the ON or OFF position. These handle lock-offs cannot be padlocked.

Handle Padlock Attachment

The handle padlock attachment allows padlocking the circuit breaker handles in either the ON or OFF position or in the OFF only position. Handle padlock attachments are available in two styles: removable and fixed.

The removable style is intended to be a temporary device. Once work on the circuit breaker has been completed, the attachment can be removed from the circuit breaker to resume normal operation.

The fixed style is intended to be a permanent device. Once the work on the circuit has been completed, the padlock can be removed for the circuit breaker to resume normal operation, but the attachment stays in place.

Mechanical Interlock Attachment

The mechanical interlock attachment locks the handles of two adjacent circuit breakers to prevent both circuit breakers from being on at the same time. Both circuit breakers may be switched to the off position with the mechanical interlock in place.

Mechanical Interlock Attachment with Retaining Kit

The mechanical interlock attachment locks the handles of two adjacent back-fed circuit breakers in dual power supply applications.

Trip Curves

The tripping characteristics of QO and QOB circuit breakers can be represented by a characteristic tripping curve that plots tripping time versus current level. The curve shows the amount of time required by a circuit breaker to trip at a given overcurrent level. The curve has a performance band that is bound by a minimum and a maximum value of clearing time. Total clearing time is the sum of the sensing time, unlatching time, mechanical operating time and arcing time of the circuit breaker. For currents in excess of 135% of the circuit breaker rating at rated ambient temperature (40°C), the circuit breaker will automatically open the circuit within limits specified by the band.

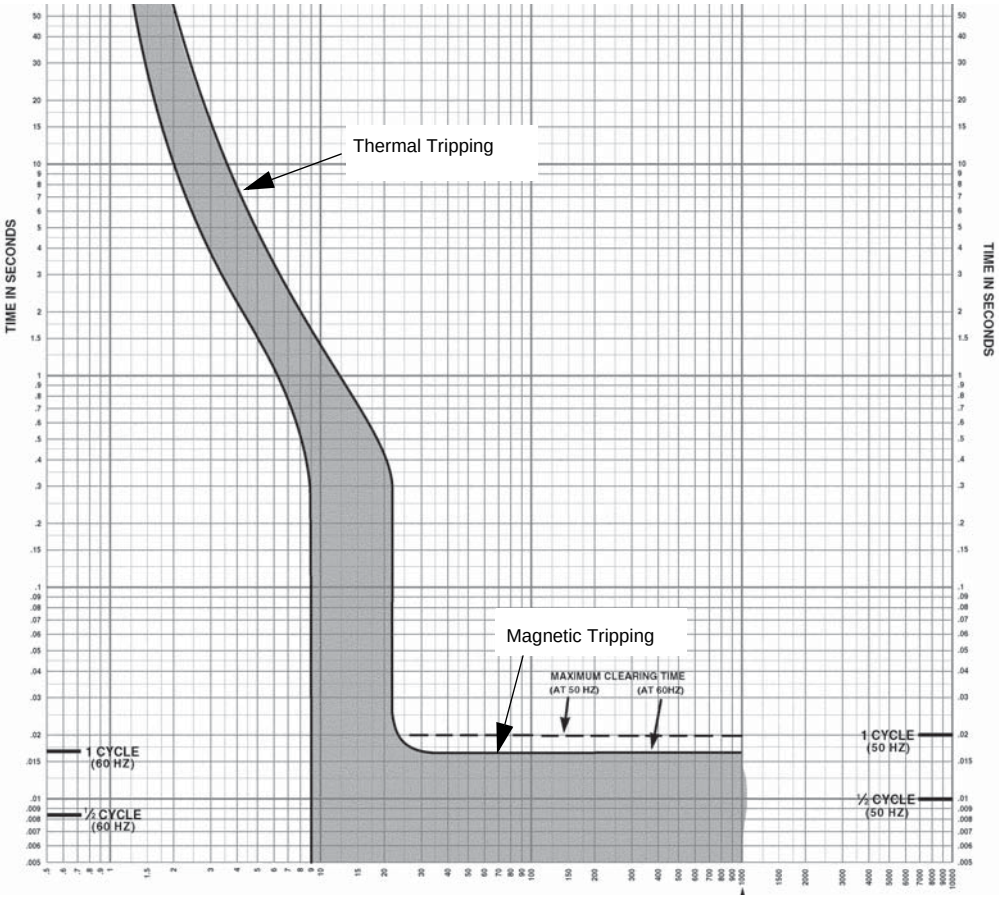
Thermal Tripping Characteristics

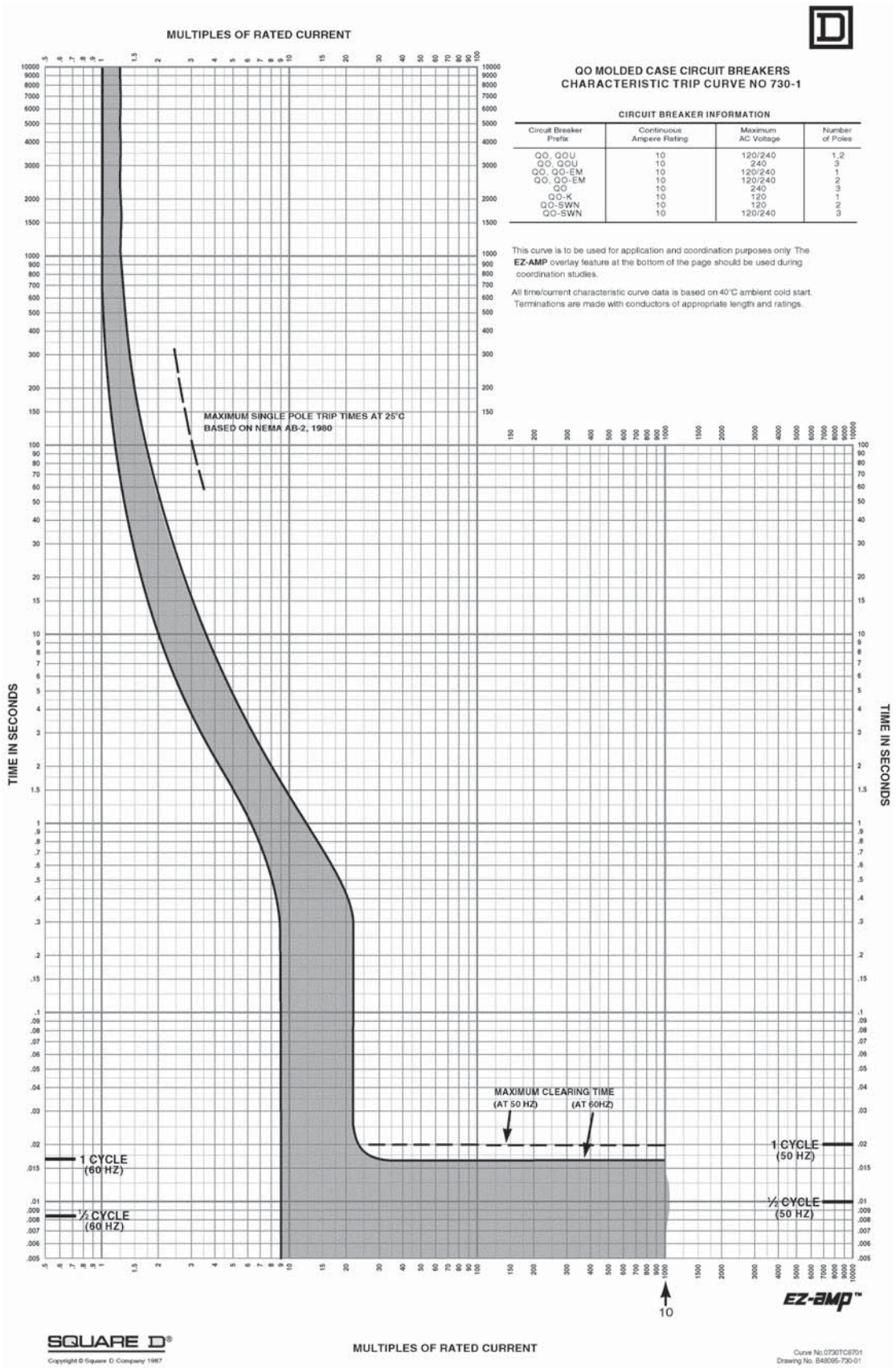
The upper left portion of each trip curve displays the thermal response of the circuit breaker. On low-fault current levels, up to the magnetic tripping level, thermal tripping occurs when a bimetal in the circuit breaker responds to heat associated with the overcurrent. The bimetal deflects, unlatching the mechanism and mechanically causing the circuit breaker to trip and open the circuit. The greater the overcurrent, the faster the circuit breaker will operate to clear the circuit.

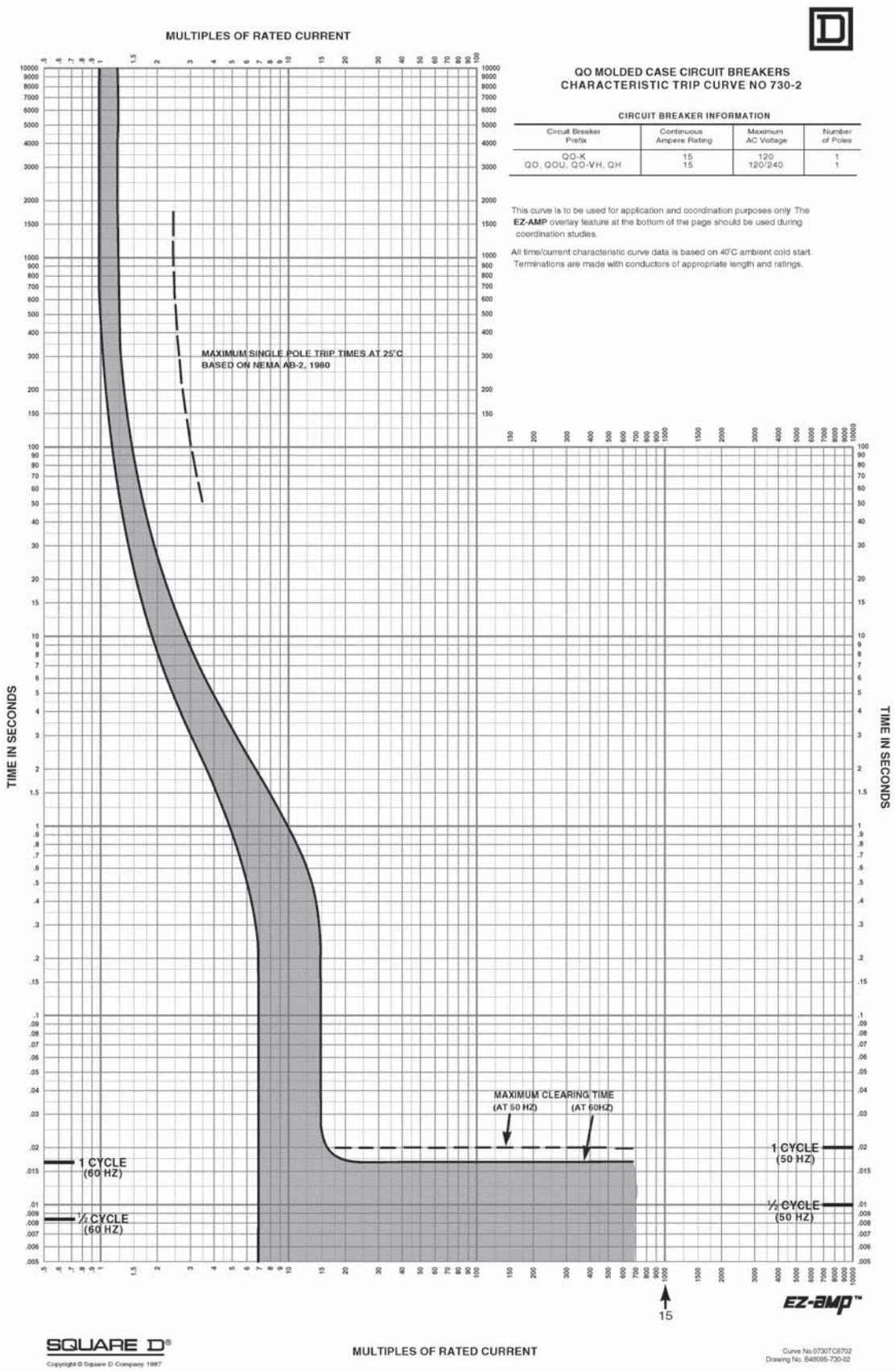
Magnetic Tripping Characteristics

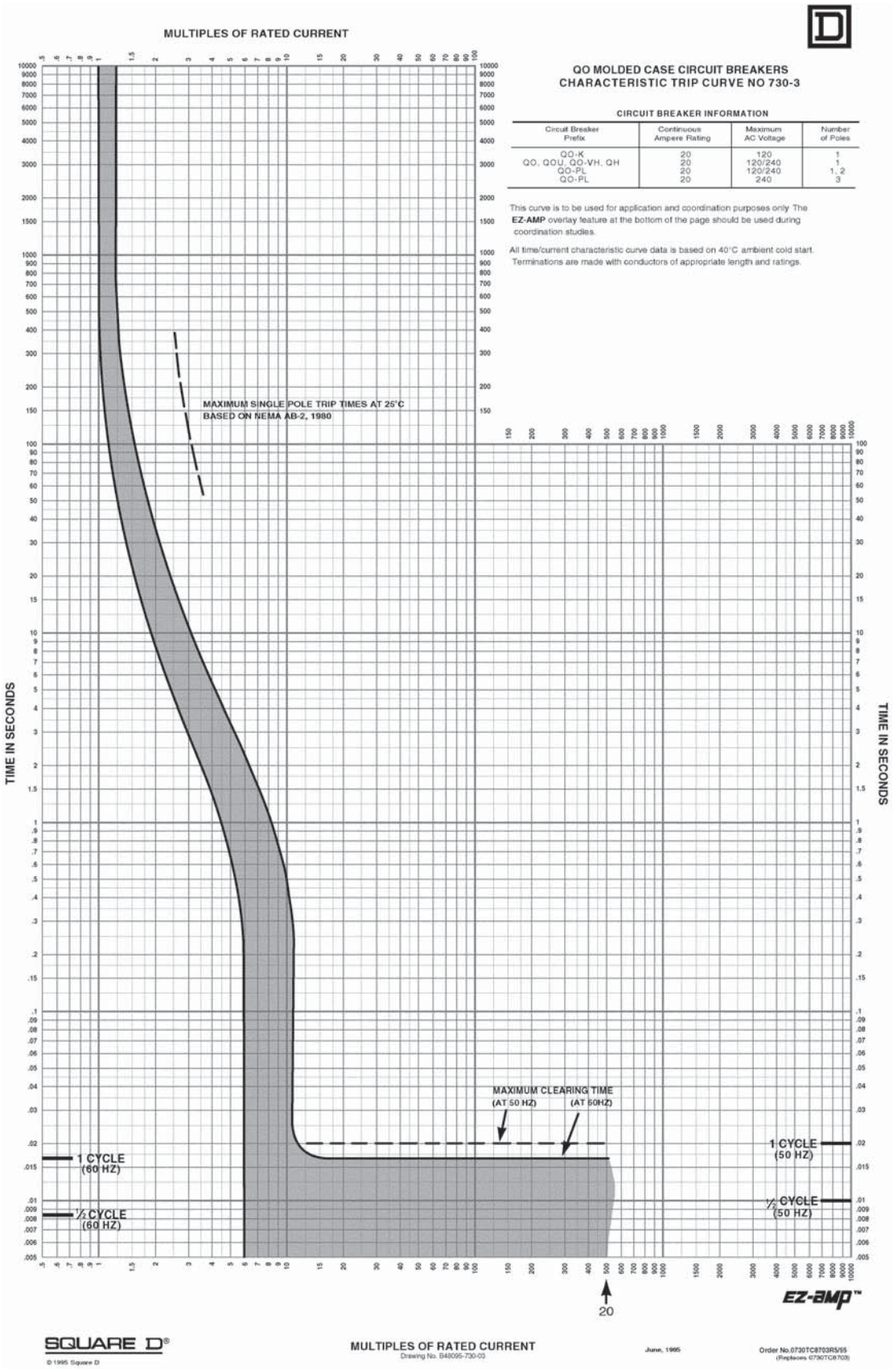
The lower right portion of each trip curve displays the magnetic tripping response of the circuit breaker. This takes place when overcurrents of sufficient magnitude operate in an internal magnetic armature which unlatches the mechanism. Magnetic tripping occurs with no intentional time delay.

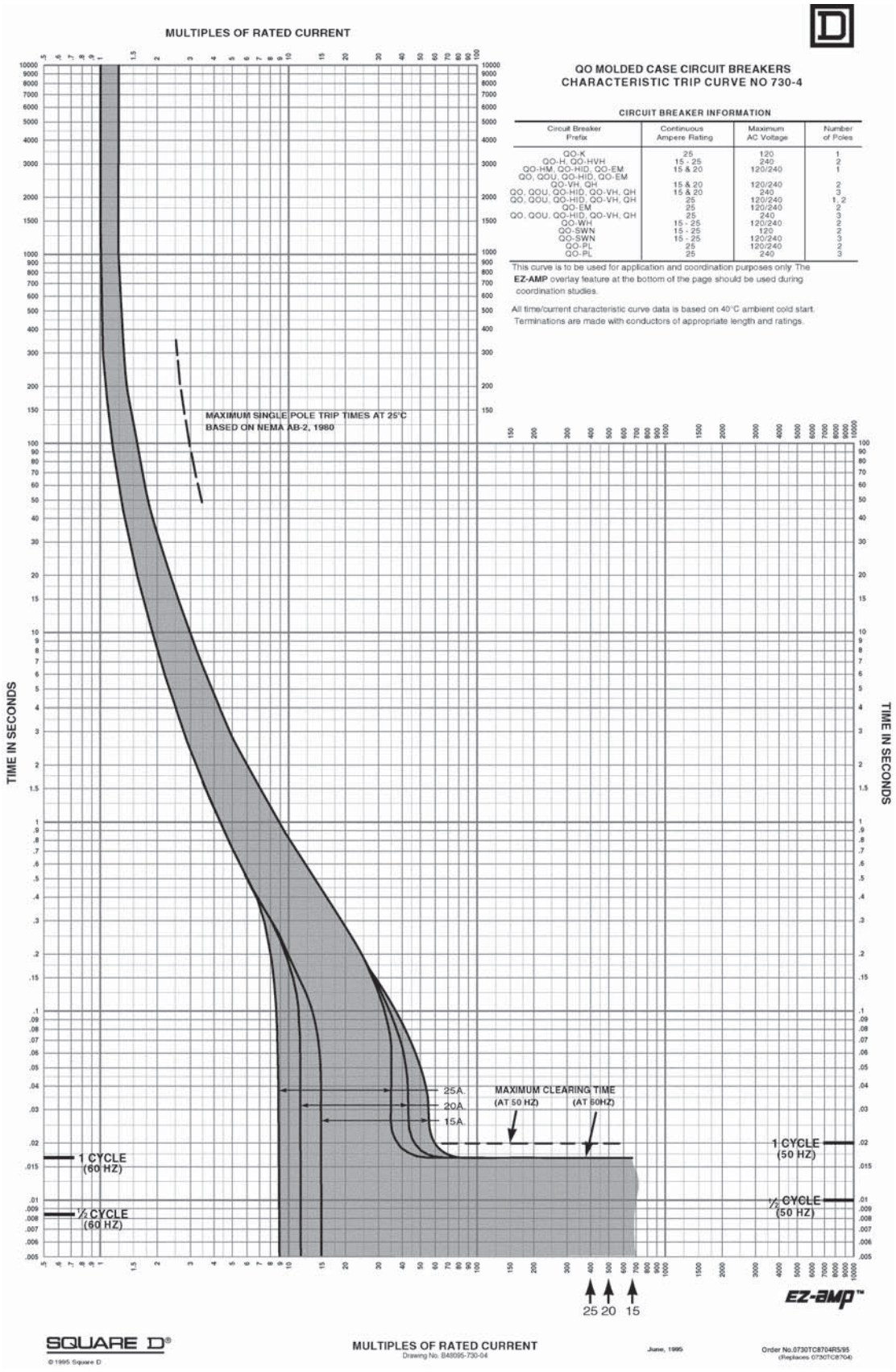
Figure 9: Typical QO Trip Curve

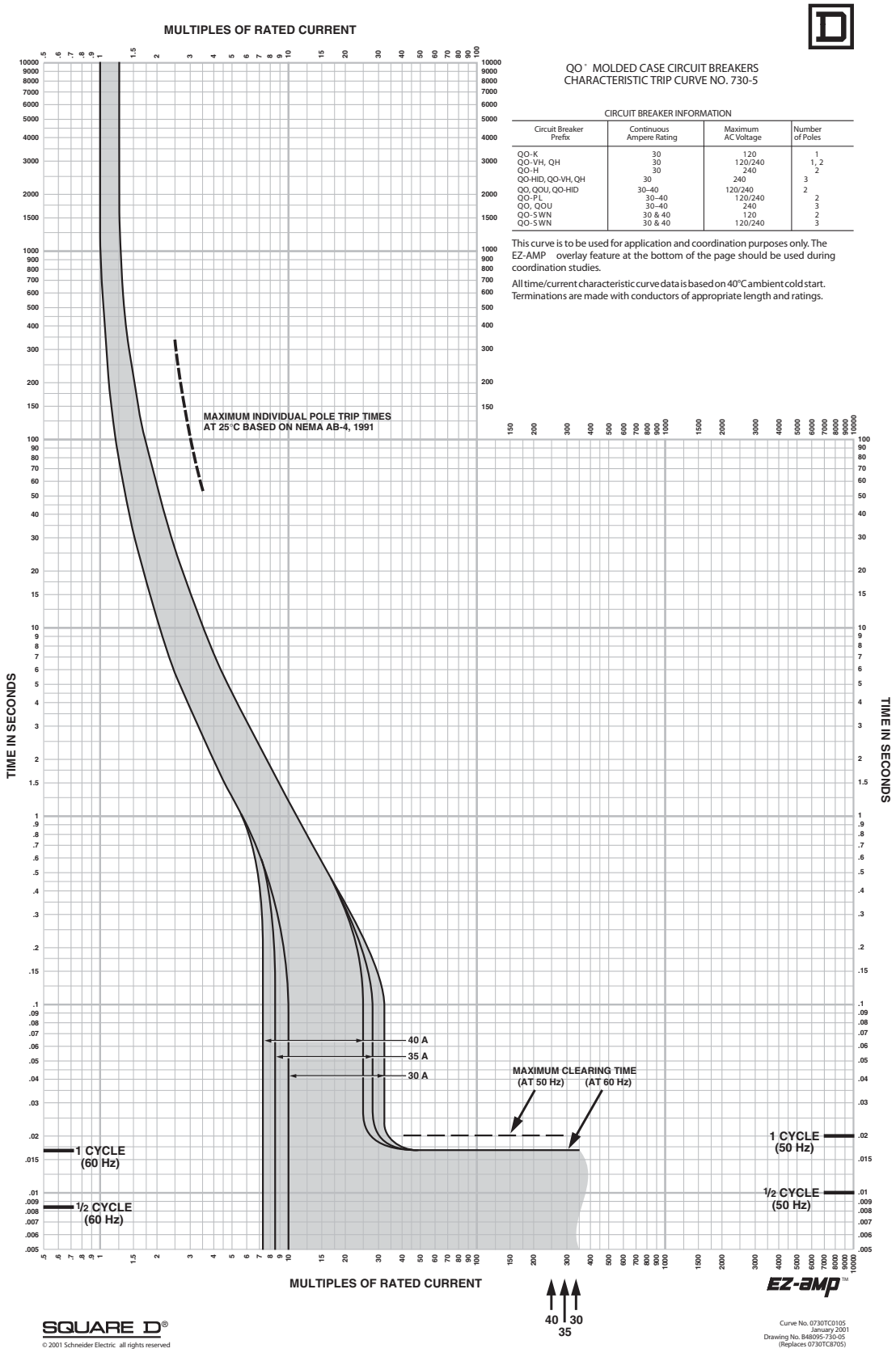












QO® MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 730-5

CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
QO-K	30	120	1
QO-VH, QH	30	120/240	1, 2
QO-H	30	240	2
QO-HID, QO-VH, QH	30	240	3
QO, QOU, QO-HID	30–40	120/240	2
QO-PL	30–40	120/240	2
QO, QOU	30–40	240	3
QO-SWN	30 & 40	120	2
QO-SWN	30 & 40	120/240	3

This curve is to be used for application and coordination purposes only. The EZ-AMP® overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.

SQUARE D®

Curve No. 0730TC0105
January 2001
Drawing No. B48095-730-05
(Replaces 0730TC8705)

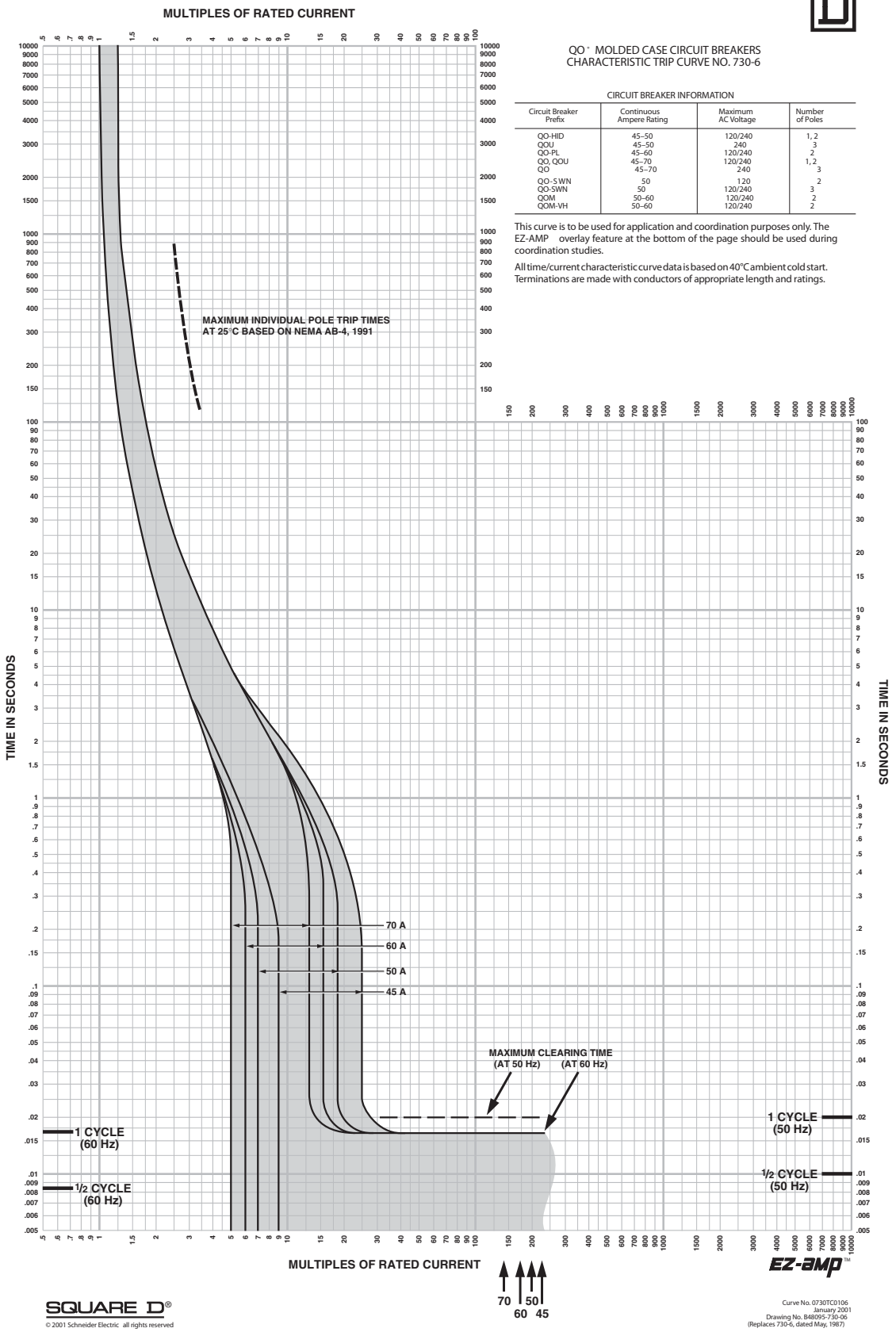
QO® MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 730-6

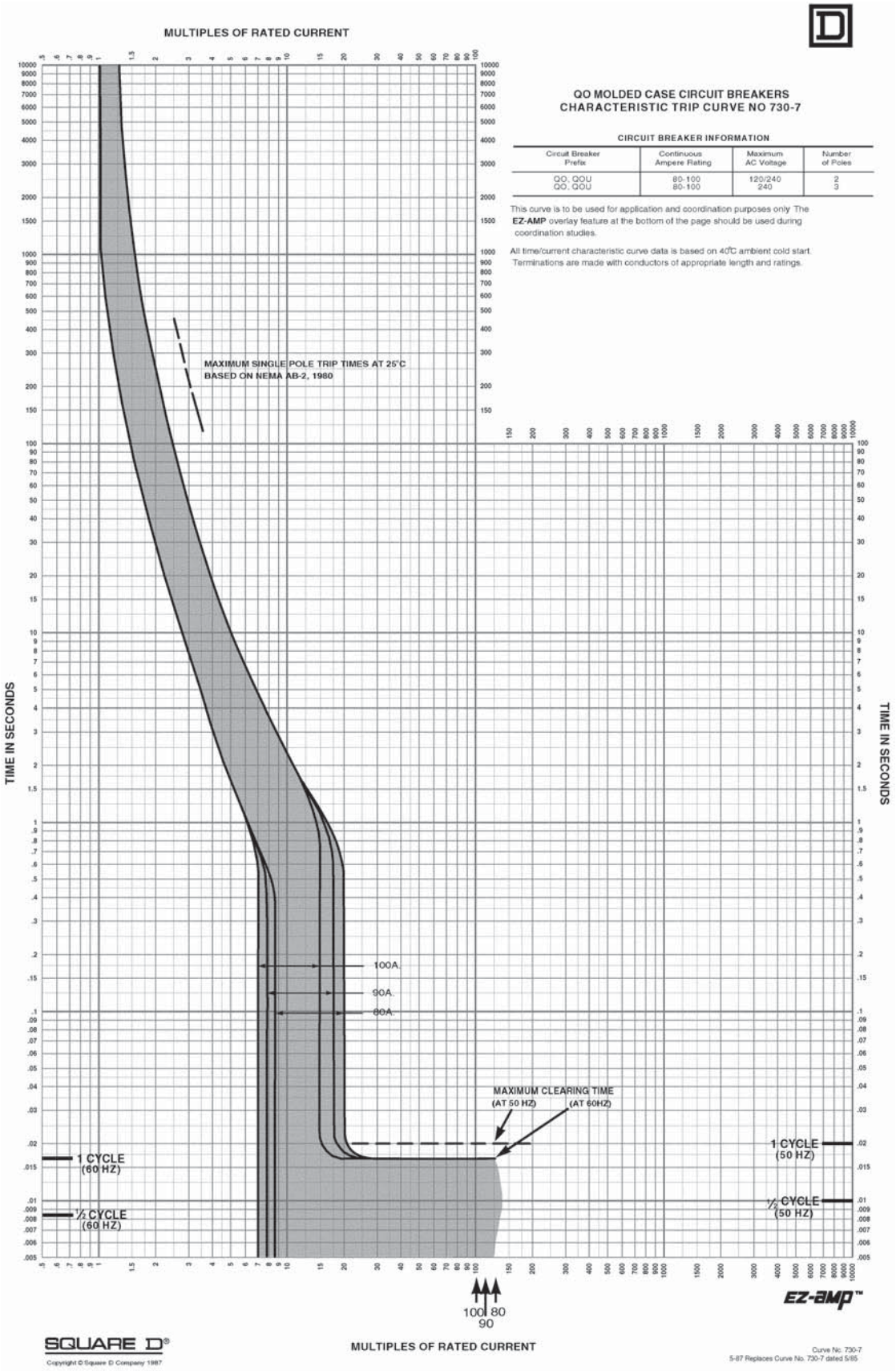
CIRCUIT BREAKER INFORMATION

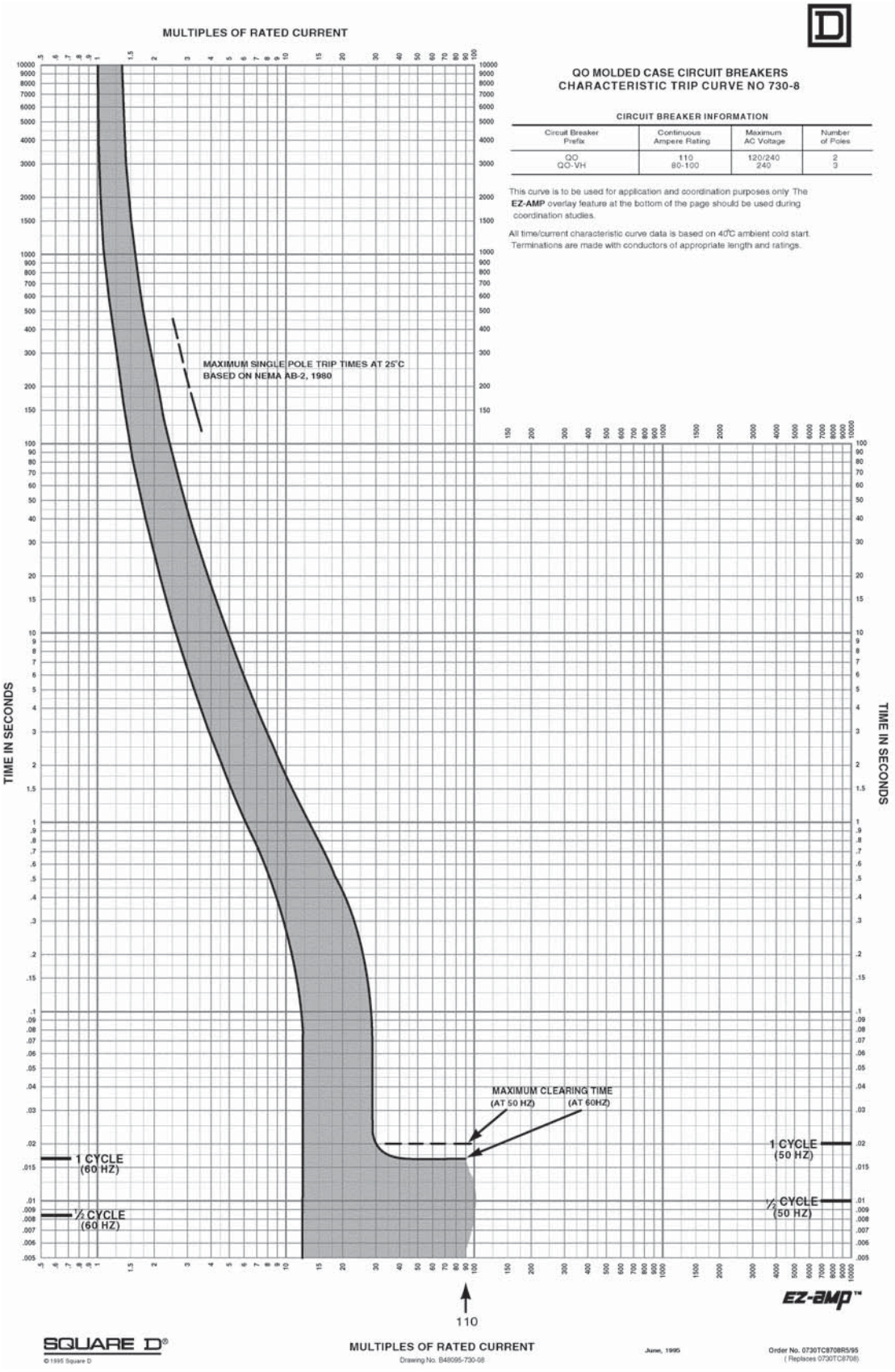
Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
QO-HID	45–50	120/240	1, 2
QOU	45–50	240	3
QO-PL	45–60	120/240	2
QO, QOU	45–70	120/240	1, 2
QO	45–70	240	3
QO-SWN	50	120	2
QO-SWN	50	120/240	3
QOM	50–60	120/240	2
QOM-VH	50–60	120/240	2

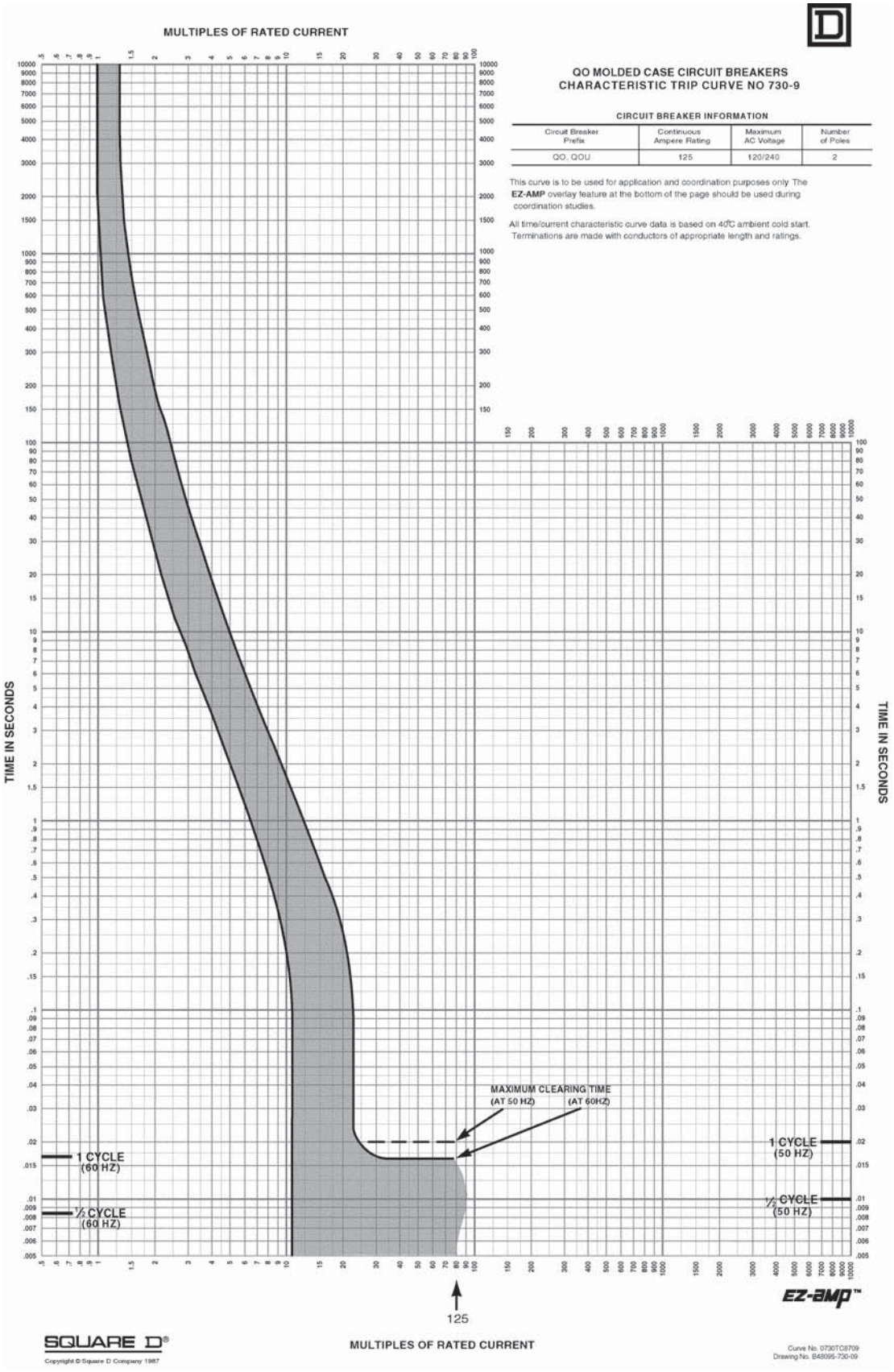
This curve is to be used for application and coordination purposes only. The EZ-AMP overlay feature at the bottom of the page should be used during coordination studies.

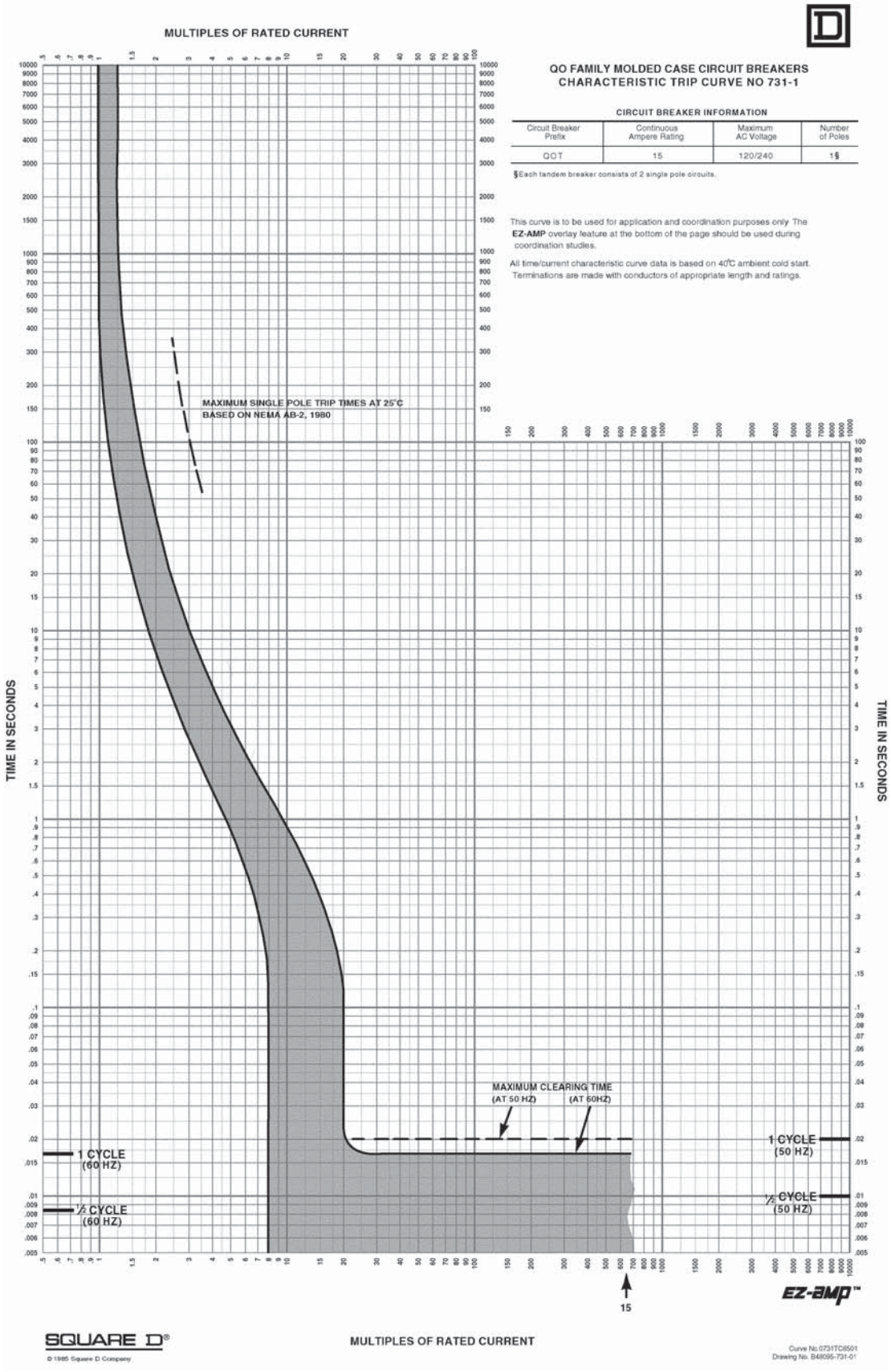
All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.

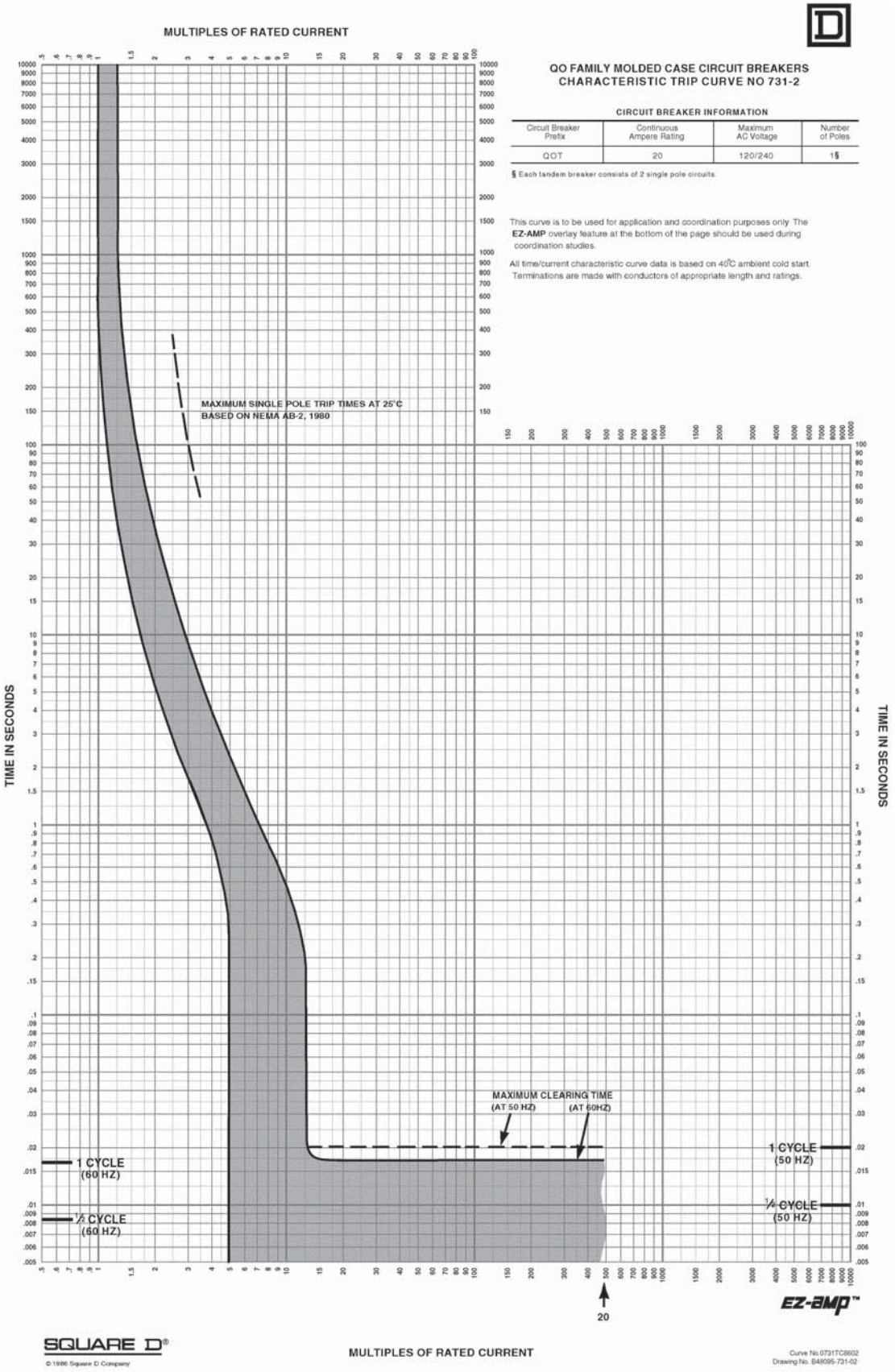


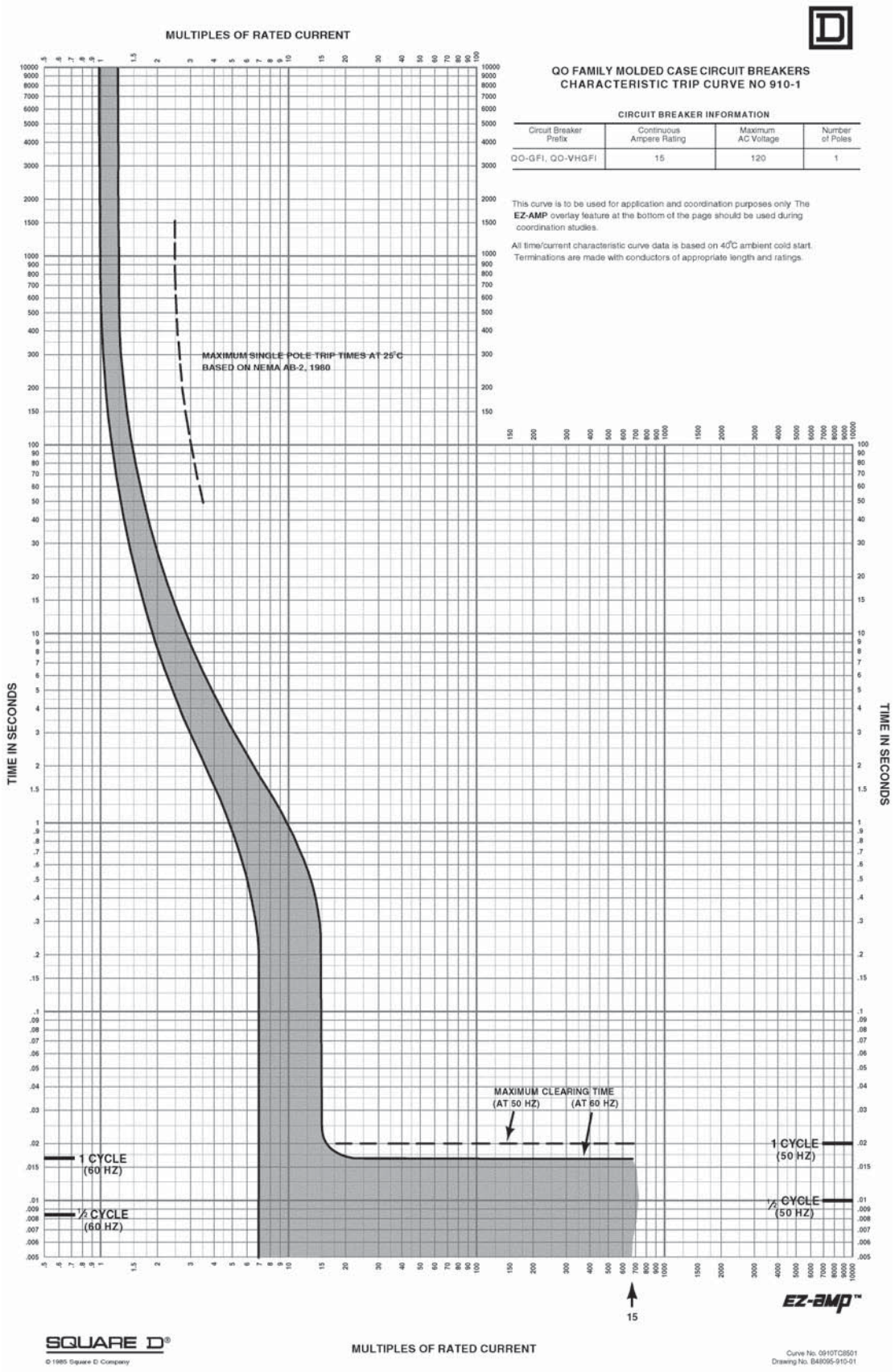


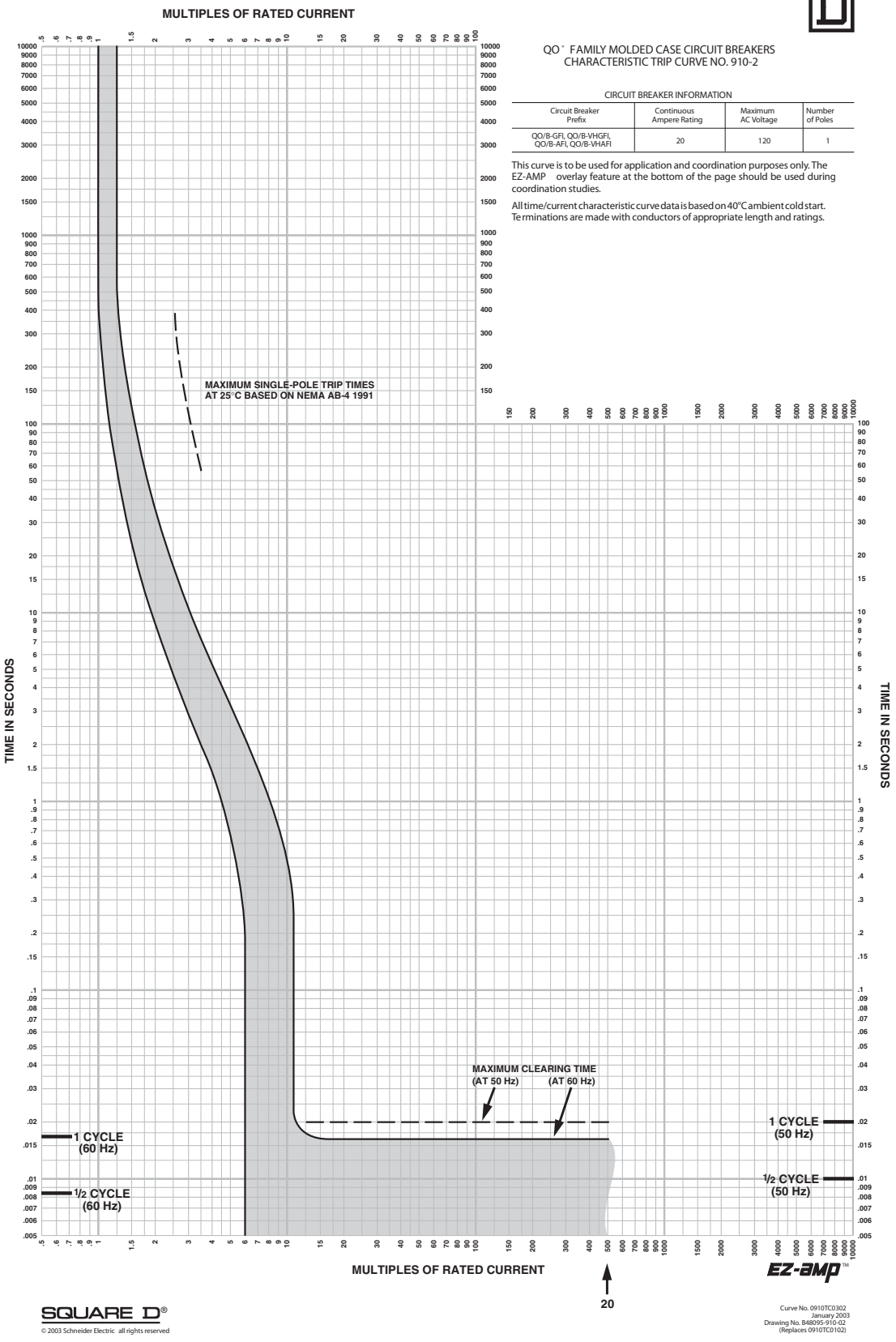












QO ' FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 910-2

CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
QO/B-GFI, QO/B-VHGFI, QO/B-AFI, QO/B-VHAFI	20	120	1

This curve is to be used for application and coordination purposes only. The EZ-AMP overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.

Curve No. 0910TC0302
January 2003
Drawing No. B48095-910-02
(Replaces 0910TC0102)

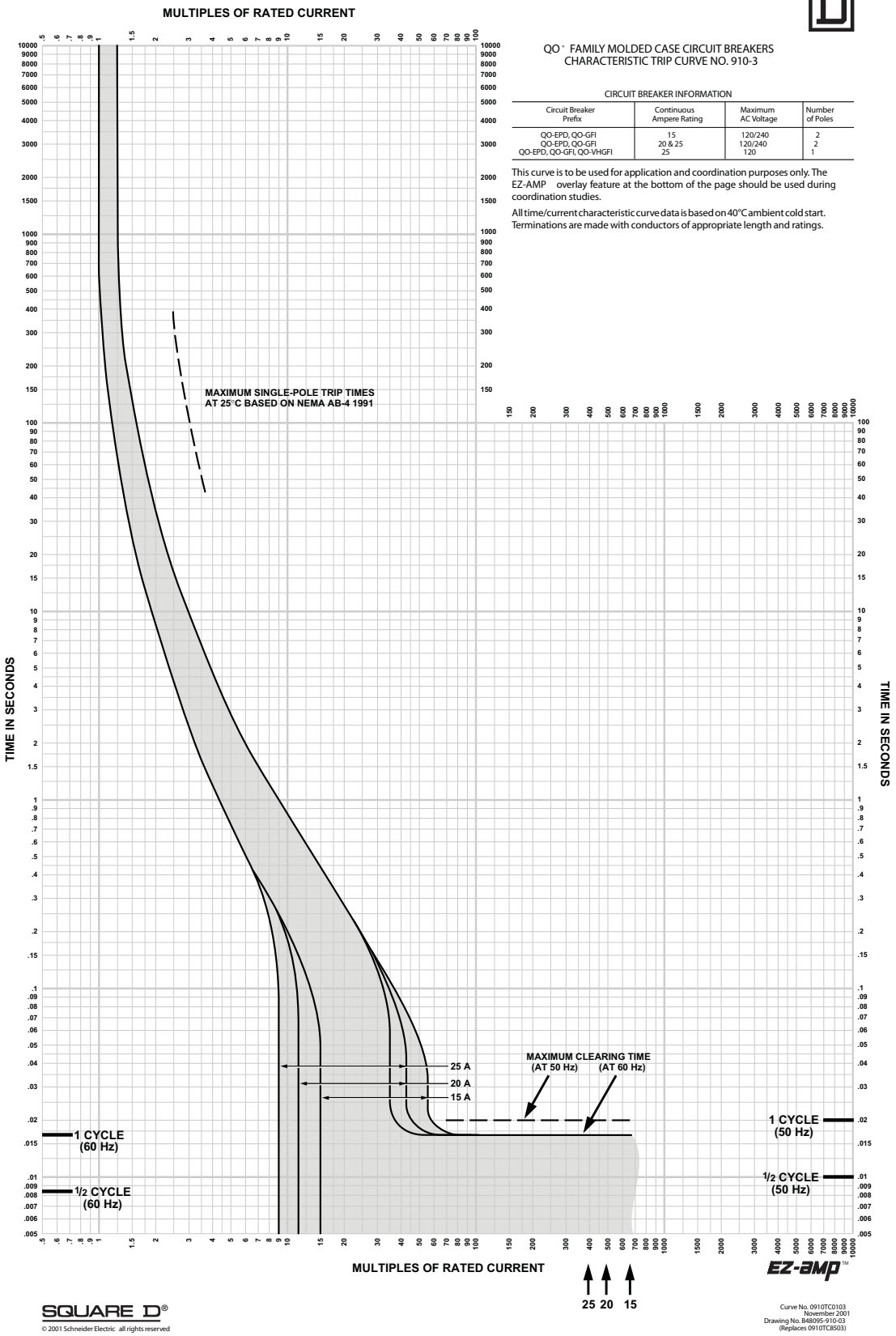
QO® FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 910-3

CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
QO-EPD, QO-GFI	15	120/240	2
QO-EPD, QO-GFI	20 & 25	120/240	2
QO-EPD, QO-GFI, QO-VHGFI	25	120	1

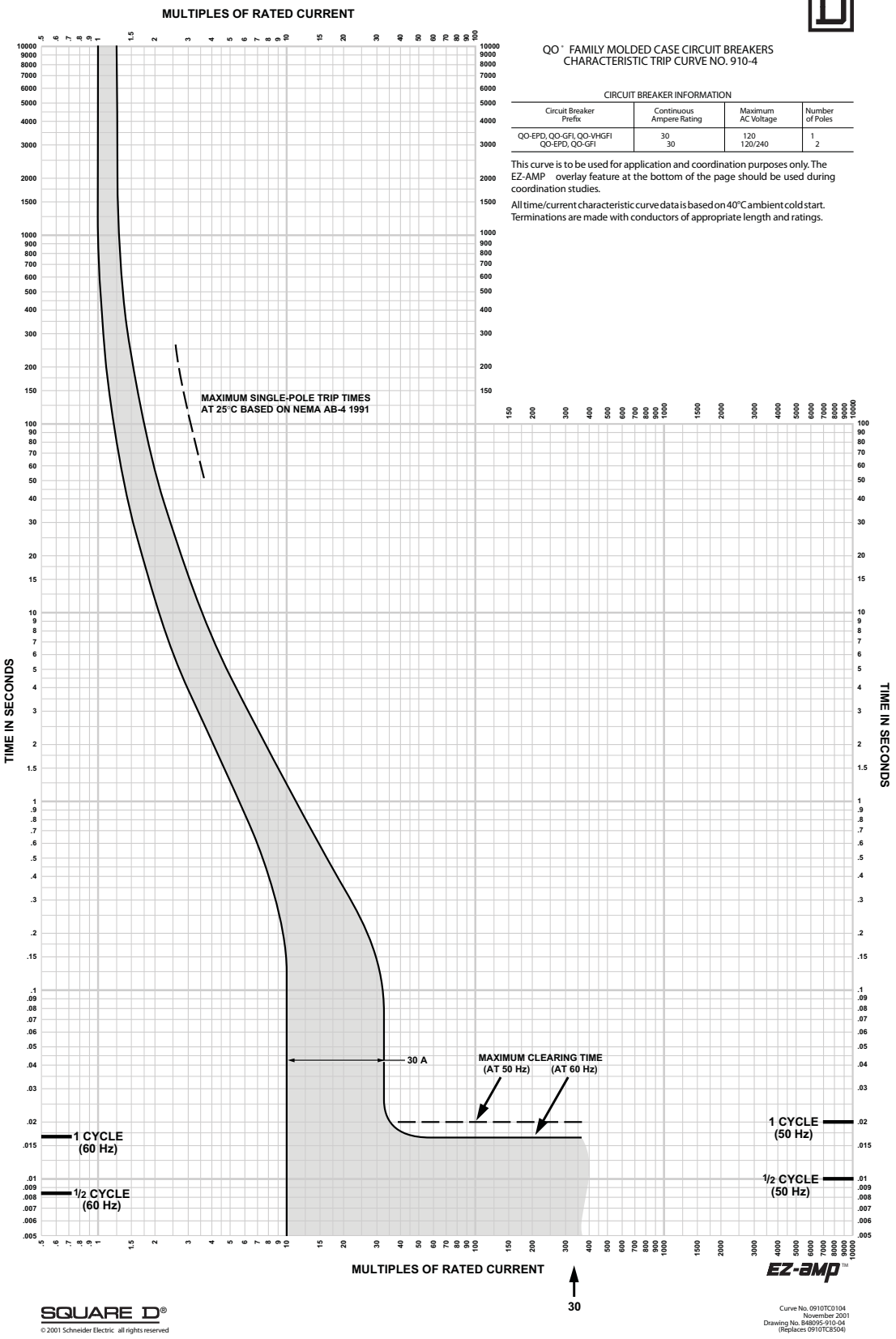
This curve is to be used for application and coordination purposes only. The EZ-AMP® overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.



SQUARE D®

Curve No. 0910TC0103
November 2001
Drawing No. B48095-910-03
(Replaces 0910TC8503)



QO® FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 910-4

CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
QO-EPD, QO-GFI, QO-VHGFI QO-EPD, QO-GFI	30 30	120 120/240	1 2

This curve is to be used for application and coordination purposes only. The EZ-AMP overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.

SQUARE D®

Curve No. 0910TC0104
November 2001
Drawing No. B48095-910-04
(Replaces 0910TC8504)

QO™ FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 910-5

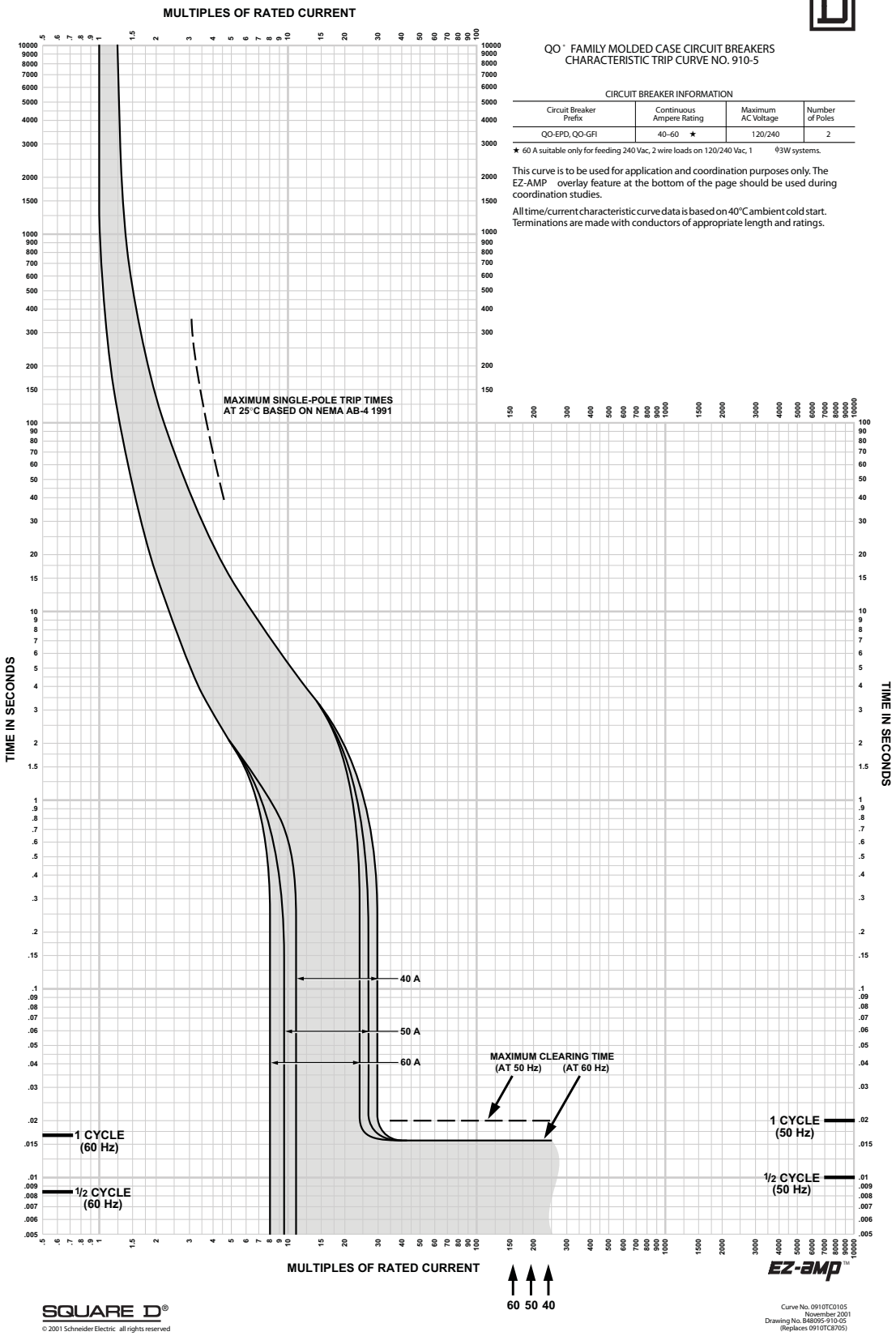
CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
QO-EPD, QO-GFI	40–60 ★	120/240	2

★ 60 A suitable only for feeding 240 Vac, 2 wire loads on 120/240 Vac, 1 Φ3W systems.

This curve is to be used for application and coordination purposes only. The EZ-AMP™ overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.



SQUARE D®

Curve No. 0910TC0105
November 2001
Drawing No. B48095-910-05
(Replaces 0910TC8705)

Dimensions

Figure 10: Type QO Plug-On Circuit Breaker

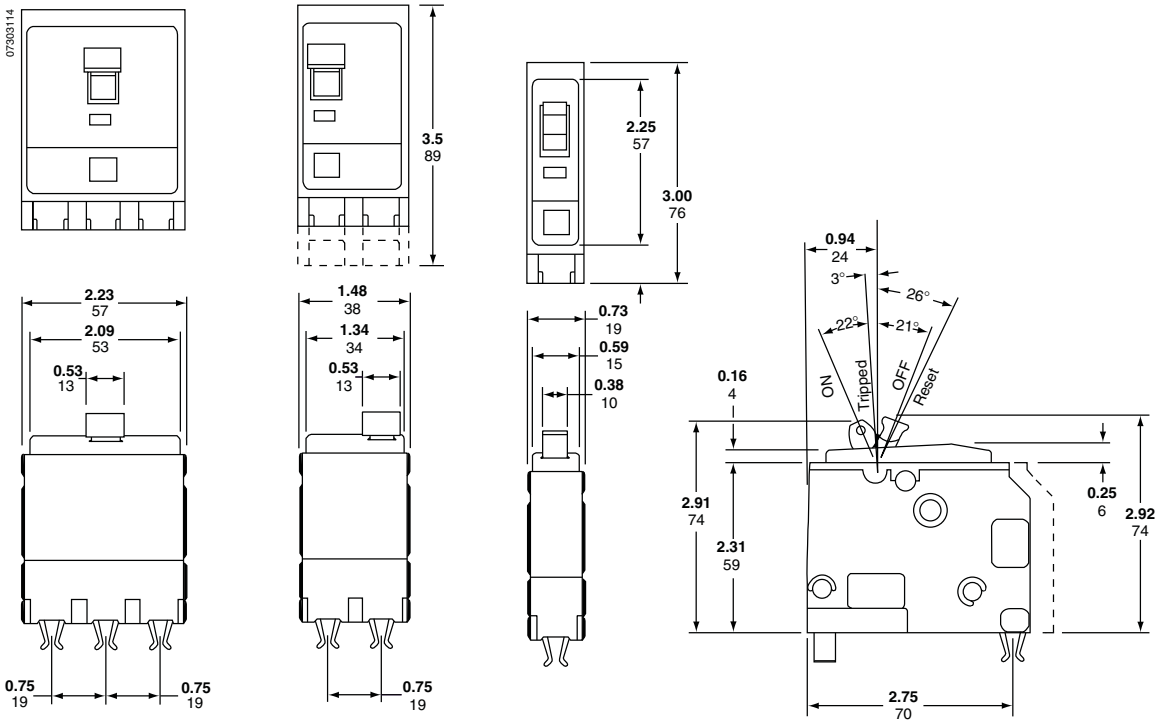


Figure 11: Type QOB Bolt-On Circuit Breaker

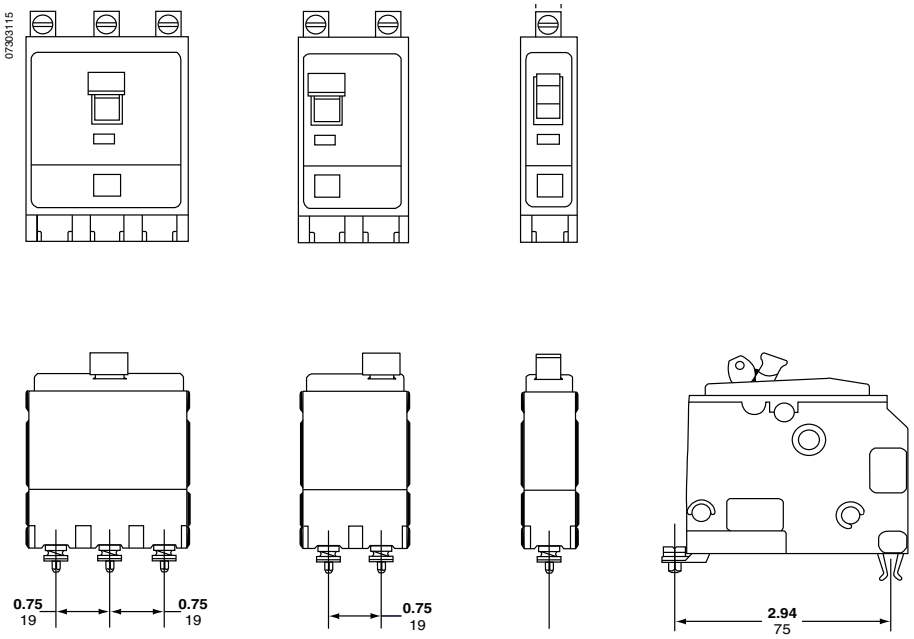


Figure 12: Type QO-GFI Circuit Breaker

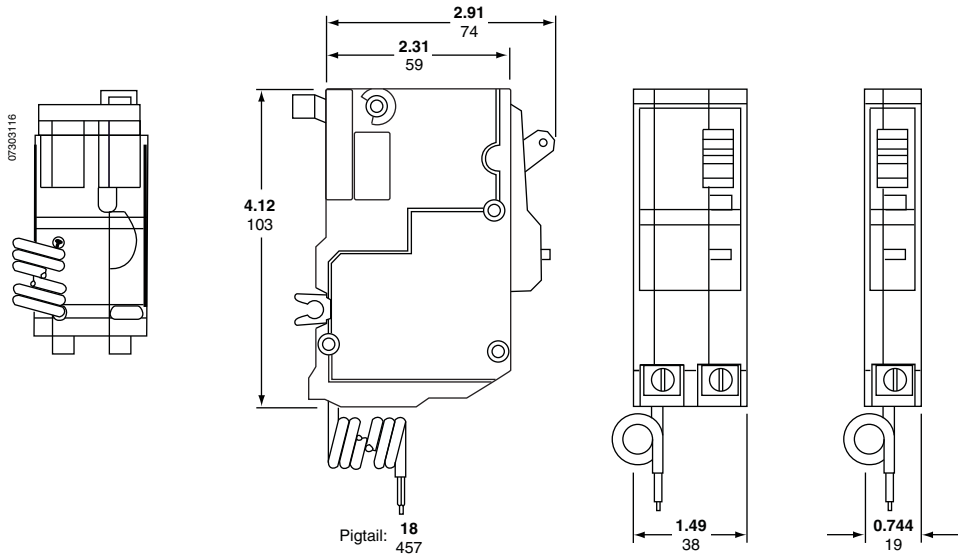


Figure 13: Type QO-AFI and QO-AFCI Circuit Breakers

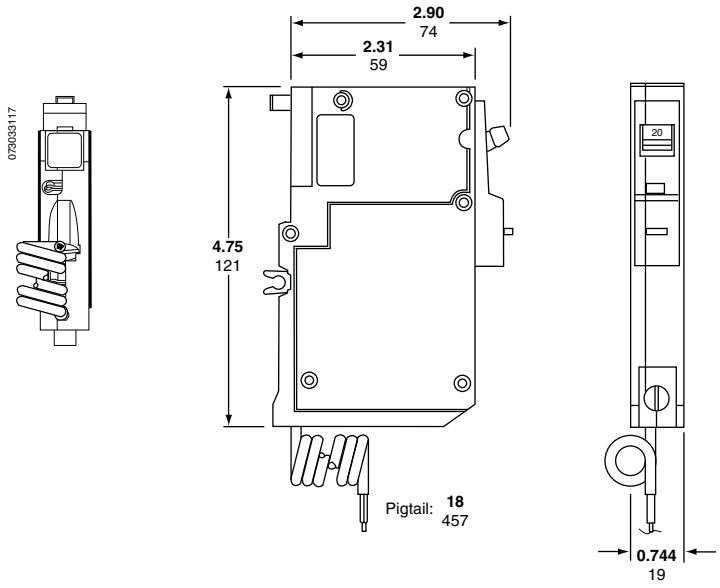
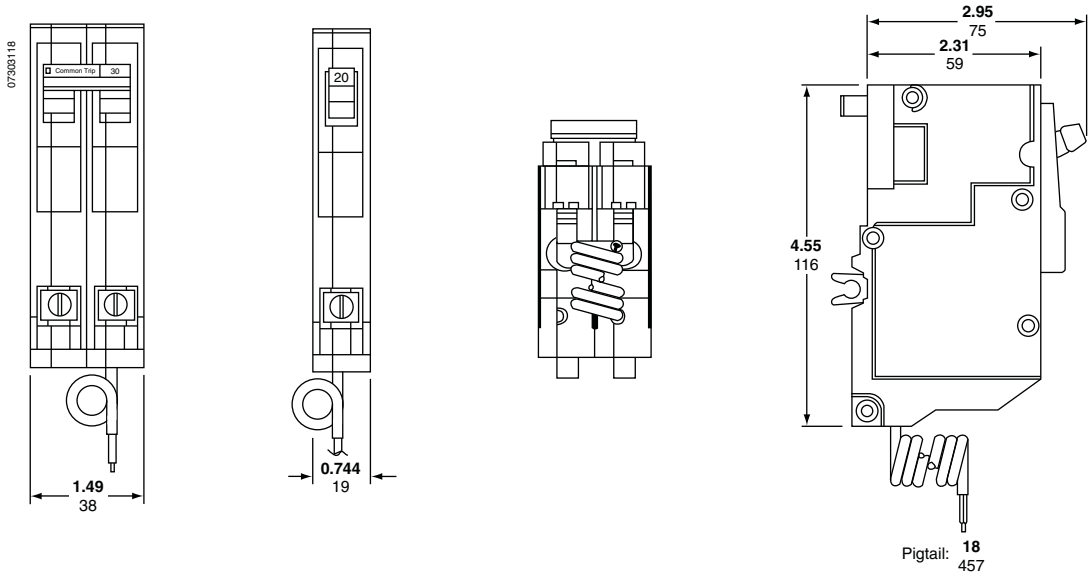


Figure 14: Type QO-PL Remote Control Circuit Breaker



Schneider Electric USA
3700 Sixth St. SW
Cedar Rapids, IA 52404 USA
1-888-Square D
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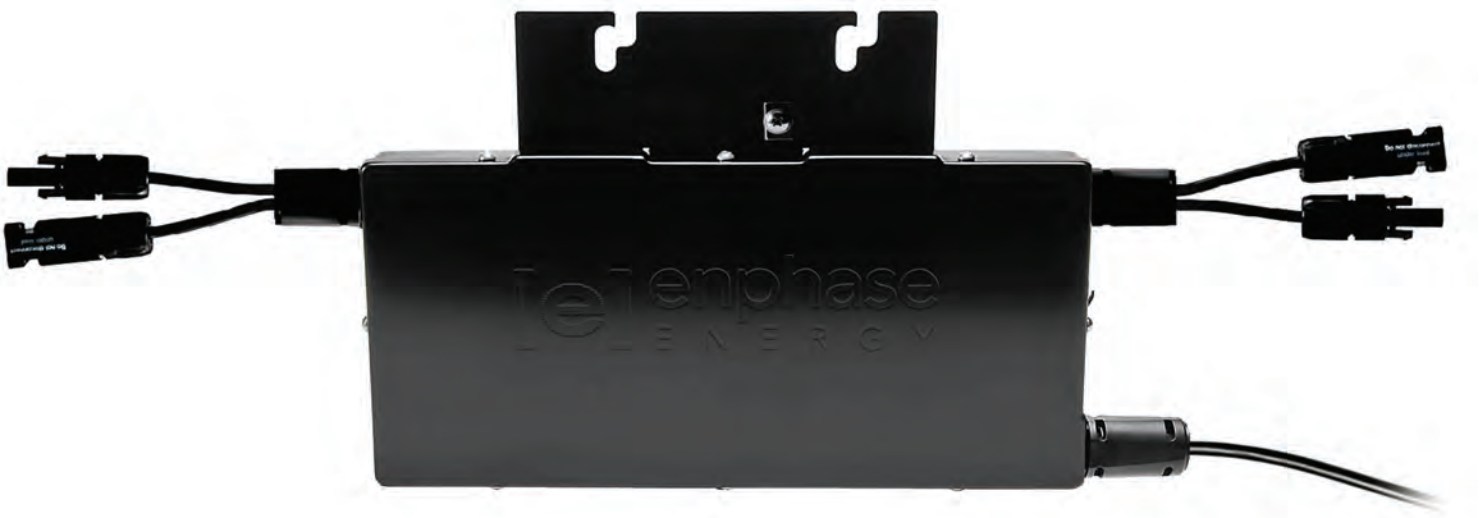
ENPHASE MICROINVERTER D380



The Enphase Energy Microinverter System improves energy harvest, increases reliability, and dramatically simplifies design, installation and management of solar power systems. The Enphase System includes the microinverter, the Envoy Communications Gateway, and the web-based Enlighten monitoring and analysis website.

PRODUCTIVE
- Maximum energy production
- Resilient to dust, debris and shading
- Performance monitoring per module

RELIABLE
- System availability greater than 99.8%
- No single point of system failure

SMART
- Quick & simple design, installation and management
- 24/7 monitoring and analysis

SAFE
- Low voltage DC
- Reduced fire risk

MICROINVERTER TECHNICAL DATA

60 and 72 Cell Modules

The D380 "TwinPack" microinverters contain 2 independent DC inputs. The Input Data (DC) values below apply to both DC Inputs A and B individually

Input Data (DC)

D380-72-2LL-S12/3 and D380-72-2LL-S12/3-NA

Recommended input power (STC)	230W
Maximum input DC voltage	56V
Peak power tracking voltage	22V – 40V
Min./Max. start voltage	28V/54V
Max. DC short circuit current	12A
Max. input current	10A

Output Data (AC)

	@208 Vac	@240 Vac
Maximum output power	380W	380W
Nominal output current	1.8A	1.6A
Nominal voltage/range	208V/183V-229V	240V/211V-264V
Extended voltage/range	208V/179V-232V	240V/206V-269V
Nominal frequency/range	60.0/59.3-60.5	60.0/59.3-60.5
Extended frequency/range	60.0/59.2-60.6	60.0/59.2-60.6
Power factor	>0.95	>0.95
Maximum units per 20A branch	15	10

Efficiency

Peak inverter efficiency	95.5%
CEC weighted efficiency	95.0%
Nominal MPP tracking	99.6%

Mechanical Data

Operating temperature range	-40°C to +65°C
Night time power consumption	50mW
Dimensions (WxHxD)	12.25" x 6.00" x 1.33"
Weight	6.25 lbs
Cooling	Natural Convection – No Fans
Enclosure environmental rating	Outdoor – NEMA 6

Features

Communication	Powerline
Warranty	15 Years
Compliance	UL1741/IEEE1547, FCC Part 15 Class B

Enphase Energy, Inc.
201 1st Street, Suite 300, Petaluma, CA 94952
877 797 4743 enphaseenergy.com

142-00007 REV 05

Installation and Operations Manual

Enphase Microinverter Model D380-72-2LL

Contact Information

Enphase Energy Inc.
201 1St Street
Petaluma, CA 94952
Phone: 707-763-4784 Toll Free: 877-797-4743
Fax: 707-763-0784

http://www.enphaseenergy.com

info@enphaseenergy.com

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance may void the user's authority to operate the equipment.

Other Information

Product information is subject to change without notice. All trademarks are recognized as the property of their respective owners.

For Enphase Envoy Warranty Terms and Conditions, see the Appendix on page 23 of this manual.

Table of Contents

Important Safety Information

Read this First

This manual contains important instructions to follow during installation and maintenance of the Enphase Microinverter.

To reduce the risk of electrical shock, and to ensure the safe installation and operation of the Enphase Microinverter, the following safety symbols appear throughout this document to indicate dangerous conditions and important safety instructions.

WARNING! This indicates a situation where failure to follow instructions may be a safety hazard or cause equipment malfunction. Use extreme caution and follow instructions carefully.

NOTE: This indicates information particularly important for optimal system operation. Follow instructions closely.

Safety Instructions

WARNING: Be aware that the body of the Enphase Microinverter is the heat sink and can reach a temperature of 80°C under extreme conditions. To reduce risk of burns, do not touch.

- Perform all electrical installations in accordance with all local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.
- Be aware that only qualified personnel should install and/or replace Enphase Microinverters.
- Do not attempt to repair the Enphase Microinverter; it contains no user-serviceable parts. If it fails, please contact Enphase customer service to obtain an RMA number and start the replacement process. Tampering with or opening the Enphase Microinverter will void the warranty.
- Before installing or using the Enphase Microinverter, please read all instructions and cautionary markings in the technical description and on the Enphase Microinverter system and the PV-array.
- Connect the Enphase Microinverter to the electrical utility grid only after receiving prior approval from the utility company.
- Do NOT disconnect the PV module from the Enphase Microinverter without first removing AC power.

The Enphase Microinverter System

The Enphase Microinverter System is the world's most technologically advanced inverter system for use in utility-interactive applications. This manual details the safe installation and operation of the Enphase Microinverter.

The three key elements of an Enphase Microinverter System are:

- the Enphase Microinverter
- the Enphase Envoy™ Communications Gateway
- the Enphase Enlighten™ web-based monitoring and analysis system

This integrated system maximizes energy harvest, increases system reliability, and simplifies design, installation and management.

1. **Enphase Microinverter System**
   - installed on the racking beneath each solar module
   - maximizes energy harvest
2. **AC power travels over AC wiring to the load center**
   - performance data is also sent via the AC wiring
   - plug and play communications
3. **Envoy Communications Gateway**
   - plugs into any AC outlet
   - collects information via the AC wiring
   - transmits data through a standard ethernet router to the internet
4. **Standard Ethernet Router**
   - information collected by the Enphase Envoy is then transmitted to Enlighten in 5-minute intervals
5. **Enphase Enlighten Monitoring**
   - provides monitoring and analysis
   - performance information can be viewed from any web browser

How the D380 Microinverter Works

The Enphase Microinverter maximizes energy production from your photovoltaic (PV) array. Each Enphase D380 houses two microinverters and is individually connected to two PV modules in your array. This unique configuration means that an individual Maximum Peak Power Point Tracker (MPPT) controls each PV module. This insures that the maximum power available from each PV module is exported to the utility grid regardless of the performance of the other PV modules in the array. That is, although individual PV modules in the array may be affected by shading, soiling, orientation, or module mismatch, the Enphase Microinverter insures top performance for its associated PV module. The result is maximum energy production from your PV system.

System Monitoring

Indoors, you can install the Envoy Communications Gateway by plugging it into any convenient 120Vac wall socket and providing an Ethernet connection to your broadband router or modem. After installation of the Envoy, the full network of Enphase Microinverters automatically begins reporting to the Enphase Enlighten web server. The Enlighten software presents current and historical system performance trends, and it informs you when the PV system is not performing as expected.

Optimal Reliability

Microinverter systems are also inherently more reliable than centralized or string inverters. The distributed nature of a microinverter system ensures that there is no single point of system failure in the PV system. Enphase Microinverters are designed to operate at full power at ambient temperatures as high as 65°C (150°F). The inverter housing is designed for outdoor installation and complies with the NEMA6 environmental enclosure rating standard:

> NEMA6 rating definition: Indoor or outdoor use primarily to provide a degree of protection against hose-directed water, and the entry of water during occasional temporary submersion at a limited depth, and damage from external ice formation.

Ease of Design

PV systems using Enphase Microinverters are very simple to design and install. You will not need string calculations, and you can install individual PV modules in any combination of module quantity, type, age and orientation. You won't need to install cumbersome centralized or string inverters. Each microinverter quickly mounts on the PV racking, directly beneath each PV module. Low voltage DC wires connect from the PV module directly to the co-located microinverter, eliminating the risk of personnel exposure to lethal 600Vdc power.

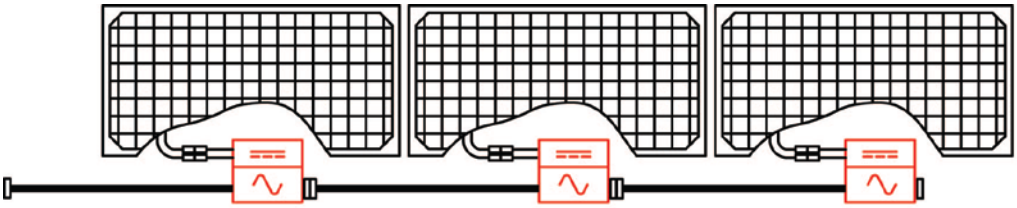
Enphase Enclosure Formats

Enphase Microinverters are available in two enclosure designs:

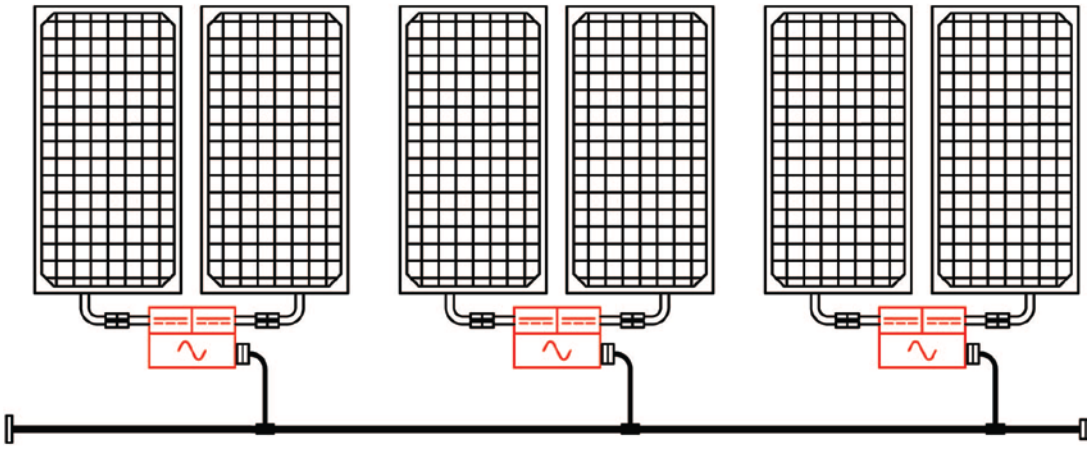
- The M190 and M210 single microinverter enclosures contain one DC input section and one AC output cable per enclosure. The integral AC cable of the single enclosure connects to the adjacent microinverter to create a continuous branch circuit.

- The "TwinPack" (D380) Microinverter enclosure contains two DC input sections and a single AC output connector. There is no integral AC cable on the TwinPack Microinverter enclosure; the AC connection is accomplished with a separate AC trunk cable assembly as shown in the diagram below.

  This manual describes the installation and operation of the D380 TwinPack enclosure model.



M190 Single Enclosure Connections



D380 TwinPack Enclosure Connections

D380 Planning Considerations

The Enphase D380 Microinverters are **electrically** compatible with most 60 and 72-cell PV module configurations. They can be used with 240 VAC single phase service or with 208 VAC service. Different trunk cables are required depending on this service type. Balanced 208 VAC is accomplished by alternating phases between microinverters.

Refer to the Enphase website (http://www.enphaseenergy.com/support/downloads) for a list of **electrically**-compatible PV modules and approved PV module racking systems. To ensure **mechanical** compatibility, be sure to order the correct connector type for both microinverter and PV module from your distributor.

See the Enphase website (http://www.enphaseenergy.com/support/downloads.cfm) for a list of approved PV module racking systems.

The following tables summarize **electrical** compatibility, trunk cables, and branch limits.

D380 TwinPack Model Numbers	Works with PV Module Type	Module Connector Type
D380-72-2LL-S12 D380-72-2LL-S12-NA	60 and 72 cell	MC-4 or Amphenol H4 Type 2 Locking
D380-72-2LL-S13 D380-72-2LL-S13-NA	60 and 72 cell	Tyco Solarlok Locking

D380 Trunk Cable Model Numbers	Description
ET3R-G2-06	AC Trunk Cable with Drops for (3) D380 Inverters, 240Vac Only
ET3C-G2-06	AC Trunk Cable with Drops for (3) D380 Inverters, 208Vac Only
ET1RC-G2-06	AC Trunk Cable with Drops for (1) D380 Inverters, 240Vac or 208Vac

Maximum number of D380s Per 20 amp AC branch circuit
10 @ 240V (20 PV modules)
15 @ 208V (30 PV modules)

For more specifications, see the Technical Data section on page 20 of this manual.

Enphase D380 Installation

Follow the instructions in this section to install Enphase D380™ Microinverters.

WARNING: Before installing the Enphase Microinverter, read all instructions and cautionary markings in the user manual, on the Enphase Microinverter, and on the photovoltaic array.

WARNING: Perform all electrical installations in accordance with all local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.

WARNING: Connect the Enphase Microinverter to the electrical utility grid only after receiving prior approval from the utility company.

WARNING: Be aware that only qualified personnel should connect the Enphase Microinverter to the electrical utility grid.

WARNING: Be aware that installation of this equipment includes risk of electric shock. Normally grounded conductors may be ungrounded and energized when a ground fault is indicated.

Parts and Tools Required

In addition to the D380 Microinverters, PV modules, racking, and associated hardware, you will need the following items.

Enphase equipment:

- One AC interconnect cable per branch
- AC trunk cables (three-drop and/or single drop models), as needed
- End caps, as needed

Other items:

- Junction box
- Continuous grounding conductor, grounding washers
- Number 2 Phillips screwdriver
- Torque wrench, sockets, wrenches for mounting hardware
- Adjustable wrench or open ended wrench (for cord grips)
- Tool for PV module locking connectors
- ¼" flat blade screwdriver for trunk cable latches

Lightning Surge Suppression

In some areas, the statistical frequency of lightning strikes near a PV installation is high enough that lightning protection should be installed as part of an Enphase system. In areas with lighting flashes greater than 8.0 per square mile per year, the following protection device is recommended. It has been tested to ensure that it does not interfere with power line communications. Install per vendor instructions.

Vendor: Citel
Part Number: DS72RS-120
Application: Residential 120/240V Split Phase where N-G bond exists.

See the vendor datasheet for DS70R, (which includes the DS72RS-120) at http://www.citelprotection.com/english/citel_data_sheets/ac_protection/.

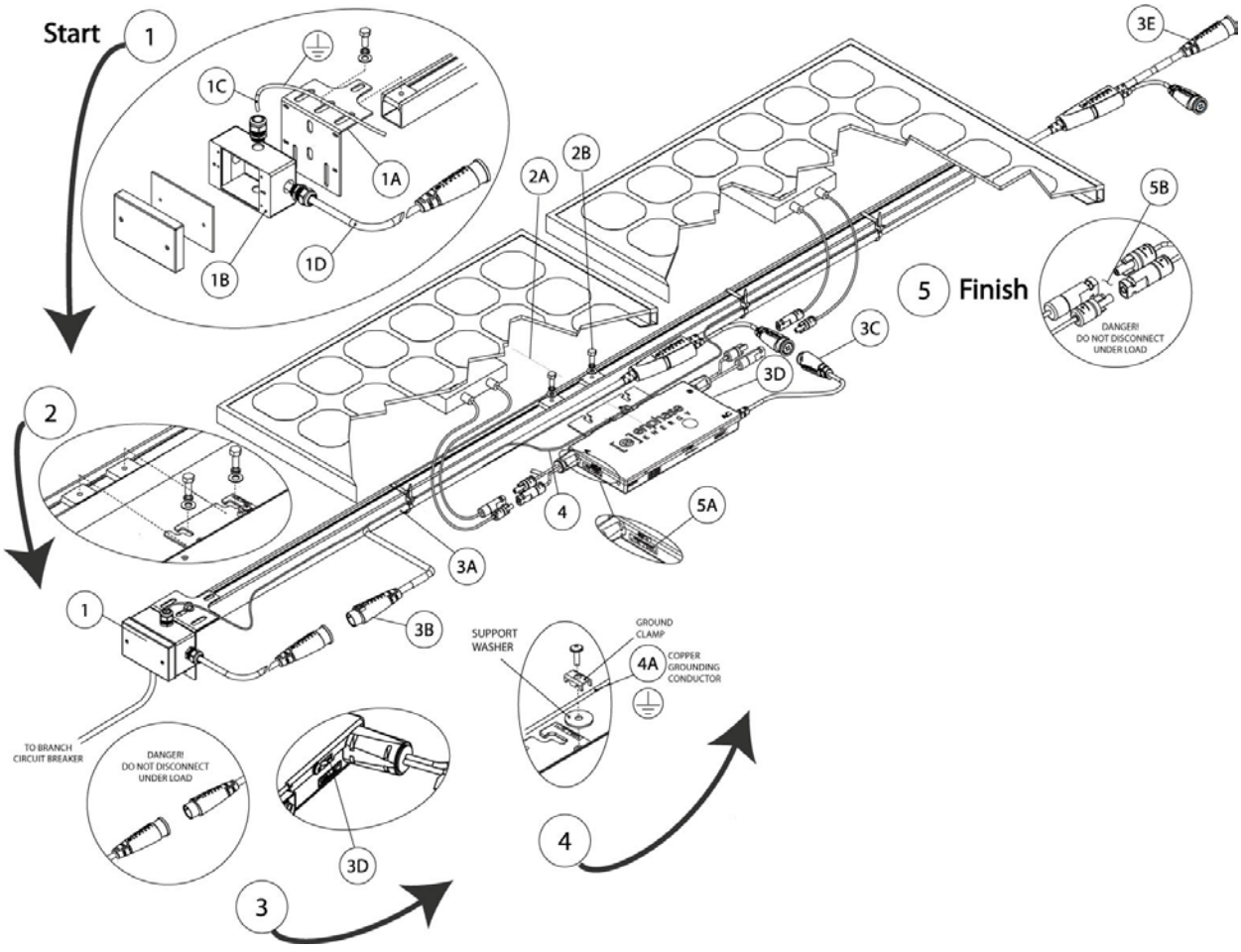
Installation Procedure

Installing the Enphase Microinverter System involves several key steps:

1. Measuring service and Installing the AC branch circuit junction box
2. Attaching the Enphase Microinverters to the racking
3. Installing the AC interconnect cable and AC Trunk cables and connecting the Enphase Microinverters to the AC Trunk cables
4. Grounding the system
5. Connecting the PV Modules, and Completing the Enphase Installation map

Each of the detailed installation steps in the following sections is numerically referenced in the installation diagram below.

WARNING: DO NOT connect Enphase Microinverters to the utility grid or energize the AC circuit(s) until you have completed all of the installation procedures as described in the following sections.



Step 1 - Install the AC Branch Circuit Junction Box

a. Measure service entrance conductors to confirm AC service at the site. Acceptable ranges are shown in the table below:

240 Volt AC Single Phase		208 Volt AC 3 Phase	
L1 to L2	211 to 264 Vac	L1 to L2 to L3	183 to 229 Vac
L1, L2 to neutral	106 to 132 Vac	L1, L2, L3 to neutral	106 to 132 Vac

b. Install an appropriate junction box at a suitable location on the PV racking system (typically at the end of a row of modules).

WARNING: Use electrical system components approved for wet locations only.

c. Connect the open wire end of the Enphase AC interconnect cable into the junction box using an appropriate gland or strain relief fitting. The AC interconnect cable requires a strain relief connector with an opening of 0.5 inches in diameter.

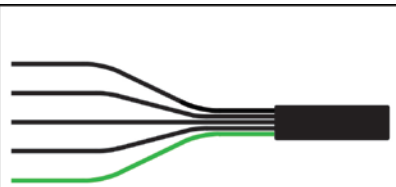
Refer to the wiring diagram for your microinverter model. These diagrams are located in the Appendix of this manual.

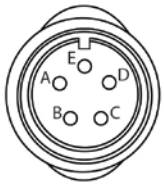
WARNING: Use care when terminating phase conductors to the junction box. **If you inadvertently terminate a phase-conductor to Neutral at the junction box, you will damage or destroy all D380 units on that branch-circuit.** Pay careful attention to the correct wire terminations.

NOTE: The AC interconnect cable used with the D380 TwinPack Microinverter is a different cable than used with other Enphase microinverters, please be aware of the difference in wire color code.

All wires except ground are sheathed in black and labeled. Line 1 is labeled "1 – Black", Line 2 is labeled "2 – RED", Line 3 is labeled "3 – BLUE" (used only for three phase 208) and Neutral is labeled "4 – ORANGE". Ground is sheathed in green.

240 VOLT AC SPLIT PHASE WIRING	208 VOLT AC THREE PHASE WIRING
BLACK - L1	BLACK - L1
RED - L2	RED - L2
BLUE - UNUSED	BLUE - L3
ORANGE - NEUTRAL	ORANGE - NEUTRAL
GREEN - GROUND	GREEN - GROUND





PIN DESIGNATION
PIN A - L1
PIN B - L2
PIN C - L3
PIN D - NEUTRAL
PIN E - GROUND

Step 2 - Attach the Enphase Microinverters to the Racking

WARNING: Allow a minimum of .75 inches between the top of the roof and the bottom of the microinverter. We also recommend that you allow 1.0 inch between the back of the PV module and the top of the inverter. Mount the microinverter to the module racking so that the ground clamp is accessible. Do not mount the microinverter in a location that allows long-term exposure to direct sunlight.

The D380 Twinpack Microinverter is design to support two PV modules. The microinverter should be located so that, once the two associated PV modules are installed, the DC wires of the modules can reach the microinverter DC input connectors. The AC trunk cable is constructed using a large gauge trunk cable with smaller gauge tap cables located at two modules wide intervals, approximately 66". This tap cable spacing accommodates most array designs with modules mounted in portrait or landscape orientation.

a. Mount one microinverter under every other module using hardware recommended by the module racking vendor. Since every microinverter is connected to two modules, position the microinverter so that both module DC cables reach the microinverter DC input connectors. Evaluate the location of the microinverter with respect to the PV module junction box or any other obstructions.

b. If using grounding washers (e.g., WEEB) to ground the microinverter chassis to the PV module racking, choose a grounding washer that is approved for the racking manufacturer. Install a minimum of one grounding washer per microinverter. Torque the microinverter fasteners to the values listed below.

- 1/4" mounting hardware – 45 in-lbs minimum
- 5/16" mounting hardware – 80 in-lbs minimum

Compatible grounding washer part numbers are included in the Racking Compatibility Application Note. Installation guidelines are included in the Grounding Washer Application Note. Refer to both documents at: http://www.enphaseenergy.com/support/downloads.cfm

Step 3 – Install the AC Trunk Cabling

a. Fasten the AC trunk cable to the racking system so that the tap cables align with the microinverter locations.

b. Connect the first AC trunk cable to the AC interconnect cable.

c. Connect the AC trunk cables, end to end, to create the desired branch circuit length.

NOTE: The AC and DC connectors of each microinverter have been evaluated and approved for use as the load break disconnect as required by the NEC.

WARNING: Do NOT exceed the maximum number of microinverters in an AC branch circuit as listed on page 21 of this manual. Each microinverter AC branch circuit must be protected by a 20A maximum breaker.

d. Plug the AC drop connectors of the trunk cable to the connector of a D380.

e. Fasten the drop cable to the microinverter chassis slot next to the AC connector.

f. Install a protective end cap on the open AC connector of the last AC trunk cable on the AC branch circuit.

WARNING: Make sure protective end caps have been installed on all unused AC connectors. Unused AC microinverter wire harness connectors may be live when the system is energized by the utility system.

WARNING: Size the AC wire gauge to account for voltage drop. All components of system wiring must be considered, including internal voltage drop within the length of ETD cabling. Use the voltage drop charts at: http://www.enphaseenergy.com/support/downloads.cfm to select the correct wire size based on the distance from the beginning of the microinverter branch circuit to the breaker in the load center. NEC guidelines for voltage drop on feeder and branch circuit conductors will not be adequate for microinverter branch circuits that contain the maximum allowable microinverters. Refer also to our *Voltage Drop Calculations Application Note* at http://www.enphaseenergy.com/support/downloads.cfm.

Step 4 – Ground the System

If you are not using grounding washers to ground the microinverter chassis as described in step 2, follow the step below. Each Enphase Microinverter comes with a ground clip that can accommodate a 6-10 AWG conductor.

a. Route a continuous GEC through each of the microinverters to the NEC approved AC grounding electrode. The racking and module could be grounded to this conductor using a crimp connection. An alternative method would be to connect the microinverter to the grounded racking using a grounding washer approved for the racking.

NOTE: The AC output neutral is not bonded to ground inside the microinverter.

Step 5 – Complete the Installation Map and Connect the PV Modules

The Enphase Installation Map is a diagrammatic representation of the physical location of each microinverter in your PV installation. The virtual array in Enlighten is created from the map you create. Use the blank map in the Appendix to record microinverter placement for the system, or provide your own layout if a larger or more intricate installation map is required.

Complete the Enphase Map

a. Each Enphase Microinverter has a removable serial number label located on the mounting plate. Peel the removable serial number label from each Enphase Microinverter and affix it to the respective location on the Enphase installation map (see map on page 25). You can also download installation maps and examples from www.enphaseenergy.com/quickstart. Remember to keep a copy of the installation map for your records.

Alternative: Create Your Own Map

a. Draw a top-down view of the array using the Array Map template (using either the grid on Side A or the freeform area on Side B). Make sure to leave enough room to place the serial number stickers.

b. When installing the microinverters, remove the serial number labels located next to the DC input cables and place them in the correct order on your drawing of the system. Remember to keep a copy of the installation map for your records.

Connect the PV Modules

NOTE: Completely install all microinverters and all system inter-wiring connections prior to installing the PV modules.

a. Mount the PV modules above the microinverters. Each microinverter comes with two sets of oppositely sexed multi-contact connectors.

b. First connect the positive DC wire from the PV module to the negatively marked DC connector (male pin) of the microinverter. Then connect the negative DC wire from the PV module to the positively marked DC connector (female socket) of the microinverter. This process will need to be repeated for both A and B inputs of the microinverter. Repeat for all remaining PV modules using one D380 for two PV modules.

Step 6 – Build the Virtual Array

In this step, you will create the virtual array in Enlighten from the map you created in the last step. Once the virtual array is built, Enlighten displays a graphic representation of the PV system. It also shows detailed current and historical performance information. Please go to www.enphaseenergy.com for more information on the Enphase Enlighten web-based monitoring and analysis.

a. Use Array Builder to create the virtual array in Enlighten.

NOTE: Go to http://www.enphaseenergy.com/support/learningcenter.cfm to view an Array Builder demo.

b. If you do not already have an account, please go to www.enphaseenergy.com for more information on the Enphase Enlighten web-based monitoring and analysis.

Commissioning

WARNING: Connect the Enphase Microinverter to the electrical utility grid only after receiving prior approval from the utility company.

WARNING: Be aware that only qualified personnel must connect the Enphase Microinverter to the electrical utility grid.

WARNING: Ensure that all AC and DC wiring is correct. Ensure that none of the AC and DC wires are pinched or damaged. Ensure that all junction boxes are properly closed.

NOTE: The Status LED of each microinverter will blink green six times to indicate normal start-up operation **one minute after DC power is applied**.

To commission the Enphase Microinverter PV system:

1. Turn ON the AC disconnect or circuit breaker on each microinverter AC branch circuit.
2. Turn ON the main utility-grid AC circuit breaker. Your system will start producing power **after a five-minute wait time**.
3. The Enphase Microinverters will start to send performance data over the power lines to the Envoy. The time required for all the microinverters in the system to report to the Envoy will vary with the number of microinverters in the system. The first units should be detected within 15 minutes but the entire system could take hours to detect. Please refer to the *Envoy Installation and Operation Manual* for information on the Envoy.

Operating Instructions

The Enphase Microinverter is powered on when sufficient DC voltage from the module is applied. The status LED will blink green six times indicating proper start–up. The TwinPack Microinverter can be powered from either the A or B DC input and only requires a module to be connected to one of the inputs to operate. A single status LED reports for both the A and B DC inputs.

NOTE: In the event of a GFDI failure, the status LED will display continuous red after the fault occurs. This will persist when AC and DC power are cycled to the microinverter. Refer to page 17 for information on troubleshooting a GFDI condition.

You can also verify proper operation of the Enphase Microinverters via the Envoy. See the *Envoy Communications Gateway Installation and Operation Manual* for more information.

Troubleshooting

Adhere to all the safety measures described throughout this manual. Qualified personnel can use the following troubleshooting steps if the PV system does not operate correctly.

WARNING: Do not attempt to repair the Enphase Microinverter; it contains no user-serviceable parts. If it fails, please contact Enphase customer service to obtain an RMA number and start the replacement process.

Status LED Indications and Error Reporting

Startup LED Operation:

One minute after DC power is first applied to the microinverter, six short green blinks indicate a successful microinverter startup sequence.

Six short red blinks after DC power is first applied to the microinverter indicate a failure during microinverter startup.

Post-Startup LED Indications:

Flashing Green – Producing power and communicating with Envoy
Flashing Orange – Producing power and not communicating with Envoy
Flashing Red – Not producing power

GFDI Fault:

A solid red status LED when DC power has been cycled, indicates the microinverter has detected a ground fault (GFDI) error. The LED will remain red and the fault will continue to be reported by the Envoy until the error has been cleared.

The condition should clear with operator intervention, unless conditions causing the event have not been remedied or if the failure is permanent. Follow the instructions in the *Envoy Communications Gateway Installation and Operation Manual* to clear this condition. Or, for assistance, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.

Other Faults:

All other faults are reported to the Envoy. Refer to the *Envoy Installation and Operation Manual* for a list of additional faults and troubleshooting procedures.

WARNING: Be aware that only qualified personnel should troubleshoot the PV array or the Enphase Microinverter.

Troubleshooting an Inoperable Microinverter

To troubleshoot an inoperable microinverter, follow the steps in the order shown:

1. Check the connection to the utility grid. Verify the utility voltage and frequency are within allowable ranges shown in the Technical Data section on page 20 of this manual. Verify utility power is present at the inverter in question by removing AC, then DC power. **Never disconnect the DC wires while the microinverter is producing power.** Re-connect the DC module connectors. After one minute, watch for six short LED blinks.
2. Check the AC branch circuit interconnection harness between all the microinverters. Verify that each inverter is energized by the utility grid as described in the previous step.
3. Make sure that any AC disconnects are functioning properly and are closed.
4. Verify the PV module DC voltage is within the allowable range shown in the Technical Data section on page 20 of this manual.
5. Check the DC connections between the microinverter and the PV module.
6. If the problem persists, please call customer support at Enphase Energy.

WARNING: Do not attempt to repair the Enphase Microinverter; it contains no user-serviceable parts. If troubleshooting methods fail, please return the microinverter to your distributor for maintenance.

Disconnecting a Microinverter from the PV Module

To ensure the microinverter is not disconnected from the PV modules under load, adhere to the following disconnection steps in the order shown:

1. Disconnect the AC by opening the branch circuit breaker.

WARNING: Never disconnect the DC wire connectors under load. Ensure that no current is flowing in the DC wires prior to disconnecting. An opaque covering may be used to cover the module prior to disconnecting the module.

WARNING: Always disconnect AC power before disconnecting the PV module wires from the Enphase Microinverter. The AC connector of the first microinverter in a branch circuit is suitable as a disconnecting means once the AC branch circuit breaker in the load center has been opened.

WARNING: The Enphase Microinverters are powered by DC power from the PV modules. Make sure you disconnect the DC connections and reconnect DC power to watch for the six short LED blinks one minute after DC is applied.

2. Disconnect the first AC connector in the branch circuit.
3. Cover the module with an opaque cover.

4. Using a DC current probe, verify there is no current flowing in the DC wires between the PV module and the microinverter.
5. Care should be taken when measuring DC currents, most clamp-on meters must be zeroed first and tend to drift with time.
6. Disconnect the PV module DC wire connectors from the microinverter.
7. Remove the microinverter from the PV array racking.

Installing a Replacement Microinverter

1. Attach the replacement microinverter to the PV module racking using hardware recommended by your module racking vendor. If you are using grounding washers (e.g. WEEB) to ground the chassis of the microinverter, the old grounding washer should be discarded, and a new grounding washer must be used when installing the replacement microinverter. Torque the microinverter fasteners to the values listed below.
   - 1/4" mounting hardware – 45 in-lbs minimum
   - 5/16" mounting hardware – 80 in-lbs minimum
2. If you are using a grounding electrode conductor to ground the microinverter chassis, attach the grounding electrode conductor to the microinverter ground clamp.
3. Connect the AC cable of the replacement microinverter and the neighboring microinverters to complete the branch circuit connections.
4. Energize the branch circuit breaker, and verify operation of the replacement microinverter by checking the indicator light.
5. Initiate a device scan at the Envoy. To do this, press and hold the Menu button on Envoy for two seconds to bring up the Envoy menu on the LCD window. When the LCD window displays "Enable Communication Check", release the Menu button.
6. Use Enlighten's Array Builder function to add the newly detected microinverter to the virtual array.

NOTE: To view an Array Builder demonstration, go to http://www.enphaseenergy.com/support/learningcenter.cfm.

Technical Data

Technical Considerations

The Enphase D380 Microinverters are designed to operate with most 60 and 72-cell PV modules. Be sure to verify the voltage and current specifications of your PV module match with those of the microinverter. For more information, refer to the Enphase website (http://www.enphaseenergy.com/support/downloads.cfm) for a list of compatible PV module racking systems and PV modules.

WARNING: You must match the DC operating voltage range of the PV module with the allowable input voltage range of the Enphase Microinverter.

WARNING: The maximum open circuit voltage of the PV module must not exceed the specified maximum input voltage of the Enphase Microinverter.

The output voltage and current of the PV module depends on the quantity, size and temperature of the PV cells, as well as the solar insolation on each cell. The highest PV module output voltage occurs when the temperature of the cells is the lowest and the module is at open circuit (not operating). The maximum short circuit current rating of the module must be equal to or less than the maximum input DC short circuit current rating of the microinverter. A list of compatible PV modules is maintained on the Enphase website (http://www.enphaseenergy.com/support/downloads.cfm).

Technical Specifications

The D380 Microinverters contain two independent DC inputs. The DC operating parameters below apply to both DC inputs A and B individually.

Enphase D380 TwinPack Microinverter Operating Parameters				
Topic	**Unit**	**Min**	**Typical**	**Max**
DC Operating Parameters				
MPPT voltage range	V	22		40
Maximum DC input voltage	V			56
Minimum / Maximum start voltage	V	28		54
Maximum DC input short circuit current	A			12
Maximum DC input current	A			10
Ground fault protection	mA			1000
Maximum input source backfeed current to input source	A			0

Enphase D380 TwinPack Microinverter Operating Parameters				
Topic	**Unit**	**Min**	**Typical**	**Max**
AC Operating Parameters				
Maximum AC output Power (-40 to 65 °C)	W	380		
Output power factor		0.95	0.99	1
Nominal AC output voltage range D380-72-2LL-S1x or D380-72-2LL-S1x-NA @240 Vac	Vrms	211	240	264
D380-72-2LL-S1x or D380-72-2LL-S1x-NA @ 208 Vac	Vrms	183	208	229
Extended AC output voltage range D380-72-2LL-S1x or D380-72-2LL-S1x-NA @ 240 Vac	Vrms	206	240	269
D380-72-2LL-S1x or D380-72-2LL-S1x-NA @ 208 Vac	Vrms	179	208	232
Maximum AC output current D380-72-2LL-S1x or D380-72-2LL-S1x-NA @ 240 Vac	A		1.6	1.8
D380-72-2LL-S1x or D380-72-2LL-S1x-NA@ 208 Vac	A		1.8	2.0
Nominal AC output frequency range	Hz	59.3	60	60.5
Extended AC output frequency range	Hz	59.2	60	60.6
Maximum AC output over current protection	A		20 A	
Maximum AC output fault current & duration	A_p/ms		47Apk over 3.51ms 2.18Arms over 3 cycles 2.16Arms over 5 cycles	
High AC Voltage trip limit accuracy	%	±2.5		
Low AC Voltage Trip limit accuracy	%	±4.0		
Frequency trip limit accuracy	Hz	±0.1		
Trip time accuracy	ms	±33		
Miscellaneous Operating Parameters				
Maximum inverters per 20 amp AC branch circuit D380-72-2LL-S1x or D380-72-2LL-S1x-NA @ 240 Vac		1		10
D380-72-2LL-S1x or D380-72-2LL-S1x-NA@ 208 Vac		1		15
Peak inverter efficiency	%			95.5
CEC weighted efficiency	%			95.0
Nominal MPP tracking efficiency	%			99.6
Total Harmonic Distortion	%		2.5	5

Enphase D380 TwinPack Microinverter Operating Parameters				
Topic	**Unit**	**Min**	**Typical**	**Max**
Operating temperature range	°C	-40		65
Night Tare Loss	mW		50	
Storage temperature range	°C	-40		65
Features				
Dimensions (approximate)	12.25" x 6" x 1.33 "			
Weight	6.25 Lbs			
Enclosure environmental rating	NEMA6			
Cooling	Convective – no fan			
AC cable rating	TC-ER, #12 AWG, Dry-rated to 90°C, UV-resistant, crush-resistant, direct burial			
DC cable rating	USE-2, #10 AWG			
Communication	Power line			
GFDI	A GFI sensor is internal to the microinverter and meets UL 1741.			
Standard warranty term	15 years			
Compliance	UL 1741, IEEE 1547, FCC Part 15 Class B			
Integrated AC Disconnect	The AC connector has been evaluated and approved for use as the load-break disconnect required by the NEC.			
Integrated DC Disconnect	The DC connector has been evaluated and approved for use as the load-break disconnect required by the NEC.			

Voltage and Frequency Limits for Utility Interaction			
Condition	Simulated utility source		Maximum time (sec) (cycles) at 60 Hz before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	$< 0.50\ V_{Typical}$	Rated	0.16
B	$0.50\ V_{Typical} \leq V < 0.88\ V_{Typical}$	Rated	2
C	$1.10\ V_{Typical} < V < 1.20\ V_{Typical}$	Rated	1
D	$1.20\ V_{Typical} \leq V$	Rated	0.16
E	Rated	$f > 60.5$	0.16
F	Rated	$f < (59.8 - 57.0)$	0.16 – 300
G	Rated	$f < 57.0$	0.16

Appendix

Limited Warranty

Enphase Energy Inc. ("**Enphase**") has developed a highly reliable microinverter that is designed to withstand normal operating conditions when used for its originally intended purpose in compliance with the Enphase User Manual supplied with the originally shipped system. The Enphase limited warranty ("**Limited Warranty**") covers defects in workmanship and materials of the Enphase Microinverter ("**Defective Product**") for a period of fifteen (15) years from the date of original purchase of such microinverter at point of sale to the originally-installed end user location (the "**Warranty Period**"). During the Warranty Period, the warranty is transferable to a different owner as long as the microinverter remains installed at the originally-installed end user location.

During the Warranty Period, Enphase will, at its option, repair or replace the Defective Product free of charge, provided that Enphase through inspection establishes the existence of a defect that is covered by the Limited Warranty. Enphase will, at its option, use new and/or reconditioned parts in repairing or replacing the Defective Product. Enphase reserves the right to use parts or products of original or improved design in the repair or replacement of Defective Product. If Enphase repairs or replaces a Defective Product, the Limited Warranty continues on the repaired or replacement product for the remainder of the original Warranty Period or ninety (90) days from the date of Enphase's return shipment of the repaired or replacement product, whichever is later.

The Limited Warranty covers both parts and labor necessary to repair the Defective Product, but does not include labor costs related to un-installing the Defective Product or re-installing the repaired or replacement product. The Limited Warranty also covers the costs of shipping repaired or replacement product from Enphase, via a non-expedited freight carrier selected by Enphase, to locations within the United States (including Alaska and Hawaii) and Canada, but not to other locations outside the United States or Canada. The Limited Warranty does not cover, and Enphase will not be responsible for, shipping damage or damage caused by mishandling by the freight carrier and any such damage is the responsibility of the freight carrier.

To obtain repair or replacement service under this Limited Warranty, the customer must comply with the following policy and procedure:

- All Defective Product must be returned with a Return Merchandise Authorization Number (RMA) which customer must request from Enphase. Before requesting the RMA, however, the customer should contact an Enphase technical support representative to evaluate and troubleshoot the problem while the Enphase Microinverter is in the field, since many problems can be solved in the field.
- If in-field troubleshooting does not solve the problem, Customer may request the RMA number, which request must include the following information:
  - Proof-of-purchase of the Defective Product in the form of (1) the dated purchase receipt from the original purchase of the product at point of sale to the end user, or (2) the dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status, or (3) the dated invoice or purchase receipt showing the product exchanged under warranty.

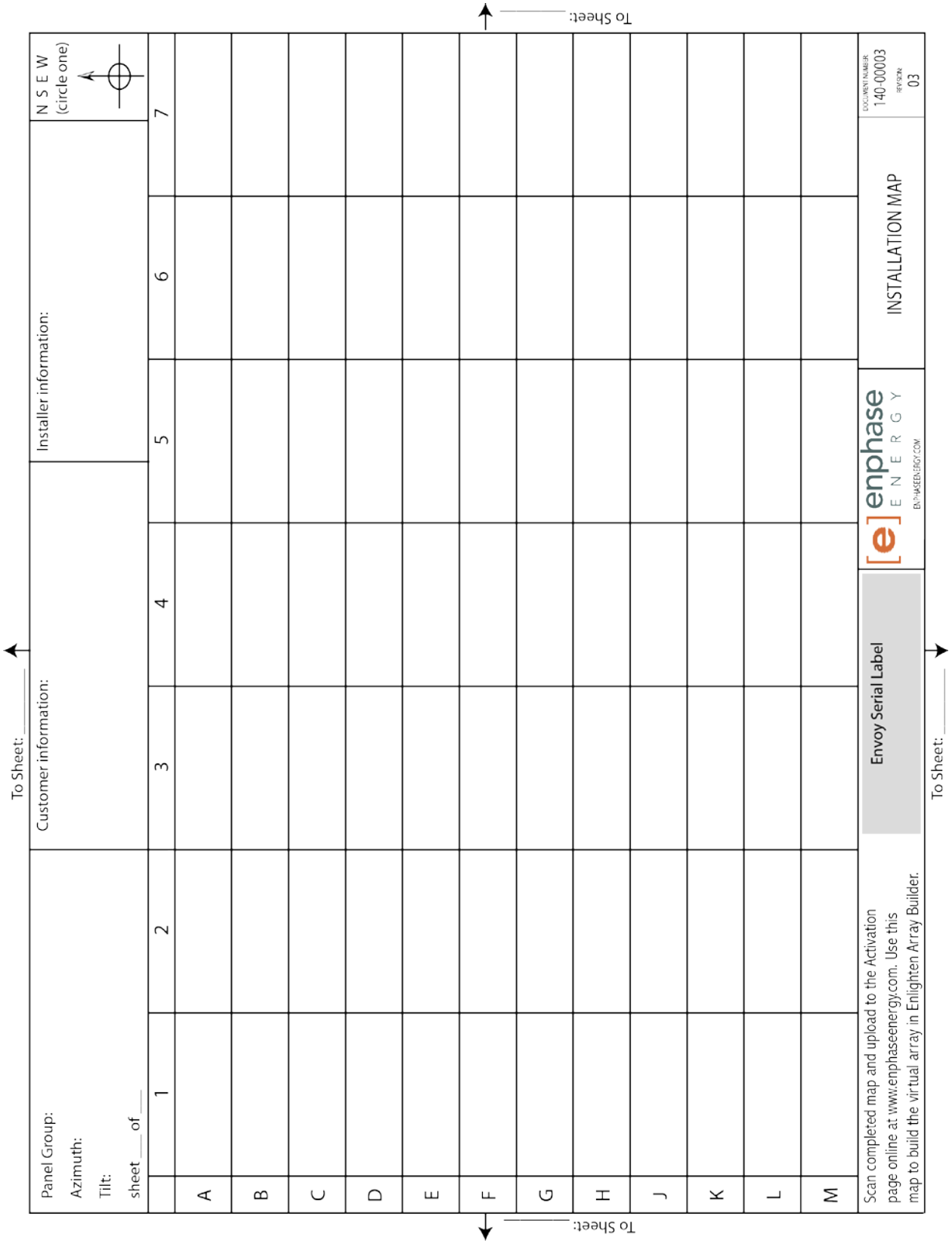
- Model number of the Defective Product
- Serial number of the Defective Product
- Detailed description of the defect
- Shipping address for return of the repaired or replacement product

- All Defective Product authorized for return must be returned in the original shipping container or other packaging that is equally protective of the product
- The returned Defective Product must not have been disassembled or modified without the prior written authorization of Enphase

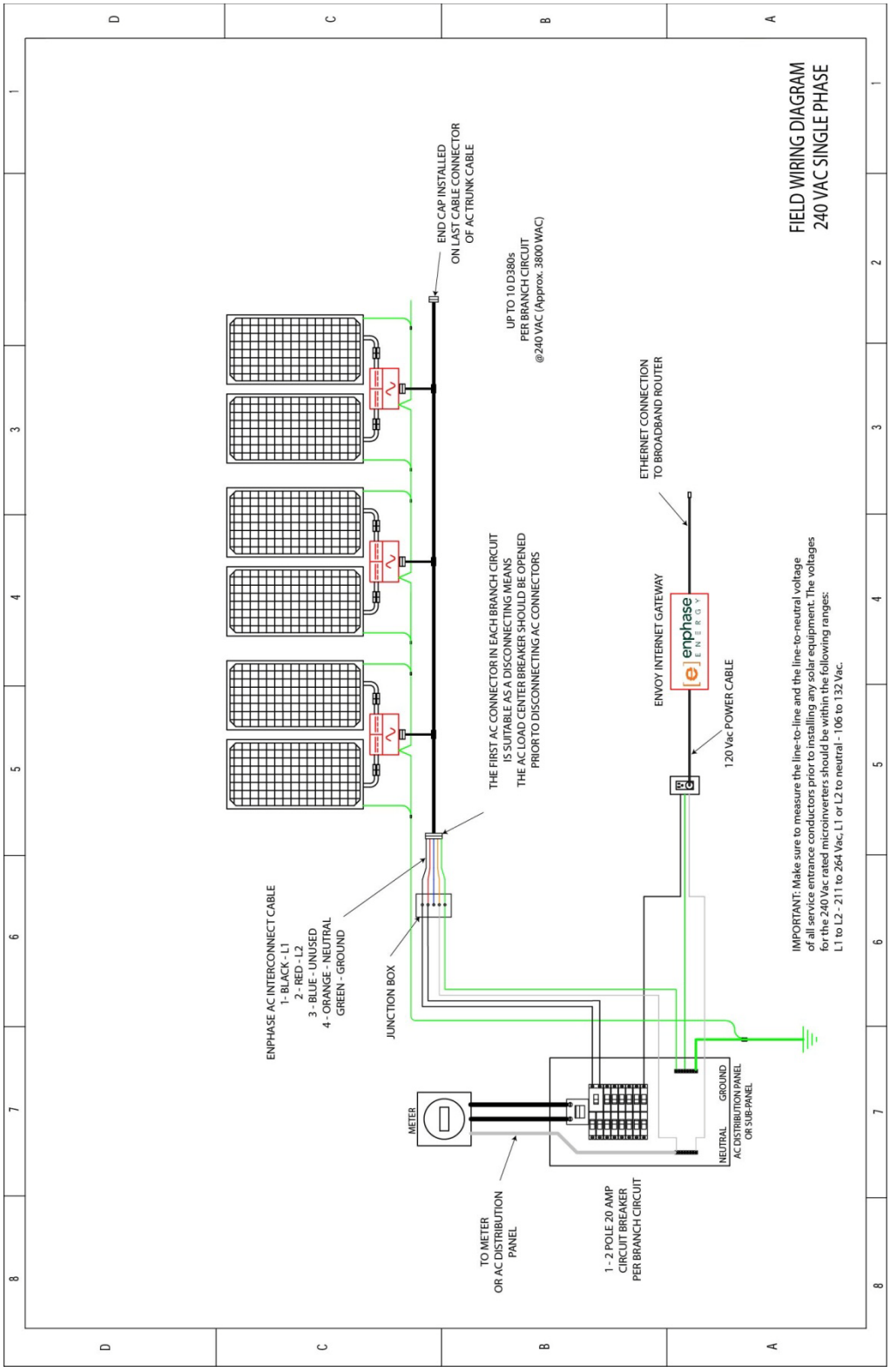
Enphase Microinverters are designed to withstand normal operating conditions and typical wear and tear when used for their original intent and in compliance with the installation and operating instructions supplied with the original equipment. The Limited Warranty does not apply to, and Enphase will not be responsible for, any defect in or damage to any Enphase Microinverter: (1) that has been misused, neglected, tampered with, altered, or otherwise damaged, either internally or externally; (2) that has been improperly installed, operated, handled or used, including use under conditions for which the product was not designed, use in an unsuitable environment, or use in a manner contrary to the Enphase User Manual or applicable laws or regulations; (3) that has been subjected to fire, water, generalized corrosion, biological infestations, acts of God, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the Enphase Microinverter specifications, including high input voltage from generators or lightning strikes; (4) that has been subjected to incidental or consequential damage caused by defects of other components of the solar system; or (5) if the original identification markings (including trademark or serial number) of such microinverter have been defaced, altered, or removed. The Limited Warranty does not cover costs related to the removal, installation or troubleshooting of the customer's electrical systems. The Limited Warranty does not extend beyond the original cost of the Enphase Microinverter.
THE LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY GIVEN BY ENPHASE AND, WHERE PERMITTED BY LAW, IS MADE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF TITLE, QUALITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OR WARRANTIES AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN MANUALS OR OTHER DOCUMENTATION. IN NO EVENT WILL ENPHASE BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, COSTS OR EXPENSES HOWEVER ARISING, WHETHER IN CONTRACT OR TORT, INCLUDING WITHOUT LIMITATION ANY ECONOMIC LOSSES OF ANY KIND, ANY LOSS OR DAMAGE TO PROPERTY, OR ANY PERSONAL INJURY.

To the extent any implied warranties are required under applicable law to apply to the Enphase Microinverter, such implied warranties shall be limited in duration to the Warranty Period, to the extent permitted by applicable law. Some states and provinces do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply. This Limited Warranty gives the customer specific legal rights, and the customer may have other rights that may vary from state to state or province to province.

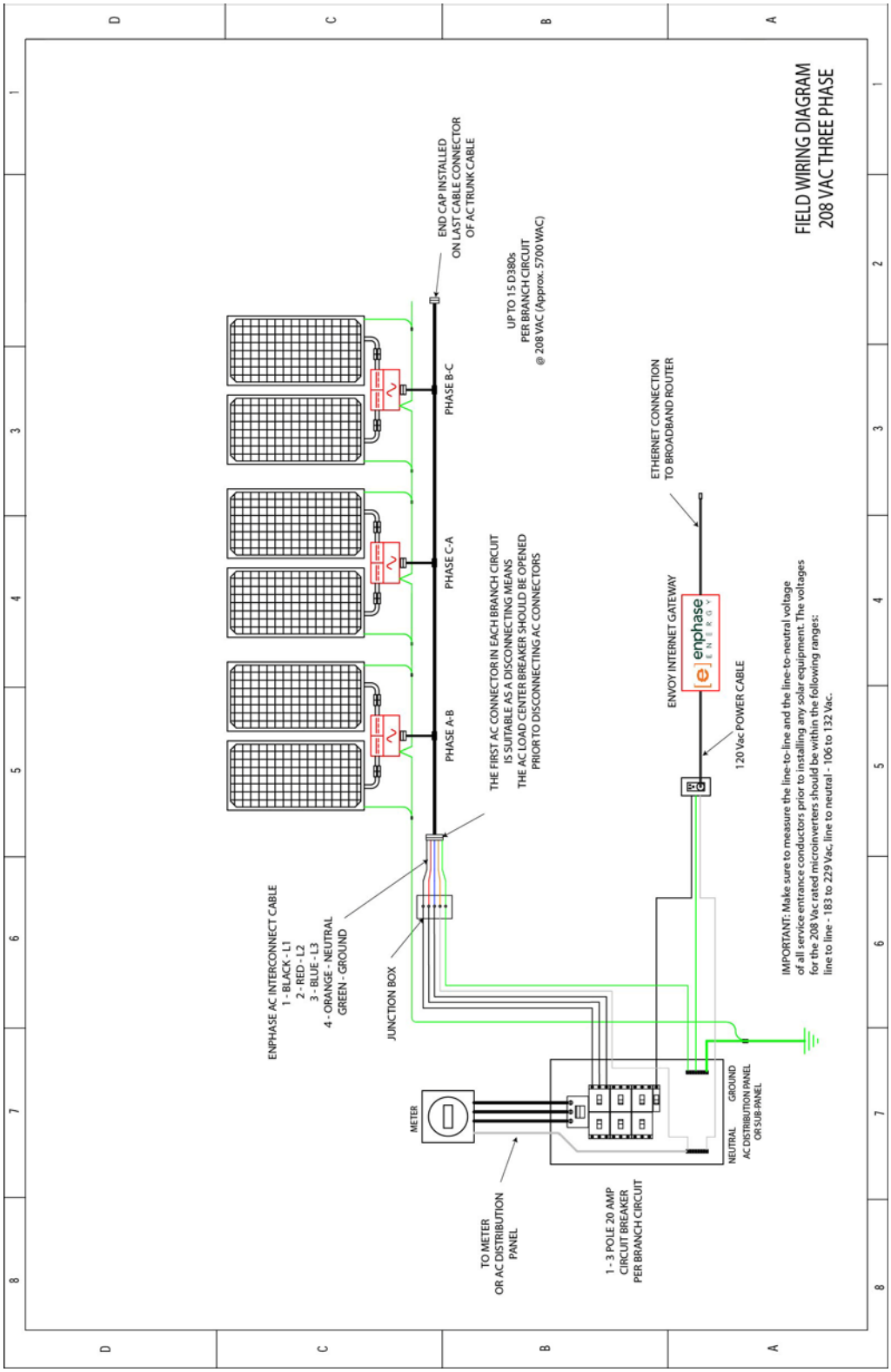
Enphase Installation Map



Sample Wiring Diagram – D380, 240 Vac



Sample Wiring Diagram – D380, 208 Vac



Enphase Energy Inc.
201 1St Street
Petaluma, CA 94952
Phone: 707-763-4784
TOLL FREE: 877-797-4743
Fax: 707-763-0784
www.enphaseenergy.com
info@enphaseenergy.com

ENPHASE ENVOY COMMUNICATIONS GATEWAY

The Enphase Microinverter continuously monitors itself and the performance of its associated PV module. This data is communicated over the existing power line to the Enphase Envoy communications gateway.

Enphase Envoy may be plugged into any AC wall socket and connected using a standard ethernet cable to a broadband router, making it a true plug-and-play communications solution. Data collected by Enphase Envoy is then transmitted to the Enphase Enlighten website for monitoring and analysis.

C US

ENPHASE ENVOY TECHNICAL DATA

Interface	
Powerline	Enphase Proprietary
LAN	10/100 Auto-sensing, Auto-negotiating
Power Requirements	
AC Outlet	120 Vac, 60 Hz, 100mA
Power Consumption	5 Watts
Mechanical Data	
Dimensions (WxHxD) in Inches	8.8" x 4.4" x 1.7"
Weight	12 oz (340g)
Ambient Temperature Range	-40°C to +65°C (-40° to +149° F)
Cooling	Natural Convection - No Fans
Enclosure Environmental Rating	Indoor - NEMA 1
Features	
Standard Warranty Term	1 Year
Compliance	UL 60950, EN 60950 FCC Part 15 Class B

Enphase Energy, Inc.
201 1st Street, Suite 300, Petaluma, CA 94952
877 797 4743 enphaseenergy.com

Installation and Operations Manual

Envoy™ Communications Gateway

Contact Information

Enphase Energy Inc.
201 1St Street
Petaluma, CA 94952
Phone: 707-763-4784 TOLL FREE: 877-797-4743
Fax: 707-763-0784

http://www.enphaseenergy.com

info@enphaseenergy.com

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance may void the user's authority to operate the equipment.

Other Information

For third-party license information, refer to www.enphaseenergy.com/licenses.

Product information is subject to change without notice. All trademarks are recognized as the property of their respective owners.

For Enphase Envoy Warranty Terms and Conditions, see the Appendix on page 41 of this manual.

Table of Contents

Important Safety Information

Read this First

- **Follow the instructions in this manual. These instructions are key to the installation and maintenance of the Enphase Envoy Communications Gateway (Envoy™).**
- **To reduce the risk of electrical shock, and to ensure the safe installation and operation of the Envoy, note the following safety symbols that appear throughout this document to indicate dangerous conditions and important safety instructions.**

WARNING! This indicates a situation where failure to follow instructions may be a safety hazard or cause equipment malfunction. Use extreme caution and follow instructions carefully.

NOTE: This indicates information particularly important for optimal system operation. Follow instructions closely.

Safety Instructions

- Perform all electrical installations in accordance with all local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.
- Do not attempt to repair the Envoy; it contains no user-serviceable parts. If the Enphase Envoy fails, please return the unit to your distributor for maintenance. Tampering with or opening the Envoy will void the warranty.
- Before installing or using the Envoy, please read all instructions and cautionary markings in the technical description and on the Enphase Envoy.

The Enphase Envoy Communications Gateway

The Envoy is an integral component of the Enphase Energy Microinverter system. It operates between the Enphase Microinverters and the Enphase Enlighten™ web-based monitoring and analysis system. The Envoy functions as a gateway and monitors the microinverters that are connected to the photovoltaic modules. The Envoy collects energy and performance data from the microinverters over in-home AC power lines. It then forwards that data to Enlighten, via the Internet, for statistical reporting.

The three key elements of an Enphase system are:

- the Enphase Microinverter
- the Enphase Envoy Communications Gateway
- the Enphase Enlighten™ web-based monitoring and analysis

This integrated system maximizes energy harvest, increases system reliability, and simplifies design, installation and management. The following diagram shows the Envoy in the system.

1. **Enphase Microinverters**
   - installed on the racking beneath each solar module
   - maximize energy harvest
2. **AC power travels over AC wiring to the load center**
   - performance data is also sent via the AC wiring
   - plug and play communications
3. **Envoy Communications Gateway**
   - plugs into any AC outlet
   - collects information via the AC wiring
   - transmits data through a standard ethernet router to the internet
4. **Standard Ethernet Router**
   - information collected by the Enphase Envoy is then transmitted to Enlighten in 5-minute intervals
5. **Enphase Enlighten Monitoring**
   - provides moniforing and analysis
   - performance information can be viewed from any web browser

Other Elements in the Enphase System

The **Enphase Microinverter** is a fully integrated device that converts the DC output of the solar module into grid-compliant AC power. In addition to performing the DC to AC conversion, it maximizes the modules' energy production by using a sophisticated Maximum Power Point Tracking (MPPT) algorithm. This integrated system maximizes energy harvest, increases system reliability, and simplifies design, installation and management.

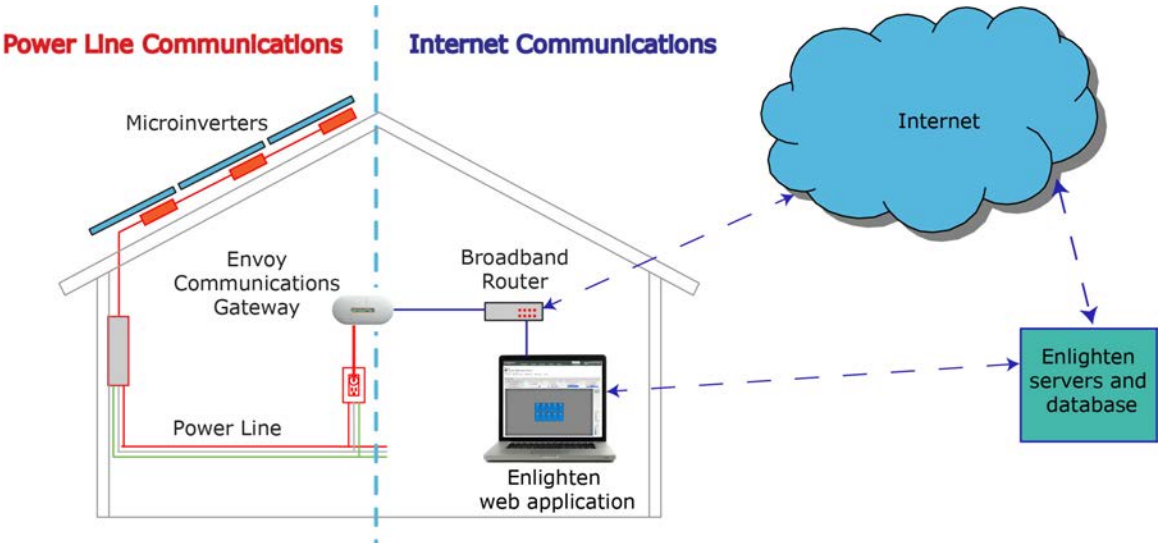
The **Enphase Enlighten** web-based monitoring and analysis system analyzes the per-module data collected by each communicating microinverter. Enlighten automatically detects any shortfall in energy production, identifies possible causes, and suggests solutions. Enlighten constantly monitors every microinverter connected to Enlighten.

How the Envoy Communications Gateway Works

Installation and operation of the Envoy requires no special computer or networking knowledge, nor any specialized equipment. The Envoy simply connects to the on-premise router for communications with the Enphase Enlighten monitoring and analysis website. The Envoy communicates with the individual microinverters using the existing power lines in the residence or business. After the Envoy is installed.

After the Envoy is installed and completes its initial scan, it maintains an internal database of all known Enphase Microinverters at the site it manages. At regular intervals, the Envoy polls each microinverter for its energy data. Using your site's broadband router, the Envoy then forwards that information to the Enphase Enlighten monitoring and analysis website. The Envoy also reports any error conditions that affect itself or the microinverters. You can view both energy data and error conditions in the Enphase Enlighten web-based monitoring and analysis system.

The Envoy is a "gateway device", incorporating power line and Internet communications functions. As shown in the following diagram, one side of the Envoy communicates with the microinverters through power lines at the site. The other half of the Envoy communicates with the Internet using a standard Ethernet/network cable plugged into your broadband router.



Envoy Installation

Preparation

Before installing the Envoy, make sure that your site meets the following minimum requirements:

- Standard AC electrical outlet is available

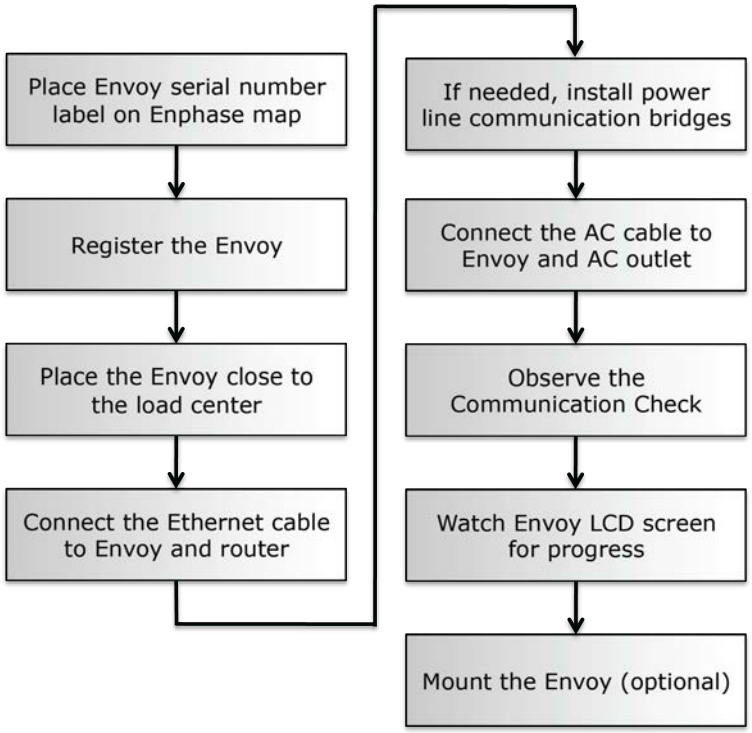
If you plan to use Enlighten web-based monitoring and analysis, additional requirements include:

- Always-on broadband Internet connection
- Broadband router with spare Ethernet port.
- Up-to-date web browser to view Enlighten. Supported browsers are Internet Explorer 8 or higher, Firefox 3.6 or higher, Chrome 5 or higher, and Safari 4 or higher. Enlighten requires Adobe Flash Player 10 or higher.

Check the Envoy shipping box for the following items:

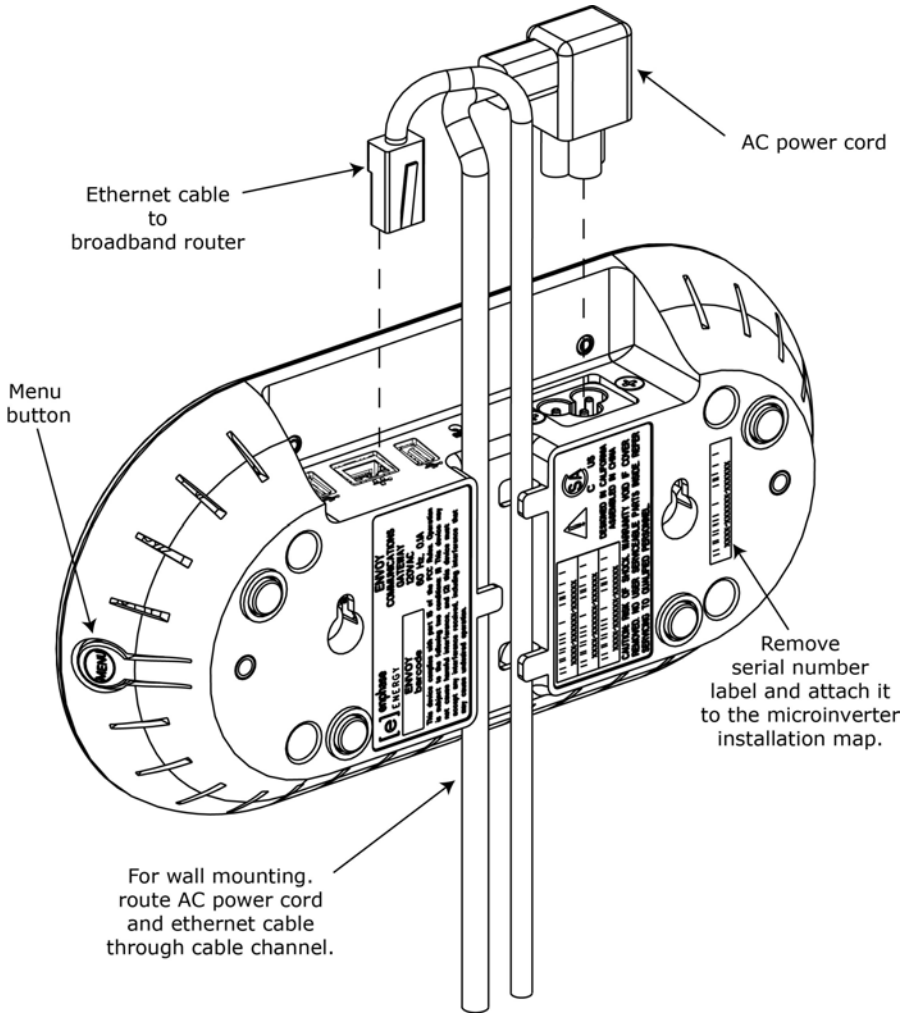
- Envoy Communications Gateway
- Ethernet cable
- AC power cord
- Power line communication bridges
- Installation and Operation Manual
- Read This First document

Installation Flow



Install the Envoy

To install the Envoy, perform the steps below while referring to the diagram shown.



1. Add Serial Number Label to Map

a. Remove the Envoy removable serial number label as shown in the diagram.

b. Attach the serial number label to the microinverter installation map. (This applies to new installations only and is not necessary for an Envoy replacement.)

2. Register the Envoy

Register the Envoy at the beginning of the solar system installation.

a. Visit https://enlighten.enphaseenergy.com

b. If not already done, register the site owner information in the online form.

c. Register the Envoy serial number in the space provided in the online form.

3. Place the Envoy

As a best practice, Enphase recommends that the Envoy be placed as close to the electrical service-panel (load-center) as possible. This ensures that the Envoy receives the strongest possible signal from each microinverter.

a. Locate an electrical outlet **close to the site's electrical load center**. Place the Envoy so that its AC cord can reach this outlet.

b. The Envoy can be placed on a table or it can be wall mounted. For wall mounting instructions, see Wall Mounting on page 12.

4. Connect Ethernet Cabling

a. Plug the Ethernet cable into the RJ-45 port on the Envoy.

b. Plug the other end of the cable into a spare port on the broadband router.

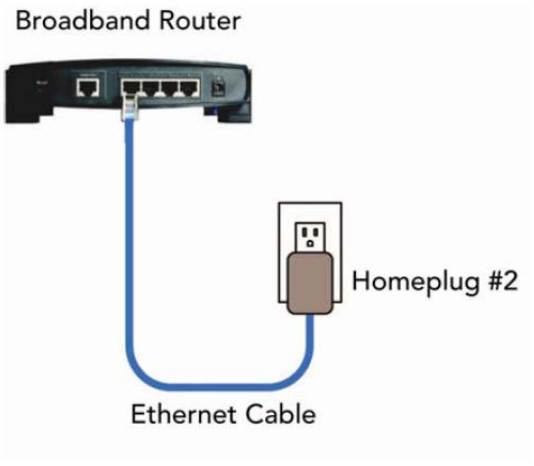
The Envoy needs to obtain a DHCP (Dynamic Host Configuration Protocol) IP address and have a path to the Internet. The Envoy will request a dynamically assigned (DHCP) IP address from the broadband router during the power-up sequence.

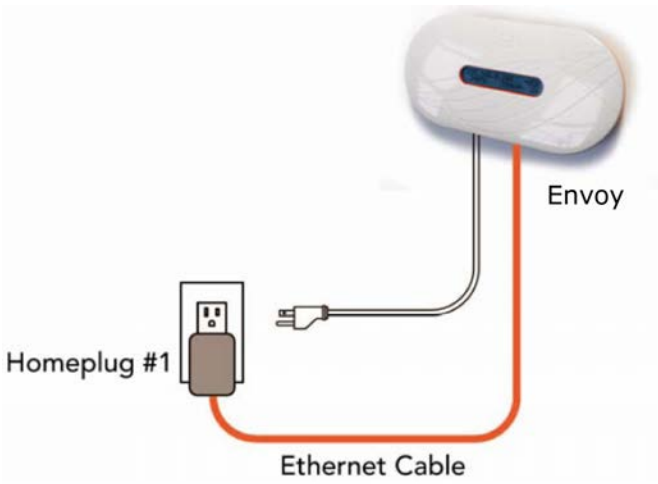
Two small green LEDs on the Ethernet port indicate link and activity. One LED will be solid green, and the other will blink green every few seconds.

NOTE: Next to the Ethernet port on the Envoy, there are one or two ports identified by a USB symbol. These ports can be used to connect optional devices, such as a wireless communication device for the Enphase Environ Smart Thermostat, but cannot be used for a wired or a wireless Ethernet connection.

5. Connect Power Line Communication Bridges (Optional)

If the Envoy needs to be located away from the router, at a distance where an Ethernet cable is not practical, use the power line communication bridges provided with the Envoy or purchase a wireless Ethernet bridge. Bridges allow the Envoy to communicate with the broadband router without the need for additional Ethernet cabling.





Install the power line communication bridges:

a. Plug one of the home-plug devices into the same wall socket that the Envoy's power-cord is plugged in to.
b. Connect one end of the Ethernet LAN cable into the LAN port on the Envoy.
c. Connect the other end of that LAN cable into the bridge.
d. Plug the other bridge into a wall-socket near your broadband router.
e. Connect one end of a second Ethernet LAN cable into that second bridge.
f. Connect the other end of that LAN cable into the broadband router.

6. Connect to AC Power

a. Plug the AC power cord into the AC input on the Envoy.
b. Plug the other end of the power cord into an ordinary 120VAC power outlet (not a power strip). For best results, the outlet should be near the load center.

WARNING! Do **not** plug the Envoy into a power strip, surge protector, or uninterruptable power supply (UPS). The surge suppression or filtering from a power strip or other protective device can substantially diminish communication performance. If possible, do not plug a power strip power cord into the same outlet that the Envoy is using. The surge suppression or filtering components of a power strip may still interfere with communications if they are close to the Envoy.

7. Observe the Communication Check and Initialization

After installing your Envoy, it will automatically perform a Communication Check as described on page 19.

a. Watch the LCD display for progress, noting the number of bars shown in the communication check.
b. See page 19 for more information on running a Communication Check.
c. Refer to Initial Screen Displays on page 15 for more information.

8. Wall Mount the Envoy (Optional)

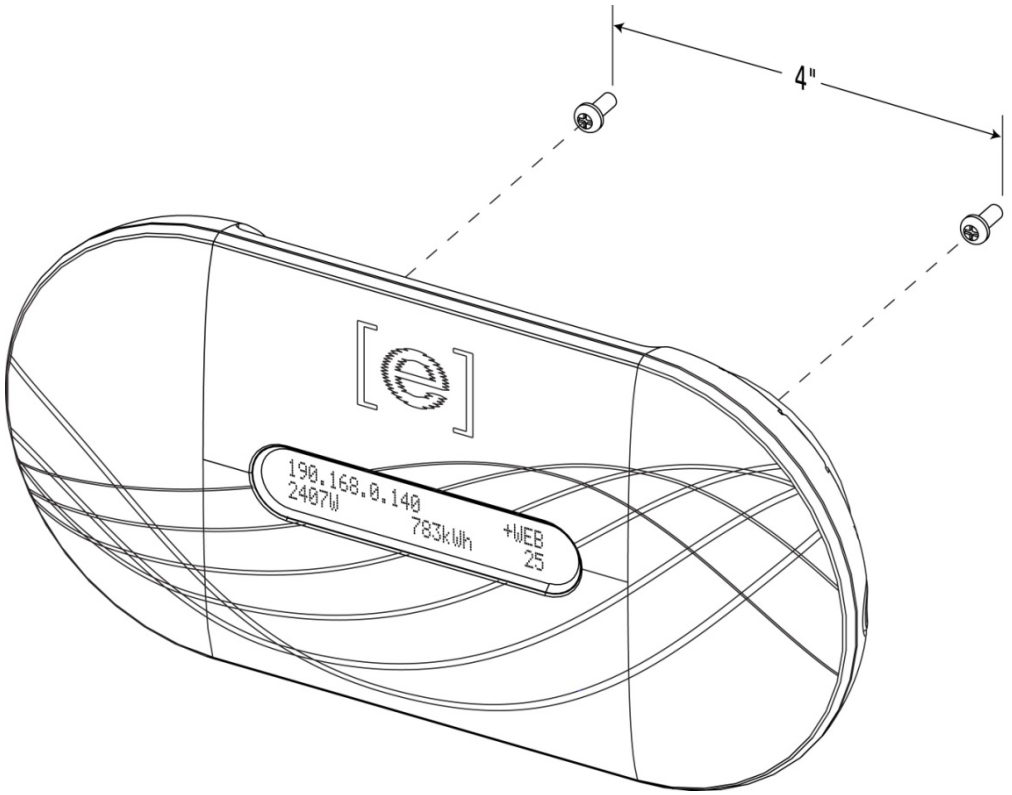
NOTE: Before mounting the Envoy, it is best to perform a Communication Check as described on page 19 to optimize the location of your Envoy.

After you have positioned your Envoy for optimal communications and it is has begun to detect devices, you may want to mount the Envoy on a wall. To do this:

a. Select a cool, dry, indoor location to locate the Envoy.

b. Use two drywall screws or wall anchors (not included in kit) to affix the Envoy to the wall, mounted at the dimensions shown. Maximum screw head diameter is .35 inches. A #8 screw is recommended.

c. Slide the Envoy onto the mounting screws, aligning the Envoy screw holes with the screws installed in step b.

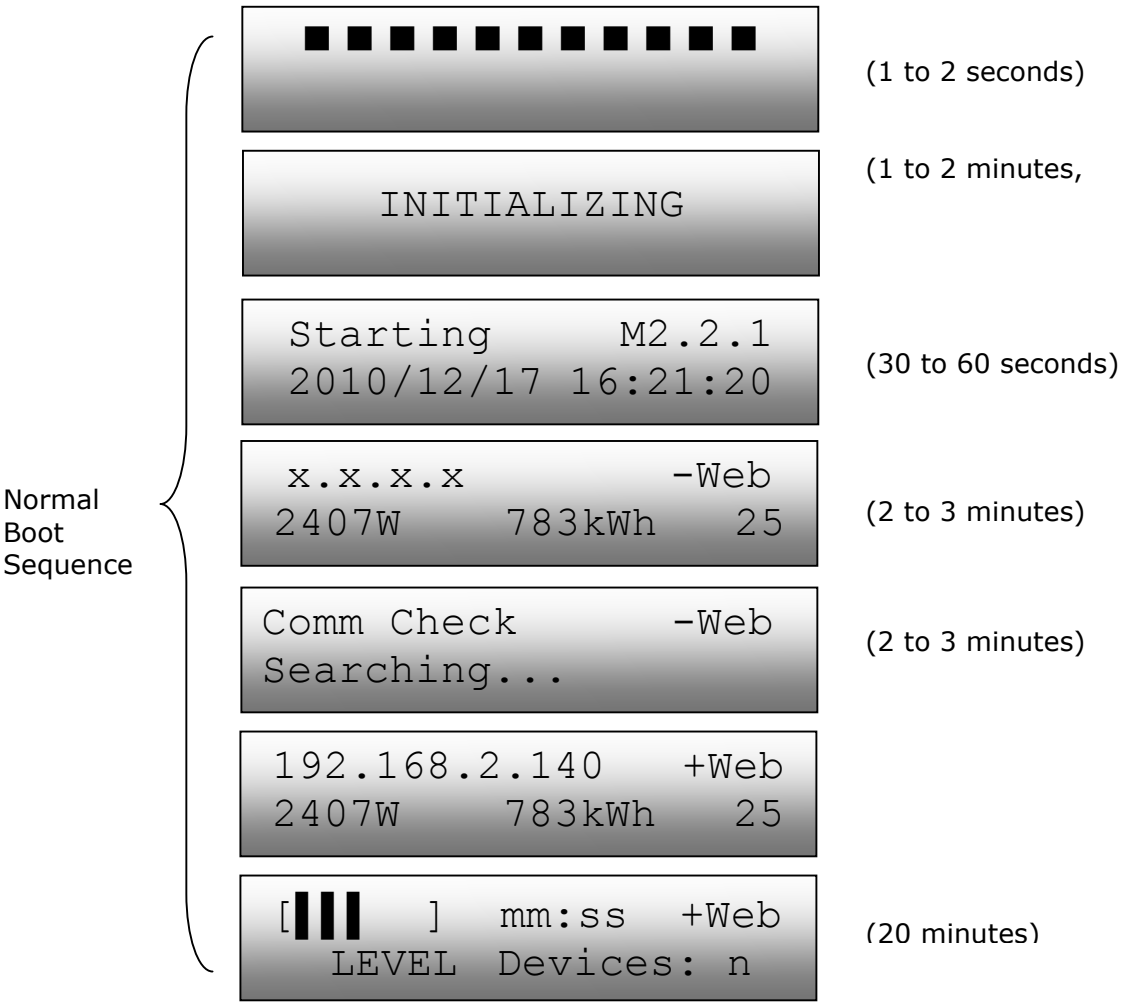


Envoy Operation

Initial Screen Displays

It takes less than five minutes for the Envoy to be ready to work after applying power. This five-minute period is known as a boot sequence. You will know the Envoy has completed booting and has started normal operation when it displays both an IP address and the "+Web" status indication in the LCD window. This information is displayed on the "home screen".

Boot sequence screens and the amount of time each is displayed:



The Envoy displays "-WEB" for 2 to 3 minutes after the first start up. This is normal. Then it sends its first inventory report to Enlighten and gets a successful response. At that point it turns to +WEB. Power production will be 0W and 0kWh at first, and then it starts discovering inverters and adding up the power.

First Scan for Microinverters

A newly installed Envoy automatically performs an initial scan to discover all of the microinverters that are installed and powered up at the site. This initial scan continues to search for new microinverters for seven days from initial start up of the Envoy. The purpose of this long scanning period is to account for additional microinverters that may be installed during this initial seven-day time frame. This one-time process is not repeated. During the scan, you will notice some values increasing on the Envoy display.

NOTE: If you power up the Envoy, even for just a few minutes, the seven-day scan begins at that point. If you then power it back down and leave it off until you are ready to discover the inverters, the initial scan may have completed. A new scan can be initiated, and will be required if the installation is done in stages over more than seven days. The steps for initiating a new device scan are described on page 21 of this manual.

The Envoy identifies each device by its unique serial number. If a microinverter is ever added or replaced at your site, you must initiate a new scan so that the Envoy can discover the new microinverter. The steps for initiating a new device scan are described on page 21 of this manual.

After the Envoy has detected at least one new device, it will automatically enter Priority Scan mode. The LCD screen will display:

```
Priority Scan
Is Active
```

NOTE: No power production data will be collected or displayed on the Envoy or in Enlighten while Priority Scan is active. Also, the Communication Check function will not operate during this period.

When the Envoy does not detect a device during a polling interval (usually 5 minutes), it will exit Priority Scan mode. If, subsequently, the Envoy detects another device, it will return to Priority Scan mode. It will remain in this mode until it again completes an interval where no devices are detected.

Normal Operation

Once the Envoy completes a scan, it begins or resumes normal operation. At this point, the indicators in the LCD window show current values for your system. This is the home screen:

```
192.168.2.140  +Web
2407W    783kWh   25
```

The data on the home screen may take a few minutes to appear after starting up the Envoy or initiating a scan. Information shown during normal operation includes:

- Local IP address, for example: **192.168.2.140** (your actual local IP address will be different). The Envoy will attempt to get a dynamically assigned DHCP (Dynamic Host Configuration Protocol) IP address during power up sequence. The Envoy uses the DHCP IP address as a path to the Internet. If 169.254.120.1 is shown, the Envoy has not yet acquired a dynamic IP; Refer to Troubleshooting on page 23, if this address continues to display.
- Web connection indication: **+Web.** The web status indicates whether the Envoy is connected to Enlighten.
- Indication of the present power-production, in watts: **(n)W** (where n is a number)
- Indication of the life time kilowatt hours reported to this Envoy: **(n)kWh** (where n is a number)
- Indication of the number of online microinverters producing power and reporting in to the Envoy: **(n)** (where n is a number). The number of microinverters displayed will be zero at night.

After the Envoy establishes an IP address and the web connection, the Envoy periodically contacts an NTP (Network Time Protocol) server so that it can maintain an accurate local time.

How the Envoy Works with Enlighten

Once you have registered the system and successfully installed the Envoy, Enphase will set up an account for the site owner. You can then use Array Builder, a tool available to installers, to build the virtual array. You will need to use the installation map you created during installation as a reference during this task.

NOTE: Go to http://www.enphaseenergy.com/support/learningcenter.cfm to view an Array Builder demo.

If you do not already have an account, please go to www.enphaseenergy.com for more information on Enphase Enlighten web-based monitoring and analysis.

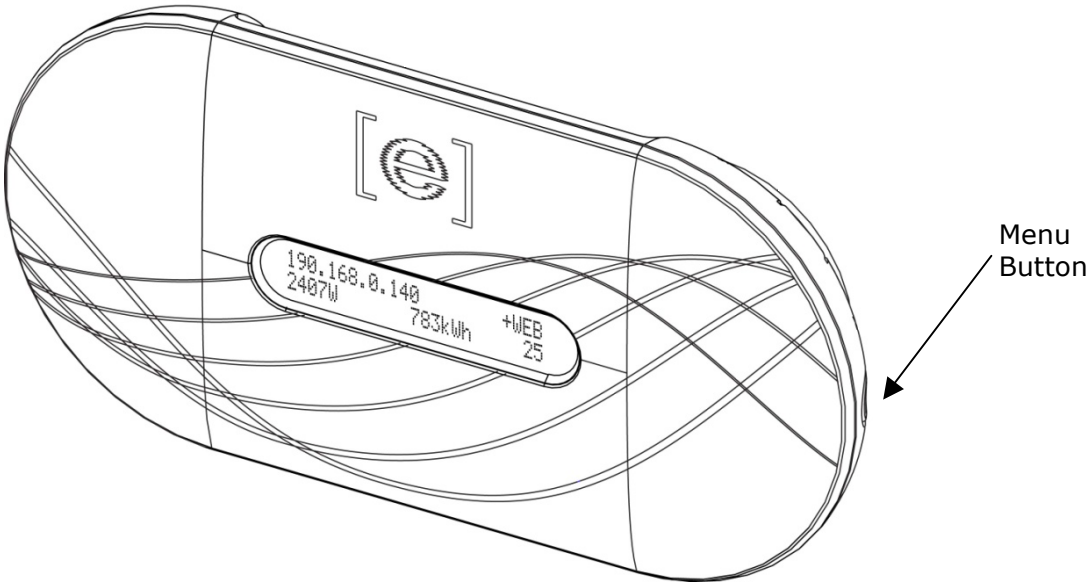
When you complete these steps, Enphase sends account information to the site owner so that they can log in to the Enlighten website and view system performance.

Enlighten provides a wide range of information on system and module performance. A graphical representation of the solar array provides "at a glance" information on the status of each module. You can also access more detailed information, including current and lifetime performance metrics. You can even access Enlighten on your mobile device and view real-time performance information wherever you are.

Site owners receive an initial free subscription to Enlighten. Before this initial period expires, Enphase will send a reminder to both the installer and site owner telling how to renew the subscription to Enlighten.

The Envoy LCD Panel Menu

You can use the Envoy Menu button located on the right side of the Envoy to access the Envoy LCD panel menu.



Press and hold this button; after two seconds you will enter the Envoy menu screens. Continue holding the Menu button. Menu items will appear in the following order:

Exit Menu
Enable New Device Scan
Disable New Device Scan
Enable Communication Check

To select a menu item, release the Menu button when the desired menu item appears. The menu continues to cycle as long as you are pressing the Menu button. The Exit Menu option returns to the default display.

See the following sections for detailed procedures.

Performing a Communication Check

If, when you are installing the Envoy, you are unsure of where it should be located for maximum performance, you may want to install the Envoy in different locations and check signal strength. Normally, a communication check starts automatically after an Envoy restart. Alternatively, you can initiate a communication check with the Envoy Menu button or through the administration page when connected to the Envoy local interface with a computer.

NOTE: If a Priority Scan is active, the Communication Check will not occur until the Priority Scan has expired. If you need to run a Communication Check, you can power cycle (unplug the Envoy and then reapply power) the Envoy or wait until priority scanning has ended during which time the signal bars will return.

NOTE: Device scans and communication checks can only be successfully performed during daylight hours when the microinverters are powered by the PV modules.

To use the Envoy Menu button to initiate a communication check:

1. Press and hold the Menu button on the right side of the Envoy to bring up the Envoy menu on the LCD window.
2. When the LCD window displays “Enable Communication Check”, release the Menu button.

The LCD window then reads:

The Envoy begins a 20-minute communication check to assess the signal strength between the Envoy and the devices detected at your site. Until the Envoy begins detecting devices (microinverters), the display reads:

When the Envoy begins detecting devices (microinverters), the display reads:

The "LEVEL" indicator in the LCD window may display any number of bars from zero to five.

NOTE: Until devices are detected, the communications indicator shows no bars.

You can assume that signal strength is acceptable if three to five bars are displayed and all devices are accounted for. A number of 1-2 may not be effective for consistent communication.

3. If fewer than three bars are displayed, refer to Power Line Communications Troubleshooting on page 23.

   Remaining minutes and seconds in Comm Check are displayed ("mm:ss" in the example). The "Devices" counter displays the number of devices detected and will increase until all devices are detected. Ultimately, the number of devices detected should match the number of installed microinverters.

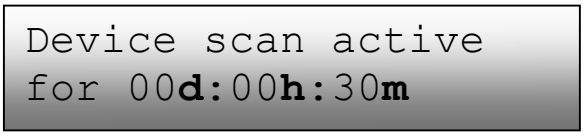
4. After 20 minutes, the communication check automatically stops. If you want to end the communication check before it times out, press and hold the menu button to activate the Envoy menu. When "Disable Communication Check" displays, release the menu button.

Initiating a Scan for New Microinverters

If you add additional microinverters to an existing system or replace a microinverter, you will need to run a scan to detect the new devices. To initiate a scan after you add new microinverters to an existing Enphase system:

1. Press and hold the Envoy Menu button; after two seconds you will enter the Envoy menu.
2. Continue holding the Menu button; when the LCD window displays "Enable New Device Scan", release the Menu button.

The LCD window then reads:



The Envoy begins a 30-minute scan (if a longer scan is not already in progress) to identify all of the microinverters deployed at the premises.

3. Use your previously issued username and password to check for the new inverter in the Enphase Enlighten web-based monitoring and analysis system. If you do not have a link to Enlighten, go to www.enphaseenergy.com and click **Enlighten Login**. From here you can register (if not already done) and view data on a per microinverter basis (and, hence, a per PV module basis).
4. To disable or cancel a scan, press and hold the Envoy Menu button for two seconds to view the Envoy menu. When the LCD window displays: "Disable New Device Scan", release the Menu button.

Enabling a Connection to Enphase

The Enable Connection to Enphase menu item creates a secure connection to Enphase allowing Enphase personnel to troubleshoot the system remotely.

The LCD window now reads:

Once the connection is open, the LCD will return to the default display.

Disabling a Connection to Enphase

The Disable Connection to Enphase menu item closes the secure connection to Enphase.

The LCD window now reads:

Once the connection is closed, the LCD will return to the default display.

Networking and Firewall Info

The Envoy communicates with the Enphase Enlighten website by initiating outbound TCP (Transmission Control Protocol) connections to Enphase over HTTPS (Hypertext Transfer Protocol over Secure Socket Layer) (TCP:443). The Envoy uses NTP (Network Time Protocol) (UDP:123) to periodically synchronize time/date with an external pool of NTP servers. You do not need to open any inbound firewall ports for normal operation.

NOTE: The Envoy automatically reports system performance data to Enphase upon connection to the Internet. Please consult the Enphase privacy policy at http://www.enphaseenergy.com/privacy/ to learn more about Enphase's use of this data.

Troubleshooting

The following sections describe possible problems and solutions. For information on system status and event messages, see Event Messages on page 33.

Power Line Communications Troubleshooting

At power-up, the Envoy performs a "Communication Check". After a few minutes, it will display a number of bars in the LCD window. This value, from 0 to 5, indicates the signal strength of the power line communications between the Envoy and the microinverters. A number from 3-5 is good. A number of 1-2 is not ideal. Zero bars means that either the Envoy needs to be relocated, or there are one or more devices causing interference.

Troubleshoot power line communications issues as described in the following.

PROBLEM: The microinverter count doesn't match number of installed units. This may indicate that the Envoy is not done scanning/discovering the entire array. Alternatively, it may indicate that the Envoy is having difficulty communicating over the power lines. It could also be a result of low light levels and the module voltage being too low for the microinverter to power-up.

- Make sure that the Envoy is plugged directly into the wall and **not** into a power strip or surge protector.
- Relocate your Envoy as close to the electrical service-panel (load-center) as possible. This ensures that the Envoy receives the strongest possible signal from each microinverter.
- Try unplugging any other device that may be sharing the outlet with the Envoy. Or, as an alternative, plug the Envoy into a circuit that supports fewer electronic devices. Devices sharing a receptacle with the Envoy may interfere with power line communications.
- If this problem occurs when light levels are low, try again during daylight hours.

PROBLEM: Envoy displays fewer than three bars. Follow the procedure above.

PROBLEM: Envoy displays zero bars. The following conditions may exist.

1. **Is there a Phase-imbalance?**
   - Ask the Electrician to measure the hot legs and neutral to verify that the phases are balanced. In cases where the phases are not balanced, electricians must recheck their work.

2. **Is the system energized?** PV modules power Microinverters, PV modules provide power only during daylight hours, and microinverters communicate only when powered.
   - Run another scan during daylight hours.

- Check that the solar circuit breakers are in the "ON" position. For the Envoy to communicate with the microinverters, the circuit breakers for the solar have to be in the "ON" position in the electrical load-center.
- Verify that the PV modules are connected to the microinverters.

3. **Envoy plugged into a circuit on the primary load-center, but the solar circuits are on a downstream sub-panel:** The primary load-center is full and doesn't have additional capacity to add circuit breakers for solar.
   - Add a subpanel with a small subset of circuit breakers. In this case, it is best to add an additional 5-Amp circuit breaker and then run an outlet off that subpanel. Plug the Envoy into that outlet, so that it can be close to the solar-circuits.

Local Area Networking Troubleshooting

PROBLEM: IP address issues. If the IP address displayed on the Envoy's LCD window is 169.254.120.1, or if the IP address does not match the DHCP subnet on your internal network, this means that the Envoy was unsuccessful in obtaining a DHCP lease from your router.

- Check network connectivity to the router or other DHCP server. You may also wish to contact your Internet Service Provider or refer to your router documentation for assistance.
- Check that you are using a network router and not a switch or a hub. Many hubs and switches cannot provide a DHCP lease and may not allow the Envoy to connect to the web.
- Use the Envoy menu button to "Get New IP Address". See page 18 for more information.
- Unplug all units in the chain, applying power again in this order: Modem, Router, and Envoy. Allow a few minutes for the IP address to be reassigned.

PROBLEM: LCD Window displays "-Web". This means that the Envoy has no connection to the Enlighten website.

- Check network connectivity to the router. You may also wish to contact your Internet Service Provider or refer to your router documentation for assistance.
- Allow a few minutes longer. If the Envoy has recently received a valid IP address, it will likely display +Web momentarily.

PROBLEM: LCD Window displays "Envoy Failure +Web or -Web". This message displays after the Envoy has tried unsuccessfully three times to initialize.

- Unplug the Envoy from the electrical outlet and plug it in once again. Leave it in place for at least 15 minutes. If it continues to display Envoy Failure or if it never moves beyond the Initialization stage, call Enphase Customer Support at 877-797-4743.

PROBLEM: The Envoy is in a location that yields a good signal-strength, but using an Ethernet cable here is not practical:

- In this case, you may need to use Power line Ethernet bridges or a wireless Ethernet bridge.

Envoy Local Interface

Connection to the Enphase Enlighten web-based monitoring and analysis website requires an Internet connection. However, if there is no Internet access at the installation site, it is still possible to communicate directly with the Envoy using the Ethernet port and a personal computer with a web browser. The following steps describe how to access the Envoy data through the local connection.

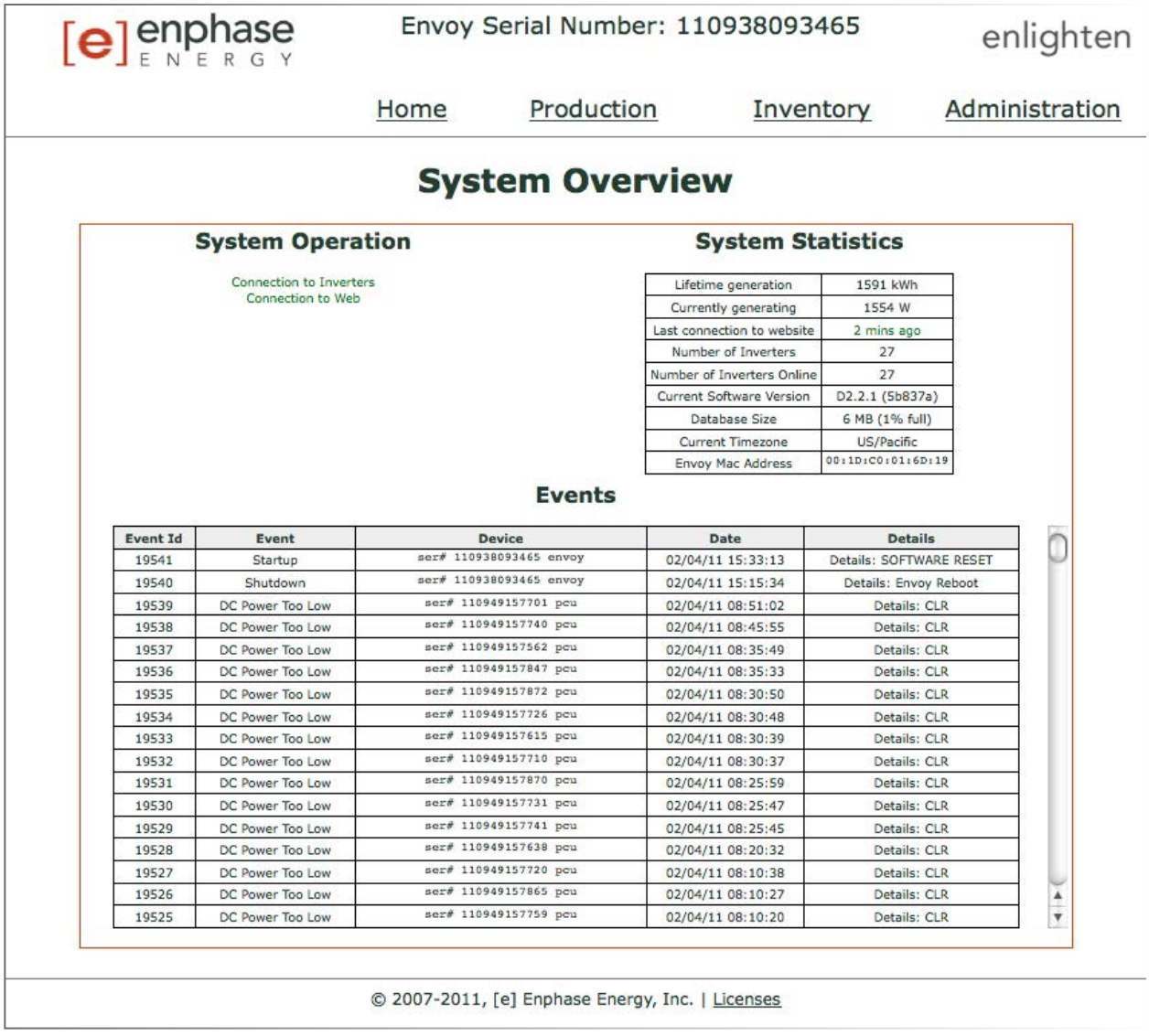
1. Connect one end of the Ethernet cable supplied with the Envoy to the Ethernet port on the Envoy.
2. Connect the other end of the Ethernet cable to the RJ45 network port of the computer.
3. Open the Internet browser application on the computer.
4. In the browser address window, enter the IP address displayed in the LCD window of the Envoy.

NOTE: If you fail to make a connection at this point, you can manually configure your subnet to 169.254.120.2 and subnet mask to 255.255.0.0. If this does not correct the problem, call Enphase Customer Support at 877-797-4743.

Once the browser has successfully connected with the Envoy, the home screen is displayed in the browser window.

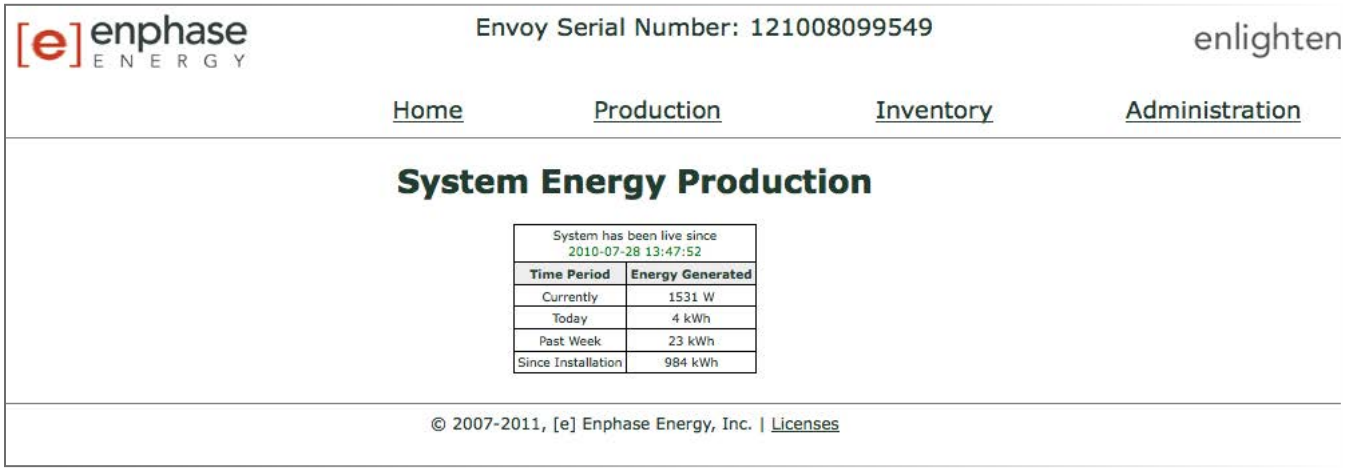
Home Screen

The home screen provides a system overview and shows the current status of the inverters that have been identified by this Envoy. From this screen, you can access other screens in the interface.



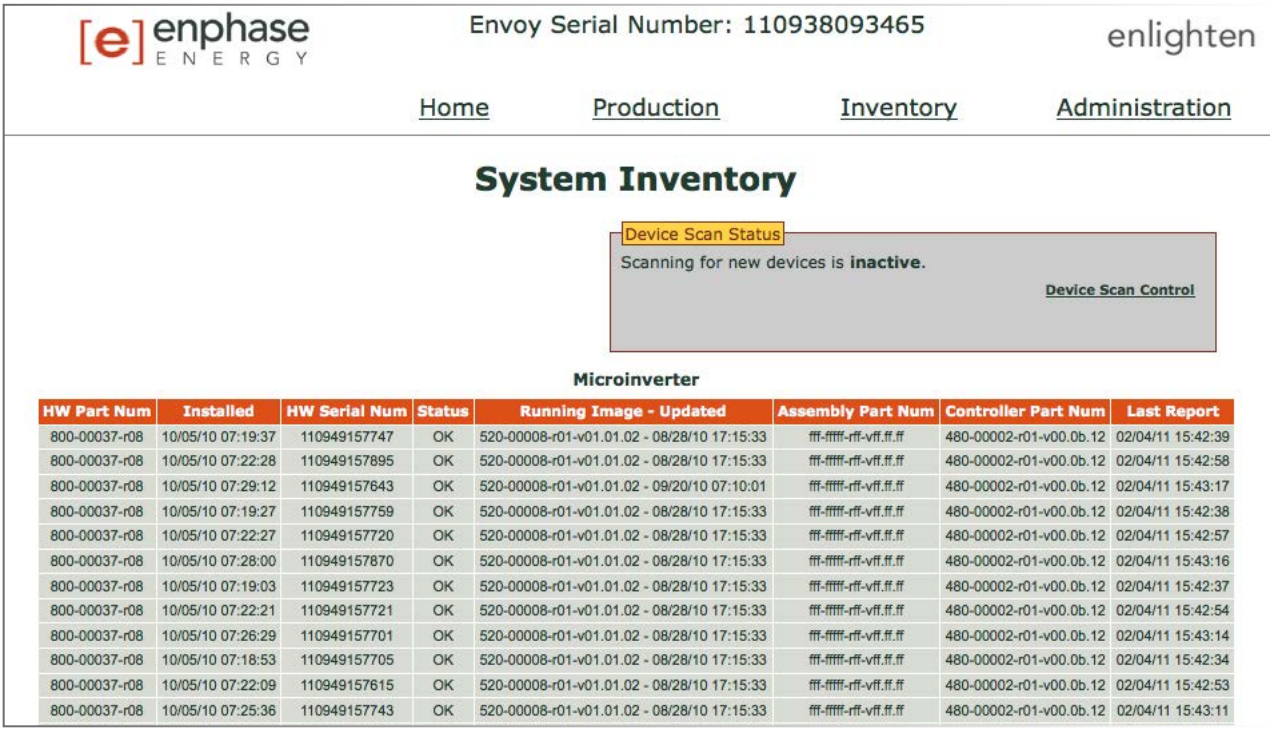
Production Screen

To view system energy harvest statistics for your system, click **Production** from the Envoy home screen to navigate to the production screen.



Inventory Screen

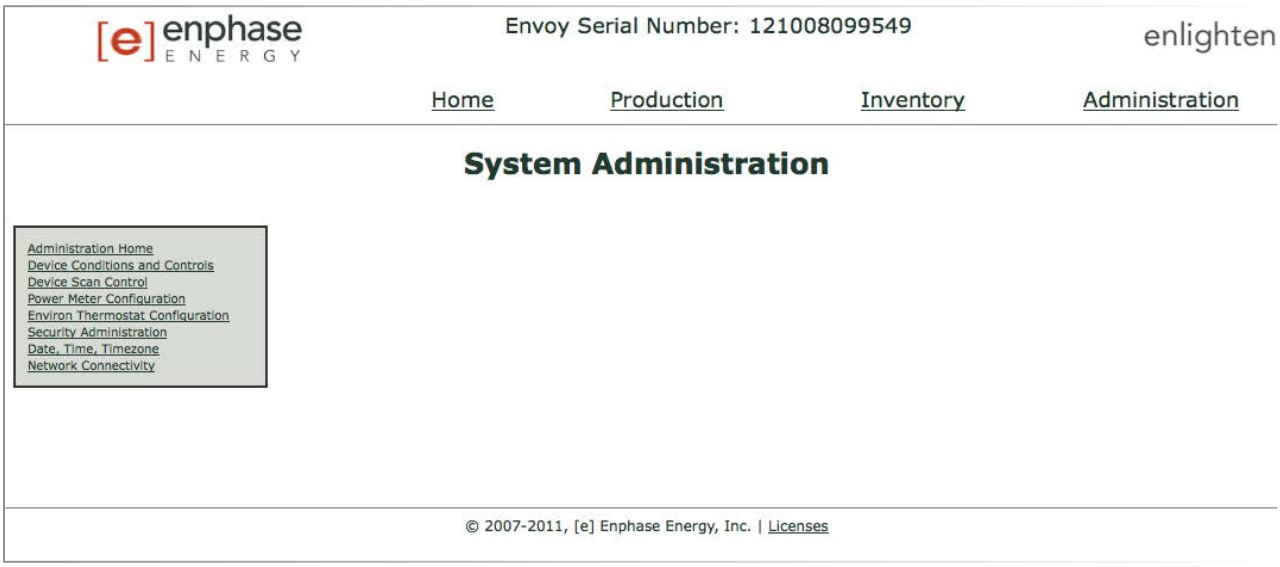
To view a listing of the devices in your system, click **Inventory** from any screen to navigate to the inventory screen.



HW Part Num	Installed	HW Serial Num	Status	Running Image - Updated	Assembly Part Num	Controller Part Num	Last Report
800-00037-r08	10/05/10 07:19:37	110949157747	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:39
800-00037-r08	10/05/10 07:22:28	110949157895	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:58
800-00037-r08	10/05/10 07:29:12	110949157643	OK	520-00008-r01-v01.01.02 - 09/20/10 07:10:01	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:43:17
800-00037-r08	10/05/10 07:19:27	110949157759	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:38
800-00037-r08	10/05/10 07:22:27	110949157720	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:57
800-00037-r08	10/05/10 07:28:00	110949157870	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:43:16
800-00037-r08	10/05/10 07:19:03	110949157723	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:37
800-00037-r08	10/05/10 07:22:21	110949157721	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:54
800-00037-r08	10/05/10 07:26:29	110949157701	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:43:14
800-00037-r08	10/05/10 07:18:53	110949157705	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:34
800-00037-r08	10/05/10 07:22:09	110949157615	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:42:53
800-00037-r08	10/05/10 07:25:36	110949157743	OK	520-00008-r01-v01.01.02 - 08/28/10 17:15:33	fff-ffff-rff-vff.ff.ff	480-00002-r01-v00.0b.12	02/04/11 15:43:11

Administration Screen

The Administration screen of the Envoy local interface contains a number of configurable options. Click **Administration** to access this menu.



The default log in credentials for the Administration menu are:
Username: admin
Password: admin

NOTE: For Envoy performance reasons, Enphase does not recommend giving the Envoy a publicly-accessible IP address. However, if you must place the Envoy on a public-facing IP address, Enphase recommends that you change the admin password to disallow unauthorized modification to your Envoy. **(This situation is rare, since consumer-grade routers normally provide the Envoy with an internal network IP address that is not publicly accessible.)**

For reference, private/internal IP address space will be in the 192.168.x.x, 172.16.x.x, 10.x.x.x or 169.254.x.x range. If you are unsure if your Envoy is on the public Internet, please see your network administrator or Internet Service Provider.

Administration Screen Tasks

Several Administration Screen tasks are described in the following sections. Perform these tasks only when needed. The tasks include:

- Clear GFI Tripped Condition
- Device Scan Control
- Setting Time Zone

Clear GFI Tripped Condition

A solid red status LED on the microinverter indicates the microinverter has detected a ground fault (GFDI) error. The LED will remain red and the fault will continue to be reported by the Envoy until the error has been cleared.

If a microinverter registers a GFI Tripped condition, you can attempt to clear this condition through the Envoy Interface. If the condition does not clear after you perform the following procedure, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.

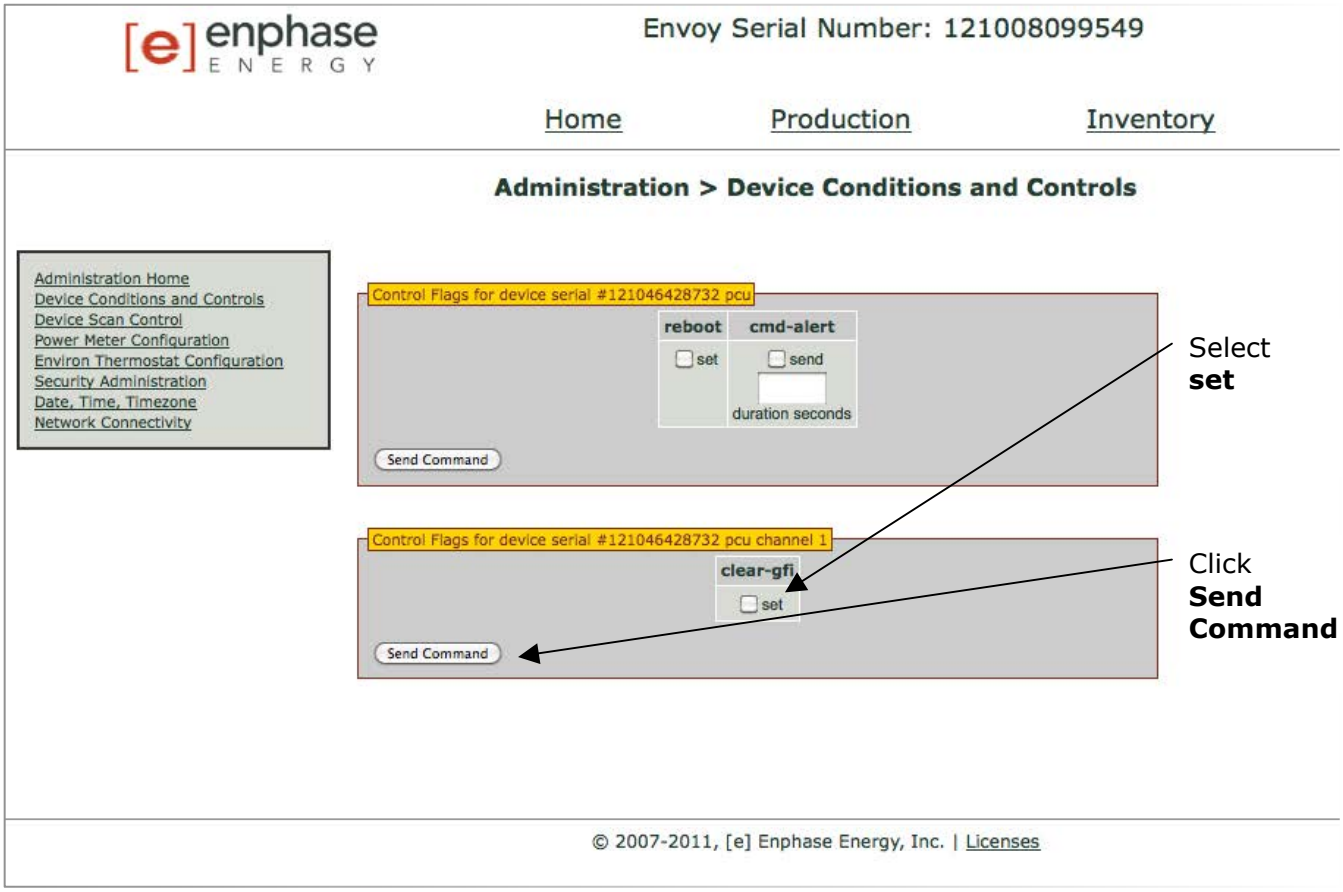
To send the Clear-GFI message to a microinverter:

1. From the Admin menu, choose **Device Conditions and Controls**.

2. Click on the **serial number** of the unit showing the GFI condition.

NOTE: Do not click or select the box under the column labeled **Select**.

3. In the clear-gfi box, select **set**.



4. Click **Send Command** to complete this task.

Device Scan Control

The Controlled device scan differs from other Envoy device scans in that it allows control over scan period, scanning method, and number of devices. When first installed, the Envoy initiates a seven-day scan. This initial seven-day scan is the only scan needed for most systems.

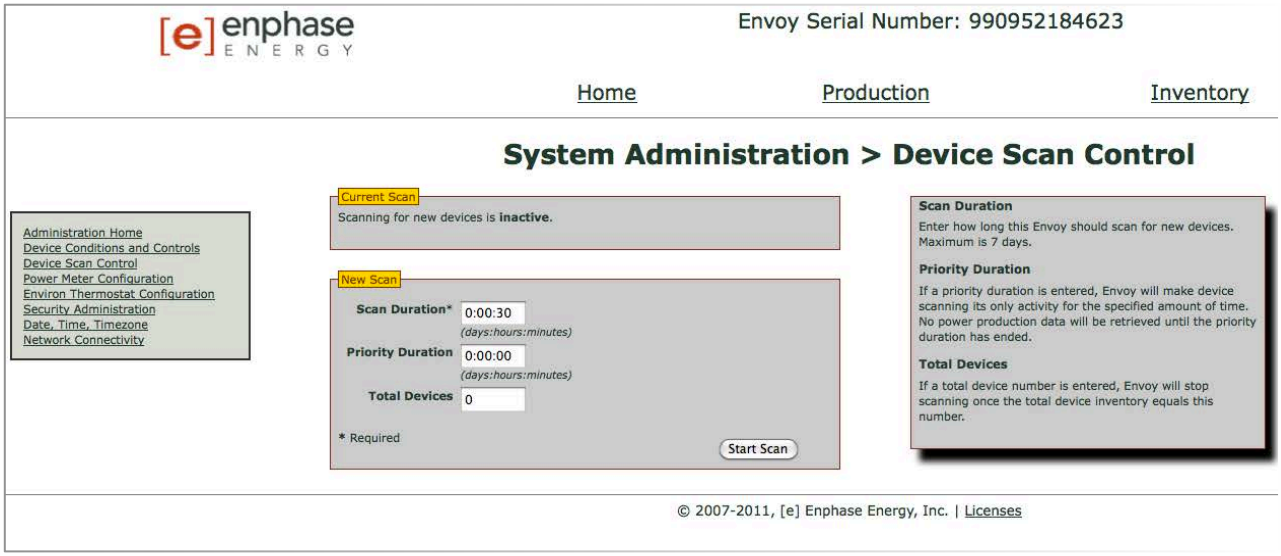
NOTE: At sites with more than 100 microinverters, we recommend specifying the total number of devices to be discovered in order to speed up the discovery process. See the following procedure for details.

A controlled scan should only be run as needed to detect new or previously undetected microinverters. You may want to use this feature in instances where you need to run a controlled device scan for a large site or for a site with communications issues.

To run a controlled scan:

1. From the Admin menu, choose **Device Scan Control**.

2. Enter a **Scan Duration** in days:hours:minutes (e.g., 0:00:60 to indicate zero days, zero hours, and 60 minutes). The scan duration will depend on many factors, such as number of devices to be detected and quality of power line communications. You may want to start with a one-hour scan and increase the duration as needed.



3. Although optional, it is **best practice** to enter a value for **Total Devices**. Enter a value in this field. The Envoy will stop scanning once it has detected an equal number of devices.

NOTE: The Total Devices option can be used in conjunction with the Priority Duration option to help discover any last few microinverters at a large site.

4. Enter a **Priority Duration** (optional) in days:hours:minutes (e.g., 0:00:20 to indicate zero days, zero hours, and 20 minutes). If you enter a value in this field, the Envoy will make scanning its sole activity for the period specified.

NOTE: The Priority Duration option should only be used in limited situations, e.g., at large sites or sites experiencing problems discovering devices with the normal scan.

5. Click Start Scan to complete this task. The LCD panel will read:

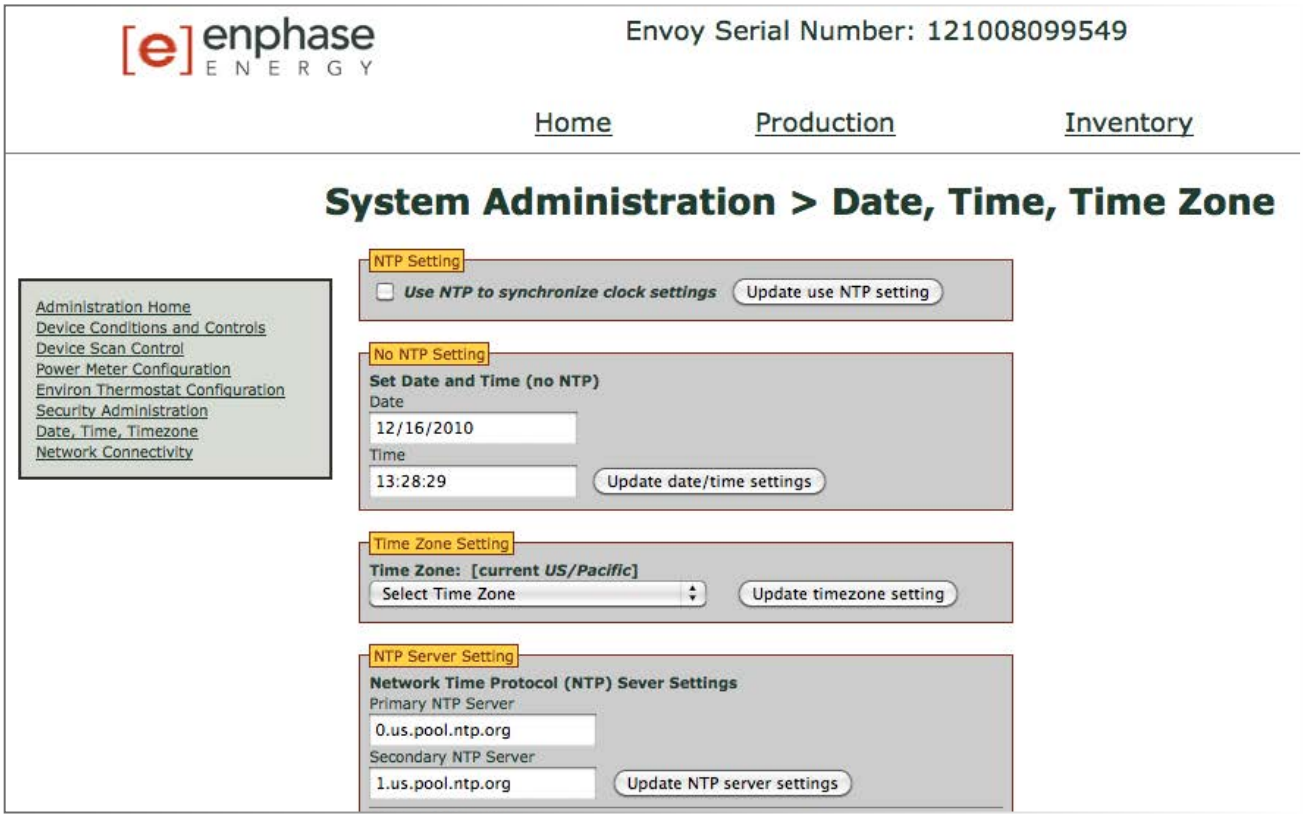
NOTE: No power production data will be collected or displayed on the Envoy or in Enlighten while Priority Scan is active. Also, the Communication Check function will not operate during this period.

Setting Time Zone

If you do not have an Internet connection to the Envoy, you may want to set the local time zone on your Envoy.

To set the Envoy time zone:

1. From the Admin menu, choose **Date, Time, Time Zone**.
2. Under **Time Zone Setting**, select a time zone from the **Select Time Zone** drop down menu.
3. Click **Update Time Zone** to complete this task.



Event Messages

The table below lists messages that the Envoy can produce to indicate certain conditions. These messages appear on screen when your computer is connected to the Envoy local interface.

Where message is displayed:		Description
Home Screen	**Inventory Screen**	
AC Frequency Out Of Range	ac-freq-oor	The inverter reports that the frequency of the AC grid is either too low or too high as specified by UL 1741. This condition should correct itself. No action is required. If the condition persists, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
AC Voltage Out Of Range	ac-voltage-oos-p# (# = 1, 2 or 3)	The inverter reports that the AC voltage coming from the utility is either too low or too high as specified by UL standards (UL1741). Occasional instances of the event are self-correcting and require no action. This condition should correct itself. No action is required in most cases. However, if the condition persists, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Audible alarm active	audible-active	The inverter's buzzer is active, either due to an internally detected error or by user command. This is applicable only to inverter models M175 and M200. If the inverter has detected ground fault, follow the directions on the Device Conditions and Controls page to clear this condition. The condition should clear, unless conditions causing the event have not been remedied or if the failure is permanent. For assistance, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Bad Flash Image	bad-flash-image	The inverter is not producing power due to a software problem. For assistance, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.

Where message is displayed:		Description
Home Screen	**Inventory Screen**	
Commanded Reset	commanded-reset	The inverter was reset, either following a successful software download or by user command. No action is required; it will automatically resume normal operation momentarily.
Control Request		The Envoy has received a control request made via the Envoy interface (Administration > Device Conditions and Controls page) or via Enlighten. This uncommon condition will occur only during isolated troubleshooting procedures by Enphase personnel. No action is required.
Critical Temperature	critical-temp	This rare condition occurs if the inverter reports an internal temperature that exceeds its rated range. It reacts by producing less power to reduce internal temperature (see Over Temperature). Once the internal temperature of the inverter diminishes, it will begin to produce full power and this error message will clear. No action is required unless the condition persists. If it persists, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
DC Too High	dc-voltage-hi	The inverter reports that DC input voltage from the PV module is too high. Check that the PV module and inverter are compatible. Refer to the Module Compatibility List for more information: http://www.enphaseenergy.com/support/

Where message is displayed:		Description
Home Screen	**Inventory Screen**	
DC Too Low	dc-voltage-lo	The inverter reports that DC input voltage from the PV module is too low. Most instances of this event reflect normal microinverter operation, and no action is required. If this condition persists, and does not clear during hours of full daylight, the microinverters may be shaded or covered by snow. If this event occurs and clears daily or often during hours of full daylight, check that the PV module and inverter are compatible. Refer to the Module Compatibility List for more information: http://www.enphaseenergy.com/support/ Usually, this is a normal condition during hours of low light and at night, but if this event occurs during full daylight or if the condition persists, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Download to module begun		The Envoy has started a software upgrade to the indicated inverter. This process may take a few minutes. No action is required.
Download to module ended		The Envoy has successfully delivered a software upgrade to an inverter. No action is required.
Download to module failed		The Envoy was unable to successfully deliver a software upgrade to an inverter. No action is required; the Envoy will repeat the attempt.
Filesystem integrity audit failed		The Envoy file system integrity audit has failed. For assistance, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.

Where message is displayed:		Description
Home Screen	**Inventory Screen**	
GFI Tripped	gfi-tripped	The inverter has detected ground fault current greater than one amp. Follow the directions on page 29. After being reset, the condition should clear unless conditions causing the event have not been remedied or if the failure is permanent. For assistance, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Grid Gone	grid-gone	The inverter reports that power from the utility is no longer present. If, there is a power outage in your area and the system has stopped production, no action is required. Solar production will resume when the utility restores power to your area. If power is present at the site, check that the circuit breaker to the affected array or branch is turned on. If Grid Gone events repeatedly occur on one microinverter or only on portions of a branch, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Grid Instability	grid-instability	The inverter is not producing power due to one or more of these conditions: AC Frequency Out Of Range, AC Voltage Out Of Range, or Grid Gone. Note that Grid Instability will remain for about 5 minutes after the underlying conditions clear. No power is produced during this time. No action is required unless the condition persists. If it persists, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Module added		The Envoy has detected and is now associated to a new inverter. No action is required.

Where message is displayed:		Description
Home Screen	**Inventory Screen**	
Module failed to report		The Envoy has not received a response to the last three messages sent to an inverter. Relocate the Envoy closer to the load center or remove devices that may be sharing the outlet with the Envoy. See Troubleshooting Power Line Communications on page 23.
Module Sleeping		The Inverter is off for the night. No action is required.
Over Temperature	over-temp	The inverter is too hot and is not producing power. This very rare condition usually clears on its own. No action is required unless the condition persists. If it persists, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Power generation off by command	forced-pwr-prod-off	The inverter is not producing power by user command. This uncommon condition will occur only during isolated troubleshooting procedures by Enphase personnel. No action is required.
Power On Reset	power-on-reset	The inverter has powered on after having both AC and DC disconnected. No action is required.
Shutdown		The Envoy has been powered down (unplugged from AC power). Restore AC power to the Envoy.
Skipped Cycles	skipped-cycles	The inverter has not produced power for more than 5% of the most recent production cycle; this may be due to real problems in the grid or a hardware failure of the inverter. If the condition persists, contact Enphase Energy customer support at 877-797-4743 or at support@enphaseenergy.com.
Startup		The Envoy has been powered back up (plugged back in to AC power). No action is required.

Technical Data

Communications Interface	
Power line	Enphase proprietary
Ethernet	10/100 auto-sensing, auto-negotiation
USB (one or two ports, depending on Envoy model)	USB 2.0 interface, auto-sensing, auto-negotiation
Power Requirements	
AC outlet	120 VAC, 60 Hz
Power consumption	2.5 watts typical, 7 watts maximum
Mechanical Data	
Dimensions (WxHxD)	8.8” x 4.4” x 1.7” (222.5 mm x 112mm x 43.2mm)
Weight	12 oz (340g)
Ambient temperature range	-40°C to +65°C (-40° to 149°F)
Cooling	Natural convection – no fans
Enclosure environmental rating	Indoor - NEMA 1
Features	
Standard warranty term	1 year
Compliance	UL 60950, EN 60950, FCC Part 15 Class B

Appendix A

Limited Warranty

Enphase Energy Inc. ("**Enphase**") has developed a highly reliable Envoy Communications Gateway that is designed to withstand normal operating conditions when used for its originally intended purpose in compliance with the Enphase User Manual supplied with the originally shipped system. The Enphase limited warranty ("**Limited Warranty**") covers defects in workmanship and materials of the Envoy Communications Gateway ("**Defective Product**") for a period of one (1) year from the date of original purchase of such Envoy Communications Gateway at point of sale to the originally-installed end user location (the "**Warranty Period**"). During the Warranty Period, the warranty is transferable to a different owner as long as the Envoy Communications Gateway remains installed at the originally-installed end user location.

During the Warranty Period, Enphase will, at its option, repair or replace the Defective Product free of charge, provided that Enphase through inspection establishes the existence of a defect that is covered by the Limited Warranty. Enphase will, at its option, use new and/or reconditioned parts in repairing or replacing the Defective Product. Enphase reserves the right to use parts or products of original or improved design in the repair or replacement of Defective Product. If Enphase repairs or replaces a Defective Product, the Limited Warranty continues on the repaired or replacement product for the remainder of the original Warranty Period or ninety (90) days from the date of Enphase's return shipment of the repaired or replacement product, whichever is later.

The Limited Warranty covers both parts and labor necessary to repair the Defective Product, but does not include labor costs related to un-installing the Defective Product or re-installing the repaired or replacement product. The Limited Warranty also covers the costs of shipping repaired or replacement product from Enphase, via a non-expedited freight carrier selected by Enphase, to locations within the United States (including Alaska and Hawaii) and Canada, but not to other locations outside the United States or Canada. The Limited Warranty does not cover, and Enphase will not be responsible for, shipping damage or damage caused by mishandling by the freight carrier and any such damage is the responsibility of the freight carrier.

To obtain repair or replacement service under this Limited Warranty, the customer must comply with the following policy and procedure:

- All Defective Product must be returned with a Return Merchandise Authorization Number (RMA) which customer must request from Enphase. Before requesting the RMA, however, the customer should contact an Enphase technical support representative to evaluate and troubleshoot the problem while the Envoy Communications Gateway is in the field, since many problems can be solved in the field.
- If in-field troubleshooting does not solve the problem, Customer may request the RMA number, which request must include the following information:

    - Proof-of-purchase of the Defective Product in the form of (1) the dated purchase receipt from the original purchase of the product at point of sale to the end user, or (2) the dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status, or (3) the dated invoice or purchase receipt showing the product exchanged under warranty
    - Model number of the Defective Product.
    - Serial number of the Defective Product.

- Detailed description of the defect.
- Shipping address for return of the repaired or replacement product.

- All Defective Product authorized for return must be returned in the original shipping container or other packaging that is equally protective of the product.
- The returned Defective Product must not have been disassembled or modified without the prior written authorization of Enphase.

The Enphase Envoy Communications Gateways are designed to withstand normal operating conditions and typical wear and tear when used for their original intent and in compliance with the installation and operating instructions supplied with the original equipment. The Limited Warranty does not apply to, and Enphase will not be responsible for, any defect in or damage to any Enphase Envoy Communications Gateway: (1) that has been misused, neglected, tampered with, altered, or otherwise damaged, either internally or externally; (2) that has been improperly installed, operated, handled or used, including use under conditions for which the product was not designed, use in an unsuitable environment, or use in a manner contrary to the Enphase User Manual or applicable laws or regulations; (3) that has been subjected to fire, water, generalized corrosion, biological infestations, acts of God, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the Enphase Envoy Communications Gateway specifications, including high input voltage from generators or lightning strikes; (4) that has been subjected to incidental or consequential damage caused by defects of other components of the solar system; or (5) if the original identification markings (including trademark or serial number) of such Envoy Communications Gateway have been defaced, altered, or removed. The Limited Warranty does not cover costs related to the removal, installation or troubleshooting of the customer's electrical systems. The Limited Warranty does not extend beyond the original cost of the Enphase Envoy Communications Gateway.

THE LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY GIVEN BY ENPHASE AND, WHERE PERMITTED BY LAW, IS MADE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF TITLE, QUALITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OR WARRANTIES AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN MANUALS OR OTHER DOCUMENTATION. IN NO EVENT WILL ENPHASE BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, COSTS OR EXPENSES HOWEVER ARISING, WHETHER IN CONTRACT OR TORT, INCLUDING WITHOUT LIMITATION ANY ECONOMIC LOSSES OF ANY KIND, ANY LOSS OR DAMAGE TO PROPERTY, OR ANY PERSONAL INJURY.

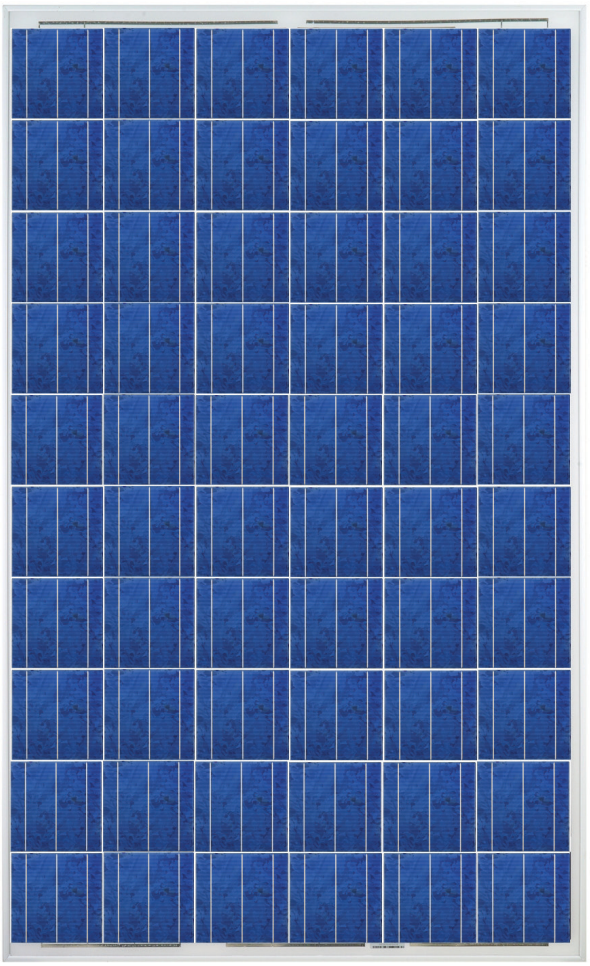
To the extent any implied warranties are required under applicable law to apply to the Envoy Communications Gateway, such implied warranties shall be limited in duration to the Warranty Period, to the extent permitted by applicable law. Some states and provinces do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply. This Limited Warranty gives the customer specific legal rights, and the customer may have other rights that may vary from state to state or province to province.

Enphase Energy Inc.
201 1St Street
Petaluma, CA 94952
Phone: 707-763-4784
TOLL FREE: 877-797-4743
Fax: 707-763-0784
www.enphaseenergy.com
info@enphaseenergy.com

Conergy P 235PA

The Conergy P 235PA offers high output levels at an attractive price/performance ratio. Equipped with 60 efficient, polycrystalline cells, they have proven their value in practical applications and years of operation. They are characterized by high yields and a long service life. Conergy P production is certified to ISO 9001 international quality standards and Conergy continually monitors the production process to insure product quality. These high-efficiency modules are powerful and versatile enough for any application from residential through utility scale.

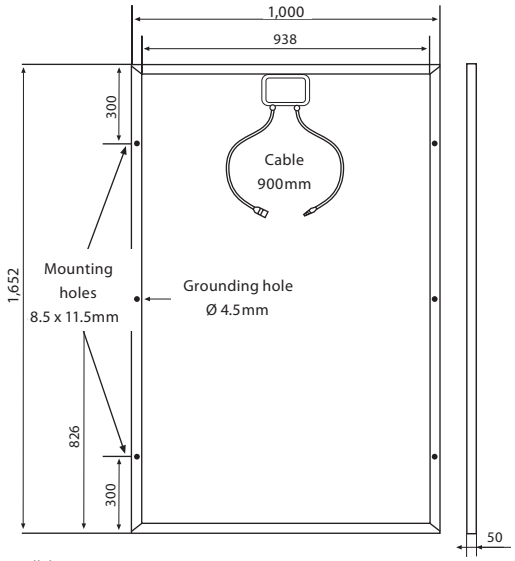
Solar modules in the Conergy P-series are also available with monocrystalline and polycrystalline cells in other power classes and different module dimensions.



Features:

- Attractive price/performance ratio
- High-efficiency 3-busbar cells
- Certified to UL1703, IEC/EN61215, 61730
- High-performance, ±3% power tolerance
- 5-year product warranty

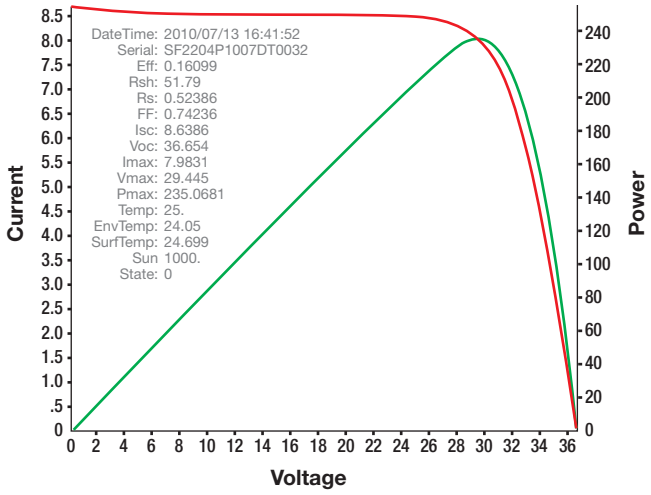
Conergy P 235PA



All dimensions in mm

Module dimensions (L x W x H)	1,651 × 986 × 46 mm (65 x 38.8 x 1.8 in)
Cell dimensions	156 x 156 mm (6.14 x 6.14 in)
Number of cells	60
Module weight	22kg (48.5 lb)
Static wind/snow load	5400PA / 113psf
Glass	Tempered, A/R coating
Junction box	IP65 Class
Cable	900mm/35.4in PV Wire, 4mm²
Connector	Amphenol H4 (MC4 compatible)
Certifications	
Operating certifications	cULus, IEC 61215 Ed.2
Fire safety classification	Class C
Warranty	
Material and workmanship warranty	5 years
Power warranty 1	90%/12 years
Power warranty 2	80%/25 years

	Conergy P 235PA
Rated power (P_{max})[1]	235W
Power tolerance	±3%
Module efficiency	14.20%
Maximum power voltage (V_{mpp})	30.01V
Maximum power current (I_{mpp})	7.81A
Open circuit voltage (V_{oc})	33.5V
Short circuit current (I_{sc})	8.44A
Nominal Operating Cell Temperature (NOCT)	45.3°C/113.5°F
Temperature coefficient (P_{max})	-0.45%/°C
Temperature coefficient (V_{oc})	-0.32%/°C
Temperature coeficient (I_{sc})	+0.04%/°C
Operating temperature range	-40°C - +85°C / -40°F - +136°F
Maximum system voltage	600V (UL)/1000V (IEC)
Maximum Series Fuse Rating	15A



[1] At Standard Test Conditions (STC): 1000W/m², 25°C, AM 1.5 spectral density
[2] Available at additional cost

Available from:

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www eco-fasten com

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Toll Free Fax 1.888.766.9994
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Eco-Fasten™ - Universal Roof Attachment
Roof Attachment System Components

Build the **Eco-Fasten** System From the Bottom Up to Fit Your Needs

Eco-Fasten- 65-ST / GA-10 / F201-3/8 / UNI-V

Flashing

GA-10 = 10"x10" Galvalume
GA-14 = 10"x14" Galvalume
TP = 12"x12" Membrane

Attachment

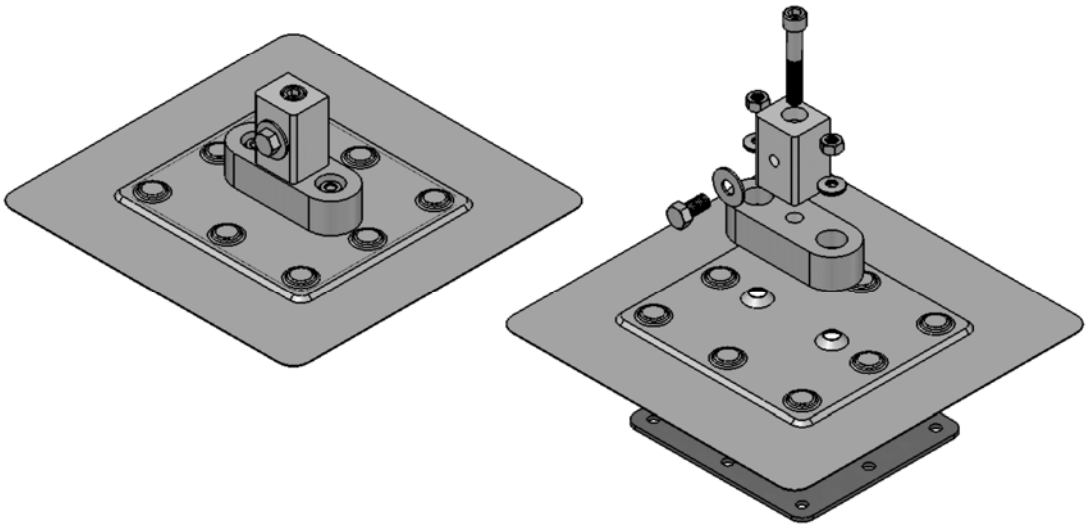
F201-1/4 = Flat 1/4-20 Tapped Hole
F201-5/16 = Flat 5/16-18 Tapped Hole
F201-3/8 = Flat 3/8-16 Tapped Hole

F202-1/4 = Flat Two 1/4-20 Tapped Holes
F202-5/16 = Flat Two 5/16-18 Tapped Holes
F202-3/8 = Flat Two 3/8-16 Tapped Holes

T203 = Vertical Three Hole

Accessory - if Needed

UNI-V = Vertical UniStrut Adaptor (Requires F201-3/8 or F202-3/8)
UNI-A = Adjustable Angle UniStrut Adaptor (Requires F202-3/8)
VFM = Female Vibration Isolator (Requires F201-5/16 or F202-5/16)
VM = Male Vibration Isolator (Requires F201-5/16 or F202-5/16)



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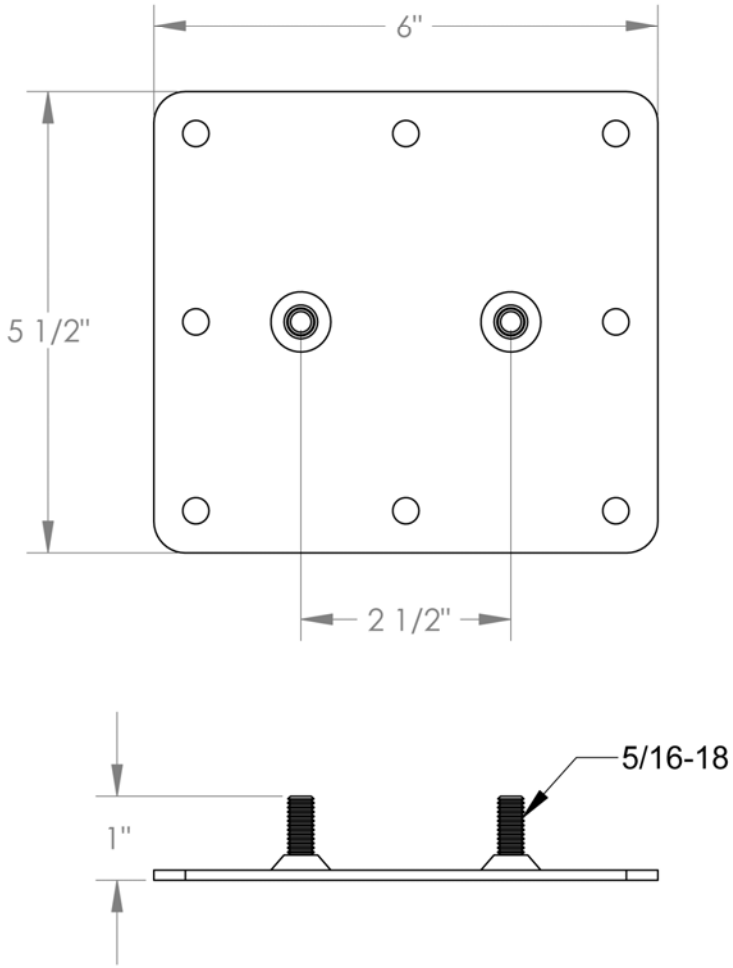
Eco-Fasten™ - Universal Roof Attachment
Base Plate

NOTES:
1.INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2.DO NOT SCALE DRAWINGS.
3.CONTACT MANUFACTURER FOR DETAILED LAYOUT.

REVISIONS		
REV.	DESCRIPTION	DATE



Base Plate: 65-ST

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Galvalume® Flashing

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REVISIONS		
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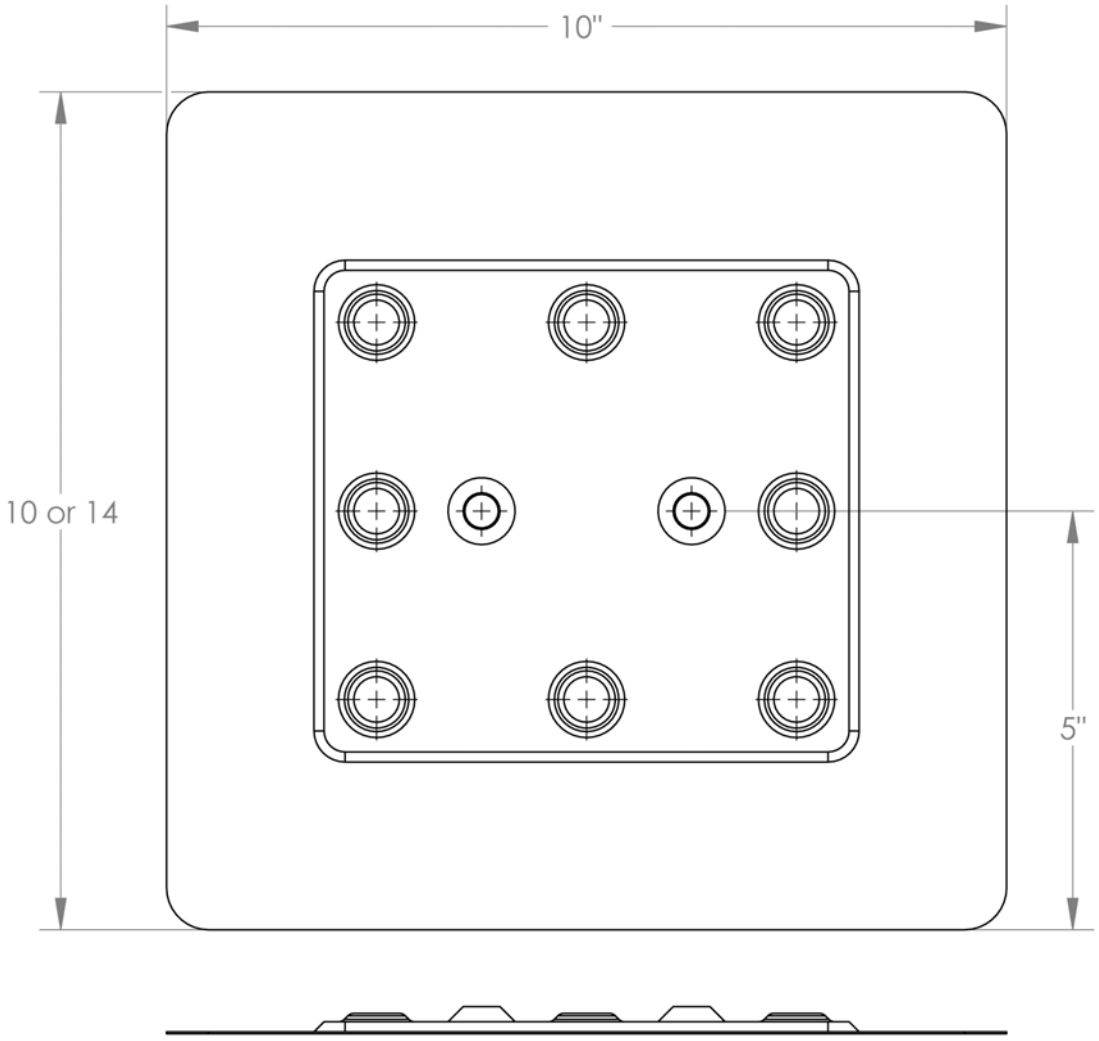

Flashing: GA- ____

10: 10" x 10"
14: 10" x 14"

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Membrane Flashing

NOTES:
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REVISIONS		
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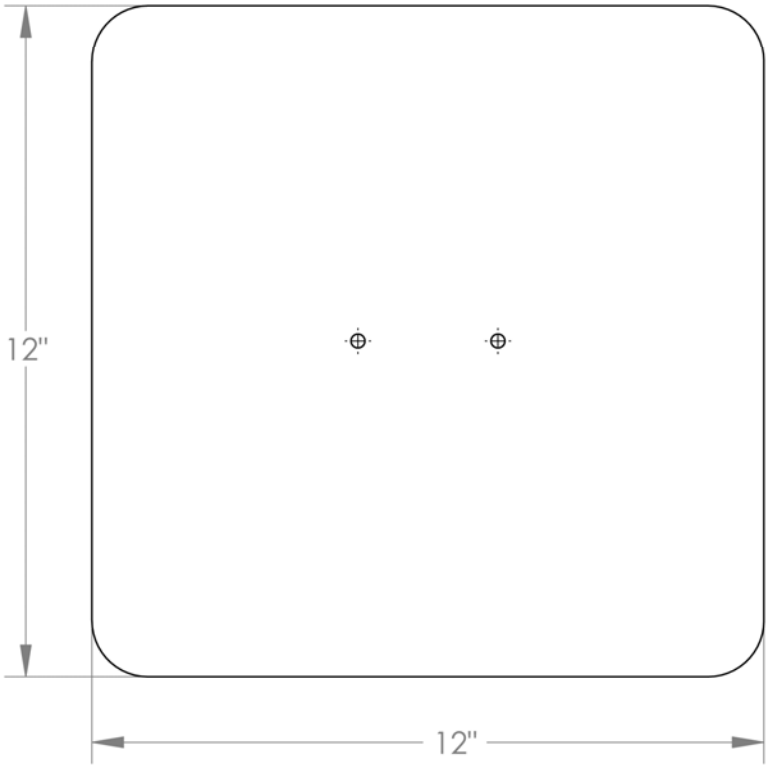

Flashing: TP

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Eco-Fasten™ - Universal Roof Attachment
F201 – Top Plate One Fastener Attachment

NOTES:
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REVISIONS		
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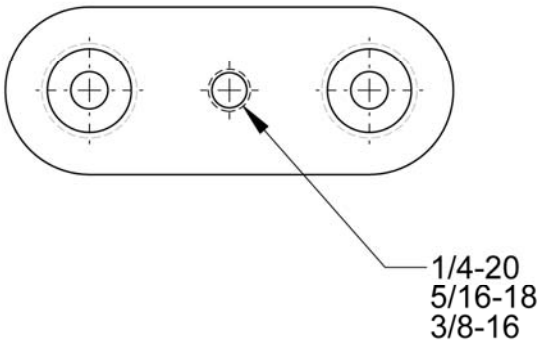

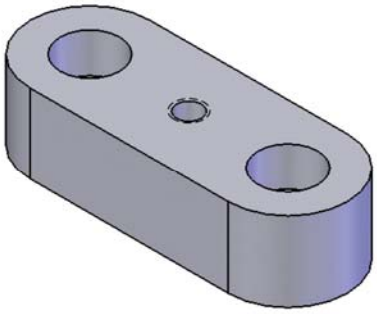

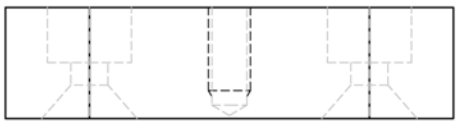

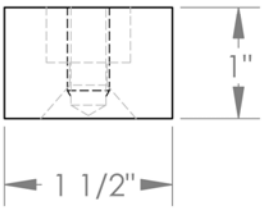

Attachment: F201-_____

1/4: 1/4-20
5/16: 5/16-18

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F202 – Top Plate Two Fastener Attachment

NOTES:
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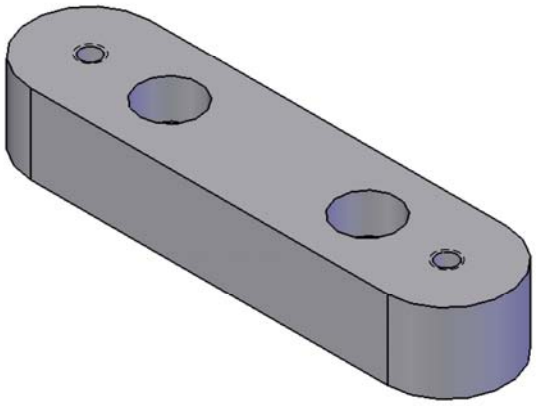
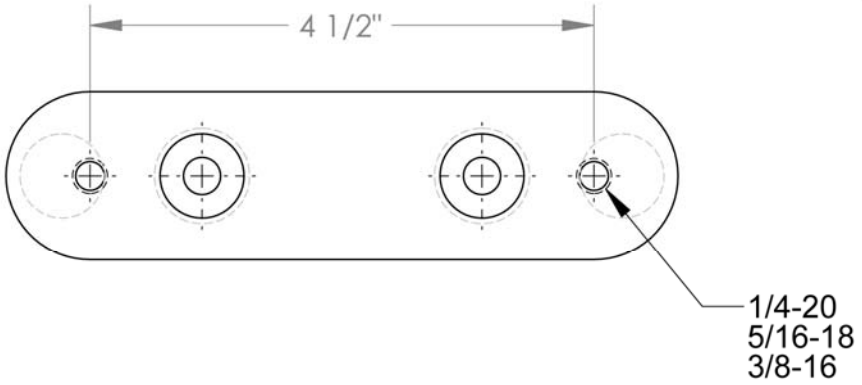
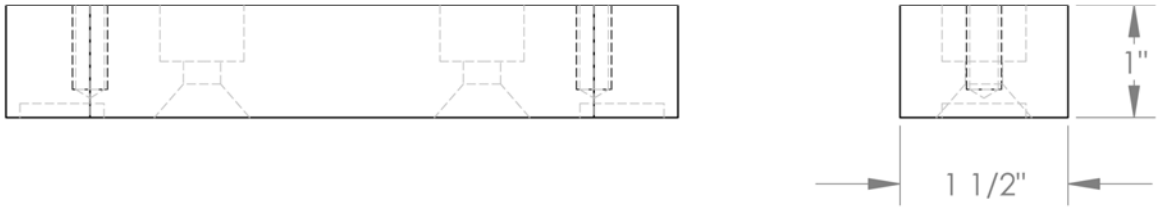
REVISIONS		
REV.	DESCRIPTION	DATE







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1/4: 1/4-20
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3/8: 3/8-16

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T203 – Top Plate Vertical Three Fastener Attachment

NOTES:
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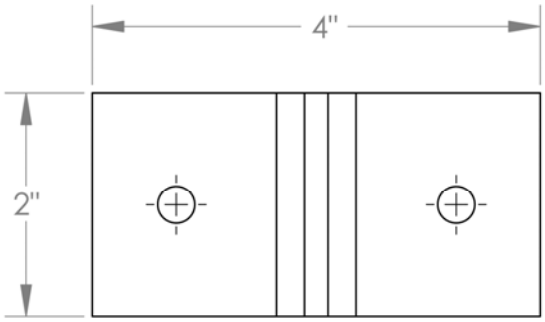
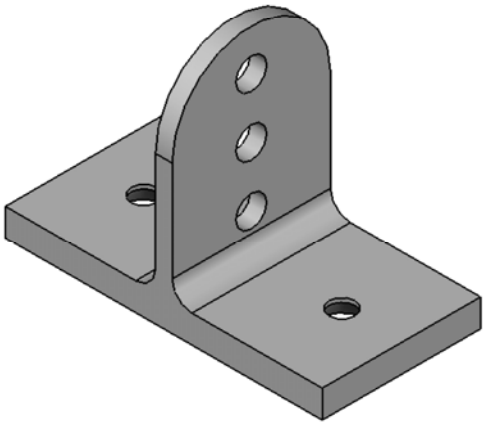
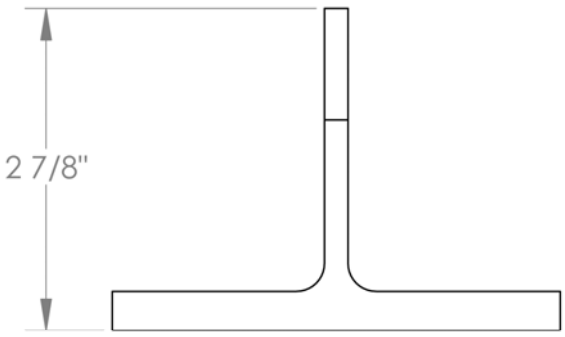
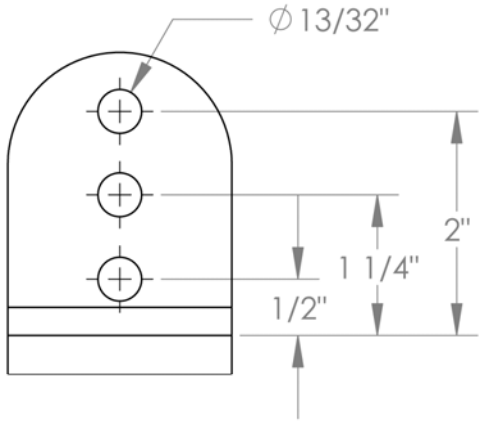
REVISIONS		
REV.	DESCRIPTION	DATE









Attachment: T203

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Eco-Fasten™ - Universal Roof Attachment
UNI-V – Unistrut® Adapter

NOTES:
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2.DO NOT SCALE DRAWINGS.
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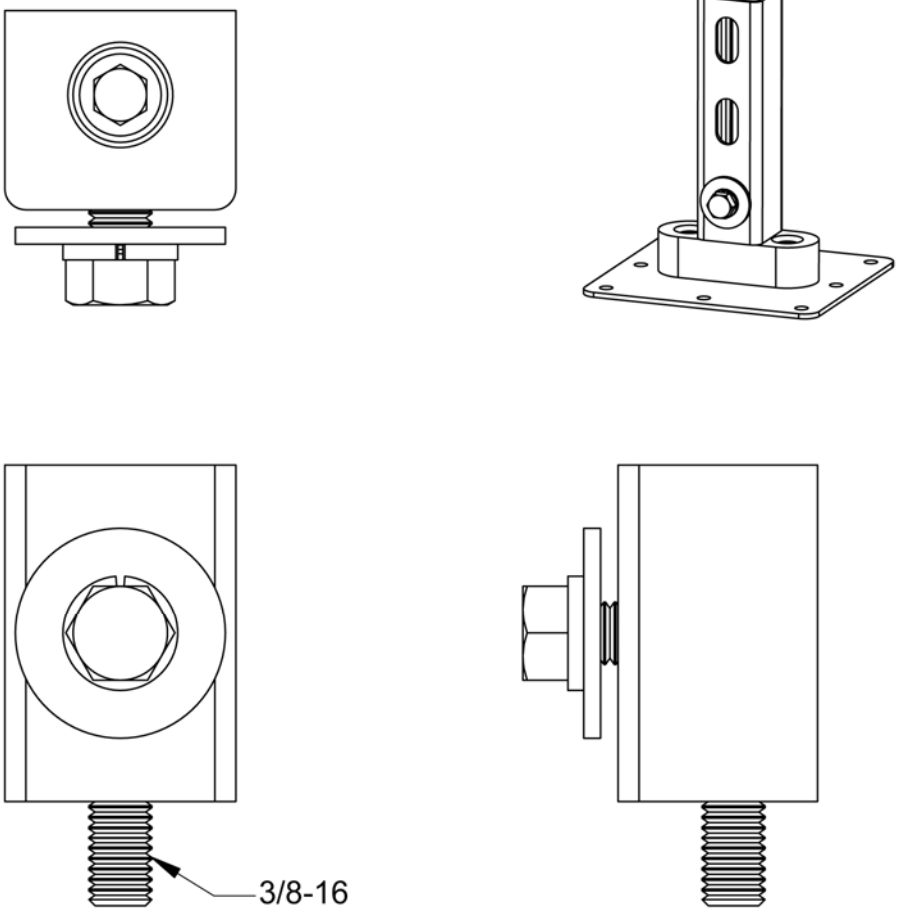
REVISIONS		
REV.	DESCRIPTION	DATE

Allows Attachment of 1-5/8" Unistrut



Accessory: UNI-V

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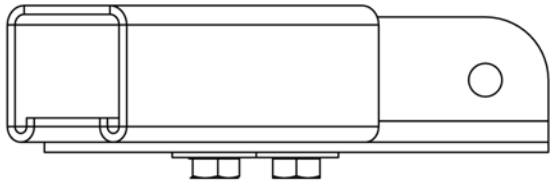
E-mail info@eco-fasten.com

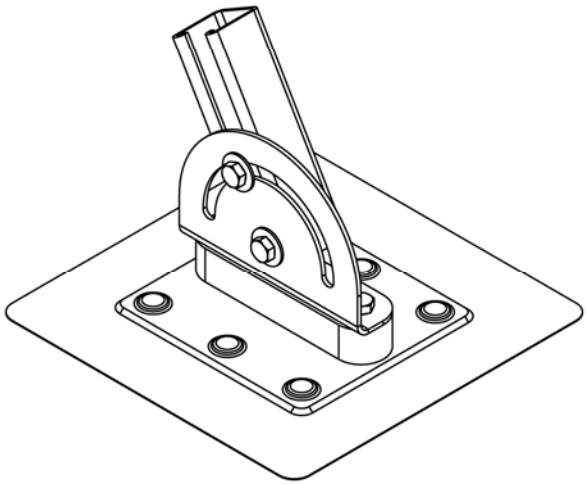
Eco-Fasten™ - Universal Roof Attachment
UNI-A – Unistrut® Adjustable Adapter

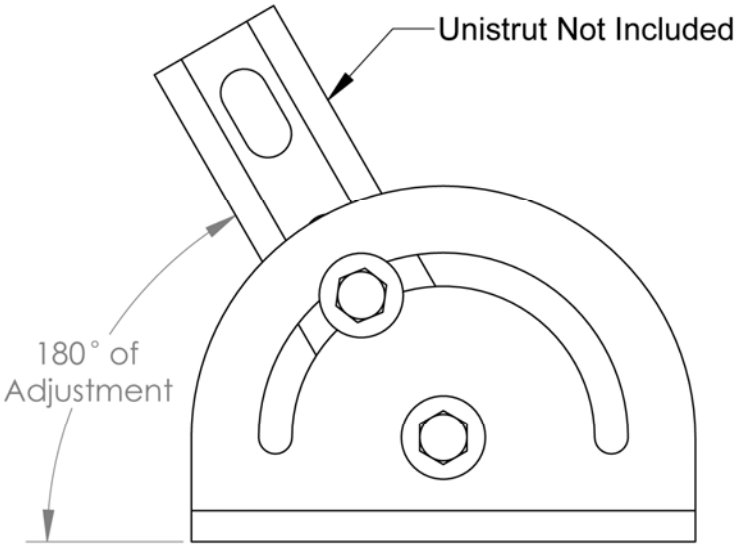
NOTES:
1.INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2.DO NOT SCALE DRAWINGS.
3.CONTACT MANUFACTURER FOR DETAILED LAYOUT.

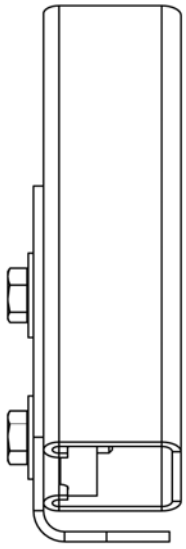
REVISIONS		
REV.	DESCRIPTION	DATE

Allows Attachment of 1-5/8" Unistrut at Any Angle









Accessory: UNI-A

Document version 03.18.2008

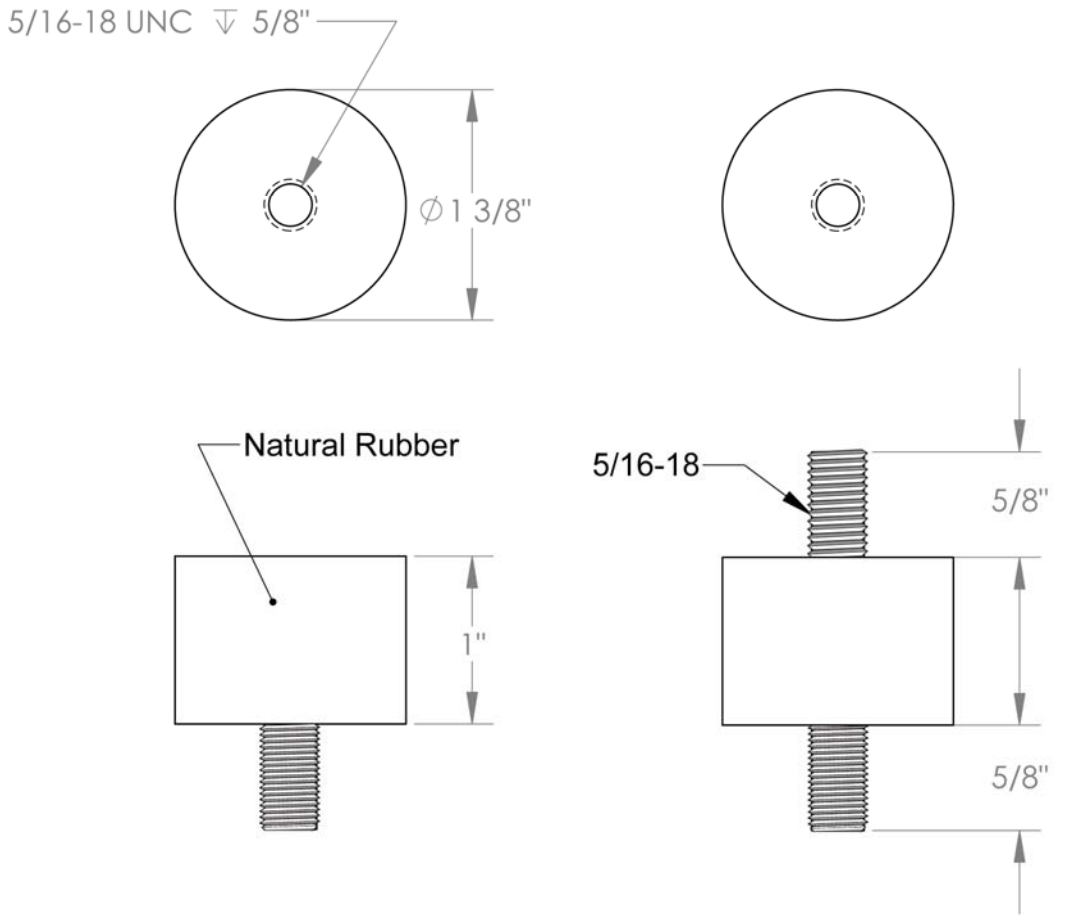
Eco-Fasten™
www eco-fasten com

289 Harrel Street
Morrisville, VT 05661
Toll Free Phone 1.888.766.4273
Toll Free Fax 1.888.766.9994
E-mail info@eco-fasten.com

Eco-Fasten™ - Universal Roof Attachment
VI-F, VI-M Vibration Isolator

NOTES:
1.INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2.DO NOT SCALE DRAWINGS.
3.CONTACT MANUFACTURER FOR DETAILED LAYOUT.

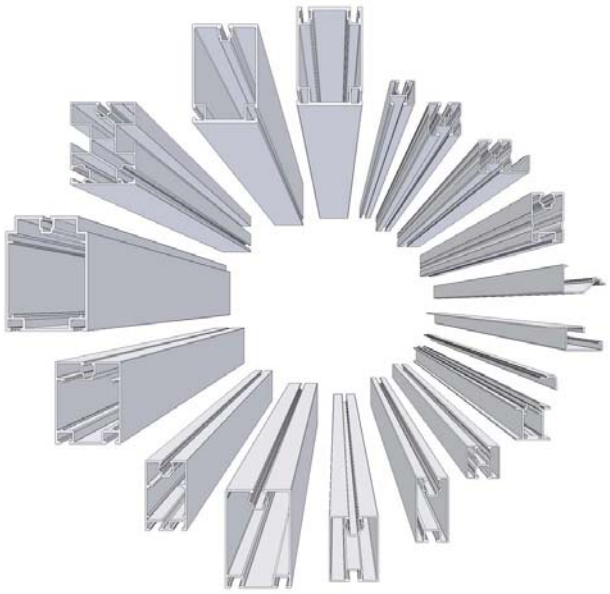
REVISIONS		
REV.	DESCRIPTION	DATE



Accessory: VI-F **Accessory: VI-M**

Document version 03.18.2008

Schletter - Profiles



Huge variety on profiles!

- **New series with click system!**
- **All girders include system statics**
- **The biggest variety on special profiles!**
- **Span- and Load tables as assistance**
- **10 year guarantee**

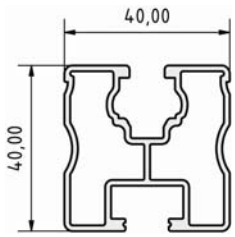
Schletter holds design and product patents for a variety of profiles. Our huge selection on different profiles and their different characteristics ensure many design and combination possibilities and applications to the PV-System.

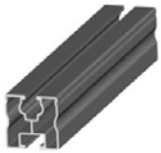
Please note following hint:

Every profile design has its own article number. The add-on represents the standard length (e.g. 430 010–6 for a 6 m long profile). Of course all profiles can be customized to the length you need them.

1 Girder profiles for standard applications:

Mostly used as cross beams





430 070

Girder profile Solo 05

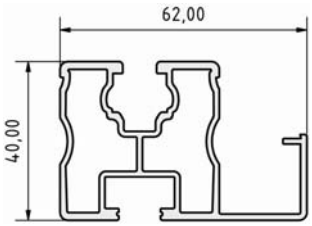
Use:
Cross beam for tilted roofs and erected systems

Support distance:
Please see span tables.

Lengths:
6 m (20 ft), 4 m (13 ft), customized lengths

Statics:
System statics profiles 05

Mechanical connection:
Top: Click component with square nut M8
Bottom: Hexagonal screw M10



430 010

Girder Profile Pro 05

Use:
Cross beam for tilted roofs and erected systems.

Support distance:
Please see span tables

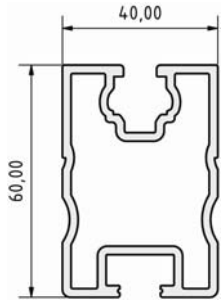
Lengths:
6 m (20 ft), 4 m (13 ft), customized lengths

Statics:
System statics profiles 05

Mechanical connection:
Top: Click component with square nut M8
Bottom: Hexagonal screw M10

430 022

Optional add on:
Lid Cable duct for Pro 05 (see below)



430 015
Girder Profile ProPlus

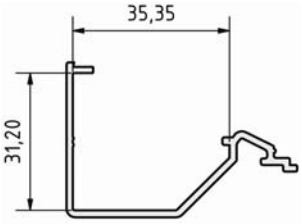
Use:
Cross beam for tilted roofs and erected systems. Able to handle bigger span distances.

Support distance:
Please see span tables

Lengths:
6 m (20 ft), customized lengths

Statics:
System statics profiles 05

Mechanical connection:
Top: Click component with square nut M8
Bottom: Hexagonal screw M10



430 020 (on inquiry)
Additional Cable Duct

Use:
Usable with profiles Solo 05, Pro 05, ProPlus.
Clicks in ti the above mentioned profiles

Lengths:
6 m (20 ft), 4m (13 ft), customized lengths

Mechanical connection:
Click in to profile

430 022
Optional add on:
Lid Cable duct (see below)

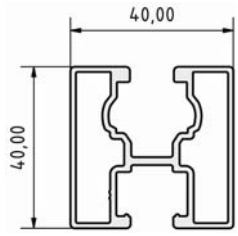
430 022
Lid Cable Duct

Use:
Lid for above mentioned cable ducts

Lengths:
6 m (20 ft), 4 m (13 ft), customized lengths

Mechanical connection:
Click on to cable ducts

2 Double groove profiles – DN series
Mostly used as carrier beam



400 064 (on inquiry)
Mounting structure DN0

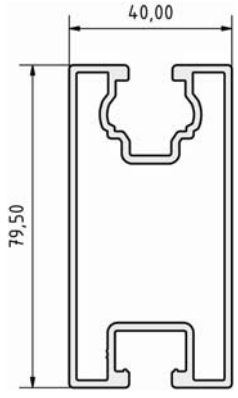
Use:
- Vertical beam in Schletter FR-CompactVario system.
- Bottom carrying crossbeam in erected systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), customized lengths

Statics:
Please contact us

Mechanical connection:
Top: Hexagonal screw M10 or Click component with square nut M8
Bottom: Hexagonal screw M10



400 065
Mounting structure DN1

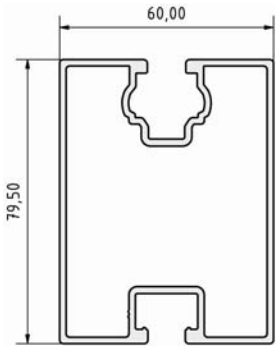
Use:
- Vertical beam in Schletter FR-CompactVario system.
- Bottom carrying crossbeam in erected systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), customized lengths

Statics:
Please contact us

Mechanical connection:
Top: Hexagonal screw M10 or Click component with square nut M8
Bottom: Hexagonal screw M10



400 082
Mounting structure DN2

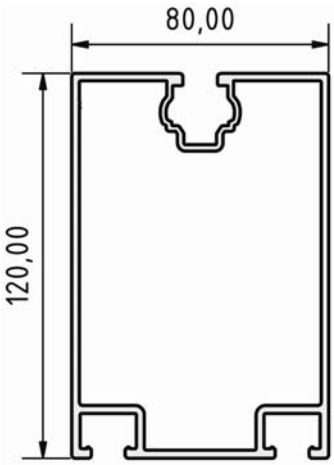
Use:
- Vertical beam in Schletter FR-CompactVario system.
- Bottom carrying crossbeam in erected systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), customized lengths

Statics:
Please contact us

Mechanical connection:
Top: Hexagonal screw M10 or Click component with square nut M8
Bottom: Hexagonal screw M10



400 083
Mounting structure DN3

Use:
- Vertical beam in Schletter FR-CompactVario system.
- Bottom carrying crossbeam in erected systems

Support distance:
Please contact us

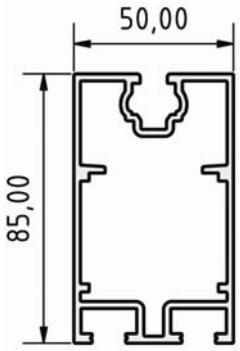
Lengths:
6 m (20 ft), customized lengths

Statics:
Please contact us

Mechanical connection:
Top: Hexagonal screw M10 or Click component with square nut M8
Bottom: Hexagonal screw M10

3 Special Girder profiles, GP - series

For objects with extreme wide span length



400 085

Cross beam GP1

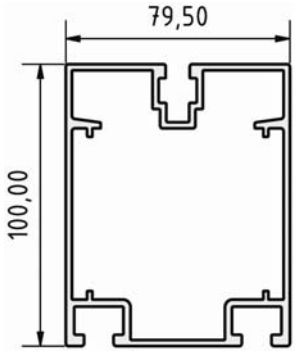
Use:
Cross beam for special span lengths (please see Schletter system static), with bending resistant plugin connectors

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Please contact us

Mechanical connection:
Top: Hexagonal screw M10 or Click component with square nut M8
Bottom: 2 x Hexagonal screw M10



400 090

Cross beam GP2

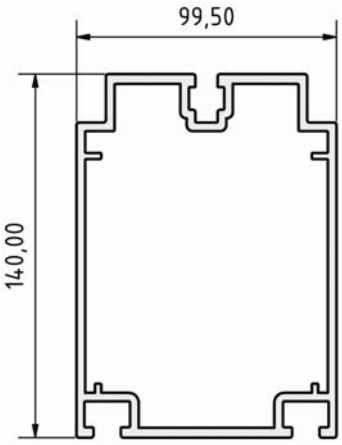
Use:
Cross beam for special span lengths (please see Schletter system static), with bending resistant plugin connectors

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Please contact us

Mechanical connection:
Top: Hexagonal screw M10 or Click component with square nut M8
Bottom: 2 x Hexagonal screw M10



400 091

Cross beam GP3

Use:
Cross beam for special span lengths (please see Schletter system static), with bending resistant plugin connectors

Support distance:
Please contact us

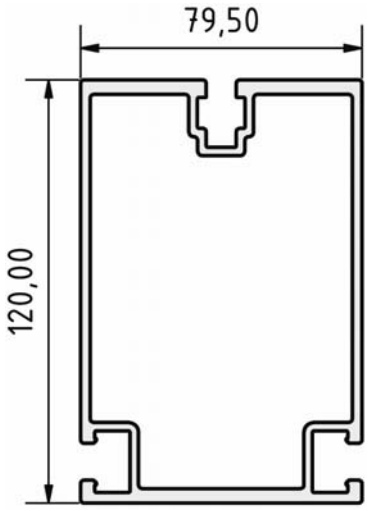
Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Please contact us

Mechanical connection:
Top: Hexagonal screw M10 or Click component with square nut M8
Bottom: 2 x Hexagonal screw M10

4 *Special girder profiles, XX – series*

for Free Field systems and special applications



400 080 (on inquiry)

Mounting structure XX2

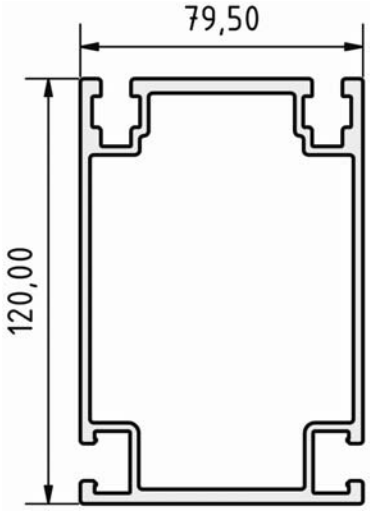
Use:
- Crossbeam in Free Field System PVMax,
- Crossbeam for special requirements to roof and roof systems

Support distance:
Please contact us

Lengths:
6m (20 ft), customized lengths in large PV-projects

Statics:
Please contact us

Mechanical connection:
Top & Bottom: Click component with square nut M8
Sides: Click component with 2 x hexagon nut M10



400 081 (on inquiry)

Mounting structure XX3

Use:
- Crossbeam in Free Field System PVMax,
- Crossbeam for special requirements to roof and roof systems

Support distance:
Please contact us

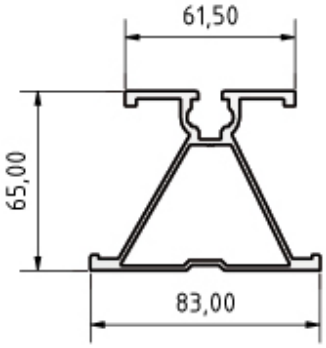
Lengths:
6m (20 ft), customized lengths in large PV-projects

Statics:
Please contact us

Mechanical connection:
Top & Bottom: Click component with square nut M8
Sides: Click component with 2 x hexagon nut M10

6 Module carrier profiles, S – series

System IsoTop, FS, PVMax3 and special applications



440 130

Module carrier S0

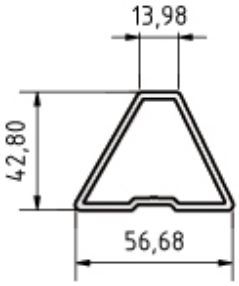
Use:
- Crossbeam in Free Field System
- Optimized features for large span length in Free Field systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special claw (please contact us)



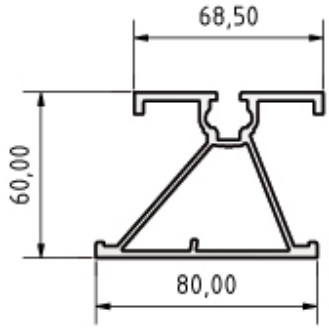
440 130-VE

Connector for Module carrier S0

Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws



430 131

Module carrier S1 Inside

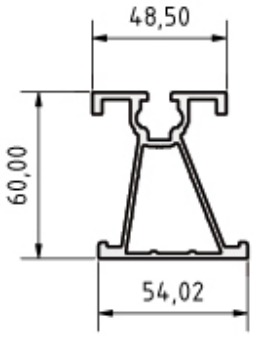
Use:
- Crossbeam in Free Field System
- Optimized features for large span length in Free Field systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special claw (please contact us)



440 135

Module carrier S1 Outside

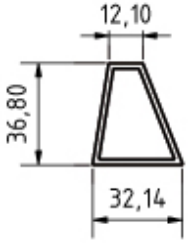
Use:
- Crossbeam in Free Field System
- Optimized features for large span length in Free Field systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special claw (please contact us)



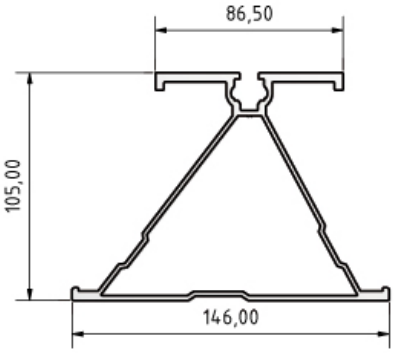
440 131-VE

Connector for Module carrier S1

Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws



430 132

Module carrier S2

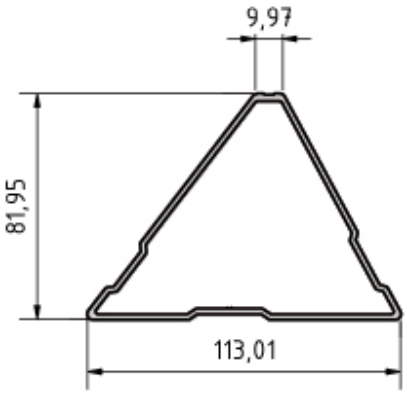
Use:
- Crossbeam in Free Field System
- Optimized features for large span length in Free Field systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special claw (please contact us)



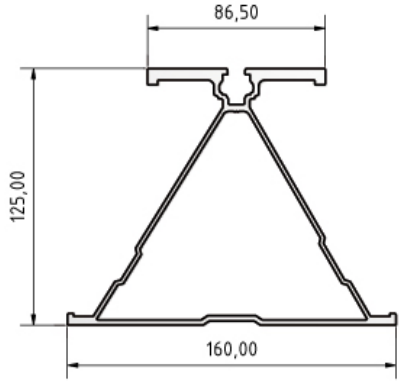
440 132-VE

Connector for Module carrier S2

Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws



430 133

Module carrier S3

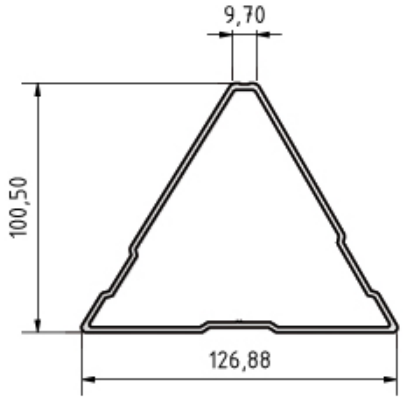
Use:
- Crossbeam in Free Field System
- Optimized features for large span length in Free Field systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special claw (please contact us)



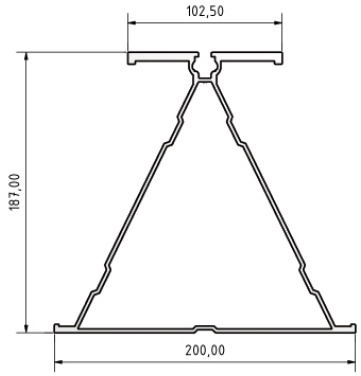
440 133-VE

Connector for Module carrier S3

Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws



430 134

Module carrier S4

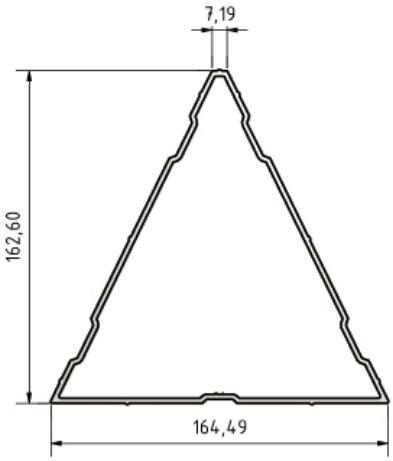
Use:
- Crossbeam in Free Field System
- Optimized features for large span length in Free Field systems

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special claw (please contact us)



440 134-VE

Connector for Module carrier S4

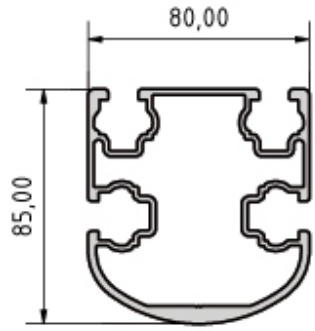
Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws

7 Mounting structures, BF - series

For projects with large spans and FS system, IsoTop



440 120

Load distributer BF0

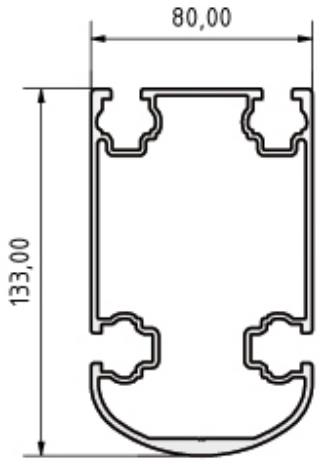
Use:
- Profile as adapter for S-series profile
- Distributes loads over wide spans

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special joint (please contact us)



440 121

Load distributer BF1

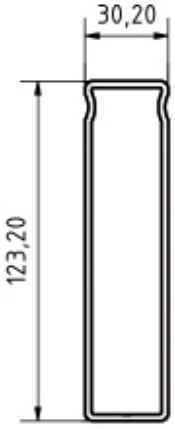
Use:
- Profile as adapter for S-series profile
- Distributes loads over wide spans

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special joint (please contact us)



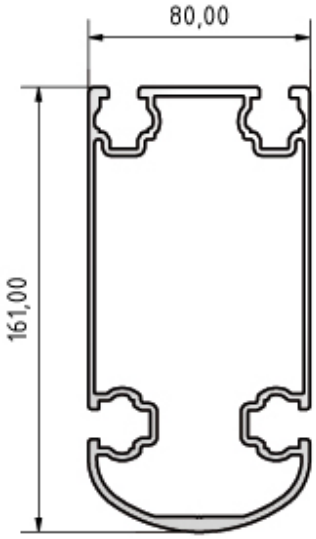
440 121-VE

Connector for Load distributer BF1

Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws



440 122

Load distributer BF2

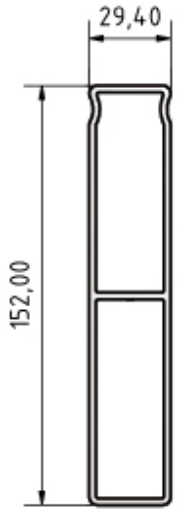
Use:
- Profile as adapter for S-series profile
- Distributes loads over wide spans

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special joint (please contact us)



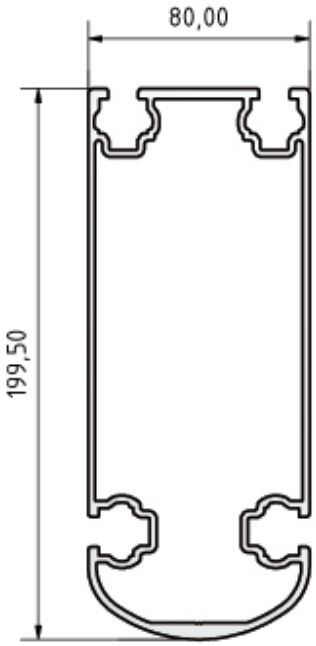
440 122-VE

Connector for Load distributer BF2

Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws



440 123

Load distributer BF3

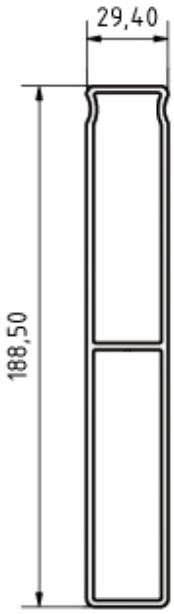
Use:
- Profile as adapter for S-series profile
- Distributes loads over wide spans

Support distance:
Please contact us

Lengths:
6 m (20 ft), 8 m (26 ft), customized lengths

Statics:
Individual each project

Mechanical connection:
Top: Click component with square nut M8
Bottom: Special joint (please contact us)



440 123-VE

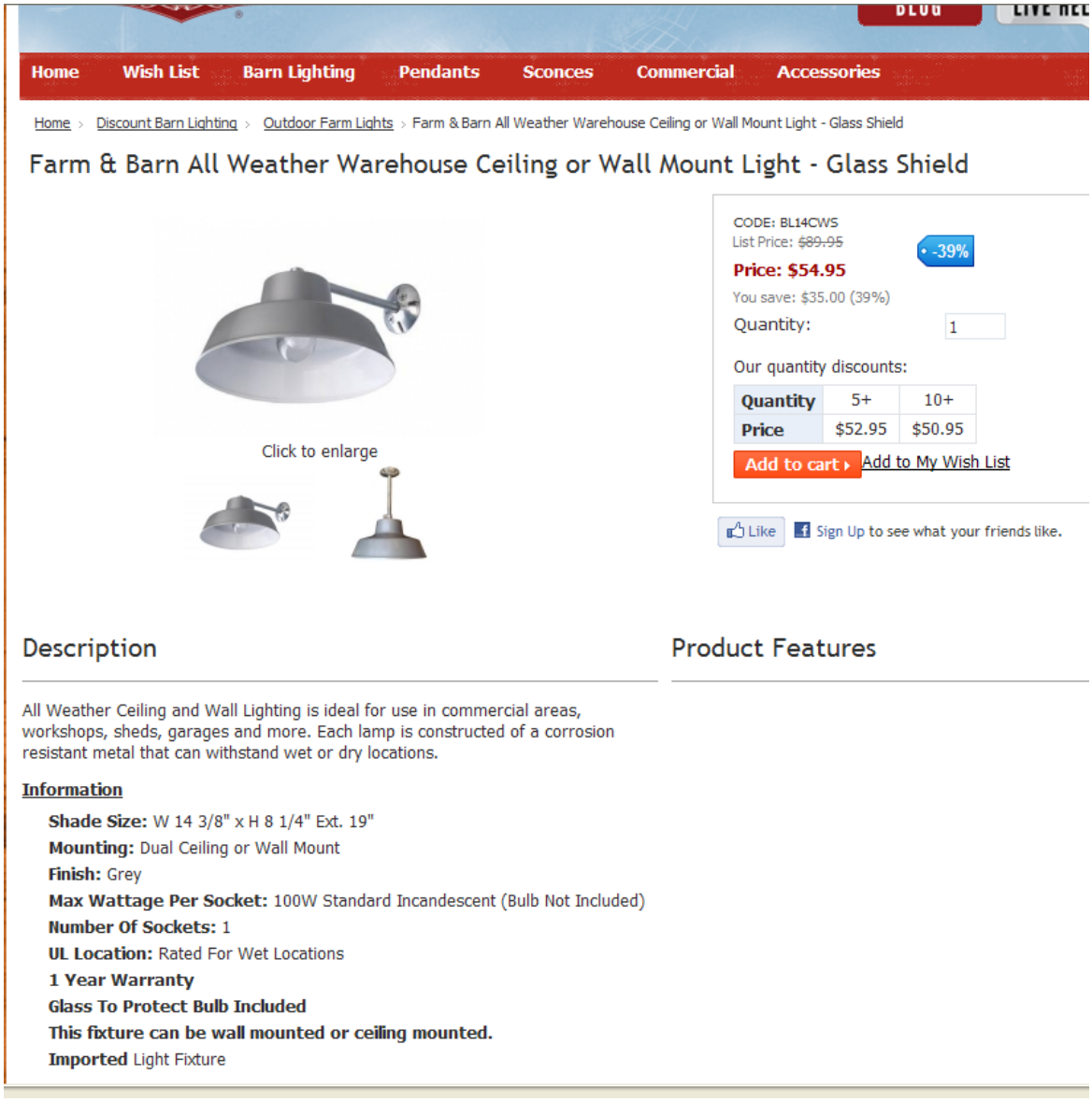
Connector for Load distributer BF3

Length:
500 mm (1.6 ft)

Statics:
Individual each project

Mechanical connection:
Self-drilling screws

Porch and Walkway Lighting



Recessed Lighting for Hallway

ATTENTION:

Cet appareil a été conçu pour un usage intérieur. Consulter un électricien pour une installation sécuritaire.

COUPEZ L'ALIMENTATION AUX FILS DU SECTEUR (120V) AVANT D'EFFECTUER LES CONNECTIONS.

BRANCHEMENTS:
Connectez le fil noir (charge) au fil de couleur, le fil blanc (neutre) au fil blanc et le fil de cuivre (mise à terre) au fil de cuivre de l'appareil. L'usage d'un serre-fil (non-inclus) est recommandé. Conformez-vous aux normes du code de l'électricité en vigueur dans votre région.

INSTALLATION:
1) Retirez le réflecteur d'aluminium.
2) Retirez l'ampoule.
3) Insérez et retenez l'appareil dans le trou d'installation. (Utilisez le gabarit fournit de 4 1/2 po./11.4 cm de diamètre).
4) Serrez les 2 vis jusqu'à ce que l'appareil tienne bien en place.
5) Replacez l'ampoule.
6) Replacez le réflecteur.

ATTENTION: Utilisez des gants et manipulez l'ampoule par la base.

WARNING: Use gloves and hold the bulb by the base.

TROU D'INSTALLATION / INSTALLATION HOLE:
4 1/2" / 11.4 cm
**Utiliser le gabarit sur le côté opposé de la boîte / Use template on the opposite side of the box*

WARNING:

This product is designed for indoor use.
Consult a qualified electrician for a safe installation.

SHUT OFF POWER TO SERVICE LEADS BEFORE PROCEEDING WITH CONNECTIONS.

CONNECTIONS:
Connect black wire (live) to colored wire, white (neutral) to white and bare copper (ground) to bare copper wire from fixture. The use of a wire clip (not included) is recommended. Installation must be in conformance with the electrical code of your region.

INSTALLATION:
1) Remove the aluminium reflector.
2) Remove the bulb.
3) Push and hold the fixture into the installation hole (use the template provided: 4 1/2 inch/11.4cm).
4) Tighten the 2 screws until the fixture sits firmly in place.
5) Replace the bulb.
6) Replace the reflector.

CANARM
CEILING FANS & LIGHTING

VENTILATEURS DE PLAFOND ET ÉCLAIRAGE
CANARM

Vanity Strip

Polished Brass or Chrome or White Finish

4 ½" H x 18" W

Maximum 3 x 60 Watt Medium Base G Type Bulbs (not included)

1 Year Warranty

Model No. IVLBS13 BP or IVLBS13 CH or IVLBS13 WH

Rampe D'éclairage

Fini Laiton Poli ou Chrome ou Blanc

4 ½" H x 18" L

Maximum 3 x 60 Watts Bases Moyennes De Type G (en sus)

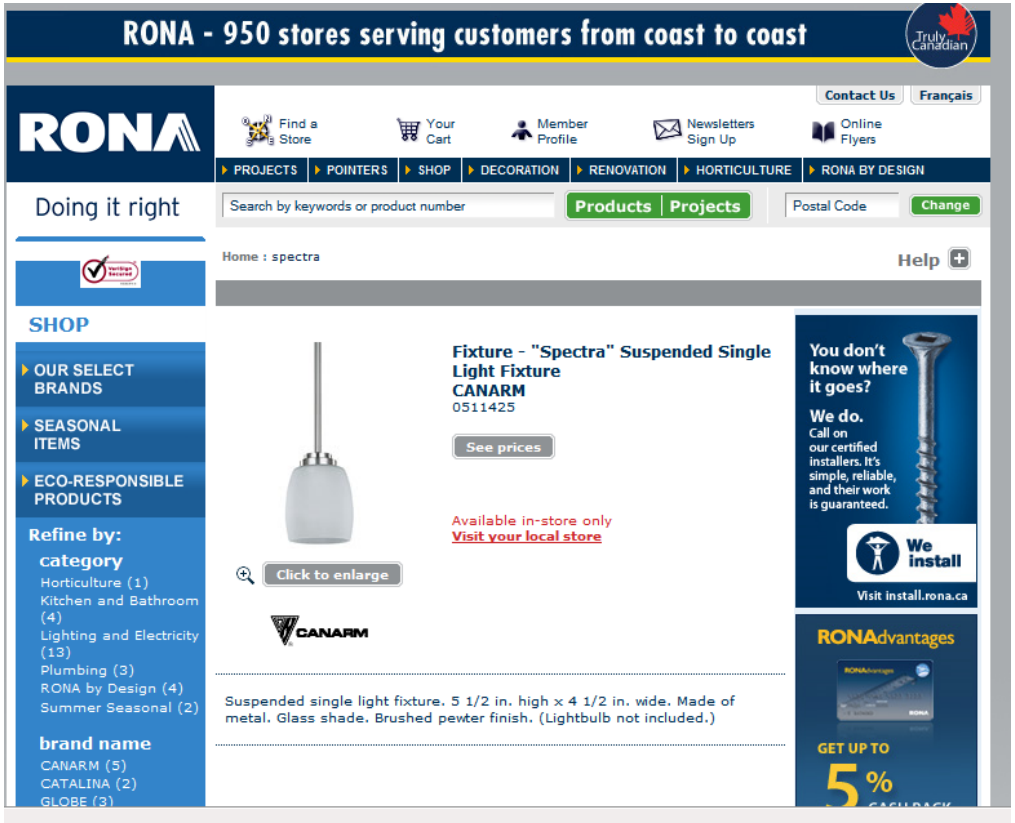
1 An De Garantie

No. Modèle IVLBS13 BP ou IVLBS13 CH ou IVLBS13 WH

Customer Helpline 1-800-265-1833/Ligne D'aide à la Clientèle 1-800-567-2513

Imported by Canarm Ltd., 2157 Parkedale Avenue, Brockville, Ontario K6V 5V6. Telephone: (613) 342-5424. Website: www.canarm.com
Importé par Canarm Ltée., 2157 Avenue Parkedale, Brockville, Ontario K6V 5V6. Téléphone: (613) 342-5424. Adresse Electronique: www.canarm.com

08/05/2011



CSA Listing Shown on box


Pend
Lumière Suspe
nt /
Luz colgante
CANARM
4 1/2" W x 8 1/2" H
08/05/2011
Frosted Glass
Vitre givrée
Vidrio de esmerilado
5 additional extension rods (10") to adjust drop to 58 1/2"
5 Tiges d'extension (10") additionelle pour allonger d'environ 58 1/2"
5 Vara de extensión de (10 pulg.) adicional para ajustar la caída a 58 1/2 pulg.
Can be mounted on sloped ceilings
Peut être installé sur un plafond cathédrale
Puede ser montado en techos con pendiente
Maximum 1 x 60W A Bulb (not included)
Maximum de 1 ampoule de 60W type A (en sus)
Máximo 1 bombilla tipo A de 60W (no incluidas)
IPL233A01BPT
Brushed Pewter Finish
Fini étain brossé
Terminación en peltre
0 62345 23974 3

FACTO

PLAFONNIER

- Série OMNI
- Finition nickel satiné avec le verre d'albâtre
- 7-1/8 po large (18,11 cm)
- Garantie 1 an

1 Type A15/R16 | 60 W Max 130V

Non comprise

C ETL US

3151830

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Galaxy Lighting

... a passion for Lighting

Galaxy Lighting

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Select Type:

Ceiling Fixture

Select Family:

--ALL--

Search by Item No.

go

[Back]

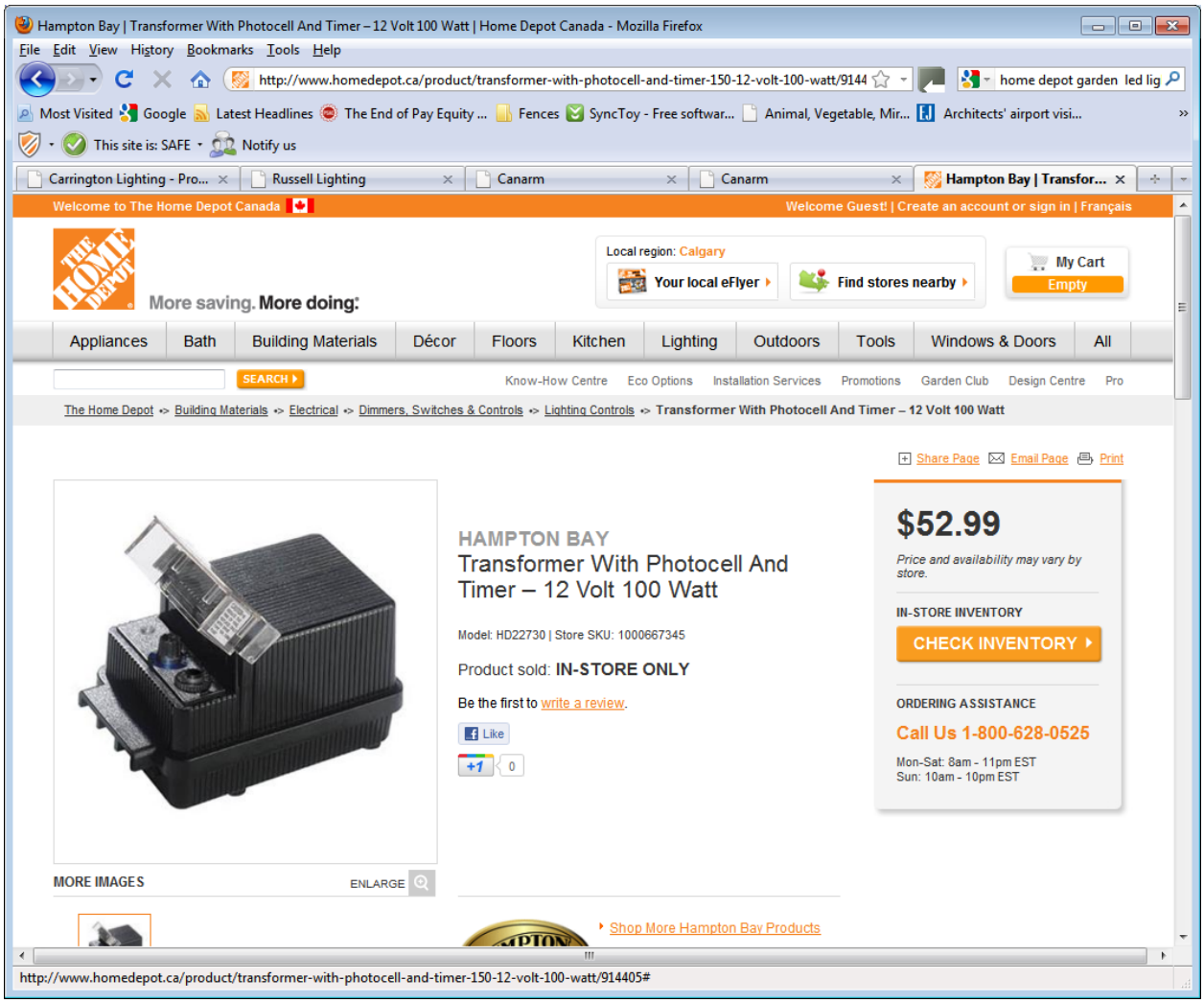
810210PT

CP Item #:	810210PT
Description:	Utility Flush Mount - Pewter w/ White Glass
Category:	Ceiling Fixture
Finish:	Pewter
Diameter:	9-1/2"
Height:	5-1/8"
Lamp Quantity:	1
Lamp Type:	A19, Med. Base
Lamp Wattage:	100W

Have a product question? Galaxy distributors and design professionals are invited to contact us directly by fax: (Vancouver) 604 278-2551 (Toronto) 416 747-6989 or email: sales@galaxy-lighting.com. If you are a residential customer, please contact Galaxy retailer in your area.

Done

UL Listing Shown on Socket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Product sold: IN-STORE ONLY
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$52.99
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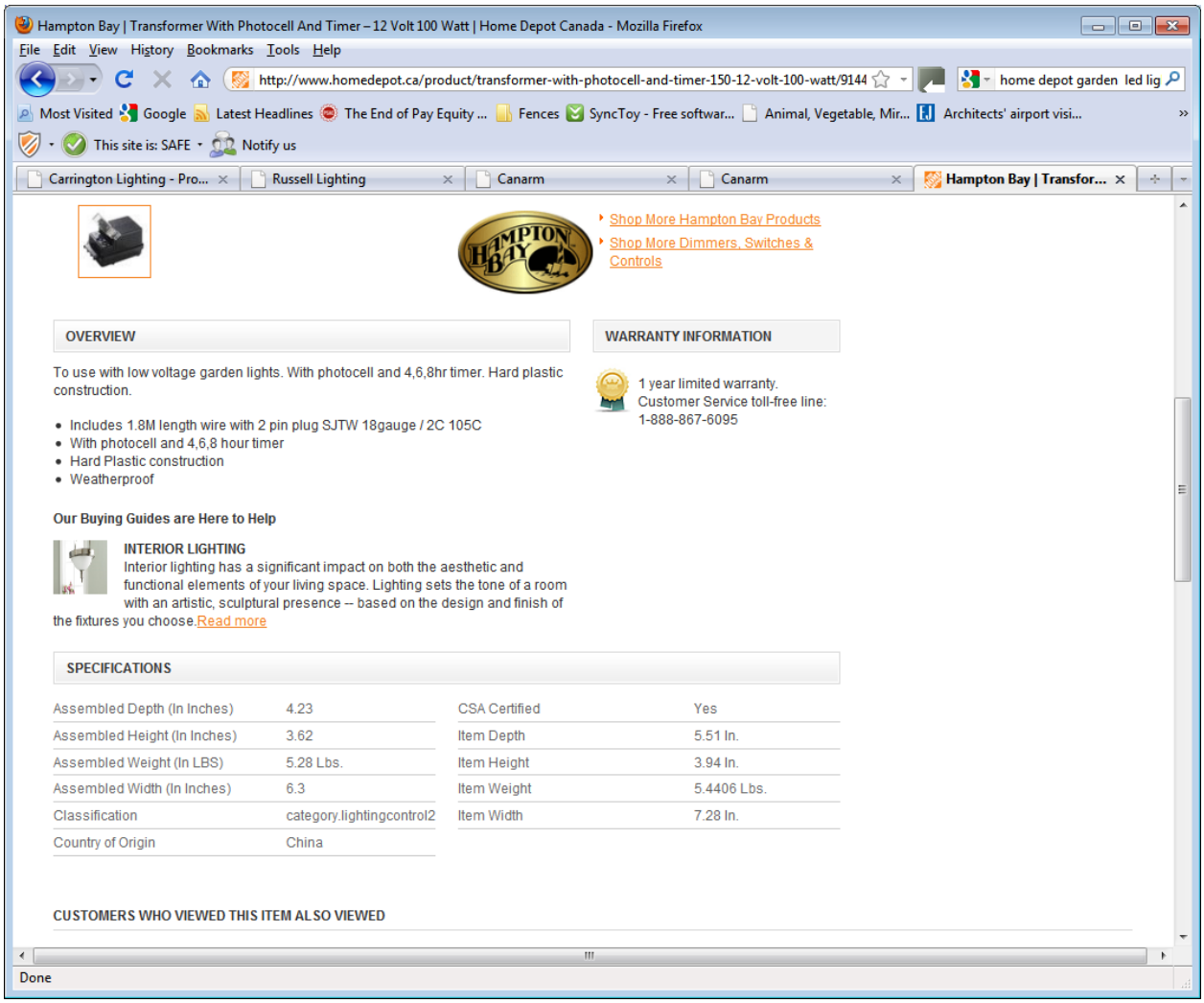
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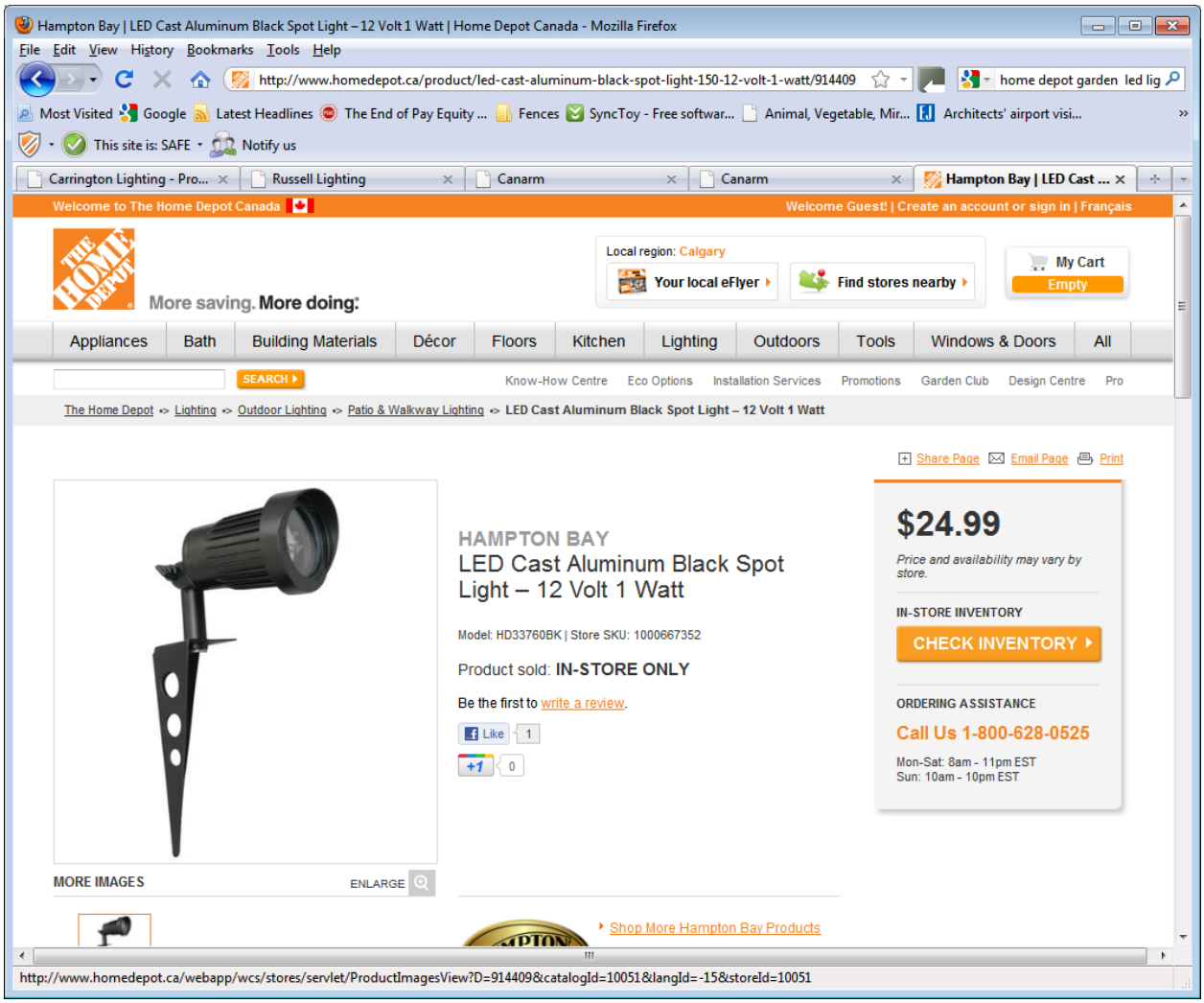
OVERVIEW
To use with low voltage garden lights. With photocell and 4,6,8hr timer. Hard plastic construction.
Includes 1.8M length wire with 2 pin plug SJTW 18gauge / 2C 105C
With photocell and 4,6,8 hour timer
Hard Plastic construction
Weatherproof
Our Buying Guides are Here to Help
INTERIOR LIGHTING
Interior lighting has a significant impact on both the aesthetic and functional elements of your living space. Lighting sets the tone of a room with an artistic, sculptural presence -- based on the design and finish of the fixtures you choose.Read more
WARRANTY INFORMATION
1 year limited warranty.
Customer Service toll-free line:
1-888-867-6095
SPECIFICATIONS
Assembled Depth (In Inches) 4.23
Assembled Height (In Inches) 3.62
Assembled Weight (In LBS) 5.28 Lbs.
Assembled Width (In Inches) 6.3
Classification category.lightingcontrol2
Country of Origin China
CSA Certified Yes
Item Depth 5.51 In.
Item Height 3.94 In.
Item Weight 5.4406 Lbs.
Item Width 7.28 In.
CUSTOMERS WHO VIEWED THIS ITEM ALSO VIEWED
Done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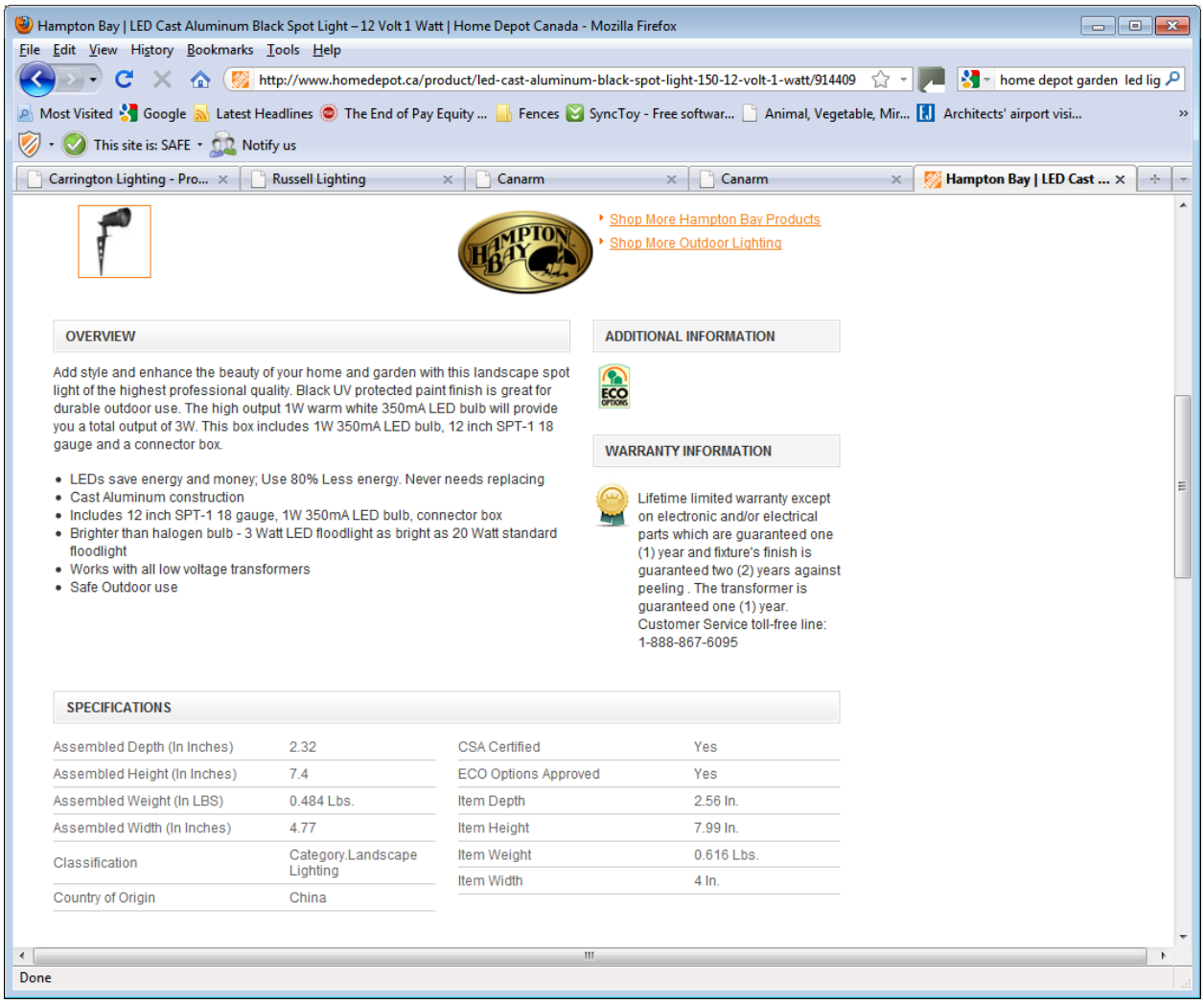
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OVERVIEW
Add style and enhance the beauty of your home and garden with this landscape spot light of the highest professional quality. Black UV protected paint finish is great for durable outdoor use. The high output 1W warm white 350mA LED bulb will provide you a total output of 3W. This box includes 1W 350mA LED bulb, 12 inch SPT-1 18 gauge and a connector box.
LEDs save energy and money; Use 80% Less energy. Never needs replacing
Cast Aluminum construction
Includes 12 inch SPT-1 18 gauge, 1W 350mA LED bulb, connector box
Brighter than halogen bulb - 3 Watt LED floodlight as bright as 20 Watt standard floodlight
Works with all low voltage transformers
Safe Outdoor use
ADDITIONAL INFORMATION
WARRANTY INFORMATION
Lifetime limited warranty except on electronic and/or electrical parts which are guaranteed one (1) year and fixture's finish is guaranteed two (2) years against peeling . The transformer is guaranteed one (1) year. Customer Service toll-free line: 1-888-867-6095
SPECIFICATIONS
Assembled Depth (In Inches) 2.32
Assembled Height (In Inches) 7.4
Assembled Weight (In LBS) 0.484 Lbs.
Assembled Width (In Inches) 4.77
Classification Category.Landscape Lighting
Country of Origin China
CSA Certified Yes
ECO Options Approved Yes
Item Depth 2.56 In.
Item Height 7.99 In.
Item Weight 0.616 Lbs.
Item Width 4 In.
Done

Russell Lighting
789-701/BCH

Fixture Number	789-701/BCH
Lamping	1 x 100A
Glass	gl# 030890 Opal
Project	Solar Decathlon
Fixture Type	Wall Sconce
Notes	
Height	13 1/2"
Diameter	7"
Extension	9 5/8"

www.russell-lighting.com
email this page

Items appearing in red are custom features - you must communicate these options to your sales person at the time of your order.

RUSSELL LIGHTING

From the Desk of Sylvia Sebastian

4062 McConnell Drive
Burnaby, B.C.
V5A 3A8

(604)420-2440 Phone
(604)420-4393 Fax
E-Mail: sylvia@russell-lighting.com

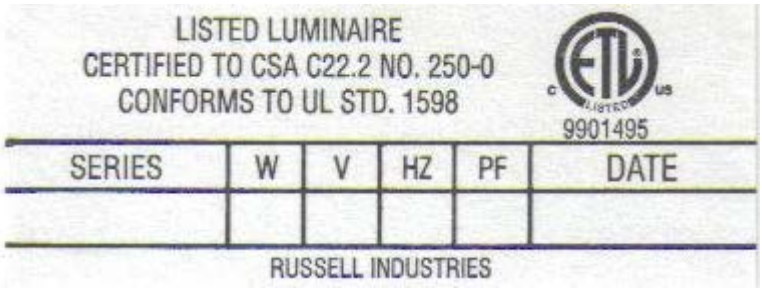
To Whom It May Concern:

Please note that Russell Industries uses Electronic Testing Laboratories as it's certifying agency. ETL conforms to UL Standard 1598 certified to CSA C22.2 No. 250-0.

If you have any further questions or concerns, please do not hesitate to contact us.

Sincerely,

Sylvia Sebastian
Russell Lighting



ITT

Goulds Pumps

AquaBoost™ II

Variable Speed Constant Pressure Systems

** Available up to 100 GPM systems*

GOULDS PUMPS

Goulds Pumps is a brand of ITT Corporation.

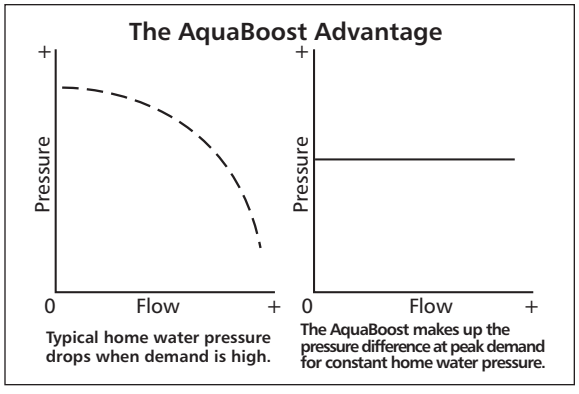
www.goulds.com

Engineered for life

FEATURES

The AquaBoost II variable speed pump controller and complete booster package kits, provide an economical answer for municipal water district customers with low water pressure. Both domestic and light commercial applications can benefit. As water use increases, the AquaBoost II changes pump speed to maintain pressure. Large supply tanks are eliminated and less wear and tear on your pump and motor.

Think of it as "Cruise Control" for your pump! The AquaBoost II is available with a range of flow rates to handle homes with up to four baths, irrigation, filtration and fire suppression systems. Light commercial applications up to 100 GPM at 45 PSI boost. The AquaBoost II is available as either a separate controller or as part of a complete pump package with everything you need to plumb it to a domestic water line.



COMPONENTS

***1AB2** — 4.2 Amp, 208-230 V, single phase input, 1 HP AquaBoost II variable speed controller, wall mount set, transducer, pre-wired. (Pump and tank not included.)

***1AB2LB1035** — 1 HP AquaBoost II controller, wall mount set, LB stainless steel jet pump, transducer, V6P tank, pressure gauge, discharge tee. Controller is pre-wired to the pump. Flows to 15 GPM.

2AB2 — 6.9 Amp, 208-230 V, single phase input, 2 HP AquaBoost II variable speed controller, wall mount set, transducer, pre-wired. (Pump and tank not included.)

2AB21MC1F2B2 — 2 HP AquaBoost II controller, wall mount set, MCC cast iron / stainless steel pump, transducer, V6P (2 gal.) tank and pressure gauge. Controller is pre-wired. Flows to 27 GPM.

2AB21MC1G2A2 — 2 HP AquaBoost II controller, wall mount kit, MCC cast iron / stainless steel pump, transducer, V6P (2 gal.) tank and pressure gauge. Controller is pre-wired. Flows to 32 GPM.

⚠CAUTION AquaBoost System CANNOT be set above 80 psi, for the total discharge pressure (suction plus discharge).

***1AB21HM1E2D0** — 1 HP AquaBoost II controller, wall mount kit, HMS stainless steel pump, transducer, V6P (2 gal.) tank and discharge pipe tee. Controller is pre-wired. Flows to 20 GPM.

***1AB22HM1E2D0** — 1 HP AquaBoost II controller, wall mount kit, HMS stainless steel pump, transducer, V6P (2 gal.) tank, pressure gauge and discharge pipe tee. Controller is pre-wired. Flows to 30 GPM.

2AB22HM1F2E0 — 2 HP AquaBoost II controller, wall mount kit, HMS stainless steel pump, transducer, V6P (2 gal.) tank, pressure gauge and discharge pipe tee. Controller is pre-wired. Flows to 30 GPM.

3AB2LCB1H2D0 — 3 HP AquaBoost II controller, wall mount kit, LCB stainless steel pump, transducer, V6P (2 gal.) tank, pressure gauge and discharge pipe tee. Controller is pre-wired. Flows to 50 GPM.

2AB22MC1G2D2 — 2 HP AquaBoost II controller, wall mount kit, MCC cast iron/stainless steel impeller pump, pressure transducer, V6P (2 gal.) tank, pressure gauge, 1¼" bronze discharge tank tee. Controller and motor are pre-wired. Flows to 80 GPM.

****5AB22MC1J2K2** — 5 HP AquaBoost II controller, wall mount, MCC cast iron/stainless impeller pump, pressure transducer, pressure gauge, 1¼" bronze tank tee, controller and motor are pre-wired. Flows to 100 GPM.

****5AB2LCC1J2D0** — 5 HP AquaBoost II controller, wall mount, LCC stainless steel pump, pressure transducer, pressure gauge, 1¼" bronze tank tee, controller and motor are pre-wired. Flows to 70 GPM.

*** 1 HP available in 115 volt models.**

**** Tank not included.**

AQUABOOST II SYSTEM SELECTION

PSI BOOST	2-10 GPM	20 GPM	30 GPM	40 GPM	50 GPM	60 GPM	70 GPM	80 GPM	90 GPM	100 GPM
20	1	3	3	5	5	9	9	9	10	10
25	1	3	3	6	9	9	9	10	10	10
30	1	3	3	6	9	10	10	10	10	10
35	1	3	3	6	6	10	10	10	10	10
40	1	3	3	6	7	10	10	10	10	10
45	1	3	3	6	8	10	10	10	10	10
50	1	3	4	7	8	10	10	10	10	
55	1	3	4	7	8	10	10			
60	1	4	7	8	8					
65	2	4	7	8	8					
70	2	4	8	8						
75	4	4	8							
80	4									

***1**	**1AB2LB1035** (1 HP, stainless steel pump, 1" discharge, 1¼" suction)
***2**	**1AB21HM1E2D0** (1 HP, stainless steel pump, 1" discharge, 1¼" suction)
***3**	**1AB22HM1E2D0** (1 HP, stainless steel pump, 1" discharge, 1¼" suction)
4	**2AB22HM1F2E0** (1½ HP, stainless steel pump, 1" discharge, 1¼" suction)
5	**2AB21MC1F2B2** (1½ HP, cast iron pump, 1" discharge, 1¼" suction)
6	**2AB21MC1G2A2** (2 HP, cast iron pump, 1" discharge, 1¼" suction)
7	**3AB2LCB1H2D0** (3 HP, stainless steel pump, 1" discharge, 1¼" suction)
8	**5AB2LCC1J2D0** (5 HP, stainless steel pump, 1" discharge, 1½" suction)
9	**2AB22MC1G2D2** (2 HP, cast iron pump, 1¼" discharge, 1½" suction)
10	**5AB22MC1J2K2** (5 HP, cast iron pump, 1¼" discharge, 1½" suction)

** 1 HP available in 115 volt input models. See Price Pages.*
Items # 8 and #10 do not include tank. Recommend at least 13 gallon volume bladder tank.
***NOTE:** PSI is boosting pressure, NOT total system pressure.*

AQUABOOST CONTROLLER FEATURES

Input Power* — 208-230V ±15%, single phase (controller only)

Output Power — Up to 230V three phase (based on input voltage). Motor rated for 208-230V, ±10%.

Maximum Output Current — 4.2 amps – 1AB2 (1 HP)
— 6.9 amps – 2AB2 (2 HP)

Input Controls — Up and down buttons to set pressure.

Signal Lights — Power on, pump running, inverter stopped, pump stopped, standby, faults/errors.

Electrical Efficiency — Over 95% at full load

Protection Against — Short circuit, under voltage, overload, motor temperature, dead heading, run out, suction loss, sensor fault, bound pump, over voltage, static discharge. **Note:** Suction loss/run out is set for minimum 10 psi at discharge!

Ambient Temperature — 34º F to 104º F

Maximum Humidity — 95% at 104º F, non-condensing

Air Pollution — Avoid mounting in areas with excessive dust, acids, corrosives and salts.

Approvals — cULus CE

Controller Enclosure — Outdoor, NEMA 3R, IP 43 (Rain-tight)

Mounting — Wall mount with mounting hardware.

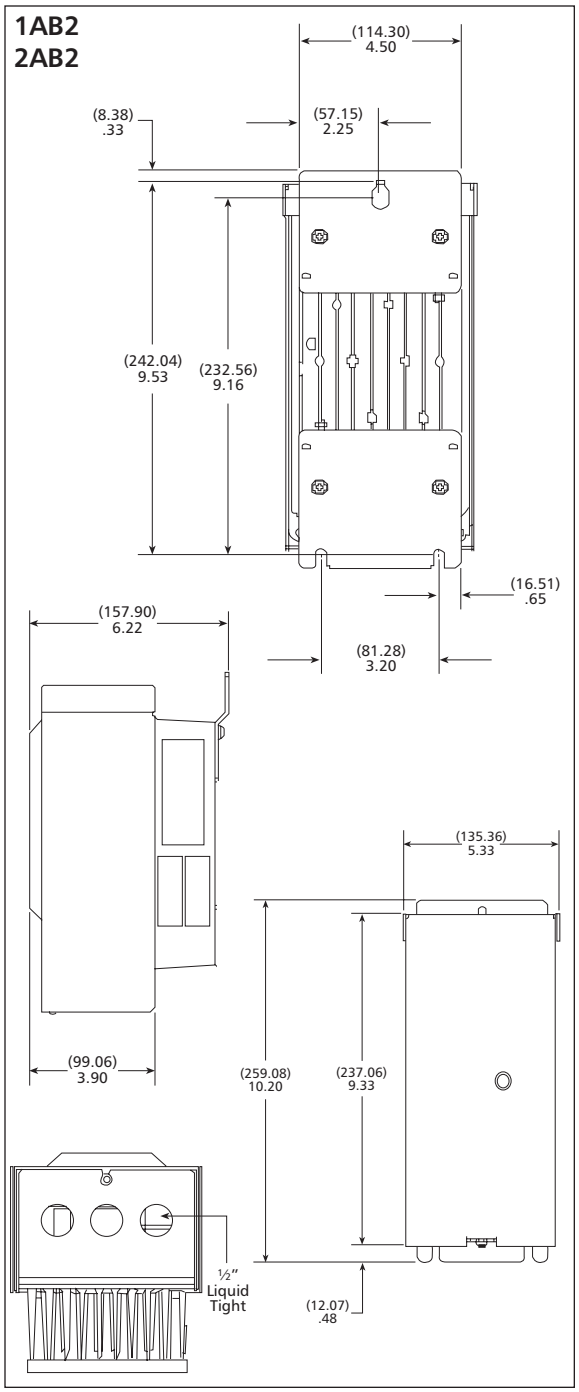
Cooling — Convection with cast aluminum heat sink.
— 3 HP, 5 HP with temp. fan.

Transducer — 0.5 - 4.5 VDC with 5 VDC power supply, 100 psi range, 80-inch 3-wire shielded cable.

Input Wire — 5 feet of 14, 10 or 8 gauge cable. Depending on size, cable is pre-wired to controller and motor conduit box.

Output Wire — 10 feet of 14 gauge cable. Cable is pre-wired to controller and pump motor (when provided).

*Low input voltage may affect motor operation.



PRESSURE RANGE

Nominal Range — Field adjustable from 20 - 80 psi, total system pressure.

⚠WARNING **DO NOT SET REQUIRED SYSTEM PRESSURE ABOVE 80 PSI. SEVERE DAMAGE TO PLUMBING COULD RESULT. PLUMB RELIEF VALVE OUTSIDE OR DRAIN.**

SUGGESTED AQUABOOST INSTALLATION FOR MUNICIPAL WATER SYSTEM

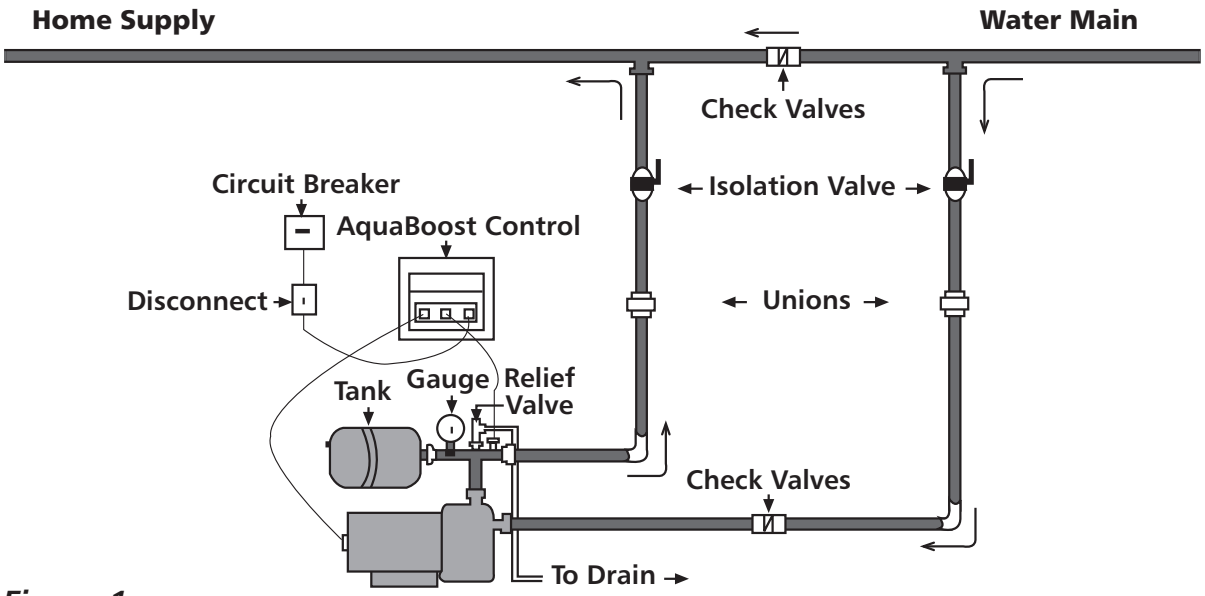


Figure 1

SUGGESTED AQUABOOST INSTALLATION FOR WELL PUMP SYSTEM

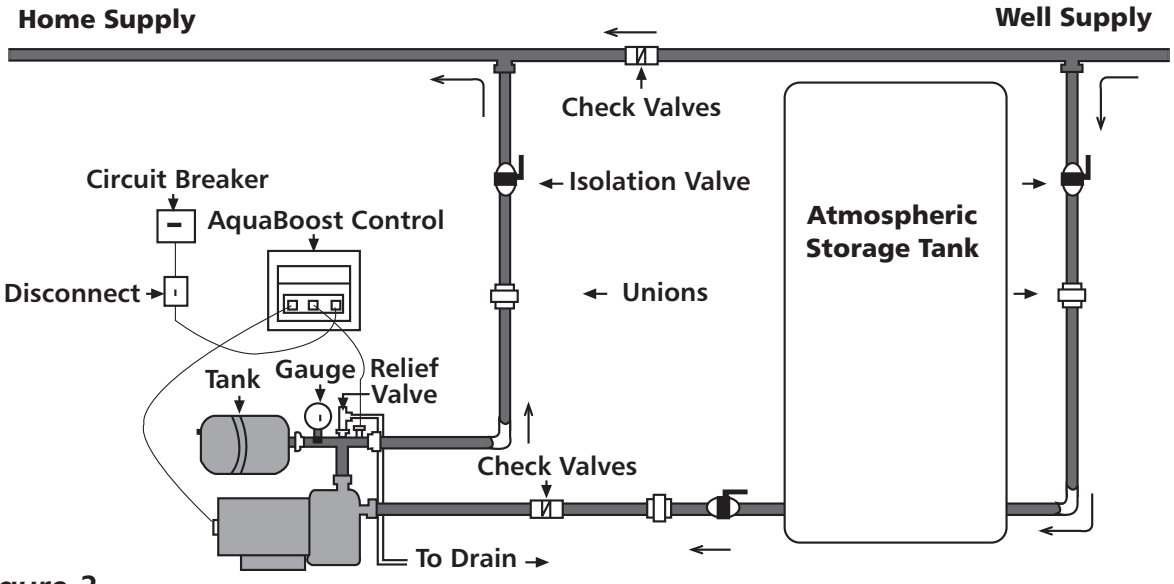
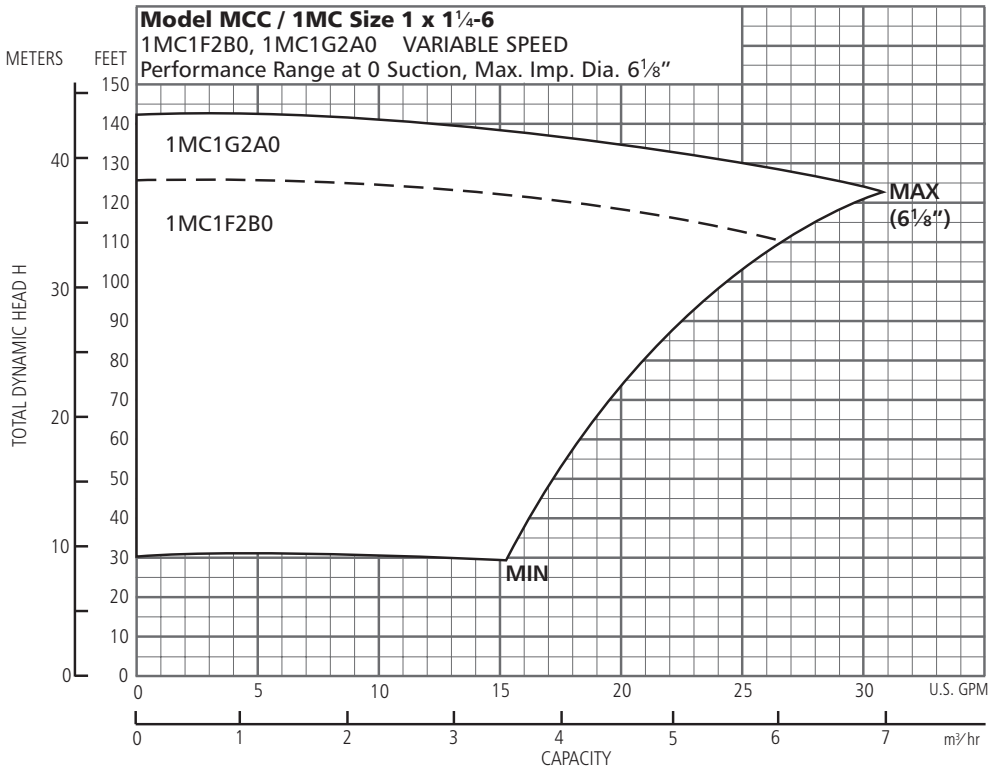
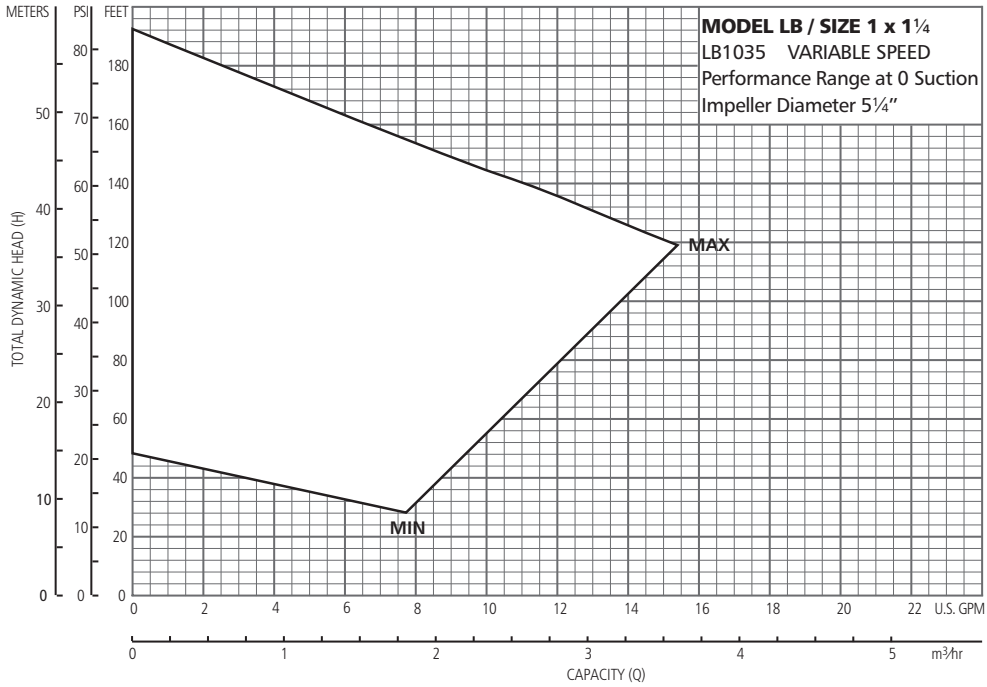


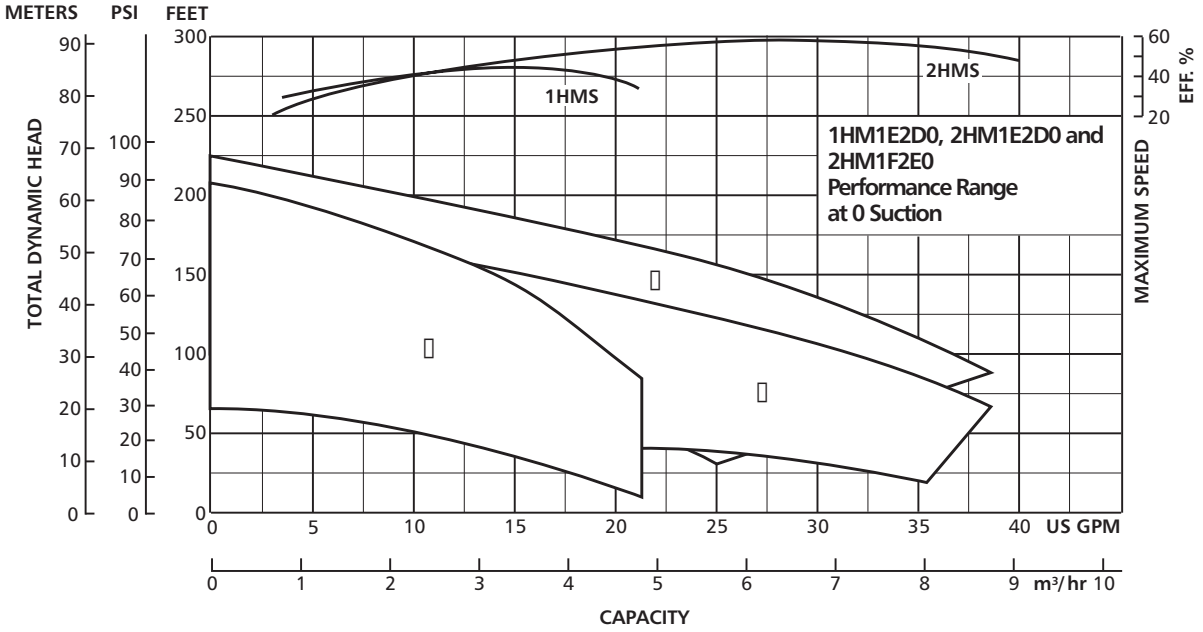
Figure 2



Indicates 1MC1F2B0 pump with 5¾" diameter impeller.



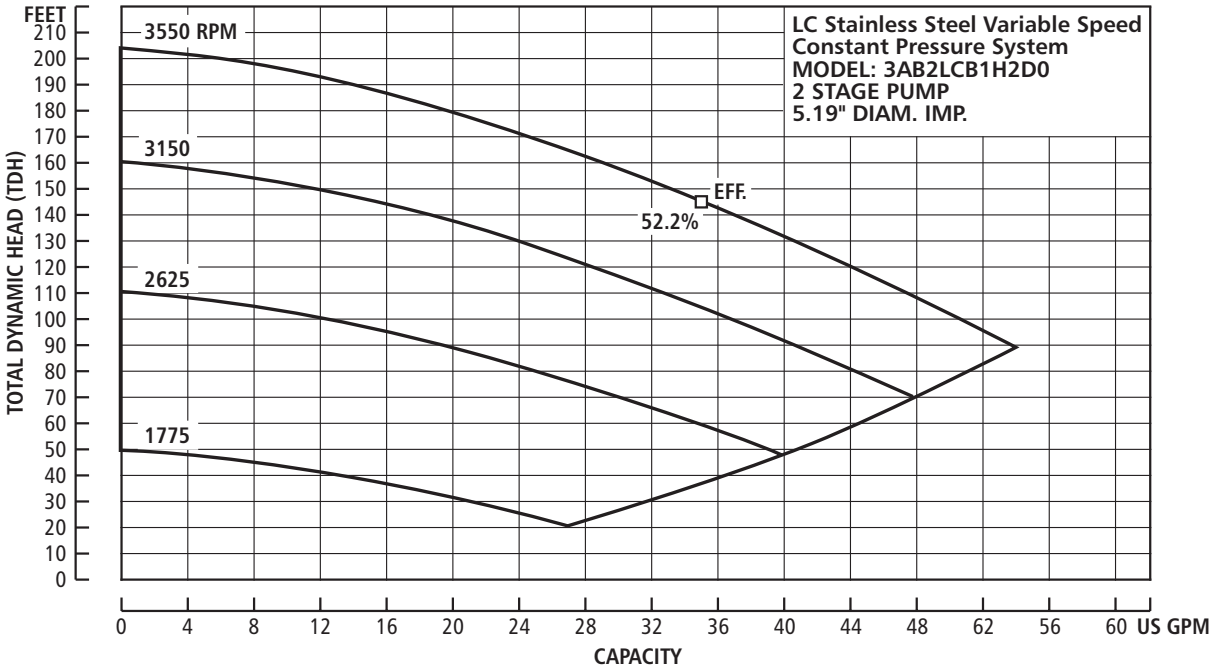
NOTE: Operation beyond pictured range, may overload controller and cause shutdown.

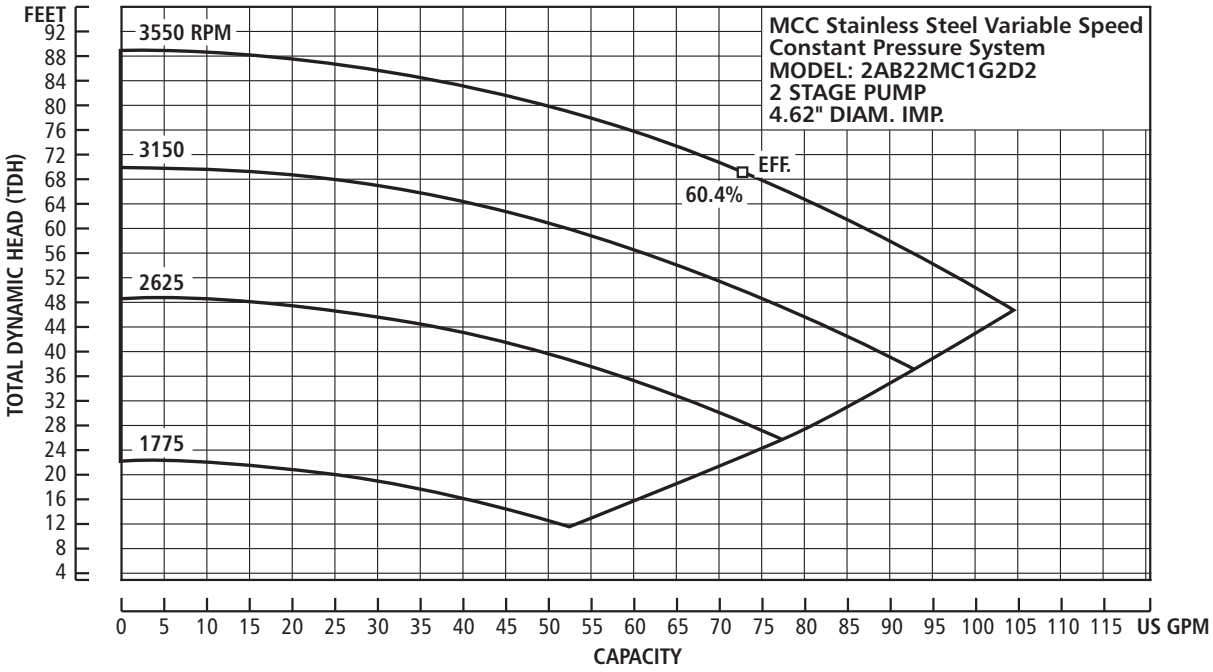


① Curve represents pump model 1HM1E2D0.

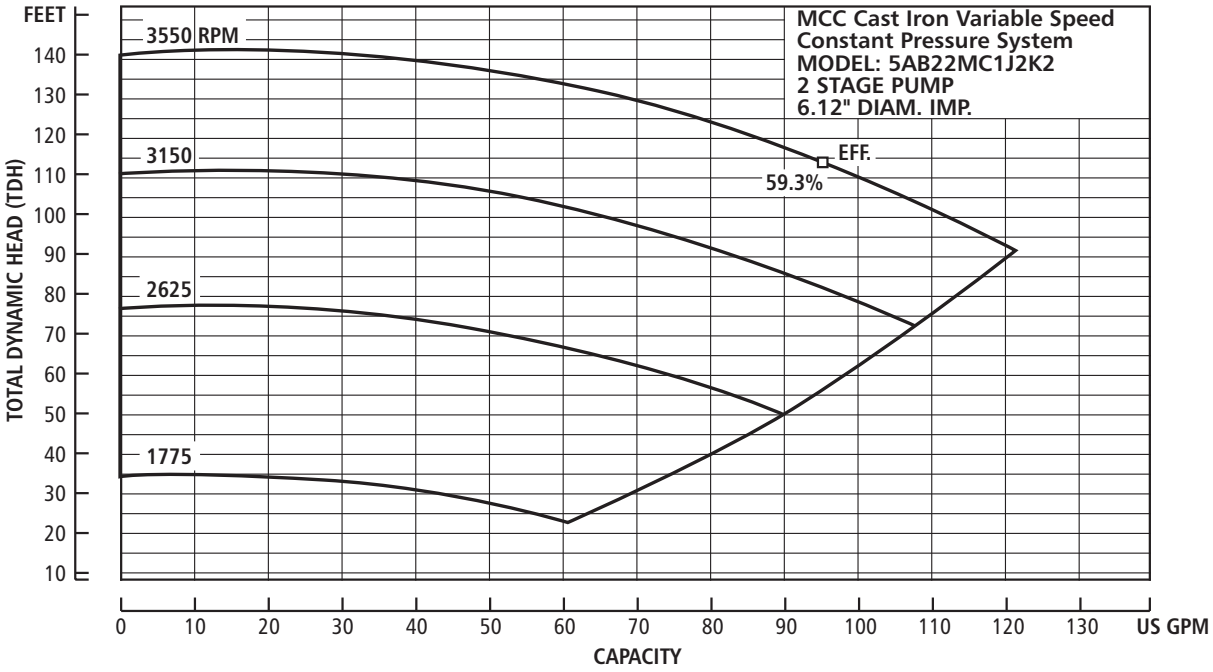
② Curve represents pump model 2HM1E2DO.

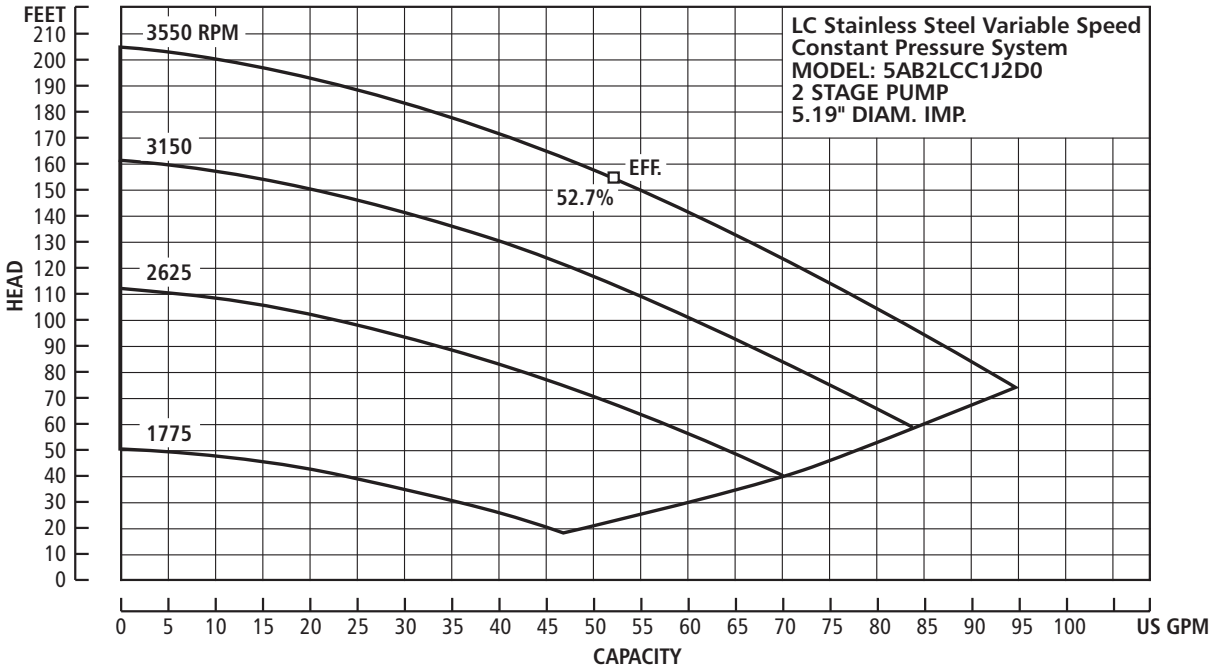
③ Curve represents pump model 2HM1F2E0.





NOTE: Curves indicate boost pressure.





NOTE: Curves indicate boost pressure.

DIMENSIONS

LB PUMP (LB1035) WITH TANK AND TEE

Capacities — to 15 GPM

Rotation — Right hand clockwise, viewed from motor end

Materials — 304 stainless steel casing
Noryl impeller

Motor — 1 HP, ODP, Three Phase, 208-230/460V

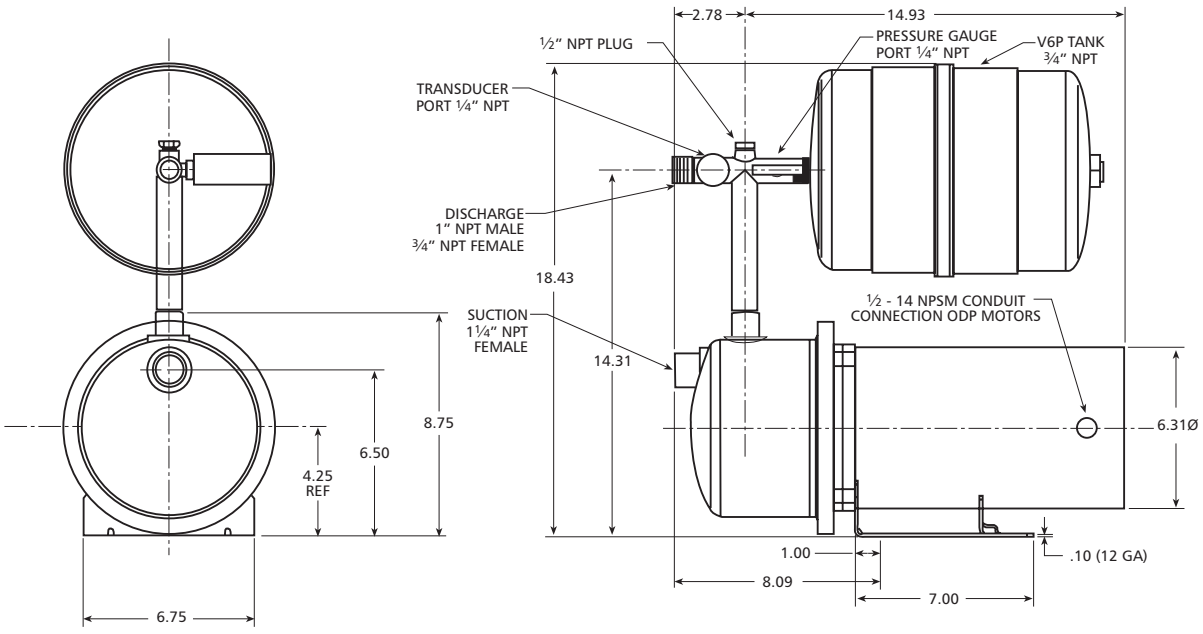
Pipe Connections — 1 x 1¼ NPT

Maximum Temperature of Water — 120º F
NOTE: Tank Liquid Temperature Limit is 120º F
Pump Liquid Temperature Limit is 140º F

Maximum System Working Pressure — 85 psi

Seal — Carbon / Silicon Carbide / EPR

Overload protection, starters, heaters not required.
Dimensions are in inches.



Approximate Packaged Shipping Weight — 55 lbs.

DIMENSIONS

MCC PUMP (1MC1G2A2 AND 1MC1F2B2) WITH TANK AND TEE

Capacity — to 32 GPM (1MC1G2A2)
— to 27 GPM (1MC1F2B2)

Rotation — Right hand clockwise, viewed from motor end

Materials — Cast iron casing
316 stainless steel impeller

Motor — 1½ HP, ODP, Three Phase, 208-230/460V
— 2 HP, ODP, Three Phase, 208-230/460V

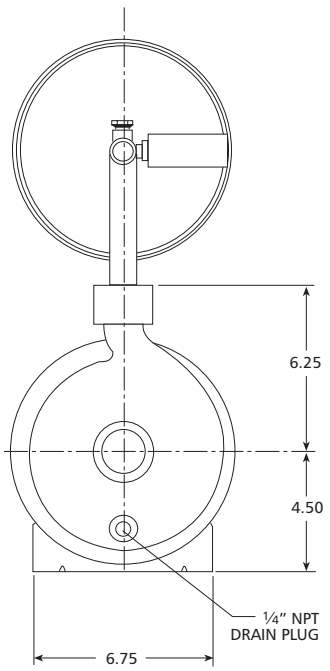
Pipe Connections — 1 x 1¼ NPT

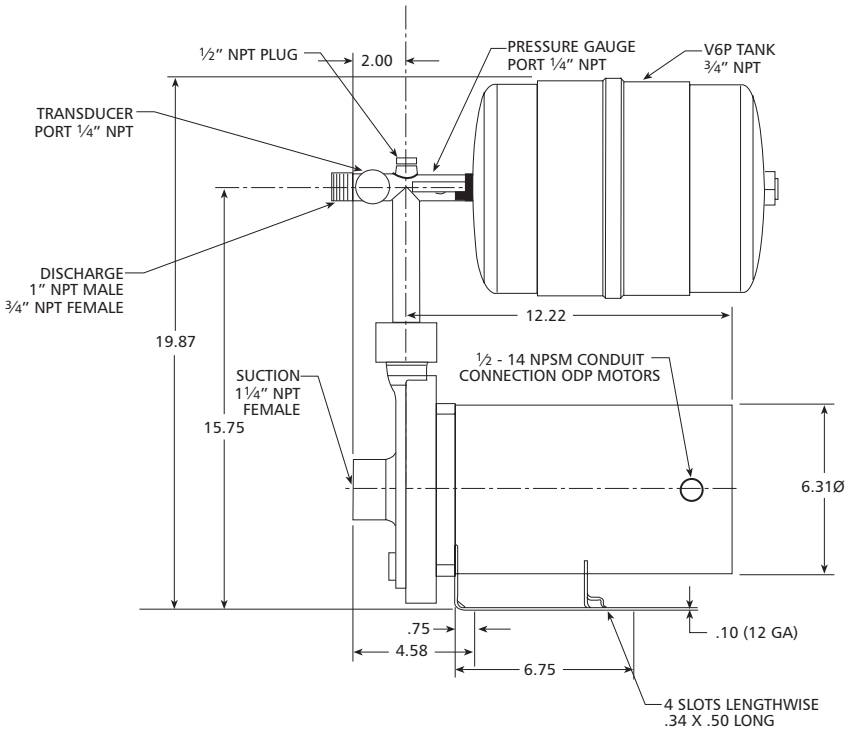
Maximum Temperature of Water — 120º F
NOTE: Tank Liquid Temperature Limit is 120º F
Pump Liquid Temperature Limit is 212º F

Maximum System Working Pressure — 85 psi

Seal — Carbon / Silicon Carbide / EPR

Overload protection, starters, heaters not required.
Dimensions are in inches.





Approximate Packaged Shipping Weight — 75 lbs.

DIMENSIONS

HMS PUMPS (1HM1E2D0, 2HM1E2D0)

Capacities — to 20 GPM (1HM)
to 38 GPM (2HM4/2HM5)

Rotation — Right hand clockwise, viewed from motor end

Materials — 316L stainless steel for all liquid handling components

Pipe Connections — 1 x 1¼ NPT

Maximum Temperature of Water — 120º F

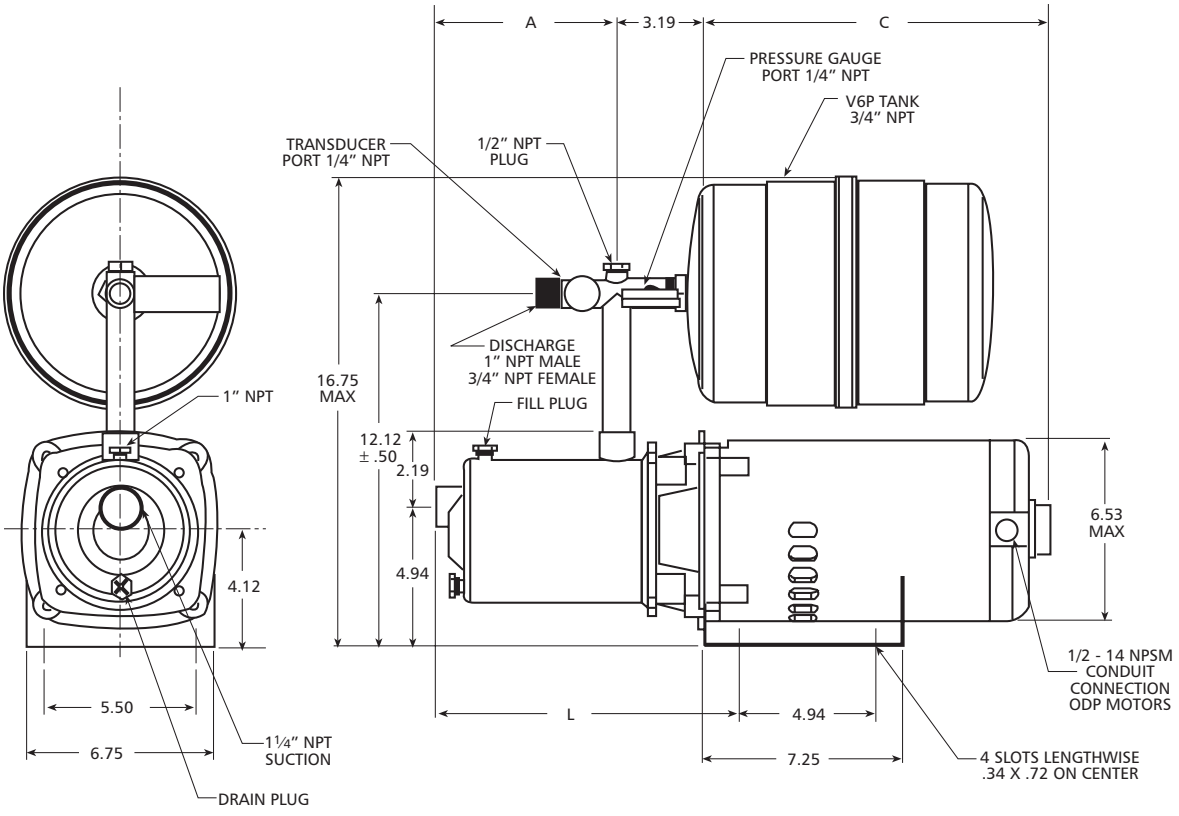
NOTE: Tank Liquid Temperature Limit is 120º F
Pump Liquid Temperature Limit is 212º F

Maximum System Working Pressure — 85 psi

Seal — Carbon / Silicon Carbide / EPR

Motor — 1 HP, ODP, Three Phase,208-230/460V (1HM/2HM4)
— 1.5 HP, ODP, Three Phase,208-230/460V (2HMS5)

Overload protection, starters, heaters not required. Dimensions are in inches.



AQUABOOST	A	L	C	MOUNTING
1AB22HM1E2D0	5.75	10.75	11.62	View B
1AB21HM1E2D0	5.75	10.75	11.12	View A
2AB22HM1F2E0	6.73	11.75	11.62	View B

Approximate Packaged Shipping Weight — 55 lbs.

ALTERNATE PUMP MODELS FOR USE WITH 1AB2 CONTROLLER

MCC — ½, ¾, 1 HP, 3 ph, ODP or TEFC motor versions
3642 — ⅓, ½, 1 HP, 3 ph, ODP or TEFC motor versions
GT073, GT103 — 3 ph, ODP or TEFC motor versions
HSC07, HSC10 — 3 ph, ODP or TEFC motor versions
HMS — ½, ¾, 1 HP, 3 ph, ODP or TEFC motor versions
5GB, 7GB — ½, ¾, 1 HP, 3 ph, ODP or TEFC motor versions
NPE — ½, ¾, 1 HP, 3 ph, ODP or TEFC motor versions
NPO — ½, ¾, 1 HP, 3 ph, ODP or TEFC motor versions
MCS — ½, ¾, 1 HP, 3 ph, ODP or TEFC motor versions
ICS — ½, ¾, 1 HP, 3 ph, ODP or TEFC motor versions
LB — ½ and ¾ HP, 3 ph, ODP or TEFC motor versions

Note: These pumps are not currently offered as a packaged kit, from Goulds Pumps.

All units require three phase motors.

Size pumps and controllers according to service factor amps of the motor.

Submersible Pumps — Additional, external load filters and programming required. Consult factory.

ALTERNATE PUMP MODELS FOR USE WITH 2AB2 CONTROLLER

3642 — 1½, 2 HP, 3 ph, ODP or TEFC motor versions
GT — 1½, 2 HP, 3 ph, ODP or TEFC motor versions
HSC — 1½, 2 HP, 3 ph, ODP or TEFC motor versions
HMS — 1½ HP, 3 ph, ODP or TEFC motor versions
10GB — 1½, 2 HP, 3 ph, ODP or TEFC motor versions
NPE — 1½, 2 HP, 3 ph, ODP or TEFC motor versions
NPO — 1½, 2 HP, 3 ph, ODP or TEFC motor versions
MCS — 1½, 2 HP, 3 ph, ODP or TEFC motor versions
ICS — 1½, 2 HP, 3 ph, ODP or TEFC motor versions

Note: These pumps are not currently offered as a packaged kit, from Goulds Pumps.

All units require three phase motors.

Size pumps and controllers according to service factor amps of the motor.

PACKAGED HARDWARE WITHOUT PUMP AND MOTOR (SEE PRICING PAGE)

Part Number 15K40

KIT INCLUDES:

1) Tank – V6P (2 gal.)
2) 1" Bronze Discharge Tee – AV 20-6
3) Pipe Plug – ½", 6K68
4) Pressure Gauge – AG5 (1 – 100 PSI)

ITT

Residential and Commercial Water Systems

GOULDS PUMPS

Engineered for life

1. Domestic Hot Water Tank

1.1 Features

- Stainless steel domestic hot water tank & heat exchanger
- Integrated 3kW electric booster heater
- Two sizes (50 gal & 80 gal)
- 3-way valve included

Domestic Hot Water (DHW) Tank

The EKHWS domestic hot water tank with integrated 3 kW electric booster heater can be connected to both the split system hydrobox or monobloc. The domestic hot water tank is available in two sizes: 50 gallon (200 liter) or 80 gallon (300 liter). These domestic hot water tanks are for floor-standing indoor installations.

2. Specifications - DHW

2-1 TECHNICAL SPECIFICATIONS				EKHWS050BA3VJU	EKHWS080BA3VJU
Casing	Color			Neutral white	
	Material			Epoxy-coated mild steel	
Dimensions	Packing	Height	in (mm)	47-1/4 (1,200)	65 (1,650)
		Width	in (mm)	23-5/8 (600)	23-5/8 (600)
		Depth	in (mm)	23-5/8 (600)	23-5/8 (600)
	Unit	Height	in (mm)	45-3/8 (1,150)	63 (1,600)
		Width	in (mm)	22-7/8 (580)	22-7/8 (580)
		Depth	in (mm)	22-7/8 (580)	22-7/8 (580)
Weight	Unit		lb (kg)	99.2 (45)	130 (59)
	Packed Unit		lb (kg)	112.4 (51)	145.5 (66)
Packing	Material			EPS	
				Carton	
	Weight		lb (kg)	8.81 (4)	11 (5)
Main components	Tank	Water volume	gal (l)	50 (200)	80 (300)
		Material		Stainless steel 316LSS	
		Max. temperature	°F (°C)	185 (85)	185 (85)
		Max. water pressure	PSI (bar)	145 (10)	145 (10)
Tank	Insulation	Material		Polyurethane foam	
		Min. thickness	in (mm)	1-5/8 (40)	1-5/8 (40)
Main components	Heat exchanger	Quantity		1	1
		Material		Stainless steel 316LSS	
	Booster heater	Quantity		1	1
		Capacity	BTU/hr (kW)	10,255 (3)	10,255 (3)
	3-Way Valve	Coefficient of flow at 14.5 PSI (1 bar)	gpm (m^3/h)	44 (10)	44 (10)
		Inlet	inch	Rp1	
		Outlet	inch	2xRp1	
Temperature sensor	Cable length		ft (m)	39.4 (12)	39.4 (12)
Piping connections	Water inlet H/E Diameter		inch (BSPP)	G 3/4 (female)	
	Water outlet H/E Diameter		inch (BSPP)	G 3/4 (female)	
	Cold water in Diameter		inch (BSPP)	G 3/4 (female)	
	Hot water out Diameter		inch (BSPP)	G 3/4 (female)	
	Recirculation connection		inch (BSPP)	G 3/4 (female)	

2-2 ELECTRICAL SPECIFICATIONS				EKHWS050BA3VJU	EKHWS080BA3VJU
Unit	Power Supply	Phase		1~	1~
		Frequency	Hz	60	60
		Voltage	V	208/230	208/230
	Current	Minimum Circuit Amps (MCA)	A	14.3	14.3
		Maximum Overcurrent Protection (MOP)	A	20	20

3. Domestic Hot Water Basic Performance Overview

The Daikin Altherma heat pump in combination with the optional domestic hot water tank provides hot water for household usage (Altherma TW DHW).

The following data provides information to select the proper sized domestic hot water tank to ensure maximum comfort and efficiency.

(1) Domestic hot water volume:

The volume of hot water available for domestic usage depends on the physical volume of the tank, the domestic hot water setpoint temperature, and the temperature spreading in the tank. Therefore the *equivalent hot water volume* is termed **EHWV**.

Definition EHWV = The volume of hot water available for domestic usage at a temperature of 104° (40°C), which is considered a comfortable domestic hot water temperature.

Tank	Setpoint temp °F (°C)	EHWV gal (l)	Usage Pattern		
	131 (55)	42 (160)	Modest	Medium	High
50 gal (200 l)	149 (65)	53 (200)	+	–	–
	167 (75)	63 (240)	++	+	–
	131 (55)	78 (205)	++	++	–
80 gal (300 l)	149 (65)	102 (385)	++	++	–
	167 (75)	102 (435)	++	++	+

Grade: ++ excessive availability of domestic hot water
+ sufficient availability of domestic hot water
– temporary shortage of domestic hot water can occur

Usage Pattern: Modest: Daily demand up to 58 gal (220 l) = typical 2-person usage pattern
Medium: Daily demand up to 85 gal (325 l) = typcial 3 - 4 person usage pattern
High: Daily demand up to 145 gal (550 l) = typical 4 - 6 person usage pattern

(2) Heat up time:

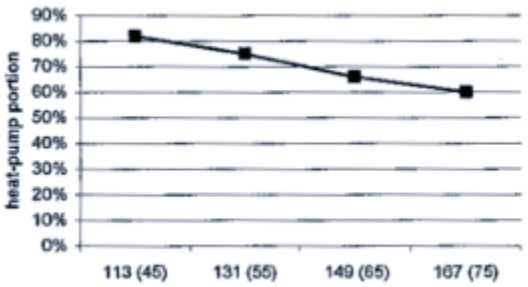
Definition of ***Heat-Up Time***: The time required to reheat the domestic hot water tank to 131 F (55 C) after tapping a certain volume of hot water. NOTE: Changing the field settings (see installation manual) can influence the heat-up time.

Tank	Setpoint °F (°C)	Heat up time for 39 gal (150 l) bath (min)	Heat up time for 13 gal (50 l) bath (min)
50 gal (200 l)	131 (55)	60	40
80 gal (300 l)	131 (55)	50	30

Conditions for testing: Ta =44.6°CDB / 42.8°FWB, Troom =68°F, Tstart = 50°F, outdoor unit type: ERLQ054*VJU
Conditions for testing: Ta = 7°CDB / 6 °CWB, Troom = 20°C, Tstart = 10°C, outdoor unit type: ERLQ054*VJU

(3) Efficiency of domestic hot water production:

In the Daikin Altherma system, both the heat pump and the electric booster heater supply the energy to produce domestic hot water. The higher the portion of energy supplied by the heat pump, the more energy efficient the system is. Lowering the setpoint temperature increases the portion of energy supplied by the heat pump and thus the efficiency of the system. The percentage of energy supplied by the heat pump in relation to total energy need for domestic hot water is displayed in the following graph:



Conditions:

Simulation of daily real-life conditions based upon medium usage.

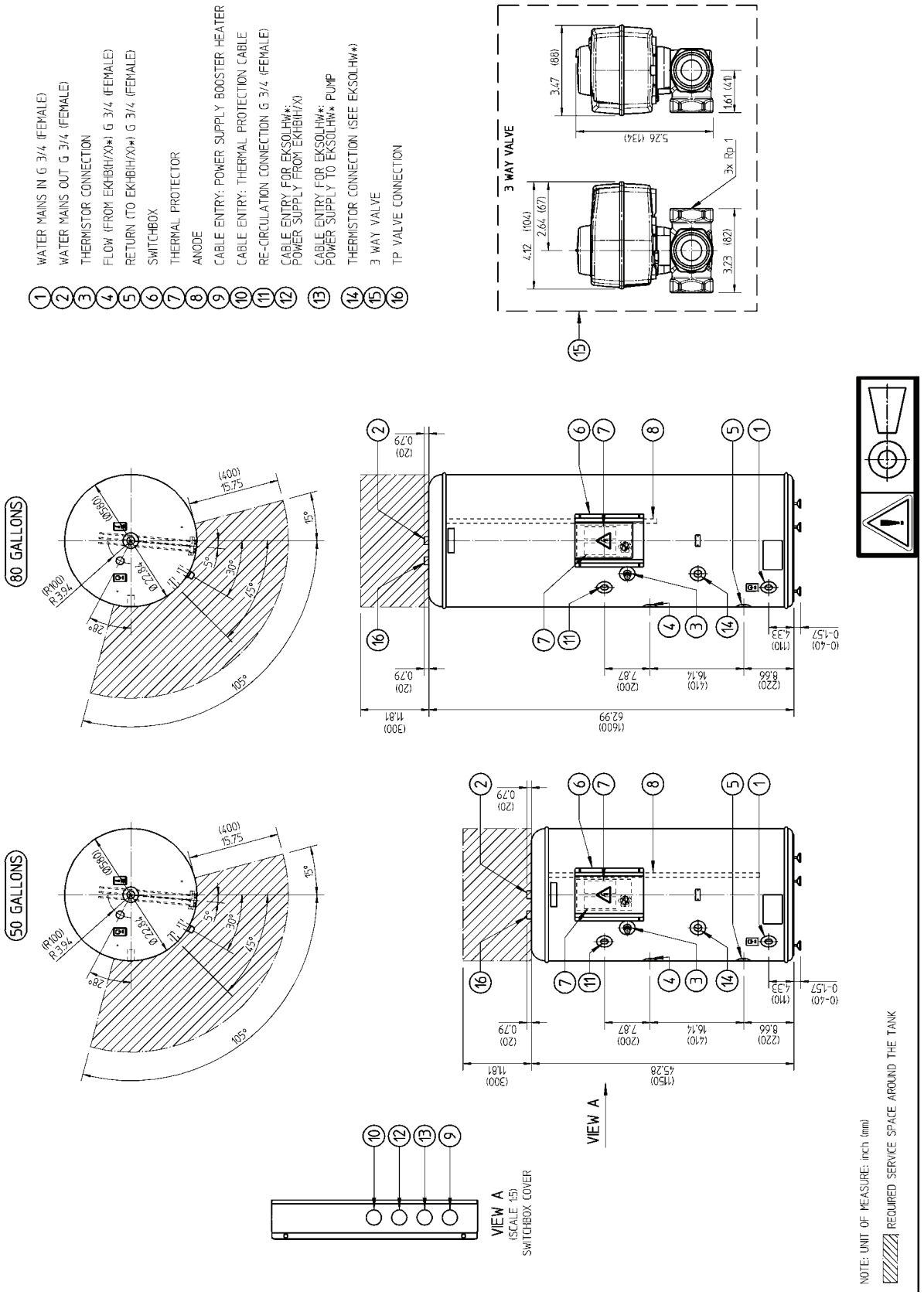
Outdoor temp: 44.6°FDB /42.8° FWB (7°CDB/ 6°CWB)

Room temp: 68 F (20 C)

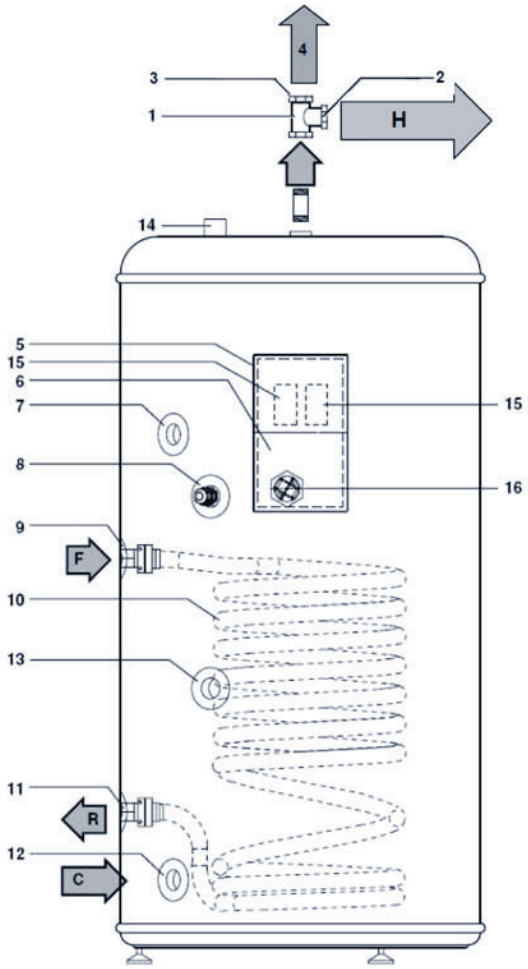
Tank Type: 50 gal (200 l)

Field Settings: Default field settings (see Installation Manual)

4. Dimensional Drawing & Center of Gravity - DHW



4.1 Domestic Hot Water Tank Summary

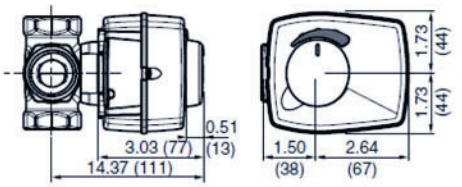


1	Field supply
2	Hot water connection (H)
3	Pressure relief valve connection
4	Pressure relief valve (field supply)
5	Electrical box
6	Electrical box lid
7	Recirculation hole
8	Thermistor socket
9	Flow inlet connection (F) (from the main unit)
10	Heat exchanger coil
11	Return outlet connection (R) (to the main unit)
12	Cold water connection (C)
13	Threaded thermistor hole for use with the solar kit option. Refer to the installation manual EKSOLHW*.
14	Temperature and pressure relief valve connection
15	Thermal protectors (Q2L, Q3L)
16	Booster heater
⇨	Flow direction

5. Three-Way Valve Summary

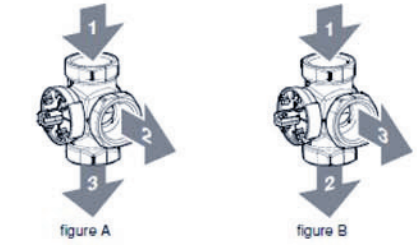
Connecting the 3-way valve

1 Refer to the figure below before making the connection. Values between brackets are the conversion from inch to mm.



2 Installation position.

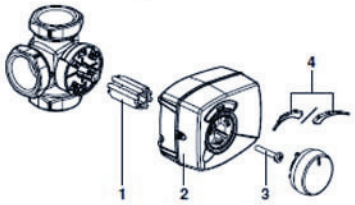
It is advised to connect the 3-way valve as close as possible to the unit. It can be installed in accordance with one of the following four configurations.



1 From indoor unit
2 To domestic hot water tank
3 To room heating

3 Unpack the 3-way valve body and 3-way valve motor.

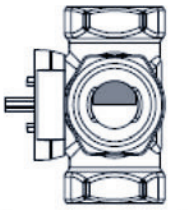
Verify that following accessories are provided with the motor.



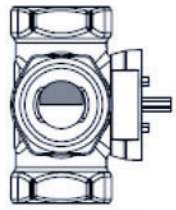
1 Sleeve
2 Valve motor cover
3 Screw
4 Scale

4 Install the 3-way valve body in the pipework.

- Make sure the shaft will be positioned in such a way that the motor can be mounted and replaced.
- Put the sleeve on the valve and turn the valve to the middle position of the scale plate.
  Check that the valve is positioned as in the figure below. It shall be blocking the outlet connection to the domestic hot water for 50% and the outlet connection to the room heating also for 50%.



Installation in accordance with figure A and figure B



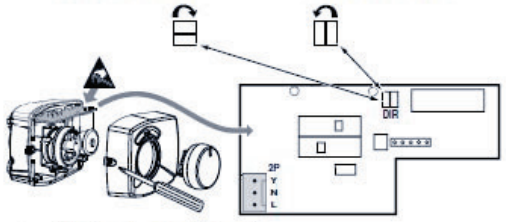
Installation in accordance with figure C and figure D

NOTE If the valve is not positioned in this way before mounting the motor, the valve will give way to both domestic water and room heating during operation.

5 When installing in accordance with figure A or figure D, open the valve motor cover by loosening the screw and change the jumper so as to change the rotation direction of the valve.

By default the jumper is factory set to apply for installation in accordance with figure B and figure C.

Installation in accordance with figure A and figure D | Installation in accordance with figure B and figure C



Rotation direction of the valve

6 Push the motor on the motor sleeve.

Make sure not to rotate the sleeve during this action, so as to maintain the valve position as set during step 4.

7

8 Put the scale on the valve as shown below.

Domestic hot water tank | Room heating

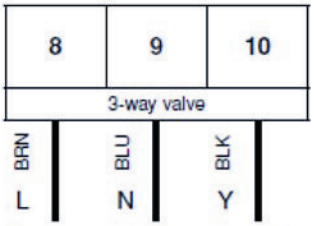
Installation in accordance with figure B and figure C

Room heating | Domestic hot water tank

Installation in accordance with figure A and figure D

9 Make sure to firmly fix the power supply cord onto the 3-way valve body with a field supplied cable tie like in illustration below.

10 Perform the wiring in the unit in accordance with the following figure:



Refer also to the drawing on page 8.

11 Connect the water inlet and water outlet.

12 Connect the hot and cold water supply tubes.

13 Connect the pressure relief valve (field supply, opening pressure maximum 145 psi (10 bar)) and drain.

CAUTION

If a discharge pipe is connected to the pressure relief device it must be installed in a continuously downward direction and in a frost-free environment. It must be left open to the atmosphere.

A.O.SMITH

Dura-Power

COMMERCIAL ELECTRIC WATER HEATERS

DEN & DEL MODELS

Designed for use as a recovery heater having its own storage tank. Available in upright standard models (DEN) and lowboy models (DEL).

FEATURES

GLASS-LINED TANK - Thirteen sizes; 6 thru 119 gallon capacity. Tank interior is coated with glass specially developed by A. O. Smith Ceramic Research for water heater use. Tanks rated 150 psi working pressure; tested at 300 psi. Foam insulation provides maximum energy savings by minimizing radiant standby heat loss.

ELEMENTS - Zinc plated copper sheaths for longer life. Medium watt density; means lower surface temperature to minimize scale build-up and more surface to heat water. Element sizes from 1.5 to 6 KW. Maximum input 12 KW (see chart on back).

STANDARD VOLTAGES - 120, 277 single phase and 208, 240 and 480V unbalanced three-phase delta; easily converted to single-phase at terminal block (except 208V with 6000 watt elements). Single element heater, single-phase only.

TERMINAL BLOCK - Factory installed. Just bring the service to heater and connect to block. Terminal block not supplied on 120V & 277 volt models.

CONTROLS - Temperature control (adjustable through a range of 110° to 170°F on single element and 120° to 180°F on dual element) and manual reset high temperature cutoff per element (dual element models). Factory wired for non-simultaneous operation; easily converted to simultaneous element operation (three phase models only).

OPTIONAL

GOLDENROD ELEMENTS - All DEN & DEL models are available with the Goldenrod 24K gold plated elements (patent pending). Goldenrod elements provide long life and 6 times the scaling resistance of standard incoloy elements. Goldenrod elements carry a three-year warranty against failure due to lime scale build-up.

ELEMENT AVAILABILITY CHART

Input	120V	208V	240V	277V	480V
1,500	YES	YES	YES	YES	—-
2,000	YES	YES	YES	YES	YES
2,500	YES	YES	YES	YES	YES
3,000	YES	YES	YES	YES	YES
3,500	—-	—-	YES	—-	—-
4,000	—-	YES	YES	YES	YES
4,500	—-	YES	YES	YES	YES
5,000	—-	YES*	YES*	YES*	YES*
5,500	—-	—-	YES*	—-	—-
6,000	—-	YES**	YES	YES	YES

NOTE: DEL-6 not available in above 2.5 KW.
DEL-6 not available in 480V.
* Not available in DEL-10, DEL-15 and DEN-30.
** A6 non-simultaneous circuit only.

Meets or exceeds the requirements of ASHRAE 90.1-1999 Standard for energy efficiencies.

See page C 029.0 for service wiring and fuse selection.

DEL MODELS **DEN MODELS**

LIMITED WARRANTY OUTLINE

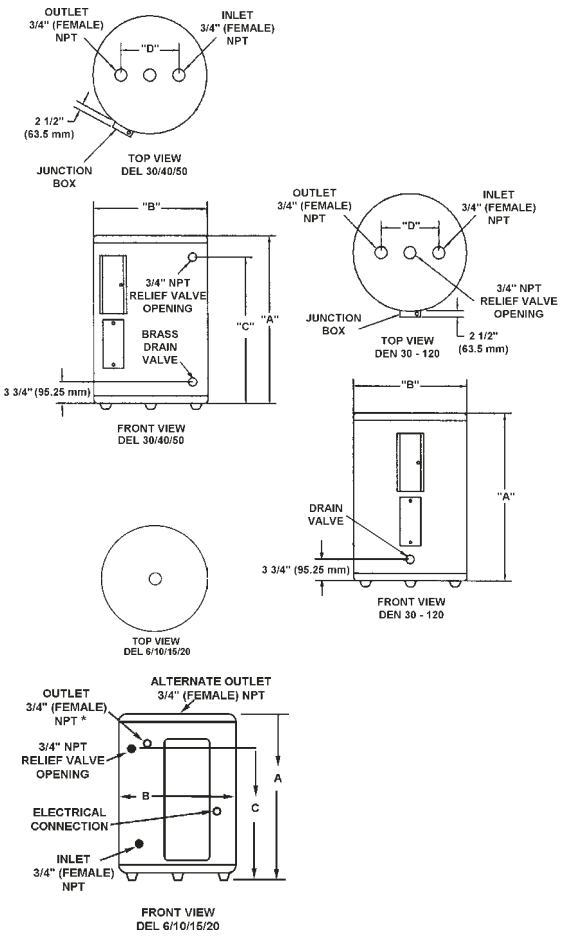
If the tank should leak any time during the first three years, under the terms of the warranty, A. O. Smith will furnish a replacement heater; installation, labor, handling and local delivery extra. **THIS OUTLINE IS NOT A WARRANTY.** For complete information, consult the written warranty or A. O. Smith Water Products Company.

OTHER STANDARD FEATURES

- Factory installed T&P AGA/ASME relief valve
- Simplified circuitry, color coded for ease of service
- Anode rod for maximum corrosion protection
- Cabinet has bonderized undercoat with baked enamel finish
- Top inlet and outlet openings • Drain valve
- UL approved field conversion program.

ROUGH-IN DIMENSIONS

Models Dimensions	No. of Elements	Tank Capacity US Gals.	Tank Capacity Litres	A inches	A mm	B inches	B mm	C inches	C mm	D inches	D mm	Approx. Shipping Weight. Lbs.	Approx. Shipping Weight. Kg.
DEL-6	1	6	23	15 1/2	394	14 1/4	362	11	279	-	-	35	15.9
DEL-10	1	10	38	18 1/4	464	18	457	12 1/2	318	-	-	54	24.5
DEL-15	1	15	57	26	660	18	457	20 1/2	521	-	-	58	26.3
DEL-20	1	20	76	22 1/4	565	21 3/4	552	15 3/8	391	-	-	73	33.1
DEL-30	2	30	114	30 7/8	784	21 3/4	552	24 1/8	613	8	203	100	45.4
DEL-40	2	40	151	32 1/4	819	24	610	25 9/16	649	8	203	125	56.7
DEL-50	2	50	189	32 1/4	819	26 1/2	673	25 1/8	638	8	203	166	75.3
DEN-30	1	30	114	34 1/2	876	20 1/2	521	-	-	8	203	98	44.5
DEN-40	2	40	151	45 1/8	1146	20 1/2	521	-	-	8	203	113	51.3
DEN-52	2	50	189	54 7/8	1394	20 1/2	521	-	-	8	203	131	59.4
DEN-66	2	66	250	60 3/4	1543	21 3/4	552	-	-	8	203	176	79.8
DEN-80	2	80	303	59 3/8	1508	24	610	-	-	8	203	211	95.7
DEN-120	2	119	450	62 7/16	1586	29 3/8	746	-	-	8	203	326	147.9



ELECTRIC CHARACTERISTICS AND CAPACITIES

Element Wattage Upper/Lower	NON-SIMULTANEOUS AND SINGLE ELEMENT OPERATION Recovery Capacities GPH @ Temperature Rise Of 40°	60°	80°	100°	120°	Full Load Current In Amperes Connected to Single Phase Power (All Terminals - L1,L2,&L3) 208V	240V	480V
1500	15	10	8	6	5	7.2	6.3	3.2
2000	21	14	10	8	7	9.6	8.3	4.2
2500	26	18	13	10	9	12.0	10.4	5.2
3000/3000	31	20	15	12	10	14.4	12.5	6.3
4000/4000	41	27	20	16	14	19.2	16.7	8.3
4500/4500	46	31	23	18	15	21.6	18.8	9.4
5000/5000	51	34	26	20	17	24.0	20.8	10.4
6000/6000	61	41	31	25	20	28.8	25.0	12.5
	SIMULTANEOUS DUAL ELEMENT OPERATION (both elements on when entire tank is cold)							
Element Wattage Upper/Lower	Recovery Capacities GPH @ Temperature Rise Of 40°	60°	80°	100°	120°	Full Load Current In Amperes Connected to Three Phase Power (Terminal L2/Terminals L1 & L3) 208V	240V	480V
3000/3000	61	41	31	24	20	25.0/14.4	21.7/12.5	10.8/6.3
4000/4000	81	54	41	33	27	33.3/19.2	28.9/16.7	14.4/8.3
4500/4500	91	61	45	37	31	37.5/21.6	32.5/18.8	16.2/9.4
5000/5000	102	68	51	41	34	41.6/24.0	36.1/20.8	18.0/10.4
6000/6000	122	81	61	49	41	N/A	43.3/25.0	21.7/12.5

Recovery capacities at 100°F rise equal: for non-simultaneous element operation - 4.1 gal. x KW of one element; for simultaneous element operation - 4.1 gal. x 2/3 KW of both elements. For other rises multiply element KW as previously explained by 410 and divide by temperature rise. Full load current for single phase = total watts ÷ voltage.

SUGGESTED SPECIFICATIONS

The water heater(s) shall be Dura-Power Model(s) No. _____ as manufactured by A. O. SMITH or an approved equal. Heater(s) shall be rated at _____ KW, _____ volts, _____ phase, 60 cycle AC, and listed by Underwriters' Laboratories. Tank(s) shall be _____ gallon capacity. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. All internal surfaces of the heater(s) exposed to water shall be glass-lined with an alkaline borosilicate composition that has been fused to steel by firing at a temperature range of 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation. Electrical junction box with heavy duty terminal block shall be provided (except on 120V & 277V [no junction box on DEL-6 thru 20]). The drain valve shall be located in the front for ease of servicing. Heater tank shall have a three year limited warranty as outlined in the written warranty. Fully illustrated instruction manual to be included.

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www.hotwater.com

For Technical Information and Automated Fax Service,
Phone: 800-527-1953

A. O. Smith
Water Products Company
Ashland City, TN
A Division of A. O. Smith Corporation

A. O. Smith Corporation reserves the right to make product changes or improvements at any time without notice.

ACESS00307

Printed in U.S.A.

A.O.SMITH

Dura-Power

COMMERCIAL ELECTRIC WATER HEATERS

DEN & DEL MODELS

Designed for use as a recovery heater having its own storage tank. Available in upright standard models (DEN) and lowboy models (DEL).

FEATURES

GLASS-LINED TANK - Thirteen sizes; 6 thru 119 gallon capacity. Tank interior is coated with glass specially developed by A. O. Smith Ceramic Research for water heater use. Tanks rated 150 psi working pressure; tested at 300 psi. Foam insulation provides maximum energy savings by minimizing radiant standby heat loss.

ELEMENTS - Zinc plated copper sheaths for longer life. Medium watt density; means lower surface temperature to minimize scale build-up and more surface to heat water. Element sizes from 1.5 to 6 KW. Maximum input 12 KW (see chart on back).

STANDARD VOLTAGES - 120, 277 single phase and 208, 240 and 480V unbalanced three-phase delta; easily converted to single-phase at terminal block (except 208V with 6000 watt elements). Single element heater, single-phase only.

TERMINAL BLOCK - Factory installed. Just bring the service to heater and connect to block. Terminal block not supplied on 120V & 277 volt models.

CONTROLS - Temperature control (adjustable through a range of 110° to 170°F on single element and 120° to 180°F on dual element) and manual reset high temperature cutoff per element (dual element models). Factory wired for non-simultaneous operation; easily converted to simultaneous element operation (three phase models only).

OPTIONAL

GOLDENROD ELEMENTS - All DEN & DEL models are available with the Goldenrod 24K gold plated elements (patent pending). Goldenrod elements provide long life and 6 times the scaling resistance of standard incoloy elements. Goldenrod elements carry a three-year warranty against failure due to lime scale build-up.

ELEMENT AVAILABILITY CHART

Input	120V	208V	240V	277V	480V
1,500	YES	YES	YES	YES	—-
2,000	YES	YES	YES	YES	YES
2,500	YES	YES	YES	YES	YES
3,000	YES	YES	YES	YES	YES
3,500	—-	—-	YES	—-	—-
4,000	—-	YES	YES	YES	YES
4,500	—-	YES	YES	YES	YES
5,000	—-	YES*	YES*	YES*	YES*
5,500	—-	—-	YES*	—-	—-
6,000	—-	YES**	YES	YES	YES

NOTE: DEL-6 not available in above 2.5 KW.
DEL-6 not available in 480V.
* Not available in DEL-10, DEL-15 and DEN-30.
** A6 non-simultaneous circuit only.

Meets or exceeds the requirements of ASHRAE 90.1-1999 Standard for energy efficiencies.

See page C 029.0 for service wiring and fuse selection.

DEL MODELS **DEN MODELS**

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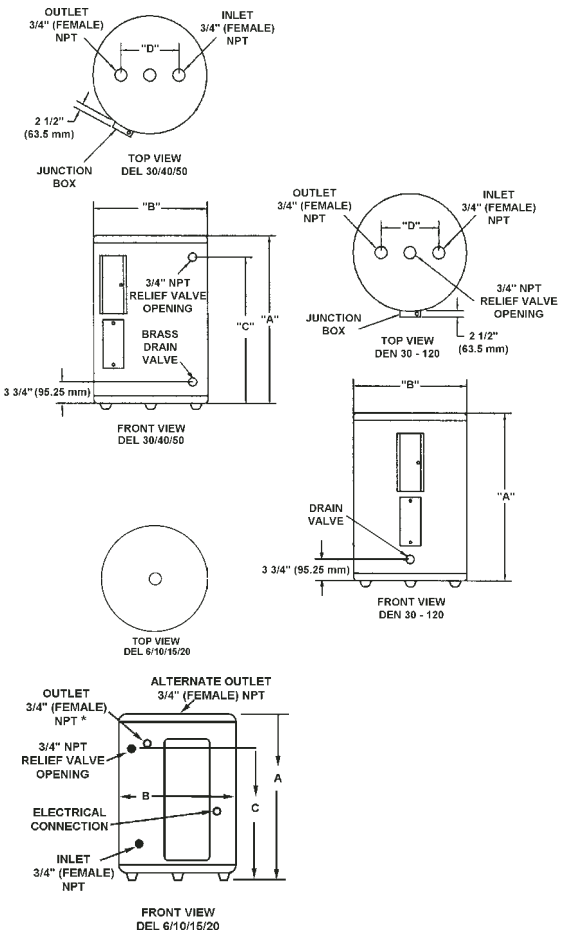

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Printed in U.S.A.

SAMPLE SPECIFICATION – EN400, EN500, EN700 and EN900 Integrated Air Handler

1. GENERAL

1.1 System Description: Air Handler with air handling by way of electronically commutated motor (ECM) with constant CFM algorithm to power the main blower in heating, cooling and circulation modes. Unit complete with internal circulator and microprocessor.

SYSTEM OPTIONS:
1.1.1 Integral DX coil.---------- BTU (27,333 max.)
1.1.2 Integral chilled water coil----------BTU (27,000 max).
1.1.3 Integral heat/energy recovery ventilator with dedicated wet room exhaust and non-recirculating proportional defrost---------- ----------CFM (142@ 0.4" ESP max).

1.1 Standard of Acceptance: Enerboss EN400, EN500, EN700, EN900 Series

1.4 Quality Assurance: Each unit shall be CSA approved or equivalent.

2. CABINET

2.1 Casing: The fan coil shall be constructed of 0.050 prepainted aluminum with 1" foil face insulation where appropriate for thermal performance and noise reduction.

2.2 Service Access: Removable front service panel for easy access to all components

2.2 Location: Mechanical room within 60' (equivalent length) of ventilation exterior wall caps.

3. HYDRONIC COMPONENTS

3.1 Coil: The coil shall be constructed of 5/8 x 0.016 copper tube and return bend connectors. The tubing shall be mechanically joined to corrugated aluminum fins 0.006" thick with 12 fins per inch.

3.2 Pump: *Circulation pump must be integral to the AHU with controls that do not allow coil water to become stagnant for more than 24 hours*.

4. AIR MOVEMENT COMPONENTS

4.1 Blower motor: The blower motor shall be direct drive electronically commutating (ECM) and operate in constant CFM mode. The motor shall be capable of delivering constant airflow in fan only, heating, cooling and high ventilation speeds.

4.2 Main Blower: The main blower shall be a DWDI forward curve ---------- with galvanized wheel and housing.

Blower Selection:- EN400: GT9-DD; EN500 & EN700: G9-DD; EN900: GT12-10.

5. INTEGRAL HRV/ERV

5.1 HRV fan: Supply air shall be via the main fan. Independent exhaust fan dedicated wet room pick-up. The exhaust fan shall be backward curved motorized impellor. High and low speed shall be adjustable by way of the microprocessor for in-suite air balancing.

5.2 Core Media: The HRV core shall be aluminum/polypropylene/enthalpy fixed plate with an apparent sensible effectiveness of ___% at ___ C.

Apparent sensible effectiveness: Aluminum core: 76% at -25C
Polypropylene core:78% at 0C
Enthalpy core: 75% Sen/54% Lat

5.3 Defrost: HRV defrost by way of exhaust air pre-heat. Recirculation of exhaust air not permitted. Unit capable of preventing over ventilation during heating and cooling by way of fresh air damper.

6. ELECTICAL

6.1 Electrical Disconnect: Single point electrical hard wired connection 115VAC, ----------A.

Amps:- EN400, EN500, EN700: 15A
EN900: 20A

7. FILTERS

7.1 Filters: The unit shall be provided with return air, outside air and exhaust air filters.

Revised Jan 7, 2008

ENERBOSS By nu-air Sustainability Through Innovation

EN 500 SERIES ENERBOSS AIR HANDLER SPECIFICATIONS

Dimensional Data	Height	Width	Depth	Supply	Return	HRV	
Enerboss 5018e, 5024e, 5030e, 5036e, 5018i, 5024i, 5030i	31	23	27	22 x 22	20 x 16	n/a	(models without HRV)
Enerboss 5118e, 5124e, 5130e, 5136e, 5118i, 5124i, 5130i,	48	23	27	22x22	20x16	6 dia	(models with HRV)

MODELS

Preliminary Selection Chart	5018i, 5018e	5024i, 5024e	5030i, 5030e	5036e	5118i, 5118e	5124i, 5124e	5130i, 5130e	5136e
Air Handler Output (Btu/hr) 110 F	20,155							
Air Handler Output (Btu/hr) 120 F	33,949							
Air Handler Output (Btu/hr) 130 F	40,927							
Air Handler Output (Btu/hr) 140 F	47,951							
Air Handler Output (Btu/hr) 150 F	55,013							
Air Handler Output (Btu/hr) 160 F	62,111							
Air Handler Output (Btu/hr) 170 F	69,238							
Air Handler Output (Btu/hr) 180 F	76,391							
Nominal Water flow (USGPM)	4							
Nominal airflow (heating)	950							
Nominal airflow, circulation mode	350							
Nominal airflow, cooling mode*	650	850	1050	1200	650	850	1050	1200
Motor FLA	7.7							
Pump FLA	0.57							
Installed Pump	Circo Star 11 BU							
Coil Pressure Drop at nominal flow (water side) (ft)	1.5							
Coil Pressure Drop at heating speed (air side) (inwc)	0.13							
HRV capacity, exhaust @ 0.4" esp	N/A				142			
HRV Efficiency (Sensible%)					69			
Estimated Weight	75				100			

* The ECM blower motor utilizes a constant CFM operating mode. RPM and torque are continuously monitored and adjusted to maintain constant CFM over wide static pressure ranges

For information on factory engineered high velocity duct systems, contact your local Enerboss representative @ 1 800 565 2261.

HYDRONIC COIL DATA - ENERBOSS 500 SERIES

Coil Construction	
Type	***Hot Water***
Fin Height x Fin Length	21 x 20 in
Rows Deep	3
Fins per inch	12

Tube OD	5/8	
Fin Type	Corrugated Aluminum .006"	
Face Area	2.9 sqft	
Header	3/4 Pipe	

		Entering Water Temperature (F)							
Air Side Performance		**100**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Flow	cfm	950							
Entering Air Dry Bulb	F	70							
Entering Air Wet Bulb	F	n/a							
Leaving Air Dry Bulb	F	89	103	109	116	123	130	137	144
Leaving Air Wet Bulb	F	n/a							
Face Velocity	FPM	326							
Air Side Pressure Drop	inwg	0.14							

Water Side Performance									
Return Water Temperature	F	90	103	109	116	122	128	135	141
Number of Circuits	F	3							
Flow Rate	gpm	4							
Water Pressure Drop	ft	1.55	1.52	1.54	1.52	1.51	1.5	1.49	1.47
Liquid Velocity	FPS	1.5							
Heat Output	Btu/hr	**20155**	**33949**	**40,927**	**47,951**	**55,013**	**62111**	**69238**	**76,391**

DX Coil Data - Enerboss 500 Series

Coil Construction	
Type	*Evaporator*
Fin Height x Fin Length	20 x 18
Rows Deep	4
Fins per inch	12
Nozzle Size	1/2" OD

Tube OD	3/8	
Fin Type	Corrugated Aluminum .006"	
Face Area	2.22	sqft
Suction	7/8	
Liquid	3/8	

Air Side Performance				
Nominal Compressor Ton		1.5	2	2.5
Flow	cfm	650	850	1050
Entering Air Dry Bulb	F	80	80	80
Entering Air Wet Bulb	F	67	67	67
Leaving Air Dry Bulb	F	55	55	55
Leaving Air Wet Bulb	F	54	54	54
Face Velocity	FPM	260	340	420
Air Side Pressure Drop	inwg	0.23	0.37	0.55

Liquid Side Performance				
Evaporator Temperature	F	45	45	45
Number of Circuits	ea	4	4	4
Refrigerant Type		R22/R410A		
Refrigerant Pres. Drop	ft	2.46	3.75	4.93

Total Cooling *	**Btu/hr**	**25,264**	**30,691**	**35,789**
Sensible Cooling *	**Btu/hr**	**16,489**	**20,536**	**24,100**

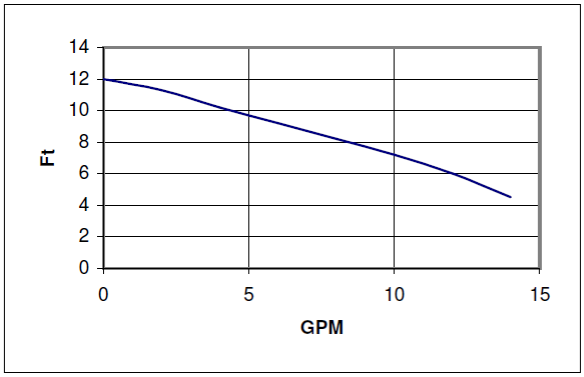
*** Performance based on R410 A**

WILO CIRCO STAR 11 CIRCULATOR (ENERBOSS 400, 500, 700, AND 900 SERIES)

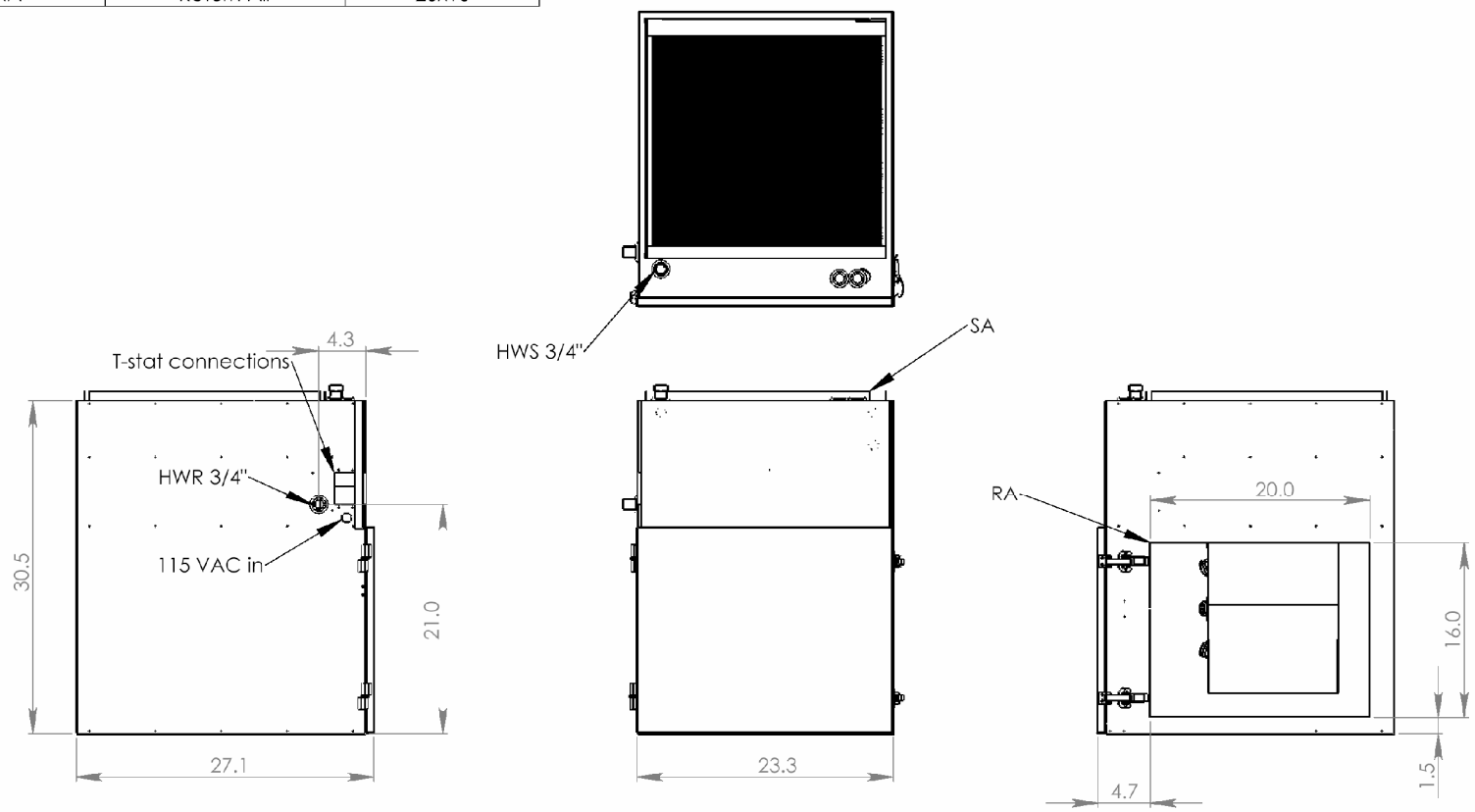
Electrical Data

Volts	Amps	Watts	HP	Capacitor
115	0.57	64	1/25	7 uf/250V

Flow	Head
0	12
2	11
4	10
6	8.5
8	8
10	7
12	6
14	5



Duct Connections		
SA	Supply Air	22x22
RA	Return Air	20x16



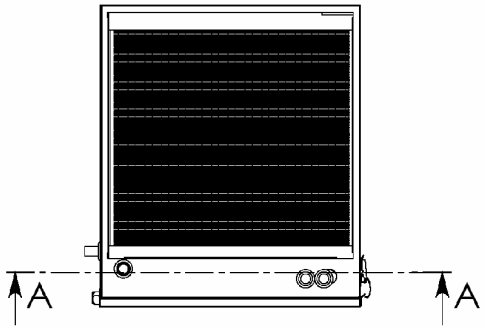
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

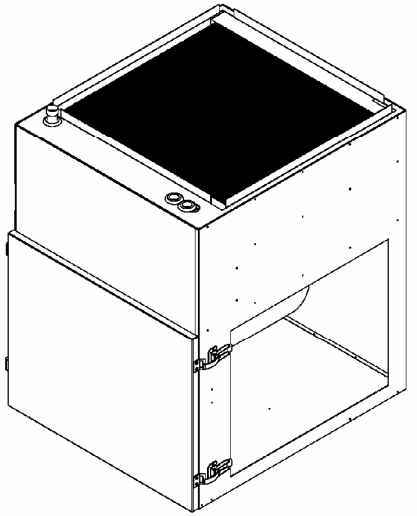
TITLE: EN5018e/5024e/5030E/5036e

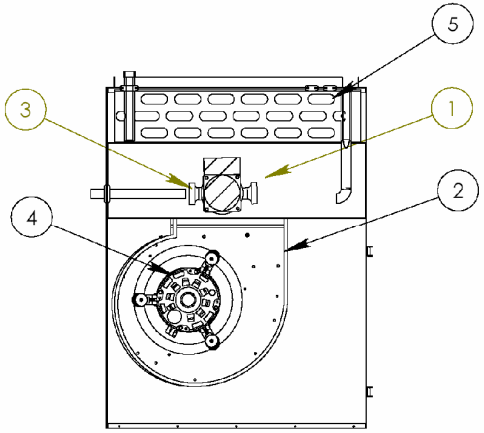
SIZE	DWG. NO.	REV
B	14026	1

SCALE: 1:10 WEIGHT: SHEET 1 OF 2

Revised Jan 7, 2008







SECTION A-A

Item	Description
1	Circulator Pump
2	G9DD Blower
3	Union Connection
4	1/2 hp ECM
5	3 Row Hot Water Coil

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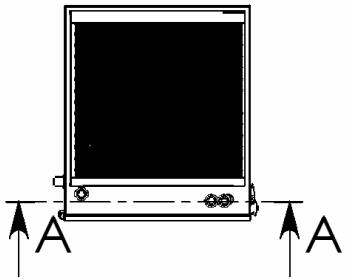
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

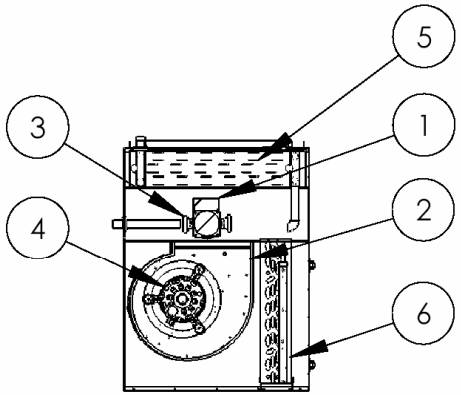
TITLE:
EN5018e/5024e/5030E/5036e

SIZE	DWG. NO.	REV
B	14026	1

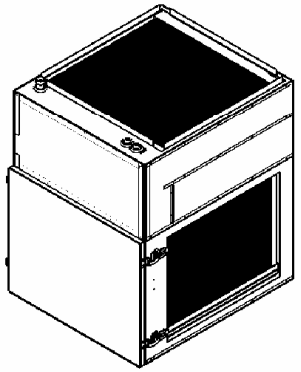
SCALE: 1:10 WEIGHT: SHEET 2 OF 2

Revised Jan 7, 2008





SECTION A-A



Item	Description
1	Circulator Pump
2	G9DD Blower
3	Union connection
4	1/2 hp ECM
5	3 Row Hot Water Coil
6	Dx30 Evaporator Coil

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

EN5018i/5024i/5030i

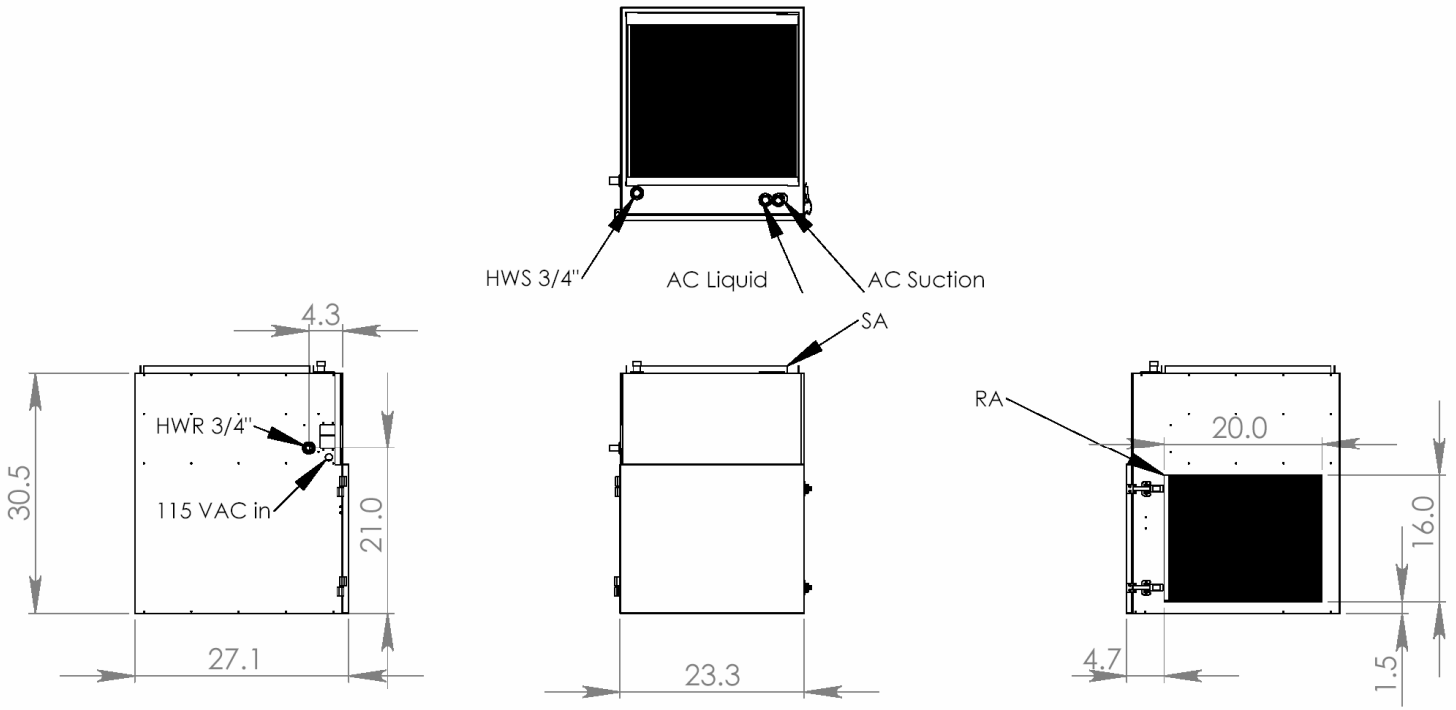
SIZE	DWG. NO.	REV
A	14037	1

SCALE: 1:20 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

Revised Jan. 7, 2008

Duct connections		
SA	Supply Air	22x22
RA	Return Air	20x16



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			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

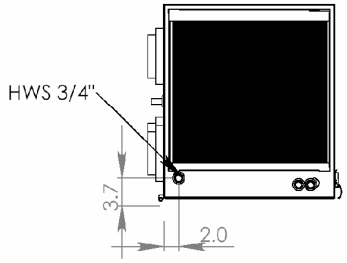
EN5018i/5024i/5030i

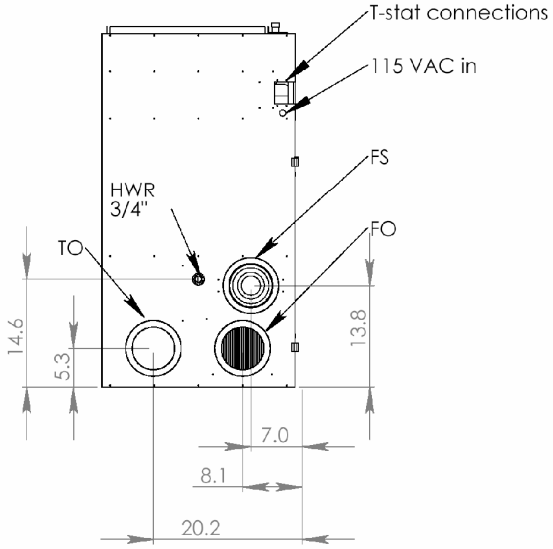
SIZE	DWG. NO.	REV
A	14037	1
SCALE: 1:20	WEIGHT:	SHEET 1 OF 2

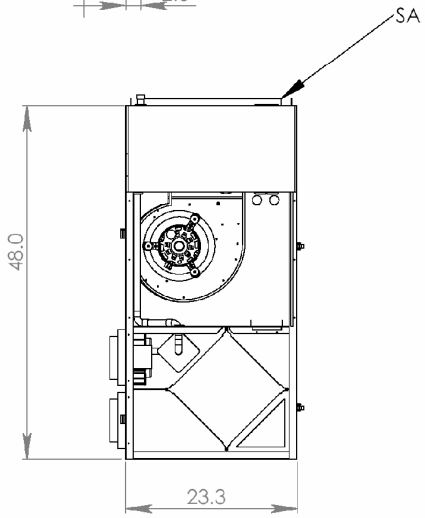
5 4 3 2 1

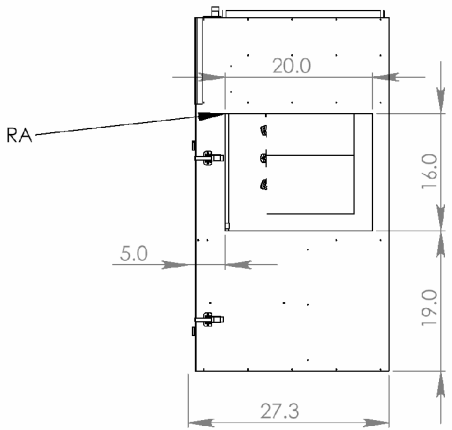
Revised Jan. 7, 2008

Duct Connections		
SA	Supply Air	22x22
RA	Return Air	20x16
FS	Exhaust Air From Space	6" dia
TO	Exhaust Air To Outside	6" dia
FO	Fresh Air From Outside	6" dia









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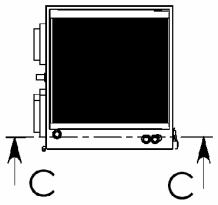
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

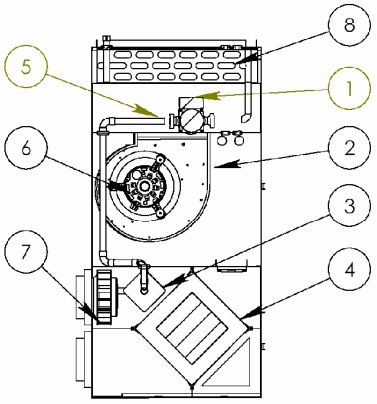
TITLE: EN5118e/5124e/5130e/5136e

SIZE	DWG. NO.	REV
B	14025	1

SCALE: 1:15 WEIGHT: SHEET 1 OF 2

Revised Jan. 7, 2008





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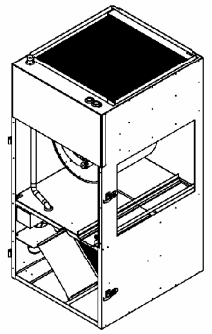


Item #	Description
1	Circulator Pump
2	G9-DD Blower
3	Secondary Hx
4	Heat Recovery Core
5	Union connection
6	1/2 hp ECM
7	HRV Exhaust Fan
8	3 Row Hot Water Coil

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION
DO NOT SCALE DRAWING

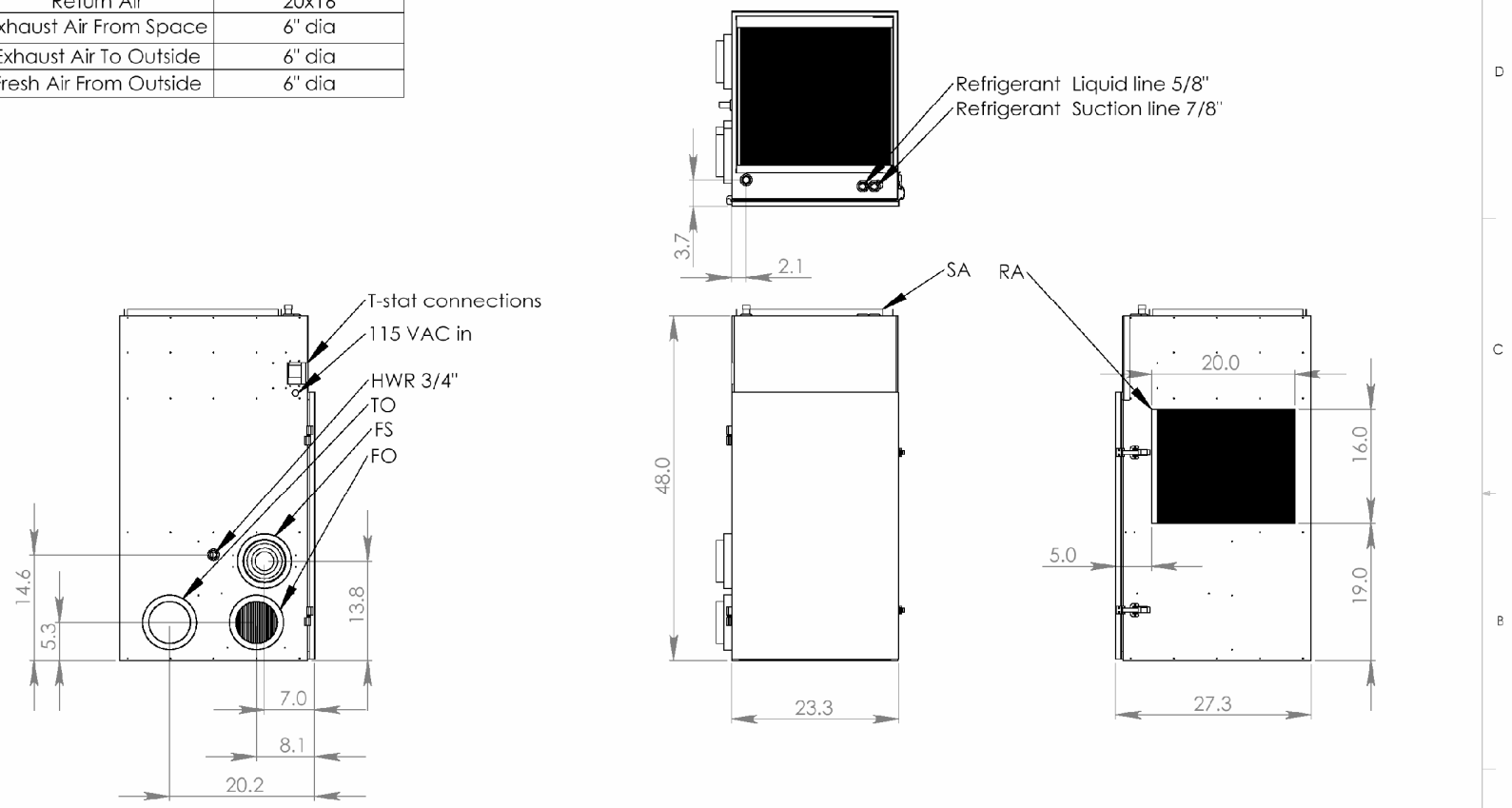
	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

TITLE:
EN5118e/5124e/5130e/5136e

SIZE B | DWG. NO. 14025 | REV 1
SCALE: 1:15 WEIGHT: | SHEET 2 OF 2

Revised Jan. 7, 2008

Duct Connections		
SA	Supply Air	22x22
RA	Return Air	20x16
FS	Exhaust Air From Space	6" dia
TO	Exhaust Air To Outside	6" dia
FO	Fresh Air From Outside	6" dia



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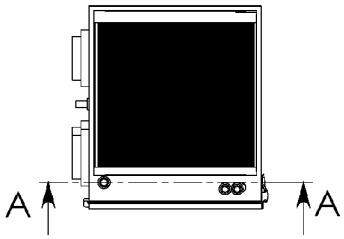
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

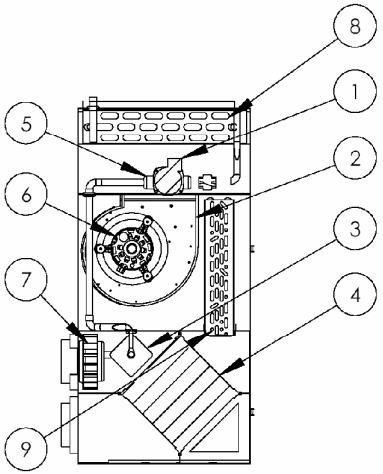
TITLE: EN5118i/5124i/5130i

SIZE	DWG. NO.	REV
B	14033	1

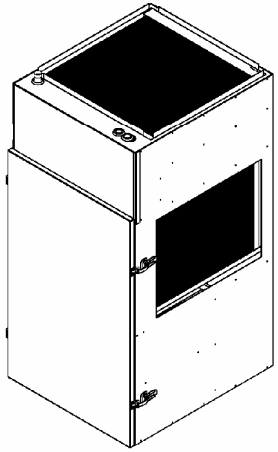
SCALE: 1:15 WEIGHT: SHEET 1 OF 2

Revised Jan. 7, 2008





SECTION A-A



Item #	Description
1	Circulator Pump
2	G9-DD Blower
3	Secondary Hx
4	Heat Recovery Core
5	Union connection
6	1/2 hp ECM
7	HRV Exhaust Fan
8	3 Row Hot Water Coil
9	Evaporator Coil

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MATERIAL
FINISH
NEXT ASSY | USED ON
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	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

TITLE:
EN5118i/5124i/5130i

SIZE	DWG. NO.	REV
B	14033	1

SCALE: 1:15 | WEIGHT: | SHEET 2 OF 2

Revised Jan. 7, 2008

ENERBOSS 400M SERIES ECM FAN COILS - NOMENCLATURE

MECHANICAL ROOM UNITS - FINISHED CABINET, DUCTED RETURN
2-PIPE OR 4-PIPE

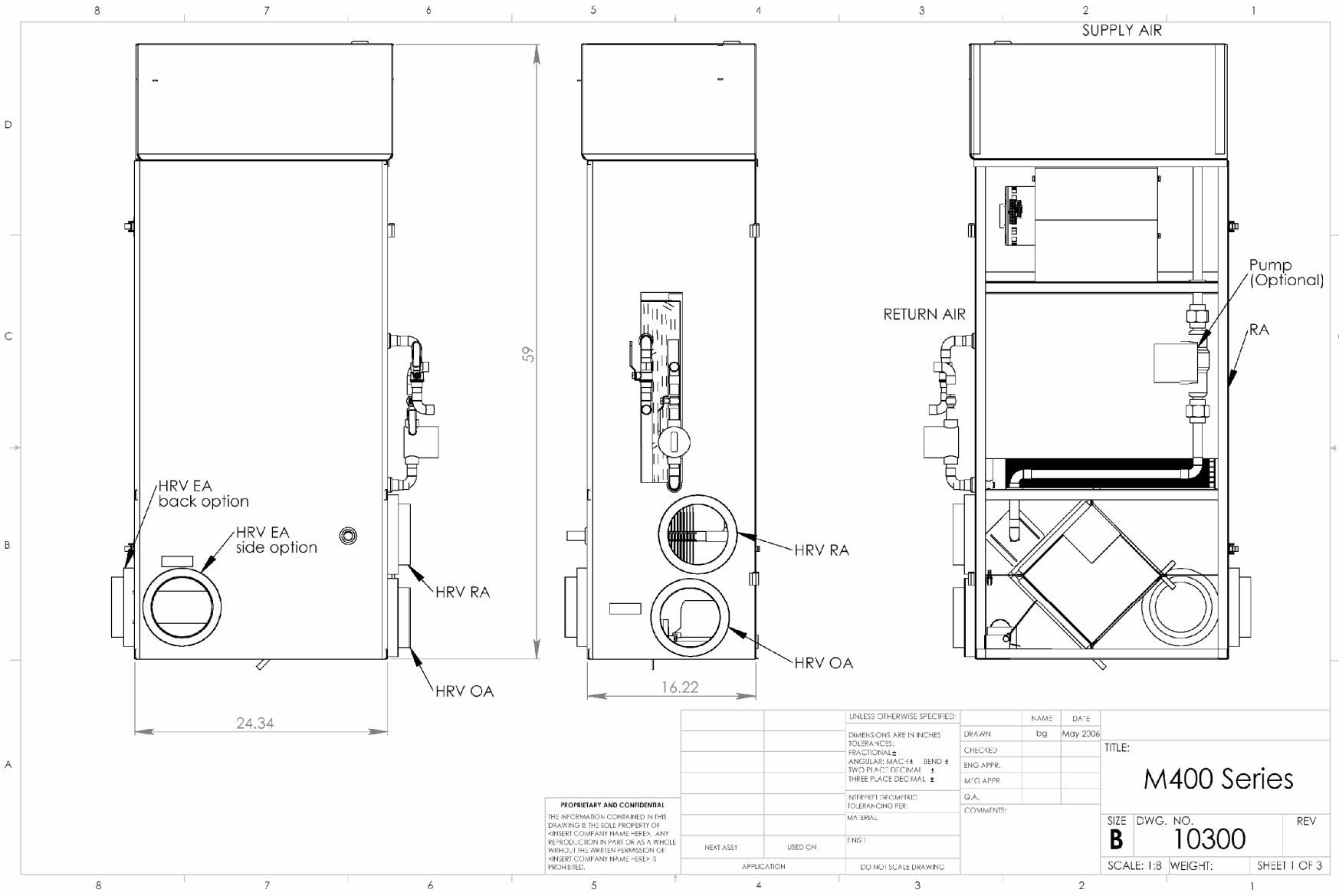
HEATING COIL				COOLING COIL		HRV	HEATING LOOP	COOLING LOOP
M4			-		-		-	-
MECHANICAL ROOM INSTALLATION	00	NONE		00	NONE	0 - NO HRV	0 - NONE	0 - NONE
	09	25 MBH		17	17 MBH AT 450 CFM	1 - POLY	2 - 2 WAY VALVE	2 - 2 WAY VALVE
	12	39 MBH		22	22 MBH AT 600 CFM	2 - ALUM	3 - 3 WAY VALVE	3 - 3 WAY VALVE
	18	52 MBH		30	30 MBH AT 850 CFM	3 - ENTHALPY	C - CIRCULATING PUMP	

Revised Feb. 12, 2009

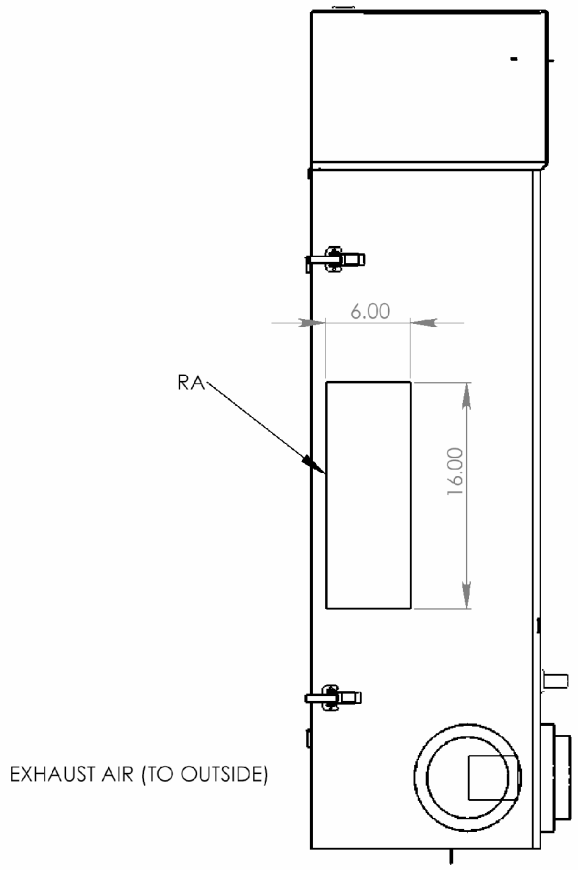
400M SERIES HEATING AND COOLING COIL DATA

Coil Construction		MODEL 409			MODEL 412			MODEL 418			MODEL CW1	MODEL CW1
Type		WATER			WATER			WATER			WATER	WATER
Fin Height x Finned Length (in)		20 X10			20 x 10			20 x 10			18X20	18X20
Face Area (sq ft)		1.39			1.39			1.39			2.50	2.50
Fins per inch		12.00			12.00			12.00			12.00	12.00
Nominal Ton		0.75			1.00			1.50			1.00	1.00
Tube OD		3/8			1/2			1/2			3/8	3/8
Rows Deep		2			2			3			4	4
Air Side Performance		**HEATING**			**HEATING**			**HEATING**			**COOLING**	**COOLING**
Flow	cfm	**450**	**450**	**450**	**600**	**600**	**600**	**650**	**650**	**650**	**450**	**600**
Circulation speed		**(38% of cooling speed)**			**(38% of cooling speed)**			**(38% of cooling speed)**			171	228
Entering Air Dry Bulb	F	70	70	70	70	70	70	70	70	70	80	80
Entering Air Wet Bulb	F										67	67
Leaving Air Dry Bulb	F	121.7	110.9	100.1	129.4	116.5	103.6	143.4	127.8	112	56.4	56.4
Leaving Air Wet Bulb	F										54.3	55.1
Face Velocity	FPM	324	324	324	432	432	432	468	468	468	180	240
Air Side Pressure Drop	inwg	0.09	0.09	0.09	0.12	0.12	0.12	0.21	0.21	0.21	0.14	0.2
Liquid Side Performance												
Entering Water Temperature	**F**	**180**	**160**	**140**	**180**	**160**	**140**	**180**	**160**	**140**	**44**	**44**
Leaving Water Temperature	F	160.4	140.4	120.4	160.4	140.4	120.4	160.4	140.4	120.4	56	55.9
Number of Circuits	ea	2	2	2	2	2	2	3	3	3	4	4
Fluid Flow	gpm	2.7	2.1	1.5	4.1	3.2	2.3	5.4	4.3	3.1	2.8	3.6
Water Pres. Drop	ft	7.55	5.07	3.01	3.48	2.3	1.32	3.1	2.76	1.6	4.53	6.84
Total Capacity	Btu/hr										17,399	21,892
Sensible Capacity	**Btu/hr**	**25,432**	**20,122**	**14,793**	**38,959**	**30,518**	**22,044**	**52,190**	**41,067**	**29,874**	**11,953**	**15,213**

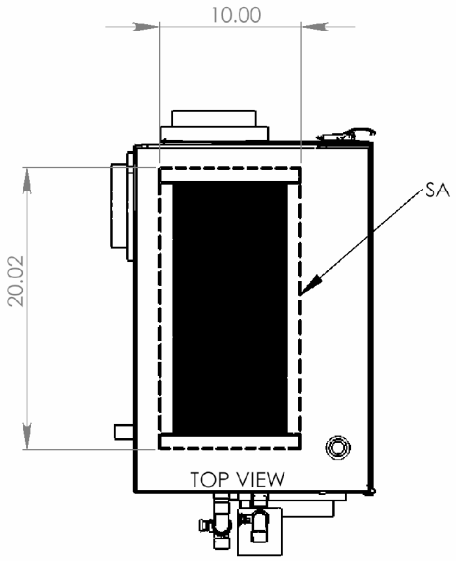
Revised Feb. 15, 2008



Revised Jan 7, 2008



BACK VIEW



TOP VIEW

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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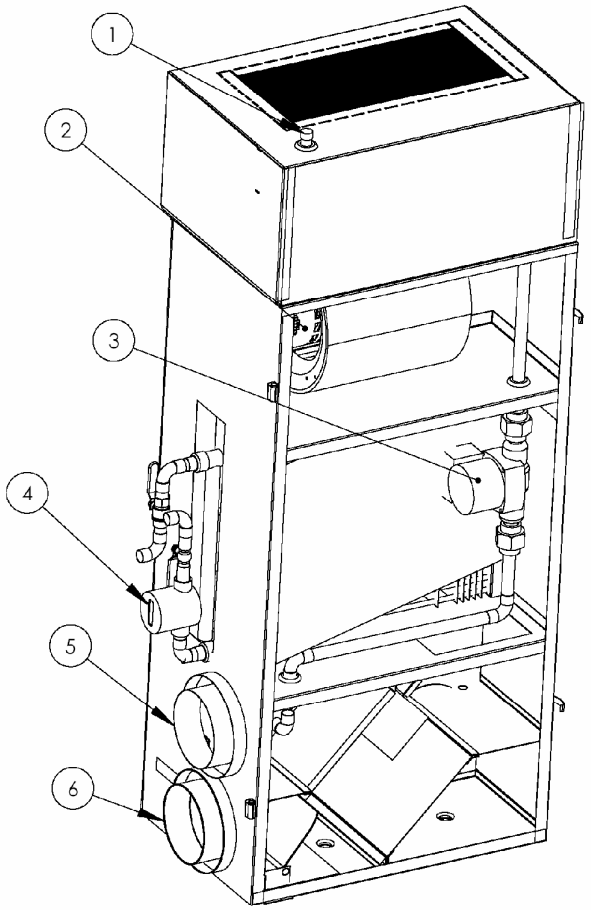
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE: M400 Series

SIZE	DWG. NO.	REV
B	10300	

SCALE:1:8 | WEIGHT: | SHEET 2 OF 3

Revised Jan 7, 2008



HOT WATER RETRUN AT BACK
EA to Outisde at back or right

1	HOT WATER IN
2	ECM
3	CIRCULATOR
4	BTU METER Optional by others
5	EA FROM SPACE
6	OUTSIDE AIR

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
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APPLICATION
DO NOT SCALE DRAWING

	NAME	DATE
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CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

TITLE:
M400 Series

SIZE B | DWG. NO. 10300 | REV
SCALE: 1:8 | WEIGHT: | SHEET 3 OF 3

Revised Jan 7, 2008

SAMPLE SPECIFICATION – 400M

1. GENERAL

1.1 System Description: Vertical 2-pipe or 4-pipe fan coil with separately plumbed hot and chilled water. ECM motor with constant CFM control to power the main blower in heating, cooling and circulation modes. Unit complete with a) internal circulator for in-suite water heater application, or b) solenoid valve for central boiler application. Integral heat/energy recovery ventilator with dedicated wet room exhaust and non-recirculating proportional defrost.

1.2 Quality Assurance: Each unit shall be CSA approved or equivalent.

2. CABINET

2.1 Casing: The fan coil shall be constructed of 14 ga. aluminum with 1" foil face insulation where appropriate for thermal performance and noise reduction.

2.2 Service Access: Removable front service panel for easy access to all components

2.2 Location: Mechanical room within 60' (equivalent length) of ventilation exterior wall caps.

3. HYDRONIC COMPONENTS

3.1 Coils: The coils shall be constructed of 3/8 x 0.014 (1/2 x 0.016) copper tube and return bend connectors. The tubing shall be mechanically joined to corrugated aluminum fins 0.006" thick with 12 fins per inch.

3.2 Coil branches and headers: The coils shall be joined to the riser stub using ⅝" type L copper tube.

3.3 Risers: The risers shall be supplied integral to the fan coil unit (optional). Risers shall be __ inches long and flared at the top to accept the riser directly below. Riser pipe shall be insulated with 1" polyethylene pipe wrap within the height of the fan coil. The riser diameters shall be specified in the equipment schedule.

3.4 Control Valve: The fan coil shall come complete with: a) two 2-way, or b) three 3-way motorized control valves normally closed to the coil.

3.5 Isolating valves: The fan coil shall come complete with two ball valves fitted to the riser stubs.

Revised Jan 7, 2008

4. AIR MOVEMENT COMPONENTS

4.1 Blower motor: The blower motor shall be direct drive electronically commutating (ECM) and operate in constant CFM mode. The motor shall be capable of delivering constant airflow in fan only, heating, cooling, and high ventilation speeds.

4.2 Main Blower: The main blower shall be a DWDI forward curve GT9-DD with galvanized wheel and housing.

5. INTEGRAL HRV/ERV

5.1 HRV fan: Supply air shall be via the main fan. The unit shall be capable of exhausting stale air from sources of contamination by way of a duct system and independent exhaust fan. The exhaust fan shall be backward curved motorized impellor. High and low speed shall be adjustable by way of the fan coil control for in-suite air balancing.

5.2 Core Media: The HRV core shall be aluminum/polypropylene/enthalpy fixed plate with an apparent sensible effectiveness of ___% at ___ C.

Apparent sensible effectiveness: Aluminum core: 75% at -25C
Polypropylene core:78% at 0C
Enthalpy core: 75% Sen/54% Lat

5.3 Defrost: Unit shall have continuous non-recirculating air exchange during defrost. Fan shut down and recirculating defrost are unacceptable.

5.4 Interlock: HRV shall be interlocked with in-suite dryer to provide make-up air during dryer operation.

6. ELECTICAL

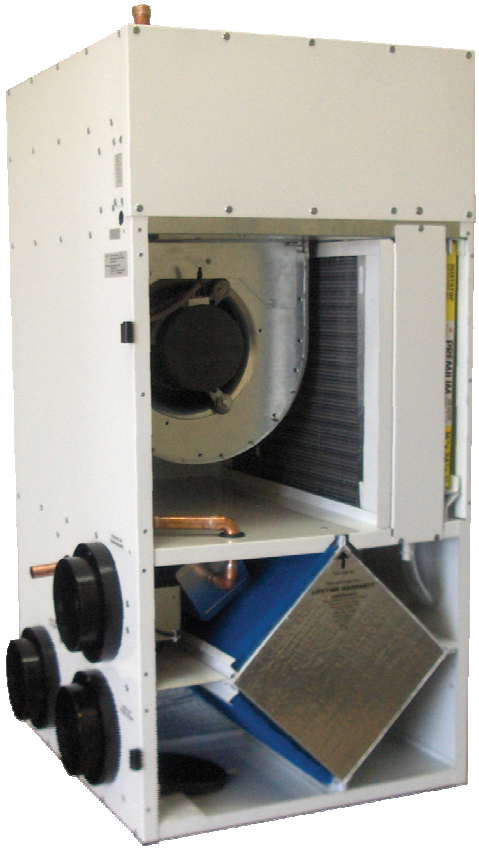
6.1 Electrical Disconnect: A 20 amp dedicated circuit with overload protection is required. Units with electric elements shall be provided with an overload fuse for the electric heater.

7. FILTERS

7.1 Filters: The unit shall be provided with return air, outside air and exhaust

ENERBOSS

By: Nu-Air Ventilation Systems Inc.



- Heat Your Home
- Cool Your Home
- Ventilate Your Home
- All With One Unit

OPERATING MANUAL

EN400, EN500, EN700, AND EN900 SERIES

nu-air
Sustainability Through Innovation

TABLE OF CONTENTS

1 GETTING STARTED

The unit is shipped complete with the following:

1. The air-handler HRV module
2. Circulating pump
3. Check valve
4. Filters
5. HRV drain kit

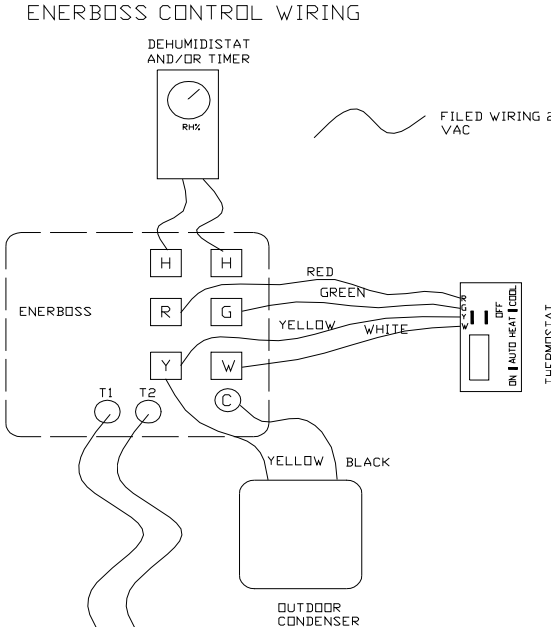
Additional items required which are field installed include: plumbing fittings and valves such as an air purge valve, anti scald valve, shut off valve, gate valves, pipe insulation and drain valves. Also required are duct fittings, a thermostat, a dehumidistat and other accessories such as grills and wire.

Note: When locating/placing the Enerboss, ensure there is a minimum clearance of 8 inches below to allow for drain pipe connections. This can be accomplished by way of stand (Part # Ener Stand) or blocks.

2 ELECTRICAL CONNECTIONS

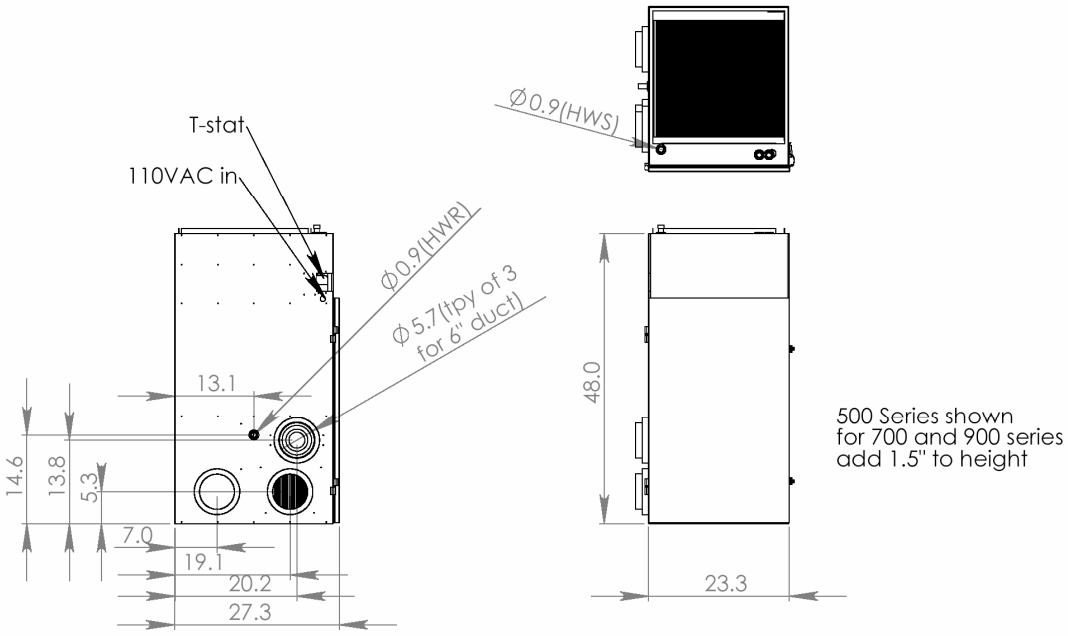
A single point, hard-wired electrical connection requiring 115 VAC service and a **dedicated** 15 amp fused circuit (20 Amp for EN900 series, 1 hp).

There are six available terminals for thermostat and dehumidistat connections. A heat/cool thermostat with fan switch connects to R, G, Y, W. A two wire dehumidistat connects to two additional terminals (H, H). A 24 V common return (black) is provided to facilitate controlling an outdoor condenser unit and/or humidifier. The two blue wires connect to the boiler thermostat T_1, and T_2. (Where applicable)

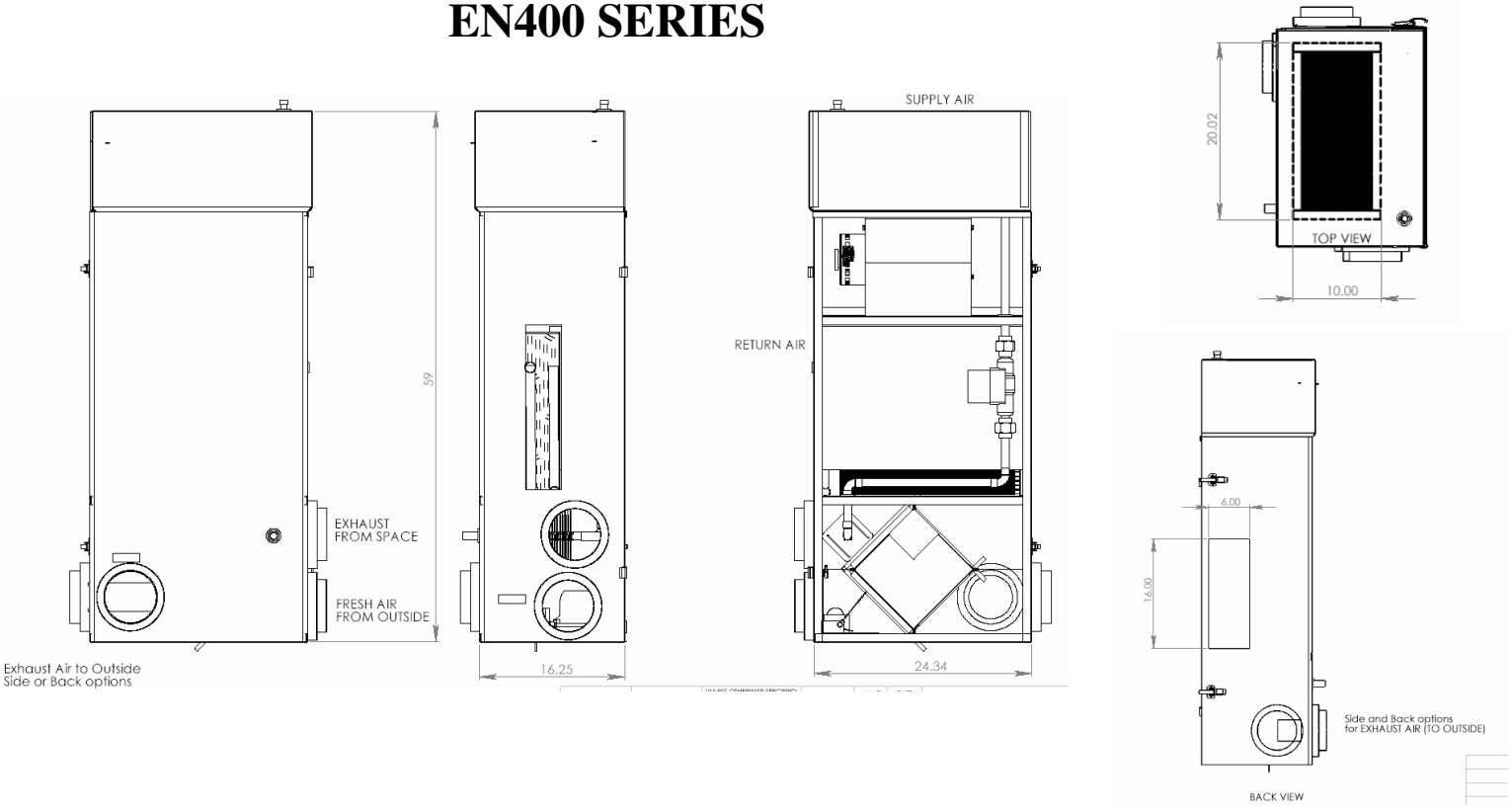


3 DIMENSIONAL DATA

EN500, EN700, AND EN900 SERIES



EN400 SERIES



4 PLUMBING

All plumbing between components is typically done with 3/4" copper pipe and appropriate fittings. All interconnecting piping is to be insulated.

System Types:

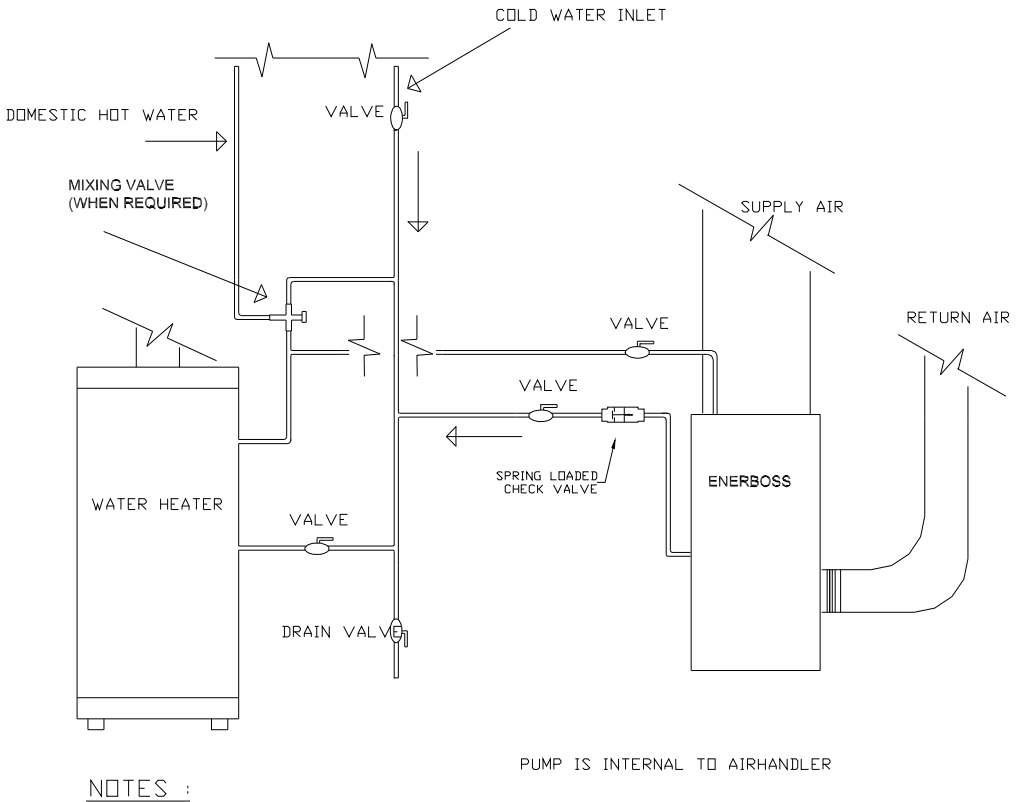
a) An **Open System** uses hot water from the residential hot water heater to supply both domestic hot water and hot water to the Enerboss for space heat. See schematic on next page. Well systems that incorporate a pressure tank are normally open systems.

b) A system becomes **closed** when a backflow prevention valve or check valve is installed in the cold water pipe upstream of the water heater. The backflow prevention valve does not allow pressure created by the heated water to be relieved into the cold water system. Therefore an expansion tank must be installed. Local codes may require this type of system.

The **spring loaded check valve** (supplied) must be installed on the return water line close to the Enerboss. Ensure flow arrow points to tank or boiler.

An **air purge valve** should be installed at the high point in the supply line close to the Enerboss.

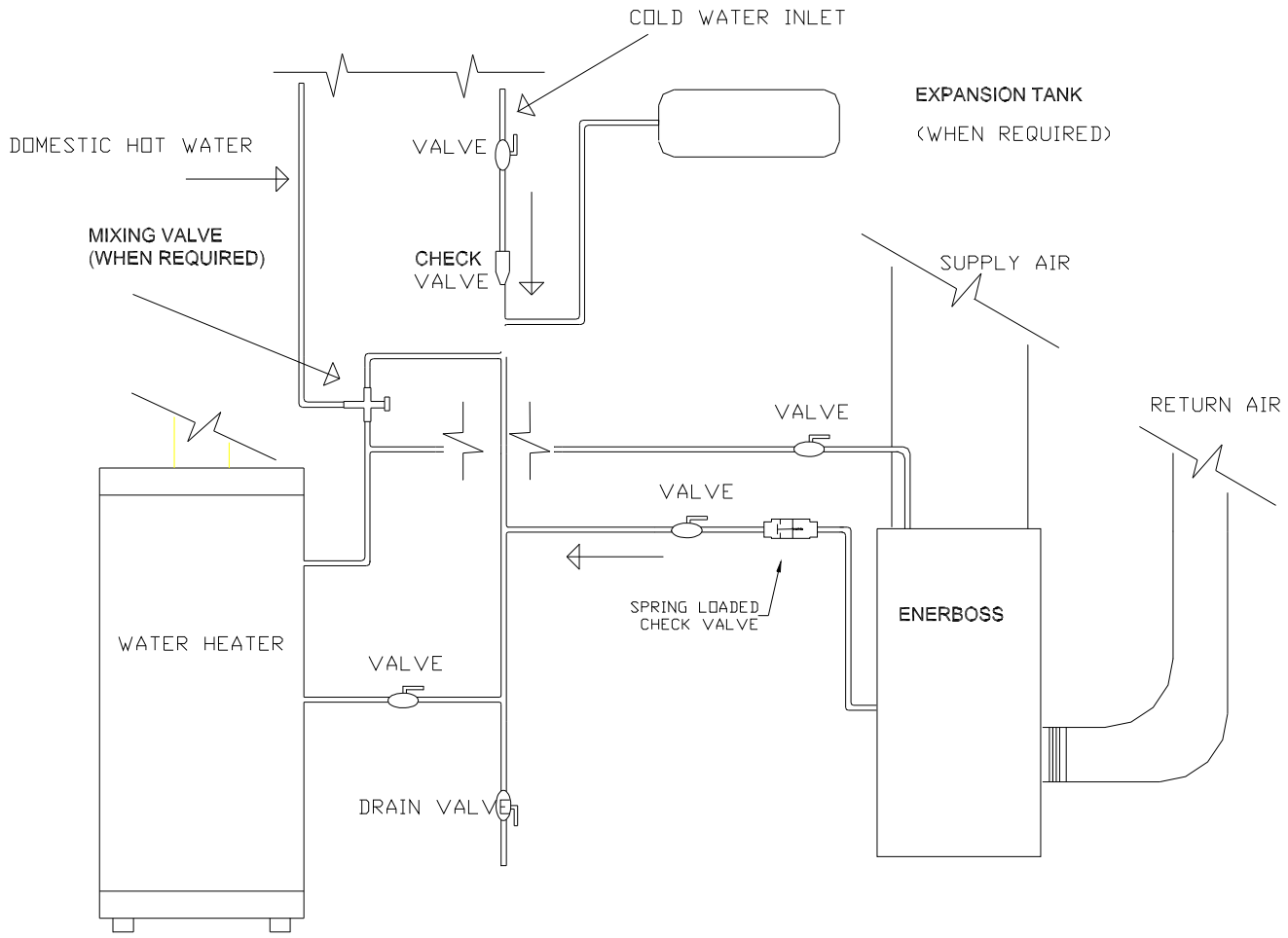
4.1 Open System



NOTES :

1) PLUMBING COMPONENTS AND SYSTEM CONFIGURATION MAY VARY FROM THE DIAGRAM PORTRAYED. REFER TO PROVINCIAL CODES, LOCAL BYLAWS AND INSTALLATION MANUALS SUPPLIED WITH THE WATER HEATER AND ENERBOSS BEFORE STARTING ANY INSTALLATION WORK.

4.2 Closed System



4.3 Off Season Pump Exerciser

The Enerboss's control features an automatic six (6) hour pump exerciser. If there has been no pump activity after six hours, the Enerboss will automatically circulate water in the system for four (4) minutes. This is done to prevent water in the coil from becoming stagnant during long periods without a call for heat.

4.4 Cooling Coil Connection

The (optional) cooling coil is supplied with a ½" OD nozzle (this is not an orifice). **To ensure proper flow, the use of a TX Valve with ½" outlet is recommended inline between the nozzle and outdoor unit**. The TX valve (not included) may be soldered directly to the nozzle, followed by the copper pipe to the outdoor unit (contractor to supply fittings as necessary). Direct application of heat to the nozzle fitting is acceptable and will not cause damage. Protect the distributor tubes with a wet rag. (Use R22 or R410).

Models EN4018i, EN4118i, EN5018, 5118i with -
R22 Refrigerant **use Sporlan Valve p/n SBFVE-A-C sweat fit, externally equalized or equivalent.**

R-410 Refrigerant **use Sporlan Valve p/n RZE11/2GA sweat fit, externally equalized or equivalent.**

Models EN4024i, EN4124i, EN5024i, EN5124i, EN5030i, EN5130i, EN7024i, EN7124i, EN7030i, EN7130i with -
R22 Refrigerant **use Sporlan Valve p/n SBFVE-B-C sweat fit, externally equalized or equivalent.**
R-410 Refrigerant **use Sporlan Valve p/n RZE2GA sweat fit, externally equalized or equivalent.**

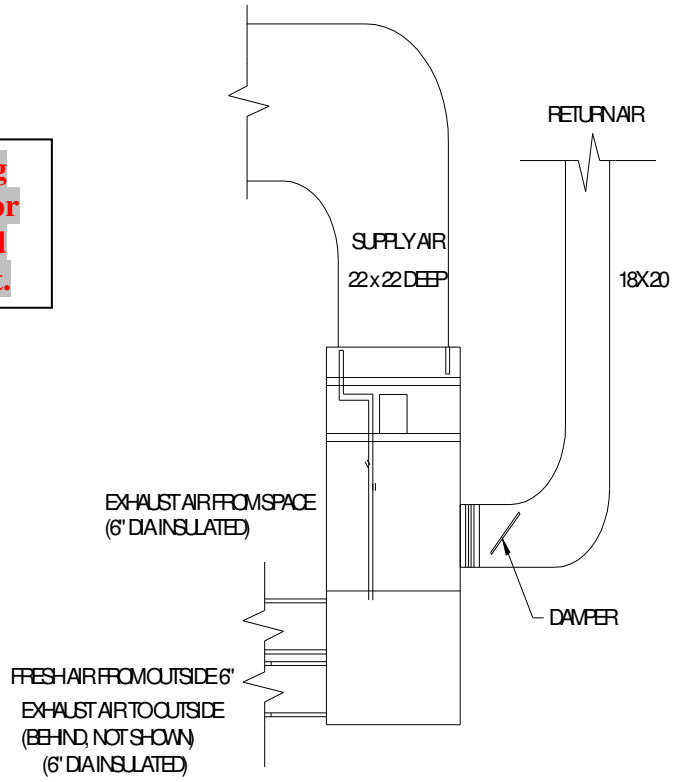
DX Heat Pump Systems
For heat pump systems contact your condenser unit manufacturer for the recommended TX valve type.

NOTE: **Nu-Air does NOT supply TX valves**, these should be available from your condenser supplier.

5 DUCTING

Air Handler
The Enerboss distributes heating, cooling and ventilation air through a 22x22 (500, 700, and 900 series) or 20"x10" (400 series) rectangular plenum in an up-blast configuration. Return air enters the unit through an 16x20 (500, 700, and 900 series) or 16"x6" (400 series) rectangular duct opening located on the side.

NOTE: Units with HRV or integrated cooling coil must be installed on a minimum 8" stand or blocking to allow for condensate drainage and easy access to connections from below the unit.



5.1 Traditional Ducting (Low Velocity)

Good engineering practice should be followed when designing a duct system. Nu-Air recommends the use of HRAI's Residential Air System Design Manual. **Supply air should be 700 to 800 fpm and return air velocity 600 to 700 fpm.**

NOTE: A damper is required in the main return duct for balancing the HRV during commissioning.

5.2 High Velocity Ducting

HI VELOCITY DUCT DESIGN

General System Description:

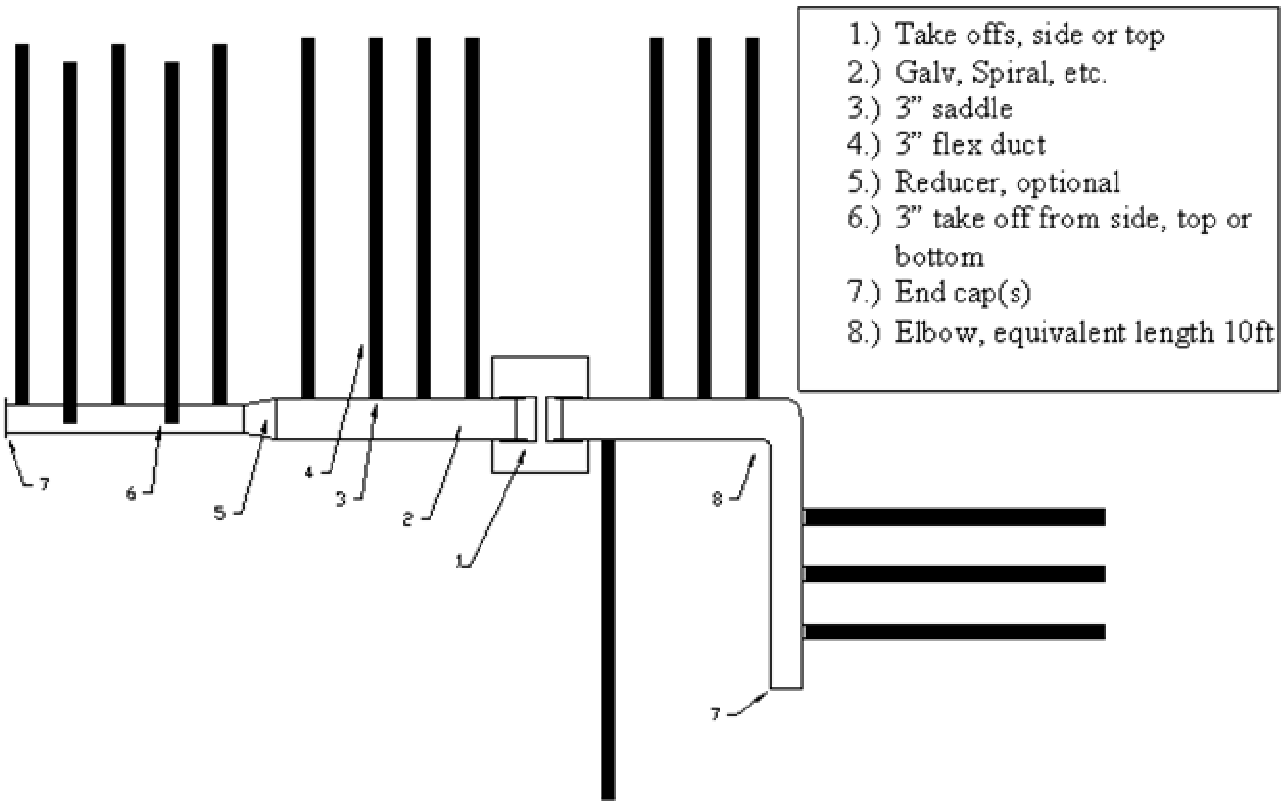
1. Nu-Air's high velocity system is based on a 3" diameter aluminum flex duct system with a **maximum lead length of 25 feet** and **minimum lead length 10'**.
2. A directional **3" vertical throw** grill should be used (EN-GR3).
3. A plenum of 22"x 22" (500, 700, and 900 series) or 20"x 10" (400 series) inches square and a **minimum of 24 inches high** connect the Enerboss to the duct system. Good engineering practice should be followed. It is recommended that the **plenum be acoustically insulated** for sound attenuation.
4. High velocity duct systems operate at higher pressures than traditional duct systems. Care must be taken to **seal all joints** and seams with duct compound or tape to ensure proper air distribution and noise control. **Trunk ducts should carry a max. 1500 fpm velocity.**
5. Follow good engineering practices. Avoid placing ducts in attics or unconditioned spaces. If this cannot be avoided, insulate the ducts to the R-value required in the National Building for your design temperature.
6. A room by room heat loss and heat gain determination is recommended.
7. Balance the airflow, heat and cooling output at each grill using a **CFM range of 50-70 per lead** and outputs within 25% of design.
8. Follow the table above to determine the maximum and minimum number of leads available.
9. Return air ducting connects to the Enerboss using a 16" x 20" (500, 700, and 900 series) or 16"x 6" (400 series) opening. **Vibration isolation (e.g. flex connector)** is recommended at the return air drop.
10. Return air should be picked up in a neutral, central location and is sized in the same way as a traditional low velocity system (max. 700 fpm). **Return air must be filtered** prior to entering the Enerboss using the filter provided.
11. **A damper is required in the main return duct for balancing the HRV during commissioning.**

High Velocity Ducting Options

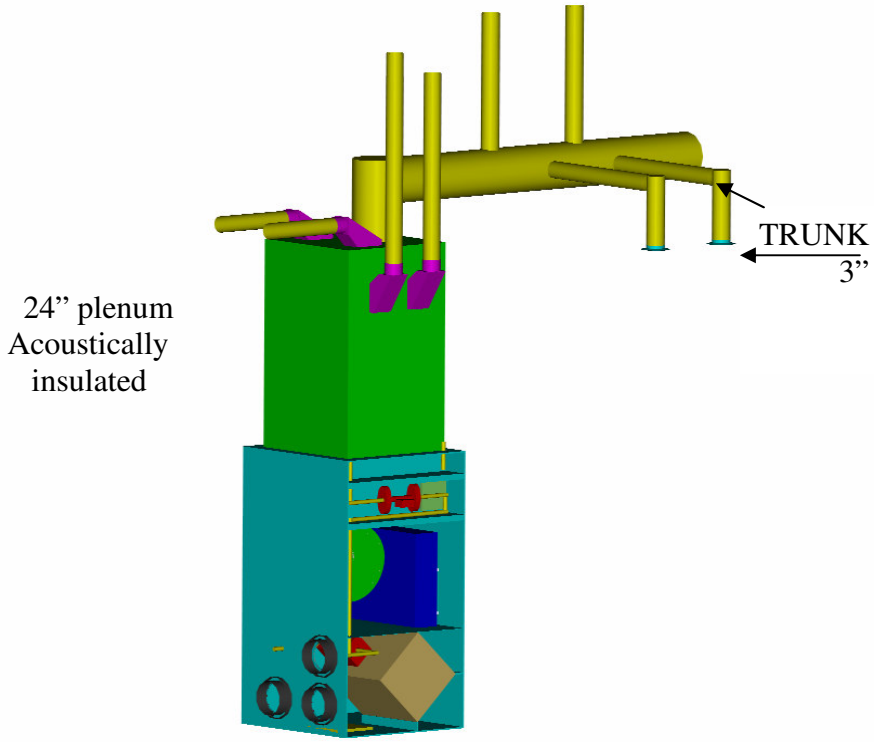
System 1 – Termination Grills Within 25ft of Supply Plenum
When maximum lead length is 25' or less from plenum, leads can be taken directly off the plenum using side or top take-offs. This can eliminate bulkheads and the cost associated with boxing these in. Only two fitting types - flex duct and HV-GR3 grills are needed.

System 2 - Leads Longer Than 25 Feet
For systems where the length from grill to plenum is longer than 25', one (1) or two (2) main carrying trunk(s) is needed (see Enerboss HI-V Duct sizing Table).

Hi-Velocity Example (system 2)



System 3 - Elements of System 1 and 2 Combined.



General design criteria for the HI-V system are:

- Trunk duct should be designed to carry the greater of heating or cooling CFM at 1500 FPM
- Trunk duct lengths are shown in equivalent length
- Two trunks can be used or a combination of system 1 and 2 with one trunk is acceptable
- Take offs should be spaced a minimum of 12" apart
- Take offs can be oriented in any suitable direction
- Branch ducts should be designed to deliver 50 to 70 CFM at each 3" grill.

Return Duct Sizing

The return duct is always low velocity with maximum 700FPM and optimum 600FPM.

To calculate return duct size:

Minimum duct size = $\frac{\text{Max Airflow (CFM)}}{\text{Max Velocity (FPM)}}$

E.G.: 713 choose highest of cooling and heating cfm.

Minimum Return Duct = $\frac{1200\text{CFM}}{700\text{FPM}}$ = 1.71sq/ft = 1.71 x 144 = 247 sq/in = 20" x 12" **minimum** return duct

Optimum Return Duct = $\frac{1200\text{CFM}}{600\text{FPM}}$ = 2.00 sq/ft = 2.00 x 144 = 288 sq/in = 24" x 12" **optimum** return duct

Branch Ducts

Use 3" galvanized duct or 3" foil flex duct.

In cooling systems use insulated duct.

In high pressure systems it is important to tape or seal all seams & joints against leakage.

NOTE: The Hi-Velocity duct system must be designed so that total external static does not exceed 1.5" w.c.

EN SERIES BTU / LEAD - HEATING

							BTU/Hr in Heating @ Inlet Water Temperature															
							100 F		120 F		130 F		140 F		150 F		160 F		170 F		180 F	
Model	CFM	Trunk Duct(s)	Max. Trunk Length	Take-Offs/ Trunk	# Leads/ trunk	CFM/ Lead	BTU / Lead	Total	BTU / Lead	Total	BTU / Lead	Total	BTU / Lead	Total	BTU / Lead	Total	BTU / Lead	Total	BTU / Lead	Total	BTU / Lead	Total
4018e, 4024e, 4018i, 4024i, 4118e, 4124e, 4118i, 4124i	650	8" x 1	50'	10 to 13	10	65	1320	13202	2223	22230	2679	26794	3134	31338	3601	36006	4065	40646	4531	45305	4998	49981
					11	59	1200		2021		2436		2849		3273		3695		4119		4544	
					12	54	1100		1853		2233		2612		3001		3387		3775		4165	
					13	50	1016		1710		2061		2411		2770		3127		3485		3845	
	325 x 2	6" x 2	25' ea.	5 to 7	5	65	1320		2223		2679		3134		3601		4065		4531		4998	
					6	59	1100		1853		2233		2612		3001		3387		3775		4165	
					7	46	934		1576		1902		2220		2548		2885		3210		3542	
5018e, 5024e, 5030e, 5036e, 5018i, 5024i, 5030i, 5118e, 5124e, 5130e, 5136e, 5118i, 5124i, 5130i	950	10" x 1	80'	14 to 19	14	68	1440	20155	2425	33949	2923	40927	3425	47951	3930	55013	4437	62111	4946	69238	5457	76391
					15	63	1344		2263		2728		3197		3668		4141		4616		5093	
					16	61	1260		2122		2558		2997		3438		3882		4327		4774	
					17	56	1186		1997		2407		2821		3236		3654		4073		4494	
					18	53	1120		1886		2274		2664		3056		3451		3847		4244	
					19	50	1061		1787		2154		2524		2895		3269		3644		4021	
	475 x 2	8" x 2	50' ea.	7 to 10	7	67	1440		2425		2923		3425		3930		4437		4946		5457	
					8	59	1260		2122		2558		2997		3438		3882		4327		4774	
					9	53	1120		1886		2274		2664		3056		3451		3847		4244	
					10	48	1031		1712		2063		2418		2705		3125		3490		3852	
7024e, 7030e, 7036e, 7024i, 7030i, 7124e, 7130e, 7136e, 7124i, 7130i	1150	12" x 1	150'	17 to 23	17	68	1567	26637	2640	44882	3183	54114	3730	63408	4280	72755	4832	82150	5387	91585	5944	101056
					18	64	1480		2493		3006		3523		4042		4564		5088		5614	
					19	61	1402		2362		2848		3337		3829		4324		4820		5319	
					20	58	1332		2244		2706		3170		3638		4108		4579		5053	
					21	55	1268		2137		2577		3019		3465		3912		4361		4812	
					22	52	1211		2040		2460		2882		3307		3734		4163		4593	
					23	50	1158		1951		2353		2757		3163		3572		3982		4394	
	575 x 2	8" x 2	30' ea.	8 to 12	8	72	1656		2795		3382		3938		4527		5103		5694		6264	
					9	64	1480		2493		3006		3523		4042		4564		5088		5614	
					10	58	1332		2244		2706		3170		3638		4108		4579		5053	
					11	52	1211		2040		2460		2882		3307		3734		4163		4593	
					12	48	1110		1864		2255		2623		3020		3408		3792		4176	
9048e, 9148e	1600	14" x 1	125'	24 to 30	24	67	1,806	43,353	2,272	54,536	2,743	65,825	3,217	77,208	3,699	88,674	4,176	100,213	4,736	113,669	5,230	125,528
					25	64	1,734		2,181		2,633		3,088		3,551		4,009		4,547		5,021	
					26	62	1,667		2,098		2,532		2,970		3,414		3,854		4,372		4,828	
					27	59	1,606		2,020		2,438		2,860		3,288		3,712		4,210		4,649	
					28	57	1,548		1,948		2,351		2,757		3,170		3,579		4,060		4,483	
					29	55	1,495		1,881		2,270		2,662		3,061		3,456		3,920		4,329	
					30	53	1,445		1,818		2,194		2,574		2,959		3,340		3,789		4,184	
	800 x 2	10" x 2	35' ea	12 to 15	12	67	1,806		2,272		2,743		3,217		3,695		4,176		4,736		5,230	
					13	62	1,667		2,098		2,532		2,970		3,411		3,854		4,372		4,828	
					14	57	1,548		1,948		2,351		2,757		3,167		3,579		4,060		4,483	
					15	53	1,445		1,818		2,194		2,574		2,956		3,340		3,789		4,184	
9060e, 9160e	2000	16" x 1	150'	30 to 36	30	67	1,615	48,461	2,033	60,997	2,455	73,664	2,882	86,449	3,311	99,337	3,826	114,775	4,272	128,157	4,720	141,588
					31	65	1,569		1,968		2,376		2,789		3,204		3,702		4,134		4,567	
					32	63	1,520		1,906		2,302		2,702		3,104		3,587		4,005		4,425	
					33	61	1,474		1,848		2,232		2,620		3,010		3,478		3,884		4,291	
					34	59	1,431		1,794		2,167		2,543		2,922		3,376		3,769		4,164	
					35	57	1,390		1,743		2,105		2,470		2,838		3,279		3,662		4,045	
					36	56	1,351		1,694		2,046		2,401		2,759		3,188		3,560		3,933	
	1000 X 2	12" x 2	50' ea.	15 to 18	15	67	1,615		2,033		2,455		2,882		3,311		3,826		4,272		4,720	
					16	63	1,514		1,906		2,302		2,702		3,104		3,587		4,005		4,425	
					17	59	1,425		1,794		2,167		2,543		2,922		3,376		3,769		4,164	
					18	56	1,346		1,694		2,046		2,401		2,759		3,188		3,560		3,933	

EN SERIES BTU / LEAD - COOLING

Model	Max. CFM	Trunk Duct	Max. Trunk Length	Take-Offs/ Trunk	# Leads/ trunk	CFM/ Lead	BTU/ Hr Cooling: BTU / Lead	BTU/ Hr Cooling: Total
4018i, 4118i, 5018i, 5118i	650	8" x 1	50'	10 to 13	10	65	1921	24264
					11	59	1747	
					12	54	1601	
					13	50	1478	
	325 x 2	6" x 2	25' ea.	5 to 7	5	65	1921	
					6	59	1601	
					7	46	1372	
4024e, 4124e 4024i, 4124i, 5024i, 5124i, 7024i, 7124i	850	10" x 1	100'	13 to 17	13	65	1973	30691
					14	61	1832	
					15	57	1710	
					16	53	1603	
					17	50	1509	
	425 x 2	7" x 2	30' ea.	6 to 9	6	71	2138	
					7	61	1832	
					8	53	1603	
					9	47	1425	
5030i, 5130i, 7030i, 7130i	1050	12" x 1	150'	15 to 21	15	70	1822	35789
					16	66	1709	
					17	62	1608	
					18	58	1519	
					19	55	1439	
					20	53	1367	
					21	50	1302	
	525 x 2	8" x 2	50' ea.	8 to 11	8	66	1711	
					9	58	1521	
					10	53	1369	
					11	48	1244	
5036e, 5136e, 7036e, 7136e	1200	12" x 1	120'	17 to 24	17	71	2118	36000
					18	67	2000	
					19	63	1895	
					20	60	1800	
					21	57	1714	
					22	55	1636	
					23	52	1565	
					24	50	1500	
	600 x 2	8" x 2	30' ea.	9 to 12	9	67	2000	
					10	60	1800	
					11	55	1636	
					12	50	1500	
9048e, 9148e	1600	14 x 1	150'	24 to 30	24	67	2,000	48,000
					25	64	1,920	
					26	62	1,846	
					27	59	1,778	
					28	57	1,714	
					29	55	1,655	
					30	53	1,600	
	800 x 2	10 x 2	50' ea	12 to 15	12	67	2000	
					13	62	1846	
					14	57	1714	
					15	53	1600	
9060e, 9160e	2000	16 x 1	150'	30 to 36	30	67	2,000	60,000
					31	65	1,935	
					32	63	1,875	
					33	61	1,818	
					34	59	1,765	
					35	57	1,714	
					36	56	1,667	
	1000 X 2	12 x 2	50' ea	15 to 18	15	67	2000	
					16	63	1875	
					17	59	1765	
					18	56	1667	

EN SERIES Hi-V DUCT SIZING

Model*	Max. CFM	Trunk Duct(s)	**Max. Trunk Length	Take-Offs/ Trunk	# Leads/ trunk	CFM/ Lead	Min. # Take-offs before reducing Trunk	Reduce To
4018i, 4024e (heat only), 4118i, 4124e, (heat only)	650	8" x 1	50'	10 to 13	10	65	3	7"
					11	59	4	
					12	54	5	
					13	50	5	
	325 x 2	6" x 2	25' ea.	5 to 7	5	65	2	5"
					6	59	2	
					7	46	3	
4024i, 4024e 4124i, 4124e	850	10" x 1	100'	13 to 17	13	65	5	8"
					14	61	5	
					15	57	6	
					16	53	6	
					17	50	7	
	425 x 2	7" x 2	30' ea.	6 to 9	6	71	3	5"
					7	61	4	
					8	53	5	
					9	47	5	
5018i, 5024i, 5036e (heat only), 518i1, 5124i, 5136e (heat only)	950	10" x 1	80'	14 to 19	14	68	6	8"
					15	63	7	
					16	61	7	
					17	56	8	
					18	53	8	
					19	50	9	
	475 x 2	8" x 2	50' ea.	7 to 10	7	67	3	6"
					8	59	3	
					9	53	3	
					10	48	3	
5030i, 5130i 5030e, 5130e	1050	12" x 1	150'	15 to 21	15	70	7	8'
					16	66	8	
					17	62	8	
					18	58	9	
					19	55	9	
					20	53	10	
					21	50	10	
	525 x 2	8" x 2	50' ea.	8 to 11	8	66	3	6"
					9	58	4	
					10	53	4	
					11	48	5	
7018i, 7024i, 7030i, 7036e (heat only), 7118i, 7124i, 7130i, 7136e (heat only)	1150	12" x 1	120'	17 to 23	17	68	9	8"
					18	64	10	
					19	61	10	
					20	58	11	
					21	55	12	
					22	52	12	
					23	50	13	
	575 x 2	8" x 2	30' ea.	8 to 12	8	72	4	6"
					9	64	4	
					10	58	5	
					11	52	5	
					12	48	5	
5036e (w/ext. 3-ton)*, 5136e (w/ext. 3-ton)*, 7036e (w/ext. 3-ton)*, 7136e (w/ext. 3-ton)*	1200	12" x 1	120'	17 to 24	17	71	10	8"
					18	67	10	
					19	63	11	
					20	60	11	
					21	57	12	
					22	55	12	
					23	52	13	
					24	50	13	
	600 x 2	8" x 2	30' ea.	9 to 12	9	67	4	6"
					10	60	5	
					11	55	5	
					12	50	6	
EN9048e, EN9148e	1600	14" x 1	150'	24 to 30	24	67	7	12"
					25	64	7	
					26	62	8	
					27	59	8	
					28	57	8	
					29	55	9	
					30	53	9	
	800 x 2	10" x 2	50' ea	12 to 15	12	67	5	8"
					13	62	5	
					14	57	6	
					15	53	6	
EN9060e, EN9160e	2000	16" x 1	150'	30 to 36	30	67	6	14"
					31	65	6	
					32	63	7	
					33	61	7	
					34	59	7	
					35	57	7	
					36	56	7	
	1000 X 2	12" x 2	50' ea.	15 to 18	15	67	8	8"
					16	63	8	
					17	59	9	
					18	56	9	

Models with external coils: Trunk ducts must be sized to the higher of the heating or cooling CFM e.eg. EN5036e or EN5136e with 3-ton externalcoil; trunk duct musr be sized for 1200 cfm.

** Equivalent Length

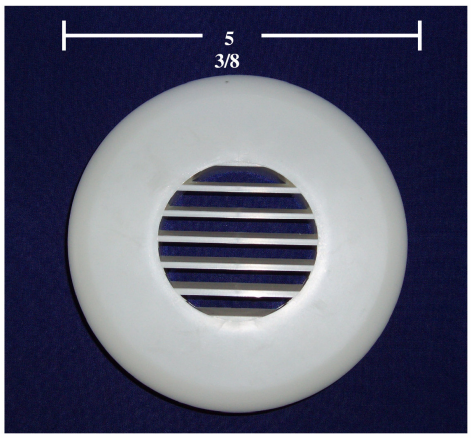
5.2.1 3" Hi-Velocity Grills (HV-GR3)

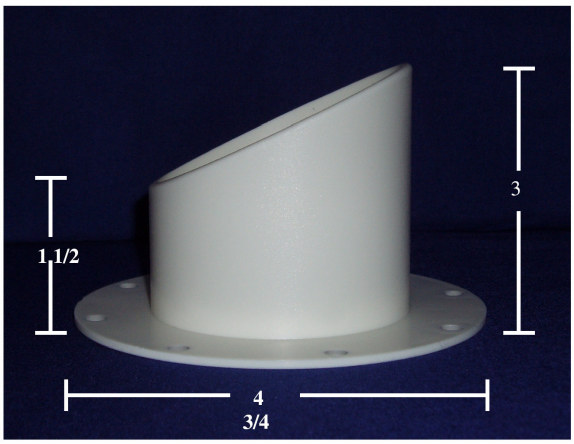
The Enerboss 3" grill (Part#HV-GR3) is specifically designed for the Enerboss Hi- Velocity system to minimize noise and maximize performance and comfort.
Grills can be located in ceiling, floor, walls, and kick plates.
The high velocity system is designed to "throw" the delivered air for proper mixing from floor to ceiling.
It is important therefore to note the following:

- Locate grills in low traffic areas:
  - Room corners
  - Behind doors
  - Next to windows
  - Away from curtains
  - Kick plates (avoid in front of sink or mirrors)

- Avoid locations where: grills are:
  - Likely to be covered by furniture
  - Directly above tall furniture or cabinets.
  - Directly above seating areas

3" Hi-Velocity Grill (Part#HV-GR3)





(Top View) (Side View)

The HV-GR3 grill features a fixed louvered design with a 7 degree pitch. Rotation of the grill can be used to direct airflow towards or away from an object. The 45 degree collar allows for a 90 degree bend in flex without rigid elbows.

NOTE: Enerboss 3" grills (Part#HV-GR3) are paintable ABS plastic. Use paints formulated to bond to plastic e.g. "KRYLON FUSION" spray paint by SHERWIN-WILLIAMS. Alternatively prime with an ALKYD primer and top coat with latex or oil.

5.3 HRV Ducting

Fresh air from the outside, exhaust air from space and exhaust air to outside all connect to the left hand side of the unit via 6-inch diameter ducting. The Enerboss with integrated HRV allows for wet room collection of exhaust air via an independent duct system. Six-inch diameter main lines branch off, reduce in size and terminate in the kitchen, washroom, laundry, etc. HRAI and others offer guidelines for duct sizing. Nu-Air recommends the use of these guidelines as good engineering practice.

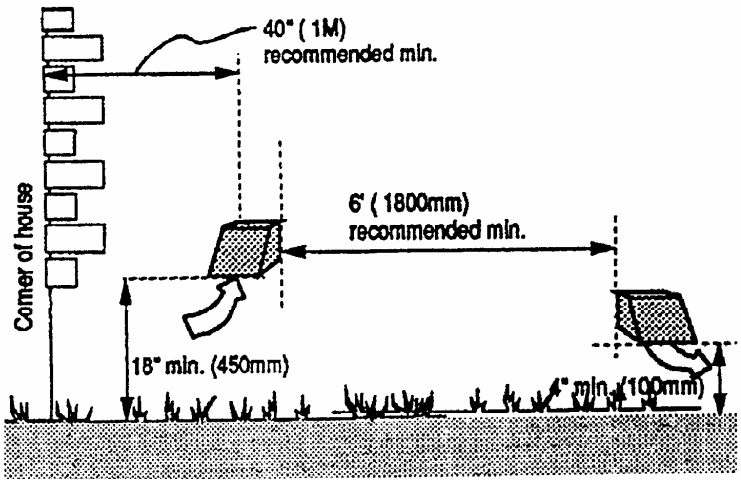
5.3.1 Ducting To The Outside

Between the weather hoods and the HRV you must use fully insulated ducting with an integrated **vapour** barrier. Insulated ducting with an integrated **vapour** barrier must also be used on all runs passing through unheated areas. This will avoid condensation problems and energy losses.

The minimum RSI value of insulation should equal that of the local building codes.

Weather Hoods

1. Insulated flex duct slides over the galvanized sleeve of the weather hood.
2. Use sheathing tape (red) to join the inner duct to the hood's sleeve.
3. Tape the **vapour** barrier to back of the hood without compressing the insulation. Caulk or foam seal around the collars and hoods to eliminate air and water leaks.
4. Locate the hoods for easy access to the bird screen for cleaning purposes.



Make the insulated duct that connects the weather hoods to the HRV as short as possible to minimize airflow restrictions. Avoid sharp bends and stretch out the inner lining of the flex duct as much as possible to reduce static pressure and maximize airflow.

5.3.2 Locating the Weather Hoods

There should be a minimum of 6' (feet) of separation between the fresh air and exhaust hoods. Supply hoods should be a minimum of 18" (inches) above the ground level. Exhaust hoods should be at least 4 "(inches) above the ground level. Holes through the wall should be 1" larger then the collar on the hood. Fresh air hoods must be 3' away from any other appliance exhaust vent or furnace vent.

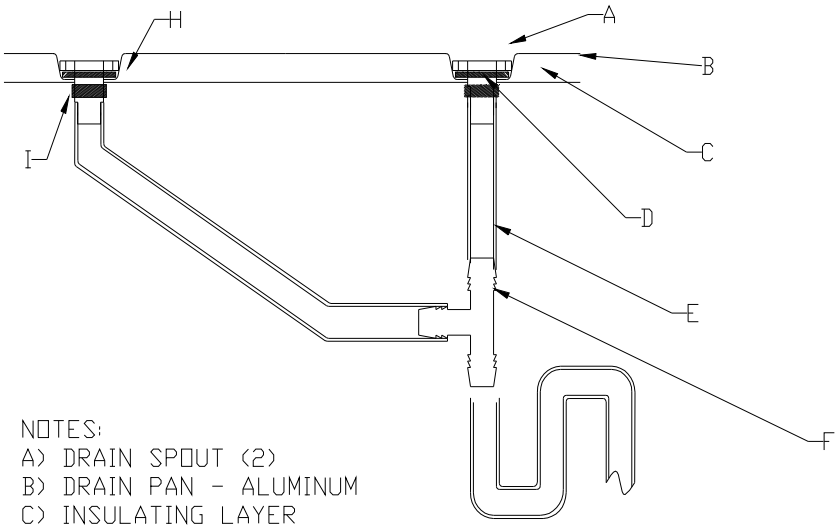
Notes on Locating the Weather Hoods

Fresh air intakes should be located away from possible sources of contamination such as:

Gas meters	Garbage containers
Oil fill pipes	Vehicle exhaust
Dryer or other exhaust	Within attics or crawl spaces

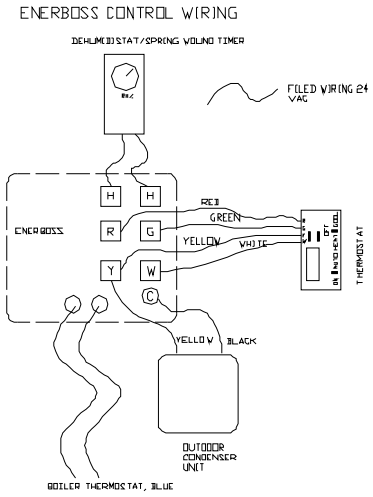
6 DRAINS

Install drain spouts in the bottom of the HRV section. Tighten with a speed nut and connect 5/8" plastic hose as shown below. Fill the trap with water.



NOTES:
A) DRAIN SPOUT (2)
B) DRAIN PAN - ALUMINUM
C) INSULATING LAYER
D) O-RING (2)
E) DRAIN HOSE 5/8" ID, (10 feet)
F) TEE FITTING, BARBED
G) "P" TRAP
H) EMBOSS (2)
I) SPEED NUT (2)

7 EXTERNAL CONTROLS



Minimum control requires a thermostat with Heat/Cool and Fan/Auto selector switches. (J6 Appendix A).
For HRV models, a dehumidistat and/or mechanical timer(s) can be used to activate high speed ventilation. (J7 Appendix A).

7.1 Thermostat

Thermostat should be 24 Volt heat/cool type with a system switch and fan switch. Set the system switch to Heat or Cool as appropriate.

- ⇒ For continuous air circulation (and low speed ventilation on HRV models) set the fan switch to "ON".
- ⇒ For intermittent fan operation (and intermittent low ventilation on HRV models) only when a call for heat or cooling is on, set the fan switch to "AUTO".

Setback thermostats can be used.

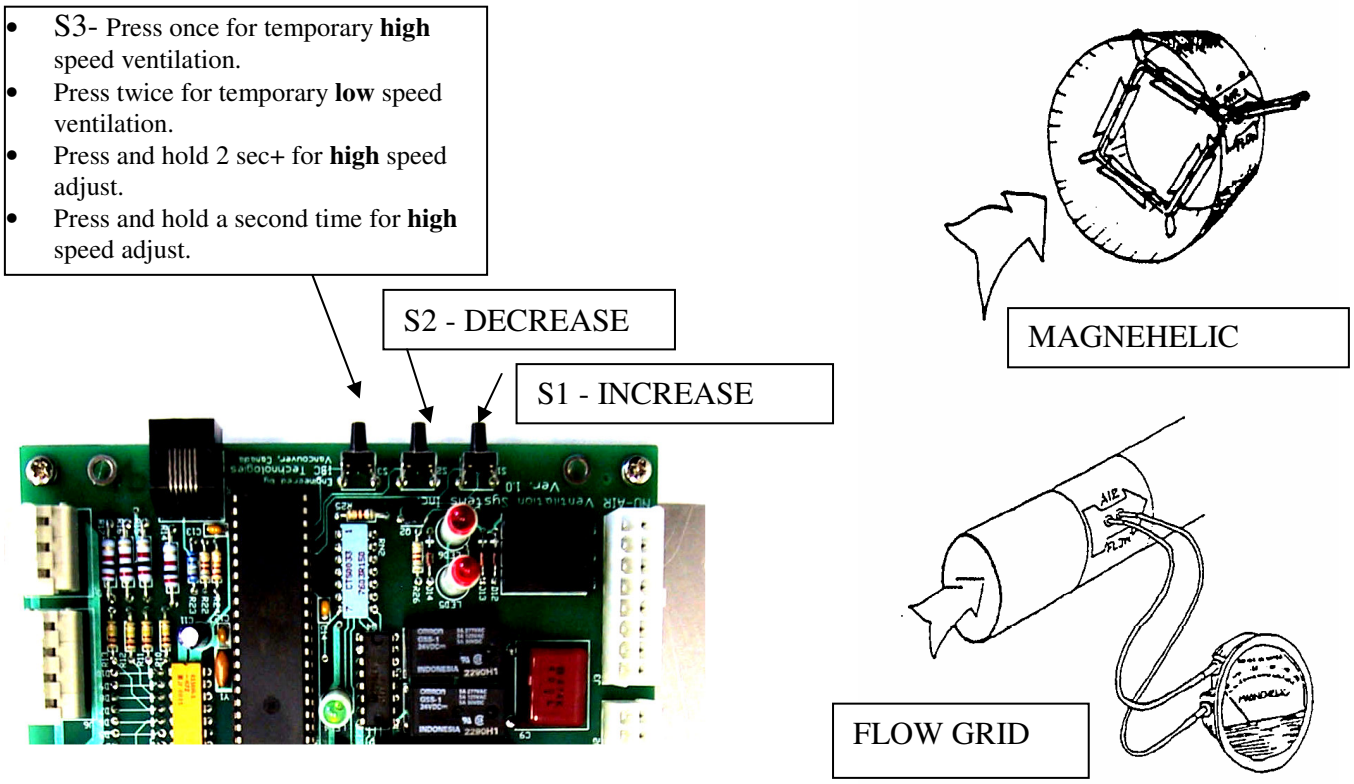
7.2 24V Dehumidistat & Timers

A **24V dehumidistat** can be used for automatic high speed ventilation on a rise in humidity (RH%). Connect to HH at the Enerboss and set to 40-60% or as desired. Dehumidistats are best located in a central area (next to the thermostat), on an interior wall, away from direct sources of heat or sunlight

24V mechanical (spring wound) timers can be used for timed high-speed ventilation on demand. Timers are usually installed in wet rooms and other areas with concentrations of odour, pollutants and humidity.

8 COMMISSIONING

Commissioning of an Enerboss system requires both air and water side balancing. Units that have an integrated HRV additionally require balancing of the supply and exhaust air streams to within 10% of each other on high speed. Hot water flow and temperature adjustment to the air handler is required on all units as is a **thorough flushing of the plumbing to remove any loose solder sludge that can cause problems with the circulator pump and valves**. Commissioning measurements should be recorded on the form provided in Appendix C.



AIR SIDE COMMISSIONING AND BALANCING

For systems which have an integrated 2-speed HRV, the air flows can be balanced in both high and low speeds for optimal airflow. Programming the HRV fan is only enabled when the room thermostat contacts and humidistat contacts are open (i.e. OFF). Three switches along the top edge of the board are used for programming the HRV fan.

8.1 HRV Balancing

The HRV *exhaust air* can be adjusted in low and high speed using the control board and the procedure that follows. The amount of outside air is adjusted using dampers. A ***field installed*** damper in the return air drop can be closed (partially) to increase outside air flow, or opened to decrease outside air flow. If outside air needs to be reduced, a ***field installed*** damper located in the HRV outside air collar or duct should be used.

When balancing the HRV:

⇒ Close all windows, doors and fireplace dampers
⇒ Turn off any exhaust systems such as bathroom fans, range hoods, central vacuums or dryers.
⇒ Turn the thermostat to the "System Off" position.

NOTE: Balancing dampers must be installed in rigid duct or in the collar of the HRV. Be sure the outside air damper does not interfere with the control damper internal to the unit.

There are two modes of operation in which the HRV needs to be balanced.
1) High speed (High ventilation switch).
2) Low speed (thermostat fan on, no heat or cool calls).

8.1.2 High Speed Balancing:

Exhaust Air High Speed Adjustment

1. With all dampers fully open (and the exhaust fan speeds at the factory default maximum setting), using the dehumidistat contacts run the air handler in high ventilation mode.
2. Measure exhaust air rate with a flow collar and magnehelic gauge or other flow measuring device.
3. Open the d-stat contacts (i.e. turn off the d-stat if installed). Using the three toggles on the bottom of the circuit board adjust exhaust fan (CFM) to desired level using S1, S2, and S3 as described below.
    - Press and hold S3 for 2 seconds to enter high-speed adjust mode. Pressing S3 again for 2 seconds will place the control in low speed adjust. (LED 4 will display a double pulse when in high speed and a short pulse when the HRV fan is in low speed).
    - Press **S1 to increase** fan speed and **S2 to decrease** (S1 and S2 have no effect when not in program mode).

Use S1 and S2 to vary the speed, and S3 to toggle between high and low speed. After 30 seconds of no switch activity, the new speeds will be written to EEPROM and re-loaded every time the system is powered up and is saved in the event of power failure.

NOTE: The HRV exhaust fan cannot be adjusted if either the thermostat, fan switch or dehumidistat is on.

TECH TIP: Use amp meter on J1, Pin#7 (see diagram pg.22) **to get indication of speed. Higher flow is proportional to higher amps.**

Supply Air High Speed Adjustment

1. Close the dehumidistat contact to run HRV in high speed. (Exhaust fan goes to high speed; main ECM fan ramps up to cooling speed.)
2. Measure fresh air rate using a magenhelic and flow station or other device.
3. If your duct system results in too **little fresh air**, damper down the field installed RETURN AIR damper
4. If there is **too much fresh air**, damper down FRESH AIR from outside damper (field installed). Adjust the OA flow rate to within 10% of the EA rate.

8.1.3 Low Speed Adjusting & Balancing:

1. **Turn off R&G and all other thermostat and dehumidistat contacts.**
2. Run the Enerboss in continuous fan mode by closing terminals R&G.(low speed)
3. Measure the amount of **fresh air** being delivered - ***record fresh air rate.***
4. Measure the **Exhaust Air From Space** - ***record exhaust air rate***
5. Use the three buttons on the side of the main Enerboss control board to set the **low speed exhaust airflow** to equal that of the low speed fresh air.

    - Press and hold S3 for 2 seconds to enter adjust mode. Press and hold a second time for low speed adjust. Balance the exhaust air to match supply air low speed rate using S1 and S2.
    - If no switches are pressed for 30 seconds, the programs are saved and the control returns to normal operation mode.

NOTE: For low speed balancing a micro manometer should be used. Magnehelic gagues do not have low enough resolution for these low pressures. Alternatively, velocity may be measured at the outside hoods with a vane anemometer or similar

8.2 Water Side Commissioning

8.2.1 Filling the water heater and setting system temperature:

1. At this point all valves should be closed and the system dry.
2. Open the cold water supply valve and a hot water tap.
3. Fill the water heater/boiler with water allowing air to escape at the open tap. Shut off the tap when air has stopped escaping.
4. Using the boiler or water heater's control, set the system to operate at your design temperature. See Equipment Selection Chart and preliminary design information forms.
5. Following the manufacturers instructions, start the water heater and allow it to reach the set point.

For cases where high water temperatures are used, an anti-scald valve will be required. Set this to 120 F and verify by measuring the water temperature at the taps.

8.2.2 To fill the heating loop:

1. Connect a garden hose to the drain valve and direct water to a floor drain or similar.
2. Open the drain valve.
3. Open the heating loop's hot water supply shut off valve
4. Allow water to flow until only water (no air) is flowing at the drain.
5. Close the hot water shut off valve.
6. Open the return water shut off valve and allow water to flow until no air is escaping at the drain.
7. Close the drain valve.
8. Open the hot water shut off valve.

8.2.3 Purging the pump and verifying flow in the heating loop:

1. Turn on electrical power to the Enerboss.
2. Set the house thermostat well above room temperature to force a call for heat.
3. Check that the circulating pump and fan are operating.
4. Hot water should be entering the fan coil and cooler water leaving.
5. Warm air should be exiting all supply grills/diffusers.
6. Apply the supplied warning label to the water heater near the aqua stat without covering any existing labels.

8.2.4 Water flow Balancing:

This step should be done when both the room air temperature and water heater temperature are stabilized.
NOTE: Return air temperature needs to be near 70 F (21 C).

1. Initiate a call for heat from the room thermostat.
2. Measure the supply (SAT) and return (RAT) air temperatures.
3. Measure the supply (SWT) and return (RWT) water temperatures
4. Calculate the heat output by the formula:

   Btu/hr = (SAT-RAT) x CFM x 1.08

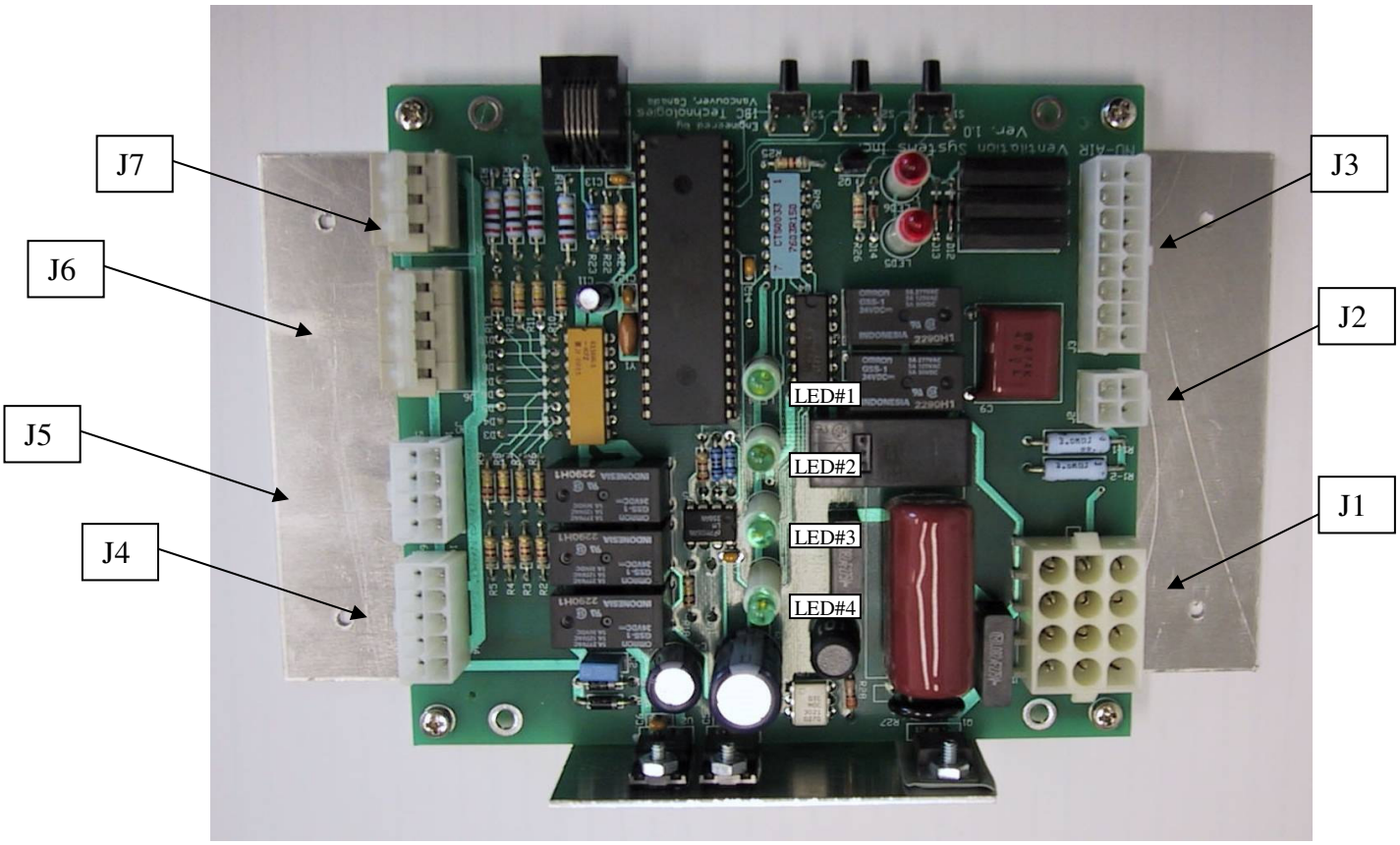
   (See Enerboss spec sheet for CFM at heating speed.)
5. If the design heat loss is not being met at this condition, increase the water heater temperature set point and repeat the previous steps
6. If the water temperature drop in the fan coil is less than 20 F, adjust the throttling valve to reduce water flow. NOTE: ▲T increases above 20 F (11 C) increases water heater efficiency.
7. Repeat until heat loss is met and water temperature drop is greater than or equal to 20 F.
8. The minimum recommended supply air temperature is 115 F.
9. If the supply air temperature or heat output cannot be met at with a 20 F water temperature drop, allow a lower temperature drop across the coil.
10. **Important - Verify the anti-scald valve is adjusted properly once final adjustments have been made. [140 F (60 C) or less]**

9 SERVICE AND MAINTENANCE:

Nu-Air recommends annual service and maintenance by a qualified HVAC contractor. The annual check should include:

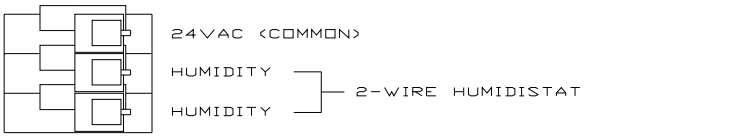
- Filter Replacement - Return air and HRV
- Coil cleaning - hot water and evaporator
- HRV Core cleaning
- Vacuuming of the fan blades with soft brush
- Wipe down of all interior surfaces of the cabinet with disinfectant
- Check the controls for proper operation
- Rebalance the HRV
- Check water heater set point against commissioning report
- Inspection of the duct work
- Check outside hoods for debris and blockage

10 APPENDIX A - ENERBOSS CONTROLLER WIRING INFORMATION

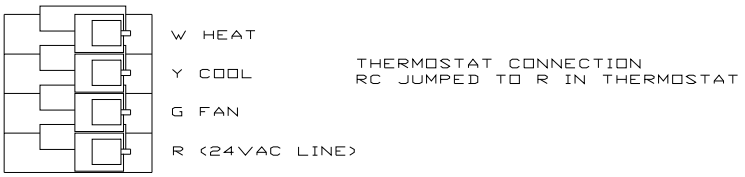


J1 - 120 V supply, pump, HRV fan, Main Fan power
J2 - Damper motor
J3 - Main Fan control
J4 - Fan Coil valve motor, 24 VAC line & common
J5 - HRV defrost clix-on
J6 - thermostat R, G, Y, W
J7 – Dehumidistat and hi-speed timers H,H.

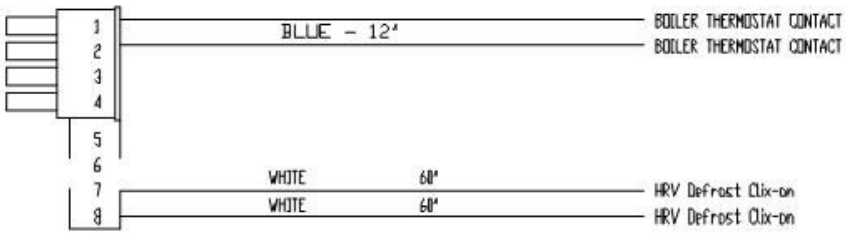
J7



J6



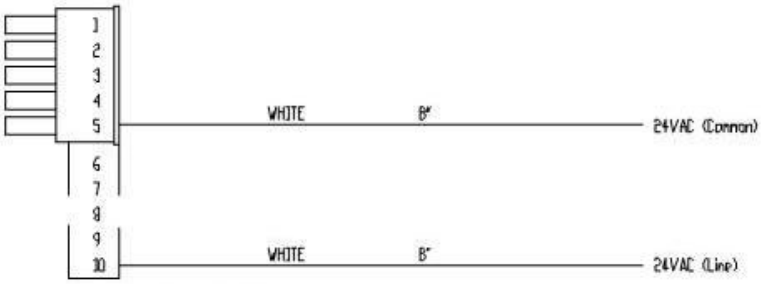
J5



Connector Housing Molex 39-01-2080
Terminal Socket Molex 39-01-0039

Wiring Harnesses for J4 (Zone Valves and 24VAC)
and J5 (Boiler control and Sensors)
18AWG TR-64 wire or equ.

J4



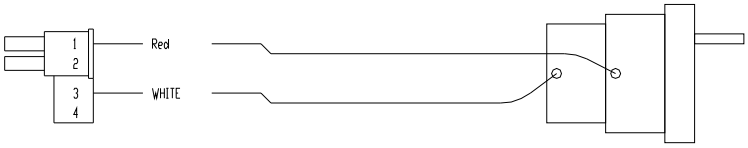
Connector Housing Molex 39-01-2100
Terminal Socket Molex 39-01-0039

J1

J1

10 RED HRV	11 BLACK PUMP	12 BLACK 120V
7 BLACK HRV	8 BLACK 120V	9 BLACK ECM
4 BLUE HRV	5 WHITE 120V PUMP	6 WHITE ECM
1 GREEN HRV	2 GREEN 120V	3 GREEN ECM

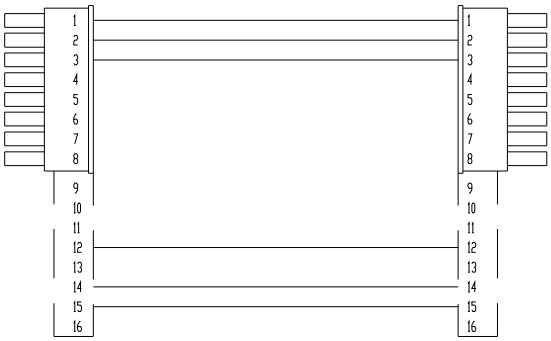
J2



Connector Housing: Molex 39-01-2040
Terminal Socket: Molex 39-00-0047 or 39-00-0039

Damper Motor

J3



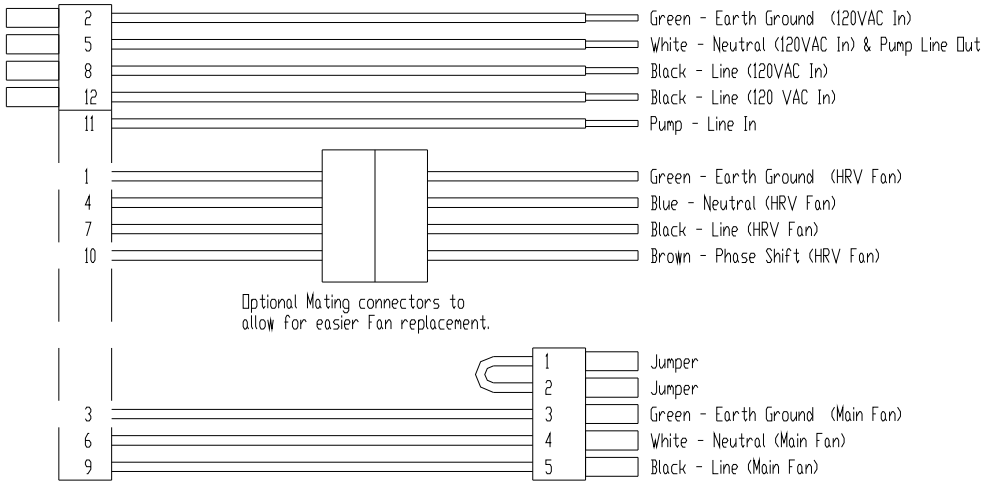
Connector Housing: Molex 39-01-2160
Terminal Socket: Molex 39-00-0039

Connector Housing: AMP 770583-1
Terminal Socket: AMP 770988-1

Wiring Harnesses for J2 (Damper motor)
and J3 (Main Fan Control)
18AWG TR-64 wire or equ. for J3

Nu-Air/Aims Controller
J2 and J3 Wiring Harnesses
Date: March 14, 2001 / Scale: N/A
Drwn by: Allan Teron / File: HARNJCAD

J1



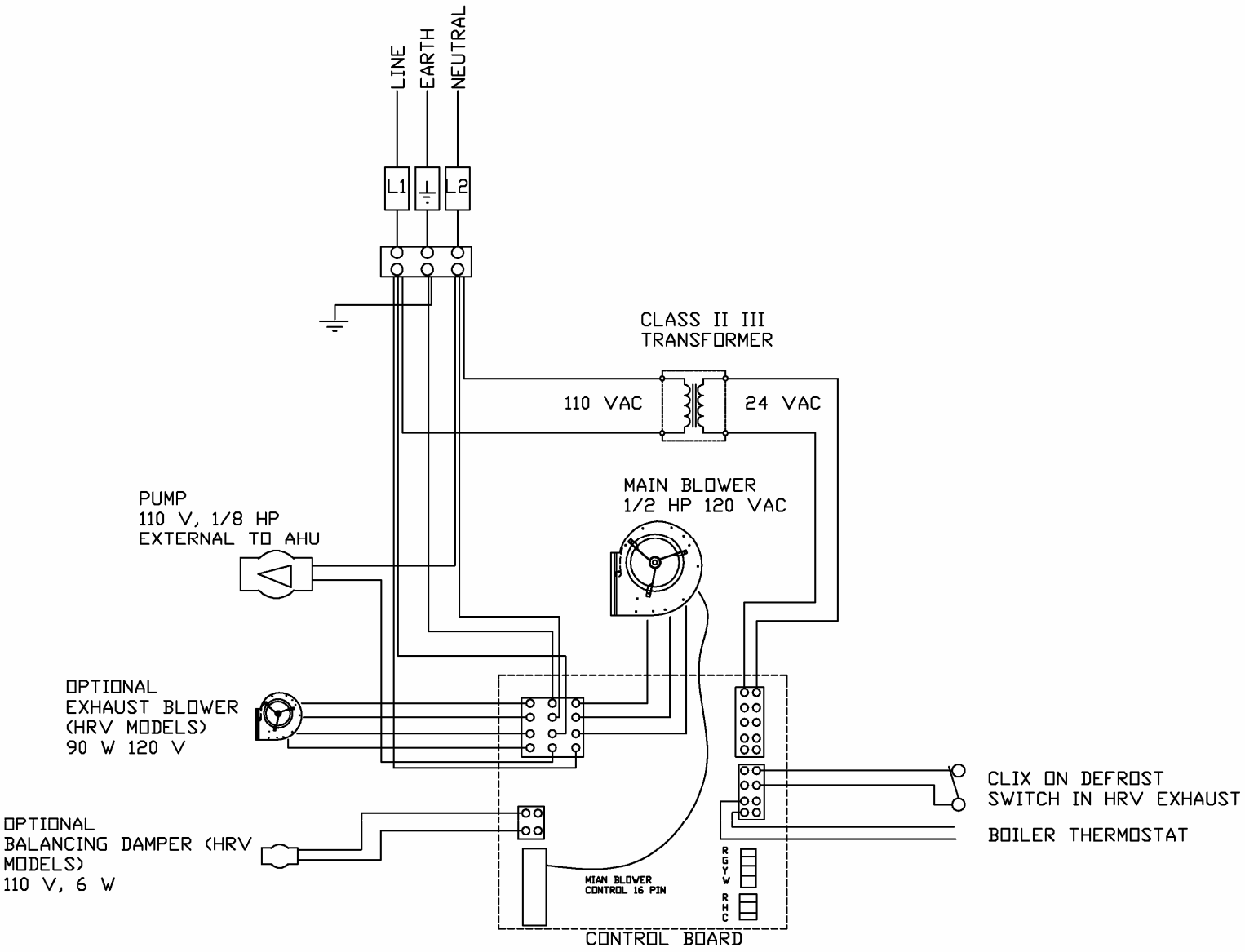
Connector Housing - AMP 1-480708-0
Terminals -AMP 350689-1 or 350550-1

Connector Housing - AMP 1-480763-0
Terminals - AMP 350689-1 or 350550-1

Wiring Harness for J1
120 VAC In, Pump Control and Fans
18AWG TR-64 or equ. wire

Nu-Air/Aims Controller
J1 Wiring Harness
Date: March 14, 2001 / Scale: N/A
Drwn by: Allan Teron / File: HARNJCAD

WIRING DIAGRAM



11 APPENDIX B – LED STATUS INDICATORS

Six LED indicators are found on the main control board. Green LEDs indicate the status of the Fans and controls.

LED1 – Standby/Program Indicator

Condition	GREEN LED
Boiler Off (Boiler thermostat contacts are open)	Medium Pulse
Boiler On (Boiler thermostat contacts are closed)	On
Speed Program Mode	Short Pulse

LED2 – Call for Heat Indicator

Condition	GREEN LED
No Call for Heat	Off
Fan Coil only	Medium Pulse

LED3 – Main Fan Status Indicator

Condition (order of precedence)	GREEN LED	Main Fan	Fan Contacts
Fan Coil at Temp., S3 High Speed, or Humidity	Long Pulse	High Speed	W/W1 and G(fan)
Cool contact closed	On	Cool Speed	Y/Y2 and G(fan)
Fan On or Low-speed fan adjust	Medium Pulse	Low Speed	G(fan)
No thermostat calls or Humidity	Off	Off	None

LED4 – HRV Fan Status Indicator

Condition (order of precedence)	GREEN LED	HRV Fan
High420 (or high-speed fan program)	Double Pulse	High Speed
Humidity	Long Pulse	High Speed
Low-speed Fan program	Short Pulse	Low Speed
Any Thermostat contact closed	Medium Pulse	Low Speed
No Humidity, thermostat or speed program	Off	Off

LED 5 AND 6 DO NOT PROVIDE INFORMATION USED BY INSTALLERS

The Following Table Outlines Switch Arrangements and Resulting Operating Modes.

THERMOSTAT CONNECTIONS	DEHUMIDISTAT CONNECTIONS	RESULTING MODE OF OPERATION
R & G	OPEN	CONTINUOUS LOW SPEED VENTING
R & W	OPEN	HEATING MODE
R & Y	OPEN	COOLING MODE
ANY	CLOSED	HIGH SPEED VENTILATION

12 APPENDIX C – COMISSIONING SHEET

Equipment Installed			
Enerboss		Design Heat Loss	
Water Heater			
Make		Design Heat Gain	
Model			
Storage		USGal	
Input		Btu/hr	

System Components Installed			
Heating Loop Shut off Valves		Anti-scald Valve	
Drain Valve		Back flow prevention valve	
Throttling Valve		Expansion Tank	
Air Purge Valve		Off Season Circulation control	Yes

System Start Up Check List			
Fill Water Heater with Water		Start Air Handler	
Heater at design temperature		Check Circulation Pump	
Fill Heating Loop with Water		Check Fan Operation	
Purge Circulation Pump		Label Water Heater	

Design Information					
Total Heat Loss		Air handler Output (110-140% DHL)		Effective Water Heater Output (120% AHO)	
					F8
Return Air Temperature	70	Entering Water Temperature		Heating Speed Airflow	
Cooling Speed Airflow		Delivered Air Temperature		Return Water Temperature	

Commissioning Measurements					
	F1		F2		F9
Entering Water Temperature Measured		Air handler Output at EWT		Return Air Temperature Measured	
	F10		F11		F12
Required Air temp. rise (F2/(F8x1.08))		Required Supply Air Temp. F9 + F10		Return Water Temperature Measured	
	F13		F14		F15
Water temp. drop F1 - F12		Actual Supply Air Temp. Measured		Anti-scald Outlet Temp. Measured	

Note: The key criteria when comparing commissioning vs design is to meet Btu output, maintain 20F temperatre drop and ensure domestic water temperature at the fixtures is below 140F.
System Check: BTU/HR = (SAT - RAT) = CFMx1.08

$$cfm = \frac{BTU/HR}{1.08 \times \blacktriangle T}$$

ENERBOSS By nu-air Sustainability Through Innovation

Enerboss EN Series - 2008 Nomenclature

ENERBOSS MODEL NUMBERING SYSTEM

ENERBOSS PREFIX	NOMINAL HEAT OUTPUT BTU at 150 F	NOMINAL VENTILATION CAPACTIY	EVAPORATOR COIL IN MBU	PREVIOUS COIL NOMENCLATURE
EN	4 = 40000 5 = 50000 7 = 70000 9 = 90000	0 = NONE 1 = 150 CFM	e = EXTERNAL i = INTERNAL 18 = 1.5 TON 24 = 2 TON 30 = 2.5 TON 36 = 3 TON 48 = 4 TON 60 = 5 TON	0 = EXTERNAL 1 = 1.5 TON 2 = 2 TON 3 = 2.5 TON
NOTE: All external coils by others				

The 400 Series

EN	4	0	18e	N/A
EN	4	0	24e	0
EN	4	0	18i	1
EN	4	0	24i	2
EN	4	1	18e	N/A
EN	4	1	24e	0
EN	4	1	18i	1
EN	4	1	24i	2

The 500 Series

EN	5	0	18e	n/a
EN	5	0	24e	n/a
EN	5	0	30e	n/a
EN	5	0	36e	0
EN	5	0	18i	1
EN	5	0	24i	2
EN	5	0	30i	3
EN	5	1	18e	n/a
EN	5	1	24e	n/a
EN	5	1	30e	n/a
EN	5	1	36e	0
EN	5	1	18i	1
EN	5	1	24i	2
EN	5	1	30i	3

The 700 Series

EN	7	0	24e	n/a
EN	7	0	30e	n/a
EN	7	0	36e	0
EN	7	0	24i	2
EN	7	0	30i	3
EN	7	1	24e	n/a
EN	7	1	30e	n/a
EN	7	1	36e	0
EN	7	1	24i	2
EN	7	1	30i	3

The 900 Series

EN	9	0	48e
EN	9	1	48e
EN	9	0	60e
EN	9	1	60e

ENERBOSS By nu-air Sustainability Through Innovation

EN400 DX SERIES ENERBOSS AIR HANDLER SPECIFICATIONS

Dimensional Data	Height	Width	Depth	Supply (TOP)	Return (RIGHT)	HRV	
EN4018i; EN4024i EN4018e; EN4024e	48	25	16	20X10	16X6	n/a	(models without HRV)
EN4118i; EN4124i EN4118e; EN4124e	59	25	16	20X10	16X6	6" dia	(models with HRV)

MODELS

Preliminary Selection Chart	EN4018i	EN4024i	EN4018e	EN4024e	EN4118i	EN4124i	EN4118e	EN4124e
Heating Capacity (Btu/hr) 100 F (EWT)	13202							
Heating Capacity (Btu/hr) 120 F (EWT)	22230							
Heating Capacity (Btu/hr) 130 F (EWT)	26794							
Heating Capacity (Btu/hr) 140 F (EWT)	31338							
Heating Capacity (Btu/hr) 150 F (EWT)	36006							
Heating Capacity (Btu/hr) 160 F (EWT)	40646							
Heating Capacity (Btu/hr) 170 F (EWT)	45305							
Heating Capacity (Btu/hr) 180 F (EWT)	49981							
Nominal Water flow (USGPM)	4	4	4	4	4	4	4	4
Nominal airflow (heating 0 - 1.5 " esp) *	650	650	650	650	650	650	650	650
Nominal airflow, circulation mode	250	250	250	250	250	250	250	250
Nominal airflow, cooling mode*	650	850	650	850	650	850	650	850
Motor FLA	7.7							
Pump FLA	0.57							
Installed Pump	Circo Star 11 BU							
Heating Coil Pressure Drop at nominal flow (water side) (ft)	5.1							
Coil Pressure Drop at heating speed (air side) (inwc)	0.25							
HRV capacity, exhaust @ 0.4" esp	n/a	n/a	n/a	n/a	130	130	130	130
HRV Efficiency (SRE%)	n/a	n/a	n/a	n/a	62	62	62	62
Estimated Weight (lb)	75	75	60	60	90	90	80	80

HOT WATER COIL DATA - ENERBOSS 400 SERIES

Coil Construction

Type	Hot Water
Fin Height x Fin Length	10x21.25
Rows Deep	3
Fins per inch	12

Tube OD	1/2	
Fin Type	Corrugated Aluminum .006"	
Face Area	1.46 sqft	
Header	3/4 Pipe	

		Entering Water Temperature (F)							
Air Side Performance		**100**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Flow	cfm	650	650	650	650	650	650	650	650
Entering Air Dry Bulb	F	70							
Entering Air Wet Bulb	F	n/a							
Leaving Air Dry Bulb	F	88.6	101.3	108.4	114.9	121.5	128.2	134.8	141.5
Leaving Air Wet Bulb	F	n/a							
Face Velocity	FPM	440.5	440.5	440.5	440.5	440.5	440.5	440.5	440.5
Air Side Pressure Drop	inwg	0.2							

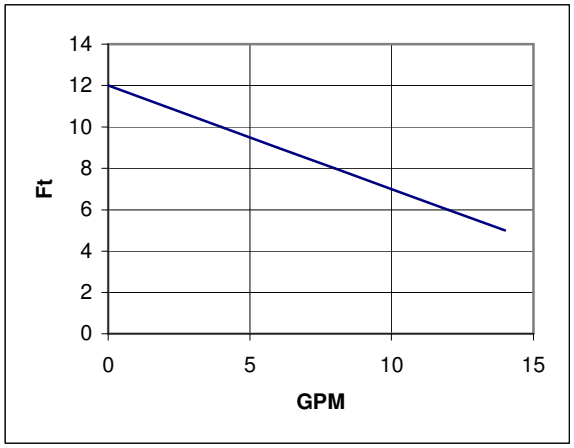
Water Side Performance									
Leaving Water Temperature	F	93.4	108.8	116.2	123.8	131.4	138.9	146.5	154
Number of Circuits	F	3							
Flow Rate	gpm	4							
Water Pressure Drop	ft	2.67	2.59	2.55	2.52	2.49	2.46	2.43	2.4
Heat Output	**Btu/hr**	**13,202**	**22,230**	**26,794**	**31,388**	**36,006**	**40,646**	**45,305**	**49,981**

WILO CIRCO STAR 11 CIRCULATOR (ENERBOSS 400, 500, 700, AND 900 SERIES)

Electrical Data

Volts	Amps	Watts	HP	Capacitor
115	0.57	64	1/25	7 uf/250V

Flow	Head
0	12
2	11
4	10
6	9
8	8
10	7
12	6
14	5



DX COIL DATA - EN 400 SERIES

Coil Construction	
Type	Evaporator
Fin Height x Fin Length	20 x 18
Rows Deep	4
Fins per inch	12
Nozzle Size	1/2" OD

Tube OD	3/8
Fin Type	Corrugated Aluminum .006"
Face Area	2.22 sqft
Suction	7/8
Liquid	3/8

Air Side Performance			
Nominal Compressor Ton		1.5	2
Flow	cfm	650	850
Entering Air Dry Bulb	F	80	80
Entering Air Wet Bulb	F	67	67
Leaving Air Dry Bulb	F	55	55
Leaving Air Wet Bulb	F	54	54
Face Velocity	FPM	260	340
Air Side Pressure Drop	inwg	0.23	0.37

Liquid Side Performance			
Evaporator Temperature	F	45	45
Number of Circuits	ea	4	4
Refrigerant Type		22/410	22/410
Refrigerant Pres. Drop	ft	2.46	3.75

Total Cooling *	**Btu/hr**	**25,264**	**30,691**
Sensible Cooling *	Btu/hr	16489	20,536

* Performance based on R410 A

EN 500, EN700 & EN900 SERIES ENERBOSS AIR HANDLER SPECIFICATIONS

Dimensional Data	Height	Width	Depth	Supply	Return	HRV	
Enerboss 5018e, 5024e, 5030e, 5036e, 5018i, 2024i, 5030i	31	23	27	22x22	20x16	n/a	(models without HRV)
Enerboss 7024e, 7030e, 7036e, 7024i, 7030i, 9048e, 9060e	32	23	27	22x22	20x16		
Enerboss 5118e, 5124e, 5130e, 5136e, 5118i, 5124i, 5130i,	48	23	27	22x22	20x16	6 dia	(models with HRV)
Enerboss 7124e, 7130e, 7136e, 7124i, 7130i, 9148e, 9160e	49	23	27	22x22	20x16	6 dia	

ENERBOSS By nu-air Sustainability Through Innovation

	MODELS																	
Preliminary Selection Chart	5018i, 5018e	5024i, 5024e	5030i, 5030e	5036e	5118i, 5118e	5124i, 5124e	5130i, 5130e	5136e	7024i, 7024e	7030i, 7030e	7036i	7124i, 7124e	7130i, 7130e	7136e	9048e	9148e	9060e	9160e
Air Handler Output (Btu/hr) 110 F	20,155								26,637						43,353		48,461	
Air Handler Output (Btu/hr) 120 F	33,949								44,882						54,536		60,997	
Air Handler Output (Btu/hr) 130 F	40,927								54,114						65,825		73,664	
Air Handler Output (Btu/hr) 140 F	47,951								63,408						77,208		86,449	
Air Handler Output (Btu/hr) 150 F	55,013								72,755						88,674		99,337	
Air Handler Output (Btu/hr) 160 F	62,111								82,150						100,213		114,775	
Air Handler Output (Btu/hr) 170 F	69,238								91,585						113,669		128,157	
Air Handler Output (Btu/hr) 180 F	76,391								101,056						125,528		141,588	
Nominal Water flow (USGPM)	4								5						5			
Nominal airflow (heating)	950								1150						1600		2000	
Nominal airflow, circulation mode	350								350						700		900	
Nominal airflow, cooling mode*	650	850	1050	1200	650	850	1050	1200	850	1050	1200	850	1050	1200	1600		2000	
Motor FLA	7.7														12.8			
Pump FLA	0.57														0.57			
Installed Pump	Circo Star 11 BU														Circo Star 11 BU			
Coil Pressure Drop at nominal flow (water side) (ft)	1.5								1.83						1.8			
Coil Pressure Drop at heating speed (air side) (inwc)	0.13								0.24						0.52		0.76	
HRV capacity, exhaust @ 0.4" esp	N/A				142				N/A			142			N/A	142	N/A	142
HRV Efficiency (Sensible%)					69							69				69		69
Estimated Weight	75				100				85			110			95	120	95	120

* The ECM blower motor utilizes a constant CFM operating mode. RPM and torque are continuously monitored and adjusted to maintain constant CFM over wide static pressure ranges
For information on factory engineered high velocity duct systems, contact your local Enerboss representative @ 1 800 565 2261.

HYDRONIC COIL DATA - ENERBOSS 500 SERIES

Coil Construction	
Type	***Hot Water***
Fin Height x Fin Length	21 x 20 in
Rows Deep	3
Fins per inch	12

Tube OD	5/8	
Fin Type	Corrugated Aluminum .006"	
Face Area	2.9 sqft	
Header	3/4 Pipe	

		Entering Water Temperature (F)							
Air Side Performance		**100**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Flow	cfm	950							
Entering Air Dry Bulb	F	70							
Entering Air Wet Bulb	F	n/a							
Leaving Air Dry Bulb	F	89	103	109	116	123	130	137	144
Leaving Air Wet Bulb	F	n/a							
Face Velocity	FPM	326							
Air Side Pressure Drop	inwg	0.14							

Water Side Performance									
Return Water Temperature	F	90	103	109	116	122	128	135	141
Number of Circuits	F	3							
Flow Rate	gpm	4							
Water Pressure Drop	ft	1.55	1.52	1.54	1.52	1.51	1.5	1.49	1.47
Liquid Velocity	FPS	1.5							
Heat Output	Btu/hr	**20155**	**33949**	**40,927**	**47,951**	**55,013**	**62111**	**69238**	**76,391**

HYDRONIC COIL DATA - ENERBOSS 700 SERIES

Coil Construction	
Type	***Hot Water***
Fin Height x Fin Length	21 x 20 in
Rows Deep	4
Fins per inch	12

Tube OD	5/8	
Fin Type	Corrugated Aluminum .006"	
Face Area	2.9	
Header	3/4 Pipe	

		Entering Water Temperature (F)							
Air Side Performance		**100**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Flow	cfm	1150							
Entering Air Dry Bulb	F	70							
Entering Air Wet Bulb	F	n/a							
Delivered Air Dry Bulb	F	91	106	113	120	128	135	143	150
Delivered Air Wet Bulb	F	n/a							
Face Velocity	FPM	394							
Air Side Pressure Drop	inwg	0.29							

Water Side Performance									
Entering Water Temperature		**100**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Return Water Temperature	F	89	102	108	114	120	127	133	139
Number of Circuits	F	4							
Flow Rate	gpm	5							
Water Pressure Drop	ft	1.83	1.8	1.79	1.78	1.77	1.75	1.74	1.73
Liquid Velocity	FPS	1.4							
Heat Output	**Btu/hr**	**26637**	**44882**	**54,114**	**63,408**	**72,755**	**82150**	**91585**	**101,056**

HYDRONIC COIL DATA - ENERBOSS 900 SERIES

Coil Construction	
Type	***Hot Water***
Fin Height x Fin Length	21 x 20 in
Rows Deep	4
Fins per inch	12

Tube OD	5/8	
Fin Type	Corrugated Aluminum .006"	
Face Area	2.9	
Header	3/4 Pipe	

EN9048e/9148e		**Entering Water Temperature (F)**							
Air Side Performance		**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Flow	cfm	1600							
Entering Air Dry Bulb	F	70							
Entering Air Wet Bulb	F	n/a							
Delivered Air Dry Bulb	F	94.8	101.2	107.6	114.1	120.7	127.3	135.0	141.7
Delivered Air Wet Bulb	F	n/a							
Face Velocity	FPM	565.5							
Air Side Pressure Drop	inwg	0.52							

Water Side Performance									
Entering Water Temperature		**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Return Water Temperature	F	92.5	98.0	103.4	108.7	114.0	119.2	123.2	128.2
Number of Circuits	F	4							
Flow Rate	gpm	5							
Water Pressure Drop	ft	1.85	1.83	1.82	1.81	1.79	1.78	1.77	1.76
Liquid Velocity	FPS	1.4							
Heat Output	**Btu/hr**	**43,353**	**54,536**	**65,825**	**77,208**	**88,674**	**100,213**	**113,669**	**125,528**

EN9060e/9160e		**Entering Water Temperature (F)**							
Air Side Performance		**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Flow	cfm	2000							
Entering Air Dry Bulb	F	70							
Entering Air Wet Bulb	F	n/a							
Delivered Air Dry Bulb	F	92.2	97.9	103.7	109.5	115.4	122.5	128.6	134.7
Delivered Air Wet Bulb	F	n/a							
Face Velocity	FPM	706.9							
Air Side Pressure Drop	inwg	1.85							

Water Side Performance									
Entering Water Temperature		**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
Return Water Temperature	F	90.5	95.4	100.2	105	109.7	112.9	117.2	121.5
Number of Circuits	F	4							
Flow Rate	gpm	5							
Water Pressure Drop	ft	1.85	1.84	1.82	1.81	1.80	1.79	1.78	1.76
Liquid Velocity	FPS	1.4							
Heat Output	**Btu/hr**	**48,461**	**60,997**	**73,664**	**86,449**	**99,337**	**114,775**	**128,157**	**141,588**

DX Coil Data - Enerboss 500, 700 Series

Coil Construction	
Type	*Evaporator*
Fin Height x Fin Length	20 x 18
Rows Deep	4
Fins per inch	12
Nozzle Size	1/2" OD

Tube OD	3/8
Fin Type	Corrugated Aluminum .006"
Face Area	2.22 sqft
Suction	7/8
Liquid	3/8

Air Side Performance				
Nominal Compressor Ton		1.5	2	2.5
Flow	cfm	650	850	1050
Entering Air Dry Bulb	F	80	80	80
Entering Air Wet Bulb	F	67	67	67
Leaving Air Dry Bulb	F	55	55	55
Leaving Air Wet Bulb	F	54	54	54
Face Velocity	FPM	260	340	420
Air Side Pressure Drop	inwg	0.23	0.37	0.55

Liquid Side Performance				
Evaporator Temperature	F	45	45	45
Number of Circuits	ea	4	4	4
Refrigerant Type		R22/R410A		
Refrigerant Pres. Drop	ft	2.46	3.75	4.93

Total Cooling *	**Btu/hr**	**25,264**	**30,691**	**35,789**
Sensible Cooling *	**Btu/hr**	**16,489**	**20,536**	**24,100**

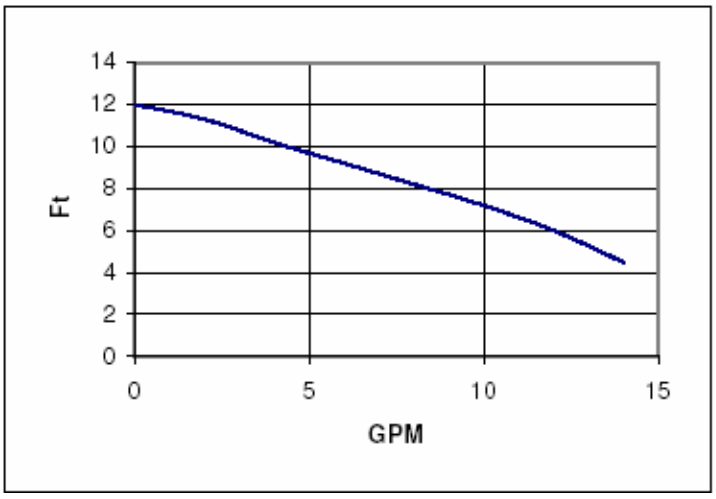
*** Performance based on R410 A**

WILO CIRCO STAR 11 CIRCULATOR (ENERBOSS 400, 500, 700, AND 900 SERIES)

Electrical Data

Volts	Amps	Watts	HP	Capacitor
115	0.57	64	1/25	7 uf/250V

Flow	Head
0	12
2	11
4	10
6	8.5
8	8
10	7
12	6
14	5

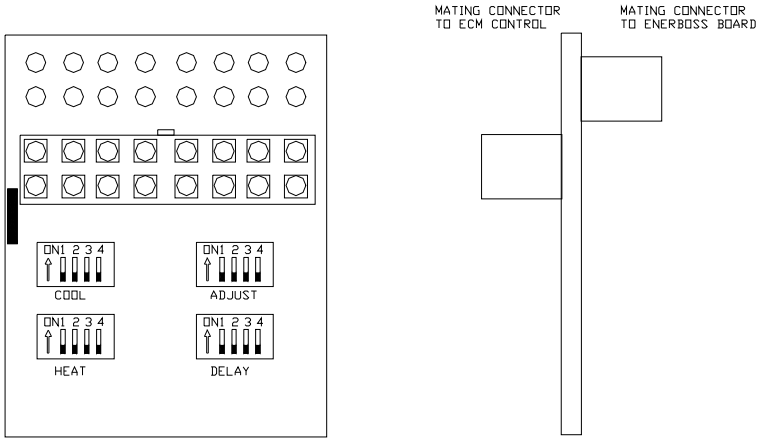


14 ECM Patch boards

Models 400, 500, 700, and 900 series manufactured after March 22, 2005.

Nu-Air has developed an add on control that enables field selection of 12 heating speeds and 12 cooling speeds on EN400, 500, 700, and 900 series Enerboss. The control is a printed circuit board that mounts directly to the Enerboss mother board between in line with the ECM motors control wiring.

The table below outlines the speeds available. Note adjust tap # 4 on the patch board is not used nor are the delay taps. When no tabs are on, this is equivalent to tap # 1. Only select one tap in each group. Powering down of the Enerboss is necessary when changing heat or cool taps. Adjust taps can be changed while the unit is running.



EN400 SERIES PATCH BOARD SPECIFICATION										
			MODELS							
			EN4018i, EN4018e		EN4118i, EN4118e		EN4024i, EN4024e		EN4124i, EN4124e	
T-STAT MODE	TAP #	ADJUST TAP #	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED
HEAT	1	1	500		500		500		500	
		2	575		575		575		575	
		3	425		425		425		425	
	2	1	675		675		675		675	
		2	776		776		776		776	
		3	574		574		574		574	
	3	1	575		575		575		575	
		2	661		661		661		661	
		3	489		489		489		489	
	4	1	650		650		650		650	
		2	748		748		748		748	
		3	553		553		553		553	
COOL	1	1	575	219	575	219	650	247	650	247
		2	661	251	661	251	748	284	748	284
		3	489	186	489	186	553	210	553	210
	2	1	675	257	675	257	850	323	850	323
		2	776	295	776	295	978	371	978	371
		3	574	218	574	218	723	275	723	275
	3	1	600	228	600	228	700	266	700	266
		2	690	262	690	262	805	306	805	306
		3	510	194	510	194	595	226	595	226
	4	1	650	247	650	247	800	304	800	304
		2	748	284	748	284	920	350	920	350
		3	553	210	553	210	680	258	680	258

denotes Factory Default Speeds

500 SERIES PATCH BOARD SPECIFICATION

			MODELS													
			EN5018i, EN5018e		EN5024i, EN5024e		EN5030i, EN5030e		EN5036e, EN5036e		EN5118i, EN5118e		EN5124i, EN5124e		EN5130i, EN5130e	
T-STAT MODE	TAP #	ADJUST TAP #	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED
HEAT	1	1	820		820		820		820		820		820		820	
		2	943		943		943		943		943		943		943	
		3	697		697		697		697		697		697		697	
	2	1	770		770		770		770		770		770		770	
		2	886		886		886		886		886		886		886	
		3	655		655		655		655		655		655		655	
	3	1	1070		1070		1070		1070		1070		1070		1070	
		2	1231		1231		1231		1231		1231		1231		1231	
		3	910		910		910		910		910		910		910	
	4	1	950		950		950		950		950		950		950	
		2	1093		1093		1093		1093		1093		1093		1093	
		3	808		808		808		808		808		808		808	
COOL	1	1	1200	456	650	399	850	456	650	456	1200	456	650	399	850	456
		2	1380	524	748	284	978	371	748	284	1380	524	748	284	978	371
		3	1020	388	553	210	723	275	553	210	1020	388	553	210	723	275
	2	1	850	247	1050	247	1200	247	1050	323	850	247	1050	247	1200	247
		2	978	371	1208	459	1380	524	1208	459	978	371	1208	459	1380	524
		3	723	275	893	339	1020	388	893	339	723	275	893	339	1020	388
	3	1	1050	399	1200	323	650	323	850	399	1050	399	1200	323	650	323
		2	1208	459	1380	524	748	284	978	371	1208	459	1380	524	748	284
		3	893	339	1020	388	553	210	723	275	893	339	1020	388	553	210
	4	1	650	247	850	323	1050	399	1200	456	650	247	850	323	1050	399
		2	748	284	978	371	1208	459	1380	524	748	284	978	371	1208	459
		3	553	210	723	275	893	339	1020	388	553	210	723	275	893	339

DEFAULT VALUES

* VALUES ABOVE 1200 CFM AND BELOW 300 CFM MAY BE CLIPPED TO A LOWER/HIGHER SPEED

* Continuous/Circulation speed is a percentage of Cooling speed. Adjustments to cooling affect Circulation according to the table values

700 SERIES PATCH BOARD SPECIFICATION

			MODELS											
			EN7024i, EN7024e		EN7030i, EN7030e		EN7036e		EN7124i, EN7124e		EN7130i, EN7130e		EN7136e	
T-STAT MODE	TAP #	ADJUST TAP #	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED
HEAT	1	1	770		770		770		770		770		770	
		2	886		886		886		886		886		886	
		3	655		655		655		655		655		655	
	2	1	950		950		950		950		950		950	
		2	1093		1093		1093		1093		1093		1093	
		3	808		808		808		808		808		808	
	3	1	820		820		820		820		820		820	
		2	943		943		943		943		943		943	
		3	697		697		697		697		697		697	
	4	1	1150		1150		1150		1150		1150		1150	
		2	1323		1323		1323		1323		1323		1323	
		3	978		978		978		978		978		978	
COOL	1	1	650	456	850	399	650	456	650	456	850	456	650	456
		2	748	284	978	371	748	284	748	284	978	371	748	284
		3	553	210	723	275	553	210	553	210	723	275	553	210
	2	1	1050	247	1200	247	1050	247	1050	247	1200	247	1050	247
		2	1208	459	1380	524	1208	459	1208	459	1380	524	1208	459
		3	893	339	1020	388	893	339	893	339	1020	388	893	339
	3	1	1200	323	650	323	850	399	1200	399	650	323	850	399
		2	1380	524	748	284	978	371	1380	524	748	284	978	371
		3	1020	388	553	210	723	275	1020	388	553	210	723	275
	4	1	850	323	1050	399	1200	456	850	323	1050	399	1200	456
		2	978	371	1208	459	1380	524	978	371	1208	459	1380	524
		3	723	275	893	339	1020	388	723	275	893	339	1020	388

DEFAULT VALUES

* VALUES ABOVE 1200 CFM AND BELOW 300 CFM MAY BE CLIPPED TO A LOWER/HIGHER SPEED

900 SERIES PATCH BOARD SPECIFICATION

			MODELS							
			EN9048e		EN9148e		EN9060e		EN9160e	
T-STAT MODE	TAP #	ADJUST TAP #	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED	HIGH SPEED	CONTINUOUS SPEED
HEAT	1	1	1700		1700		2100		2100	
		2	1955		1955		2415		2415	
		3	1445		1445		1785		1785	
	2	1	1500		1500		1800		1800	
		2	1725		1725		2070		2070	
		3	1275		1275		1530		1530	
	3	1	1400		1400		1700		1700	
		2	1610		1610		1955		1955	
		3	1190		1190		1445		1445	
	4	1	1600		1600		2000		2000	
		2	1840		1840		2300		2300	
		3	1360		1360		1700		1700	
COOL	1	1	1700	646	1700	646	2100	798	2100	798
		2	1955	743	1955	743	2415	918	2415	918
		3	1445	549	1445	549	1785	678	1785	678
	2	1	1500	570	1500	570	1800	684	1800	684
		2	1725	656	1725	656	2070	787	2070	787
		3	1275	485	1275	485	1530	581	1530	581
	3	1	1400	532	1400	532	1700	646	1700	646
		2	1610	612	1610	612	1955	743	1955	743
		3	1190	452	1190	452	1445	549	1445	549
	4	1	1600	608	1600	608	2000	760	2000	760
		2	1840	699	1840	699	2300	874	2300	874
		3	1360	517	1360	517	1700	646	1700	646

DEFAULT VALUES

* VALUES ABOVE 1200 CFM AND BELOW 300 CFM MAY BE CLIPPED TO A LOWER/HIGHER SPEED

15 WARRANTY

YOUR *Enerboss*

TRANSFERABLE WARRANTY

Should your ***Enerboss*** cease to function within Five (5) years of the date of original purchase due to defective material of workmanship of the product, ***NU-AIR*** Ventilation Systems Inc. will supply a new or rebuilt part FOB factory to replace the defective part. Delivery, installation, and labor cost would be your responsibility.

Lifetime Core Warranty

If the aluminum or Polypropylene core in your ***NU-AIR*** Heat Recovery Ventilator fails due to a defect in material or workmanship ***NU-AIR*** Ventilation Systems Inc. will supply a new core FOB factory to replace the defective part. Delivery and labor costs are your responsibility.
(There is a two year warranty on our latent core)

Warranty Limitations

The above warranty does not cover damage to the unit while in your possession (other than damages caused by defective parts or material) due to the following: 1) improper installation or unreasonable use of unit: 2) failure to provide reasonable and necessary maintenance. If the unit is put to commercial use or application other than consumer use, warranty is for a period of one (1) year. This warranty does not cover water heaters, instantaneous water heaters, boilers or condenser units supplied or used with the Enerboss. See water heater, boiler or compressor manufacturer's warranty.

nu-air
Sustainability Through Innovation

P.O. Box 2758 16 Nelson St., Windsor, NS B0N 2T0
Tel: (902) 798-2261 Fax: (902) 798-2557
Email: nuair@nu-airventilation.com Website: www.nu-airventilation.com

PRODUCT SUBMITTAL &

HYDRAULIC CALCULATION

BOOKLET

for

SOLAR DECATHLON 2011

TEAM CANADA

U.S. DEPARTMENT OF ENERGY

VSC Job # VSC001

Submitted By VSC Fire & Security
David Victor - Project Designer (Baltimore Division)
10640 Iron Bridge Road, Suite "G"
Jessup, Maryland 20794
Office: (301) 575-1500 / Fax: (301) 575-1501

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FIRE SPRINKLER HEADS

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HOME FIRE SPRINKLER SYSTEM

Series LFII Residential Sprinklers 4.9 K-Factor Pendent and Recessed Pendent Wet Pipe and Dry Pipe Systems

General Description

The TYCO RAPID RESPONSE Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) are decorative, fast response, frangible bulb sprinklers designed for use in residential occupancies such as homes, apartments, dormitories, and hotels. When aesthetics and optimized flow characteristics are the major consideration, the Series LFII Residential Sprinklers should be the first choice.

The Series LFII Residential Sprinklers are intended for use in the following scenarios:

- wet and dry pipe residential sprinkler systems for one- and two-family dwellings and mobile homes per NFPA 13D
- wet and dry pipe residential sprinkler systems for residential occupancies up to and including four stories in height per NFPA 13R
- wet and dry pipe sprinkler systems for the residential portions of any occupancy per NFPA 13

Historically residential sprinklers, based on their Listing, have been limited to wet pipe sprinkler systems to assure speed of water delivery for a given prescribed design area (number of design sprinklers).

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

The Listing for the Series LFII Residential Pendent and Recessed Pendent Sprinklers now offers the laboratory approved option of designing dry pipe residential sprinkler systems.

Through extensive testing, it has been determined that the number of design sprinklers (hydraulic design area) for the Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) need not be increased over the number of design sprinklers (hydraulic design area) as specified for wet pipe sprinkler systems, as is accustomed for density/area sprinkler systems designed per NFPA 13.

Consequently, the Series LFII Residential Sprinklers offer the features of non-water filled pipe in addition to not having to increase the number of design sprinklers (hydraulic design area) for systems designed to NFPA 13, 13D, or 13R. Non-water filled pipe will permit options for areas sensitive to freezing.

These Sprinklers have a 4.9 (70,6) K-Factor that provides the required residential flow rates at reduced pressures, enabling smaller pipe sizes and water supply requirements.

The recessed version of the Series LFII Residential Sprinklers is intended for use in areas with finished ceilings. It employs a two-piece Style 20 Recessed Escutcheon.

The Recessed Escutcheon provides 1/4 inch (6,4 mm) of recessed adjustment or up to 1/2 inch (12,7 mm) of total adjustment from the flush ceiling position. The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the pipe nipples to the sprinklers must be cut.

The Series LFII Residential Pendent and Recessed Pendent Sprinklers have been designed with heat sensitivity and water distribution characteristics proven to help in the control of residential fires and to improve the chance for occupants to escape or be evacuated.

NOTICE

The Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) described herein must be installed and maintained in compliance with this document and the applicable standards of the National Fire Protection Association, in addition to the standards of any authorities having jurisdiction. Failure to do so may impair the performance of these devices.

Owners are responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Maximum Coverage Area [a] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	WET PIPE SYSTEM Minimum Flow [b] and Residual Pressure				
		For Horizontal Ceiling (Maximum 2-Inch Rise for 12-Inch Run)	For Sloped Ceiling (Greater than 2-Inch Rise up to Maximum 4-Inch Rise for 12-Inch Run)		For Sloped Ceiling (Greater than 4-Inch Rise up to Maximum 8-Inch Rise for 12-Inch Run)	
		155°F (68°C) or 175°F (79°C)	155°F (68°C)	175°F (79°C)	155°F (68°C)	175°F (79°C)
12 x 12 (3,7 x 3,7)	12 (3,7)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)
18 x 18 (5,5 x 5,5)	18 (5,5)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)	17 GPM (64,3 LPM) 12.0 psi (0,83 bar)
20 x 20 (6,1 x 6,1)	20 (6,1)	20 GPM (75,7 LPM) 16.7 psi (1,15 bar)	20 GPM (75,7 LPM) 16.7 psi (1,15 bar)	20 GPM (75,7 LPM) 16.7 psi (1,15 bar)	21 GPM (79,5 LPM) 18.4 psi (1,27 bar)	22 GPM (83,3 LPM) 20.2 psi (1,39 bar)

(a) For coverage area dimensions less than or between those indicated, use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) The Minimum Flow requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-Factor. Refer to Hydraulic Design under the Design Criteria section.

TABLE A
SERIES LFII RESIDENTIAL PENDENT AND RECESSED PENDENT SPRINKLERS (TY2234)
NFPA 13D AND 13R HYDRAULIC DESIGN CRITERIA
WET PIPE SYSTEMS

Maximum Coverage Area [a] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	DRY PIPE SYSTEM Minimum Flow [b] and Residual Pressure	
		For Horizontal Ceiling (Maximum 2-Inch Rise for 12-Inch Run)	
		155°F (68°C)	175°F (79°C)
12 x 12 (3,7 x 3,7)	12 (3,7)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	14 GPM (53,0 LPM) 8.2 psi (0,57 bar)	14 GPM (53,0 LPM) 8.2 psi (0,57 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	15 GPM (56,8 LPM) 9.4 psi (0,65 bar)	15 GPM (56,8 LPM) 9.4 psi (0,65 bar)
18 x 18 (5,5 x 5,5)	18 (5,5)	18 GPM (68,1 LPM) 13.5 psi (0,93 bar)	18 GPM (68,1 LPM) 13.5 psi (0,93 bar)
20 x 20 (6,1 x 6,1)	20 (6,1)	21 GPM (79,5 LPM) 18.4 psi (1,27 bar)	21 GPM (79,5 LPM) 18.4 psi (1,27 bar)

(a) For coverage area dimensions less than or between those indicated, use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) The Minimum Flow requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-Factor. Refer to Hydraulic Design under the Design Criteria section.

TABLE B
SERIES LFII RESIDENTIAL PENDENT AND RECESSED PENDENT SPRINKLERS (TY2234)
NFPA 13D HYDRAULIC DESIGN CRITERIA
DRY PIPE SYSTEMS

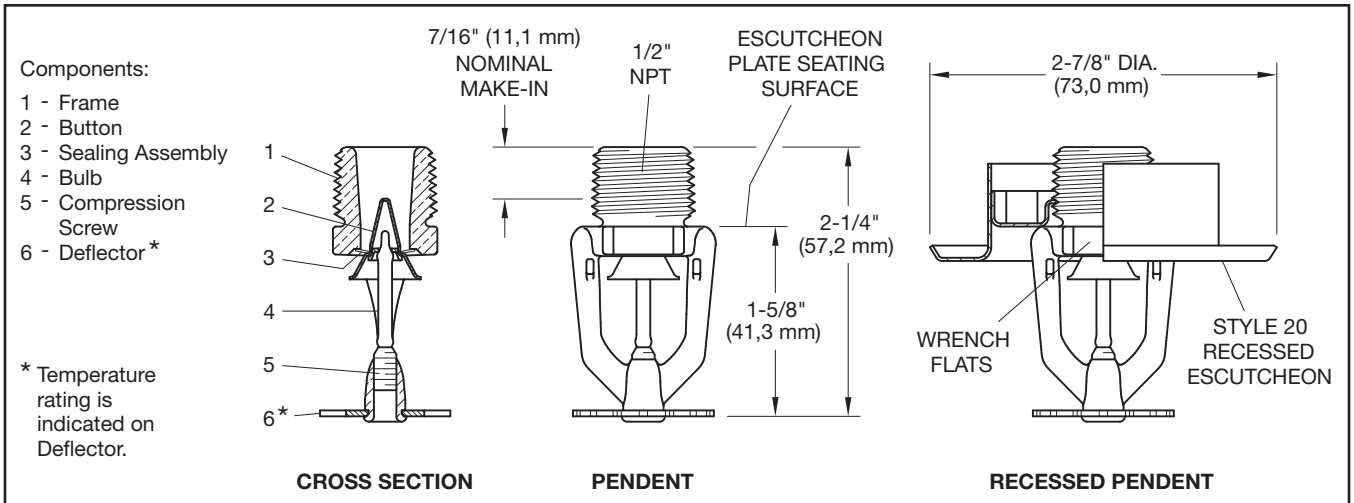


FIGURE 1
RAPID RESPONSE SERIES LFII RESIDENTIAL
PENDENT AND RECESSED PENDENT SPRINKLERS (TY2234)

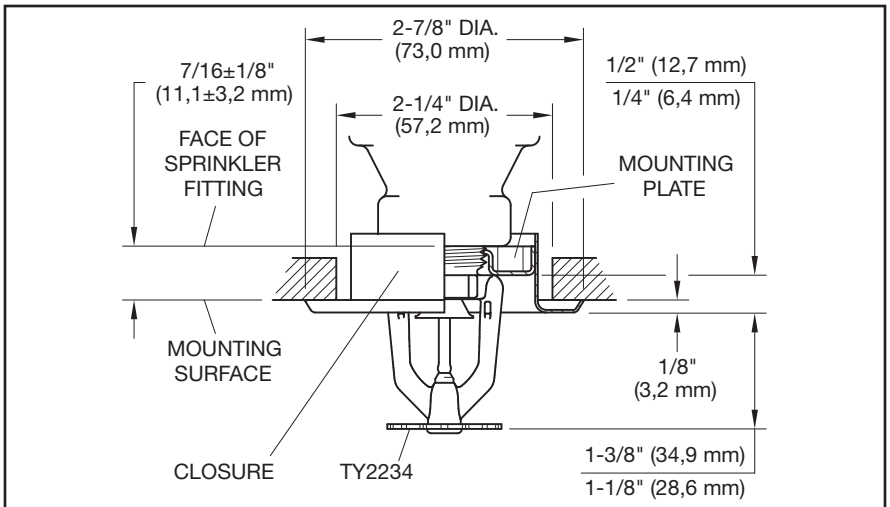


FIGURE 2
STYLE 20 RECESSED ESCUTCHEON FOR USE WITH THE SERIES LFII RESIDENTIAL PENDENT SPRINKLERS (TY2234)

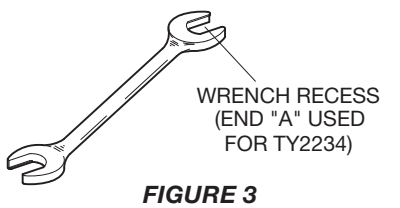


FIGURE 3
W-TYPE 6
SPRINKLER WRENCH

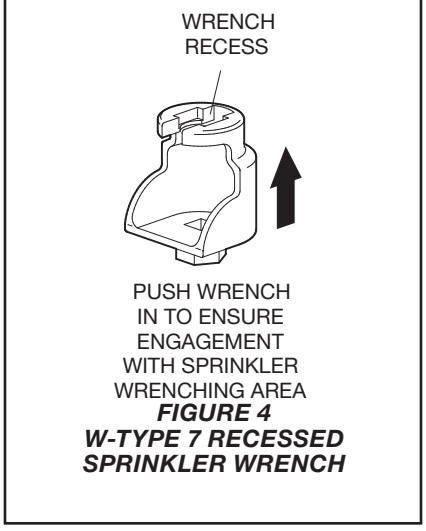


FIGURE 4
W-TYPE 7 RECESSED
SPRINKLER WRENCH

Model/Sprinkler Identification Number (SIN)

TY2234

Technical Data

Approvals
- UL Listed for use with wet pipe and dry pipe systems
- C-UL Listed for use only with wet pipe systems
- NYC Approved under MEA 44-03-E

For details on these approvals, refer to the Design Criteria section.

Maximum Working Pressure
175 psi (12,1 bar)

Discharge Coefficient
K=4.9 GPM/psi$^{1/2}$ (70,6 LPM/bar$^{1/2}$)

Temperature Rating
155°F (68°C) or 175°F (79°C)

Finishes
- White Polyester
- Chrome Plated
- Natural Brass

Physical Characteristics

Frame	Brass
Button	Bronze
Sealing Assembly	Beryllium Nickel w/Teflon*
Bulb (3 mm)	Glass
Compression Screw	Bronze
Deflector	Bronze
Ejection Spring	Stainless Steel

Operation

The glass Bulb contains a fluid that expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass Bulb, allowing the sprinkler to activate and flow water.

Design Criteria

The RAPID RESPONSE Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) are UL and C-UL Listed for installation in accordance with the following criteria.

*Registered trademark of Dupont

Note: *When conditions exist that are outside the scope of the provided criteria, refer to the Residential Sprinkler Design Guide TFP490 for the manufacturer's recommendations that may be acceptable to the local authority having jurisdiction.*

System Types
Per the UL Listing, wet pipe and dry pipe systems may be utilized. Per the C-UL Listing, only wet pipe systems may be utilized.

- For dry systems corrosion-resistant or internally galvanized pipe shall be utilized with the sprinklers described in this data sheet.
- For dry systems not using CPVC, pendent sprinklers shall be installed on return bends, where the sprinklers, return bends, and branch line piping (that is, potential areas for trapped water) are in areas at or above 40°F (4°C).

Refer to technical data sheet TFP485 about the use of Residential Sprinklers in residential dry pipe systems.

NOTICE

When corrosion-resistant or internally galvanized pipe and fittings with a potable water supply is utilized, return bends need not be installed. However, any portion of the piping that has the potential to trap water must be maintained at or above 40°F (4°C) unless provision to drain such areas is provided and maintained dry.

Water Delivery
When using the Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) in dry pipe sprinkler systems, the requirements for "Dry System Water Delivery" per Section 8.3.4.3 of the 2010 edition of NFPA 13D apply. For a residential hazard, in no case shall the time of water delivery exceed 15 seconds for the most remote operating sprinkler.

Hydraulic Design (NFPA 13D and 13R)
The minimum required sprinkler flow rate for systems designed to NFPA 13D or NFPA 13R are given in Tables A and B as a function of temperature rating and the maximum allowable coverage areas. The sprinkler flow rate is the minimum required discharge from each of the total number of "design sprinklers" as specified in NFPA 13D or NFPA 13R.

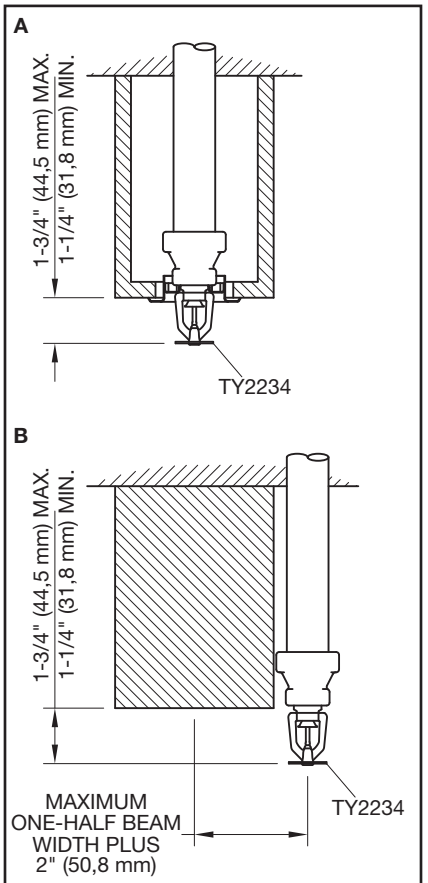


FIGURE 5
SPRINKLER POSITIONING UNDER PRIMARY BEAMS WET PIPE SYSTEMS ONLY
(Refer to the "Beam Ceiling Design Criteria" section.)

NOTICE

The number of "design sprinklers" specified in NFPA 13D and 13R for wet pipe systems is to be applied when designing dry pipe systems. There is no need to increase the design area, as is the case for density/area systems, in accordance with U.S. Patent 7,712,543. Refer to technical data sheet TFP485.

ALL FIGURES: DISTANCES ARE MEASURED TO COMPARTMENT WALL FACES AND TO CENTERLINES OF BEAMS

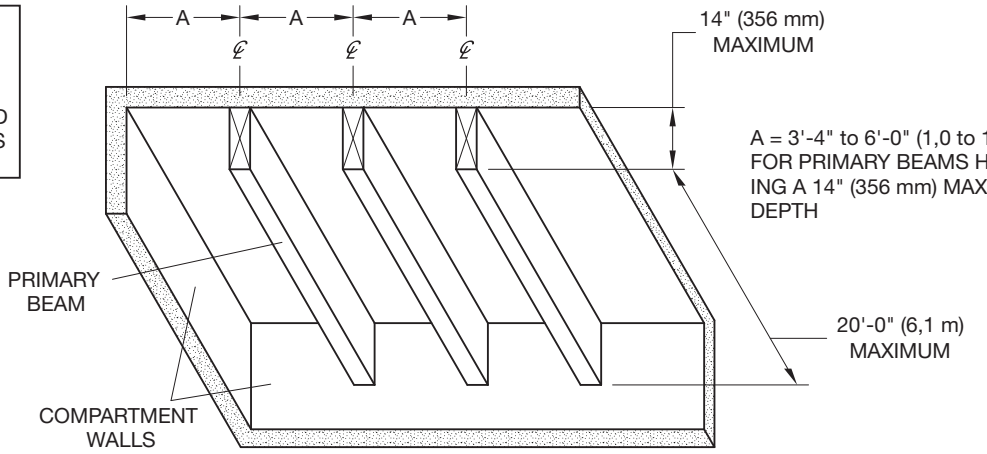


FIGURE 6A
PRIMARY BEAM SPANS UP TO 20'-0" (6,1 m)

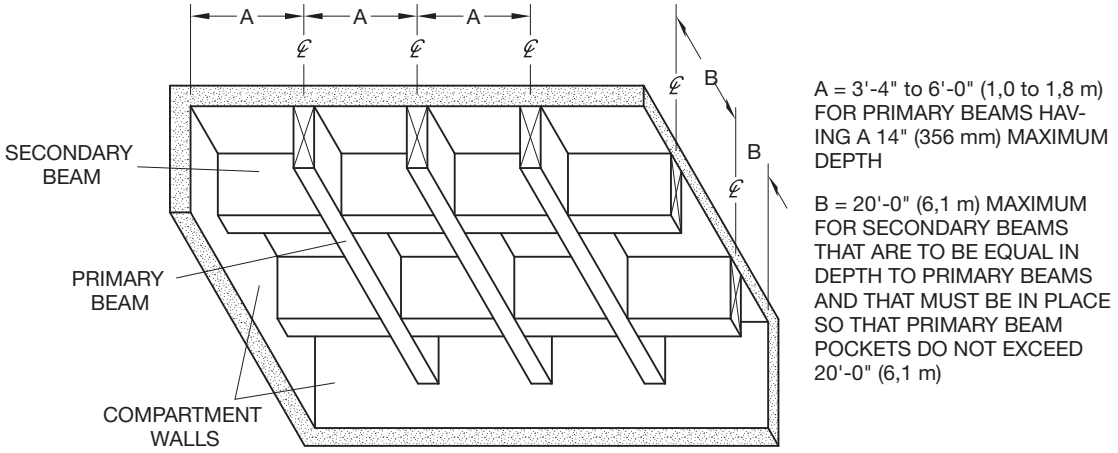
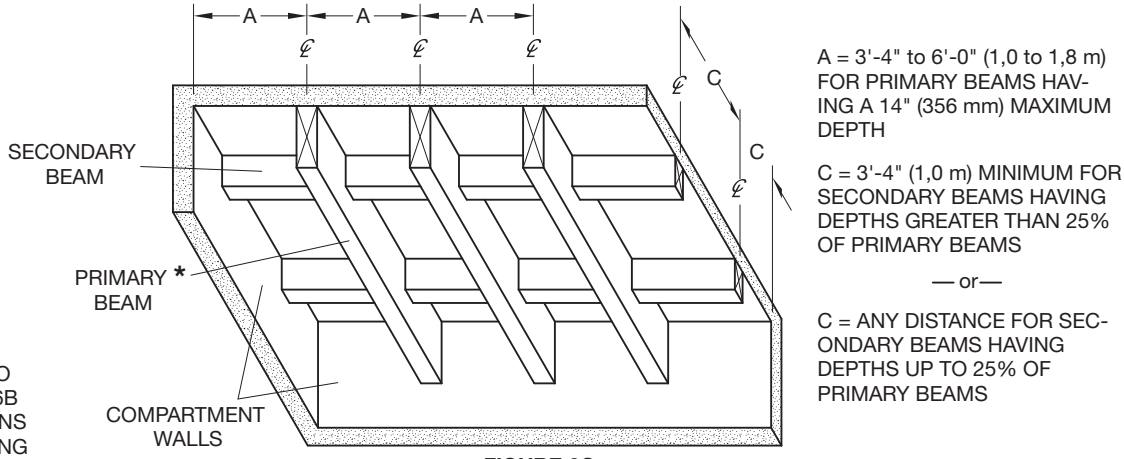


FIGURE 6B
PRIMARY BEAM SPANS GREATER THAN 20'-0" (6,1 m)



* REFER TO FIGURE 6B FOR SPANS EXCEEDING 20'-0" (6,1 m)

FIGURE 6C
COMBINATIONS OF PRIMARY AND SECONDARY BEAMS

FIGURE 6
BEAM ARRANGEMENTS
WET PIPE SYSTEMS ONLY
(Refer to the "Beam Ceiling Design Criteria" section.)

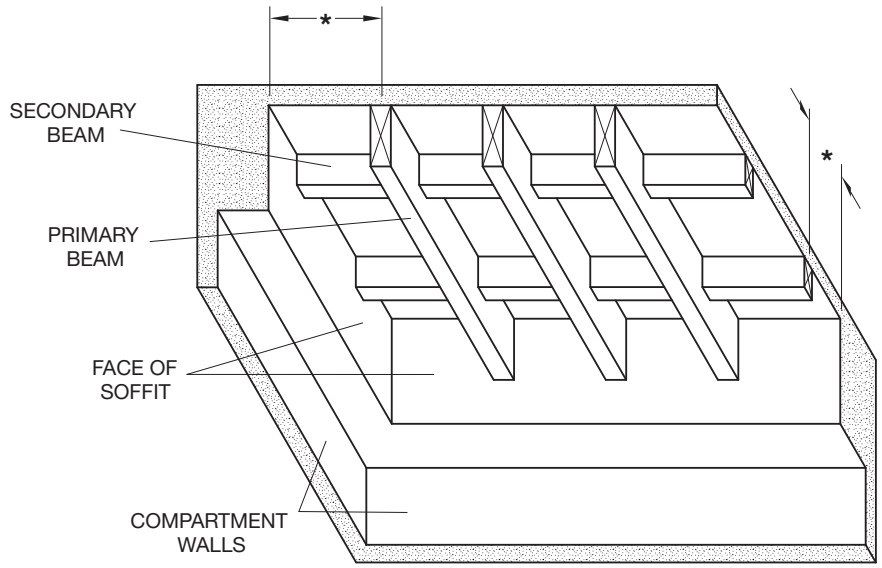


FIGURE 7
BEAM AND SOFFIT ARRANGEMENTS
WET PIPE SYSTEMS ONLY
(Refer to the "Beam Ceiling Design Criteria" section.)

Hydraulic Design (NFPA 13)
For systems designed to NFPA 13, the number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in Tables A or B for NFPA 13D and 13R as a function of temperature rating and the maximum allowable coverage area.
- A minimum discharge of 0.1 GPM/sq. ft. over the "design area" comprised of the four most hydraulically demanding sprinklers for actual coverage areas protected by the four sprinklers.

NOTICE

The number of "design sprinklers" specified in NFPA 13 for wet pipe systems is to be applied when designing dry pipe systems. There is no need to increase the design area, as is the case for density/area systems, in accordance with U.S. Patent 7,712,543. Refer to technical data sheet TFP485.

Obstruction to Water Distribution
Sprinklers are to be located in accordance with obstruction rules defined by NFPA 13 for residential sprinklers.

Operational Sensitivity
For ***Horizontal Ceilings*** (maximum 2-inch rise for 12-inch run), the sprinklers are to be installed with a deflector-to-ceiling distance of 1-3/8 to 4 inches or in the recessed position using only the Style 20 Recessed Escutcheon as shown in Figure 2.

NOTICE

The "Beam Ceiling Design Criteria" section permits deflector-to-ceiling distances up to 15-3/4 inches.

To help avoid obstructions to water distribution, a maximum 12-inch deflector-to-ceiling distance is permitted for NFPA 13D and NFPA 13R applications where the sprinklers are located in closets.

For ***Sloped Ceilings*** (greater than 2-inch rise up to 8-inch rise for 12-inch run), the sprinklers are to be installed with a deflector-to-ceiling distance of 1-3/8 to 4 inches or in the recessed position using only the Style 20 Recessed Escutcheon as shown in Figure 2.

Sprinkler Spacing
The minimum spacing between sprinklers is 8 feet (2,4 m). The maximum spacing between sprinklers cannot exceed the length of the coverage area (Table A) being hydraulically calculated; maximum 12 feet for a 12 ft. x 12 ft. coverage area, or 20 feet for a 20 ft. x 20 ft. coverage area.

Beam Ceiling Design Criteria

The RAPID RESPONSE Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) are UL and C-UL Listed for installation in wet pipe systems only for residential occupancies with horizontal ceilings (that is, slopes up to a 2-inch rise over a 12-inch run) with beams when installed in accordance with the following criteria.

General Information
The basic concept of this protection scheme is to locate the sprinklers on the underside of the beams, refer Figure 5, (not in the beam pockets); to identify the main beams that principally run in one direction as "primary beams"; and, to identify the beams that run principally perpendicular to the main beams, as may be present (or in some cases may be necessary for proper sprinkler protection), as "secondary beams".

Primary and Secondary Beam Types
Solid surface, solid or hollow core, combustible or non-combustible.

Primary and Secondary Beam Positioning
Directly attached to the underside of a combustible or non-combustible smooth ceiling at any elevation.

Primary Beam Cross-Section
Maximum depth of 14 inches and the maximum width is unlimited. The cross-sectional shape of the primary beam may be rectangular to circular.

Secondary Beam Cross-Section
Maximum depth to be no greater than the primary beam and the maximum width is unlimited. The cross-sectional shape of the secondary beam may be rectangular to circular.

Primary Beam Spacing
The primary beams (Figure 6A) are to be 3 ft. - 4 in. to 6 ft. from the compartment wall to center of the nearest beam and from center to center between beams.

Secondary Beam Spacing
The secondary beams principally run perpendicular to the primary beams. Secondary beams of a depth equal to the primary beam must be placed so that the beam pockets created by the primary beams do not exceed 20 feet in length (Figure 6B).

NOTICE

When the beam pockets created by the primary beams exceed 20 feet in length, the installation will require the use of secondary beams as described above. Otherwise, secondary beams need not be present.

Secondary beams of a cross-sectional depth greater than one-quarter the depth of the primary beams are to be a minimum of 3 ft. - 4 inches from the compartment wall to center of the nearest beam and from center to center between beams (Figure 6C).

Secondary beams of a cross-sectional depth no greater than one-quarter the depth of the primary beams may be placed at any compartment wall to center of the nearest beam distance and from any center to center distance between beams (Figure 6C).

Lintels
Lintels over doorways exiting the compartment must be present. The minimum height for the lintels is 8 inches or no less than the depth of the Primary Beams, whichever is greater.

Sprinkler Types
Series LFII Pendent and Recessed Pendent Residential Sprinklers (TY2234), 155°F (68°C) and 175°F (79°C).

Sprinkler Coverage Area and Hydraulic Design
The sprinkler coverage areas and hydraulic design criteria as presented in the Table A for "Horizontal Ceilings" are to be applied.

Sprinkler Position
The deflector to bottom of primary beams for the Series LFII Pendent and Recessed Pendent Sprinklers (TY2234) is to be 1-1/4 to 1-3/4 inches (Figure 5A). The vertical center-line of the Series LFII Pendent Sprinklers is to be no greater than half the primary beam cross-sectional width plus 2 inches from the centerline of the primary beam (Figure 5B).

NOTICE

Core drilling of beams to allow the installation of sprinkler drops requires consulting with a structural engineer.

Where core drilling is not permitted, the previously stated sprinkler position criteria for the Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) allows placement of the sprinkler drop adjacent to the primary beam.

Beam and Soffit Arrangements
A soffit is permitted to be placed around the perimeter of a compartment with the beam arrangement within the soffited area (Figure 7).

The cross-section of the soffit may be any size as long as it does not create an obstruction to water distribution per the obstruction rules of NFPA 13 for residential sprinklers.

When soffits are present, the previously provided 3 ft.-4 inches to 6 ft. "compartment wall to adjacent beam" distance for the primary and secondary beams is to be measured from the face of the soffit as opposed to the compartment wall.

Note: *Although the distance to the beams is measured from the face of the soffit, the sprinkler coverage area is to be measured from the compartment wall.*

Installation

The RAPID RESPONSE Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) must be installed in accordance with the following instructions.

NOTICE

Do not install any bulb type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm).

Obtain a leak-tight 1/2 inch NPT sprinkler joint by applying a minimum-to-maximum torque of 7 to 14 ft. lbs. (9,5 to 19,0 Nm). Higher levels of torque can distort the sprinkler Inlet with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in an Escutcheon Plate by under- or over-tightening the Sprinkler. Re-adjust the position of the sprinkler fitting to suit.

Series LFII Residential Pendent Sprinklers
The Series LFII Residential Pendent Sprinklers must be installed in accordance with the following instructions.

1. Install pendent sprinklers in the pendent position with the deflector parallel to the ceiling.
2. With pipe-thread sealant applied to the pipe threads, hand-tighten the sprinkler into the sprinkler fitting.
3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 6 Sprinkler Wrench (Figure 3). With reference to Figure 1, apply the W-Type 6 Sprinkler Wrench to the wrench flats.

Series LFII Residential Recessed Pendent Sprinklers
The Series LFII Residential Recessed Pendent Sprinklers must be installed in accordance with the following instructions.

1. Install recessed pendent sprinklers in the pendent position with the deflector parallel to the ceiling.
2. After installing the Style 20 Mounting Plate over the sprinkler threads and with pipe-thread sealant applied to the pipe threads, hand-tighten the sprinkler into the sprinkler fitting.
3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 7 Recessed Sprinkler Wrench (Figure 4). With reference to Figure 1, apply the W-Type 7 Recessed Sprinkler Wrench to the sprinkler wrench flats.
4. After the ceiling has been installed or the finish coat has been applied, slide on the Style 20 Closure over the Series LFII Residential Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the ceiling.

Care and Maintenance

The RAPID RESPONSE Series LFII Residential Pendent and Recessed Pendent Sprinklers (TY2234) must be maintained and serviced in accordance with the following instructions.

NOTICE

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, obtain permission to shut down the affected fire protection systems from the proper authorities and notify all personnel who may be affected by this action.

Absence of the outer piece of an escutcheon, which is used to cover a clearance hole, can delay sprinkler operation in a fire situation.

Owners must assure that the sprinklers are not used for hanging of any objects and that the sprinklers are only cleaned by means of gently dusting with a feather duster; otherwise, non-operation in the event of a fire or inadvertent operation may result.

Exercise care to avoid damage to sprinklers before, during, and after installation. Never paint, plate, coat, or otherwise alter automatic sprinklers after they leave the factory.

Replace sprinklers that:

- were modified or over-heated.
- were damaged by dropping, striking, wrench twisting, wrench slippage, or the like.
- are leaking or exhibiting visible signs of corrosion.
- were exposed to corrosive products of combustion but have not operated, if you cannot easily remove combustion by-products with a cloth.
- have a cracked bulb or have lost liquid from the bulb. Refer to the Installation section in this data sheet.

Initial and frequent visual inspections of random samples are recommended for corrosion-resistant sprinklers to verify the integrity of the corrosion-resistant material of construction. Thereafter, annual inspections per NFPA 25 should suffice.

Inspections of corrosion-resistant sprinklers are recommended at close range, instead of from the floor level per NFPA. Inspection at close range can better determine the exact sprinkler condition and the long-term integrity of the corrosion-resistant material, which can be affected by the corrosive conditions present.

Responsibility lies with the owner for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (that is, NFPA 25), in addition to the standards of any authorities having jurisdiction. Contact the installing contractor or sprinkler manufacturer regarding any questions.

Automatic sprinkler systems are recommended to be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire Suppression & Building Products (TFSBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFSBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFSBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFSBP to be defective shall be either repaired or replaced, at TFSBP's sole option. TFSBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFSBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFSBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFSBP was informed about the possibility of such damages, and in no event shall TFSBP's liability exceed an amount equal to the sales price.

The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and Part Number (P/N).

Sprinkler Assembly
Specify Series LFII Residential Pendent and Recessed Pendent Sprinkler (TY2234), K=4.9, with (temperature rating), (finish), and P/N (below).

155°F (68°C) or Chrome Plated . . . . . P/N 51-201-9-155
155°F (68°C) White Polyester . . . . . P/N 51-201-4-155
155°F (68°C) White (RAL9010)* . . . . . P/N 51-201-3-155
155°F (68°C) Natural Brass. . . . . P/N 51-201-1-155
175°F (79°C) or Chrome Plated . . . . . P/N 51-201-9-175
175°F (79°C) White Polyester . . . . . P/N 51-201-4-175
175°F (79°C) White (RAL9010)* . . . . . P/N 51-201-3-175
175°F (79°C) Natural Brass. . . . . P/N 51-201-1-175

*Eastern Hemisphere sales only.

Recessed Escutcheon
Specify Style 20 Recessed Escutcheon with finish and P/N. Refer to Technical Data Sheet TFP770.

Sprinkler Wrench
Specify W-Type 6 Sprinkler Wrench, P/N 56-000-6-387.

Specify W-Type 7 Sprinkler Wrench, P/N 56-850-4-001.

tyco / Fire & Building Products

Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

rapid response™
HOME FIRE SPRINKLER SYSTEM

Series LFII Residential Sprinkler Design Guide

Table of Contents

SPRINKLER/MODEL IDENTIFICATION NUMBER	TYPE	TECHNICAL DATA SHEET NUMBER
TY2234	Pendent and Recessed Pendent, K=4.9	TFP400
TY4234	Pendent, Recessed, and Concealed Pendent, K=6.9	TFP408
TY1334	Horizontal Sidewall and Recessed Horizontal, K=4.2	TFP410
TY3334	Horizontal Sidewall and Recessed Horizontal, K=5.6	TFP415
TY2284	Flush Pendent, K=4.2	TFP420
TY2384	Flush Horizontal Sidewall, K=4.2	TFP425
TY2596	Concealed Pendent Flat Plate, K=4.2	TFP440
TY3596	Concealed Pendent Flat Plate, K=4.9	TFP442
TY2234	Concealed Pendent Domed Plate, K=4.9	TFP450

TABLE A, SERIES LFII RESIDENTIAL SPRINKLERS

General

Tyco Fire Products' (TFP) Residential Sprinklers are fast response automatic sprinklers. They are to be used only in wet pipe residential sprinkler systems for one- and two-family dwellings and mobile homes per NFPA 13D; wet pipe residential sprinkler systems for residential occupancies up to and including four stories in height per NFPA 13R; or, wet pipe sprinkler systems for the residential portions of any occupancy per NFPA 13.

This document provides design guidance for the Series LFII Residential Sprinklers outlined in Table A.

Residential fire sprinkler systems should only be designed and installed by those competent and completely familiar with automatic sprinkler system design, installation procedures, and techniques. Several criteria may apply to a given installation and usage of each sprinkler. Consequently, the sprinkler system designer is recommended to review and develop a working understanding of the complete list of criteria prior to initiating the design of a residential fire sprinkler system.

WARNINGS

The Series LFII Residential Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Pro-

tection Association, in addition to the standards of any other authorities having jurisdiction. ***Failure to do so may impair the performance of these devices.***

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Design — Background

The design criteria for Residential Sprinklers begins with the Third Edition of Underwriters Laboratories Inc. UL 1626 dated July 10, 2001 — "Standard for Residential Sprinklers for Fire Protection Service". All TFP Residential Sprinklers are tested and listed under UL 1626 with specific published spacings, flows, and pressures for each residential sprinkler identified by its sprinkler/model identification number and as detailed in the Technical Data Sheets referenced in Table A.

One of the most notable revisions incorporated into the Third Edition of UL 1626 is the new minimum flow rates that are effective for product manufactured after July 12, 2002, which is intended for installation in new systems. When establishing a flow rate for UL Listing, the manufacturer must use a minimum required discharge that correlates to a 0.05 gpm/ft^2. Due to wall wetting requirements, the understanding is that the density applied at the floor will be less than 0.05 gpm/ft^2. Also, the understanding in some cases is that the UL Listed flow rate may be greater than the calculated 0.05 gpm/ft^2 to be able to successfully pass the UL 1626 fire tests. Increased flow rates for sidewall type sprinklers is common.

The design criteria for residential sprinklers contained in the current NFPA Standards must be followed except as modified by the individual UL 1626 listing information provided in the Technical Data Sheets referenced in Table A and this design guide.

NOTE

The approval of all residential sprinkler designs and installations must be made by the Authority Having Jurisdiction (AHJ) for compliance with all governmental codes and standards.

Design — Hydraulics

NFPA13D. The number of design sprinklers shall include all sprinklers within a compartment up to a maximum of two sprinklers where specific UL Listed flows are provided. The minimum required sprinkler flow rate for systems designed to NFPA 13D are given in the Technical Data Sheets referenced in Table A, as a function of temperature rating and the maximum allowable coverage areas. *For actual coverage areas less than or between those indicated in the Technical Data Sheets referenced in Table A, it is necessary to use the minimum required flow for the next largest coverage area.*

Example No. 1: Assuming the use of a pendent sprinkler, the actual coverage area being protected is 14 ft. x 16 ft. In this case the minimum flow requirement for a 16 ft. x 16 ft. coverage area must be used.

Example No. 2: Assuming the use of a pendent sprinkler, the actual coverage area being protected is 17 ft. x 17 ft. In this case the minimum flow requirement for a 18 ft. x 18 ft. coverage area must be used.

NFPA13R. The number of design sprinklers shall include all sprinklers within a compartment up to a maximum of four sprinklers where specific UL Listed flows are provided. The minimum required sprinkler flow rate for systems designed to NFPA 13R are given in the Technical Data Sheets referenced in Table A, as a function of temperature rating and the maximum allowable coverage areas. *For actual coverage areas less than or between those indicated in the Technical Data Sheets referenced in Table A, it is necessary to use the minimum required flow for the next largest coverage area.*

Example No. 1: Assuming the use of a pendent sprinkler, the actual coverage area being protected is 14 ft. x 16 ft. In this case the minimum flow requirement for a 16 ft. x 16 ft. coverage area must be used.

Example No. 2: Assuming the use of a pendent sprinkler, the actual coverage area being protected is 17 ft. x 17 ft. In this case the minimum flow requirement for a 18 ft. x 18 ft. coverage area must be used.

NFPA 13. The number of design sprinklers is to be the the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in the Technical Data Sheets referenced in Table A for NFPA 13D and 13R as a function of temperature rating and the maximum allowable coverage area. *For actual coverage areas less than or between those indicated in the Technical Data Sheets referenced in Table A, it is necessary to use the minimum required flow for the next largest coverage area.*
- A minimum discharge of 0.1 gpm/sq. ft. over the "design area" comprised of the four most hydraulically demanding sprinklers for the actual coverage areas being protected by the four sprinklers. *The greatest dimension of the actual coverage area cannot be any greater than the maximum coverage areas indicated in the Technical Data Sheets referenced in Table A.*

Example No.1: A corridor being protected is 8 ft. wide; consequently, an actual coverage area of 8 ft. x 20 ft. is being contemplated. Based on using the LFII (TY2234) Pendent Residential Pendent Sprinkler, the flow rate provided in TFP400 for a 20 ft x 20 ft. coverage area is 20 GPM. However based on minimum discharge of 0.1 gpm/sq. ft. the flow rate would be 16 GPM. In this case a minimum flow rate of 20 GPM for this design sprinkler must be utilized.

Example No.2: A long narrow room being protected is 12 ft. wide; consequently, an actual coverage area of 12 ft. x 20 ft. is being contemplated. Based on using the LFII (TY2234) Pendent Residential Pendent Sprinkler, the flow rate provided in TFP400 for a 20 ft x 20 ft. coverage area is 20 GPM. However based on minimum discharge of 0.1 gpm/sq. ft. the flow rate would be 24 GPM. In this case a minimum flow rate of 24 GPM for this design sprinkler must be utilized.

Compartment. A compartment is a space that is completely enclosed by walls and a ceiling. The compartment enclosure may have openings to an adjoining space, provided the openings have a minimum lintel depth of 8 inches from the ceiling.

Sloped Ceilings. For systems designed to NFPA 13, 13D, or 13R and where specific UL Listed flows have not been provided for sloped ceilings, consult with the local Authority Having Jurisdiction with regard to the number of "design sprinklers" for sloped ceilings having a slope greater than a 2 inch rise for a 12 inch run.

RISE, INCHES	1	2	3	4	5	6	7	8	9	10	11	12
12							60°	56°	53°	50°	46°	45°
11							58°	54°	51°	48°	45°	42°
10						59°	55°	51°	48°	45°	42°	40°
9						56°	52°	48°	45°	42°	39°	37°
8					58°	53°	49°	45°	42°	39°	36°	34°
7				60°	54°	49°	45°	41°	38°	35°	32°	30°
6				56°	50°	45°	41°	37°	34°	31°	29°	27°
5			59°	51°	45°	40°	36°	32°	29°	27°	24°	23°
4			63°	45°	39°	34°	30°	27°	24°	22°	20°	18°
3		56°	45°	37°	31°	27°	23°	21°	18°	17°	15°	14°
2		45°	34°	27°	22°	18°	16°	14°	13°	11°	10°	9°
1	45°	27°	18°	14°	11°	9°	8°	7°	6°	6°	5°	5°

RUN, INCHES

TABLE B
RISE OVER RUN CONVERSION TO DEGREES OF SLOPE

Design — Sprinkler Location

When locating Residential Sprinklers, Sprinkler Spacing, Obstruction To Water Distribution, Heat Sensitivity, Preventing Cold Soldering, and Proximity To A Heat Source must all be considered.

Table B provides a conversion of "Rise Over Run" that is a conventional method of defining slope in architectural drawings to "Degrees Of Slope" as used in this guideline.

Sprinkler Spacing Under Horizontal Ceilings (Up to 9 degrees of slope). Residential sprinklers are utilized for various maximum spacings in accordance with minimum flows and pressures. Typical coverage areas for pendent sprinklers are 12 ft. x 12 ft. up to 20 ft. x 20 ft., and typical coverage areas for horizontal sidewall sprinklers are 12 ft. x 12 ft. up to 16 ft. x 20 ft. Refer to the Technical Data Sheets referenced in Table A for coverage areas, and refer to **Figure 1 for Spacing Rules Under Horizontal Ceilings**. Understanding the intended area of coverage while using this guide is critical.

Always remember that the spacing of sprinklers under horizontal ceilings with slopes greater than 0 degrees (i.e., non-level) is measured along the slope when determining distance off of walls and between sprinklers.

Sprinkler Spacing Under Sloped Ceilings (10 to a 60 degrees of slope). Residential sprinklers are utilized for various maximum spacings in accordance with minimum flows and pressures. Typical coverage areas for pendent sprinklers are 12 ft. x 12 ft. up to 20 ft. x 20 ft., and typical coverage areas for horizontal sidewall sprinklers are 12 ft. x 12 ft. up to 16 ft. x 20 ft. Refer to the Technical Data Sheets referenced in Table A for coverage areas, and refer to **Figure 2 for Spacing Rules Under Sloped Ceilings**. Understanding the intended area of coverage while using this guide is critical.

Always remember that the spacing of sprinklers under sloped ceilings is measured along the slope when determining distance off of walls and between sprinklers.

Obstruction To Water Distribution. Location with respect to obstructions to water distribution are addressed by Figure 3. If a sprinkler water distribution pattern is obstructed, the obstruction is to be considered the maximum distance of coverage for a given sprinkler and additional sprinklers beyond the obstruction will be necessary.

Because of the varied nature of residential type construction, there will be some compartment designs that cannot be fully sprinklered in accordance with the recommendations of NFPA 13, 13D, or 13R. In the event of this condition, consult with the Authority Having Jurisdiction.

Appendix material in NFPA 13D and 13R references the evaluation of certain small areas.

Small areas created by architectural features such as planter box windows, bay windows, and similar features can be evaluated as follows:

(a) Where no additional floor space area is created by the architectural feature, no additional sprinkler protection is required.

(b) Where additional floor space is created by an architectural feature, no additional sprinkler protection is required, provided all of the following conditions are met:

- *The floor area does not exceed 18 sq. ft.*
- *The floor area is not greater than 2 ft. in depth at the deepest point of the architectural feature to the plane of the primary wall where measured along the finished floor.*
- *The floor is not greater than 9 ft. in length where measured along the plane of the primary wall.*

Measurement from the the deepest point of the architectural feature to the sprinkler should not exceed the maximum listed spacing of the sprinkler. The hydraulic design is not required to consider the area created by the architectural feature.

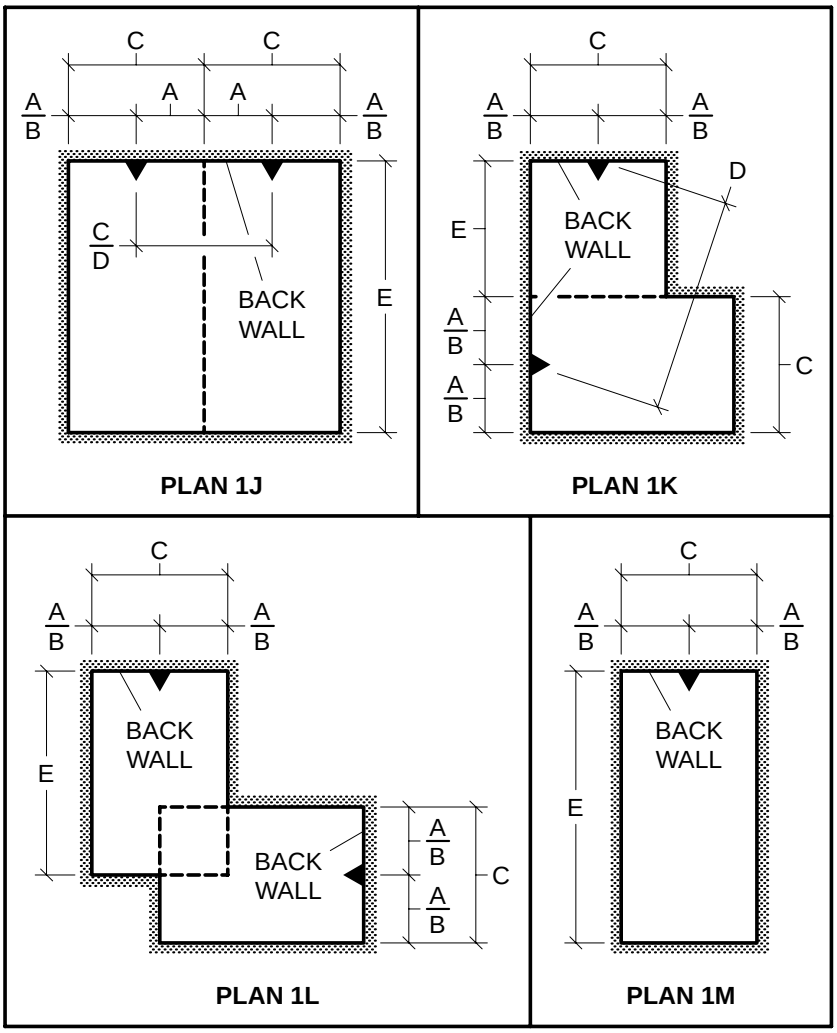
Figure 4 provides guidance for positioning of pendent and horizontal sidewall sprinklers with respect to obstructions along a wall, and in the case of pendent sprinklers the positioning of sprinklers on both sides of a continuous obstruction located at the ceiling. Consideration must be given to the size of the obstruction, as well as the allowable deflector-to ceiling distance.

Heat Sensitivity. Sensitivity to heat is critical for prompt operation of a residential sprinkler for a fire condition. The Technical Data Sheets referenced in Table A provide the allowable sprinkler deflector-to-ceiling distances.

Residential sprinklers are to be installed beneath smooth flat ceilings as defined by NFPA 13.

NOTE

Special consideration, such as increasing the number of design sprinklers being hydraulically calculated,



A - UP TO ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

B - MINIMUM 4".

C - UP TO THE MAXIMUM SPRINKLER WIDTH (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

D - MINIMUM 8'-0".

E - UP TO THE MAXIMUM SPRINKLER LENGTH (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

▼ SIDEWALL SPRINKLER.

NOTE

Sidewall sprinklers, where installed under a ceiling with a slope greater than 0 degrees to 9 degrees, must be located per one of the following:

- Locate the sprinklers at the high point of the slope and positioned to discharge down the slope.
- Locate the sprinklers along the slope and positioned to discharge across the slope.

FIGURE 1 — PART 1 of 2
SPRINKLER SPACING UNDER HORIZONTAL CEILINGS
— SIDEWALL SPRINKLER —

must be given to installations where continuous obstructions to heat flow are present (e.g., beams, lintels, etc.).

Under a sloped ceiling, the residential sprinkler(s) located at the highest elevation must not be located more than 3 feet measured vertically down from the peak.

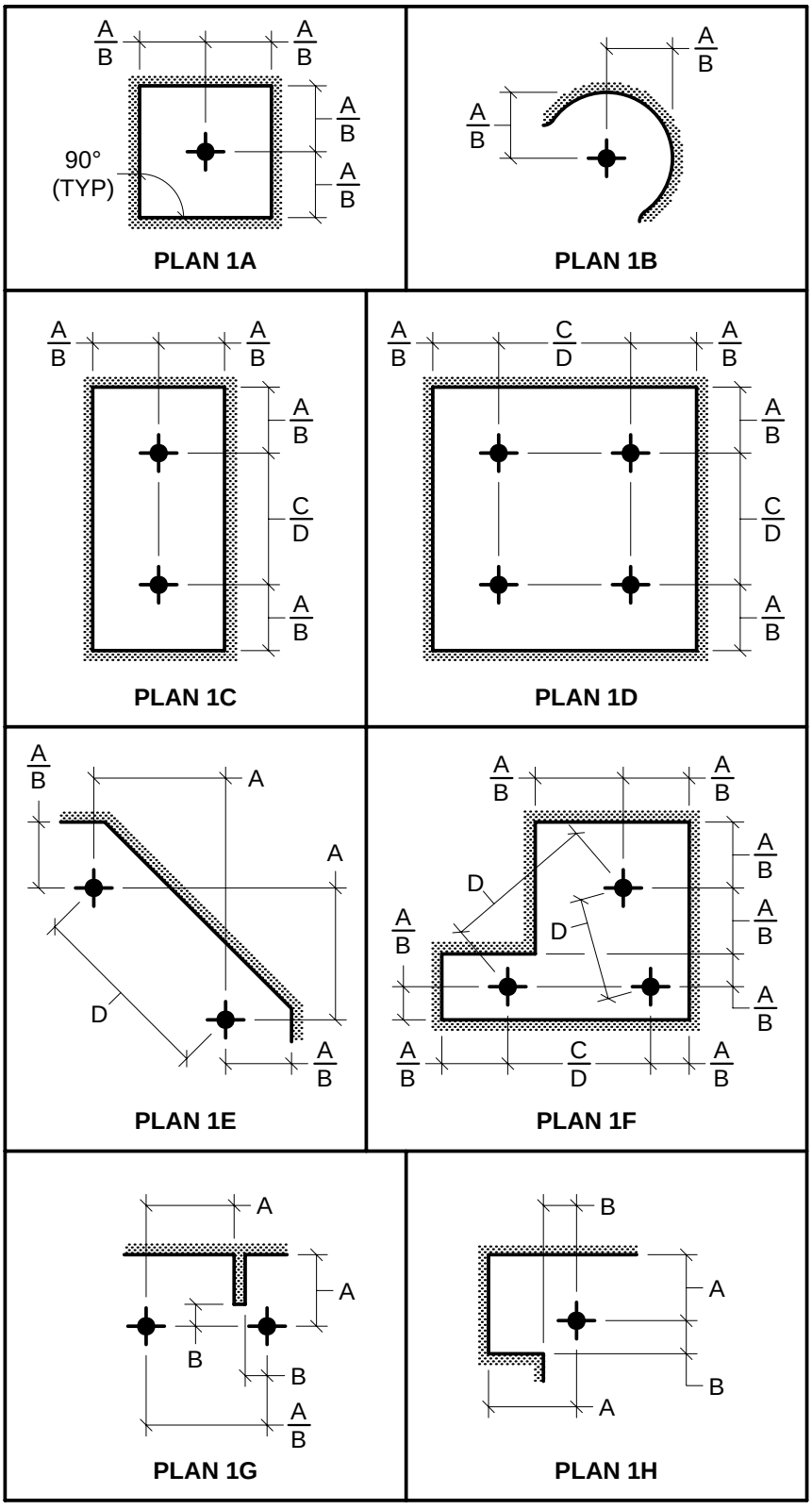
Preventing Cold Solder. A minimum distance between residential sprinklers to prevent cold soldering (i.e., the wetting from an operated sprinkler onto an unoperated sprinkler that could prevent its potential to operate if needed) must be maintained.

Under horizontal ceilings, the minimum distance between residential sprinklers to prevent cold soldering is 8 feet.

Sloped ceilings, however, present more of a cause for concern for cold soldering, since the elevation of one sprinkler may be higher than another, resulting in a different distribution pattern than that of a horizontal ceiling condition. Figure 2 for Spacing Rules Under Sloped Ceilings addresses the minimum acceptable distance under various sloped ceiling conditions that will take into account the prevention of cold soldering.

One solution to prevent cold soldering is to stagger the sprinklers so that the distance between two sprinklers is increased. In some case, baffles can be located midway between two closely located sprinklers to prevent cold soldering.

Proximity To A Heat Source. Sprinklers must be located so as to prevent an inadvertent operation due to exposure of normal heat sources. Location with respect to exposure of heat sources other than fire that may cause an inadvertent operation of a residential sprinkler is addressed by Figure 5.



A - UP TO ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

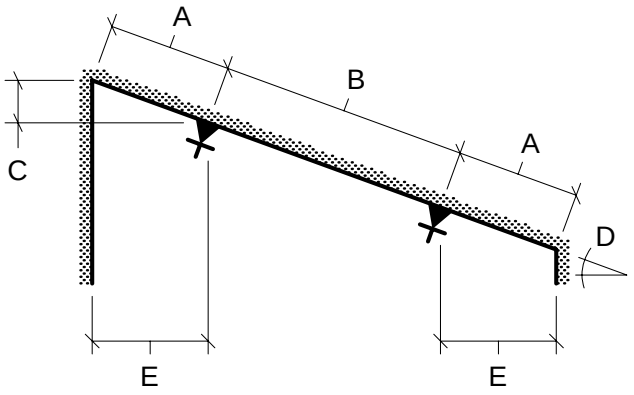
B - MINIMUM 4".

C - UP TO THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

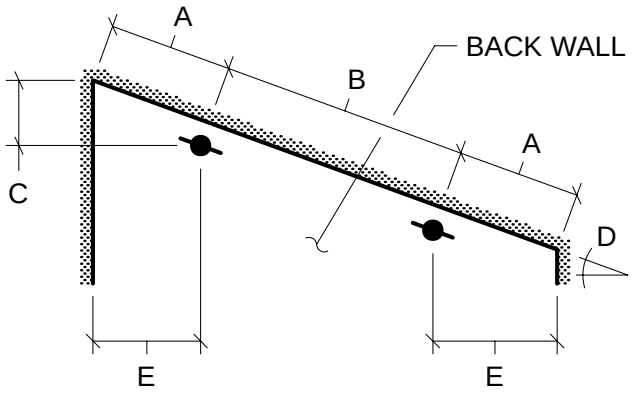
D - MINIMUM 8'-0".

PENDENT SPRINKLER.

FIGURE 1 — PART 2 of 2
SPRINKLER SPACING UNDER HORIZONTAL CEILINGS
— PENDENT SPRINKLERS —



PENDENT SPRINKLERS
ELEVATION



SIDEWALL SPRINKLERS
ELEVATION

A - MAXIMUM: ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

B - MAXIMUM: THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

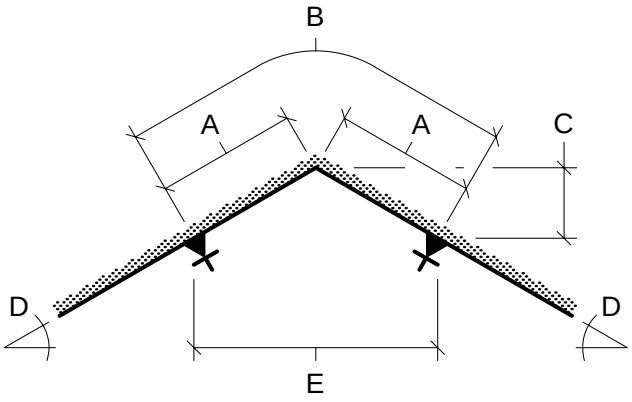
MINIMUM: 8'-0"

C - MAXIMUM: 3'-0"

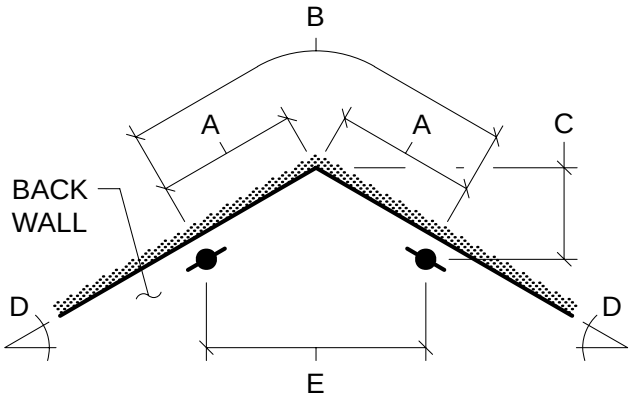
D - RANGE: 10° - 60° CEILING ANGLE.

E - MINIMUM: 4"

FIGURE 2 — PART 1 of 6
SPRINKLER SPACING UNDER SLOPED CEILINGS
— MULTIPLE SPRINKLERS ON SAME SLOPE AND DISTANCE OFF WALLS —



PENDENT SPRINKLERS
ELEVATION



SIDEWALL SPRINKLERS
ELEVATION

A - MAXIMUM: ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

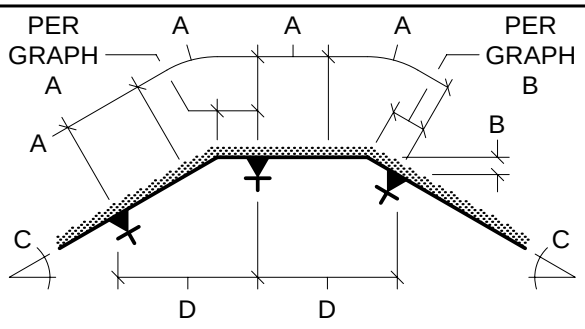
B - MAXIMUM: THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.
MINIMUM: 8'-0"

C - MAXIMUM: 3'-0"

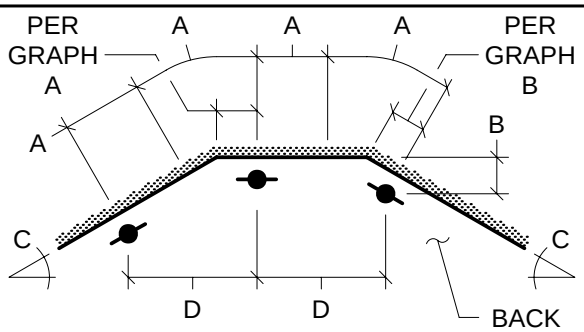
D - RANGE: 10° - 60° CEILING ANGLE.

E - MINIMUM: 8'-0"

FIGURE 2 — PART 2 of 6
SPRINKLER SPACING UNDER SLOPED CEILINGS
— SYMMETRIC SPRINKLER LOCATIONS ON OPPOSING SLOPES —



PENDENT SPRINKLERS
ELEVATION



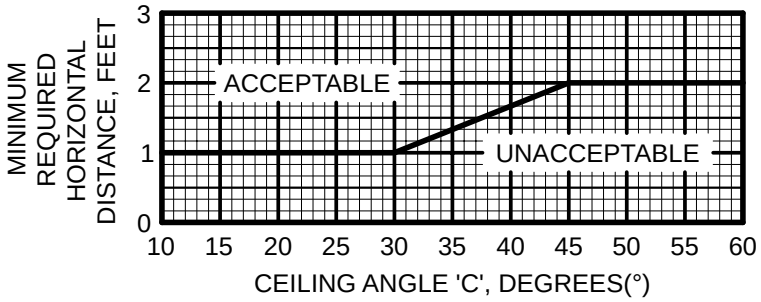
SIDEWALL SPRINKLERS
ELEVATION

A - MAXIMUM: ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

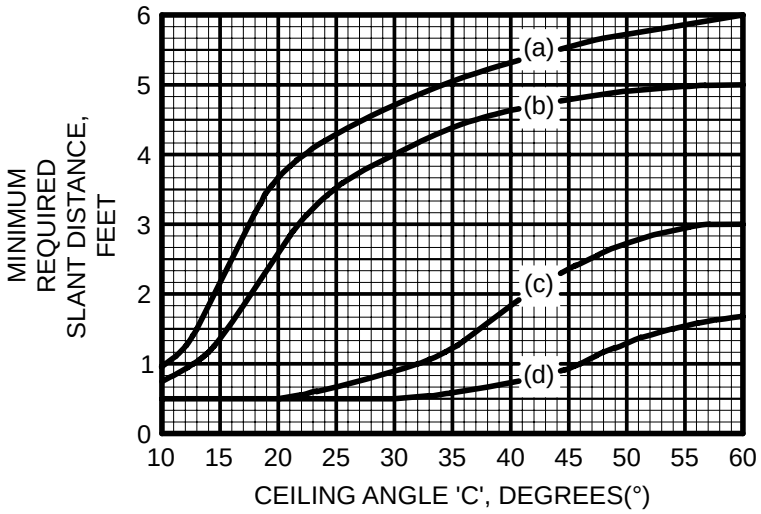
B - MAXIMUM: 3'-0" WHEN THERE ARE NO SPRINKLERS ON THE LEVEL CEILING

C - RANGE: 10° - 60° CEILING ANGLE.

D - MINIMUM: 8'-0"



GRAPH A

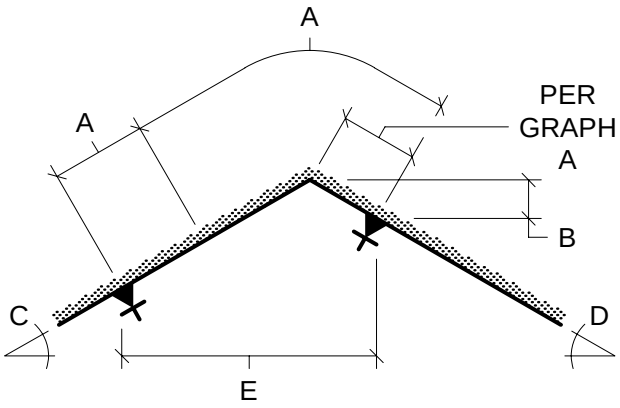


SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) BEING HYDRAULICALLY CALCULATED:

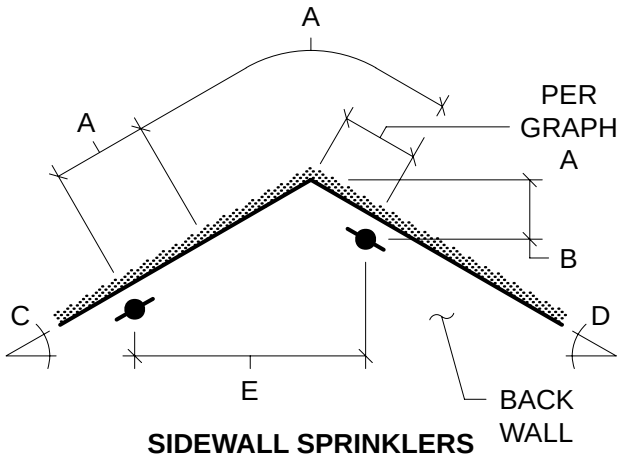
(a) 20'
(b) 18'
(c) 16'
(d) 14'
(d) 12'

GRAPH B

FIGURE 2 — PART 3 of 6
SPRINKLER SPACING UNDER SLOPED CEILINGS
SPRINKLERS LOCATED ON INTERSECTING HORIZONTAL AND SLOPE CEILINGS —



PENDENT SPRINKLERS
ELEVATION



SIDEWALL SPRINKLERS
ELEVATION

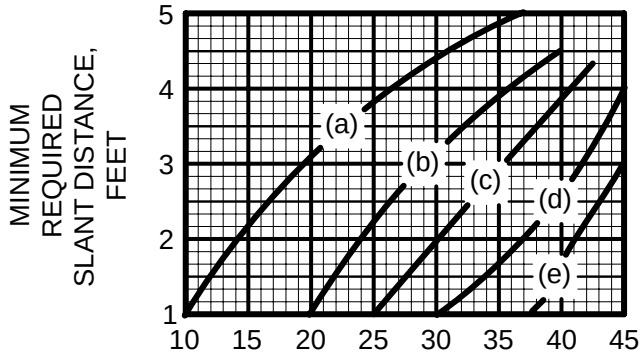
A - MAXIMUM: ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

B - MAXIMUM: 3'-0"

C - RANGE: 10° - 45° CEILING ANGLE.

D - RANGE: 10° - 45° CEILING ANGLE.

E - MINIMUM: 8'-0"



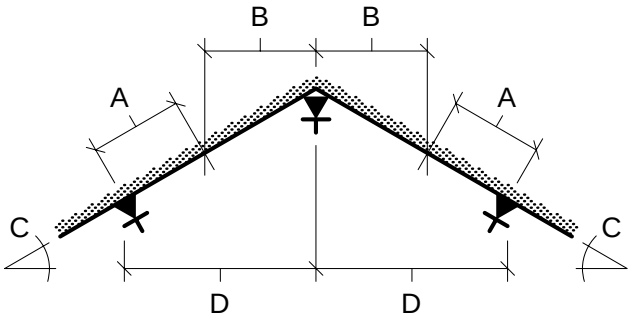
USE THE GREATER OF ANGLE 'C' OR ANGLE 'D'

SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) BEING HYDRAULICALLY CALCULATED:

(a) 20'
(b) 18'
(c) 16'
(d) 14'
(e) 12'

GRAPH A

FIGURE 2 — PART 4 of 6
SPRINKLER SPACING UNDER SLOPED CEILINGS
— NON-SYMMETRIC SPRINKLER LOCATIONS ON OPPOSING SLOPES —



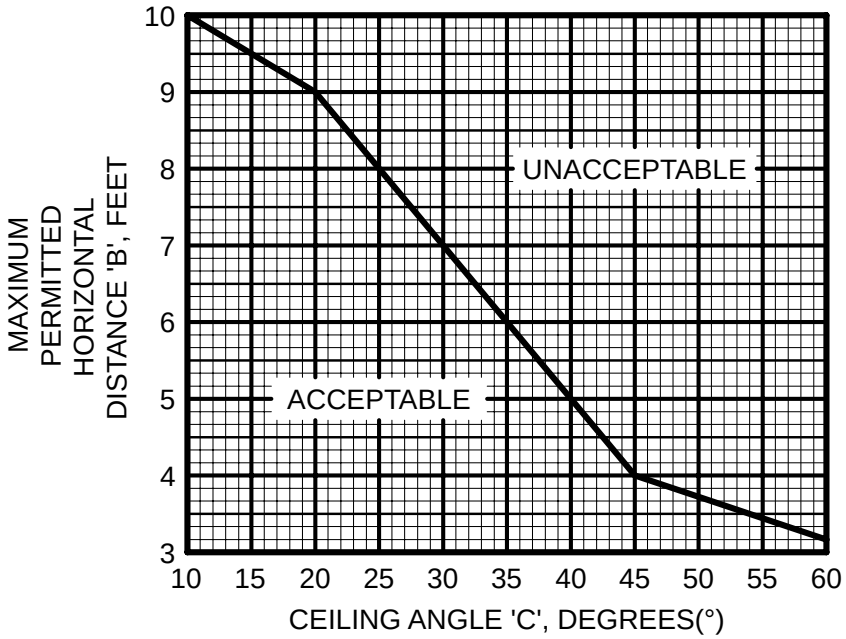
PENDENT SPRINKLERS
ELEVATION

A - MAXIMUM: ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

B - MAXIMUM: UP TO ONE HALF THE MAXIMUM SPRINKLER SPACING (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED OR AS RESTRICTED BY GRAPH A.

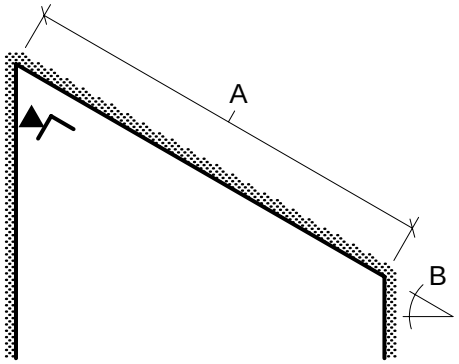
C - RANGE: 10° - 60° CEILING ANGLE.

D - MINIMUM: 8'-0"



GRAPH A

FIGURE 2 — PART 5 of 6
SPRINKLER SPACING UNDER SLOPED CEILINGS
—PENDENT SPRINKLERS LOCATED AT PEAK —

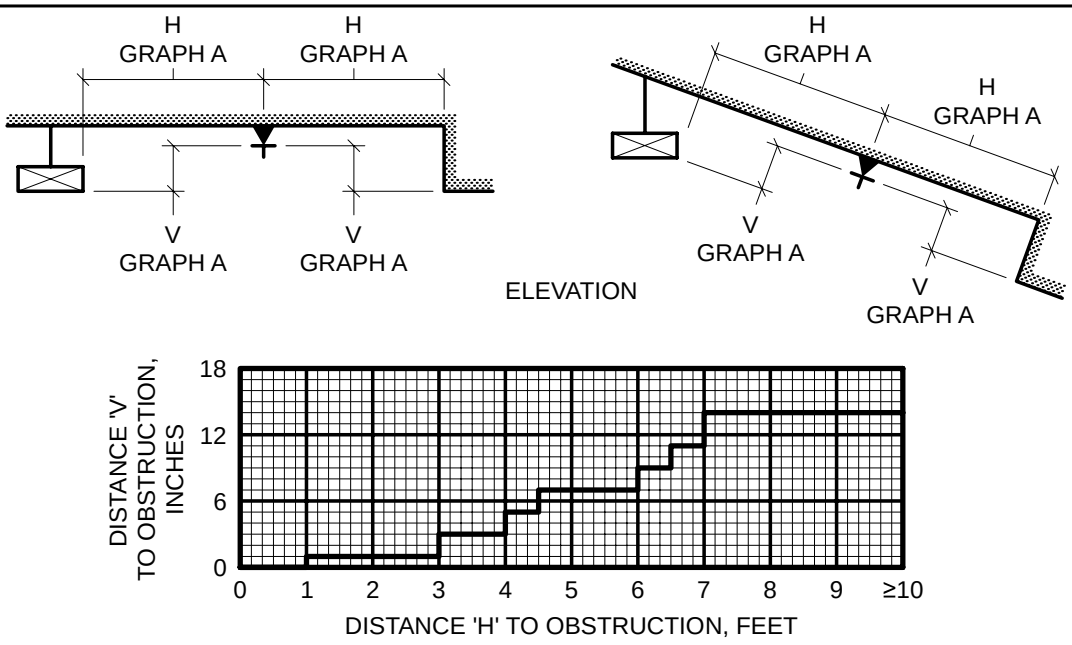


SIDEWALL SPRINKLERS
ELEVATION

A - MAXIMUM: UP TO THE MAXIMUM SPRINKLER COVERAGE AREA LENGTH (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A) FOR THE COVERAGE AREA BEING HYDRAULICALLY CALCULATED.

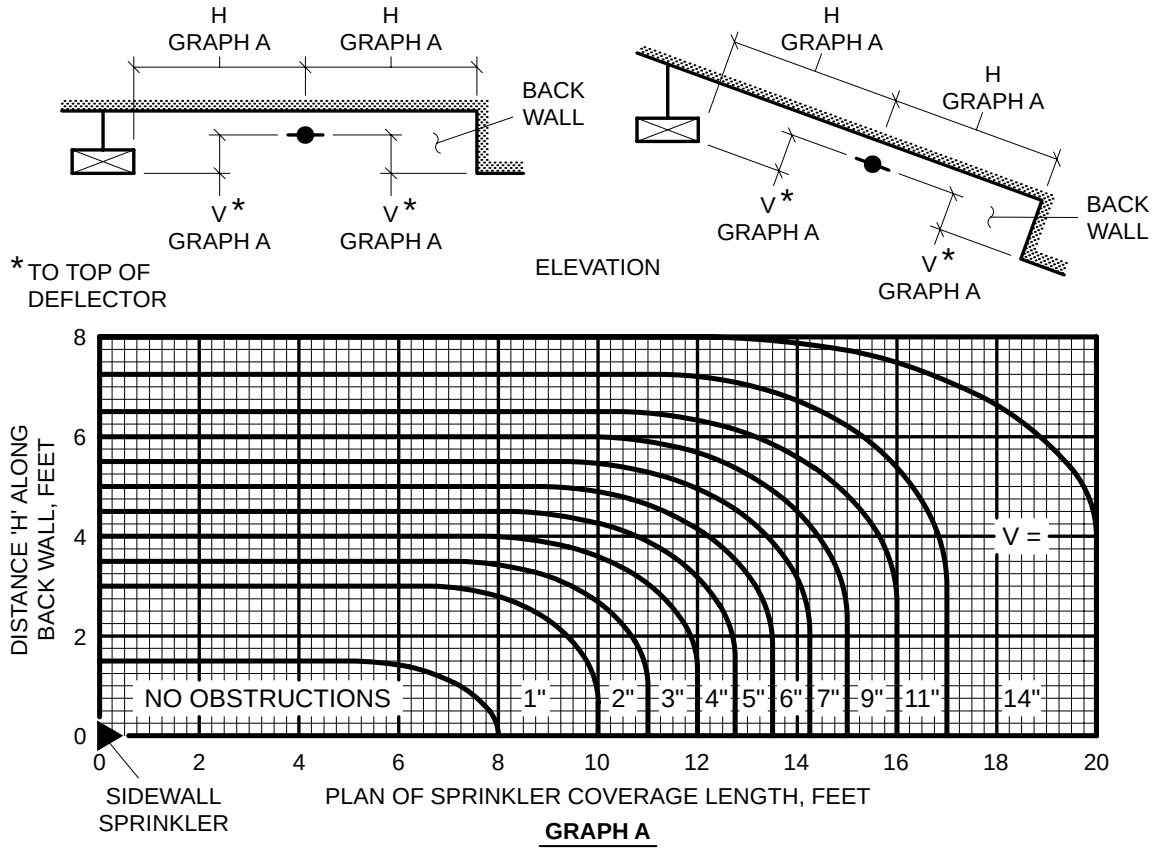
B - RANGE: 10° - 45° CEILING ANGLE.

FIGURE 2 — PART 6 of 6
SPRINKLER SPACING UNDER SLOPED CEILINGS
—SIDEWALL SPRINKLERS LOCATED AT PEAK —



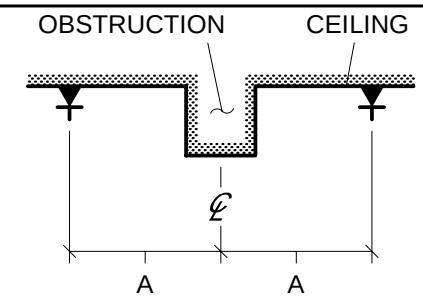
GRAPH A

FIGURE 3 — PART 1 of 2
PENDENT SPRINKLER POSITIONING TO AVOID OBSTRUCTION TO WATER DISTRIBUTION RADIALLY FROM THE PENDENT SPRINKLER



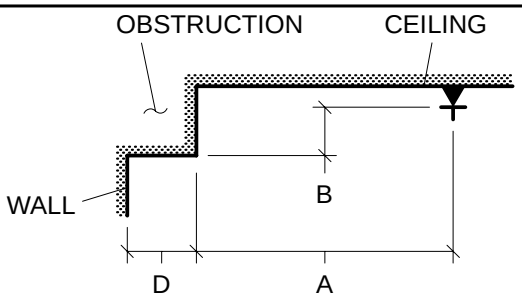
GRAPH A

FIGURE 3 — PART 2 of 2
SIDEWALL SPRINKLER POSITIONING TO AVOID OBSTRUCTION TO WATER DISTRIBUTION TO THE SIDE AND TO THE FRONT OF THE SIDEWALL SPRINKLER



PENDENT SPRINKLERS MAY BE LOCATED ON OPPOSITE SIDES OF AN OBSTRUCTION NOT EXCEEDING 4 FEET IN WIDTH PROVIDING THE DISTANCE FROM THE CENTERLINE OF THE OBSTRUCTION TO THE SPRINKLERS DO NOT EXCEED ONE HALF THE MAXIMUM SPRINKLER SPACING "A" (SEE TECHNICAL DATA SHEETS REFERENCED IN TABLE A)

ELEVATION

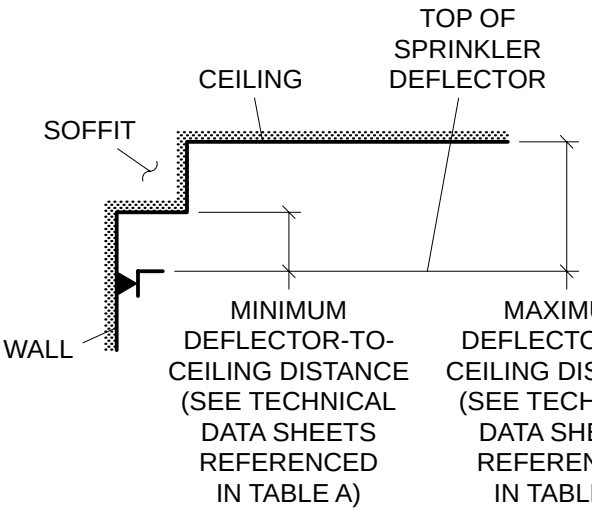


A ≥ (D - 8") + B
D ≤ 30"

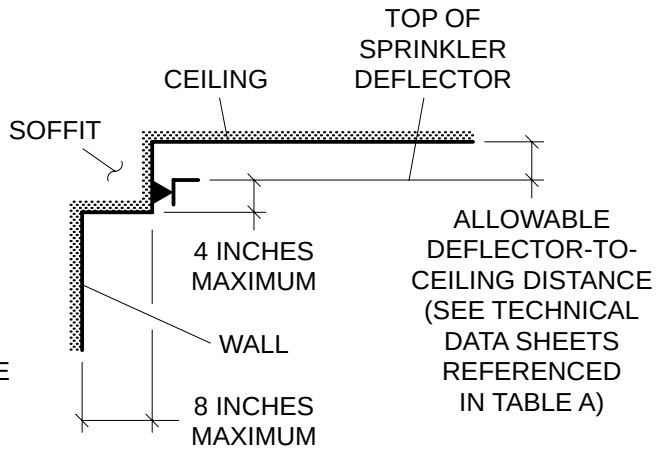
OBSTRUCTIONS LOCATED AGAINST THE WALL AND WHERE "D" IS LESS THAN OR EQUAL TO 30 INCHES IN WIDTH ARE PERMITTED TO BE PROTECTED WHEN "A" IS GREATER THAN OR EQUAL TO "D" MINUS 8 INCHES PLUS "B"

ELEVATION

FIGURE 4 — PART 1 of 2
POSITIONING OF PENDENT SPRINKLERS
WITH RESPECT TO OBSTRUCTIONS ALONG A WALL OR CONTINUOUS OBSTRUCTIONS AT THE CEILING
TO AVOID OBSTRUCTION TO WATER DISTRIBUTION



ELEVATION



ELEVATION

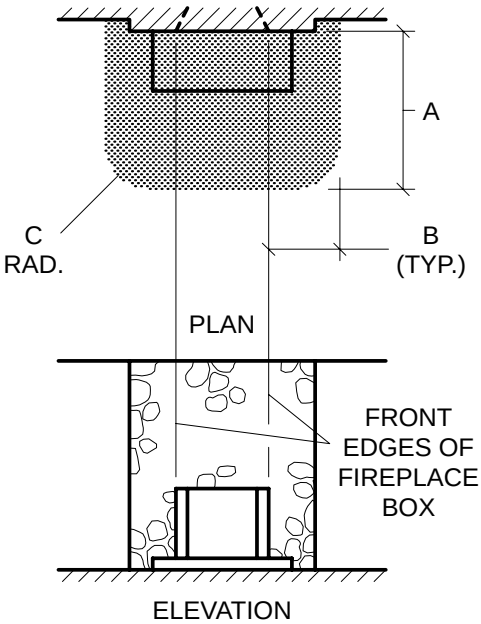
FIGURE 4 — PART 2 of 2
POSITIONING OF HORIZONTAL SIDEWALL SPRINKLERS
WITH RESPECT TO OBSTRUCTIONS ALONG A WALL
TO AVOID OBSTRUCTION TO WATER DISTRIBUTION

A. To prevent the possible release of a Residential Sprinkler's heat responsive element, due to exposure to heat sources other than abnormal fire, ordinary temperature classification (135°F-170°F temperature rating) Residential Sprinklers are only to be installed where the maximum (non-fire) temperature will not exceed 100°F/38°C; and intermediate temperature classification (175°F-225°F temperature rating) Residential Sprinklers are to be installed where the maximum (non-fire) temperature will be from 101°F/39°C to 150°F/66°C.

B. The sprinkler system piping must NOT be run through heating ducts, or connected to the domestic hot water system.

C. When installing Residential Sprinklers in the locations listed below, use the indicated temperature classification:

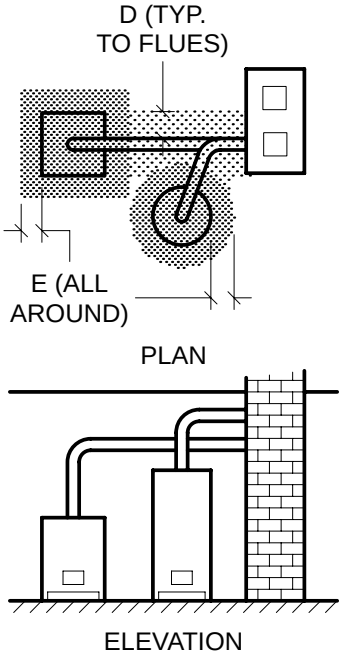
Location			Temperature Classification
1. Where they will be exposed to the rays of the sun passing through glass or plastic skylights.			Intermediate
2. In unventilated attics or in an unventilated-concealed compartment under an uninsulated roof, where the maximum ambient temperature does not exceed 150°F/66°C.			Intermediate
3. Proximity to exposed light fixtures.	Less than 250 Watts	Within 3 to 6 inches	Intermediate
		6 inches or more	Ordinary
	250-499 Watts	Within 6 to 12 inches	Intermediate
		12 inches or more	Ordinary
4. Proximity to uninsulated heating duct.		Within 9 to 18 inches	Intermediate
		18 inches or more	Ordinary
5. Proximity to uninsulated hot water pipe.		Within 6 to 12 inches	Intermediate
		12 inches or more	Ordinary
6. As specified in the adjacent illustrations in Figure 5, Parts 1 and 2.			



RECESSED HEARTH FIREPLACE

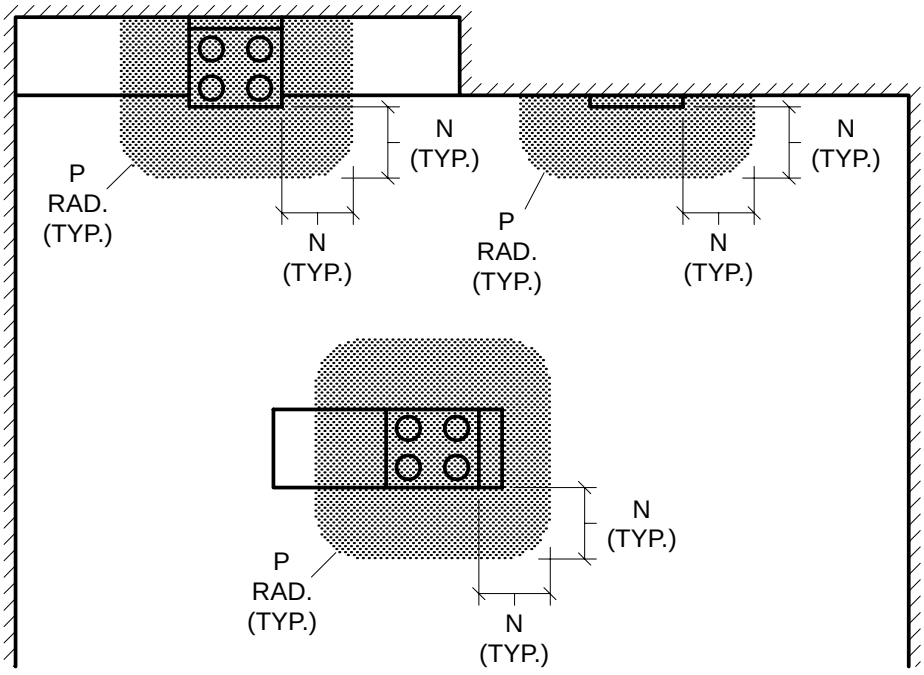
SPRINKLERS MUST BE LOCATED OUTSIDE OF SHADED AREAS

Dim.	Sprinkler Temperature Classification	
	Ordinary	Intermediate
A	5'-0"	3'-0"
B	3'-0"	1'-0"
C	2'-0"	1'-0"
D	1'-6"	0'-9"
E	0'-6"	0'-3"



FURNACE OR WATER HEATER

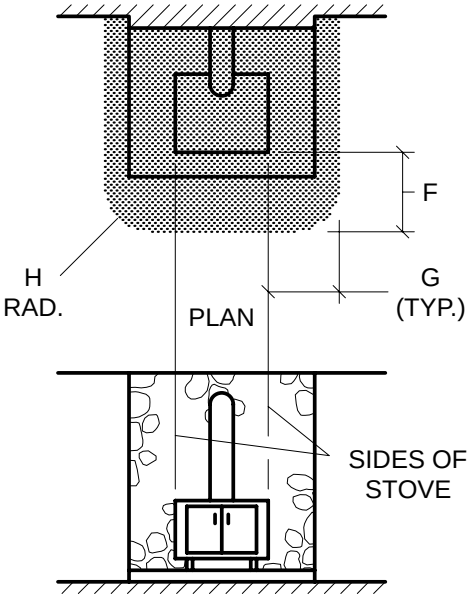
FIGURE 5 — PART 1 of 2
PROXIMITY TO HEAT SOURCES



PLAN

KITCHEN RANGE AND/OR OVEN

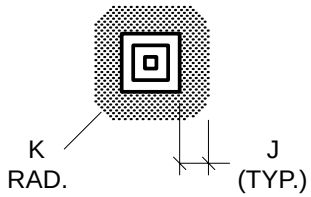
SPRINKLERS MUST BE LOCATED OUTSIDE OF SHADED AREAS



ELEVATION

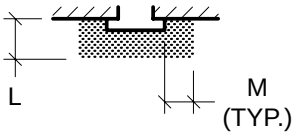
COAL OR WOOD BURNING STOVE

Dim.	Sprinkler Temperature Classification	
	Ordinary	Intermediate
F	3'-6"	1'-0"
G	3'-6"	1'-0"
H	3'-6"	1'-0"
J	2'-0"	1'-0"
K	2'-0"	1'-0"
L	3'-0"	1'-6"
M	2'-0"	1'-0"
N	1'-6"	0'-9"
P	1'-6"	0'-9"



PLAN

CEILING MOUNTED HOT AIR DIFFUSER



PLAN

WALL MOUNTED HOT AIR DIFFUSER

FIGURE 5 — PART 2 of 2
PROXIMITY TO HEAT SOURCES

Design — Beam Ceilings

Residential occupancies with horizontal ceilings (i.e., slopes up to a 2 inch rise over a 12 inch run) with beams may be sprinklered as follows:

General Information. The basic concept of this protection scheme is to locate the sprinklers on the underside of the beams, Ref. Figure 6, (not in the beam pockets); to identify the main beams that principally run in one direction as “primary beams”; and, to identify the beams that run principally perpendicular to the main beams, as may be present (or in some cases may be necessary for proper sprinkler protection), as “secondary beams”.

Primary and Secondary Beam Types. Solid surface, solid or hollow core, combustible or non-combustible.

Primary and Secondary Beam Positioning. Directly attached to the underside of a combustible or non-combustible smooth ceiling at any elevation.

Primary Beam Cross-Section: Maximum depth of 14 inches and the maximum width is unlimited. The cross-sectional shape of the primary beam may be rectangular to circular.

Secondary Beam Cross-Section. Maximum depth to be no greater than the primary beam and the maximum width is unlimited. The cross-sectional shape of the secondary beam may be rectangular to circular.

Primary Beam Spacing. The primary beams (Fig. 7A) are to be 3 ft. - 4 in. to 6 ft. from the compartment wall to center of the nearest beam and from center to center between beams.

Secondary Beam Spacing. The secondary beams principally run perpendicular to the primary beams.

Secondary beams of a depth equal to the primary beam must be placed so that the beam pockets created by the primary beams do not exceed 20 feet in length (Fig. 7B).

NOTE

When the beam pockets created by the primary beams exceed 20 feet in length, the installation will require the use of secondary beams as described above. Otherwise, secondary beams need not be present.

Secondary beams of a cross-sectional depth greater than one-quarter the depth of the primary beams are to be a minimum of 3 ft. - 4 in. from the compartment wall to center of the nearest beam and from center to center between beams (Fig. 7C).

Secondary beams of a cross-sectional depth no greater than one-quarter the depth of the primary beams may be placed at any compartment wall to center of the nearest beam distance and from any center to center distance between beams (Fig. 7C).

Lintels. Lintels over doorways exiting the compartment must be present. The minimum height for the lintels is 8 inches or no less than the depth of the Primary Beams, whichever is greater.

Sprinkler Types. Series LFII (TY2234), 155F and 175F, Pendent and Recessed Pendent Residential Sprinklers; and, Series LFII (TY2284), 162F, Flush Pendent Residential Sprinklers.

Sprinkler Coverage Area and Hydraulic Design. The sprinkler coverage areas and hydraulic design criteria as presented in Technical Data Sheets TF400 and TFP420 for “Horizontal Ceilings” are to be applied.

Sprinkler Position. The deflector to bottom of primary beams for the Series LFII (TY2234) Pendent Sprinklers or Series LFII (TY2234) Recessed Pendent Sprinklers is to be 1-1/4 to 1-3/4 inches (Fig. 6A). The vertical centerline of the Series LFII (TY2234) Pendent Sprinklers is to be no greater than half the primary beam cross-sectional width plus 2 inches from the centerline of the primary beam (Fig 6B).

The bottom of heat collector to bottom of primary beams for the Series LFII (TY2284) Flush Pendent Sprinklers is to be 23/32 to 1-3/32 inches (Fig. 6C). The vertical centerline of the Series LFII (TY2284) Flush Pendent Sprinklers is to be no greater than half the primary beam cross-sectional width plus 2 inches from the centerline of the primary beam (Fig. 6D).

NOTES

Core drilling of beams to allow the installation of sprinkler drops requires consulting with a structural engineer.

Where core drilling is not permitted, the previously stated sprinkler position criteria for the Series LFII (TY2234) Pendent Sprinklers allows for the sprinkler drop to be placed adjacent to the primary beam.

Beam and Soffit Arrangements. A soffit is permitted to be placed around the perimeter of a compartment with the beam arrangement within the soffited area (Fig.8).

The cross-section of the soffit may be any size as long as it does not create an obstruction to water distribution per

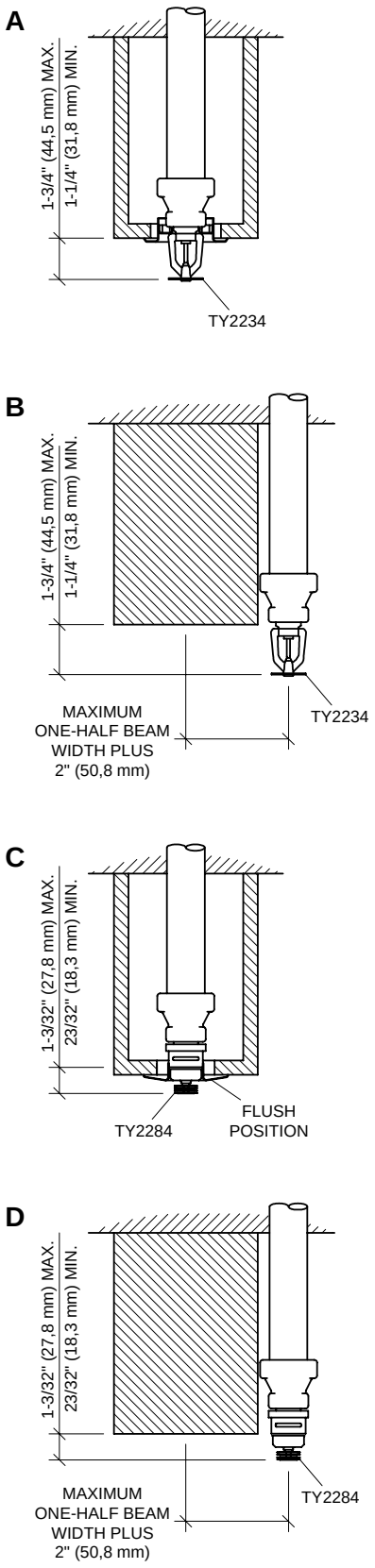


FIGURE 6
SPRINKLER POSITIONING UNDER BEAMS

ALL FIGURES: DISTANCES ARE MEASURED TO COMPARTMENT WALL FACES AND TO CENTERLINES OF BEAMS

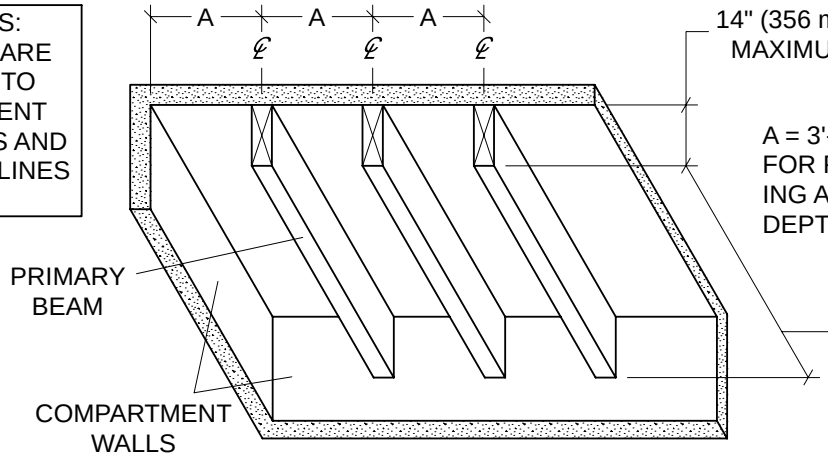
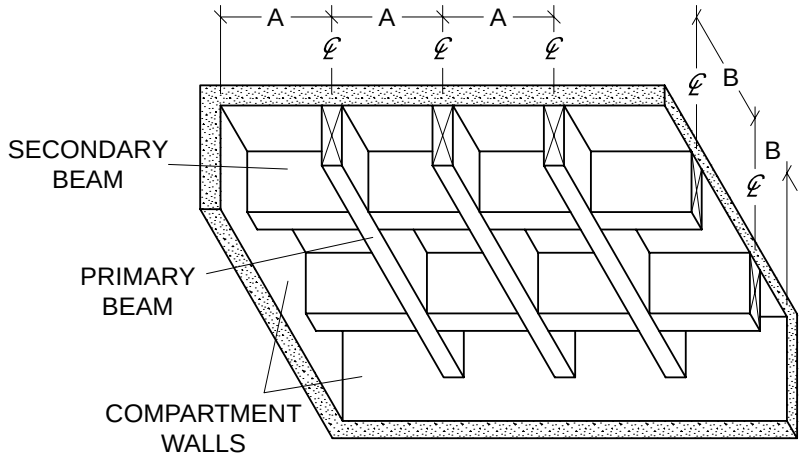


FIGURE 7A

PRIMARY BEAM SPANS UP TO 20'-0" (6,1 m)

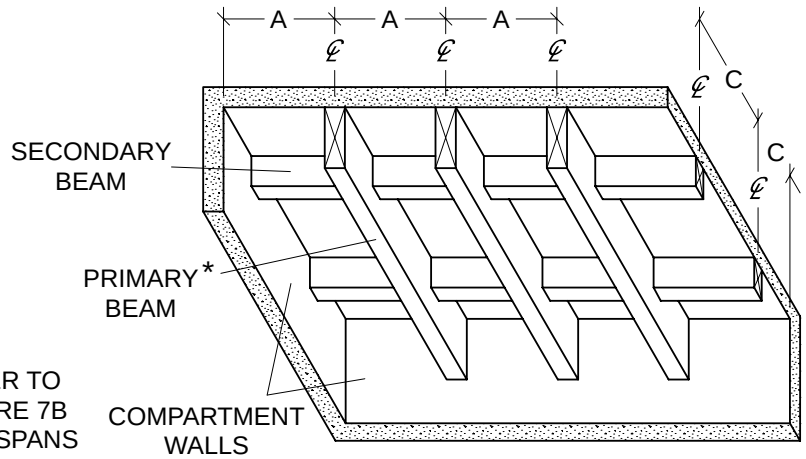


A = 3'-4" to 6'-0" (1,0 to 1,8 m) FOR PRIMARY BEAMS HAVING A 14" (356 mm) MAXIMUM DEPTH

B = 20'-0" (6,1 m) MAXIMUM FOR SECONDARY BEAMS THAT ARE TO BE EQUAL IN DEPTH TO PRIMARY BEAMS AND THAT MUST BE IN PLACE SO THAT PRIMARY BEAM POCKETS DO NOT EXCEED 20'-0" (6,1 m)

FIGURE 7B

PRIMARY BEAM SPANS GREATER THAN 20'-0" (6,1 m)



A = 3'-4" to 6'-0" (1,0 to 1,8 m) FOR PRIMARY BEAMS HAVING A 14" (356 mm) MAXIMUM DEPTH

C = 3'-4" (1,0 m) MINIMUM FOR SECONDARY BEAMS HAVING DEPTHS GREATER THAN 25% OF PRIMARY BEAMS

— or —

C = ANY DISTANCE FOR SECONDARY BEAMS HAVING DEPTHS UP TO 25% OF PRIMARY BEAMS

* REFER TO FIGURE 7B FOR SPANS EXCEEDING 20'-0" (6,1 m)

FIGURE 7C

COMBINATIONS OF PRIMARY AND SECONDARY BEAMS

FIGURE 7
PERMITTED BEAM ARRANGEMENTS

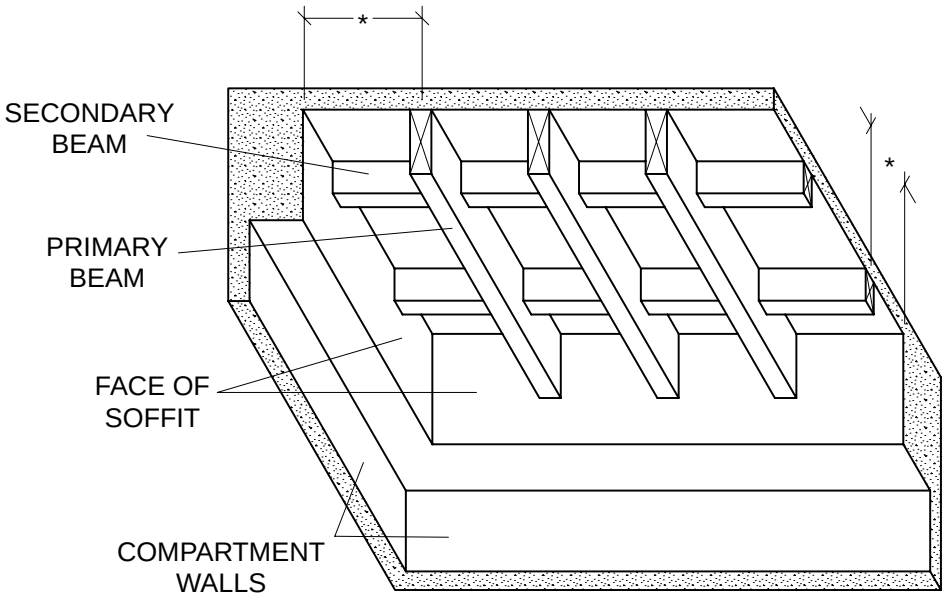


FIGURE 8
BEAM AND SOFFIT ARRANGEMENTS

the obstruction rules of NFPA 13 for residential sprinklers.

When soffits are present, the previously provided 3 ft.- 4 in. to 6 ft. "compartment wall to adjacent beam" distance for the primary and secondary beams is to be measured from the face of the soffit as opposed to the compartment wall.

NOTE
Although the distance to the beams is measured from the face of the soffit, the sprinkler coverage area is to be measured from the compartment wall.

Installation

The Series LFII Residential Sprinklers must be installed in accordance with the applicable Technical Data Sheet referenced in Table A.

Care and Maintenance

The Series LFII Residential Sprinklers must be maintained and serviced in accordance with the applicable Technical Data Sheet referenced in Table A.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

It is recommended that automatic sprinkler systems be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

PIPE

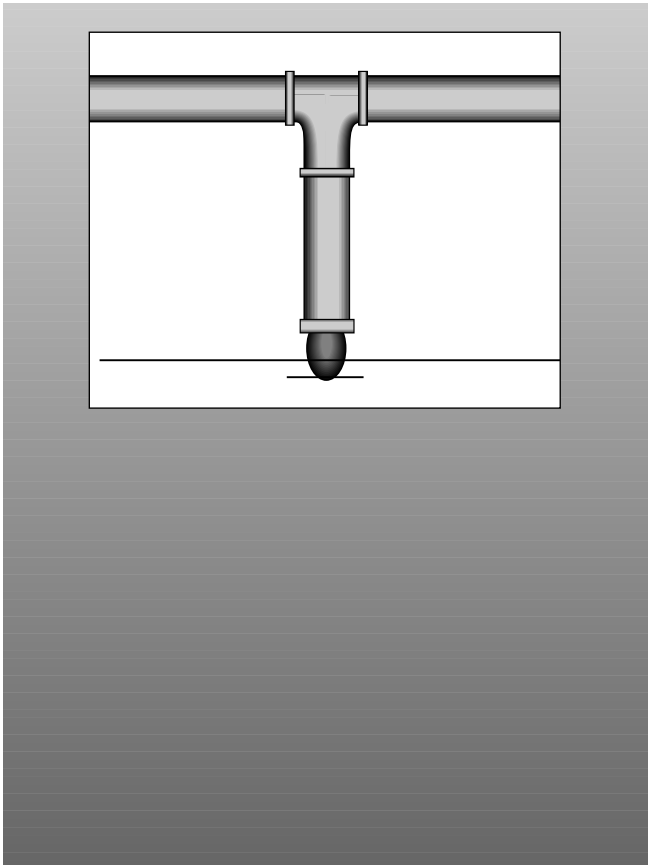
tyco / Flow Control / Tyco Fire Products

BlazeMaster®

Fire Sprinkler Pipe & Fittings Submittal Sheet

Tyco Fire Products
451 North Cannon Avenue
Lansdale, Pennsylvania 19446
www.tyco-fire.com

Technical Services
Tel: (800) 381-9312 · Fax: (800) 791-5500
E-mail: techserv@tycofp.com



No. 19–1.5
TD915
4–1.1.20
9/2001

Introduction

Tyco Fire Products (TFP) BlazeMaster® CPVC pipe and fittings are designed exclusively for use in wet pipe automatic fire sprinkler systems. They are made from a specially developed thermoplastic compound composed of post chlorinated polyvinyl chloride (CPVC) resin and state of the art additives. TFP BlazeMaster® CPVC products are easier to install than traditional steel pipe systems, and at the same time, they provide superior heat resistance and strength as compared to traditional CPVC and PVC piping materials used in the plumbing trade. Various adapters are available to connect CPVC pipe to metallic piping. All female pipe thread adapters have brass inserts for durability. Grooved adapters connect directly to grooved end valves and metallic pipe, with flexible grooved end couplings.

Technical Data

Sizes: 3/4" – 3"
Maximum Working Pressure: 175 psi
Approvals: UL, FM, CUL, NSF, Dade County, LPCB, MEA, and the City of Los Angeles
Note: See current TFP BlazeMaster Installation Instructions and Technical Manual, for exact listing/approval information

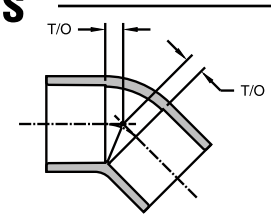
Manufacture Source: U.S.A.
Material:
Pipe: ASTM F442, SDR 13.5
Fittings: ASTM F438 (Sch. 40) and ASTM F439 (Sch. 80)
Color: Orange

Pipe

Nom.Pipe Size	Avg. O.D. Inches	Avg. I.D. Inches	Wt. Lbs./Ft.	Wt. H_2O filled Pipe Lbs./Ft.	Ft. of Pipe per Lift	Wt. per Lift Lbs.
3/4"	1.050	0.874	0.17	0.43	7875	1413
1"	1.315	1.101	0.26	0.67	5040	1320
1 1/4"	1.660	1.394	0.42	1.07	2835	1191
1 1/2"	1.900	1.598	0.55	1.40	2205	1136
2"	2.375	2.003	0.86	2.20	1260	1063
2 1/2"	2.875	2.423	1.26	3.22	1215	1531
3"	3.500	2.952	1.87	4.79	720	1344

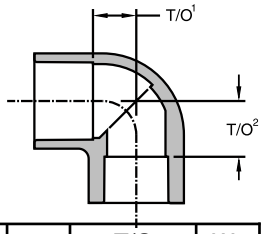
Fittings

45° Elbow



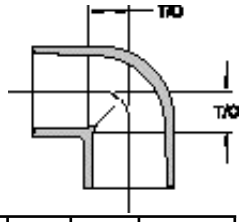
Part No.	Size	Sch.	T/O	Wt.
80050	3/4"	40	3/8"	0.08 lb.
80051	1"	40	3/8"	0.11 lb.
80052	1 1/4"	40	3/4"	0.20 lb.
80053	1 1/2"	80	7/16"	0.31 lb.
80054	2"	80	3/4"	0.56 lb.
80055	2 1/2"	80	3/4"	0.89 lb.
80056	3"	80	1"	1.19 lb.

Reducing 90° Elbow



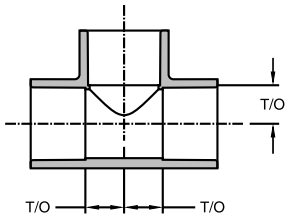
Part No.	Size	Sch.	T/O		Wt. lb.
			1	2	
80032	1" x 3/4"	40	11/16"	13/16"	0.16

90° Elbow



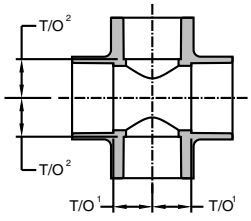
Part No.	Size	Sch.	T/O	Wt.
80025	3/4"	40	9/16"	0.09 lb.
80026	1"	40	3/4"	0.14 lb.
80027	1 1/4"	40	7/8"	0.21 lb.
80028	1 1/2"	80	1 1/16"	0.40 lb.
80029	2"	80	1 1/4"	0.79 lb.
80030	2 1/2"	80	1 1/2"	1.14 lb.
80031	3"	80	1 13/16"	1.82 lb.

Tee



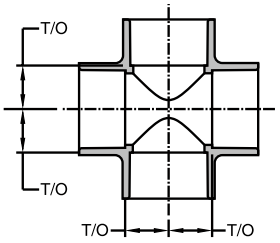
Part No.	Size	Sch.	T/O	Wt.
80000	3/4"	40	5/8"	0.11 lb.
80001	1"	40	3/4"	0.19 lb.
80002	1 1/4"	40	7/8"	0.26 lb.
80003	1 1/2"	80	1"	0.51 lb.
80004	2"	80	1 3/8"	0.90 lb.
80005	2 1/2"	80	1 9/16"	1.59 lb.
80006	3"	80	1 11/16"	2.41 lb.

Reducing Cross



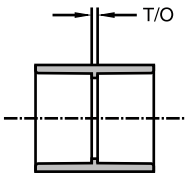
Part No.	Size	Sch.	T/O		Wt. lb.
			1	2	
80015	1" x 3/4"	40	11/16"	11/16"	0.28

Cross



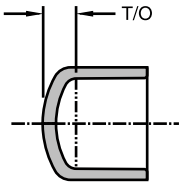
Part No.	Size	Sch.	T/O	Wt.
80009	3/4"	40	9/16"	0.13 lb.
80010	1"	40	15/16"	0.23 lb.
80011	1 1/4"	40	15/16"	0.34 lb.
80012	1 1/2"	80	1 1/16"	0.67 lb.
80013	2"	80	1 3/8"	1.00 lb.
80014	2 1/2"	80	1 9/16"	1.91 lb.
80008	3"	80	1 13/16"	2.89 lb.

Coupling



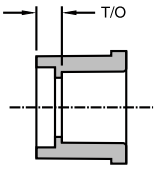
Part No.	Size	Sch.	T/O	Wt.
80075	3/4"	40	1/8"	0.07 lb.
80076	1"	40	1/8"	0.11 lb.
80077	1 1/4"	40	3/16"	0.12 lb.
80078	1 1/2"	80	3/16"	0.25 lb.
80079	2"	80	3/16"	0.38 lb.
80080	2 1/2"	80	3/16"	0.67 lb.
80081	3"	80	3/16"	0.91 lb.

Cap



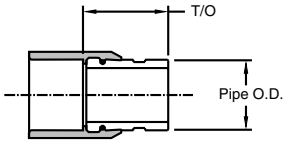
Part No.	Size	Sch.	T/O	Wt.
80100	3/4"	40	5/16"	0.04 lb.
80101	1"	40	3/8"	0.06 lb.
80102	1 1/4"	40	1/2"	0.10 lb.
80103	1 1/2"	80	5/8"	0.20 lb.
80104	2"	80	5/8"	0.31 lb.
80105	2 1/2"	80	7/8"	0.58 lb.
80106	3"	80	1"	0.88 lb.

Reducer Bushing



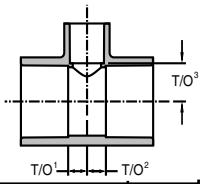
Part No.	Size	Sch.	T/O	Wt.
80200	1" x 3/4"	40	7/16"	0.04 lb.
80201	1 1/4" x 3/4"	40	7/16"	0.11 lb.
80202	1 1/4" x 1"	40	5/16"	0.12 lb.
80203	1 1/2" x 3/4"	80	5/8"	0.16 lb.
80204	1 1/2" x 1"	80	1/2"	0.14 lb.
80205	1 1/2" x 1 1/4"	80	3/8"	0.17 lb.
80206	2" x 3/4"	80	3/4"	0.27 lb.
80207	2" x 1"	80	11/16"	0.26 lb.
80208	2" x 1 1/4"	80	9/16"	0.24 lb.
80209	2" x 1 1/2"	80	7/16"	0.19 lb.
80215	2 1/2" x 1"	80	1 15/16"	0.42 lb.
80214	2 1/2" x 1 1/4"	80	1 3/4"	0.45 lb.
80213	2 1/2" x 1 1/2"	80	1 5/8"	0.46 lb.
80211	2 1/2" x 2"	80	1 9/16"	0.29 lb.
80210	3" x 2"	80	2 3/16"	0.72 lb.
80212	3" x 2 1/2"	80	1 15/16"	0.47 lb.

Grooved Coupling Adapter



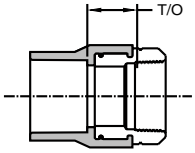
Part No.	Size	Sch.	T/O	Wt.	Pipe OD
80160	1 1/4" x 1 1/4" Grooved	40	2 5/16"	0.78 lb.	1 1/4" (1.660")
80161	1 1/2" x 1 1/2" Grooved	80	2 5/16"	0.95 lb.	1 1/2" (1.900")
80162	2" x 2" Grooved	80	2 5/16"	1.42 lb.	2" (2.375")
80163	2 1/2" x 2 1/2" Grooved	80	2 5/16"	2.28 lb.	2 1/2" (2.875")
80164	3" x 3" Grooved	80	2 1/4"	3.00 lb.	3" (3.500")
80168	3" x 76.1mm Grooved	80	2 1/4"	2.72 lb.	76.1mm (3.000")

Reducing Tee



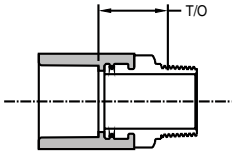
Part No.	Size	Sch.	T/O			Wt.
			1	2	3	lb.
80132	3/4" x 3/4" x 1"	40	3/4"	3/4"	5/8"	0.14
80133	1" x 3/4" x 3/4"	40	1/2"	11/16"	3/4"	0.14
80134	1" x 3/4" x 1"	40	5/8"	3/4"	3/4"	0.17
80260	1" x 1" x 3/4"	40	3/4"	3/4"	11/16"	0.16
80135	1 1/4" x 1" x 3/4"	40	7/16"	3/4"	15/16"	0.21
80136	1 1/4" x 1" x 1"	40	11/16"	3/4"	15/16"	0.22
80137	1 1/4" x 1" x 1 1/4"	40	13/16"	15/16"	13/16"	0.26
80261	1 1/4" x 1 1/4" x 3/4"	40	5/8"	5/8"	7/8"	0.23
80262	1 1/4" x 1 1/4" x 1"	40	3/4"	3/4"	7/8"	0.26
80138	1 1/4" x 1 1/4" x 1 1/2"	80	1"	1"	1"	0.43
80140	1 1/2" x 1 1/4" x 3/4"	80	1/2"	5/8"	1"	0.36
80141	1 1/2" x 1 1/4" x 1"	80	1/2"	5/8"	1 1/8"	0.38
80263	1 1/2" x 1 1/2" x 3/4"	80	9/16"	9/16"	1"	0.36
80264	1 1/2" x 1 1/2" x 1"	80	9/16"	9/16"	1"	0.38
80275	1 1/2" x 1 1/2" x 1 1/4"	80	7/8"	7/8"	1"	0.45
80265	2" x 2" x 3/4"	80	3/4"	3/4"	1 3/8"	0.61
80266	2" x 2" x 1"	80	7/8"	7/8"	1 3/8"	0.66
80274	2" x 2" x 1 1/4"	80	1"	1"	1 3/8"	0.74
80267	2" x 2" x 1 1/2"	80	1 1/8"	1 1/8"	1 3/8"	0.78
80271	2 1/2" x 2 1/2" x 1"	80	1 11/16"	1 11/16""	1 9/16"	1.43
80272	2 1/2" x 2 1/2" x 1 1/4"	80	1 11/16"	1 11/16"	1 9/16"	1.46
80273	2 1/2" x 2 1/2" x 1 1/2"	80	1 11/16"	1 11/16"	1 9/16"	1.48
80276	2 1/2" x 2 1/2" x 2"	80	1 11/16"	1 11/16"	1 9/16"	1.50
80270	3" x 3" x 1 1/2"	80	1 3/4"	1 3/4"	1 13/16"	2.28
80268	3" x 3" x 2"	80	1 3/4"	1 3/4"	1 3/4"	2.25
80269	3" x 3" x 2 1/2"	80	1 3/4"	1 3/4"	1 15/16"	2.44

Female Adapter



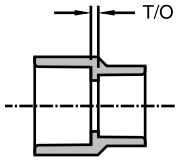
Part No.	Size	Sch.	T/O	Wt.
80142	3/4" x 3/4" NPT	40	5/8"	0.41 lb.
80145	1" x 1" NPT	40	3/4"	0.63 lb.
80146	1 1/4" x 1 1/4" NPT	40	7/8"	1.03 lb.
80147	1 1/2" x 1 1/2" NPT	80	1"	1.42 lb.
80148	2" x 2" NPT	80	1 3/8"	2.66 lb.

Male Adapter



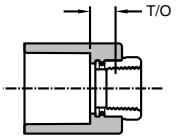
Part No.	Size	Sch.	T/O	Wt.
80157	3/4" x 3/4" NPT	40	1 5/16"	0.33 lb.
80158	1" x 1" NPT	40	1 3/8"	0.56 lb.

Reducing Coupling



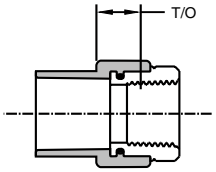
Part No.	Size	Sch.	T/O	Wt.
80220	1" x 3/4"	40	1/8"	0.08 lb.

Sprinkler Head Adapter
with Brass Threaded Insert



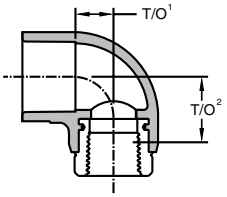
Part No.	Size	Sch.	T/O	Wt.
80175E	3/4" x 1/2" NPT	80	7/16"	0.20 lb.
80176E	1" x 1/2" NPT	80	7/16"	0.22 lb.
80177WL	3/4" x 1/2" NPT	40	9/16"	0.16 lb.
80179	1 x 3/4" NPT	40	3/4"	0.43 lb.

Sprinkler Head Adapter (Spigot)
with Brass Threaded Insert



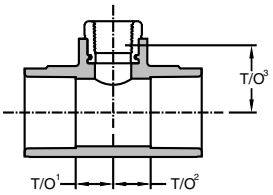
Part No.	Size	Sch.	T/O	Wt.
80177L	3/4" x 1/2" NPT	40	1/2"	0.16 lb.
80178	1" x 1/2" NPT	40	1/2"	0.20 lb.

Sprinkler Head Adapter 90° Elbow
with Brass Threaded Insert

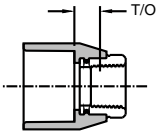


Part No.	Size	Sch.	T/O		Wt.
			1	2	lb.
80199	3/4" x 1/2" NPT	40	5/8"	15/16"	0.20
80189	1" x 1/2" NPT	40	13/16"	1 3/16"	0.26

Sprinkler Head Adapter Tee
with Brass Threaded Insert

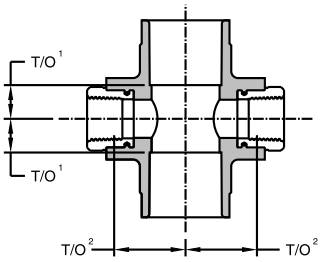


Sprinkler Head Adapter
with Brass Threaded Insert



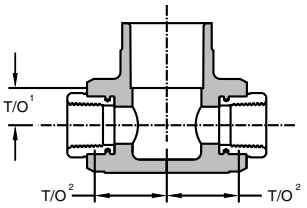
Part No.	Size	Sch.	T/O	Wt.
80175W	3/4" x 1/2" NPT	40	7/16"	0.19 lb.
80176W	1" x 1/2" NPT	40	7/16"	0.18 lb.

Back-to-Back Cross
with Brass Threaded Insert



Part No.	Size	Sch.	T/O		Wt.
			1	2	lb.
80462	1" x 1" x 1/2" NPT x 1/2" NPT	40	5/8"	1 1/8"	0.46
80463	1" x 1" x 1/2" NPT x 1/2" NPT	40	5/8"	1 5/16"	0.47

Back-to-Back Tee
with Brass Threaded Insert



Part No.	Size	Sch.	T/O		Wt.
			1	2	lb.
80459	1" x 1/2" NPT x 1/2" NPT	40	11/16"	1 5/16"	0.48
80460	1" x 1/2" NPT x 1/2" NPT	40	11/16"	1 1/8"	0.46

Part No.	Size	Sch.	T/O			Wt.
			1	2	3	lb.
80250	3/4" x 3/4" x 1/2" NPT	40	5/8"	5/8"	1"	0.22
80251	1" x 1" x 1/2" NPT	40	11/16"	11/16"	13/16"	0.29
80249	1" x 1" x 1" NPT	40	15/16"	15/16"	1 7/16"	0.73
80256	1 1/4" x 1" x 1/2" NPT	40	7/16"	9/16"	1 1/8"	0.30
80252	1 1/4" x 1 1/4" x 1/2" NPT	40	7/16"	7/16"	1 1/8"	0.31
80257	1 1/2" x 1 1/4" x 1/2" NPT	80	9/16"	5/8"	1 7/16"	0.43
80254	1 1/2" x 1 1/2" x 1/2" NPT	80	9/16"	9/16"	1 7/16"	0.46
80258	2" x 1 1/2" x 1/2" NPT	80	1/2"	5/8"	1 5/8"	0.56
80253	2" x 2" x 1/2" NPT	80	1/2"	1/2"	1 5/8"	0.62

Limited Warranty

Products manufactured by Tyco Fire Products are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by Tyco Fire Products. No warranty is given for products or components manufactured by companies not affiliated by ownership with Tyco Fire Products or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association (NFPA), and/or the standards of any other Authorities Having Jurisdiction. Materials found by Tyco Fire Products to be defective shall be either repaired or replaced, at Tyco Fire Products sole option. Tyco Fire Products neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. Tyco Fire Products shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

IN NO EVENT SHALL TYCO FIRE PRODUCTS BE LIABLE, IN CONTRACT, TORT, STRICT LIABILITY OR UNDER ANY OTHER LEGAL THEORY, FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LABOR CHARGES, REGARDLESS OF WHETHER TYCO FIRE PRODUCTS WAS INFORMED ABOUT THE POSSIBILITY OF SUCH DAMAGES, AND IN NO EVENT SHALL TYCO FIRE PRODUCT'S LIABILITY EXCEED AN AMOUNT EQUAL TO THE SALES PRICE.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ANY AND ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

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rapid response™
HOME FIRE SPRINKLER SYSTEM

BlazeMaster ® CPVC Fire Sprinkler Pipe & Fittings Submittal Sheet

General Description

Tyco® CPVC Pipe and Fittings produced by Tyco Fire & Building Products (TFBP) are designed exclusively for use in wet pipe automatic fire sprinkler systems. The Tyco CPVC Pipe and Fittings are produced from BlazeMaster® CPVC compound that is a specially developed thermoplastic compound composed of post chlorinated polyvinyl chloride (CPVC) resin and state of the art additives. Tyco CPVC Pipe and Fittings are easier to install than traditional steel pipe systems, and at the same time, provide superior heat resistance and strength as compared to traditional CPVC and PVC piping materials used in the plumbing trade. Various adapters are available to connect CPVC pipe to metallic piping. All female pipe thread adapters have brass inserts for durability. Grooved adapters connect directly to grooved end valves and metallic pipe, with flexible grooved end couplings.

NOTICE

Tyco® CPVC Pipe and Fittings produced with BlazeMaster® CPVC compound described herein must be installed and maintained in compliance with this document and with the applicable standards of the National Fire Protection Association, in addition to the standards of any authorities having jurisdiction. Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Technical Data

Sizes
3/4" to 3"

Maximum Working Pressure
175 psi

Approvals
UL, FM, C-UL, NSF, LPCB, MEA, and the City of Los Angeles. (Refer to Installation Handbook IH-1900 dated June 2008 for exact listing/approval information.)

Manufacture Source
U.S.A.

Material

- Pipe: ASTM F442, SDR 13.5
- Fittings: ASTM F438 (Sch. 40) and ASTM F439 (Sch. 80), ASTM F1970

Color
Orange

Installation

Tyco® CPVC Pipe and Fittings produced by Tyco Fire & Building Products (TFBP) are to be installed in accordance with Installation Handbook IH-1900 dated June 2008.

Care and Maintenance

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any authority having jurisdiction. The installing contractor or product manufacturer should be contacted relative to any questions.

Automatic sprinkler systems should be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

NOTICE

Before closing a fire protection system control valve for inspection or maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must first be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

After placing a fire protection system in service, notify the proper authorities and advise those responsible for monitoring proprietary and/or central station alarms.

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

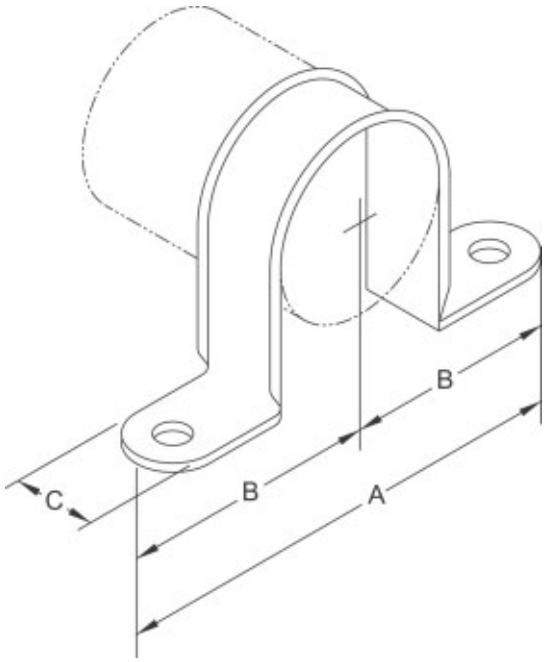
The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

HANGERS

Fig. 23 - Hanger for CPVC Plastic Pipe Double Fastener Strap Type



Size Range — 3/4" thru 2" CPVC pipe

Material — Carbon Steel, Pre-Galvanized

Function — Intended to perform as a hanger/restrainer to support only CPVC piping used in automatic fire sprinkler systems. Can be installed on the top or on the bottom of a beam. The Fig. 23 can also be installed on the side of a beam. The Fig. 23 can also function as a restrainer to prevent the upward movement of the sprinkler head during activation.

Approvals — Underwriters' Laboratories Listed in the USA **(UL)** and Canada **(cUL)** to support fire sprinkler piping. Meets and exceeds the requirements of NFPA 13, 13R and 13D.

Features — Fig. 23 incorporates features which protect the pipe and ease installation. The flared edge design* protects the CPVC pipe from any rough surface. It also incorporates snap restrainers allowing easier and faster installation. Easily attaches to the building structure using the two UL Listed hex head self threading screws** furnished with the product. It is recommended that rechargeable electric drills fitted with a hex socket attachment be used as installation tools. No impact tools (such as a hammer) or impact fasteners (such as drive screws or nails) are allowed. Damage has been known to result from installations using impact type tools.
No pre-drilling of a pilot hole in wood is required.

Finish — Pre-Galvanized

Order By — Figure number and pipe size

* Patent Pending

**** Hardened hex head self threading screw is furnished with the product and is the minimum fastener size acceptable.**

Dimensions • Weights

CPVC Pipe Size	A	B	C	Max. Hanger Spacing (Ft.)	Fastener Hex Head Size	Approx. Wt./100
3/4	$3^{1}/_{8}$	$1^{9}/_{16}$	$1^{3}/_{16}$	$5^{1}/_{2}$	5/16	9
1	$3^{3}/_{8}$	$1^{11}/_{16}$	$1^{3}/_{16}$	6	5/16	9
$1^{1}/_{4}$	$4^{3}/_{16}$	$2^{3}/_{32}$	$1^{3}/_{16}$	$6^{1}/_{2}$	5/16	11
$1^{1}/_{2}$	$4^{7}/_{16}$	$2^{7}/_{32}$	$1^{3}/_{16}$	7	5/16	12
2	$4^{7}/_{8}$	$2^{7}/_{16}$	$1^{3}/_{16}$	8	5/16	15

TOLCO
a brand of NIBCO

Fig. 28 "Stand-Off" Hanger and Restrainer for CPVC Plastic Pipe

APPLICATIONS

- For use as a hanger and/or a restrainer for CPVC pipe
- Eliminates the need for wood blocking on TJI type installations
- Can be used to hang or support horizontal or vertical plastic piping.

FEATURES

- Revolutionary new "snap-in" design allows for fast and easy installation
- Flared edge design protects pipe from sharp edges
- Provides clearance for horizontal pipe in attic installations
- Satisfies the system requirements for both a Hanger and a Restrainer

DESIGN CRITERIA

- Underwriter's Laboratories Listed in USA (UL) and Canada (cUL) as Hanger and Restrainer for Fire Sprinkler Piping
- Meets or exceeds requirements of NFPA 13, 13R and 13D

FIG. 28

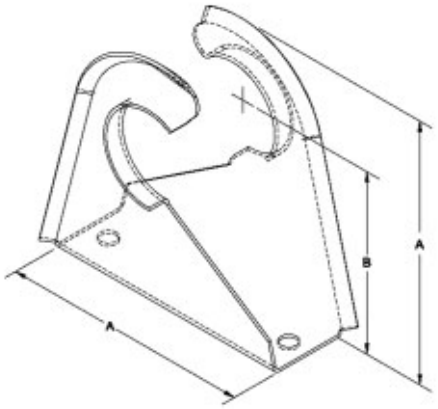
Printed in USA

Fig. 28
"Stand-Off" Hanger & Restrainer for CPVC Plastic Pipe

Size Range — ¾" through 2"

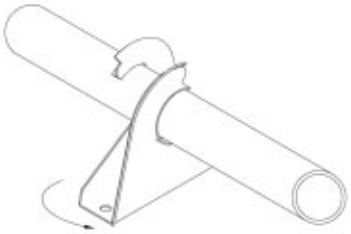
Material — Carbon Steel, Pre-Galvanized

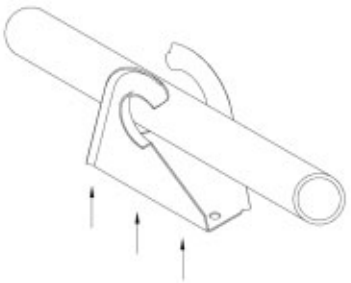
Function — Designed to be used as a hanger and restrainer for CPVC piping where the "stand-off" design will ease installation by eliminating the need for wood blocking.



Features:

- Flared edge design protects CPVC pipe from any rough or abrasive surfaces.
- Unique twist and lock design hold pipe firmly in place and allows retrofit type of installation.
- The "Stand-Off" design eliminates the need for wood block extension.
- Can be installed on horizontal or vertical piping regardless of mounting surface orientation.
- Attached easily to wood structure with two hex head self-threading screws furnished with product.
- Installs easily using rechargeable electrical driver with 5/16" extension socket eliminating impact tool damage to pipe.
- U.L. Listed as a hanger and a restrainer for fire sprinkler piping.

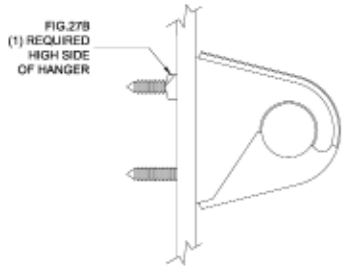




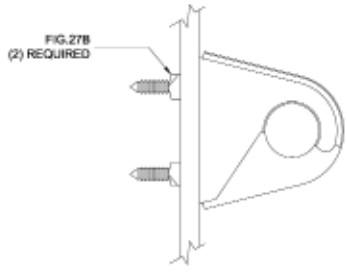
Approvals — Underwriters' Laboratory Listed in the USA **(UL)** and Canada **(cUL)** to support automatic fire sprinkler systems. Meets and exceeds the requirements of NFPA 13, 13R and 13D. Fig. 28 satisfies the UL vertical restraint requirement where needed. UL Listed as a hanger and vertical restraint when installed on 3/8" composite wood material. Use two Fig. 27B Speed Nuts when used as a hanger and restraint. Use one Fig. 27B Speed Nut on the upper installed screw when used as a hanger only.

Order by — Figure number and pipe size.

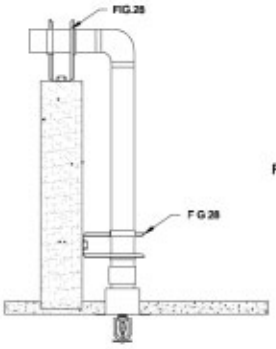
US AND INTERNATIONAL PATENT APPLICATION IN PROCESS.

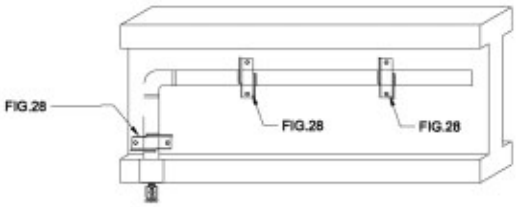


HANGER APPLICATION



HANGER & RESTRAINT APPLICATION





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RESIDENTIAL FIRE PUMP & TANK

RFP System

for

Residential Fire Protection

Specifically Designed for
NFPA 13D Applications

Quality & Service Since 1936

Specifically Designed for use in NFPA 13D Applications

General Air Products' **Residential Fire Protection Pump System** (RFP System) is the benchmark of quality for meeting current NFPA 13 D application requirements. Our RFP Systems deliver a wide variety of features & benefits that work together to meet the need of your application simply, efficiently and reliably.

RFP System Configurations

Contractors need a residential fire protection pump system that is easy to order, easy to install, and known for its reliability. Homeowners want a system that requires as little space and as little maintenance as possible while providing the safety and security they need.

General's RFP System addresses all of these needs and more. One of the ways we do this is by offering a variety of configurations - each utilizing an absolute minimum of space, easy to install, reliable and virtually maintenance free.

Open or Enclosed

Basic or Complete

Include Narrow Water Storage Tank

All RFP Systems are Completely Corrosion Resistant

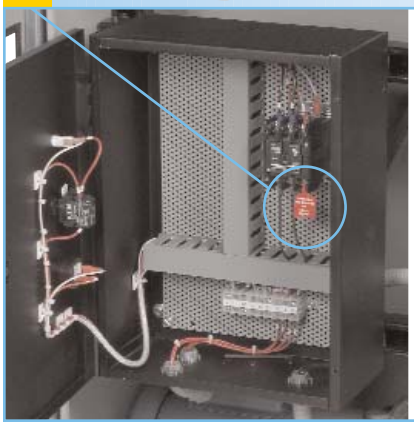
Basic Pump System

Unit Shown:
Enclosed Basic with 300 Gal. Tank

1. 29" Wide Narrow Water Tank
2. Stainless Steel Flex Hose (shipped loose)
3. Fill Valve (shipped loose)
4. Cut & Sealed Bulkhead Fittings
5. Stainless Steel TEFC Pump
6. NEMA Rated Control Box
7. "Power On" Indicator
8. Pump Test Button
9. Audible Alarm System
10. Alarm Signal Contact
11. Water Delivery Press. Gauge
12. DPDT Flow Switch
13. Non Ferrous Piping System
14. Adjustable Pressure Switch
15. Suction Line

Unit Shown:
Open Basic Stand-Alone

10 Alarm Signal Contact



The alarm signal contact allows contractors to wire the RFP System directly to an alarm bell or fire security system.

The alarm signal contact is one of many important, innovative features of the RFP System.

RFP System

Complete Pump System

Unit Shown:
Open Complete
with 300 Gal. Tank

1. 29" Wide Narrow Water Tank
2. Stainless Steel Flex Hoses (2)
3. Fill Valve (Built-in Float)*
4. Cut & Sealed Bulkhead Fittings
5. Stainless Steel TEFC Pump
6. Return Line for Testing
7. Tank Drain Valve
8. Pre-Piped for Instant Installation
9. Removable Inlet Connection
10. Alarm Signal Contact*
11. NEMA Rated Control Box
12. H-O-A Switch
13. "Power On" Indicator
14. "Pump On" Indicator
15. "Water Flow" Indicator
16. Motor Starter "Reset"
17. Audible Alarm System
18. Water Delivery Press. Gauge
19. DPDT Flow Switch
20. Non Ferrous Piping System
21. Adjustable Pressure Switch
22. Motor Overload Protection*
23. Fused Control Circuit*
24. System Drain Valve

** Features located internally*

5 Stainless Steel TEFC Pump

A standard feature on all of General's RFP Systems is a corrosion resistant Stainless Steel TEFC pump. The importance of non-ferrous components on a residential fire sprinkler system can not be overstated. Cast iron pumps and black iron fittings will corrode over time, and in the process potentially cause system failure.

All RFP Systems are Completely Corrosion Resistant.

- Stainless Steel TEFC Pump
- Non ferrous Piping
- Stainless Steel Hoses
- Many More Corrosion Resistant Components

Unit Shown:
Enclosed Complete
Stand-Alone

RFP System Accessories

Battery Backup *Power System*

General Air Products' Battery Back-up Power Systems are specifically designed to provide power to the RFP System in the event of a loss of power - ensuring that the fire protection system in the residence is fully functional at all times.

General's Battery Back-up Power System provides the maximum amount of system reliability making it the perfect solution for remote locations where reliable power supply is a problem.

- **Built-in charger and auto-switchover** guarantees your fire protection system will be ready during a power failure event.

- **Industrial duty stand** aids in the protection of the trickle charger and batteries.

- **Pre-formed cables** come standard to minimize field installation.

- **Standard units in 230v** but other voltages are available (consult factory).

RFP System Pump Selection

Use the chart below to select the correct pump horsepower for your system. For example, if your system has a flow of 30 gallons per minute (GPM) at 45 PSI the correct selection would be a 1 1/2 HP pump.

Gallons Per Minute								
		20	25	30	35	40	45	
Pressure	25	3/4	3/4	3/4	3/4	1	1 1/2	Pump HP
	30	3/4	3/4	3/4	1	1	1 1/2	
	35	3/4	1	1	1	1 1/2	2	
	40	1	1	1 1/2	1 1/2	1 1/2	2	
	45	1 1/2	1 1/2	1 1/2	2	2	2	
	50	1 1/2	1 1/2	2	2	2	5L	
	55	2	2	2	5L	5L	5L	
	60	3	3	5H	5H	5H	5H	
	65	5H	5H	5H	5H	5H	5H	
	70	5H	5H	5H	7 1/2	7 1/2	7 1/2	

All Information in this brochure is subject to change without notice. Consult factory for current information

Limited Warranty Statement

General Air Products, Inc. warrants its products to be free of defects in material and workmanship under normal use and service for 12 months from date of purchase. Our warranty applies only when such defective parts are returned to us, or our Authorized Service Depot, transportation prepaid, and subject to our inspection and approval.

Liability is limited to repair or replacement of material found defective, free of charge, F.O.B. our plant. Motors and pumps are covered by the original manufacturer's warranty only and should be returned by the customer to their authorized station for service. Unauthorized repairs or replacements will not be subject to factory warranty. This warranty is in lieu of all other warrants, expressed or implied.

Since 1936 General Air Products has offered our customers products of the highest quality. Through innovative engineering and without sacrifice of quality industrial components we continually deliver a five star level of excellence. We want you to expect nothing short of the best possible experience when you purchase any of our products.

Our sales staff is available to help you select the proper equipment to meet any unique application. Our production team and customer service representatives will ensure that your order is constructed to our five star standards and delivered on time. Once your unit is at the job site, our expert technical support staff is a phone call away and eager to assist you at each step of the installation process. After properly installed our quality assurance continues through the life of the product.

General Air Products, Inc. is proud of its role in providing quality equipment to the fire sprinkler contractor and its continued support of the fire protection industry.

General Air Products is the leading manufacturer of air compressors specifically designed for dry pipe and pre-action systems.

We offer a full line of compressors including oilless riser and tank mounted units, lubricated base and tank mounted units, air compressor accessories, and our FM Approved Dry Air Pac - designed for cold storage and freezer room applications.

SPEC CENTER

Attention Engineers and Designers

Be sure to visit the latest addition to our web site, General's Spec Center - specifically designed to make your job easier.

In the Spec Center you will find all the CAD (.DWG, .DXF), and Text (.DOC) files you need to add our complete line of air compressors to your specification booklet by simply cutting and pasting.

General Air Products, Inc.
118 Summit Drive
Exton, PA 19341

Phone: 610-524-8950
Fax: 610-524-8965

Call Toll Free 1-800-345-8207 or visit us on the web at www.GENERALAIRPRODUCTS.com

RFP System

Residential Fire Protection Pump System for NFPA 13D Applications

Pump Horsepower Selection Chart

Use the chart to select the correct RFP System for your application.

Example: Your system has a flow of 30 gallons per minute (GPM) at 45 PSI the correct selection would be a *PS18. Consult factory for confirmation of best selection.

PSIG	Feet of Head	Flow (GPM)														
		20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
25	58	*PS11	*PS11	*PS12	*PS12	*PS12	*PS15	*PS15	*PS15	*PS15	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19
30	69	*PS14	*PS14	*PS14	*PS14	*PS15	*PS15	*PS15	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19
35	81	*PS14	*PS14	*PS14	*PS15	*PS15	*PS18	*PS18	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19
40	92	*PS14	*PS14	*PS14	*PS18	*PS18	*PS18	*PS18	*PS19	*PS19	*PS19	*PS19	*PS19	*PS19	*PS22	*PS22
45	104	*PS14	*PS14	*PS18	*PS18	*PS18	*PS18	*PS19	*PS19	*PS19	*PS19	*PS22	*PS22	*PS22	*PS22	*PS22
50	116	*PS14	*PS13	*PS18	*PS18	*PS18	*PS18	*PS19	*PS20	*PS22	*PS22	*PS22	*PS22	*PS22	*PS23	*PS23
55	127	*PS18	*PS18	*PS18	*PS17	*PS20	*PS20	*PS20	*PS23	*PS23	*PS23	*PS23	*PS23	*PS23	*PS23	*PS23
60	139	*PS16	*PS16	*PS17	*PS17	*PS20	*PS20	*PS23	*PS23	*PS23	*PS23	*PS23	*PS23	*PS23	*PS23	*PS25
65	150	*PS17	*PS17	*PS17	*PS20	*PS20	*PS23	*PS23	*PS23	*PS23	*PS23	*PS23	*PS24	*PS24	*PS24	*PS25
70	162	*PS17	*PS17	*PS17	*PS20	*PS23	*PS23	*PS23	*PS21	*PS21	*PS21	*PS24	*PS24	*PS24	*PS24	*PS25

RFP System Amp Ratings

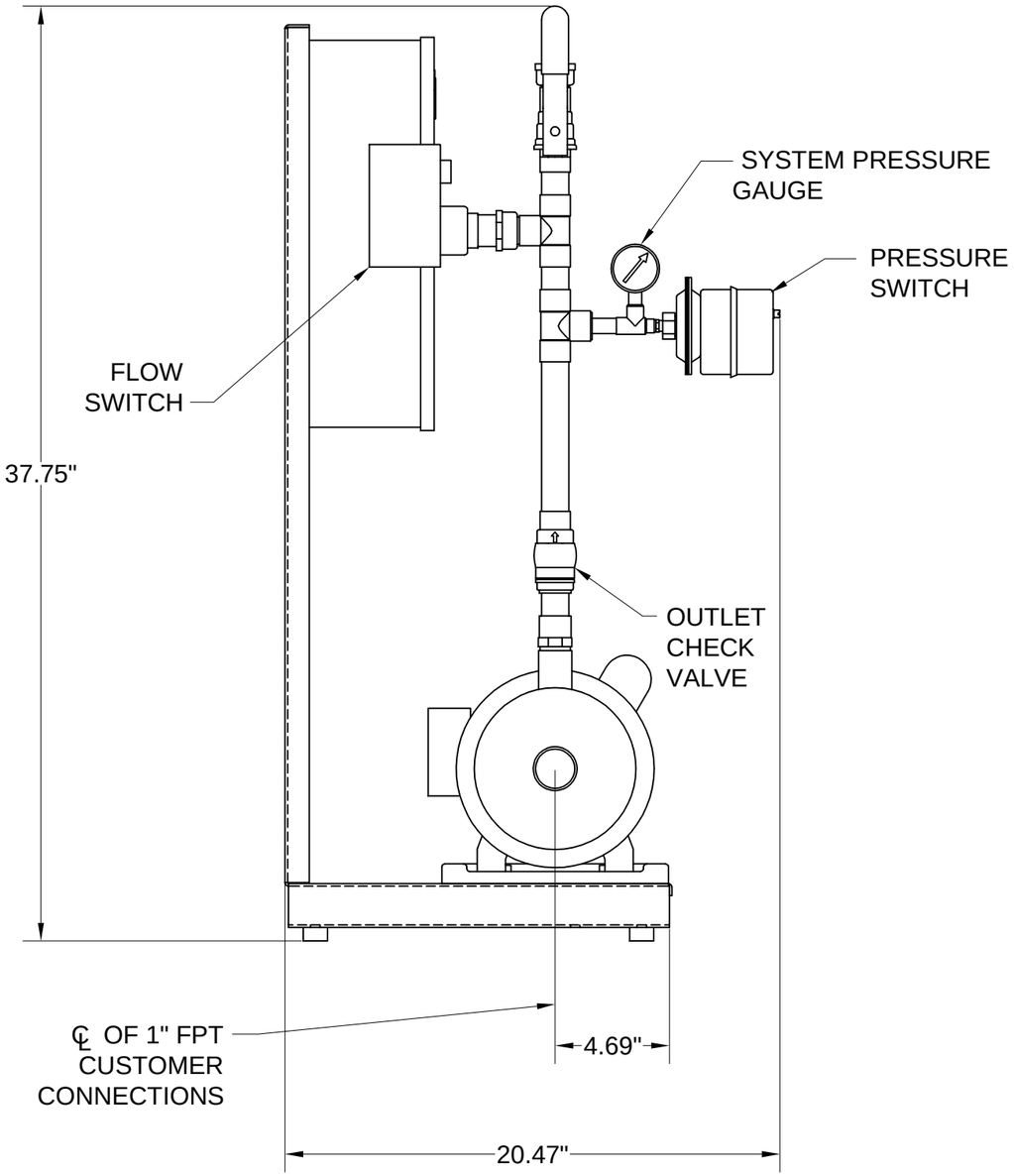
Model Number	Pump HP	FLA**
*PS11	3/4	6.70
*PS12	1	7.80
*PS13	1	8.60
*PS14	1 1/2	8.55
*PS15	1 1/2	8.55
*PS16	1 1/2	11.00
*PS17	2	12.00
*PS18	3	14.50
*PS19	3	14.50
*PS20	3	14.50
*PS21	5	19.50
*PS22	5	20.00
*PS23	5	19.50
*PS24	7 1/2	29.00
*PS24	7 1/2	29.00

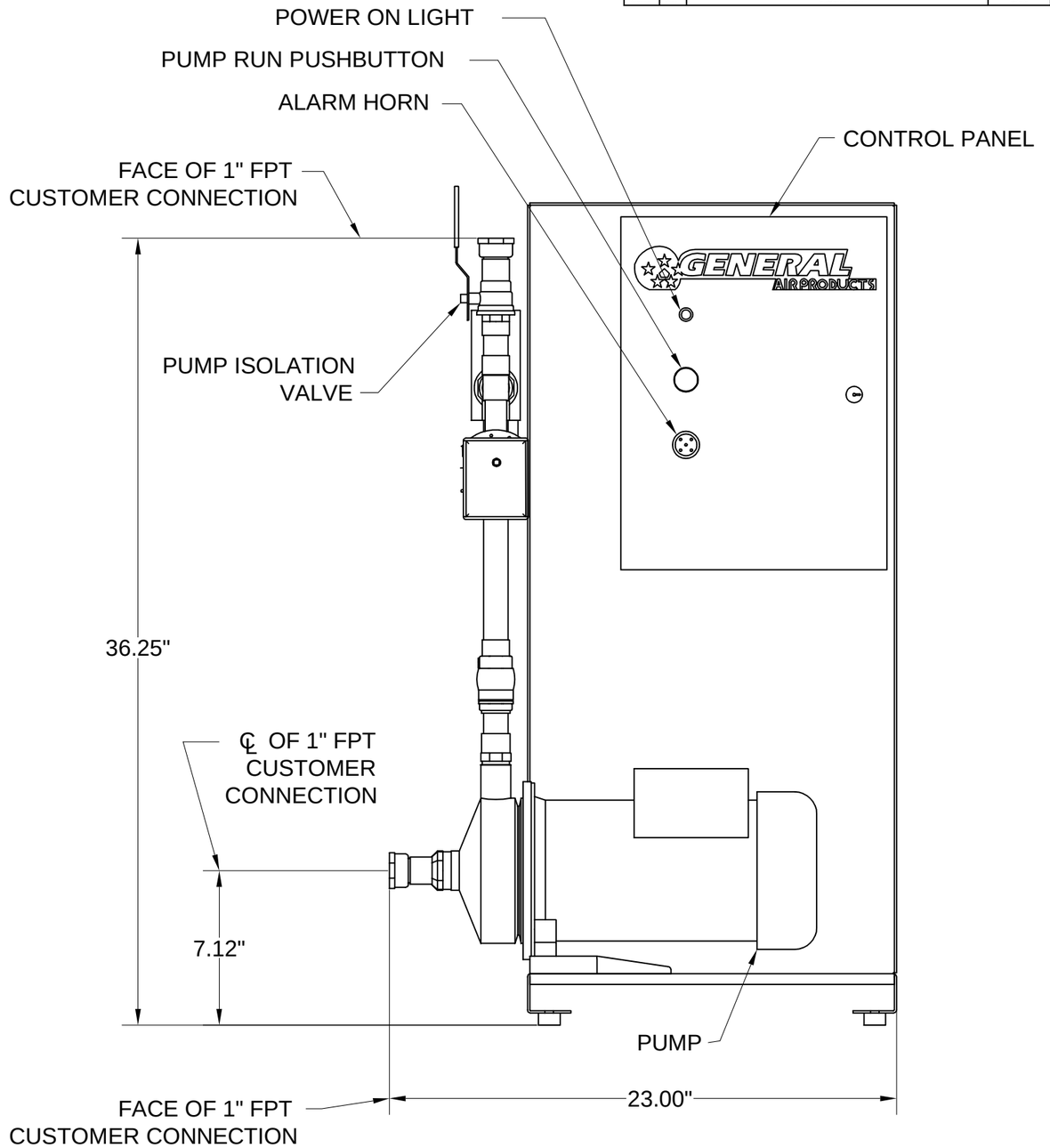
* Insert “E” for Enclosed Unit or “O” for an Open Unit
** FLA is stated for 230/1/60Hz and includes pump and controls.

CF= Consult Factory by calling 800-345-8207

Important Note: Wiring and feeder circuits should be in accordance with NEC and local codes. All information subject to change - consult factory for most up to date information.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED





UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ±1/4 DECIMALS .XX ± .13 ANGLES ±1/2°

APPROVALS	DATE
DRAWN EJR	06-22-09
CHECKED RM	02-01-07
SCALE	SIZE D
SHEET 1 OF 1	

GENERAL AIR PRODUCTS

TITLE
GENERAL ARRANGEMENT
RESIDENTIAL FIRE PROTECTION
BASIC OPEN SYTEM WITH NO TANK
MODELS OPS 11,12,14,15,18,19-X

DWG. NO. G-209180

REV 0

For Non-Health Hazard Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Series 007
Double Check Valve Assemblies

Sizes: ½" – 3" (15 – 80mm)

Series 007 Double Check Valve Assemblies shall be installed at referenced cross-connections to prevent the backflow of polluted water into the potable water supply. Only those cross-connections identified by local inspection authorities as non-health hazard shall be allowed the use of an approved double check valve assembly.

Check with local authority having jurisdiction regarding vertical orientation, frequency of testing or other installation requirements.

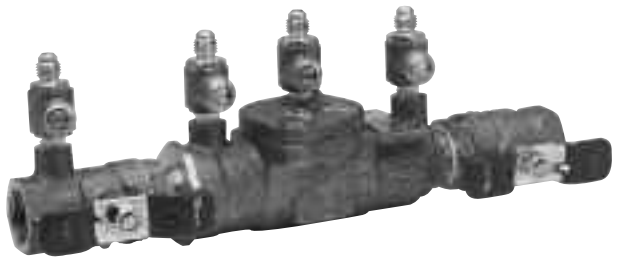
The valve shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

Features

- Ease of maintenance — only one cover
- Top entry
- Replaceable seats and seat discs
- Modular construction
- Compact design
- Cast bronze body construction — ½" – 2" (15 – 50mm)
- Fused epoxy coated cast iron body — 2½" – 3" (65 – 80mm)
- Top mounted ball valve test cocks
- Low pressure drop
- No special tools required for servicing
- ½" – 1" (15 – 25mm) have tee handles

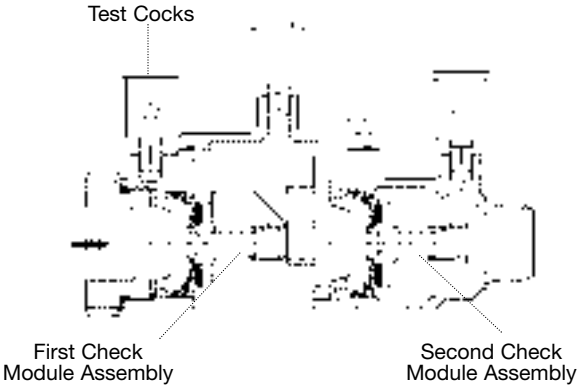
Specifications

A Double Check Valve Assembly shall be installed at each noted location. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single bronze or stainless steel access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves; four top mounted, resilient seated test cocks. The assembly shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Assembly shall be a Watts Series 007.



¾" (20mm) 007M3QT

2" (50mm) 007M1QT HC



The 007 Series features a modular design concept which facilitates complete maintenance and assembly by retaining the spring load.

Now Available
WattsBox Insulated Enclosures.
For more information, send for literature ES-WB.

IMPORTANT: *INQUIRE WITH GOVERNING AUTHORITIES FOR LOCAL INSTALLATION REQUIREMENTS*

WATTS®

Pressure — Temperature

½" – 2" (15 – 50mm)

Temperature Range: 33°F – 180°F (0.5°C – 82°C).

Maximum Working Pressure: 175psi (12.1 bar).

2½" – 3" (65 – 80mm)

Temperature Range: 33°F – 110°F (0.5°C – 43°C) continuous, 140°F (60°C) intermittent.

Maximum Working Pressure: 175psi (12.1 bar).

Standards

ASSE Std. 1015, AWWA Std. C510

IAPMO PS31, CSA B64.5

Approvals

† ASSE, AWWA, IAPMO, CSA, UPC

▲ Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

• Models LF and S are not listed.

◆ UL Classified (LF models only) ¾" – 2" (20 – 50mm) (except 007M3LF)

◆ UL Classified with OSY gate valves (2½" and 3" horizontal only.)

* Horizontal and vertical "flow up" approval on all sizes

Suffix:

S - bronze strainer

LF - without shutoff valves

LH - locking handle ball valves (open position)

SH - stainless steel ball valve handles

HC - 2½" inlet/outlet fire hydrant fittings (2" valve)

Prefix:

U - Union connections

2½" – 3" (65 – 80mm)

Suffix:

NRS - non-rising stem resilient seated gate valves

OSY - UL/FM outside stem and yoke resilient seated gate valves

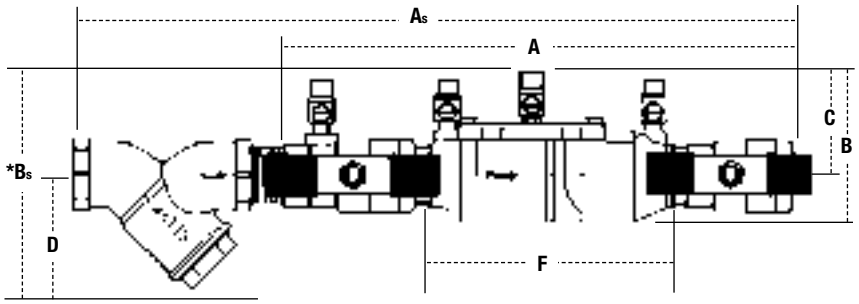
LF - without shutoff valves

QT-FDA - FDA epoxy coated quarter-turn ball valves

Dimensions – Weights

Models

Sizes: ½" – 2" (15 – 50mm)



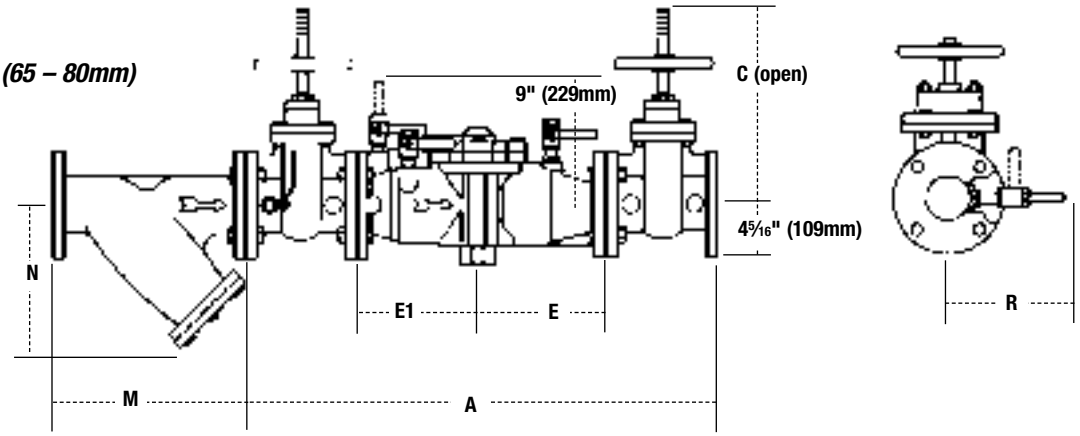
***Subscript 'S' = strainer model**

Suffix HC — Fire Hydrant Fittings dimension "A" = 23½" (594mm)

MODEL	SIZE (DN)		DIMENSIONS																WEIGHT	
			A		B		C		D		F		G		R		T			
	in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
†▲007QT	½	15	10	254	4 5/8	117	2 7/16	62	—	—	5	127	3 3/8	85	2 5/16	59	2 1/16	52	4.5	2
†▲007M3QT	¾	20	11 1/8	282	4	102	3 1/8	79	—	—	6 3/16	157	3 7/16	87	2 1/8	54	1 5/16	33	5	2.3
†▲007M1QT	1	25	13 1/4	337	5 1/8	130	4	102	—	—	7 1/2	191	3 3/8	85	1 11/16	43	1 11/16	43	12	5.4
†▲007M2QT	1 1/4	32	16 3/8	416	5	127	3 5/16	84	—	—	9 1/2	241	5	127	3	76	2	50	15	6.8
†▲007M2QT	1 1/2	40	16 3/4	425	4 7/8	124	3 1/2	89	—	—	9 3/4	248	5 13/16	148	3 1/8	79	2 11/16	68	15.9	7.2
†▲007M1QT	2	50	19 1/2	495	6 1/4	159	4	102	—	—	13 3/8	340	6 1/8	156	3 7/16	87	2 11/16	68	25.7	11.7
• 007QT-S	½	15	13	330	6	152	2 7/16	62	3	76	5	127	3 3/8	85	2 5/16	59	2 1/16	52	5.5	2.5
• 007M3QT-S	¾	20	14 1/2	368	6 1/8	156	3 1/8	79	3	76	6 3/16	157	3 7/16	87	2 1/8	54	1 5/16	33	6.7	3.1
• 007M1QT-S	1	25	17 15/16	157	7 3/4	197	4	102	3 1/4	83	7 1/2	191	3 3/8	85	1 11/16	43	1 11/16	43	14	6.4
• 007M2QT-S	1 1/4	32	21 1/2	546	7 1/16	179	3 5/16	84	3 1/2	83	9 1/2	241	5	127	3	76	2	50	19	8.6
• 007M2QT-S	1 1/2	40	25 1/16	637	7 1/16	179	3 1/2	89	3 3/4	95	9 3/4	248	5 13/16	148	3 1/8	79	2 11/16	68	19.6	8.9
• 007M1QT-S	2	50	27 1/4	692	8 3/4	222	4	102	4	102	13 3/8	340	6 1/8	156	3 7/16	87	2 11/16	68	33.5	15.2

Dimensions – Weights

Sizes: 2½" – 3" (65 – 80mm)



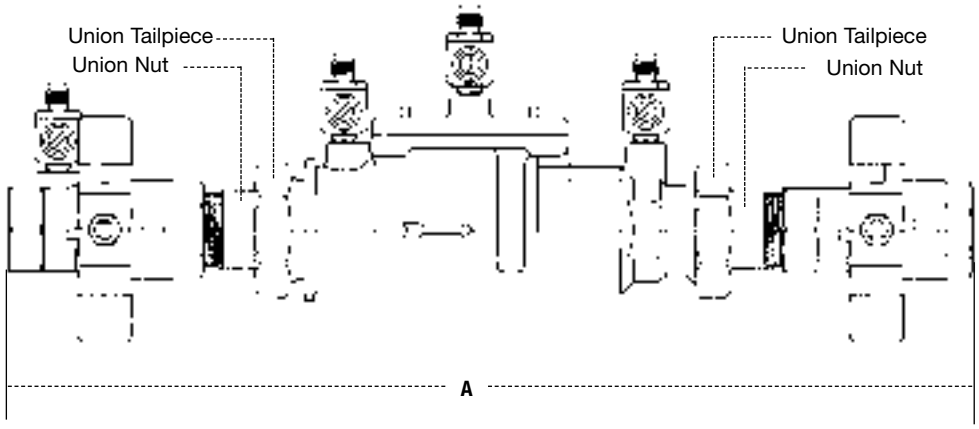
MODEL		SIZE (DN)		DIMENSIONS								WEIGHT	
				A		C		E, E1		R			
		in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
	007QT-FDA	2½	65	33⅛	841	6⅜	162	9¹⁄₁₆	230	8¾	222	155	70
▲	007-NRS	2½	65	33⅛	841	9⅜	238	9¹⁄₁₆	230	8¾	222	155	70
▲◆	007-OSY	2½	65	33⅛	841	16⅜	416	9¹⁄₁₆	230	8¾	222	158	72
	007-QT-FDA	3	80	34⅛	867	6⅜	162	9¹⁄₁₆	230	8¾	222	155	70
▲◆	007-NRS	3	80	34⅛	867	10¼	260	9¹⁄₁₆	230	8¾	222	185	84
▲	007-OSY	3	80	34⅛	867	18⅞	479	9¹⁄₁₆	230	8¾	222	185	84

Strainer Dimensions

SIZE						WEIGHT	
		M		N			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
2½	65	10	254	6½	165	28	13
3*	80	10⅛	267	7	178	34	15

*S Models only

1" U007M1QT



Sizes: ½" – 2" (15 – 50mm)

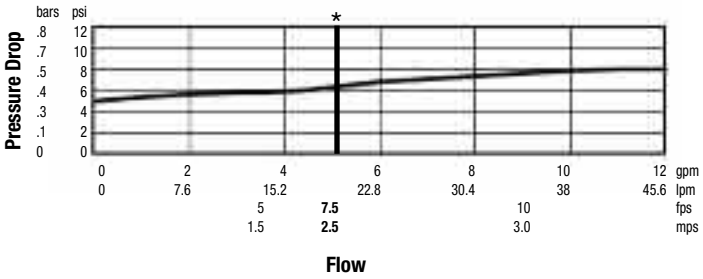
MODEL	SIZE (DN)		DIMENSIONS	
			A	
	in.	*mm*	*in.*	*mm*
U007QT	½	15	12¹³⁄₁₆	326
U007M2QT	¾	20	13¹³⁄₁₆	350
U007M2QT	1	25	16⅝	422
U007M2QT	1¼	32	20¾	527
U007M2QT	1½	40	21½	546
U007M1QT	2	50	24½	622

Capacity

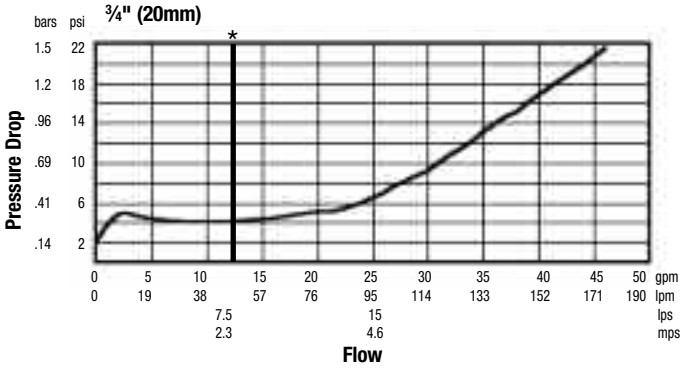
As complied from documented Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California lab tests.

* Typical maximum system flow rate (7.5 feet/sec., 2.3 meters/sec.)
** UL rated flow

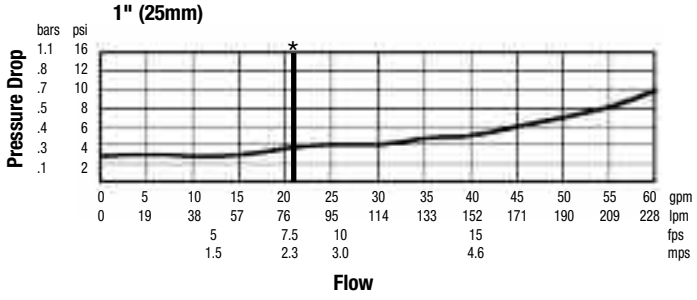
½" (15mm)



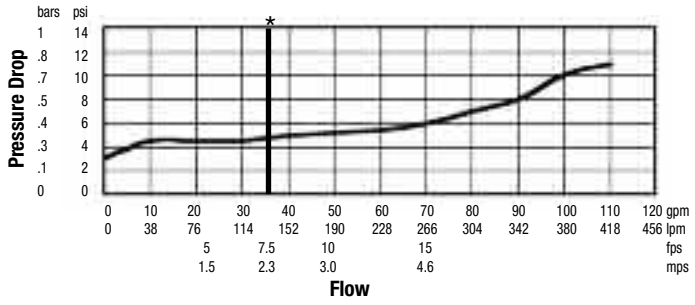
¾" (20mm)



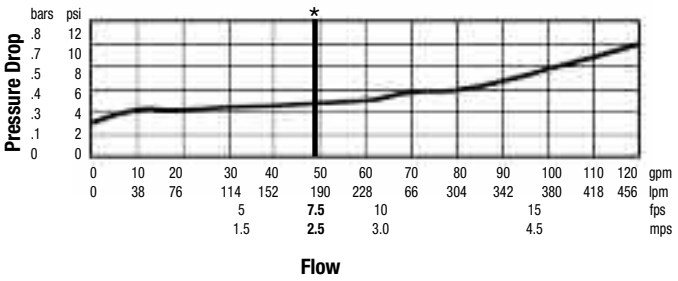
1" (25mm)



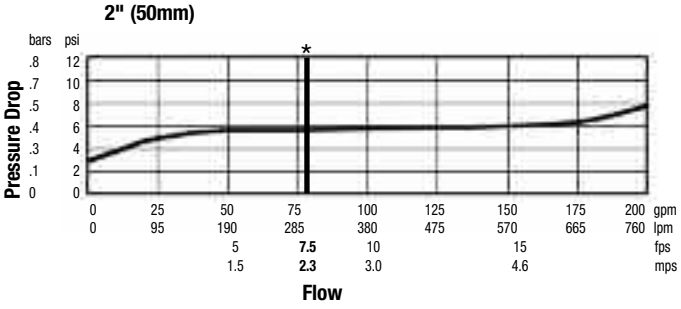
1¼" (32mm)



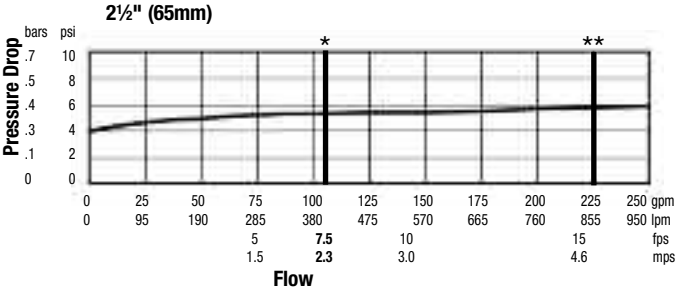
1½" (40mm)



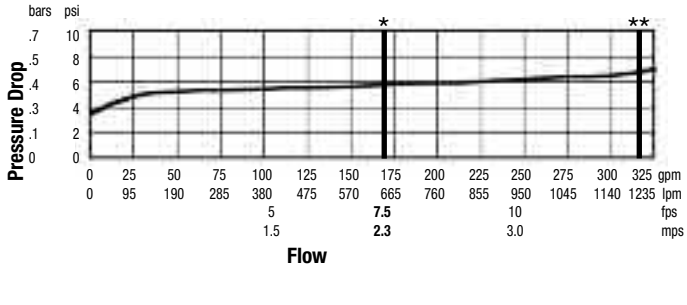
2" (50mm)



2½" (65mm)



3" (80mm)



Econo
Residential Fire Protection Pump System

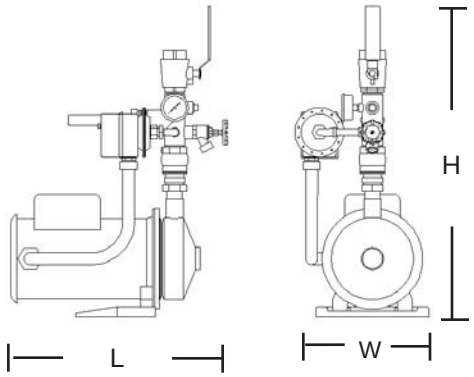
General Air Products, Inc. has expanded its residential pump line with the addition of the Econo RFP System for NFPA 13D applications. The Econo RFP System is designed to provide all 13D required features and functionality at the lowest possible cost without compromising the high level of quality the industry has come to expect from General Air Products.

As with all of the RFP Systems the Econo consists of a stainless steel pump, non-ferrous components and an industrial duty pressure switch. The Econo RFP System differs from the rest of our 13D Pump line in that it doesn't consist of much more than that – this is how we make sure that no matter how tight your budget is, the Econo is the right product for you.

Model Number	AMP Draw*	Weight (lbs.)
XPS11	9.8	49
XPS14	9.8	70
XPS15	9.8	70
XPS18	13.8	77
XPS19	13.8	77

Features:

- Stainless Steel Pump
- Non-Ferrous Piping System
- Heavy Duty Pressure Switch
- Liquid Filled Gauge
- Water Delivery Pressure Gauge
- Locking Ball Valve
- Water Hammer Arrestor
- Drain Valve
- Check Valve



L x W x H
18" x 11" x 23.5"

Standard RFP System Voltage is 230/1/60. For other voltage requirements, consult factory.

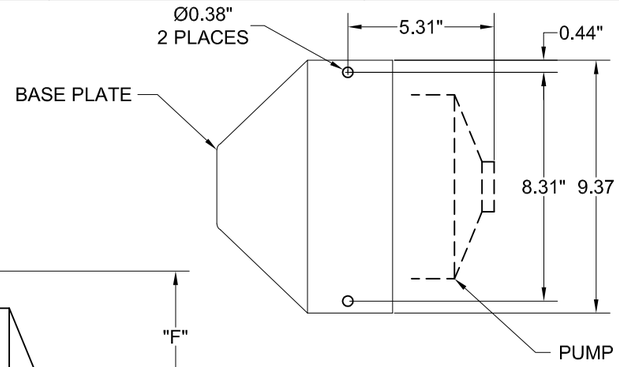
All information subject to change without notice.

Use the chart to select the correct unit for your application.

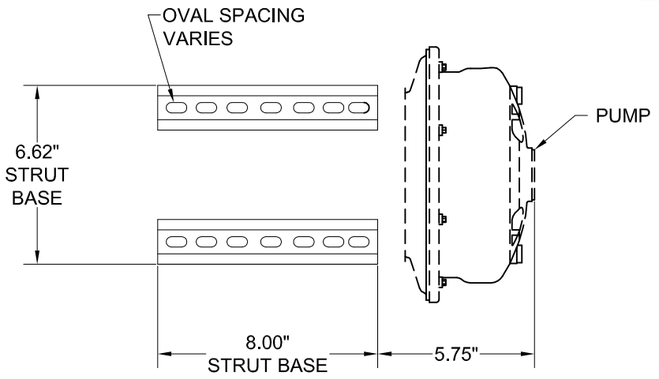
Example: Your system has a flow of 30 gallons per minute (GPM) at 45 PSI the correct selection would be a XPS18. Consult factory for confirmation of best selection.

PSIG	Feet of Head	Flow (GPM)						
		20	25	30	35	40	45	50
25	58	XPS11	XPS11	XPS14	XPS14	XPS15	XPS15	XPS15
30	69	XPS14	XPS14	XPS14	XPS14	XPS15	XPS15	XPS15
35	81	XPS14	XPS14	XPS14	XPS15	XPS15	XPS18	XPS18
40	92	XPS14	XPS14	XPS14	XPS18	XPS18	XPS18	XPS18
45	104	XPS14	XPS14	XPS18	XPS18	XPS18	XPS18	XPS19
50	116	XPS14	XPS18	XPS18	XPS18	XPS18	XPS18	XPS19

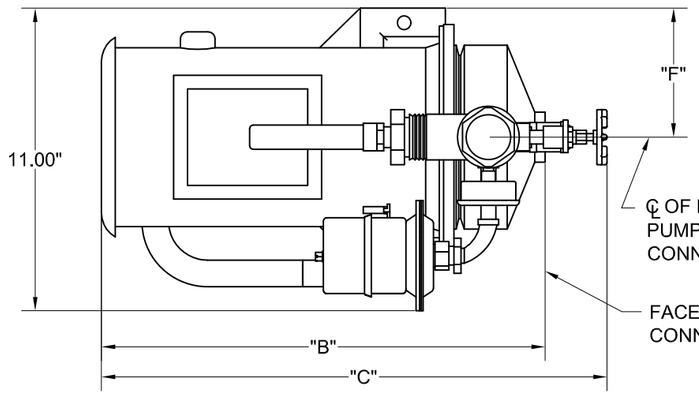
REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

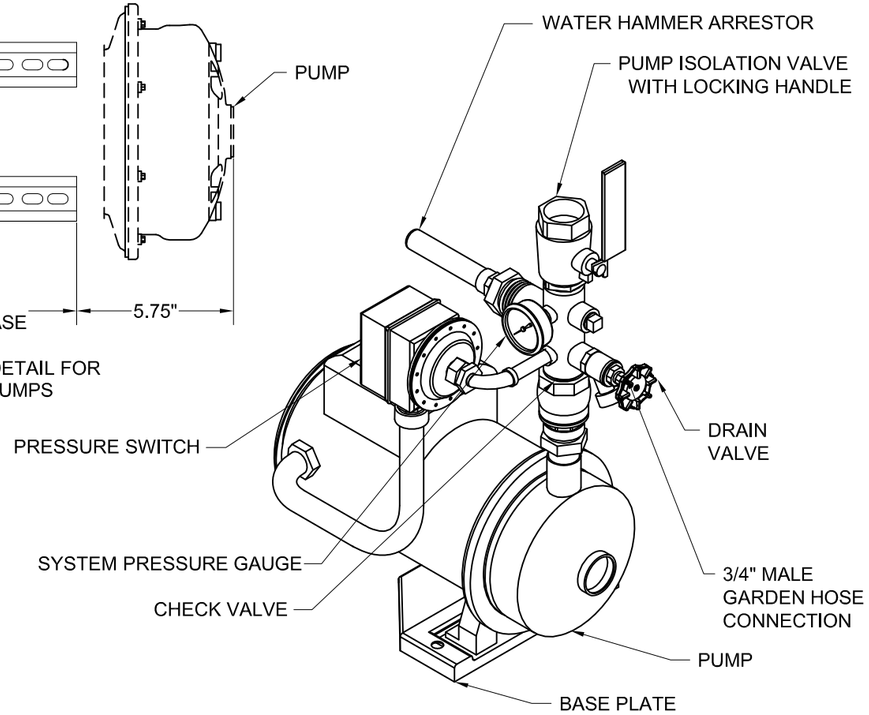


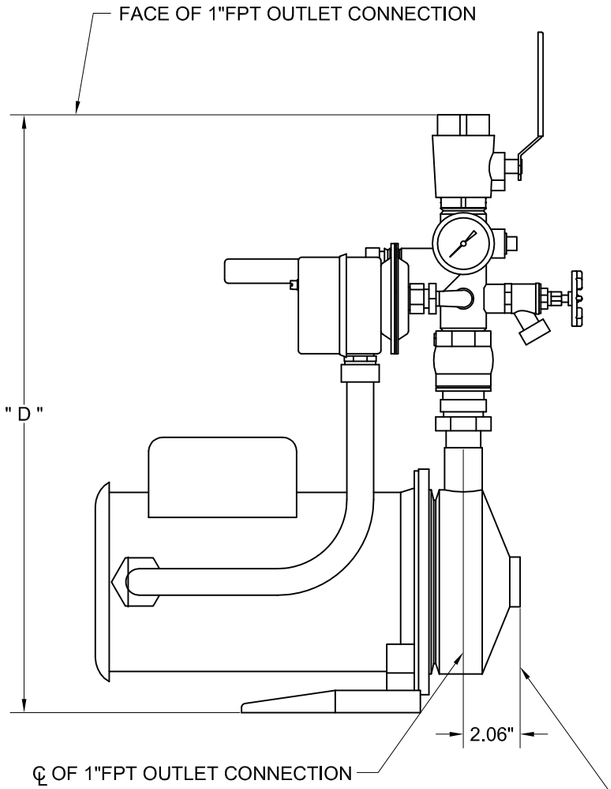
MOUNTING DETAIL FOR
"E" SERIES PUMPS

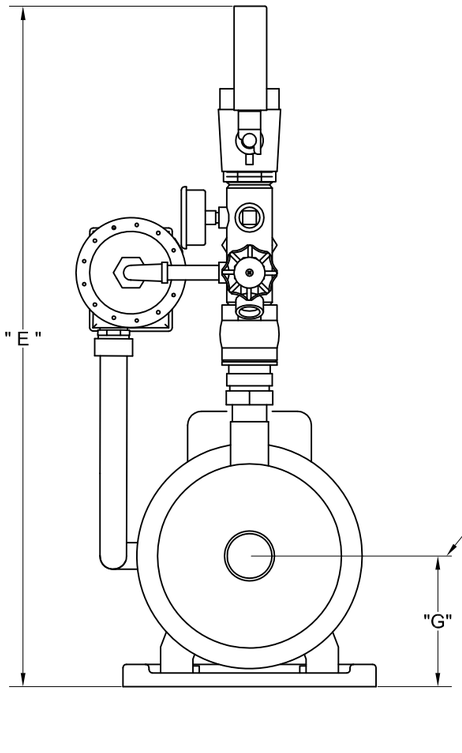


MOUNTING DETAIL FOR
"A" SERIES PUMPS









MODEL	CONN. "A"	DIM "B"	DIM "C"	DIM "D"	DIM "E"	DIM "F"	DIM "G"
XPS11E01	1 1/4"	14 "	16 1/2"	**20 1/2"**	231/2"	4.59"	4 3/4"
XPS11A01							
XPS14E03	1 1/4"	14 3/4"	17"	20 1/2"	231/2"	4.59"	4 3/4"
XPS14A02							
XPS15E04	1 1/4"	14 1/2"	17"	20 1/2"	231/2"	4.59"	4 3/4"
XPS15A02							
XPS18E05	1 1/4"	15 3/4"	18"	17"		4.59"	4 3/4"
XPS18A04	1 1/4"	15 1/2"	17 3/4"	17"		3.25"	5 1/8"
XPS19E06	1 1/2"	15 3/4"	18"	22.00"	25 1/2"	4.59"	4 3/4"
XPS19A06	1 1/4"	15 1/2"	17 3/4"	21"	24"	4.50"	5 1/8"
XPS19A07	1 1/4"	15 1/2"	17 3/4"	18"	1 1/2"	3.25"	5 1/8"

NOTES:

1-REDUCING THE SUCTION CONNECTIONS TO THE PUMP IS NOT RECOMMENDED. REDUCING SUCTION PIPING MAY LOWER PUMP CAPACITY AND COULD RESULT IN CAVATATION. CAVATATION WILL DAMAGE THE PUMP.

2-OVERALL DIMENSIONS ARE FOR REFERENCE ONLY. DIMENSIONS ARE SUBJECT TO CHANGE.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:

FRACTIONS ±1/4 DECIMALS .XX ± .50 ANGLES ±1/2°

GENERAL AIR PRODUCTS

APPROVALS	DATE
DRAWN EJR	02-26-10
CHECKED RM	02-26-10
SCALE	SIZE
SHEET 1 OF 1	D

TITLE
GENERAL ARRANGEMENT
RESIDENTIAL FIRE PROTECTION
MODESL XPS11,14,15,18,19

DWG. NO. G-210066 REV 4

Econo RFP System

Residential Fire Protection Pump System

Installation, Operation and Maintenance Manual

GENERAL AIR PRODUCTS

version 1.0
03-2010

Installation Date: _____

Contractor Name and Person Installing: _____

For Emergency Service Call: _____

Table of Contents

IMPORTANT: ALL INFORMATION SUBJECT TO CHANGE WITHOUT NOTICE.
Consult factory for the most up to date version of this manual - 1-800-345-8207.

- Please take the time to complete the forms on the back of this manual.
- Additional information can be found attached to the back of this manual.

Section 1 - Safety & Warnings

1.1 Safety Guidelines

This manual contains information that is very important to know and understand. This information is provided for SAFETY and to PREVENT EQUIPMENT PROBLEMS. To help recognize this information, observe the following symbols.

Danger indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.

Warning indicates a potentially hazardous situation which, if not avoided COULD result in death or serious injury.

Caution indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury.

Notice indicates important information, that if not followed may cause damage to equipment.

1.2 Unpacking

After unpacking the unit, carefully inspect for any damage that may have occurred during transit, Make sure to tighten fittings, bolts, etc., before putting unit into service.

Do not operate unit if damaged during shipping, handling or use.

1.3 General Safety Information

1. Read all manuals included with this product carefully. Be thoroughly familiar with the controls and the proper use of the equipment
2. Follow all local electrical and safety codes as well as National Electrical Codes (NEC), Occupational Safety and Health Act (OSHA), and National Fire Protection Association (NFPA)
3. Only persons familiar with these rules of safe operation should be allowed to use the equipment.
4. Keep visitors away and NEVER allow children in the work area.
5. Wear safety glasses and use hearing protection when operating the unit.
6. Do not stand on or use the unit as a handhold.
7. Periodic inspection and test of this equipment is required. Consult your installer and local codes to meet all requirements.
8. Check all fasteners at frequent intervals for proper tightness.

1.3 General Safety Information (Continued)

⚠ WARNING

- Motors, Electrical Equipment and Controls can cause electrical arcs that will ignite a flammable gas or vapor.
- Never operate or repair in or near a flammable gas or vapor.
- Never store flammable liquids or gases in the vicinity of the system.

⚠ NOTICE

- For up to date fire protection information please consult the National Fire Protection Association at www.nfpa.org.

⚠ WARNING

On systems with an optinal tank and inlet water piping supplied by General Air Products, use a backup wrench when adjusting the water inlet piping on the tank. There is a float and shutoff valve connected to the inlet piping. Moving the inlet piping without the use of a backup wrench will turn the float and valve out of position. This will cause possible overflow of the tank.

1.4 Optional Narrow Water Tank Safety Information

- Confined spaces must be considered hazardous. DO NOT enter tank at any time.

- Fill tank with water and hold for at least 5 hours PRIOR to use to identify leakage through unsecured fittings, shipping damage or manufacturing defects. The manufacturer's warranty of this tank is void unless upon installation of the tank, the tank is water pre-tested as a final test of suitability. Manufacturer is not responsible for loss of materials. See manufacturer's limited warranty.

- DO NOT use for vacuum or pressure applications. Tank must be properly vented.

- Continuous operating temperatures above 140°F (60°C) are NOT RECOMMENDED. Consult factory for operating temperature above 100°F (38°C).

- Protect tanks from impact (especially sharp blows).

- Installation sites for tanks should be on a reinforced concrete pad. Soil sites for smaller tanks must be solid, stable and compacted. All sites must be level, flat, free of rocks or other objects, and above known flood plains.

- Weight of strainers, valves, hose or pipe must not be carried by the tank outlets.

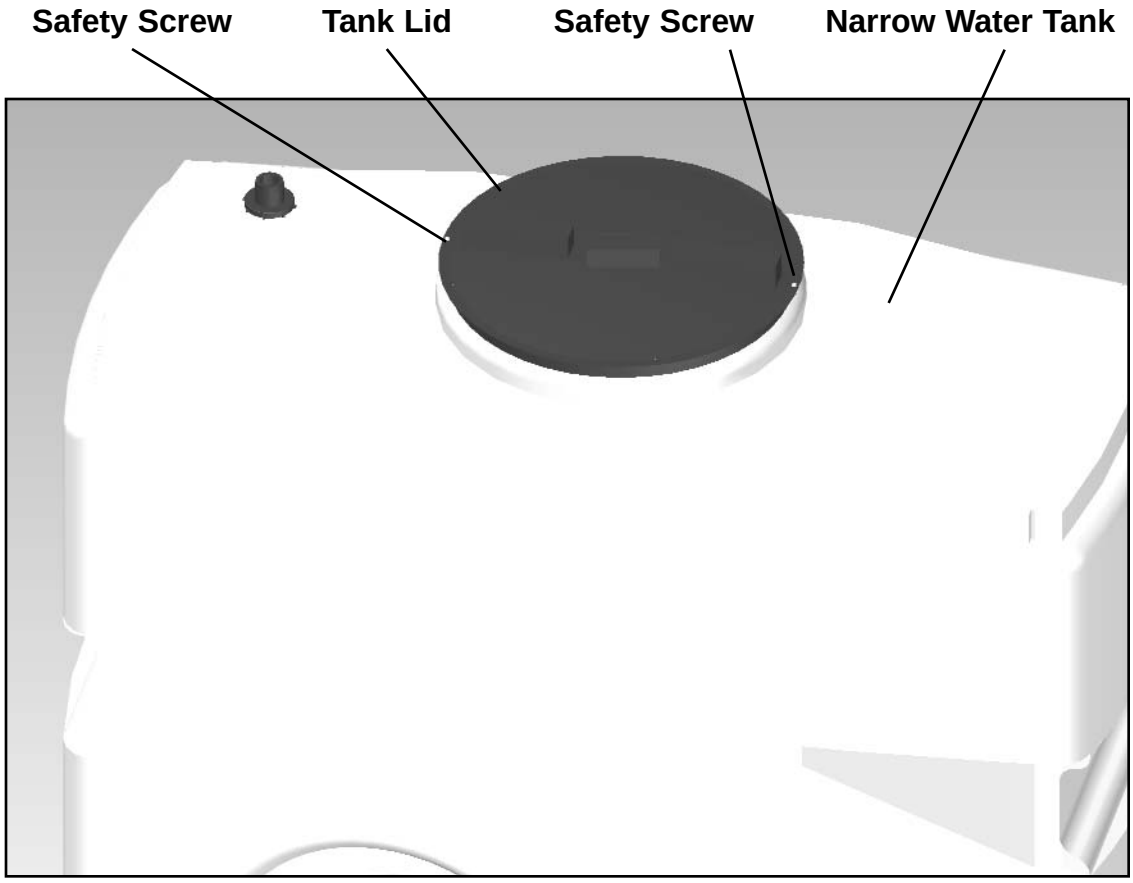
- User is responsible for determining compatibility of chemicals with tank and fitting materials. TESTING IS RECOMMENDED. Tank should not be used for anything other than water.

- Use expansion joints or other flexible connection methods at all tank fittings to prevent damage from differential expansion and contraction of piping and tank. The use of rigid piping or the failure to provide for the expansion of the tank will void all warranties.

- Observe all local, state and federal codes.

- Rinse tanks well before installation.

1.5 Optional Narrow Water Tank Lid Safety Tie Down Instructions



1 - On Complete RFP Systems, remove narrow water tank lid to remove shipping tie down string on float assembly.

2 - On Basic RFP Systems, remove tank lid to install float assembly.

⚠ DANGER

3 - For safety reasons the tank lid is secured with safety screws. **Before installation is complete, re-install safety screws to tank lid, after the lid has been put back onto the tank.**

Section 2 - System Description

This unit is a pump/tank or pump only package specifically designed for installation in residential/light commercial installations.

This system is used on the sprinkler system to supplement, or provide, from the tank, a sufficient volume of water to meet the system design limits (at the time of installation). If Code changes are made, you should consult your installer to ensure revisions are incorporated into your system as the code changes take effect.

The tank holds a given volume of water to be supplied to the sprinklers if they activate. The pump will turn on if the pressure, sensed by the pressure switch, drops to the lower set point (consult QC sheet). As long as the water pressure in the fire sprinkler system is above the lower set point the pump will not turn on.

The flow switch is designed to be tied into the alarm and control system. It incorporates an adjustable retard (time delay) to avoid false alarms. The installing technician should tie the flow switch into the system as required by the AHJ or the system designer during initial installation.

This system was custom designed to meet given flow rates and set to activate at given pressures. Consult the design limit sheet or pump curve to verify the design criteria. If the design limit sheet has not been completed, contact your installer for the information.

Section 3 - Installation Instructions

3.1 Initial Inspection

When the equipment and accessories are received, they should be immediately inspected for shortages and damage. If the equipment has been damaged in shipment or shortages are noticed, immediately notify the carrier and file a claim. If hidden damage to the residential pump system is suspected, it is recommended that the system be filled with water as a leak check prior to rigging and/or final placement.

3.2 Rigging & Moving

The exact method of handling and setting the residential pump system depends on the available equipment, the size of the unit, its final location and other variables. It is the rigger's or mover's responsibility to determine the specific method of safely handling each unit.

UNDER NO CIRCUMSTANCES SHOULD THE PIPING BE USED IN LIFTING OR MOVING THE SYSTEMS.

3.3 Location & Installation

Residential pump systems must be mounted indoors unless specifically ordered for special locations

THE SYSTEM MUST BE INSTALLED LEVEL.

THE SYSTEM MUST BE KEPT ABOVE FREEZING (32º F) AT ALL TIMES.

Section 3 - Installation Instructions

3.4 Piping

NOTICE

All fluid piping practices should be in accordance with local codes. The systems are constructed using non-ferrous piping. Whenever components made from different material are piped in a system, use dielectric isolation of the material to help prevent galvanic corrosion. All threaded pipe connections must be sealed.

Correct sizing of pipe is critical to assure proper operation. **The fire protection contractor is responsible for calculation of the piping system attached to this system.** Once all piping and accessory installation has been completed, the system is ready to leak test. Charge the system with air (15 psig maximum) and check around each connection and joint with water/soap solution (or visual check). If no leaks are found, vent the pressured air and fill the system with water.

Do not use the system pump to fill the fire system with the initial fill of water. Use the domestic water source to prime the system and tank.

3.5 Wiring

WARNING

The electrical installation should be in accordance with the National Electrical Code and any local codes and regulations. Pumps may have inherent thermal overload protection. Check nameplate voltage to be sure it is in agreement with the power supplied. An approved disconnect switch must be installed for this system (provided by others in the field). A ground lug is supplied inside the motor housing. All grounding and bonding must follow local and NEC codes for all equipment and controls.

3.6 Start-Up & Maintenance

WARNING

On start-up, the pump should be checked for proper rotation in accordance with the direction arrow decal located on the motor. Consult factory if rotation is not correct.

The pump must be isolated using the ball valves prior to hydro testing. The motors are direct connected. Motors are permanently lubricated for the life of the motor.

Section 4 - System Testing & Training

NOTICE

Periodic testing of the system is required. For information on the testing schedule, consult your installation company.

For Testing Requirements and Training Information, consult your installation company.

WARNING

The test connection between the pump discharge and the top of the (optional) tank is for testing the pump circulation. Never connect the discharge test connection to the pump inlet. This will cause excessive heat and damage to the system.

Section 5 - Start-Up Checklist

5.1 RFP System Start-Up Checklist - Pump Only Units

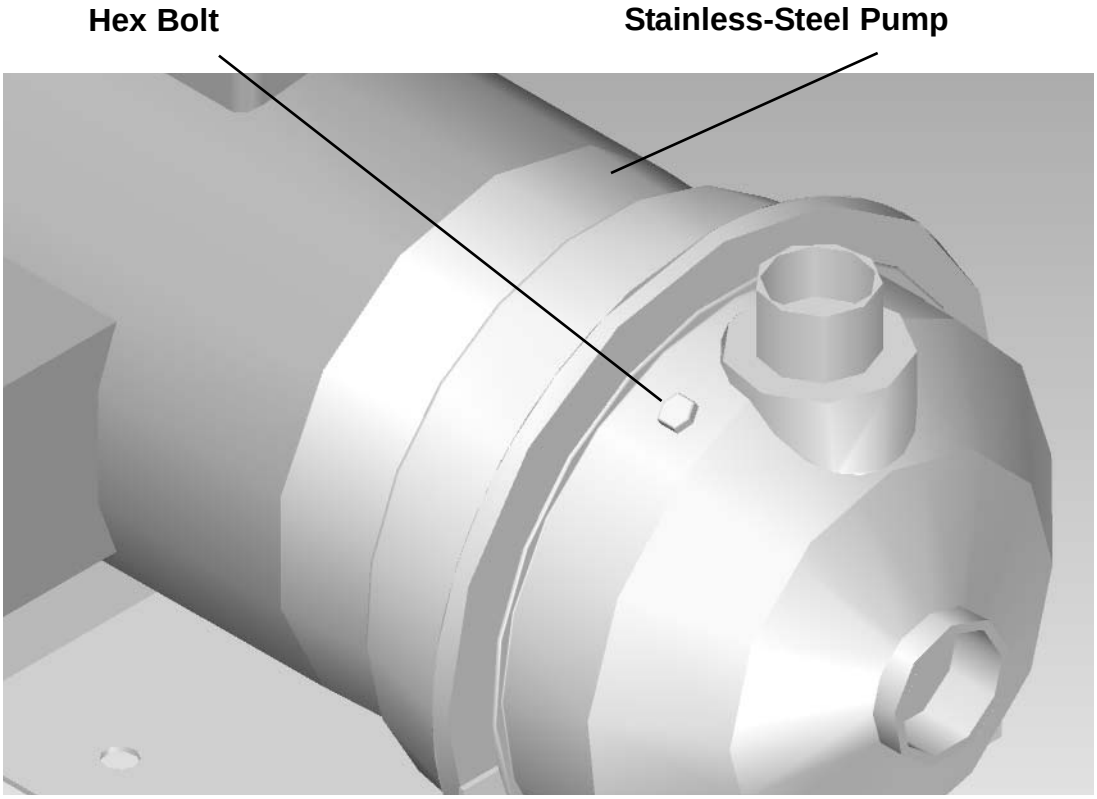
1.) System consists of pump, base and control box (optional).
2.) Check that the motor is securely fastened to the base.
3.) Connect sprinkler piping to customer connection on pump.
4.) Connect pump suction connection to water source
5.) Wire control power to pump assembly.
6.) Ensure correct voltage is applied. See product label for voltage of the system.
7.) Check the motor for proper rotation direction, correct as required.
8.) Test unit in accordance with local procedures.
9.) Verify the setting on the pressure switch is correct.
10.) Secure all valves.
11.) Post warning signs as required by local codes.

5.2 RFP System Start-Up Checklist - Pump & Tank Units

1.) System consists of pump, base, control box (optional) and tank (optional).
2.) Check that the motor is securely fastened to the base.
3.) Connect sprinkler piping to customer connection on pump/tank assembly.
4.) Wire control power to pump/tank assembly.
5.) Ensure correct voltage is applied. See product label for voltage of the system.
6.) Open the pump suction valve and system valve. Close the test/recirculation valve (optional).
7.) Fill the tank with water.
8.) Check the motor for proper rotation direction, correct as required.
9.) Test unit in accordance with local procedures.
10.) Verify the setting on the pressure switch is correct.
11.) Secure all valves.
12.) Post warning signs as required by local codes.

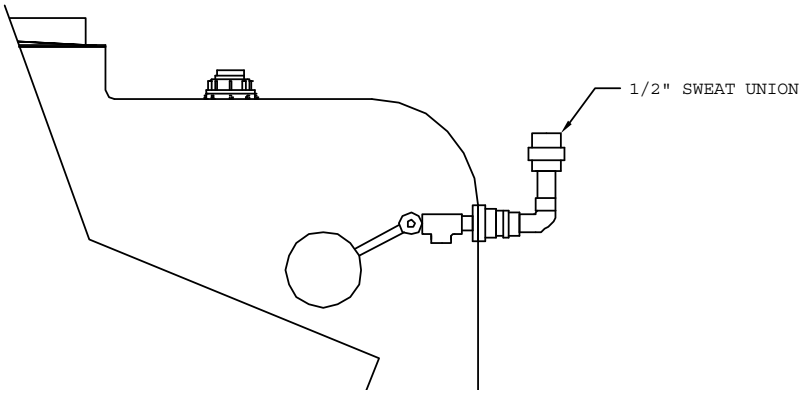
Section 6 - Filling the System

When first filling up the system, ensure that all of the air is bled out of the pump and piping. The pump is supplied with a hex bolt on the housing (see below) that allows the pump casing to be vented. Loosen the hex bolt to allow air to escape. Once the pump casing is filled with water, tighten the hex bolt.



Section 7 - Water Inlet Connection Diagram (for Tank Systems only)

7.1 For Systems Supplied with Optional Float Valve Installed



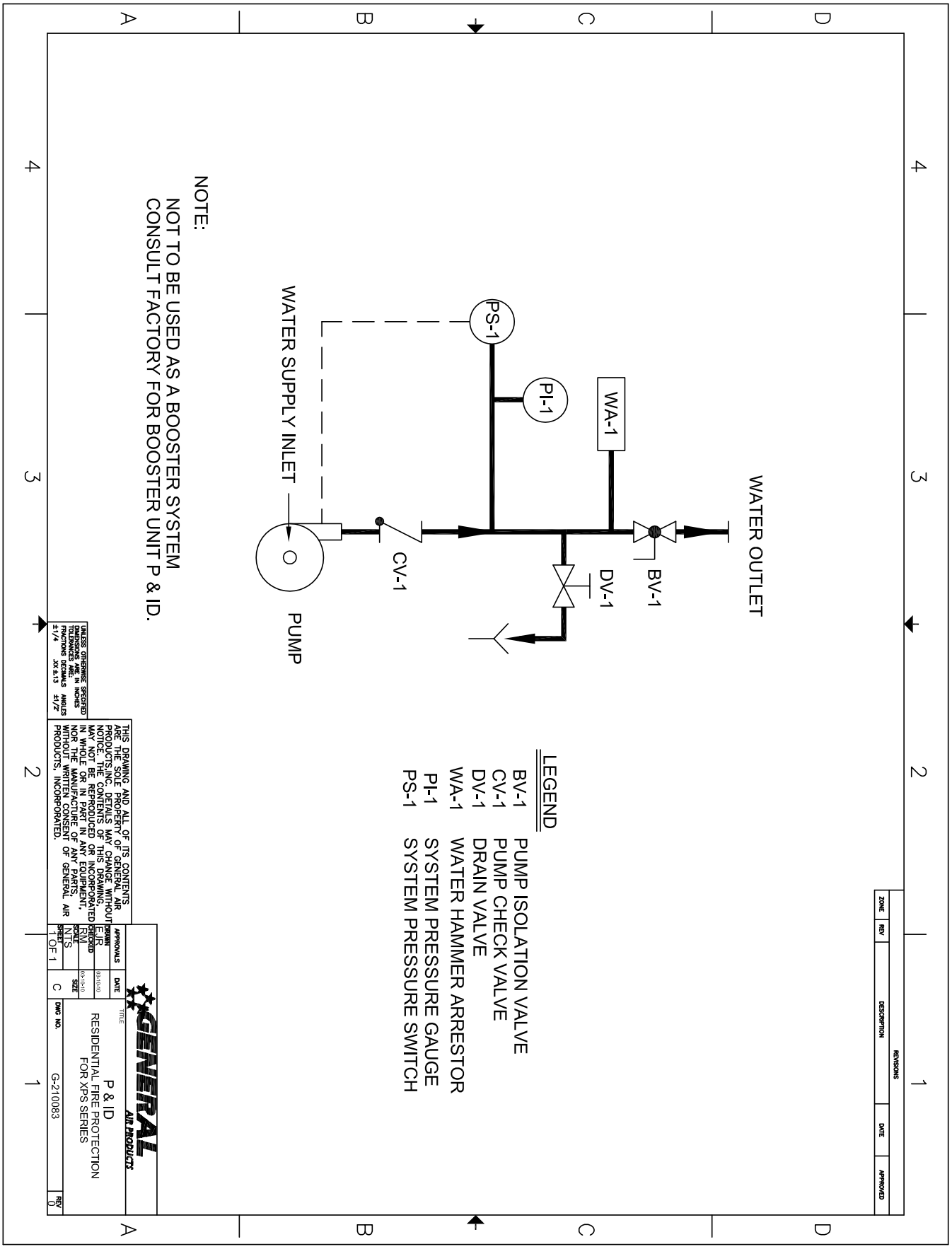
7.2 For Systems Supplied with Optional Float Valve Shipped Loose

Please note that on this system the fill valve and float assembly ship loose.

⚠ WARNING Disconnect union prior to sweating the connection to prevent heat from damaging tank or inlet bulkhead fitting.

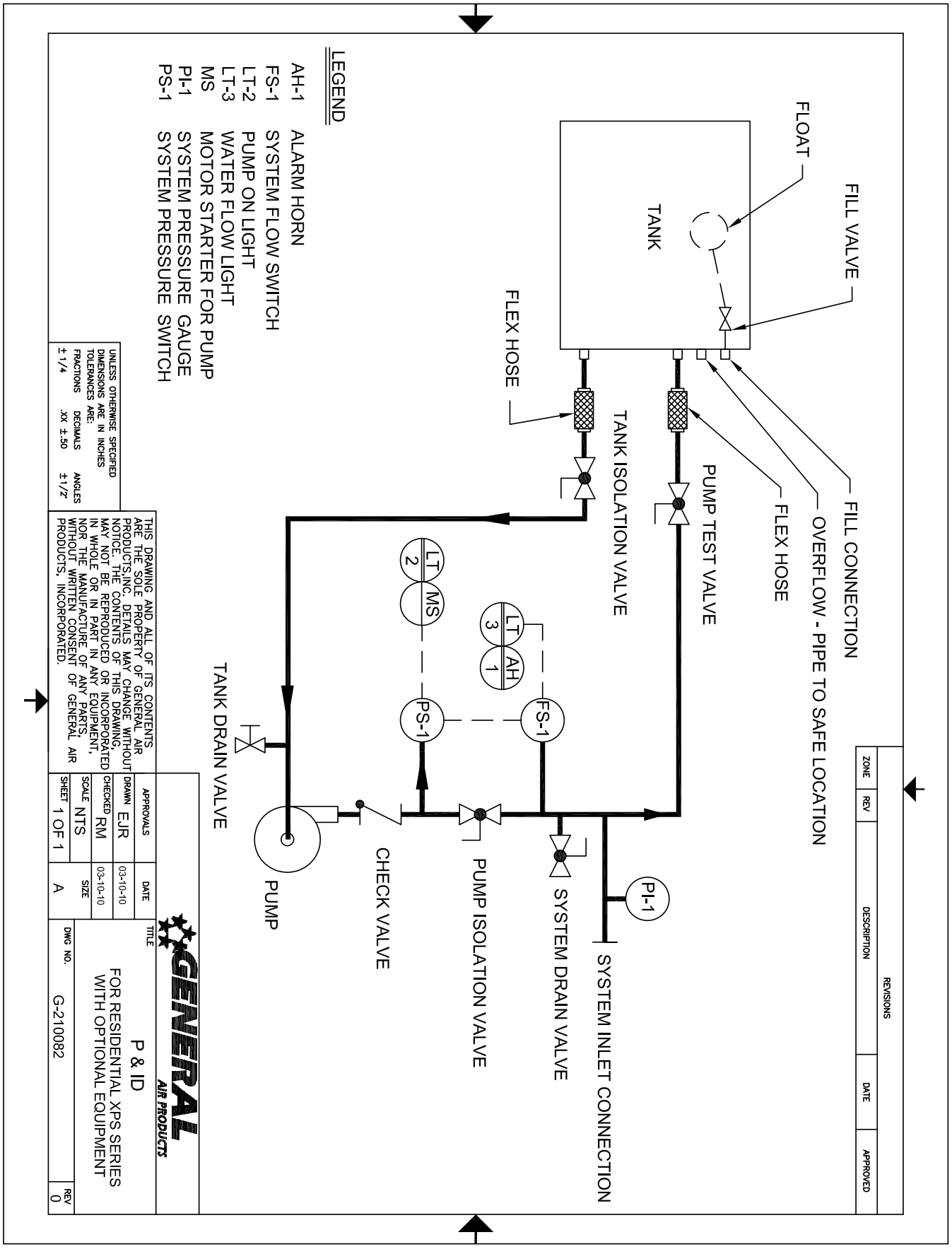
Section 8 - Process & Instrumentation Diagrams (P&ID)

8.1 P&ID for Standard Econo RFP System



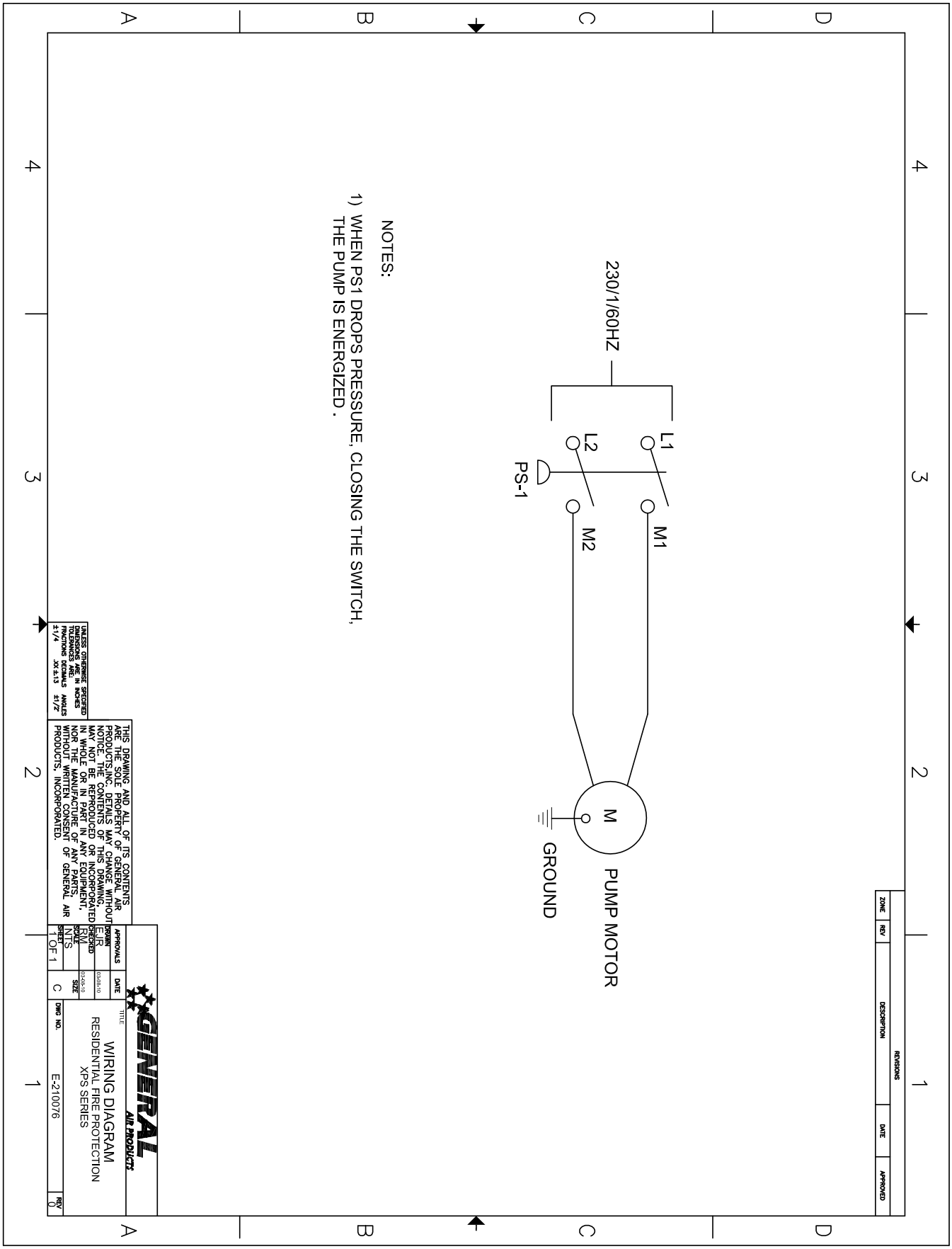
Section 8 - Process & Instrumentation Diagrams (P&ID)

8.2 P&ID for Standard Econo RFP System with Optional Equipment



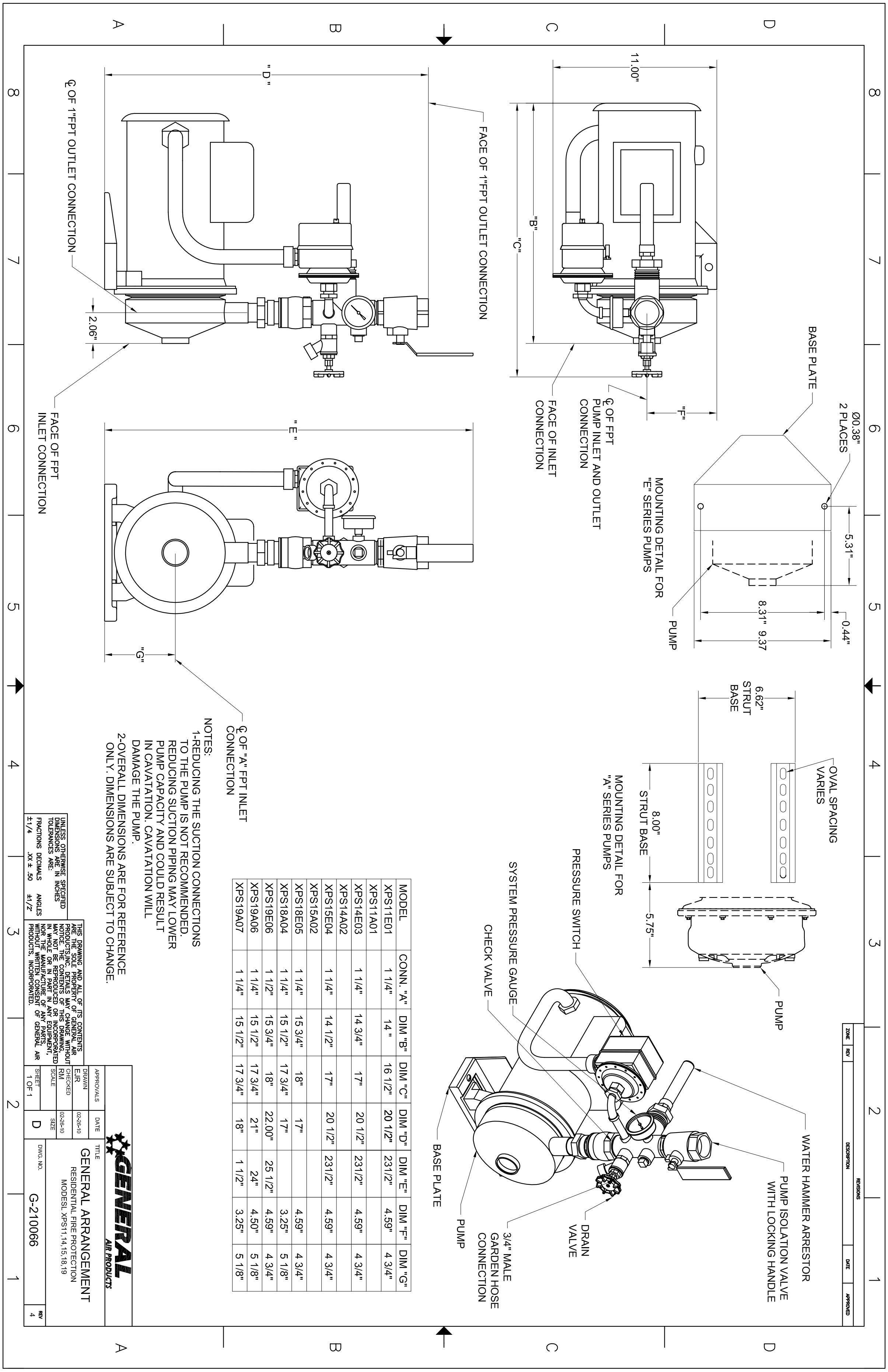
Section 9 - Master Electrical & GA Drawing

9.1 Master Electrical Drawing for Standard Econo RFP System



Section 9 - Master Electrical & GA Drawing

9.2 General Arrangement Drawing for Standard Econo RFP System



MODEL	CONN. "A"	DIM "B"	DIM "C"	DIM "D"	DIM "E"	DIM "F"	DIM "G"
XPS11E01	1 1/4"	14 "	16 1/2"	20 1/2"	231/2"	4.59"	4 3/4"
XPS11A01							
XPS14E03	1 1/4"	14 3/4"	17"	20 1/2"	231/2"	4.59"	4 3/4"
XPS14A02							
XPS15E04	1 1/4"	14 1/2"	17"	20 1/2"	231/2"	4.59"	4 3/4"
XPS15A02							
XPS18E05	1 1/4"	15 3/4"	18"	17"		4.59"	4 3/4"
XPS18A04	1 1/4"	15 1/2"	17 3/4"	17"		3.25"	5 1/8"
XPS19E06	1 1/2"	15 3/4"	18"	22.00"	25 1/2"	4.59"	4 3/4"
XPS19A06	1 1/4"	15 1/2"	17 3/4"	21"	24"	4.50"	5 1/8"
XPS19A07	1 1/4"	15 1/2"	17 3/4"	18"	1 1/2"	3.25"	5 1/8"

Section 10 - Warranty Policy

GENERAL PROVISIONS & LIMITATIONS
General Air Products, Inc. (the "Company") warrants to each original purchaser ("Purchaser") of its new products from the Company or its Authorized Distributor that such products are, at the time of delivery to the Purchaser, made with good materials and workmanship. No warranty is made with respect to:

1. Any product, which has been repaired or altered in such a way, in the Companies judgment, as to affect the product adversely.
2. Any product, which has, in the Companies judgment been subjected to negligence, accident, improper storage, improper installation or application.
3. Any product, which has not been operated or maintained in accordance with the recommendations of the Company.
4. Components or accessories manufactured, warranted and serviced by others.
5. Any reconditioned or prior owned product.

Claims for items described in 4. above should be submitted directly to the manufacturer.

WARRANTY PERIOD
The Company's obligation under this Warranty is limited to repair or, at its option, replacing during normal business hours at the designated facility of the Company, any part that in its judgment proved not to be as warranted within the applicable Warranty Period as follows.

COMPONENTS
All non-consumable components are warranted for 12 months from the date of purchase. Consumables are not covered under warranty. The unit must have been installed by either a factory authorized distributor or agent in accordance with the factory recommendations taking into account all other local site conditions not originally noted to the factory. The unit must be operated and maintained in accordance with the Factory recommendations and original design conditions. Failure to provide such proof of the above may void warranty.

LABOR TRANSPORTATION & INSPECTION
The Company will repair or replace any product or part thereof which in the Companies judgment is proved to be not as warranted. Labor costs are not covered under warranty.

All costs of transportation of product, labor or parts claimed not to be as warranted and, of repaired or replaced parts to or from factory shall be borne by purchaser. The Company may require the return of any part claimed not to be as warranted to one of its facilities as designated by the Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components.

DISCLAIMER
THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED OR STATUORY, INCLUDING ANY IMPLIED WARRANTY OR MERCHANTABILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO THE PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative or employee of the Company which is not contained in this Warranty will be binding upon the company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

PROMPT DISPOSITION
The Company will make a good faith effort for prompt correction or other adjustment with respect to any product, which proves to be defective within the warranty period. Before returning any product, write or call the distributor, agent or authorized company from which the product was purchased, describing defect and giving date and number of original invoice, a well as proof of Factory supplied consumables and proof of scheduled maintenance. Title and risk of loss pass to buyer upon delivery to the common carrier.

PRODUCT SUITABILITY
Many States, Localities and Countries have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While General Air Products, Inc. attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used? Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

REV:5/16/97

General Air Products, Inc.
118 Summit Drive
Exton, PA 19341
P: 610-524-8950
F: 610-524-8965

GENERAL AIR PRODUCTS

RFP System

Design Limits Information

Flow Rate: _____

System Pressure: _____

Pressure Switch Setting: **On** _____ **Off** _____

Service Sheet

Piping Tested By	Date	Inspected By	Date	Assembly Tested By	Date	Inspector	Date

DAIKIN

INSTALLATION MANUAL

Domestic hot water tank for air to water heat pump system

Installation manual
Domestic hot water tank for air to water heat pump system

English

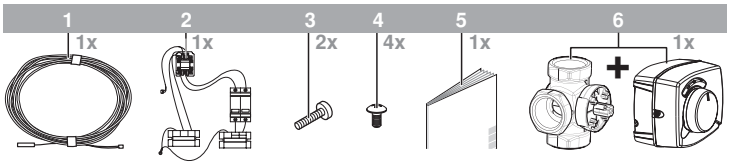
Manuel d'installation
Ballon d'eau chaude domestique pour système de pompe à chaleur air/eau

Français

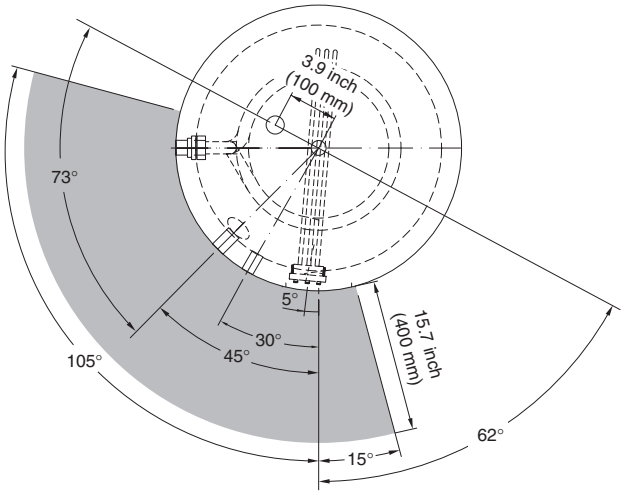
Manual de instalación
Depósito de agua caliente sanitaria para instalaciones con bomba de calor aire-agua

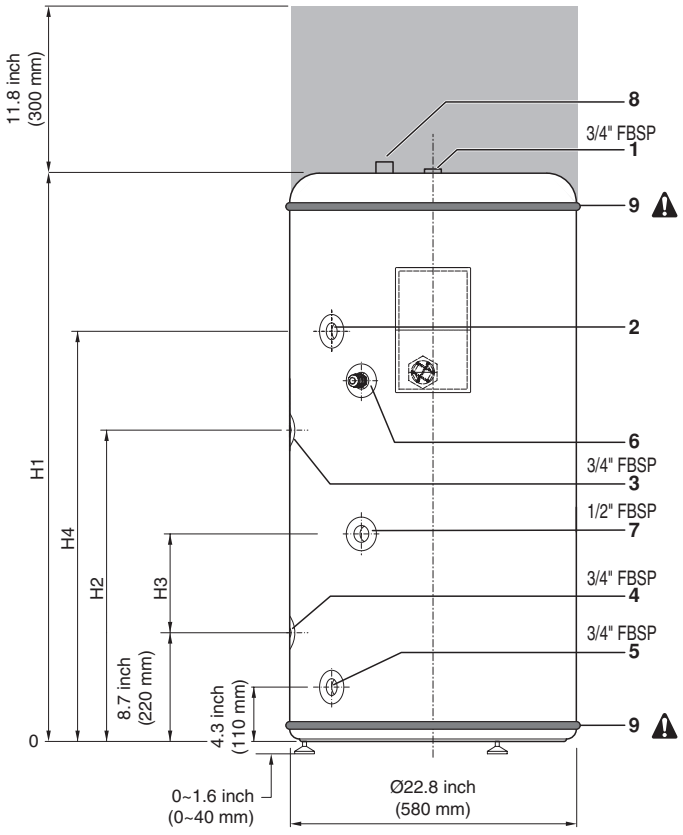
Español

EKHWS050B3VJU
EKHWS080B3VJU


1
1x
2
1x
3
2x
4
4x
5
1x
6
1x

1


3.9 inch
(100 mm)
73°
5°
30°
45°
105°
15.7 inch
(400 mm)
62°
15°


11.8 inch
(300 mm)
8
3/4" FBSP
1
9
2
6
3/4" FBSP
3
1/2" FBSP
7
3/4" FBSP
4
3/4" FBSP
5
9
H1
H4
H2
H3
8.7 inch
(220 mm)
4.3 inch
(110 mm)
0
0~1.6 inch
(0~40 mm)
Ø22.8 inch
(580 mm)

2

CONTENTS

READ THESE INSTRUCTIONS CAREFULLY BEFORE INSTALLATION. KEEP THIS MANUAL IN A HANDY PLACE FOR FUTURE REFERENCE.

IMPROPER INSTALLATION OR ATTACHMENT OF EQUIPMENT OR ACCESSORIES COULD RESULT IN ELECTRIC SHOCK, SHORT-CIRCUIT, LEAKS, FIRE OR OTHER DAMAGE TO THE EQUIPMENT. BE SURE ONLY TO USE ACCESSORIES MADE BY DAIKIN WHICH ARE SPECIFICALLY DESIGNED FOR USE WITH THE EQUIPMENT AND HAVE THEM INSTALLED BY A PROFESSIONAL.

ALL ACTIVITIES DESCRIBED IN THIS MANUAL SHALL BE CARRIED OUT BY A LICENSED TECHNICIAN.

BE SURE TO WEAR ADEQUATE PERSONEL PROTECTION EQUIPMENT (PROTECTION GLOVES, SAFETY GLASSES, ...) WHEN PERFORMING INSTALLATION, MAINTENANCE OR SERVICE TO THE UNIT.

IF UNSURE OF INSTALLATION PROCEDURES OR USE, ALWAYS CONTACT YOUR DAIKIN DEALER FOR ADVICE AND INFORMATION.

THE UNIT DESCRIBED IN THIS MANUAL IS DESIGNED FOR INDOOR INSTALLATION ONLY AND FOR AMBIENT TEMPERATURES RANGING 39°F~95°F (4°C~35°C).

The English text is the original instruction. Other languages are translations of the original instructions.

INTRODUCTION

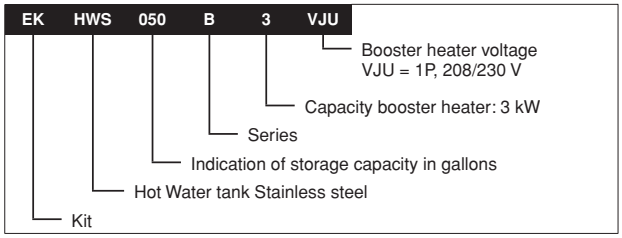
General information

The EKHWS domestic hot water tank with integrated 3 kW electrical booster heater can be connected to the indoor unit. The domestic hot water tank is available in 2 sizes: 50 and 80 gallons (200 and 300 litre). These domestic hot water tanks are floor standing models.

Scope of this manual

This installation manual describes the procedure for unpacking, installing and connecting the EKHWS domestic hot water tank.

Model identification



ACCESSORIES

Accessories supplied with the domestic hot water tank

See figure 1

1	Thermistor + connection wire (39.4 ft) (=12 m)
2	Contactor - circuit breaker assembly
3	Contactor fixing screw
4	Tapping screw
5	Installation manual
6	3-way valve + motor

SAFETY CONSIDERATIONS

The precautions listed here are divided into the following four types. They all cover very important topics, so be sure to follow them carefully.

Meanings of **DANGER**, **WARNING**, **CAUTION** and **NOTE** symbols.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE

Indicates situations that may result in equipment or property-damage accidents only.

Danger

- Before touching electric terminal parts, turn off power switch.
- When service panels are removed, live parts can be easily touched by accident.

  Never leave the unit unattended during installation or servicing when the service panel is removed.
- Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.
- Do not touch any switch with wet fingers. Touching a switch with wet fingers can cause electrical shock.
- Before touching electrical parts, turn off all applicable power supply.

Warning

- Tear apart and throw away plastic packaging bags so that children will not play with them.

  Children playing with plastic bags face danger of death by suffocation.
- Safely dispose of packing materials. Packing materials, such as nails and other metal or wooden parts, may cause stabs or other injuries.
- Be aware that the domestic hot water temperature can/will be higher than the user set point for domestic hot water depending on the selected values of certain field settings (example 2). Refer to the field settings in the installation manual of the indoor unit EKHBH/X or outdoor unit EBLQ, EBHQ, EDLQ, EDHQ.

  If this high domestic hot water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

Caution

- Ground the unit.

  Grounding resistance should be according to local laws and regulations.

  Do not connect the ground wire to gas or water pipes, lightning conductor or telephone ground wire.

  Incomplete grounding may cause electric shocks.

  - Gas pipe.
    Ignition or explosion may occur if the gas leaks.
  - Water pipe.
    Hard vinyl tubes are not effective grounds.
  - Lightning conductor or telephone ground wire.
    Electric potential may rise abnormally if struck by a lightning bolt.
- Install the power wire at least 3.28 ft (1 meter) away from televisions or radios to prevent image interference or noise.

  (Depending on the radio waves, a distance of 3.28 ft (1 meter) may not be sufficient to eliminate the noise.)
- Do not rinse the unit. This may cause electric shocks or fire.
- Do not install the unit in places such as the following:
  - Where there is mist of mineral oil, oil spray or vapour.
    Plastic parts may deteriorate, and cause them to fall out or water to leak.
  - Where corrosive gas, such as sulphurous acid gas, is produced.
    Corrosion of copper pipes or soldered parts may cause the refrigerant to leak.
  - Where there is machinery which emits electromagnetic waves.
    Electromagnetic waves may disturb the control system, and cause malfunction of the equipment.
  - Where flammable gases may leak, where carbon fibre or ignitable dust is suspended in the air or where volatile flammables, such as thinner or gasoline, are handled.
    Such gases may cause a fire.
  - Where the air contains high levels of salt.
  - Where voltage fluctuates a lot, such as that in factories.
  - In vehicles or vessels.
  - Where acidic or alkaline vapour is present.

INSTALLATION OF THE EKHWS DOMESTIC HOT WATER TANK

CAUTION

- The total system (indoor and outdoor unit) is designed for combination with a domestic hot water tank. In case another tank is being used in combination with the unit, Daikin cannot guarantee neither good operation nor reliability of the system. For those reasons Daikin cannot give warranty of the system in such case.
- The equipment is not intended for use in a potentially explosive atmosphere.
- Only this tank can be used in combination with the solar kit option (EKSOLHW*).
- Domestic hot water quality must be according to "Safe Drinking water Act (42 U.S.C. 300f)".
- Do not connect to any heating system or component previously used with a non potable water heating appliance.
- Do not introduce toxic chemicals, such as used for boiler treatment, into the system.
- Fill system only with water (EKHBH, EKHBX, EDLQ, EBLQ) or water with propylene glycol and inhibitor (only for EDLQ, EBLQ), having a toxicity rating or Class of 1, as listed in Clinical Toxicology of Commercial products, 5th edition.
- If glycol is used, limit the pressure in the system to 30 psi (2.07 bar) by means of an approved pressure relief valve. Refer to the figure in "Safety devices" on page 4.
- It is not allowed to add ethylene glycol to the water circuit. Adding ethylene glycol might lead to contamination of the domestic water if a leakage would occur in the heat exchanger coil.

- A drain device should be installed on the cold water connection on the domestic hot water tank.
- It is important that the storage capacity of the domestic hot water tank meets normal daily fluctuations in consumption of domestic hot water without any fall of the water outlet temperature during use.

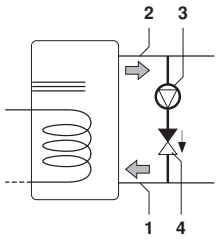
NOTE

Immediately after installation, the domestic hot water tank must be flushed with fresh water. This procedure must be repeated at least once a day the first 5 consecutive days after installation.

CAUTION

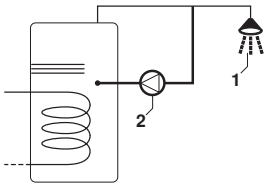
In case of limited consumption of domestic hot water, e.g. at holiday residences or at houses that are occasionally not occupied, the domestic hot water tank installation must be fitted with a shunt pump.

- The shunt pump can be time-controlled,
- the shunt pump must operate to circulate the complete volume of the domestic hot water tank 1.5 times per hour,
- and the shunt pump must operate, or be programmed for operation, during 2 uninterrupted hours per day at least.



1 Cold water connection
2 Hot water connection
3 Shunt pump (field supply)
4 Non-return valve (field supply)

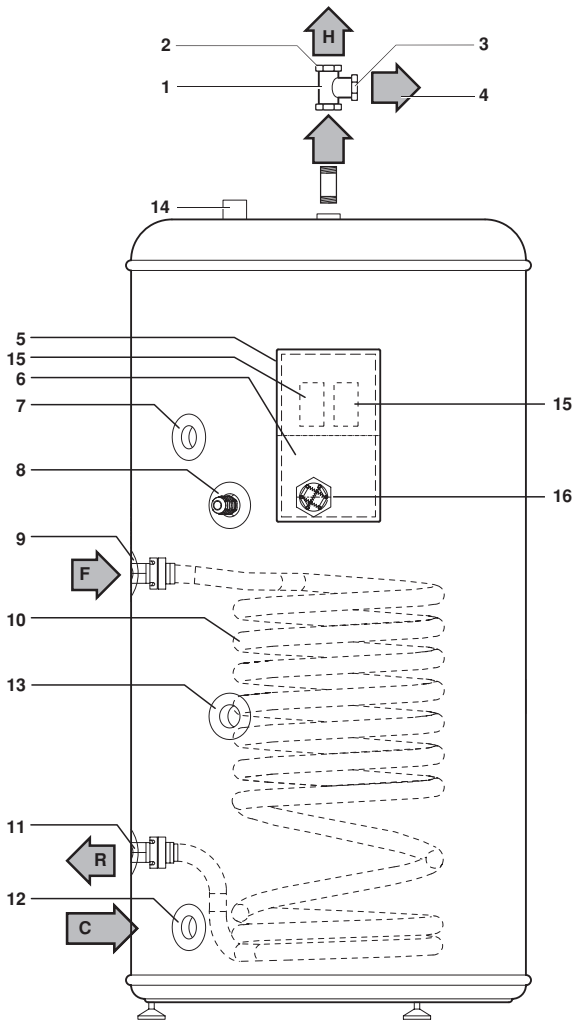
In case of very long field water piping between the domestic hot water tank and the hot water end point (shower, bath, etc.) it can take more time before the hot water from the domestic hot water tank reaches the hot water end point.



1 Shower
2 Recirculation pump

If required connect a recirculation pump in between the hot water end point and the recirculation hole in the domestic hot water tank.

Main components



1	Field supply
2	Hot water connection (H)
3	Pressure relief valve connection
4	Pressure relief valve (field supply)
5	Electrical box
6	Electrical box lid
7	Recirculation hole
8	Thermistor socket
9	Flow inlet connection (F) (from the main unit)
10	Heat exchanger coil
11	Return outlet connection (R) (to the main unit)
12	Cold water connection (C)
13	Threaded thermistor hole for use with the solar kit option. Refer to the installation manual EKSOLHW*.
14	Temperature and pressure relief valve connection
15	Thermal protectors (Q2L, Q3L)
16	Booster heater

Flow direction

NOTE

- T-piece (field supply)(1) is only necessary if a pressure relief valve is required on the hot water side and the temperature and pressure relief valve connection (14) is already used for a temperature and pressure relief valve.
- Temperature and pressure relief valve connection (14) shall be used in case a temperature and pressure relief valve (field supply) is required according to local laws and regulations.

Safety devices

CAUTION

- The domestic hot water tank relief valve connections may not be used for other purpose.
- Do not install heaters without thermal cut-outs.

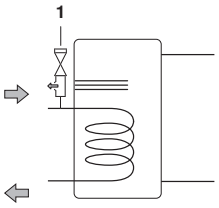
- Thermal protector — The booster heater in the domestic hot water tank is equipped with a thermal protector. The thermal protector is activated when the temperature becomes too high. When activated, the protector has to be reset on the domestic hot water tank by pressing the red button (for access, remove the electrical box lid).

CAUTION

The electrical box lid must only be opened by a licensed electrician.

Switch off the power supply before opening the electrical box lid.

- Pressure relief valve — A pressure relief valve (field supply) in accordance with relevant local laws and regulations, and with an opening pressure of maximum 145 psi (10 bar) must be connected to the pressure relief valve connection.
- If a discharge pipe is connected to the pressure relief device it must be installed in a continuously downward direction and in a frost-free environment. It must be left open to the atmosphere.
- If glycol is used, an approved pressure relief valve with an opening pressure of maximum 30 psi (2.07 bar) (field supply) must be installed in the inlet of the tank as shown in the figure below.



1 Pressure relief valve

Outlook diagram

Outlook diagram, see figure 2.

1 Hot water and pressure relief valve connection
2 Recirculation hole
3 Flow inlet connection (from the main unit)
4 Return outlet connection (to the main unit)
5 Cold water connection
6 Thermistor socket
7 Threaded thermistor hole for use with solar kit option. See Installation manual EKSOLHW*.
8 Temperature and pressure relief valve connection
9 Remove the protection tape from the domestic hot water tank

Domestic hot water tank model		H1	H2	H3	H4
EKHWS050B3VJU	(inch)	45.3	24.8	7.9	32.7
	(mm)	1150	630	200	830
EKHWS080B3VJU	(inch)	63.0	24.8	7.9	32.7
	(mm)	1600	630	200	830

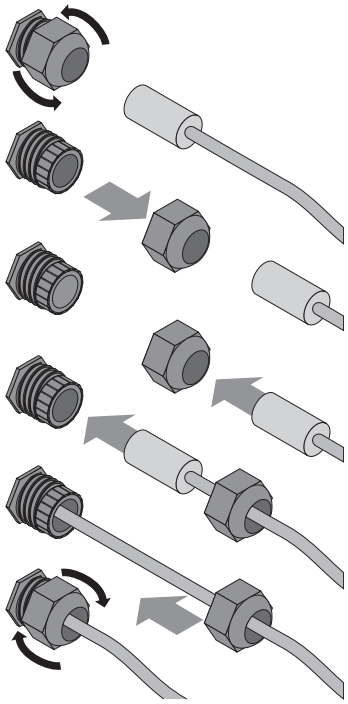
Installation guidelines

Keep in mind the following guidelines when installing the domestic hot water tank:

- The installation location is frost-free.
- Make sure to make the piping in size 1" or more (and reduce to 3/4" at the inlet of the tank) as to have sufficient water volume in the piping between unit and domestic hot water tank.
- Locate the domestic hot water tank in a suitable position to facilitate ease of maintenance; remember access is required to the electrical box. Refer to the grey-coloured zones indicated in figure 2.
- Provide a connection for the pressure relief valve blow-off and drain.
- To avoid back siphonage it is advised to install a non-return valve on the water inlet of the domestic hot water tank in accordance with local laws and regulations.
- Take care that in the event of a leak, water can not cause any damage to the installation space and surroundings.

Installing the domestic hot water tank

1 Check if all domestic hot water tank accessories (see "Accessories" on page 1) are enclosed.
2 Place the domestic hot water tank on a level surface.
3 Remove the protection tape from the domestic hot water tank (See (8) in figure 2).
4 Apply thermal paste to the thermistor and insert the thermistor as deep as possible in the thermistor socket. Fix using the nut provided.

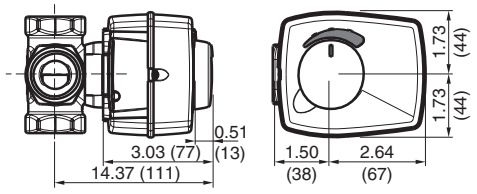


Connecting the water circuits

Refer to the chapter "Typical application examples" described in the installation manual delivered with the indoor unit for details on connecting the water circuits and the motorised 3-way valve.

Connecting the 3-way valve

1 Refer to the figure below before making the connection. Values between brackets are the conversion from inch to mm.



2 Installation position.

It is advised to connect the 3-way valve as close as possible to the unit. It can be installed in accordance with one of the following four configurations.

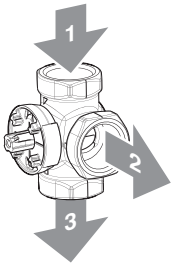


figure A

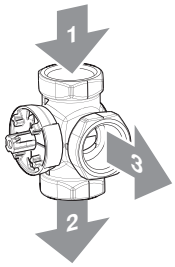


figure B

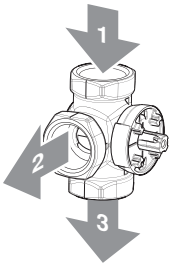


figure C

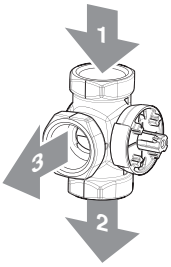


figure D

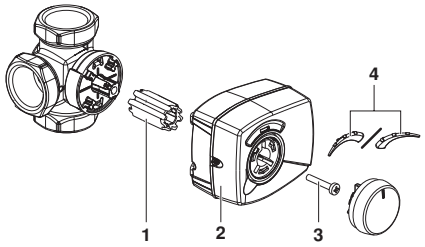
1 From indoor unit

2 To domestic hot water tank

3 To room heating

3 Unpack the 3-way valve body and 3-way valve motor.

Verify that following accessories are provided with the motor.



1 Sleeve

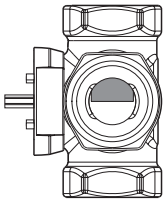
2 Valve motor cover

3 Screw

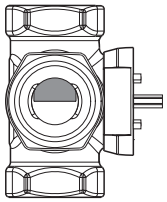
4 Scale

4 Install the 3-way valve body in the pipework.

- Make sure the shaft will be positioned in such a way that the motor can be mounted and replaced.
- Put the sleeve on the valve and turn the valve to the middle position of the scale plate.
  Check that the valve is positioned as in the figure below. It shall be blocking the outlet connection to the domestic hot water for 50% and the outlet connection to the room heating also for 50%.



Installation in accordance with figure A and figure B



Installation in accordance with figure C and figure D

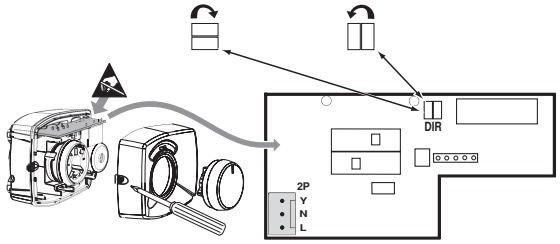
NOTE If the valve is not positioned in this way before mounting the motor, the valve will give way to both domestic water and room heating during operation.

5 When installing in accordance with figure A or figure D, open the valve motor cover by loosening the screw and change the jumper so as to change the rotation direction of the valve.

By default the jumper is factory set to apply for installation in accordance with figure B and figure C.

Installation in accordance with figure A and figure D

Installation in accordance with figure B and figure C



Rotation direction of the valve

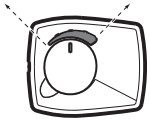
6 Push the motor on the motor sleeve.

Make sure not to rotate the sleeve during this action, so as to maintain the valve position as set during step 4.

7

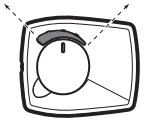
8 Put the scale on the valve as shown below.

Domestic hot water tank — Room heating



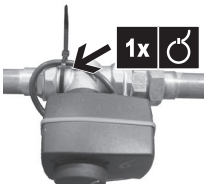
Installation in accordance with figure B and figure C

Room heating — Domestic hot water tank

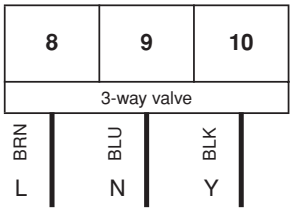


Installation in accordance with figure A and figure D

9 Make sure to firmly fix the power supply cord onto the 3-way valve body with a field supplied cable tie like in illustration below.



10 Perform the wiring in the unit in accordance with the following figure:



Refer also to the drawing on page 8.

11 Connect the water inlet and water outlet.

12 Connect the hot and cold water supply tubes.

13 Connect the pressure relief valve (field supply, opening pressure maximum 145 psi (10 bar)) and drain.

CAUTION

If a discharge pipe is connected to the pressure relief device it must be installed in a continuously downward direction and in a frost-free environment. It must be left open to the atmosphere.

Field wiring

CAUTION

- A main switch or other means for disconnection, having a contact separation in all poles, must be incorporated in the fixed wiring in accordance with relevant local laws and regulations.
- All field wiring and components must be installed by a licensed electrician and must comply with relevant local laws and regulations.
- The field wiring must be carried out in accordance with the wiring diagram supplied with the unit and the instructions given below.
- The domestic hot water tank must be grounded via the indoor unit.
- Be sure to use a dedicated power supply. Never use a power supply shared by another appliance.
- Make sure all field wiring is insulated from the tank body and heater element or can resist temperatures to 194°F (90°C).
- Select the power cable in accordance with relevant local laws and regulations.
- Be sure to install the required fuse or circuit breaker.

For cable requirements and specifications, refer to "Field wiring" in the indoor unit installation manual supplied with the EKHBX unit.

Thermistor cable

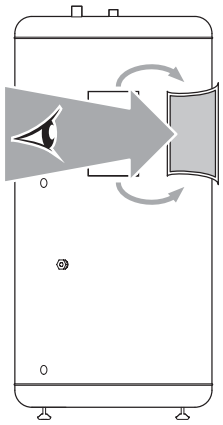
The distance between the thermistor cable and power supply cable must always be at least 2 inch (5 cm) to prevent electromagnetic interference on the thermistor cable.

DANGER

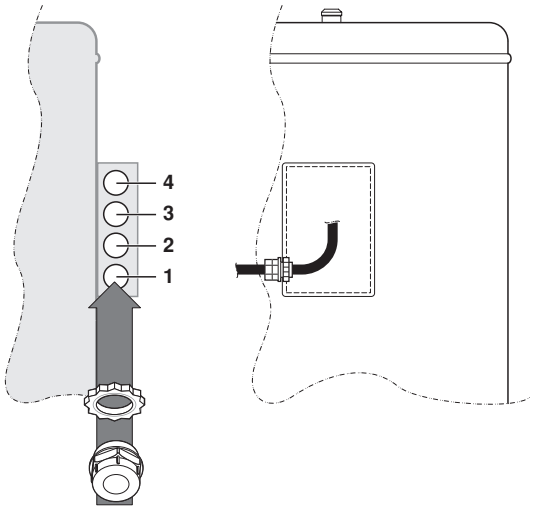
Switch off all relevant power supply (outdoor unit, backup heater, booster heater) before changing the connector.

Connections to be made in the domestic hot water tank electrical box

1 Refer to the wiring diagram sticker in the domestic hot water tank switch box.



2 Make sure to ensure strain relief of the cable by correct use of the PG nipple and PG nut (mounted on the domestic hot water tank).



Cable entry:

1	Power supply booster heater (X6M)
2	Power supply to EKSOLHW* pump (X8M, grounding, 1-2)
3	Power supply from EKHBH/X or EBLQ, EBHQ, EDLQ, EDHQ for EKSOLHW* (X8M, grounding, 1-2)
4	Thermal protector (Q3L, 3-4)

The power supply cable towards the booster heater X4M→X6M and the cable towards the thermal protector X2M (13-14)→Q3L (4-3) are separated. However, if allowed according to local laws and regulations, these 2 cables can be combined in 1 cable (5 wires).

Connections to be made in the indoor unit switch box

3 Mount the prewired contactor (K3M), circuit breaker (F2B) and terminal blocks (X3M, X4M). The contactor must be fixed with the 2 supplied contactor screws and the terminal blocks must be fixed with the 2x 2 supplied tapping screws.

4 Plug the connector connected to the contactor K3M in the socket X13A on the PCB.

5 Plug the thermistor cable connector in the socket X9A on the PCB.

6 Connect the prewired ground wires of the terminal block X3M and X4M to the grounding screw.

7 Connect the booster heater power supply and thermal protection cable (field supply) to terminal X4M ground, 1, 2, and X2M 13, 14.

8 Connect the booster heater power supply cable to the terminal block X3M.

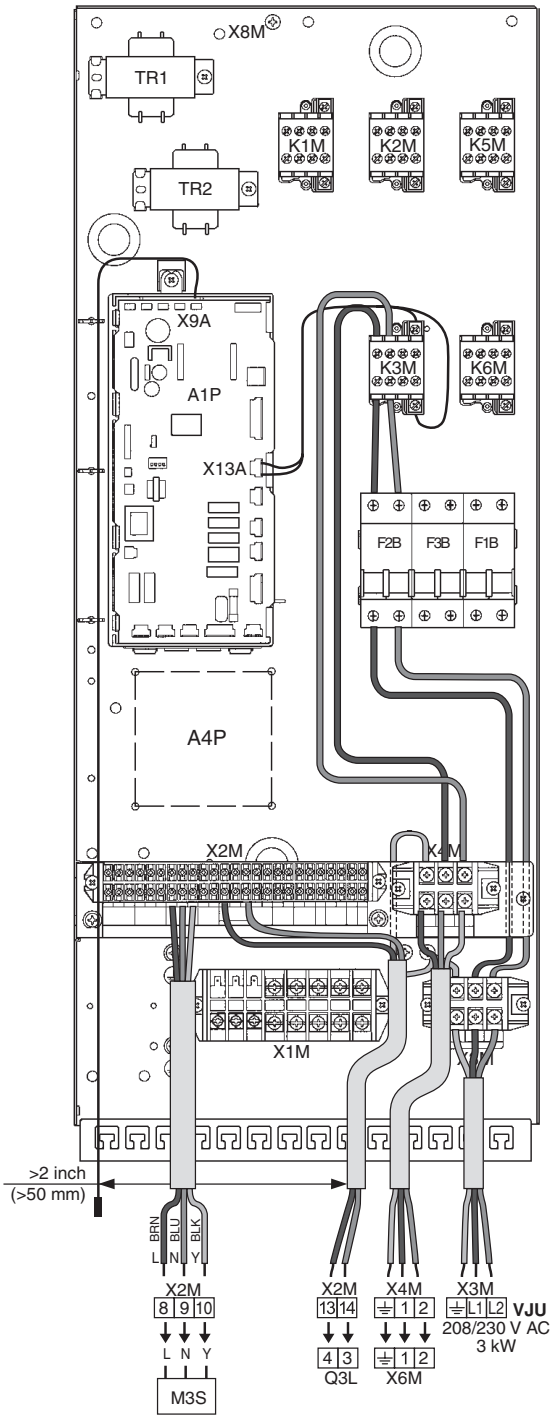
9 Fix the cables to the cable tie mountings with cable ties to ensure strain relief.

10 Set DIP switch SS2-2 on the PCB to ON.

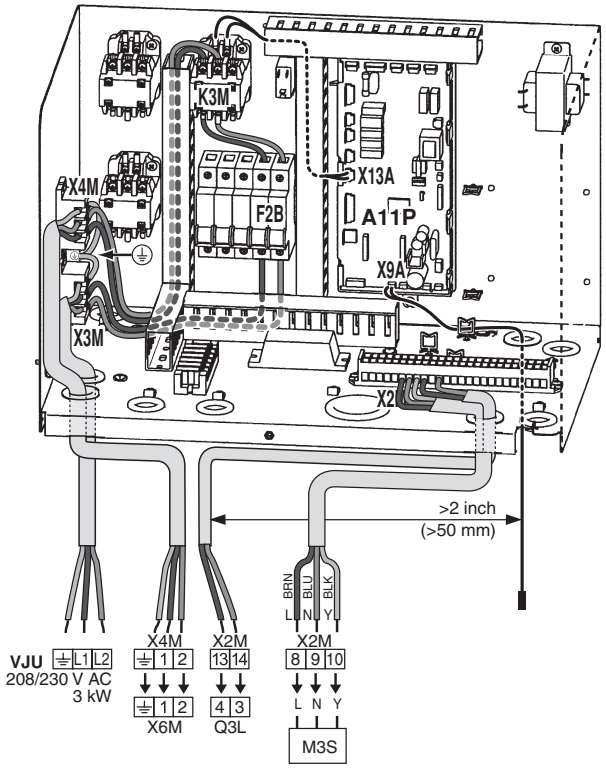
11 When routing out cables, make sure that these do not obstruct mounting of the indoor unit cover.

Note: only relevant field wiring and not all implemented parts are shown.

■ For EXHBH/X units only



■ For EDH, EBH, EDL, EBL units only



The power supply cable towards the booster heater X4M→X6M and the cable towards the thermal protector X2M (13-14)→Q3L (4-3) are separated. However, if allowed according to local laws and regulations, these 2 cables can be combined in 1 cable (5 wires).

MAINTENANCE

In order to ensure optimal availability of the unit, a number of checks and inspections on the unit and the field wiring have to be carried out at regular intervals.

CAUTION

- Before carrying out any maintenance or repair activity, always switch off the circuit breaker on the supply panel, remove the fuses or open the circuit breaker, protection devices of the unit.
- Make sure that before starting any maintenance or repair activity, also the power supply to the outdoor unit is switched off.

The described checks must be executed at least **once a year**.

1 Domestic hot water tank pressure relief valve (field supply) and/or temperature and pressure relief valve (field supply)

Check for correct operation of the pressure relief valve and/or temperature and pressure relief valve on the domestic hot water tank.

2 Domestic hot water tank booster heater

It is advisable to remove lime buildup on the booster heater to extend its life span, especially in regions with hard water. To do so, drain the domestic hot water tank, remove the booster heater from the domestic hot water tank and immerse in a bucket (or similar) with lime-removing product for 24 hours.

TROUBLESHOOTING

This section provides useful information for diagnosing and correcting certain troubles which may occur in the unit.

This troubleshooting and related corrective actions may only be carried out by your local Daikin technician.

General guidelines

Before starting the troubleshooting procedure, carry out a thorough visual inspection of the unit and look for obvious defects such as loose connections or defective wiring.

When carrying out an inspection on the supply panel or on the switch box of the unit, always make sure that the circuit breaker of the unit is switched off.

When a safety device was activated, stop the unit and find out why the safety device was activated before resetting it. Under no circumstances safety devices may be bridged or changed to a value other than the factory setting. If the cause of the problem cannot be found, call your local dealer

General symptoms

Symptom 1: No water flow from hot taps

POSSIBLE CAUSES	CORRECTIVE ACTION
The main water supply is off.	Check that all shut off valves of the water circuit are completely open.

Symptom 2: Water from hot taps is cold

POSSIBLE CAUSES	CORRECTIVE ACTION
The thermal cut-out(s) has/have operated.	• Check and reset button(s). • Check if thermistor is correctly installed in thermistor socket.
The indoor unit (EKHBX) is not operating.	Check the indoor unit (EKHBX) operation. Refer to the manual delivered with the indoor unit. If any faults are suspected, contact your local dealer.

Symptom 3: Intermittent water discharge

POSSIBLE CAUSES	CORRECTIVE ACTION
Thermal control failure (water will be hot).	Switch off power to the indoor unit. When discharge has stopped, check the thermal controls and replace if faulty. Contact your local dealer.
The expansion vessel is broken.	Replace the expansion vessel.

TECHNICAL SPECIFICATIONS

Domestic hot water tank specifications

		EKHWS050	EKHWS080
Volume	**(gal.)**	50	80
	(l)	200	300
Internal heat exchanger volume	**(gal.)**	0.8	
	(l)	3	
Overall dimensions (Ø x H)	**(inch)**	22.8 x 45.3	22.8 x 63.0
	(mm)	580 x 1150	580 x 1600
Booster heater, power supply		208/230 V 2~ 60 Hz	
Minimum circuit amps (MCA)		14.3 A	
Maximum overcurrent protect (MOP)		20 A	
Booster heater, capacity		3 kW	
Connections		3/4" FBSP[(a)]	
Weight (empty)	**(lbs)**	99.2	130.1
	(kg)	45	59
Mounting		Floor	

(a) FBSP = Female British Standard Pipe

DAIKIN

INSTALLATION MANUAL

Indoor unit for air to water heat pump system

Installation manual
Indoor unit for air to water heat pump system

English

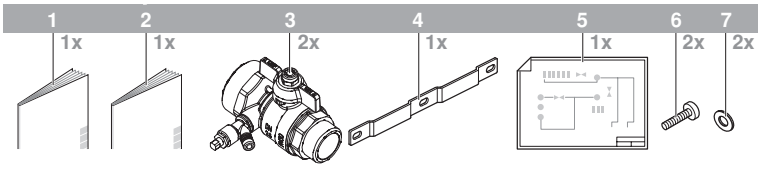
Manuel d'installation
Unité intérieure pour système de pompe à chaleur air-eau

Français

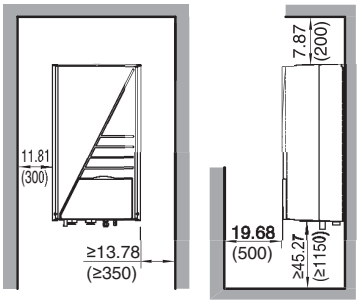
Manual de instalación
Unidad interior para bomba de calor de aire-agua

Español

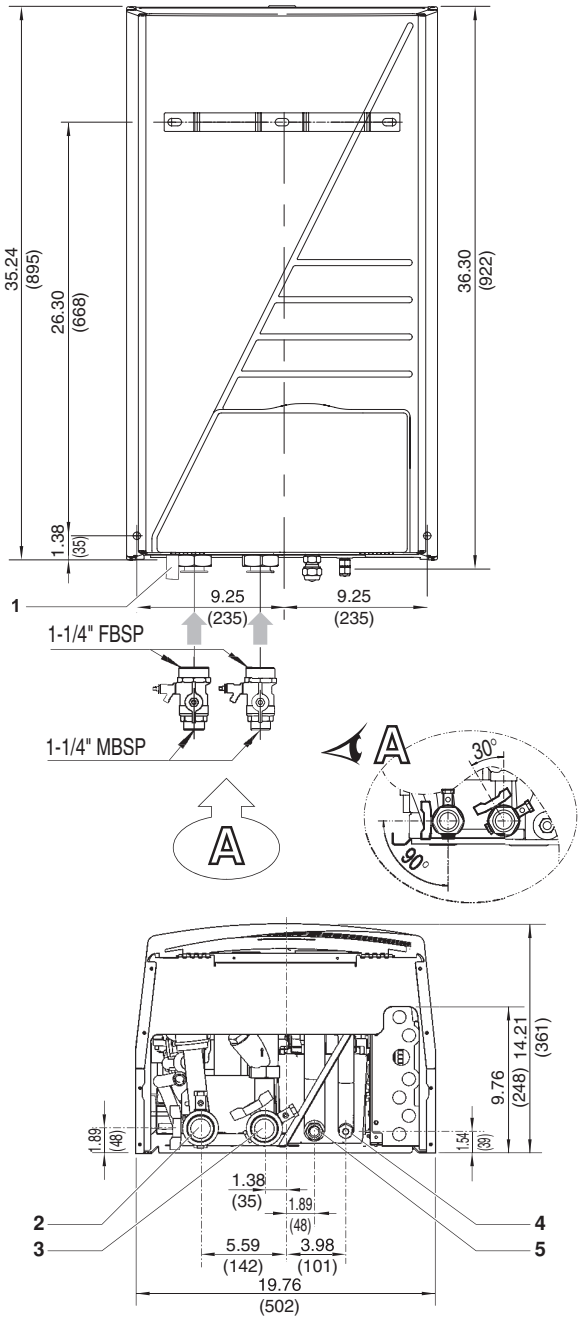
EKHBH054BA
EKHBX054BA


1
1x
2
1x
3
2x
4
1x
5
1x
6
2x
7
2x

1


11.81
(300)
≥13.78
(≥350)
7.87
(200)
19.68
(500)
≥45.27
(≥1150)

2


35.24
(895)
26.30
(668)
1.38
(35)
36.30
(922)
1
9.25
(235)
9.25
(235)
1-1/4" FBSP
1-1/4" MBSP
A
A
30°
90°
9.76
(248)
14.21
(361)
1.89
(48)
1.54
(39)
1.38
(35)
1.89
(48)
2
3
4
5
5.59
(142)
3.98
(101)
19.76
(502)

3

CONTENTS

READ THESE INSTRUCTIONS CAREFULLY BEFORE INSTALLATION. KEEP THIS MANUAL IN A HANDY PLACE FOR FUTURE REFERENCE.

IMPROPER INSTALLATION OR ATTACHMENT OF EQUIPMENT OR ACCESSORIES COULD RESULT IN ELECTRIC SHOCK, SHORT-CIRCUIT, LEAKS, FIRE OR OTHER DAMAGE TO THE EQUIPMENT. BE SURE ONLY TO USE ACCESSORIES MADE BY DAIKIN WHICH ARE SPECIFICALLY DESIGNED FOR USE WITH THE EQUIPMENT AND HAVE THEM INSTALLED BY A PROFESSIONAL.

ALL ACTIVITIES DESCRIBED IN THIS MANUAL SHALL BE CARRIED OUT BY A LICENSED TECHNICIAN.

BE SURE TO WEAR ADEQUATE PERSONEL PROTECTION EQUIPMENT (PROTECTION GLOVES, SAFETY GLASSES, ...) WHEN PERFORMING INSTALLATION, MAINTENANCE OR SERVICE TO THE UNIT.

IF UNSURE OF INSTALLATION PROCEDURES OR USE, ALWAYS CONTACT YOUR DAIKIN DEALER FOR ADVICE AND INFORMATION.

THE UNIT DESCRIBED IN THIS MANUAL IS DESIGNED FOR INDOOR INSTALLATION ONLY AND FOR AMBIENT TEMPERATURES RANGING 39°F~95°F (4°C~35°C).

The English text is the original instruction. Other languages are translations of the original instructions.

INTRODUCTION

General information

The unit is the indoor part of the air to water ERLQ heat pumps. These units are designed for wall mounted indoor installation. See "Selecting an installation location" on page 12. The units can be combined with Daikin fan coil units, floor heating applications, low temperature radiators, Daikin domestic water heating applications and solar kit for domestic hot water applications.

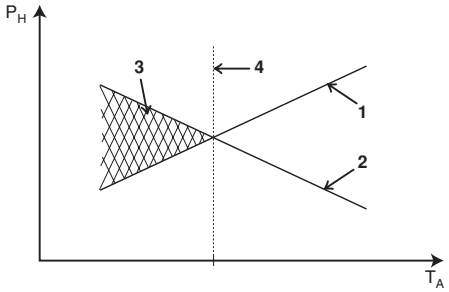
Heating/cooling units and heating only units

The unit range consists of two main versions: a heating/cooling (EKHBX) version and a heating only (EKHBH) version.

Both versions are delivered with an integrated backup heater for additional heating capacity during cold outdoor temperatures. The backup heater also serves as a backup in case of malfunctioning of the outdoor unit. The backup heater models are available for a heating capacity of 3 and 6 kW depending on the heating capacity.

Indoor unit model	Backup heater capacity	Backup heater nominal voltage
EKHB*054BA3VJU	3 kW	1x 230 V
EKHB*054BA6VJU	6 kW	1x 230 V

NOTE An ERLQ0***BA** outdoor unit can only be connected to an EKHBH/X054**BA** indoor unit (bottom plate heater at outdoor unit has to be controlled by indoor unit).



1	Heat pump capacity
2	Required heating capacity (site dependent)
3	Additional heating capacity provided by the backup heater
4	Equilibriumtemperature (can be set through the user interface, refer to "Field settings" on page 25)
T_A	Ambient (outdoor) temperature
P_H	Heating capacity

Domestic hot water tank (option)

An optional EKHW* domestic hot water tank with integrated 3 kW electrical booster heater can be connected to the indoor unit. The domestic hot water tank is available in two sizes: 50 and 80 gallons (200 and 300 litre). Refer to the domestic hot water tank installation manual for further details.

Drain pan kit (option)

For heating/cooling versions (EKHBX), it is necessary to install the EKHBDP drain pan kit.
For more information concerning the drain pan kit, refer to "Installation of the EKHBDP drain pan kit (only for EKHBX models)" on page 13.

Solar kit for domestic hot water tank (option)

For information concerning the EKSOLHW solar kit, refer to the installation manual of that kit.

Digital I/O PCB kit (option)

An optional EKRP1HB digital I/O PCB can be connected to the indoor unit and allows:

- remote alarm output
- heating/cooling ON/OFF output
- bivalent operation (permission signal for the auxiliary boiler)

Refer to the operation manual of the indoor unit and to the installation manual of the digital I/O PCB for more information.

Refer to the wiring diagram or connection diagram for connecting this PCB to the unit.

Remote thermostat kit (option)

An optional room thermostat EKRTWA can be connected to the indoor unit. Refer to the installation manual of the room thermostat for more information.

Connection to a benefit kWh rate power supply

This equipment allows for connection to benefit kWh rate power supply delivery systems. Full control of the unit will remain possible only in case the benefit kWh rate power supply is of the type that power supply is not interrupted. Refer to "Connection to a benefit kWh rate power supply" on page 19 for more details.

Scope of this manual

This installation manual describes the procedures for handling, installing and connecting all EKHBH/X indoor unit models.

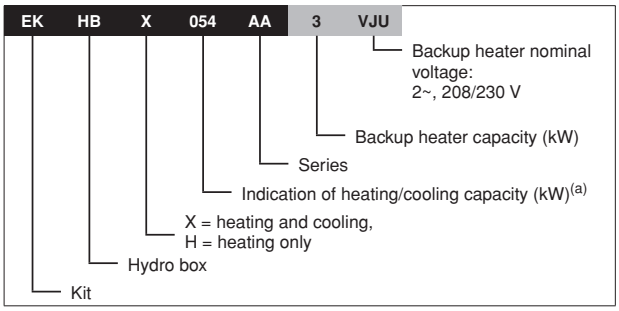
NOTE

Installation of the ERLQ heat pump outdoor unit is described in the outdoor unit installation manual.

Operation of the indoor unit is described in the indoor unit operation manual.

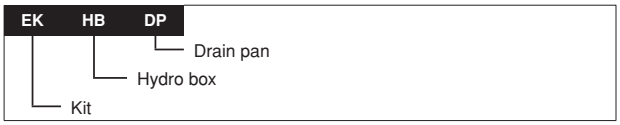
Model identification

Indoor unit



(a) For exact values, refer to "Technical specifications" on page 43.

Drain pan kit (optional)



ACCESSORIES

Accessories supplied with the indoor unit

See figure 1

1	Installation manual
2	Operation manual
3	Shut-off valve
4	Wiring diagram sticker (inside indoor unit cover)
5	Indoor unit cover fixing screw
6	Wall mounting bracket
7	Nylon washer

SAFETY CONSIDERATIONS

The precautions listed here are divided into the following four types. They all cover very important topics, so be sure to follow them carefully.

Meanings of **DANGER**, **WARNING**, **CAUTION** and **NOTE** symbols.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE

Indicates situations that may result in equipment or property-damage accidents only.

Danger

- Before touching electric terminal parts, turn off power switch.
- When service panels are removed, live parts can be easily touched by accident.

  Never leave the unit unattended during installation or servicing when the service panel is removed.
- Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.
- Do not touch any switch with wet fingers. Touching a switch with wet fingers can cause electrical shock.
- Before touching electrical parts, turn off all applicable power supply.

Warning

- Tear apart and throw away plastic packaging bags so that children will not play with them.

  Children playing with plastic bags face danger of death by suffocation.
- Safely dispose of packing materials. Packing materials, such as nails and other metal or wooden parts, may cause stabs or other injuries.
- Never directly touch any accidental leaking refrigerant. This could result in severe wounds caused by frostbite.
- Do not touch the refrigerant pipes during and immediately after operation as the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes. To avoid injury, give the pipes time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.
- Do not touch the internal parts (pump, backup heater, etc.) during and immediately after operation.

  Your hands may suffer burns if you touch the internal parts. To avoid injury, give the internal parts time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.

Caution

- Ground the unit.

  Grounding resistance should be according to local laws and regulations.

  Do not connect the ground wire to gas or water pipes, lightning conductor or telephone ground wire.

  Incomplete grounding may cause electric shocks.

  - Gas pipe.
    Ignition or explosion may occur if the gas leaks.
  - Water pipe.
    Hard vinyl tubes are not effective grounds.
  - Lightning conductor or telephone ground wire.
    Electric potential may rise abnormally if struck by a lightning bolt.
- Install the power wire at least 3.28 ft (1 meter) away from televisions or radios to prevent image interference or noise.

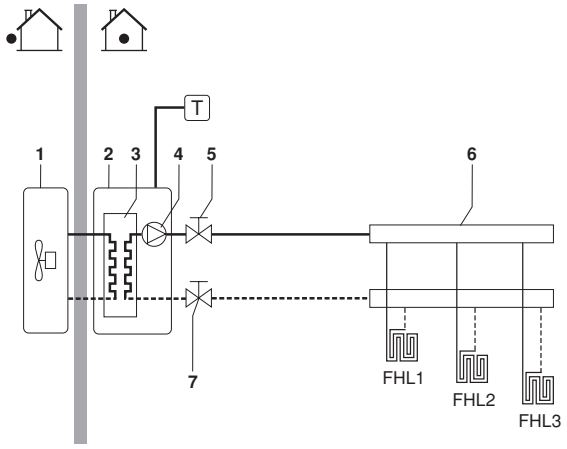
  (Depending on the radio waves, a distance of 3.28 ft (1 meter) may not be sufficient to eliminate the noise.)
- Do not rinse the unit. This may cause electric shocks or fire.
- Do not install the unit in places such as the following:
  - Where there is mist of mineral oil, oil spray or vapour.
    Plastic parts may deteriorate, and cause them to fall out or water to leak.
  - Where corrosive gas, such as sulphurous acid gas, is produced.
    Corrosion of copper pipes or soldered parts may cause the refrigerant to leak.
  - Where there is machinery which emits electromagnetic waves.
    Electromagnetic waves may disturb the control system, and cause malfunction of the equipment.
  - Where flammable gases may leak, where carbon fibre or ignitable dust is suspended in the air or where volatile flammables, such as thinner or gasoline, are handled.
    Such gases may cause a fire.
  - Where the air contains high levels of salt.
  - Where voltage fluctuates a lot, such as that in factories.
  - In vehicles or vessels.
  - Where acidic or alkaline vapour is present.

TYPICAL APPLICATION EXAMPLES

The application examples given below are for illustration purposes only.

Application 1

Space heating only application with the room thermostat connected to the indoor unit.



1	Outdoor unit	**6**	Collector (field supply)
2	Indoor unit	**7**	Shut-off valve
3	Heat exchanger	**FHL1..3**	Floor heating loop
4	Pump	**T**	Room thermostat (optional)
5	Shut-off valve		

Pump operation and space heating

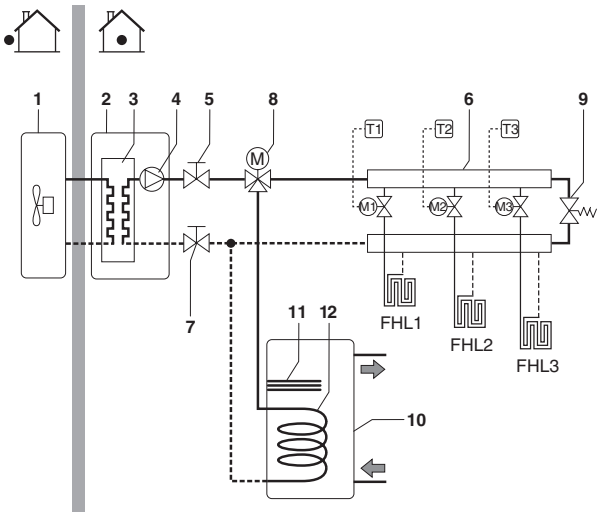
When the room thermostat (T) is connected to the indoor unit, the pump (4) will operate when there is a heating request from the room thermostat, and the outdoor unit will start operating to achieve the target leaving water temperature as set on the user interface.

When the room temperature is above the thermostat set point, the outdoor unit and pump will stop operating.

Make sure to connect the thermostat wires to the correct terminals (see "Connection of the thermostat cable" on page 18) and to configure the DIP switch toggle switches correctly (see "Room thermostat installation configuration" on page 22).

Application 2

Space heating only application without room thermostat connected to the indoor unit. The temperature in each room is controlled by a valve on each water circuit. Domestic hot water is provided through the domestic hot water tank which is connected to the indoor unit.



1	Outdoor unit	**9**	By-pass valve (field supply)
2	Indoor unit	**10**	Domestic hot water tank (optional)
3	Heat exchanger	**11**	Booster heater
4	Pump	**12**	Heat exchanger coil
5	Shut-off valve	**FHL1..3**	Floor heating loop
6	Collector (field supply)	**T1..3**	Individual room thermostat (optional)
7	Shut-off valve	**M1..3**	Individual motorised valve to control loop FHL1 (field supply)
8	Motorised 3-way valve (delivered with domestic hot water tank)		

Pump operation

With no thermostat connected to the indoor unit (2), the pump (4) can be configured to operate either as long as the indoor unit is on, or until the required water temperature is reached.

NOTE Details on pump configuration can be found under "Pump operation configuration" on page 23.

Space heating

The outdoor unit (1) will operate to achieve the target leaving water temperature as set on the user interface.

NOTE When circulation in each space heating loop (FHL1..3) is controlled by remotely controlled valves (M1..3), it is important to provide a by-pass valve (9) to avoid the flow switch safety device from being activated.

The by-pass valve should be selected as such that at all time the minimum water flow as mentioned under "Water pipework" on page 14 is guaranteed.

It is recommended to select a pressure difference controlled by-pass valve.

Domestic water heating

When domestic water heating mode is enabled (either manually by the user, or automatically through a schedule timer) the target domestic hot water temperature will be achieved by a combination of the heat exchanger coil and the electrical booster heater.

When the domestic hot water temperature is below the user configured set point, the 3-way valve will be activated to heat the domestic hot water by means of the heat pump. In case of large domestic hot water demand or a high domestic hot water temperature setting, the booster heater (11) can provide auxiliary heating.

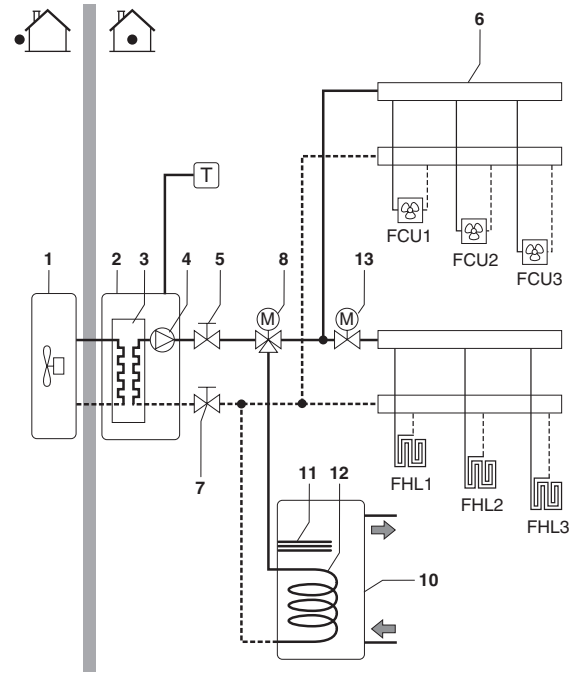
NOTE

The indoor unit can be configured so that at low outdoor temperatures the domestic hot water is exclusively heated by the booster heater. This assures that the full capacity of the heat pump is available for space heating.

Details on domestic hot water tank configuration for low outdoor temperatures can be found under "Field settings" on page 25, field settings [5-02] to [5-04].

Application 3

*Space cooling and heating application with the **room thermostat set for heating/cooling** connected to the indoor unit. Heating is provided through floor heating loops and fan coil units. Cooling is provided through the fan coil units only.*
Domestic hot water is provided through the domestic hot water tank which is connected to the indoor unit.



1	Outdoor unit	**10**	Domestic hot water tank (optional)
2	Indoor unit		
3	Heat exchanger	**11**	Booster heater
4	Pump	**12**	Heat exchanger coil
5	Shut-off valve	**13**	Motorised 2-way valve (field supply)
6	Collector (field supply)		
7	Shut-off valve	**FCU1..3**	Fan coil unit (optional)
8	Motorised 3-way valve (delivered with domestic hot water tank)	**FHL1..3**	Floor heating loop
		T	Room thermostat with heating/cooling switch (optional

Pump operation and space heating and cooling

According to the season, the customer will select cooling or heating on the room thermostat (T). This selection is not possible by operating the user interface.

When space heating/cooling is requested by the room thermostat (T), the pump will start operating and the indoor unit (2) will switch to "heating mode"/"cooling mode". The outdoor unit (1) will start operating to achieve the target leaving hot/cold water temperature.

In case of cooling mode, the 2-way valve (13) will close as to prevent cold water running through the floor heating loops (FHL).

NOTE

Make sure to connect the thermostat wires to the correct terminals (see "Connection of the thermostat cable" on page 18) and to configure the DIP switch toggle switches correctly (see "Room thermostat installation configuration" on page 22).

NOTE

Wiring of the 2-way valve (13) is different for a NC (normal closed) valve and a NO (normal open) valve! Make sure to connect to the correct terminal numbers as detailed on the wiring diagram.

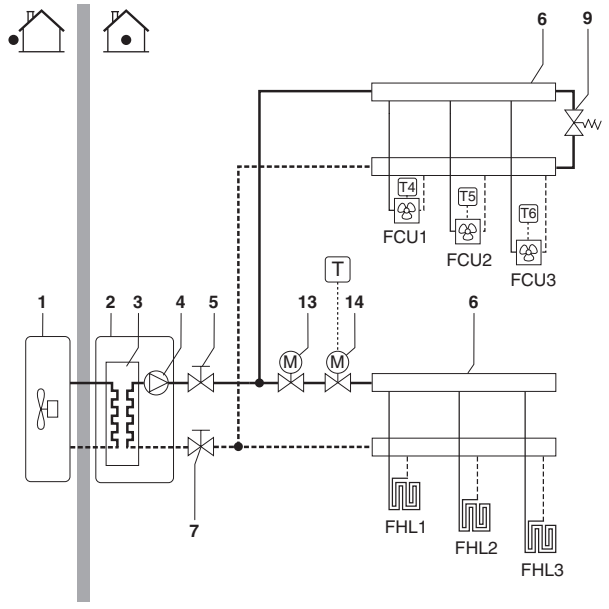
The ON/OFF setting of the heating/cooling operation is done by the room thermostat and cannot be done by the user interface on the indoor unit.

Domestic water heating

Domestic water heating is as described under "Application 2" on page 4.

Application 4

*Space cooling and heating application **without the room thermostat connected to the indoor unit**, but with the heating only room thermostat (set heating only) controlling the floor heating and the heating/cooling thermostat (set heating/cooling) controlling the fan coil units. Heating is provided through floor heating loops and fan coil units. Cooling is provided through the fan coil units only.*



1	Outdoor unit	**14**	Motorised 2-way valve for activation of the room thermostat (field supply)
2	Indoor unit		
3	Heat exchanger		
4	Pump	**FCU1..3**	Fan coil unit with thermostat (optional)
5	Shut-off valve		
6	Collector (field supply)	**FHL1..3**	Floor heating loop
7	Shut-off valve	**T**	Heating only room thermostat (optional)
9	By-pass valve (field supply)		
13	Motorised 2-way valve to shut off the floor heating loops during cooling operation (field supply)	**T4..6**	Individual room thermostat for fan coil heated/cooled room (optional)

Pump operation

With no thermostat connected to the indoor unit (2), the pump (4) can be configured to operate either as long as the indoor unit is on, or until the required water temperature is reached.

NOTE Details on pump configuration can be found under "Pump operation configuration" on page 23.

Space heating and cooling

According to the season, the customer will select heating or cooling through the user interface on the indoor unit.

The outdoor unit (1) will operate in heating mode or cooling mode to achieve the target leaving water temperature.

With the unit in heating mode, the 2-way valve (13) is open. Hot water is provided to both the fan coil units and the floor heating loops.

With the unit in cooling mode, the 2-way valve (13) is closed to prevent cold water running through the floor heating loops (FHL).

When closing several loops in the system by remotely controlled valves, it might be required to install a by-pass valve (9) to avoid the flow switch safety device from being activated. See also "Application 2" on page 4.

Wiring of the 2-way valve (13) is different for a NC (normal closed) valve and a NO (normal open) valve! Make sure to connect to the correct terminal numbers as detailed on the wiring diagram.

The ON/OFF setting of the heating/cooling operation is done by the user interface on the indoor unit.

Application 5

Space heating with an auxiliary boiler (alternating operation)

Space heating application by either the Daikin indoor unit or by an auxiliary boiler connected in the system. The decision whether either the EKHB indoor unit or the boiler will operate can be achieved by an auxiliary contact or an EKHB* indoor controlled contact.*

The auxiliary contact can e.g. be an outdoor temperature thermostat, an electricity tariff contact, a manually operated contact, etc. See "Field wiring configuration A" on page 7.

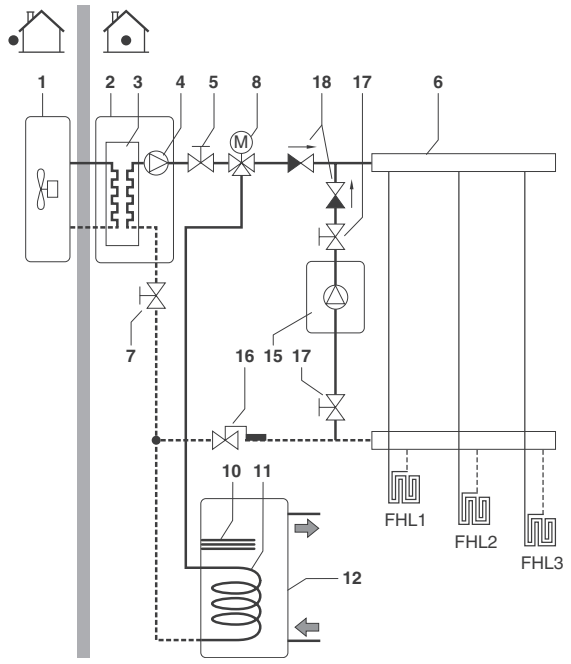
The EKHB indoor unit controlled contact (also called 'permission signal for the auxiliary boiler") is determined by the outdoor temperature (thermistor located at the outdoor unit). See "Field wiring configuration B" on page 7.*

Bivalent operation is only possible for space heating operation, **not** for the domestic water heating operation. Domestic hot water in such an application is always provided by the domestic hot water tank which is connected to the Daikin indoor unit.

The auxiliary boiler must be integrated in the piping work and in the field wiring according to the illustrations below.

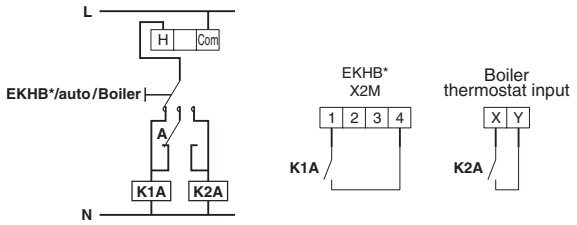
CAUTION

- Be sure that the boiler and the integration of the boiler in the system is in accordance with relevant local laws and regulations.
- Daikin can not be put responsible for incorrect or unsafe situations in the boiler system.



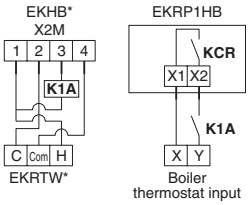
1	Outdoor unit	**11**	Heat exchanger coil
2	Indoor unit	**12**	Domestic hot water tank (optional)
3	Heat exchanger		
4	Pump	**15**	Boiler (field supply)
5	Shut-off valve	**16**	Aquastat valve (field supply)
6	Collector (field supply)		
7	Shut-off valve	**17**	Shut-off valve (field supply)
8	Motorised 3-way valve (delivered with the domestic hot water tank)	**18**	Non-return valve (field supply)
		FHL1...3	Floor heating loop (field supply)
10	Booster heater		

Field wiring configuration A



Boiler thermostat input	Boiler thermostat input
A	Auxiliary contact (normal closed)
H	Heating demand room thermostat (optional)
K1A	Auxiliary relay for activation of EKHB* unit (field supply)
K2A	Auxiliary relay for activation of boiler (field supply)

Field wiring configuration B



Boiler thermostat input	Boiler thermostat input
C	Cooling demand room thermostat (optional)
H	Heating demand room thermostat (optional)
Com	Common room thermostat (optional)
K1A	Auxiliary relay for activation of bolier unit (field supply)
KCR	Permission signal for the auxiliary boiler

Operation

■ **Configuration A**

When the room thermostat requests heating, either the EKHB* unit or the boiler starts operating, depending on the position of the auxiliary contact (A).

■ **Configuration B**

When the room thermostat requests heating, either the EKHB* unit or the boiler starts operating, depending on the outdoor temperature (status of "permission signal for the auxiliary boiler").

When the permission is given towards the boiler, the space heating operation by the EKHB* unit will be automatically switched off.

For more details see field setting [C-02~C-04].

NOTE

■ **Configuration A**

Make sure that auxiliary contact (A) has sufficient differential or time delay so as to avoid frequent changeover between the EKHB* unit and the boiler. If the auxiliary contact (A) is an outdoor temperature thermostat, make sure to install the thermostat in the shade, so that it is not influenced or turned ON/OFF by the sun.

Configuration B

Make sure that the bivalent hysteresis [C-04] has sufficient differential to avoid frequent changeover between the EKHB* unit and the boiler. As the outdoor temperature is measured via the outdoor unit, air thermistor make sure to install the outdoor unit in the shade, so that it is not influenced by the sun.

Frequent switching may cause corrosion of the boiler in an early stage. Contact the manufacturer of the boiler.

■ During heating operation of the EKHB* unit, the unit will operate so as to achieve the target leaving water temperature as set on the user interface. When weather dependent operation is active, the water temperature is determined automatically depending on the outdoor temperature.

During heating operation of the boiler, the boiler will operate so as to achieve the target leaving water temperature as set on the boiler controller.

Never set the target leaving water temperature set point on the boiler controller above 131°F (55°C).

■ Make sure to only have 1 expansion vessel in the water circuit. An expansion vessel is already premounted in the Daikin indoor unit.

NOTE

Make sure to configure the DIP switch SS2-3 on the PCB of the EKHB* switchbox correctly. Refer to "Room thermostat installation configuration" on page 22.

For configuration B: Make sure to configure the field settings [C-02, C-03 and C-04] correctly. Refer to "Bivalent operation" on page 32.

CAUTION

Make sure that return water to the EKHB* heat exchanger never exceeds 131°F (55°C).

For this reason, never put the target leaving water temperature set point on the boiler controller above 131°F (55°C) and install an aquastat[(a)] valve in the return water flow of the EKHB* unit.

Make sure that the non-return valves (field supply) are correctly installed in the system.

Make sure that the room thermostat (th) is not frequently turned ON/OFF.

Daikin shall not be held liable for any damage resulting from failure to observe this rule.

(a) The aquastat valve must be set for 131°F (55°C) and must operate to close the return water flow to the unit when the measured temperature exceeds 131°F (55°C). When the temperature drops to a lower level, the aquastat valve must operate to open the return water flow to the EKHB* unit again.

Manual permission towards the EKHB* unit on the boiler.

In case only the EKHB* unit should operate in space heating mode, disable the bivalent operation via setting [C-02].

In case only the boiler should operate in space heating mode, increase the bivalent ON temperature [C-03] to 77°F (25°C).

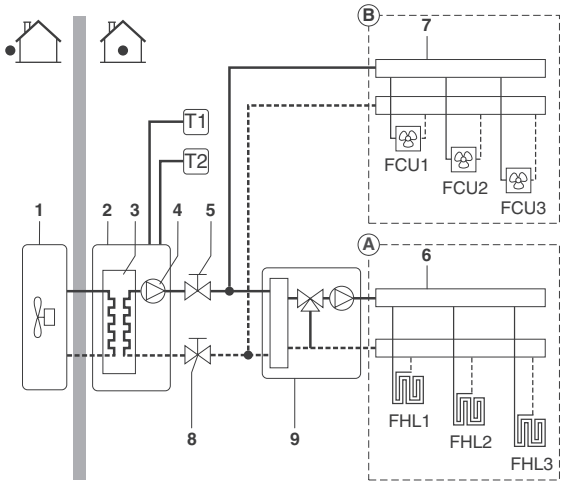
Application 6

Space heating with room thermostat application through floor heating loops and fan coil units. The floor heating loops and fan coil units require different operating water temperatures.

The floor heating loops require a lower water temperature in heating mode compared to fan coil units. To achive these two set points, a mixing station is used to adapt the water temperature according to requirements of the floor heating loops. The fan coil units are directly connected to the indoor unit water circuit and the floor heating loops after the mixing station. The control of this mixing station is not done by the indoor unit.

The operation and configuration of the field water circuit is the responsibility of the installer.

Daikin only offers a dual set point control function. By this function two set points can be generated. Depending on the required water temperature (floor heating loops and/or fan coil units are required) first set point or second set point can be activated.



1	Outdoor unit	**8**	Shut-off valve
2	Indoor unit	**9**	Mixing station (field supply)
3	Heat exchanger	**T1**	Room thermostat for zone A (optional)
4	Pump		
5	Shut-off valve	**T2**	Room thermostat for zone B (optional)
6	Collector zone A (field supply)	**FCU1..3**	Fan coil unit (optional)
7	Collector zone B (field supply)	**FHL1...3**	Floor heating loop (field supply)

The advantage of the dual set point control is that the heat pump will/can operate at the lowest required leaving water temperature when only floor heating is required. Higher leaving water temperatures are only required in case fan coil units are operating.
This results in a better performance of the heat pump.

Pump operation and space heating

When the room thermostat for the floor heating loop (T1) and the fan coil units (T2) are connected to the indoor unit, the pump (4) will operate when there is a request for heating from T1 and/or T2. The outdoor unit will start operating to achieve the target leaving water temperature. The target leaving water temperature depends on which room thermostat is requesting heating.

	Set point	Field setting	Thermo status			
Zone A	First	UI	ON	OFF	ON	OFF
Zone B	Second	[7-03]	OFF	ON	ON	OFF
Resulting water temperature			UI	[7-03]	[7-03]	—
Result pump operation			ON	ON	ON	OFF

When the room temperature of both zones is above the thermostat set point, the outdoor unit and pump will stop operating.

NOTE

- Make sure to connect the thermostat wires to the correct terminals (see "Overview of the indoor unit" on page 9).
- Make sure to configure the field settings [7-02], [7-03] and [7-04] correctly. Refer to "Dual set point control" on page 29.
- Make sure to configure the DIP switch SS2-3 on the PCB of the EKHBH switch box correctly. Refer to "Room thermostat installation configuration" on page 22.

NOTE

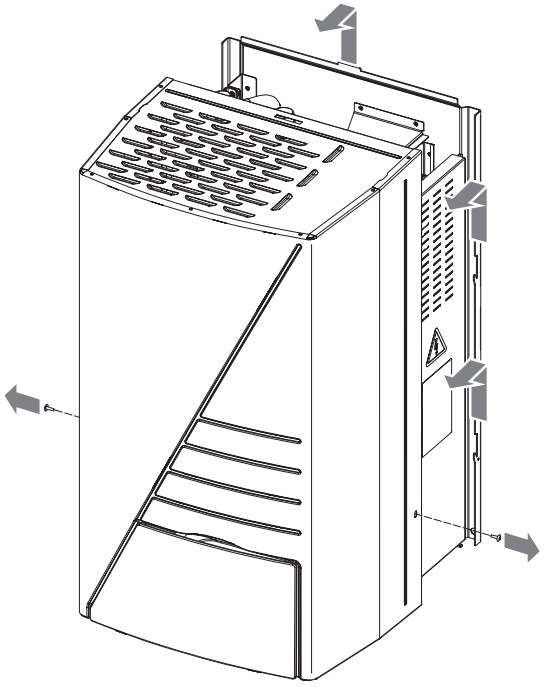
- The request signals for space heating can be implemented in two different ways (installer choice).
  - Thermo ON/OFF signal from room thermostat
  - Status signal (active/not active) from the mixing station
- It is the installers responsibility to make sure no unwanted situations can occur (e.g. too high water temperatures towards floor heating loops, etc.)
- Daikin does not offer any type of mixing station. Dual set point control only provides the possibility to use two set points.
- When only zone A request heating, zone B will be fed with water at a temperature equal to the first set point.
  This can lead to unwanted heating of zone B.
- When only zone B request heating, the mixing station will be fed with water at a temperature equal to the second set point.
  Depending on the control of the mixing station, the floor heating loop can still receive water at a temperature equal to set point of the mixing station.

Be aware that the actual water temperature through the floor heating loops depends on the control and setting of the mixing station.

Overview of the indoor unit

Opening the indoor unit

- The front flap on the indoor unit cover gives access to the manometer and user interface.
- The indoor unit cover can be removed by removing the 2 side screws and unhitching the cover.



Make sure to fix the cover with the screws and nylon washer when installing the cover (screws are delivered as accessory).

Parts inside the unit can be hot.

- To gain access to the switch box components – e.g. to connect the field wiring – the switch box service panel can be removed. Thereto, loosen the front screws and unhitch the switch box service panel.

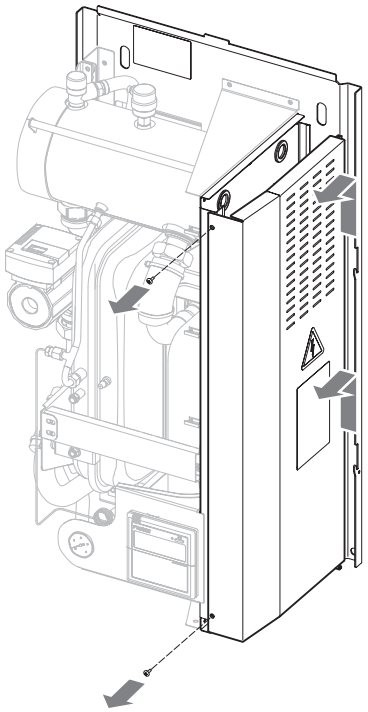
WARNING

- Switch off all power supply – i.e. outdoor unit power supply and backup heater and domestic hot water tank power supply (if applicable) – before removing the switch box service panel.
- Do not touch the refrigerant pipes during and immediately after operation as the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes. To avoid injury, give the pipes time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.
- Do not touch the internal parts (pump, backup heater, etc.) during and immediately after operation.

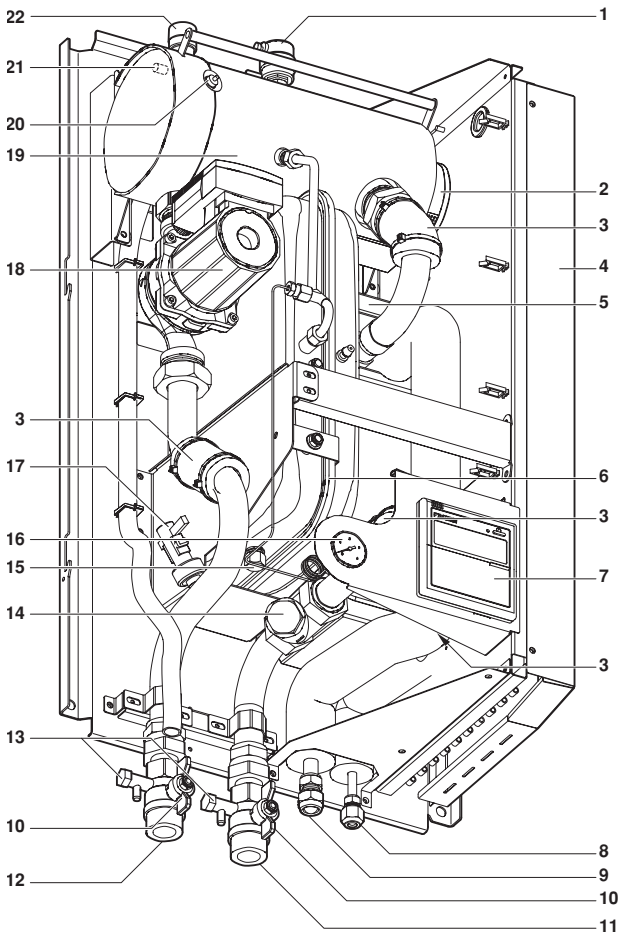
  Your hands may suffer burns if you touch the internal parts. To avoid injury, give the internal parts time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.

DANGER

- Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.
- When service panels are removed, live parts can be easily touched by accident.
  Never leave the unit unattended during installation or servicing when the service panel is removed.



Main components



1. Air purge valve
Remaining air in the water circuit will be automatically removed via the air purge valve.

2. Backup heater
The backup heater consists of an electrical heating element in the backup heater vessel that will provide additional heating capacity to the water circuit if the heating capacity of the outdoor unit is insufficient due to low outdoor temperatures.

3. Temperature sensors
Four temperature sensors determine the water and refrigerant temperature at various points in the water circuit.

4. Switch box
The switch box contains the main electronic and electrical parts of the indoor unit.

5. Heat exchanger

6. Expansion vessel (2.6 gallons) [10 l]

7. User interface
The user interface allows the installer and user to set up, use and maintain the unit.

8. Refrigerant liquid connection

9. Refrigerant gas connection

10. Shut-off valves (accessory)
The shut-off valves on the water inlet connection and water outlet connection allow isolation of the indoor unit water circuit side from the residential water circuit side. This facilitates draining and filter replacement of the indoor unit.

11. Water inlet connection

12. Water outlet connection

13. Drain and fill valves

14. Water filter
The water filter removes dirt from the water to prevent damage to the pump or blockage of the evaporator. The water filter must be cleaned on a regular base. See "Maintenance and service" on page 38.

15. Manometer
The manometer allows readout of the water pressure in the water circuit.

16. Flow switch
The flow switch checks the flow in the water circuit and protects the heat exchanger against freezing and the pump against damage.

17. Pump
The pump circulates the water in the water circuit.

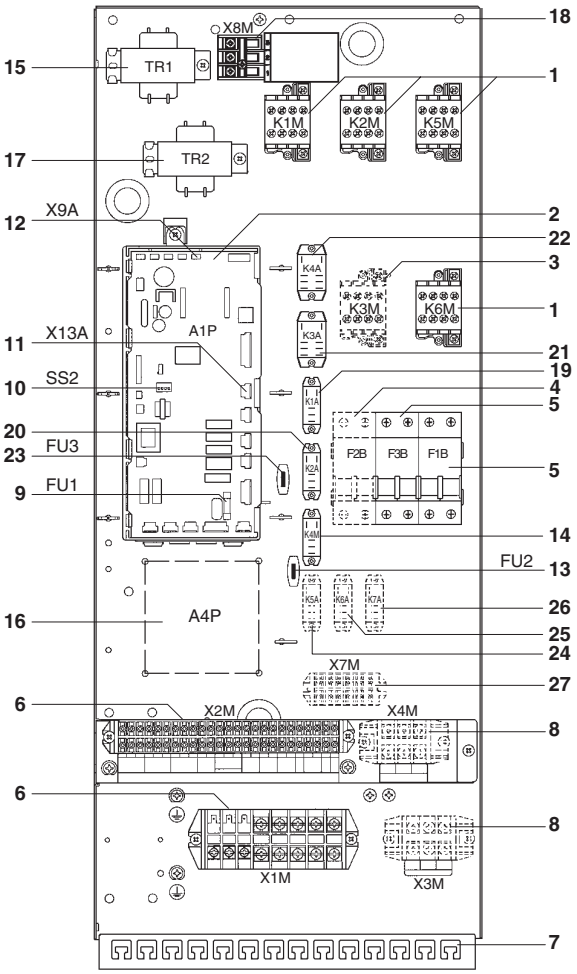
18. Backup heater thermal protector
The backup heater is equipped with a thermal protector. The thermal protector is activated when the temperature becomes too high.

19. Backup heater thermal fuse
The backup heater is equipped with a thermal fuse. The thermal fuse is blown when the temperature becomes too high (higher than the backup heater thermal protector temperature).

20. Pressure relief valve
The pressure relief valve prevents excessive water pressure in the water circuit by opening at 43.5 psi (3 bar) and discharging some water.

21. Pressure relief valve hose
The actual outlet of the pressure relief valve. Make sure to provide a proper drain.

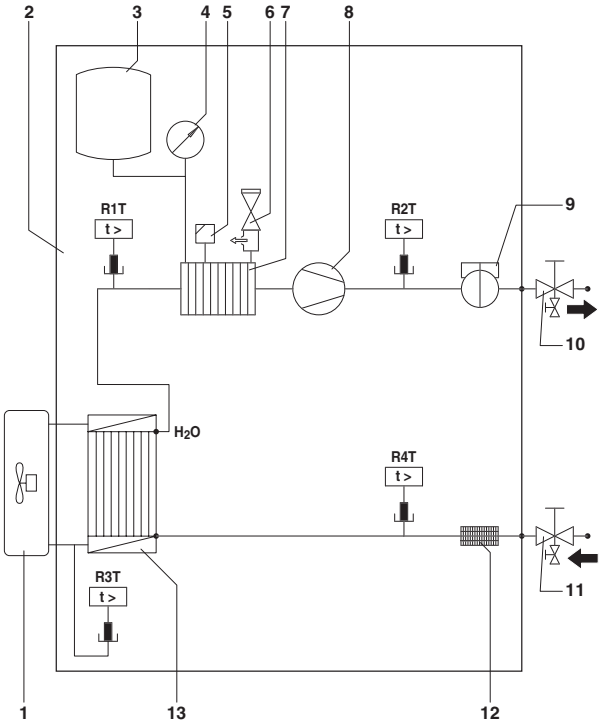
Switch box main components



1. Backup heater contactors K1M, K2M, K5M and K6M.
2. Main PCB
   The main PCB (Printed Circuit Board) controls the functioning of the unit.
3. Booster heater contactor K3M (only for installations with domestic hot water tank)
4. Booster heater circuit breaker F2B (only for installations with domestic hot water tank)
   The circuit breaker protects the booster heater in the domestic hot water tank against overload or short circuit.
5. Backup heater circuit breaker F1B, F3B
   The circuit breaker protects the backup heater electrical circuit against overload or short circuit.
6. Terminal blocks
   The terminal blocks allow easy connection of field wiring.
7. Cable tie mountings
   The cable tie mountings allow to fix the field wiring with cable ties to the switch box to ensure strain relief.
8. Terminal blocks X3M, X4M (only for installations with domestic hot water tank)
9. PCB fuse FU1
10. DIP switch SS2
    The DIP switch SS2 provides 4 toggle switches to configure certain installation parameters. See "DIP switch settings overview" on page 22.
11. X13A socket
    The X13A socket receives the K3M connector (only for installations with domestic hot water tank).
12. X9A socket
    The X9A socket receives the thermistor connector (only for installations with domestic hot water tank).
13. Pump fuse FU2 (in line fuse)
14. Pump relay K4M
15. Transformer TR1
16. A4P
    Digital I/O PCB (only for installations with solar kit or digital I/O PCB kit).
17. Transformer TR2 24 V AC for valves and relays (multi-tap)
18. Terminal block X8M
    The terminal block X8M is used to select the power input to transformer TR2.
19. 3-way valve relay K1A
20. 2-way valve relay K2A
21. Heating/second set point demand relay K3A
22. Cooling/ first set point demand relay K4A
23. Fuse for valves and relays FU3
24. Alarm output relay K5A (only for installations with digital I/O PCB kit)
25. Heating/cooling ON/OFF output relay K6A (only for installations with digital I/O PCB kit)
26. Solar input relay K7A (only for installations with solar kit)
27. Terminal block (only for installations with digital I/O PCB kit)

NOTE The electrical wiring diagram can be found on the inside of the switch box cover.

Functional diagram



1	Outdoor unit	**10**	Shut-off valve water outlet with drain valve (field installation)
2	Indoor unit		
3	Expansion vessel	**11**	Shut-off valve water inlet with drain valve (field installation)
4	Manometer		
5	Air purge valve	**12**	Filter
6	Pressure relief valve	**13**	Heat exchanger
7	Backup heater	**R1T**	Temperature sensors
8	Pump	**R2T**	
9	Flow switch	**R3T**	
		R4T	

INSTALLATION OF THE INDOOR UNIT

Selecting an installation location

The unit is to be wall mounted in an indoor location that meets the following requirements:

- The installation location is frost-free.
- The space around the unit is adequate for servicing. (See figure 2).
- The space around the unit allows for sufficient air circulation.
- There is a provision for condensate drain (only for EKHBX models with drain pan kit EKHBDP) and pressure relief valve blow-off.
- The installation surface is a flat and vertical non-combustible wall, capable of supporting the operation weight of the unit (see "Technical specifications" on page 43).
- There is no danger of fire due to leakage of inflammable gas.
- All piping lengths and distances have been taken into consideration.

Requirement	Value
Maximum allowable refrigerant piping length between outdoor unit and indoor unit	246 ft (75 m)
Minimum required refrigerant piping length between outdoor unit and indoor unit	9.8 ft[(a)] (3 m)
Maximum allowable height difference between outdoor unit and indoor unit	98.4 ft (30 m)
Maximum allowable distance between the 3-way valve and the indoor unit (only for installations with domestic hot water tank).	9.8 ft (3 m)
Maximum allowable distance between the domestic hot water tank and the indoor unit (only for installations with domestic hot water tank). The thermistor cable supplied with the domestic hot water tank is 12 m in length.	32.8 ft (10 m)

(a) When <16.4 ft (<5 m), recharging of the outdoor unit is required. Refer to the installation manual of the outdoor unit.

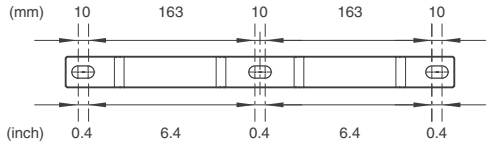
- During normal operation the hydrobox unit will produce sound which could be observed as noise. The sound origin can be water pump operation and/or contactor activation. Therefore it is advisable to install the hydrobox unit on a firm wall and not in nor close to a sound sensitive environment (e.g. bedroom).
- Do not install the unit in places with high humidity (e.g. bathroom).
- Select piping diameter in relation to required water flow and available ESP of pump.
- The equipment is not intended for use in a potentially explosive atmosphere.
- Do not install the unit in places often used as work place.
  In case of construction works (e.g. grinding works) where a lot of dust is created, the unit must be covered.
- Take care that in the event of a water leak, water can not cause any damage to the installation space and surroundings.
- Do not place any objects or equipment on top of the unit.
- Be sure that sufficient precautions are taken, in accordance with relevant local laws and regulations, in case of refrigerant leakage.

CAUTION

If the installation is equipped with a domestic hot water tank (optional), please refer to the domestic hot water tank installation manual.

Dimensions and service space

Dimensions of the wall bracket



Unit of measurement: inch (mm)

Dimensions of the unit, see figure 3

1	Flexible drain hose	**5**	Refrigerant gas connection
2	Water outlet connection		
3	Water inlet connection	**FBSP**	Female British Standard Pipe
4	Refrigerant liquid connection	**MBSP**	Male British Standard Pipe

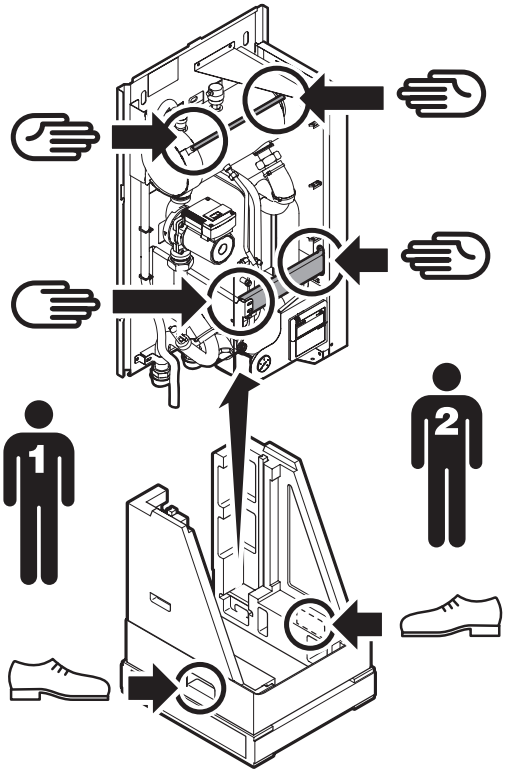
Required service space, see figure 2

Inspecting, handling and unpacking the unit

- The indoor unit is packed in a cardboard box, fixed by straps on a wooden pallet.
- At delivery, the unit must be checked and any damage must be reported immediately to the carrier claims agent.
- Check if all indoor unit accessories (see "Accessories" on page 2) are enclosed.
- Bring the unit as close as possible to its final installation position in its original package in order to prevent damage during transport.
- The indoor unit weighs approximately 123 lbs (55 kg) and should be lifted by two persons using the two lifting bars provided.

CAUTION

Do not grasp the switch box or piping to lift the unit! Two lifting bars are provided to lift the unit.



Mounting the indoor unit

CAUTION

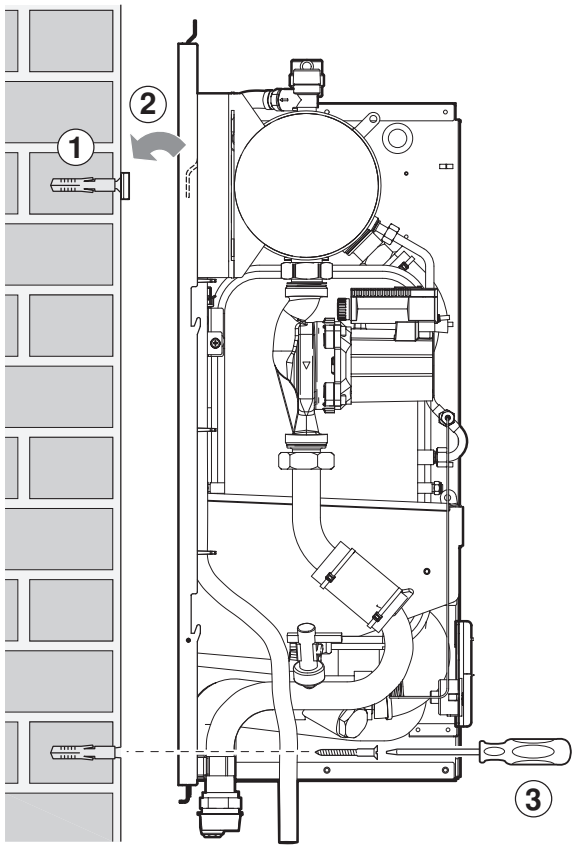
The weight of the indoor unit is approximately 123 lbs (55 kg). Two persons are required to mount the unit.

1 Fix the wall mounting bracket to the wall using appropriate plugs and screws.

Make sure the wall mounting bracket is completely level. When the unit is not installed level, air might get trapped in the water circuit resulting in malfunctioning of the unit.
Pay special attention to this when installing an EKHBX model to prevent overflow of the drain pan.

2 Hang the indoor unit on the wall mounting bracket.

3 Fix the indoor unit at the bottom side using appropriate plugs and screws. To do so, the unit is equipped with 2 holes at the bottom outer edges of the frame.



Installation of the EKHBDP drain pan kit (only for EKHBX models)

For heating/cooling models, it is necessary to install the drain pan kit (see "Accessories" on page 2).

During cooling operation, water vapour (humidity) in the air might condense to liquid and collect on the cold refrigerant and water pipes. This water is collected in the drain pan, which must be connected to a drain.

For installation instructions, refer to the instruction sheet delivered with the drain pan kit.

CAUTION

Make sure to position the pressure relief valve hose end in the drain pan. Failure to do so might lead to water coming into contact with electrical parts, resulting in electrical shocks or short-circuit of the electrical system.

Refrigerant pipework

For all guidelines, instructions and specifications regarding refrigerant pipework between the indoor unit and the outdoor unit, please refer to the outdoor unit installation manual.

The location of the gas pipe and liquid pipe on the indoor unit is shown under "Main components" on page 10.

Refrigerant piping specifications	Indoor unit	Outdoor unit
Gas pipe connection	5/8 inch (15.9 mm)	5/8 inch (15.9 mm)
Liquid pipe connection	3/8 inch (9.5 mm)	3/8 inch (9.5 mm)

When connecting the refrigerant pipes, always use two wrenches/spanners for tightening or loosening nuts! Failure to do so can result in damaged piping connections and leaks.

Water pipework

Checking the water circuit

The units are equipped with a water inlet and water outlet for connection to a water circuit. This circuit must be provided by a licensed technician and must comply with all relevant local laws and regulations.

NOTE

The unit is only to be used in a closed water system. Application in an open water circuit can lead to excessive corrosion of the water piping.

NOTE

Before continuing the installation of the unit, check the following points:

- The maximum water pressure = 43.5 psi (3 bar) + static pressure of pump.
- The maximum water temperature is 149°F (65°C) (safety device setting).
- Two shut-off valves are delivered with the unit. To facilitate service and maintenance, install one at the water inlet and one at the water outlet of the indoor unit. Mind position of the shut-off valves. Orientation of the integrated drain and fill valves is important for servicing. See figure 3.
- Drain taps must be provided at all low points of the system to permit complete drainage of the circuit during maintenance.
  Two drain valves integrated in the shut-off valves are provided to drain the water from the indoor unit water system.
- Make sure to provide a proper drain for the pressure relief valve to avoid any water coming into contact with electrical parts.
- Air vents must be provided at all high points of the system. The vents should be located at points which are easily accessible for servicing. An automatic air purge is provided inside the indoor unit. Check that this air purge valve is not tightened too much so that automatic release of air in the water circuit remains possible.
- Take care that the components installed in the field piping can withstand the water pressure and water temperature.
- Always use materials which are compatible with water used in the system and with the materials used on the indoor unit.
- Select piping diameter in relation to required water flow and available ESP of the pump.
- The minimum required water flow for the indoor unit operation is 4.23 gallons/min (16 l/min). When the water flow is lower than this minimum value, flow error 7H will be displayed and the operation of the indoor unit will be stopped.

Checking the water volume and expansion vessel pre-pressure

The unit is equipped with an expansion vessel of 2.6 gallons (10 litre) which has a default pre-pressure of 14.5 psi (1 bar).

To assure proper operation of the unit, the pre-pressure of the expansion vessel might need to be adjusted and the minimum and maximum water volume must be checked.

1 Check that the total water volume in the installation, excluding the internal water volume of the indoor unit, is 5.3 gallons (20 l) minimum. Refer to "Technical specifications" on page 43 to know the internal water volume of the indoor unit.

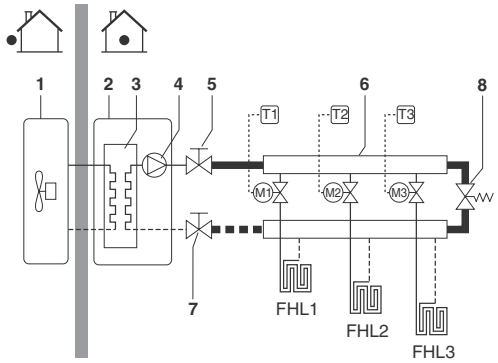
In most applications this minimum water volume will have a satisfying result.

In critical processes or in rooms with a high heat load though, extra water volume might be required.

NOTE

When circulation in each space heating loop is controlled by remotely controlled valves, it is important that this minimum water volume is kept even if all the valves are closed.

Example



1	Outdoor unit	**8**	By-pass valve (field supply)
2	Indoor unit		
3	Heat exchanger	**FHL1..3**	Floor heating loop (field supply)
4	Pump		
5	Shut-off valve	**T1..3**	Individual room thermostat (optional)
6	Collector (field supply)		
7	Shut-off valve	**M1..3**	Individual motorised valve to control loop FHL1 (field supply)

2 Using the table below, determine if the expansion vessel pre-pressure requires adjustment.

3 Using the table and instructions below, determine if the total water volume in the installation is below the maximum allowed water volume.

Installation height difference[a]	Water volume	
	≤74 gallons (280 l)	>74 gallons (280 l)
≤23 ft (≤7 m)	No pre-pressure adjustment required.	Actions required: • pre-pressure must be decreased, calculate according to "Calculating the pre-pressure of the expansion vessel" • check if the water volume is lower than maximum allowed water volume (use graph below)
>23 ft (>7 m)	Actions required: • pre-pressure must be increased, calculate according to "Calculating the pre-pressure of the expansion vessel" • check if the water volume is lower than maximum allowed water volume (use graph below)	Expansion vessel of the unit too small for the installation.

(a) Installation height difference: height difference (ft)(m) between the highest point of the water circuit and the unit. If the unit is located at the highest point of the installation, the installation height is considered 0 ft (0 m).

Calculating the pre-pressure of the expansion vessel

The pre-pressure (Pg) to be set depends on the maximum installation height difference (H) and is calculated as below:

$Pg_{(psi)}=(H_{(ft)}/32+0.3)x14.5$ psi

$Pg_{(bar)}=(H_{(m)}/10+0.3)$ bar

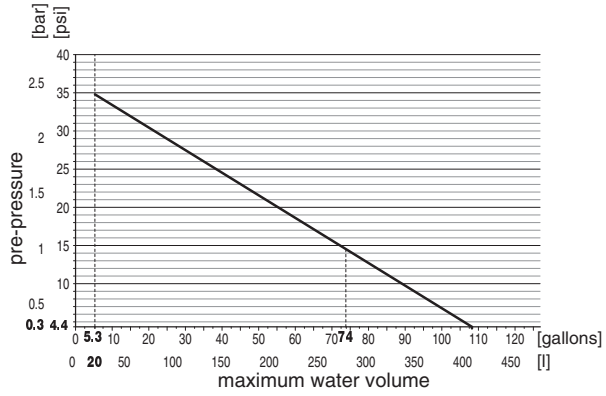
Checking the maximum allowed water volume

To determine the maximum allowed water volume in the entire circuit, proceed as follows:

1 Determine for the calculated pre-pressure (Pg) the corresponding maximum water volume using the graph below.

2 Check that the total water volume in the entire water circuit is lower than this value.

If this is not the case, the expansion vessel inside the unit is too small for the installation.



pre-pressure = pre-pressure

maximum water volume = maximum water volume

Example 1

The unit is installed 16.4 ft (5 m) below the highest point in the water circuit. The total water volume in the water circuit is 26.4 gallons (100 l).

In this example, no action or adjustment is required.

Example 2

The unit is installed at the highest point in the water circuit. The total water volume in the water circuit is 92.5 gallons (350 l).

Result:

- Since 92.5 gallons (350 l) is higher than 74.0 gallons (280 l), the pre-pressure must be decreased (see table above).
- The required pre-pressure is:
  $Pg_{(psi)} = (H_{(ft)}/32+0.3)x14.5$ psi = (0/32+0.3)x14.5 psi = 4.4 psi
  $Pg_{(bar)} = (H_{(m)}/10+0.3)$ bar = (0/10+0.3) bar = 0.3 bar
- The corresponding maximum water volume can be read from the graph: approximately 108.0 gallons (410 l).
- Since the total water volume (92.5 gallons (350 l)) is below the maximum water volume (108.0 gallons (410 l)), the expansion vessel suffices for the installation.

Setting the pre-pressure of the expansion vessel

When it is required to change the default pre-pressure of the expansion vessel (14.5 psi (1 bar)), keep in mind the following guidelines:

- Use only dry nitrogen to set the expansion vessel pre-pressure.
- Inappropriate setting of the expansion vessel pre-pressure will lead to malfunction of the system. Therefore, the pre-pressure should only be adjusted by a licensed installer.

Connecting the water circuit

Water connections must be made in accordance with local laws and regulations and the outlook diagram delivered with the unit, respecting the water in- and outlet.

NOTE

Be careful not to deform the unit piping by using excessive force when connecting the piping. Deformation of the piping can cause the unit to malfunction.

If air, moisture or dust gets in the water circuit, problems may occur. Therefore, always take into account the following when connecting the water circuit:

- Use clean pipes only.
- Hold the pipe end downwards when removing burrs.
- Cover the pipe end when inserting it through a wall so that no dust and dirt enter.
- Use a good thread sealant for the sealing of the connections. The sealing must be able to withstand the pressures and temperatures of the system.
- When using non-brass metallic piping, make sure to insulate both materials from each other to prevent galvanic corrosion.
- Because brass is a soft material, use appropriate tooling for connecting the water circuit. Inappropriate tooling will cause damage to the pipes.

NOTE

- The unit is only to be used in a closed water system. Application in an open water circuit can lead to excessive corrosion of the water piping.
- Never use Zn-coated parts in the water circuit. Excessive corrosion of these parts may occur as copper piping is used in the unit's internal water circuit.
- When using a 3-way valve in the water circuit.

  It is very important to guarantee full separation between domestic hot water and floor heating water circuit.
- When using a 3-way valve or a 2-way valve in the water circuit, the maximum change over time of the valve shall be less than 60 seconds.

Charging water

1 Connect the water supply to a drain and fill valve (see "Main components" on page 10).

2 Make sure the automatic air purge valve is open (at least 2 turns).

3 Fill with water until the manometer indicates a pressure of approximately 29 psi (2.0 bar). Remove air in the circuit as much as possible using the air purge valves. Air present in the water circuit might cause malfunctioning of the backup heater.

4 Check that the backup heater vessel is filled with water by opening the pressure relief valve. Water must flow out of the valve.

NOTE

- During filling, it might not be possible to remove all air in the system. Remaining air will be removed through the automatic air purge valves during first operating hours of the system. Additional filling with water afterwards might be required.
- The water pressure indicated on the manometer will vary depending on the water temperature (higher pressure at higher water temperature). However, at all times water pressure should remain above 4.3 psi (0.3 bar) to avoid air entering the circuit.
- The unit might dispose some excessive water through the pressure relief valve.
- Water quality must be according to "Safe Drinking water Act (42 U.S.C. 300f)".

Piping insulation

The complete water circuit, inclusive all piping, must be insulated to prevent condensation during cooling operation and reduction of the cooling and heating capacity.

If the temperature is higher than 86°F (30°C) and the humidity is higher than RH 80%, then the thickness of the sealing materials should be at least 0.79 inch (20 mm) in order to avoid condensation on the surface of the sealing.

Field wiring

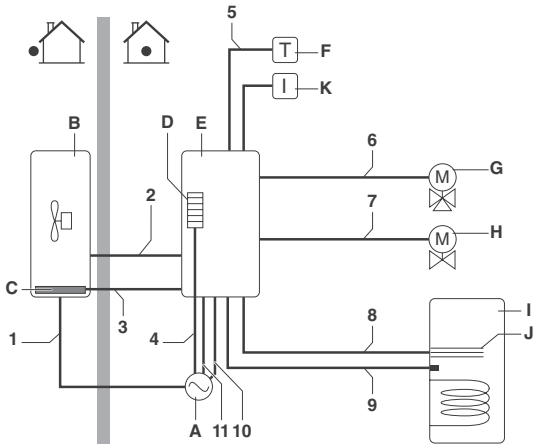
WARNING

- A main switch or other means for disconnection, having a contact separation in all poles, must be incorporated in the fixed wiring in accordance with relevant local laws and regulations.
- Switch off the power supply before making any connections.
- Use only copper wires.
- Never squeeze bundled cables and make sure that it does not come in contact with the piping and sharp edges.

  Make sure no external pressure is applied to the terminal connections.
- All field wiring and components must be installed by a licensed electrician and must comply with relevant local laws and regulations.
- The field wiring must be carried out in accordance with the wiring diagram supplied with the unit and the instructions given below.
- Be sure to use a dedicated power supply. Never use a power supply shared by another appliance.
- Be sure to establish an ground. Do not ground the unit to a utility pipe, surge absorber, or telephone ground. Incomplete ground may cause electrical shock.
- Be sure to install an ground fault circuit interrupter (30 mA) in accordance with relevant local laws and regulations. Failure to do so may cause electrical shock or fire.
- Be sure to install the required fuses or circuit breakers.

Overview

The illustration below gives an overview of the required field wiring between several parts of the installation. Refer also to "Typical application examples" on page 4.



A	Single power supply for outdoor unit, backup heater and booster heater	**G**	3-way valve for domestic hot water tank (optional)
B	Outdoor unit	**H**	2-way valve for cooling mode (field supply)
C	Bottom plate heater EKBPHT(a)	**I**	Domestic hot water tank (optional)
D	Backup heater	**J**	Booster heater (optional)
E	Indoor unit		
F	Room thermostat (optional)	**K**	User interface (digital controller)

(a) Bottom plate heater is only applicable in combination with ERLQ or in case of optional EKBPHT kit.

Item	Description	Required number of conductors	Maximum running current
1	Power supply cable for outdoor unit	2+GND	(a)
2	Indoor unit power supply and communication cable	3+GND	(b)
3	Power cable for bottom plate heater	2	(c)
4	Power supply cable for backup heater	2+GND or 3+GND	(d)
5	Room thermostat cable	3 or 4	100 mA(e)
6	3-way valve control cable	2+GND	100 mA(e)
7	2-way valve control cable	2+GND	100 mA(e)
8	Booster heater power supply and thermal protection cable	4+GND	(b)
9	Thermistor cable	2	(f)
10	Booster heater power supply cable	2+GND	13 A
11	Benefit kWh rate power supply cable (voltage free contact)	2	(g)
12	User interface cable	2	(h)

(a) Refer to nameplate on outdoor unit.
(b) Cable section AWG13 (2.5 mm^2)
(c) Minimum cable section AWG18 (0.75 mm^2)
(d) See table under "Connection of the backup heater power supply" on page 18.
(e) Minimum cable section AWG18 (0.75 mm^2)
(f) The thermistor and connection wire (39.4 ft)(12 m) are delivered with the domestic hot water tank.
(g) Cable section AWG18 till AWG16 (0.75~1.25 mm^2), maximum length: 164 ft (50 m).
Voltage free contact shall ensure the minimum applicable load of 15 V DC, 10 mA.
(h) Cable section AWG18 till AWG16 (0.75~1.25 mm^2), maximum length: 1640 ft (500 m).

CAUTION

Select all cables and wire sizes in accordance with relevant local laws and regulations.

WARNING

After finishing the electric work, confirm that each electric part and terminal inside the electric parts box is connected securely.

Internal wiring - Parts table

Refer to the internal wiring diagram supplied with the unit (on the inside of the indoor unit switch box cover). The abbreviations used are listed below.

A1P .....Main PCB
A2P .....Digital controller PCB (user interface)
A3P .....*.....Thermostat (EKRTWA) (PC= internal Power Cicuit) (optional)
A4P .....*.....Digital I/O PCB (EKRP1HB) (optional)
E1H.....Backup heater element 1
E2H.....Backup heater element 2
E4H..... #.....Booster heater (3 kW)
F1B,F3B.....Fuse backup heater
F2B ..... #.....Fuse booster heater
F1T.....Thermal fuse backup heater (250 V, 201.2°F (94°C))
FU1 .....Fuse 3.15 A T 250 V for PCB
FU2 .....Fuse 5 A T 250 V
FU3 .....Fuse 1 A T 250 V
FuR,FuS.....Fuse 5 A 250 V for digital I/O PCB
K1A~K4A .....Relays for valves and thermostat
K5A~K7A .....Relays for digital I/O PCB kit
K1M.....Contactor backup heater step 1
K2M.....Contactor backup heater step 2
K3M..... #.....Contactor booster heater
K4M.....Pump relay
K5M,K6M .....Contactor for backup heater all pole disconnection
M1P.....Pump
M2S..... ##.....2-way valve for cooling mode (field supply)
M3S..... #.....3-way valve: floor heating/domestic hot water
PHC1 .....Optocoupler input circuit
Q1DI.....Ground fault circuit interrupter (field supply)
Q1L .....Thermal protector backup heater
Q2L,Q3L . #.....Thermal protector booster heater
R1T .....*.....Ambient sensor (EKRTWA) (optional)
R1T .....Outlet water heat exchanger thermistor
R2T .....Outlet water backup heater thermistor
R3T .....Refrigerant liquid side thermistor
R4T .....Inlet water thermistor
R5T ..... #.....Domestic hot water thermistor
S1L.....Flow switch
S1S .....Solar pump station relay
S2S .....Benefit kWh rate power supply contact
S3S .....Dual set point 2 contact
S4S .....Dual set point 1 contact
SS1 .....DIP switch
TR1,TR2 .....Transformer 24 V for PCB, for relays and valves
V1S .....Spark suppression 1
V2S .....Spark suppression 2
X1M~X9M .....Terminal blocks

* Optional
\# Applications with domestic hot water tank only
\## Heating/cooling applications only

Field wiring guidelines

- Most field wiring on the indoor unit side is to be made on the terminal block inside the switch box. To gain access to the terminal block, remove the indoor unit cover and switch box service panel, see "Opening the indoor unit" on page 9.

> **WARNING**
>
> Switch off all power supply – i.e. outdoor unit power supply and backup heater and domestic hot water tank power supply (if applicable) – before removing the switch box service panel.

- Cable tie mountings are provided at the bottom of the switch box. Fix all cables using cable ties (field supply).
- A dedicated power circuit is required for the backup heater.
- Installations equipped with a domestic hot water tank (optional), require a dedicated power circuit for the **booster heater**.

  Please refer to the domestic hot water tank installation manual.

Connection of the indoor unit power supply and communication cable

Power circuit and cable requirements

Power supply for the indoor unit is to be provided through the outdoor unit. Data communication with the outdoor unit is provided through the same cable.

For all guidelines and specifications regarding field wiring between the indoor unit and the outdoor unit, please refer to the outdoor unit installation manual.

Procedure

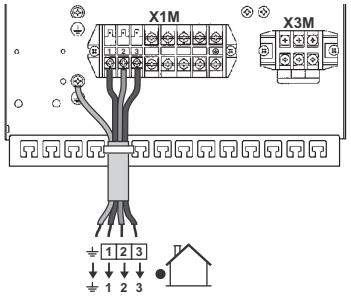
1 Using the appropriate cable, connect the power circuit to the appropriate terminals as shown on the wiring diagram and the illustration below.

2 Connect the ground conductor (yellow/green) to the grounding screw on the switch box mounting plate.

3 Fix the cable with cable ties to the cable tie mountings to ensure strain relief.

4 When routing out cables, make sure that these do not obstruct mounting of the indoor unit cover, see figure 3.

Note: only relevant field wiring is shown.



Connection of the backup heater power supply

Power circuit and cable requirements

> Use a dedicated power circuit for the backup heater and booster heater. Never use a power circuit shared by another appliance.

This power circuit must be protected with the required safety devices according to local laws and regulations.

Select the power cable in accordance with relevant local laws and regulations. For the maximum running current of the backup heater, refer to the table below.

Indoor unit model	Backup heater capacity	Backup heater nominal voltage	Minimum circuit amps	Maximum overcurrent protection
EKHB*054BA3V3	3 kW	1x 230 V	14.3 A	20 A
EKHB*054BA6V3	6 kW	1x 230 V	28.6 A	30 A

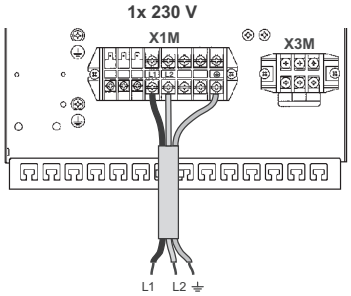
Procedure

1 Using the appropriate cable, connect the power circuit to the main circuit breaker as shown on the wiring diagram and the illustration below.

2 Connect the ground conductor (yellow/green) to the grounding screw on the X1M terminal.

3 Fix the cable with cable ties to the cable tie mountings to ensure strain relief.

Note: only relevant field wiring is shown.



Connection of the thermostat cable

Connection of the thermostat cable depends on the application.

See also "Typical application examples" on page 4 and "Room thermostat installation configuration" on page 22 for more information and configuration options on pump operation in combination with a room thermostat.

Thermostat requirements

- Power supply: battery operated
- Contact voltage: 24 V.

Procedure

1 Connect the thermostat cable to the appropriate terminals as shown on the wiring diagram and installation manual of the room thermostat kit.

2 Fix the cable with cable ties to the cable tie mountings to ensure strain relief.

3 Set DIP switch SS2-3 on the PCB to ON. See "Room thermostat installation configuration" on page 22 for more information.

Connection of the first set point and second set point contacts

The connection of the set point contact is only relevant in case dual set point contact is enabled.

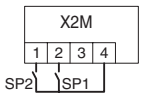
See also "Typical application examples" on page 4 and "Dual set point control" on page 29.

Contact requirements

The contact shall be a voltage free contact that ensure 24 V (100 mA).

Procedure

1 Connect the contact of first set point and second set point to the appropriate terminals as shown in the figure below



SP1 First set point contact
SP2 Second set point contact

2 Fix the cables with cable ties to the cable tie mountings to ensure strain relief.

3 Depending on the required pump operation set DIP switch SS2-3 and field setting [F-00]. See "Pump operation configuration" on page 23 and field setting [F-00] in "[F] Option setup" on page 34.

Connection of the valve control cables

Valve requirements

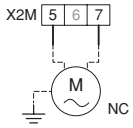
- Power supply: 24 V AC
- Maximum running current: 100 mA

Wiring the 2-way valve

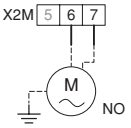
1 Using the appropriate cable, connect the valve control cable to the X2M terminal as shown on the wiring diagram.

NOTE Wiring is different for a NC (normal closed) valve and a NO (normal open) valve. Make sure to connect to the correct terminal numbers as detailed on the wiring diagram and illustrations below.

Normal closed (NC) 2-way valve



Normal open (NO) 2-way valve



2 Fix the cable(s) with cable ties to the cable tie mountings to ensure strain relief.

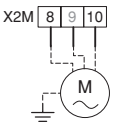
Wiring the 3-way valve

1 Using the appropriate cable, connect the valve control cable to the appropriate terminals as shown on the wiring diagram.

NOTE Type of 3-way valve to be connected. (Delivered with optional domestic hot water tank)

- "SPST 3-wire" type 3-way valve
  The 3-way valve should be fitted as such that when terminal ports 9 and 10 are electrified, the domestic hot water circuit is selected.

"SPST 3-wire" valve



2 Fix the cable(s) with cable ties to the cable tie mountings to ensure strain relief.

Power input selection to transformer TR2

This selection is needed to ensure a stable 24 V AC output.

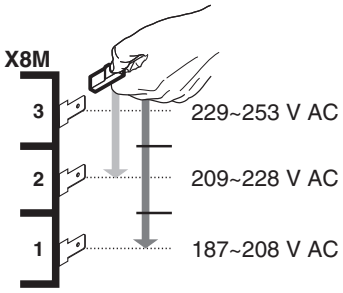
Procedure

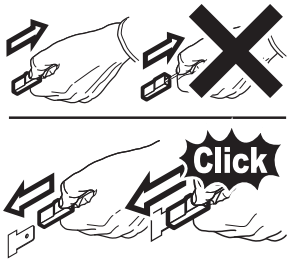
DANGER

Switch off all relevant power supply (outdoor unit, backup heater, booster heater) before changing the connector.

1 Measure main input power.

2 Reconnect wire according to the result of measurement.





Connection to a benefit kWh rate power supply

Electricity companies throughout the world work hard to provide reliable electric service at competitive prices and are often authorized to bill clients at benefit rates. E.g. time-of-use rates, seasonal rates, Wärmepumpentarif in Germany and Austria, ...

This equipment allows for connection to such benefit rate power supply delivery systems.

Consult with the electricity company acting as provider at the site where this equipment is to be installed to know whether it is appropriate to connect the equipment in one of the benefit kWh rate power supply delivery systems available, if any.

When the equipment is connected to such benefit kWh rate power supply, the electricity company is allowed to:

- interrupt power supply to the equipment for certain periods of time;
- demand that the equipment only consumes a limited amount of electricity during certain periods of time.

The indoor unit is designed to receive an input signal by which the unit switches into forced off mode. At that moment, the outdoor unit compressor will not operate.

CAUTION

For a benefit kWh rate power supply like illustrated below as type 1

- If the benefit kWh rate power supply is of the type that power supply is not interrupted, then control of the heaters is still possible.

  For the different possibilities of controlling heaters at moments that benefit kWh rate is active, refer to "[D] Benefit kWh rate power supply/Local shift value weather dependent" on page 33.

  If heaters must be controlled at moments that the benefit kWh rate power supply is off, then these heaters shall be connected to a separate power supply.
- During the period that the benefit kWh rate is active and power supply is continuous, then stand-by power consumption is possible (PCB, controller, pump, ...).

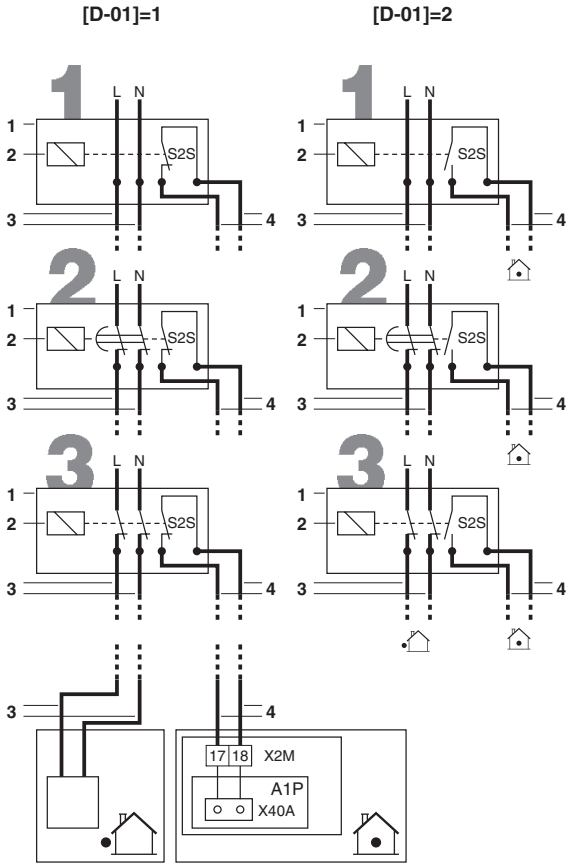
For a benefit kWh rate power supply like illustrated below as types 2 or 3

If during benefit kWh rate power supply the power supply is shut off, then heaters can not be controlled.

- This power supply interruption should not be longer than 2 hours, otherwise the real time clock of the controller will be reset.
- During power supply interruption, the controller display will be blank.

Possible types of benefit kWh rate power supply

Possible connections and requirements to connect the equipment to such power supply are illustrated in the figure below:



1	Benefit kWh rate power supply box
2	Receiver controlling the signal of the electricity company
3	Power supply to outdoor unit (refer to the installation manual delivered with the outdoor unit)
4	Voltage free contact to indoor unit

When the outdoor unit is connected to a benefit kWh rate power supply, the voltage free contact of the receiver controlling the benefit kWh rate signal of the electricity company must be connected to clamps 17 and 18 of X2M (as illustrated in the figure above).

When parameter [D-01]=1 at the moment that the benefit kWh rate signal is sent by the electricity company, that contact will open and the unit will go in forced off mode(1).

When parameter [D-01]=2 at the moment that the benefit kWh rate signal is sent by the electricity company, that contact will close and the unit will go in forced off mode(2).

Type 1

This type of benefit kWh rate power supply is not interrupted.

Type 2

This type of benefit kWh rate power supply is interrupted after elapse of time.

Type 3

This type of benefit kWh rate power supply is interrupted immediately.

(1) When the signal is released again, the voltage free contact will close and the unit will restart operation. It is therefore important to leave the auto restart function enabled. Refer to "[3] Auto restart" on page 26.

(2) When the signal is released again, the voltage free contact will open and the unit will restart operation. It is therefore important to leave the auto restart function enabled. Refer to "[3] Auto restart" on page 26.

When connecting the equipment to a benefit kWh rate power supply, change field setting [D-01]. In case the benefit kWh rate power supply is of the type that power supply is not interrupted (like illustrated above as type 1) change both field settings [D-01] and [D-00]. Refer to "[D] Benefit kWh rate power supply/Local shift value weather dependent" on page 33 of chapter "Field settings".

If the benefit kWh rate power supply is of the type that power supply is not interrupted, the unit will be forced to off. Controlling the solar pump is still possible.

When the benefit kWh rate signal is sent, the centralised control indicator will flash to indicate that the benefit kWh rate is active.

Relocation of the digital controller

The digital controller is from factory located on the indoor unit. (See "Main components" on page 10 for actual position). If required, the digital controller can be repositioned.

Be aware that only 1 digital controller can be connected to the indoor unit.

Wiring specifications

Wire specification	Value
Type	2 wire
Section	AWG18 - AWG16 (0.75~1.25 mm^2)
Maximum length	1640 ft (500 m)

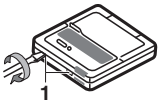
NOTE The wiring for connection is not included.

Mounting

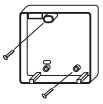
NOTE The digital controller has to be mounted indoors.

1 Remove the front part of the digital controller.

Insert a slotted screwdriver into the slots (1) in the rear part of the digital controller, and remove the front part of the digital controller.

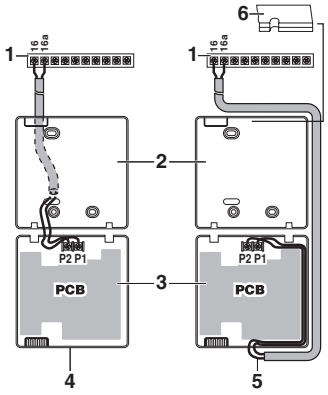


2 Fasten the digital controller on a flat surface.



NOTE Be careful not to distort the shape of the lower part of the digital controller by over tightening the mounting screws.

3 Wire the unit.

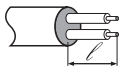


1 Unit
2 Rear part of the digital controller
3 Front part of the digital controller
4 Wired from the rear
5 Wired from the top
6 Notch the part for the wiring to pass through with nippers, etc.

Connect the terminals on top of the front part of the digital controller and the terminals inside the unit (P1 to 16, P2 to 16a).

NOTE

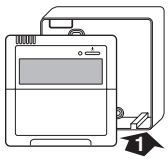
- When wiring, run the wiring away from the power supply wiring in order to avoid receiving electric noise (external noise).
- Peel the shield for the part that has to pass through the inside of the digital controller case (⟋).



4 Reattach the upper part of the digital controller.

CAUTION
Be careful not to pinch the wiring when attaching.

First begin fitting from the clips at the bottom.



START-UP AND CONFIGURATION

The indoor unit should be configured by the installer to match the installation environment (outdoor climate, installed options, etc.) and user expertise.

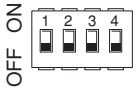
It is important that **all** information in this chapter is read sequentially by the installer and that the system is configured as applicable.

DIP switch settings overview

DIP switch SS2 is located on the switch box PCB (see "Switch box main components" on page 11) and allows configuration of domestic hot water tank installation, room thermostat connection and pump operation.

WARNING

Switch off the power supply before opening the switch box service panel and making any changes to the DIP switch settings.

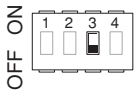


DIP switch SS2	Description	ON	OFF
1	Not applicable for installer	—	(Default)
2	Domestic hot water tank installation (see "Domestic hot water tank installation configuration" on page 23)	Installed	Not installed (Default)
3	Room thermostat connection (see "Room thermostat installation configuration" on page 22)	Room thermostat connected	No room thermostat connected (Default)
4	This setting[a] decides the operation mode of the heat pump when there is a simultaneous demand for more space heating/cooling and domestic water heating.	Heating/cooling priority	Priority to highest demand side[b]

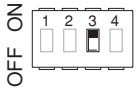
(a) Only applicable in case DIP switch 2 = ON.
(b) Heating/cooling or domestic water heating mode can be restricted by schedule timer and/or field settings (4, 5, 8).

Room thermostat installation configuration

- When **no room thermostat** is connected to the indoor unit, toggle switch SS2-3 should be set to **OFF**.



- When the **room thermostat** is connected to the indoor unit, toggle switch SS2-3 should be set to **ON**.

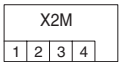
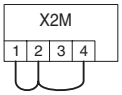


- On the room thermostat, confirm the correct settings (6-02=yes, 6-05=9, 6-06=3) to prevent the pump from repeatedly turning on and off (i.e. chattering), and thereby impacting the lifetime of the pump.

- When the room thermostat is connected to the indoor unit, the heating and cooling schedule timers are never available. Other schedule timers are not affected. For more information on the schedule timers, refer to the operation manual.
- When the room thermostat is connected to the indoor unit, and the ☀/❄ button or button is pressed, the centralised control indicator will flash to indicate that the room thermostat has priority and controls on/off operation and change over operation.

The following table summarizes the required configuration and thermostat wiring at the terminal block (X2M: 1, 2, 3, 4) in the switch box. Pump operation is listed in the third column. The three last columns indicate whether the following functionality is available on the user interface (UI) or handled by the thermostat (T):

- space heating or cooling on/off ( )
- heating/cooling changeover (☀/❄)
- heating and cooling schedule timers ( )

Thermostat	Configuration	Pump operation		☀/❄	
No thermostat	• SS2-3 = OFF • wiring: (non) 	determined by leaving water temperature[a]	UI	UI	UI
	• SS2-3 = ON • wiring: 	on when space heating or cooling is on ( )	UI	UI	UI
Heating only thermostat	• SS2-3 = ON • wiring: (see installation manual of the room thermostat kit)	on when heating request by room thermostat	T	—	—
Thermostat with heating/cooling switch	• SS2-3 = ON • wiring: (see installation manual of the room thermostat kit)	on when heating request or cooling request by room thermostat	T	T	—

(a) The pump will stop when space heating/cooling is turned off or when the water reaches the desired water temperature as set on the user interface. With space heating/cooling turned on, the pump will then run every 5 minutes during 3 minutes to check the water temperature.

Pump operation configuration

NOTE

To set the pump speed, refer to "Setting the pump speed" on page 24.

Without room thermostat: DIP switch SS2-3 = OFF

When no thermostat is connected to the indoor unit, pump operation will be determined by the leaving water temperature.

To force continuous pump operation when no room thermostat is connected do the following:

- set toggle switch SS2-3 to ON,
- short-circuit the terminal numbers 1-2-4 on the terminal block in the switch box.

With room thermostat: DIP switch SS2-3 = ON

When the thermostat is connected to the indoor unit, the pump will operate continuously whenever there is heating or cooling demand requested by the thermostat.

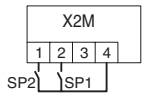
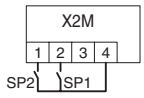
Dual set point

When dual set point is enabled, the pump operation will be determined depending on the status of the DIP switch SS2-3 and set point selection contacts. Refer to the pump operation configurations when the thermostat is connected or not as described above.

When dual set point is enabled, the "forced continuous pump operation" is not possible. When SS2-3 is ON while SP1 and SP2 are both closed, the pump operation will be the same operation as "with room thermostat" and the second set point will be the applicable set point. Refer to "Dual set point control" on page 29.

The following table summarizes the required configuration and wiring at the terminal block (X2M: 1, 2, 4) in the switch box. Pump operation is listed in the third column. The three last columns indicate whether the following functionality is available on the user interface (UI) or handled by the set point selection contacts SP1 and SP2:

- space heating or cooling on/off
- heating/cooling changeover
- heating and cooling schedule timers

Dual set point				
Configuration	**Pump operation**			
• [7-02]=1 • SS2-3 = OFF • wiring: 	determined by leaving water temperature[a]	UI	UI	UI
• [7-02]=1 • SS2-3 = ON • wiring: 	on when main or/and sub set point is requested	SP2/SP1	UI	—

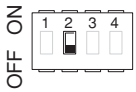
SP1 = First set point contact

SP2 = Second set point contact

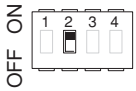
(a) The pump will stop when space heating/cooling is turned off or when the water reaches the desired water temperature as set on the user interface. With space heating/cooling turned on, the pump will then run every 5 minutes during 3 minutes to check the water temperature.

Domestic hot water tank installation configuration

- When **no domestic hot water tank** is installed, toggle switch SS2-2 should be set to **OFF** (default).



- When a **domestic hot water tank** is installed, toggle switch SS2-2 should be set to **ON**.



When SS2-3 was set to ON without all necessary and correct wiring connections between indoor unit and switchbox of the domestic hot water tank, the error code AC will be displayed on the user interface.

Initial start-up at low outdoor ambient temperatures

During initial start-up and when water temperature is low, it is important that the water is heated gradually. Failure to do so may result in cracking of concrete floors due to rapid temperature change. Please contact the responsible cast concrete building contractor for further details.

To do so, the lowest leaving water set temperature can be decreased to a value between 59°F (15°C) and 77°F (25°C) by adjusting the field setting [9-01] (heating set point lower limit). Refer to "Field settings" on page 25.

Heating between 59°F (15°C) and 77°F (25°C) is performed by the backup heater only.

Pre-operation checks

Checks before initial start-up

DANGER

Switch off all relevant power supply before making any connections.

After the installation of the unit, check the following before switching on the circuit breaker:

1 Field wiring

Make sure that the field wiring between local supply panel and indoor unit, outdoor unit and indoor unit, indoor unit and valves (when applicable), indoor unit and room thermostat (when applicable), and indoor unit and domestic hot water tank has been carried out according to the instructions described in the chapter "Field wiring" on page 16, according to the wiring diagrams and according to local laws and regulations.

2 Fuses, circuit breakers, or protection devices

Check that the fuses, circuit breakers, or the locally installed protection devices are of the size and type specified in the chapter "Technical specifications" on page 43. Make sure that neither a fuse nor a protection device has been bypassed.

3 Backup heater circuit breaker F1B/F3B

Do not forget to turn on the backup heater circuit breaker F2B in the switchbox (F1B/F3B depends on the backup heater type). Refer to the wiring diagram.

4 Booster heater circuit breaker F2B

Do not forget to turn on the booster heater circuit breaker F2B in the switch box (applies only to units with optional domestic hot water tank installed).

5 Ground wiring

Make sure that the ground wires have been connected properly and that the ground terminals are tightened.

6 Internal wiring

Visually check the switch box on loose connections or damaged electrical components.

7 Fixation

Check that the unit is properly fixed, to avoid abnormal noises and vibrations when starting up the unit.

8 Damaged equipment

Check the inside of the unit on damaged components or squeezed pipes.

9 Refrigerant leak

Check the inside of the unit on refrigerant leakage. If there is a refrigerant leak, call your local dealer.

10 Power supply voltage

Check the power supply voltage on the local supply panel. The voltage must correspond to the voltage on the identification label of the unit.

11 Air purge valve

Make sure the air purge valve is open (at least 2 turns).

12 Pressure relief valve

Check if the backup heater is completely filled with water by operating the pressure relief valve. It should purge water instead of air.

NOTE Operating the system with the backup heater not completely filled with water will damage the backup heater!

13 Shut-off valves

Make sure that the shut-off valves are correctly installed and fully open.

NOTE Operating the system with closed valves will damage the pump!

Powering up the indoor unit

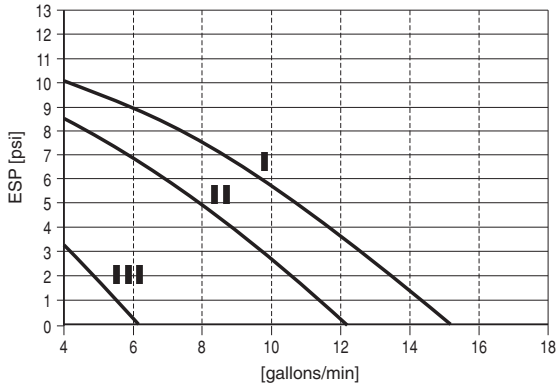
When power supply to the indoor unit is turned on, "88" is displayed on the user interface during its initialisation, which might take up to 30 seconds. During this process the user interface cannot be operated.

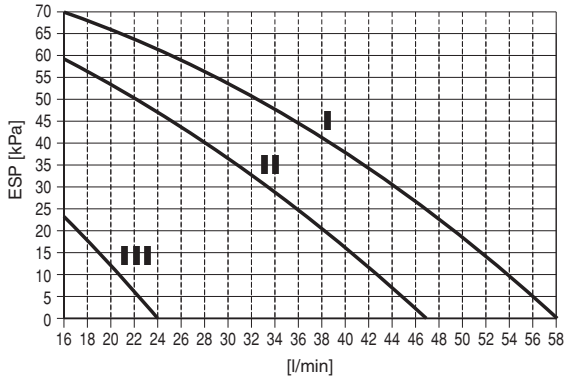
Setting the pump speed

The pump speed can be selected on the pump (see "Main components" on page 10).

The default setting is high speed (**I**). If the water flow in the system is too high (e.g., noise of running water in the installation) the speed can be set to medium speed (**II**) or low speed (**III**).

The available external static pressure (ESP, expressed in psi (kPa)) in function of the water flow (gallons/min (l/min)) is shown in the graph below.





Field settings

The indoor unit shall be configured by the installer to match the installation environment (outdoor climate, installed options, etc.) and user demand. Thereto, a number of so called field settings are available. These field settings are accessible and programmable through the user interface on the indoor unit.

Each field setting is assigned a 3-digit number or code, for example [1-03], which is indicated on the user interface display. The first digit [1] indicates the 'first code' or field setting group. The second and third digit [03] together indicate the 'second code'.

A list of all field settings and default values is given under "Field settings table" on page 35. In this same list, we provided for 2 columns to register the date and value of altered field settings at variance with the default value.

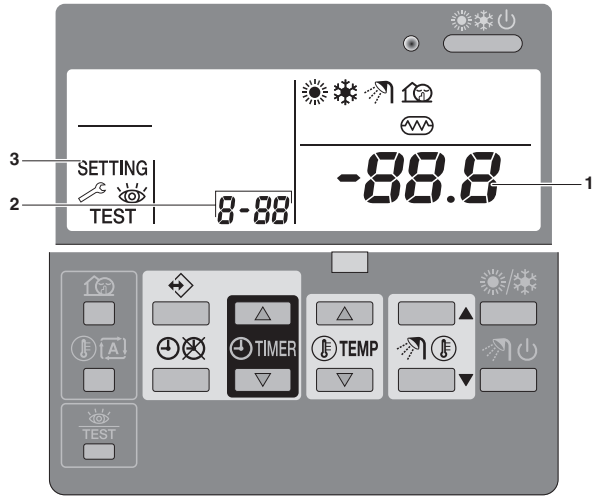
A detailed description of each field setting is given under "Detailed description" on page 25.

Procedure

To change one or more field settings, proceed as follows.

Temperature values displayed on the digital controller (user interface) are in °C.

Temperature values in °C are between brackets. Conversion from °C to °F is for information only.



1 Press the TEST button for a minimum of 5 seconds to enter FIELD SET MODE.
The **SETTING** icon (3) will be displayed. The current selected field setting code is indicated *8-88* (2), with the set value displayed to the right *-88.8* (1).

2 Press the TEMP▲ button to select the appropriate field setting first code.

3 Press the TEMP▼ button to select the appropriate field setting second code.

4 Press the TIMER▲ button and TIMER▼ button to change the set value of the select field setting.

5 Save the new value by pressing the ⊘ button.

6 Repeat step 2 through 4 to change other field settings as required.

7 When finished, press the TEST button to exit FIELD SET MODE.

NOTE Changes made to a specific field setting are only stored when the ⊘ button is pressed. Navigating to a new field setting code or pressing the TEST button will discard the change made.

- Before shipping, the set values have been set as shown under "Field settings table" on page 35.
- When exiting FIELD SET MODE, "88" may be displayed on the user interface LCD while the unit initialises itself.

Detailed description

[0] User permission level

If required, certain user interface buttons can be made unavailable for the user.

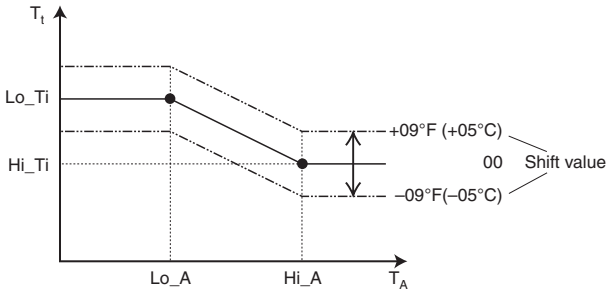
Three permission levels are defined (see the table below). Switching between level 1 and level 2/3 is done by simultaneously pressing buttons TIMER▲ and TIMER▼ immediately followed by simultaneously pressing buttons and , and keeping all 4 buttons pressed for at least 5 seconds (in normal mode). Note that no indication on the user interface is given. When level 2/3 is selected, the actual permission level – either level 2 or level 3 – is determined by the field setting [0-00].

		Permission level		
Button		**1**	**2**	**3**
Quiet mode button		operable	—	—
Weather dependent set point button		operable	—	—
Schedule timer enable/disable button		operable	operable	—
Programming button		operable	—	—
Time adjust buttons	TIMER▲ TIMER▼	operable	—	—
Inspection/test operation button	TEST	operable	—	—

[1] Weather dependent set point (heating operation only)

The weather dependent set point field settings define the parameters for the weather dependent operation of the unit. When weather dependent operation is active the water temperature is determined automatically depending on the outdoor temperature: colder outdoor temperatures will result in warmer water and vice versa. During weather dependent operation, the user has the possibility to shift up or down the target water temperature by a maximum of 9°F (5°C). See the operation manual for more details on weather dependent operation.

- [1-00] Low ambient temperature (Lo_A): low outdoor temperature.
- [1-01] High ambient temperature (Hi_A): high outdoor temperature.
- [1-02] Set point at low ambient temperature (Lo_Ti): the target outgoing water temperature when the outdoor temperature equals or drops below the low ambient temperature (Lo_A).
  Note that the Lo_Ti value should be higher than Hi_Ti, as for colder outdoor temperatures (i.e. Lo_A) warmer water is required.
- [1-03] Set point at high ambient temperature (Hi_Ti): the target outgoing water temperature when the outdoor temperature equals or rises above the high ambient temperature (Hi_A).
  Note that the Hi_Ti value should be *lower* than Lo_Ti, as for warmer outdoor temperatures (i.e. Hi_A) less warm water suffices.



T_t	Target water temperature
T_A	Ambient (outdoor) temperature
Shift value	= Shift value

[2] Disinfection function

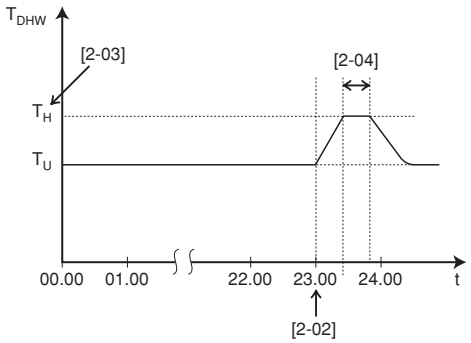
Applies only to installations with a domestic hot water tank.

The disinfection function disinfects the domestic hot water tank by periodically heating the domestic hot water to a specific temperature.

CAUTION

The disinfection function field settings must be configured by the installer according to local laws and regulations.

- [2-00] Operation interval: day(s) of the week at which the domestic hot water should be heated.
- [2-01] Status: defines whether the disinfection function is turned on (1) or off (0).
- [2-02] Start time: time of the day at which the domestic hot water should be heated.
- [2-03] Set point: high water temperature to be reached.
- [2-04] Interval: time period defining how long the set point temperature should be maintained.



T_{DHW}	Domestic hot water temperature
T_U	User set point temperature (as set on the user interface)
T_H	High set point temperature [2-03]
t	Time

WARNING

Be aware that the domestic hot water temperature at the hot water tap will be equal to the value selected in field setting [2-03] after a disinfection operation.

If this high domestic hot water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

[3] Auto restart

When power returns after a power supply failure, the auto restart function reapplies the user interface settings at the time of the power supply failure.

NOTE It is therefore recommended to leave the auto restart function enabled.

Note that with the function disabled the schedule timer will not be activated when power returns to the unit after a power supply failure. Press the ⏲⊗ button to enable the schedule timer again.

- [3-00] Status: defines whether the auto restart function is turned **ON (0)** or **OFF (1)**.

NOTE If the benefit kWh rate power supply is of the type that power supply is interrupted, then always allow the auto restart function.

[4] Backup/booster heater operation and space heating off temperature

Backup heater operation

The operation of the backup heater can altogether be enabled or disabled, or it can be disabled depending on operation of the booster heater.

- [4-00] Status: defines whether backup heater operation is enabled (1) or disabled (0).
- [4-01] Priority: defines whether backup heater and booster heater can operate simultaneously (0), or if the booster heater operation has priority over the backup heater operation (1), or if the backup heater operation has priority over the booster heater operation (2).

NOTE

When the priority field setting is set to ON (1), space heating performance of the system might be decreased at low outdoor temperatures, since in case of domestic water heating demand the backup heater will not be available for space heating (space heating will still be provided by the heat pump).

When the priority field setting is set to ON (2), domestic water heating performance of the system might be decreased at low outdoor temperatures, since in case of space heating demand the booster heater will not be available for domestic water heating. However domestic water heating by heat pump will still be available.

When the priority field setting is set to OFF (0), make sure that electrical power consumption does not exceed supply limits.

Space heating off temperature

- [4-02] Space heating off temperature: outdoor temperature above which space heating is turned off, to avoid overheating.

Booster heater operation

Applies only to installations with a domestic hot water tank.

The operation of the booster heater can be enabled or limited depending on outdoor temperature (T_A), domestic hot water temperature (T_{DHW}) or operation mode of the heat pump.

- [4-03] Booster heater operation: defines whether the optional booster heater operation is enabled (1) or has certain limitations (0/2/3).

Explanation of settings of [4-03]

Booster heater will/can only operate if domestic hot water mode is activated (🔥).

- [4-03]=0, then booster heater operation is only allowed during "[2] Disinfection function" and "Powerful domestic water heating" (see operation manual).
  This setting is only recommended in case the capacity of the heat pump can cover the heating requirements of the house and domestic hot water over the complete heating season.
  The result of this setting is that the domestic hot water will never be heated by the booster heater except for "[2] Disinfection function" and "Powerful domestic water heating" (see operation manual).

⚠ If the booster heater operation is limited ([4-03]=0) and the ambient outdoor temperature T_A is lower than the field setting to which parameter [5-03] is set and [5-02]=1, then the domestic hot water will not be heated.

The consequence of this setting is that the domestic hot water temperature (T_{DHW}) can be maximum the heat pump OFF temperature ($T_{HP\ OFF}$). Refer to setting of [6-00] and [6-01] in "[6]" on page 28.

- [4-03]=1, then booster heater heater operation is only determined by booster heater OFF temperature ($T_{BH\ OFF}$), booster heater ON temperature ($T_{BH\ ON}$) and/or schedule timer. Refer to setting "[7-00]" on page 29 and "[7-01]" on page 29.
- [4-03]=2, then booster heater operation is only allowed if heat pump is out of "operation range" of heat pump domestic water heating mode (T_A<[5-03] or T_A>95°F(35°C)) or domestic hot water temperature is 3.6°F (2°C) lower then the heat pump OFF temperature ($T_{HP\ OFF}$) for domestic hot water mode (T_{DHW}>$T_{HP\ OFF}$–3.6°F(2°C)). (Refer to setting [5-03] on page 27, [6-00] on page 28 and [6-01] on page 28). Results in the most optimum coverage of domestic hot water heated by the pump.
- [4-03]=3, then booster heater operation is the same as setting 1, except that booster heater is OFF when the heat pump is active in domestic hot water mode. The consequence of this functionality is that setting [8-03] is not relevant.
  Results in optimum coverage of domestic hot water heated by heat pump in relation with [8-04].

⚠
- When setting [4-03]=1/2/3, the booster heater operation can still be restricted by the schedule timer as well. I.e., when booster heater operation is preferred during certain period of the day. (See operation manual)
- When setting [4-03]=2, the booster heater will be allowed to operate when T_A<[5-03] independent of the status of [5-02]. If bivalent operation is enabled and permission signal for auxiliary boiler is ON, the booster heater will be restricted even when T_A<[5-03]. (See "[C-02]" on page 32).
- Booster heater is always allowed during powerful and disinfection function, except for the period that the backup heater operation is required for safety reasons and [4-02]=1.

[5] Equilibrium temperature and space heating priority temperature

Equilibrium temperature — The 'equilibrium temperature' field settings apply to operation of the **backup heater**.
When the equilibrium temperature function is enabled, operation of the backup heater is restricted to low outdoor temperatures, i.e. when the outdoor temperature equals or drops below the specified equilibrium temperature. When the function is disabled, operation of the backup heater is possible at all outdoor temperatures. Enabling this function reduces the working time of the backup heater.

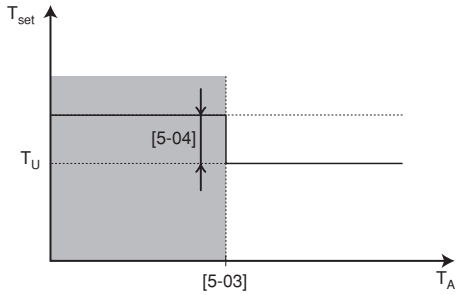
- [5-00] Equilibrium temperature status: specifies whether the equilibrium temperature function is enabled (1) or disabled (0).
- [5-01] Equilibrium temperature: outdoor temperature below which operation of the backup heater is allowed.

Space heating priority temperature — Applies only to installations with a domestic hot water tank. — The 'space heating priority temperature' field settings apply to operation of the 3-way valve and the **booster heater** in the domestic hot water tank.
When the space heating priority function is enabled, it is assured that the full capacity of the heat pump is used for space heating only when the outdoor temperature equals or drops below the specified space heating priority temperature, i.e. low outdoor temperature. In this case the domestic hot water will only be heated by the booster heater.

- [5-02] Space heating priority status: specifies whether space heating priority is enabled (1) or disabled (0).
- [5-03] Space heating priority temperature: outdoor temperature below which the domestic hot water will be heated by the booster heater only, i.e. low outdoor temperature.

⚠ If the booster heater operation is limited ([4-03]=0) and the ambient outdoor temperature T_A is lower than the field setting to which parameter [5-03] is set and [5-02]=1, then the domestic hot water will not be heated.

- [5-04] Set point correction for domestic hot water temperature: set point correction for the desired domestic hot water temperature, to be applied at low outdoor temperature when space heating priority is enabled. The corrected (higher) set point will make sure that the *total* heat capacity of the water in the tank remains approximately unchanged, by compensating for the colder bottom water layer of the tank (because the heat exchanger coil is not operational) with a warmer top layer.



T_{set}	Domestic hot water set point temperature
T_U	User set point (as set on the user interface)
T_A	Ambient (outdoor) temperature
	Space heating priority

WARNING

Be aware that the domestic hot water temperature will be automatically increased with the value selected in field setting [5-04] (if the outdoor temperature drops below field setting [5-03]) compare to the user set point for domestic hot water (T_U). Refer to field setting [5-03], [7-00] and the operation manual to select preferable set point.

If this high domestic hot water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

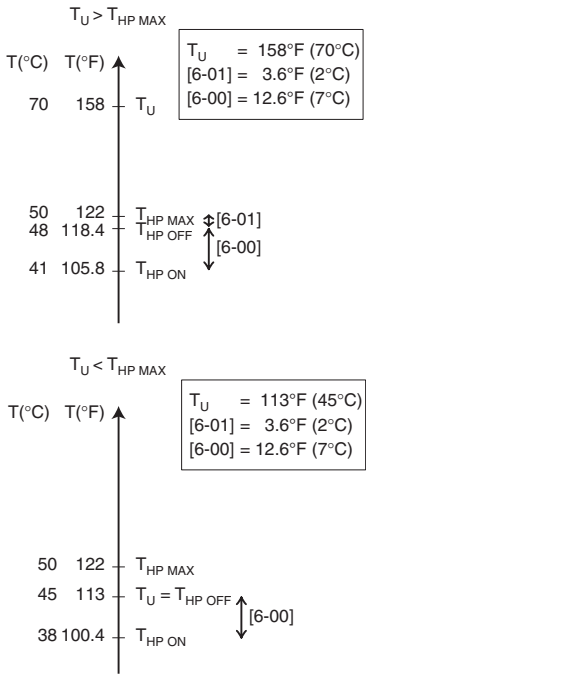
[6] DT for heat pump domestic water heating mode

Applies only to installations with a domestic hot water tank.

The 'DT (temperature difference) for heat pump domestic water heating mode' field settings determine the temperatures at which heating of the domestic hot water by the heat pump will be started (i.e., the heat pump ON temperature) and stopped (i.e., the heat pump OFF temperature).
When the domestic hot water temperature drops below the heat pump ON temperature ($T_{HP\ ON}$), heating of the domestic hot water by the heat pump will be started. As soon as the domestic hot water temperature reaches the heat pump OFF temperature ($T_{HP\ OFF}$) or the user set point temperature (T_U), heating of the domestic hot water by the heat pump will be stopped (by switching the 3-way valve).

The heat pump OFF temperature, and the heat pump ON temperature, and its relation with field settings [6-00] and [6-01] are explained in the illustration below.

- [6-00] Start: temperature difference determining the heat pump ON temperature ($T_{HP\ ON}$). See illustration.
- [6-01] Stop: temperature difference determining the heat pump OFF temperature ($T_{HP\ OFF}$). See illustration.



T_U	User set point temperature (as set on the user interface)
$T_{HP\ MAX}$	Maximum heat pump temperature at sensor in domestic hot water tank (122°F)(50°C)(depending on T_A)[(a)]
$T_{HP\ OFF}$	Heat pump OFF temperature
$T_{HP\ ON}$	Heat pump ON temperature

(a) 122°F (50°C) = $T_{HP\ MAX}$ at $T_A \leq$77°F (25°C).
118.4°F (48°C) = $T_{HP\ MAX}$ at $T_A >$77°F (25°C).

The maximum domestic hot water temperature that can be reached with the heat pump is 122°F (50°C). It is advised to select $T_{HP\ OFF}$ not higher than 118.4°F (48°C) in order to improve performance of the heat pump during domestic water heating mode.

When setting [4-03]=0 or 2 special attention to setting [6-00] is recommended. A good balance between the required domestic hot water temperature and heat pump ON temperature ($T_{HP\ ON}$) is a must.

[7] DT for booster heater and dual set point control

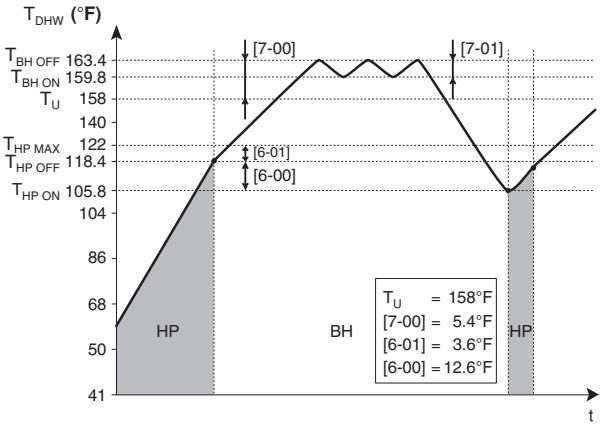
DT for booster heater

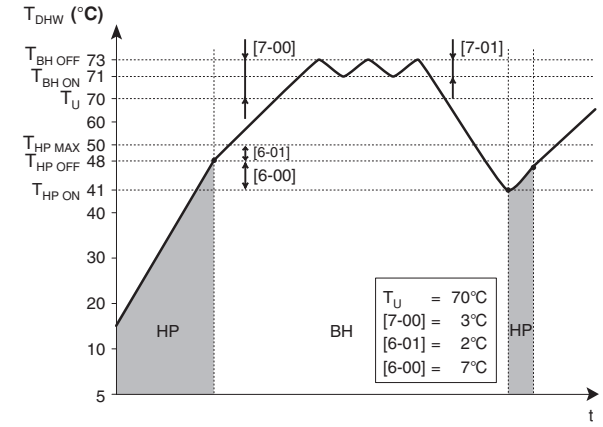
Applies only to installations with a domestic hot water tank.

When the domestic hot water is heated and the domestic hot water set point temperature (as set by the user) has been reached, the booster heater will continue to heat the domestic hot water to a temperature a few degrees above the set point temperature, i.e. the booster heater OFF temperature. These extra degrees are specified by the domestic hot water step length field setting. Correct setting prevents the booster heater from repeatedly turning on and off (i.e. chattering) to maintain the domestic hot water set point temperature. Note: the booster heater will turn back on when the domestic hot water temperature drops [7-01] (field setting) below the booster heater OFF temperature.

If the schedule timer for booster heater (see the operation manual) is active, the booster heater will only operate if allowed by this schedule timer.

- [7-00] Domestic hot water step length: temperature difference above the domestic hot water set point temperature before the booster heater is turned off.





BH	Booster heater
HP	Heat pump. If heating up time by the heat pump takes too long, auxiliary heating by the booster heater can take place
$T_{BH\ OFF}$	Booster heater OFF temperature (T_U + [7-00])
$T_{BH\ ON}$	Booster heater ON temperature ($T_{BH\ OFF}$ – [7-01])
$T_{HP\ MAX}$	Maximum heat pump temperature at sensor in domestic hot water tank
$T_{HP\ OFF}$	Heat pump OFF temperature ($T_{HP\ MAX}$ – [6-01])
$T_{HP\ ON}$	Heat pump ON temperature ($T_{HP\ OFF}$ – [6-00])
T_{DHW}	Domestic hot water temperature
T_U	User set point temperature (as set on the user interface)
t	Time

WARNING

Be aware that the domestic hot water temperature will be automatically increased (always) with the value selected in field setting [7-00] compare to the user set point for domestic hot water (T_U). Refer to field setting [7-00] and the operation manual to select preferable set point.

If this high domestic hot water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

If the booster heater operation is limited ([4-03]=0), then set point of field setting parameter [7-00] has only meaning for powerful domestic water heating.

- [7-01] Hysteresis value booster heater: temperature difference determining the booster heater ON temperature ($T_{BH\ ON}$). $T_{BH\ ON} = T_{BH\ OFF} - [7\text{-}01]$

The minimum value for booster heater ON temperature ($T_{BH\ ON}$) is 3.6°F (2°C) (fixed) below heat pump OFF temperature ($T_{HP\ OFF}$).

Dual set point control

Applies only to installations with different heat emitter which require different set points.

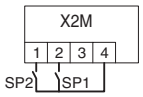
Dual set point control makes it possible to generate 2 different set points.

NOTE There is no indication available which set point is active!

- [7-02] Dual set point control status: defines whether the dual set point control is enabled (1) or disabled (0).
- [7-03] Second set point heating: specifies the second set point temperature in heating operation.
- [7-04] Second set point cooling: specifies the second set point temperature in cooling operation.

NOTE

- The first set point heating/cooling is the set point selected on the user interface.
  - In heating mode the first set point can be a fixed value or weather dependent.
  - In cooling mode the first set point is always a fixed value.
- The second set point heating [7-03] should be linked to the heat emitters which requires the highest set point in heating mode. Example: fan coil unit.
- The second set point cooling [7-04] should be linked to the heat emitters which requires the lowest set point in cooling mode. Example: fain coil unit.
- The actual second set point heating value depends on the selected value of setting [7-03].
  - In case [7-03]=1.8~43.2°F (1~24°C), the actual second set point will be first set point heating increased with [7-03] (the maximum is 131°F (55°C)).
    In this way the second set point heating is linked to the first set point heating.
  - In case [7-03]=77~131°F (25~55°C), the actual second set point heating is equal to [7-03].
- The selection of second set point or first set point is determined by the terminals (X2M: 1, 2, 4).
  The second set point has always priority on the first set point.



SP1 First set point contact

SP2 Second set point contact

When dual set point control is enabled, heating/cooling selection always has to be done on the user interface.

NOTE

It is the responsibility of the installer to make sure no unwanted situations can occur.

It is very important that the water temperature to the floor heating loops never becomes too high in heating mode or never too cold in cooling mode. Failure to observe this rule can result in construction damage or discomfort. For example in cooling mode condensation on the floor can occur when water towards the floor heating loops is too cold (dew point).

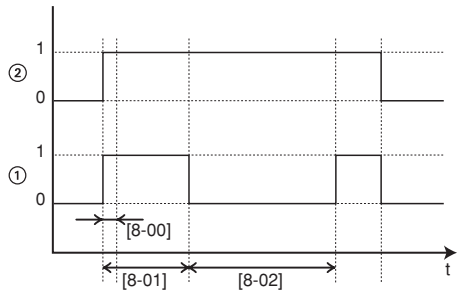
[8] Domestic water heating mode timer

Applies only to installations with a domestic hot water tank.

The 'domestic water heating mode timer' field settings defines the minimum and maximum domestic water heating times, minimum time between two domestic water heating cycles by heat pump, and booster heater delay time.

- [8-00] Minimum running time: specifies the minimum time period during which heat pump domestic water heating mode should be activated, even when the target domestic hot water temperature for heat pump ($T_{HP\ OFF}$) has already been reached.
- [8-01] Maximum running time: specifies the maximum time period during which heat pump domestic water heating mode can be activated, even when the target domestic hot water temperature for heat pump ($T_{HP\ OFF}$) has not yet been reached.
  The actual maximum running time will automatically variate between [8-01] and [8-01]+[8-04] depending on the outdoor temperature. See figure in chapter "[8-04]" on page 31.

  Note that when the unit is configured to work with a room thermostat (refer to "Room thermostat installation configuration" on page 22), the maximum running timer will only be taken into account when there is a request for space cooling or space heating. When there is no request for room cooling or room heating, domestic water heating by the heat pump will continue until the 'heat pump OFF temperature' (see field settings [6] on page 28) is reached. When no room thermostat is installed, the timer is always taken into account.
- [8-02] Anti-recycling time: specifies the minimum required interval between two heat pump domestic water heating mode cycles.
  The actual anti-recycling time will automatically variate between [8-02] and 0 depending on the outdoor temperature. See figure in chapter "[8-04]" on page 31.



1 Heat pump domestic water heating mode (1 = active, 0 = not active)

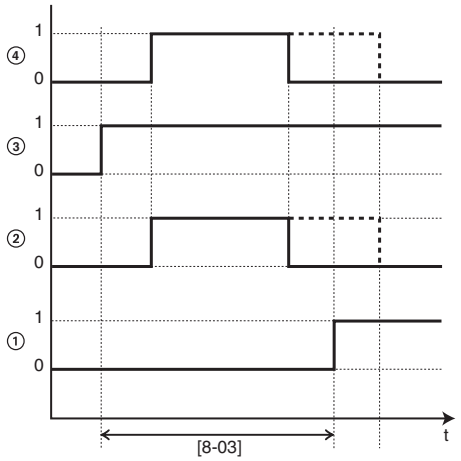
2 Hot water request for heat pump (1 = request, 0 = no request)

t Time

If the outdoor temperature is higher than the field setting to which parameter [4-02] is set, then field settings of parameters [8-01], [8-02], and [8-04] are not considered.

■ [8-03] Booster heater delay time: specifies the start-up time delay of the booster heater operation when heat pump domestic water heating mode is active.

- When heat pump is active in domestic water heating mode, the delay time of booster heater is [8-03].
- When heat pump is not active in domestic water heating mode, the delay time is 20 min.
- The delay timer starts from booster heater ON temperature ($T_{BH\ ON}$)



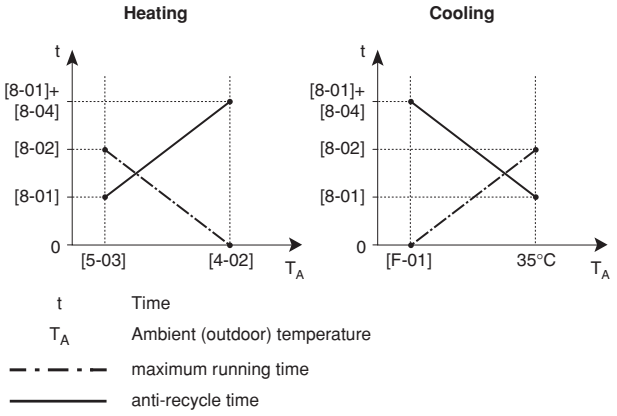
1 Booster heater operation (1 = active, 0 = not active)
2 Heat pump domestic water heating mode (1 = active, 0 = not active)
3 Hot water request for booster heater (1 = request, 0 = no request)
4 Hot water request for heat pump (1 = request, 0 = no request)
t Time

- By adapting the booster heater delay time versus the maximum running time, an optional balance can be found between the energy efficiency and the heat up time.
- However, if the booster heater delay time is set too high, it might take a long time before the domestic hot water reaches its set temperature upon domestic hot water mode request.
- The purpose of [8-03] is to delay the booster heater in relation with the heat pump operation time in domestic water heating mode.
- The setting [8-03] has only meaning if setting [4-03]=1. Setting [4-03]=0/2/3 limits the booster heater automatically in relation to heat pump operation time in domestic water heating mode.
- Take care that [8-03] is always in relation with the maximum running time [8-01].

Example: [4-03]=1

	Energy saving settings	Quick heating settings (default)
[8-01]	20~95 min	30 min
[8-03]	[8-01] + 20 min	20 min

■ [8-04] Additional running time at [4-02]/[F-01]: specifies the additional running time on the maximum running time at outdoor temperature [4-02] or [F-01]. See figure below.



t Time
T_A Ambient (outdoor) temperature
maximum running time
anti-recycle time

The full advantage of [8-04] will be applicable if setting [4-03] is not 1.

[9] Cooling and heating set point ranges

The purpose of this field setting is to prevent the user from selecting a wrong (i.e., too hot or too cold) leaving water temperature. Thereto the heating temperature set point range and the cooling temperature set point range available to the user can be configured.

CAUTION

- In case of a floor heating application, it is important to limit the maximum leaving water temperature at heating operation according to the specifications of the floor heating installation.
- In case of a floor cooling application, it is important to limit the minimum leaving water temperature at cooling operation (field setting of parameter [9-03]) to 60.8~64.4°F (16~18°C) to prevent condensation on the floor.

- [9-00] Heating set point upper limit: maximum leaving water temperature for heating operation.
- [9-01] Heating set point lower limit: minimum leaving water temperature for heating operation.
- [9-02] Cooling set point upper limit: maximum leaving water temperature for cooling operation.
- [9-03] Cooling set point lower limit: minimum leaving water temperature for cooling operation.
- [9-04] Overshoot setting: defines how much the water temperature may rise above the set point before the compressor stops. This function is only applicable in heating mode.

[A] Quiet mode

This field setting allows to select the desired quiet mode. Two quiet modes are available: quiet mode A and quiet mode B.

In quiet mode A, priority is given to the outdoor unit operating quietly under **all** circumstances. Fan and compressor speed (and thus performance) will be limited to a certain percentage of the speed at normal operation. In certain cases, this might result in reduced performance.

In quiet mode B, quiet operation might be overridden when higher performance is required. In certain cases, this might result in less quiet operation of the outdoor unit to meet the requested performance.

- [A-00] Quiet mode type: defines whether quiet mode A (0) or quiet mode B (2) is selected.
- [A-01] Parameter 01: do not change this setting. Leave it set to its default value.

NOTE Do not set other values than the ones mentioned.

[C] Setup on EKRP1HB digital I/O PCB

Solar priority mode

- [C-00] Solar priority mode setting: for information concerning the EKSOLHW solar kit, refer to the installation manual of that kit.

Alarm output logic

- [C-01] Alarm output logic: defines the logic of the alarm output on the EKRP1HB digital I/O PCB.
  [C-01]=0, the alarm output will be powered when an alarm occurs (default).
  [C-01]=1, the alarm output will not be powered when an alarm occurs. This field setting allows for distinction between detection of an alarm and detection of a power failure to the unit.

[C-01]	Alarm	No alarm	No power supply to unit
0 (default)	Closed output	Open output	Open output
1	Open output	Closed output	Open output

Bivalent operation

Applies only to installations with an auxiliary boiler (alternating operation, parallel connected). The purpose of this function is to determine —based on the outdoor temperature— which heating source can/will provide the space heating, either the Daikin indoor unit or an auxiliary boiler.

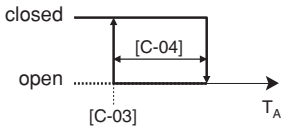
The field setting "bivalent operation" apply only the indoor unit space heating operation and the permission signal for the auxiliary boiler.

When the "bivalent operation" function is enabled, the indoor unit will stop automatically in space heating operation when the outdoor temperature drops below "bivalent ON temperature" and the permission signal for the auxiliary boiler becomes active.

When the bivalent operation function is disabled, the space heating by indoor unit is possible at all outdoor temperatures (see operation ranges) and permission signal for auxiliary boiler is always disactivated.

- [C-02] Bivalent operation status: defines whether bivalent operation is enabled (1) or disabled (0).
- [C-03] Bivalent ON temperature: defines the outdoor temperature below which the permission signal for the auxiliary boiler will be active (closed, KCR on EKRP1HB) and space heating by indoor unit will be stopped.
- [C-04] Bivalent hysteresis: defines the temperature difference between bivalent ON temperature and bivalent OFF temperature.

Permission signal X1–X2 (EKRP1HB)



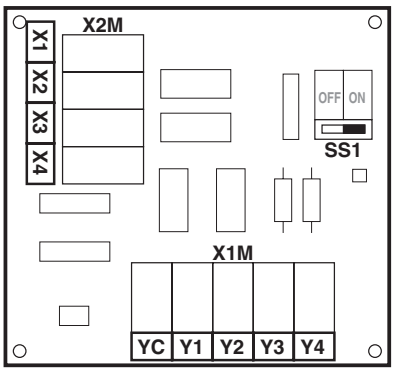
T_A Outdoor temperature

CAUTION

Make sure to observe all rules mentioned in application 5 when bivalent operation function is enabled.

Daikin shall not be held liable for any damage resulting from failure to observe this rule.

- In case the outdoor unit is single phase, the combination of setting [4-03]=0/2 with bivalent operation at low outdoor temperature can result in domestic hot water shortage.
- The bivalent operation function has no impact on the domestic water heating mode. The domestic hot water is still and only heated by the indoor unit.
- The permission signal for the auxiliary boiler is located on the EKRP1HB (digital I/O PCB). When it is activated, the contact X1, X2 is closed and open when it is disactivated. See figure for the schematic location of this contact.



[D] Benefit kWh rate power supply/Local shift value weather dependent

Benefit kWh rate power supply

■ [D-00] Switching off heaters: Defines which heaters are switched off when the benefit kWh rate signal of the electricity company is received.
If [D-01]=1 or 2 and the benefit kWh rate signal of the electricity company is received, following devices will be switched off:

[D-00]	Compressor	Back up heater	Booster heater
0 (default)	Forced off	Forced off	Forced off
1	Forced off	Forced off	Permitted
2	Forced off	Permitted	Forced off
3	Forced off	Permitted	Permitted

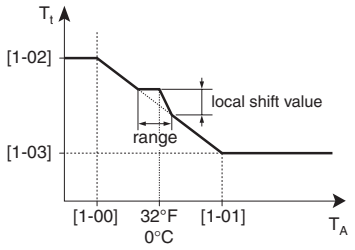
⚠ [D-00] settings 1, 2 and 3 are only meaningful if the benefit kWh rate power supply is of the type that power supply is not interrupted,

■ [D-01] Unit connection to benefit kWh rate power supply: Defines whether or not the outdoor unit is connected to a benefit kWh rate power supply.
If [D-01]=0, the unit is connected to a normal power supply (default value).
If [D-01]=1 or 2, the unit is connected to a benefit kWh rate power supply. In this case the wiring requires specific installation like explained in "Connection to a benefit kWh rate power supply" on page 19.
When parameter [D-01]=1 at the moment that the benefit kWh rate signal is sent by the electricity company, that contact will open and the unit will go in forced off mode(1).
When parameter [D-01]=2 at the moment that the benefit kWh rate signal is sent by the electricity company, that contact will close and the unit will go in forced off mode(2).

Local shift value weather dependent

The local shift value weather dependent field setting is only relevant in case weather dependent set point (see field setting "[1] Weather dependent set point (heating operation only)" on page 25) is selected.

■ [D-03] Local shift value weather dependent: determines the shift value of the weather dependent set point around outdoor temperature of 32°F (0°C).



T_t	Target water temperature
T_A	Outdoor temperature
range	Range
local shift value	Local shift value
[1-00], [1-01], [1-02], [1-03]	Applicable field setting of the weather dependent set point [1]

[D-03]	Outdoor temperature range (T_A)	Local shift value
0	—	—
1	28.4°F~35.6°F –2°C~2°C	2
2		4
3	24.8°F~39.2°F –4°C~4°C	2
4		4

[E] Unit information readout

■ [E-00] Readout of the software version (example: 23)
■ [E-01] Readout of the EEPROM version (example: 23)
■ [E-02] Readout of the unit model identification (example: 11)
■ [E-03] Readout of the liquid refrigerant temperature
■ [E-04] Readout of the inlet water temperature

NOTE [E-03] and [E-04] readouts are not permanently refreshed. Temperature readouts are updated after looping through the field setting first codes again only.

(1) When the signal is released again, the voltage free contact will close and the unit will restart operation. It is therefore important to leave the auto restart function enabled. Refer to "[3] Auto restart" on page 26.
(2) When the signal is released again, the voltage free contact will open and the unit will restart operation. It is therefore important to leave the auto restart function enabled. Refer to "[3] Auto restart" on page 26.

[F] Option setup

Pump operation

The pump operation field setting apply to the pump operation logic only when DIP switch SS2-3 is OFF.

When the pump operation function is disabled the pump will stop if the outdoor temperature is higher than the value set by [4-02] or if the outdoor temperature drops below the value set by [F-01]. When the pump operation is enabled, the pump operation is possible at all outdoor temperatures. Refer to "Pump operation configuration" on page 23.

- [F-00] Pump operation: specifies wether the pump operation function is enabled (1) or disabled (0).

Space cooling permission

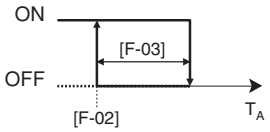
- [F-01] Space cooling permission temperature: defines the outdoor temperature below which space cooling is turned off.

> This function is only valid for EKHBX when space cooling is selected.

Bottom plate heater control

Applies only to installation with an outdoor unit ERLQ or in case the option bottom plate heater kit is installed.

- [F-02] Bottom plate heater ON temperature: defines the outdoor temperature below which the bottom plate heater will be activated by indoor unit in order to prevent ice build-up in the bottom plate of the outdoor unit at lower outdoor temperatures.
- [F-03] Bottom plate heater hysteresis: defines the temperature difference between bottom plate heater ON temperature and the bottom plate heater OFF temperature.
  Bottom plate heater



T_A Outdoor temperature

CAUTION

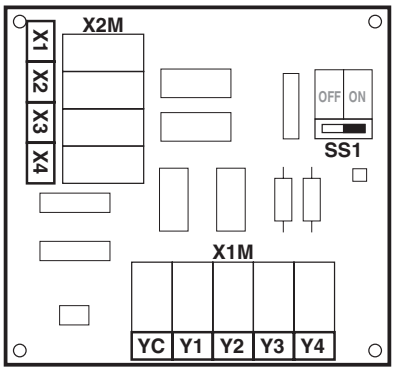
The bottom plate heater is controlled via X14A. Make sure [F-04] is correctly set.

Functionality of X14A

- [F-04] Functionality of X14A: specifies if the logic of X14A follows the output signal for the solar kit model (EKSOLHW) EKHBH/X_AA/AB (0) or if the logic of X14A follows the output for the bottom plate heater (1).

NOTE

Independent from field setting [F-04], the contact X3-X4 (EKRP1HB) follows the logic of the output signal for the solar kit model (EKSOLHW). See figure below for the schematic location of this contact.



Temperature values displayed on the digital controller (user interface) are in °C.

Temperature values in °C are between brackets. Conversion from °C to °F is for information only.

First code	Second code	Setting name	Installer setting at variance with default value				Default value	Range	Step	Unit
			Date	Value	Date	Value				
0	**User permission level**									
	00	User permission level					3	2/3	1	—
1	**Weather dependent set point**									
	00	Low ambient temperature (Lo_A)					14 (–10)	–4~41 (–20~5)	1.8 (1)	°F (°C)
	01	High ambient temperature (Hi_A)					59 (15)	50~68 (10~20)	1.8 (1)	°F (°C)
	02	Set point at low ambient temperature (Lo_TI)					104 (40)	77~131 (25~55)	1.8 (1)	°F (°C)
	03	Set point at high ambient temperature (Hi_TI)					77 (25)	77~131 (25~55)	1.8 (1)	°F (°C)
2	**Disinfection function**									
	00	Operation interval					Fri	Mon~Sun, All	—	—
	01	Status					1 (ON)	0/1	—	—
	02	Start time					23:00	0:00~23:00	1:00	hour
	03	Set point					158 (70)	104~176 (40~80)	9 (5)	°F (°C)
	04	Interval					10	5~60	5	min
3	**Auto restart**									
	00	Status					0 (ON)	0/1	—	—
4	**Backup/booster heater operation and space heating off temperature**									
	00	Status					1 (ON)	0/1	—	—
	01	Priority					0 (OFF)	0/1/2	—	—
	02	Space heating off temperature					95 (35)	57.2~95 (14~35)	1.8 (1)	°F (°C)
	03	Booster heater operation					3	0/1/2/3	—	—
	04	Not applicable					2	Read only	—	—
5	**Equilibrium temperature and space heating priority temperature**									
	00	Equilibrium temperature status					1 (ON)	0/1	—	—
	01	Equilibrium temperature					32 (0)	5~95 (–15~35)	1.8 (1)	°F (°C)
	02	Space heating priority status					0 (OFF)	0/1	—	—
	03	Space heating priority temperature					32 (0)	5~68 (–15~20)	1.8 (1)	°F (°C)
	04	Set point correction for domestic hot water temperature					18 (10)	0~36 (0~20)	1.8 (1)	°F (°C)
6	**DT for heat pump domestic water heating mode**									
	00	Start					9 (5)	3.6~36 (2~20)	1.8 (1)	°F (°C)
	01	Stop					3.6 (2)	0~18 (0~10)	1.8 (1)	°F (°C)
	02	Not applicable					0	Read only	—	—

First code	Second code	Setting name	Installer setting at variance with default value				Default value	Range	Step	Unit
			Date	Value	Date	Value				
7	**DT for booster heater and dual set point control**									
	00	Domestic hot water step length					0	0~7.2 (0~4)	1.8 (1)	°F (°C)
	01	Hysteresis value booster heater					3.6 (2)	3.6~72 (2~40)	1.8 (1)	°F (°C)
	02	Dual set point control status					0	0/1	—	—
	03	Second set point heating					18 (10)	1.8~43.2 / 77~131 (1~24 / 25~55)	1.8 (1)	°F (°C)
	04	Second set point cooling					44.6 (7)	41~71.6 (5~22)	1.8 (1)	°F (°C)
8	**Domestic water heating mode timer**									
	00	Minimum running time					5	0~20	1	min
	01	Maximum running time					30	5~60	5	min
	02	Anti-recycling time					3	0~10	0.5	hour
	03	Booster heater delay time					50	20~95	5	min
	04	Additional running time at [4-02]/[F-01]					95	0~95	5	min
9	**Cooling and heating set point ranges**									
	00	Heating set point upper limit					131 (55)	98.6~131 (37~55)	1.8 (1)	°F (°C)
	01	Heating set point lower limit					77 (25)	59~98.6 (15~37)	1.8 (1)	°F (°C)
	02	Cooling set point upper limit					71.6 (22)	64.4~71.6 (18~22)	1.8 (1)	°F (°C)
	03	Cooling set point lower limit					41 (5)	41~64.4 (5~18)	1.8 (1)	°F (°C)
	04	Overshoot setting[(a)]					1.8 (1)	1.8~7.2 (1~4)	1.8 (1)	°F (°C)
A	**Quiet mode**									
	00	Quiet mode type					0	0/2	—	—
	01	Parameter 01					3	—	—	—
	02	Not applicable					1	Read only	—	—
	03	Not applicable					0	Read only	—	—
	04	Not applicable					0	Read only	—	—
b	Not applicable									
	00	Not applicable					0	Read only	—	—
	01	Not applicable					0	Read only	—	—
	02	Not applicable					0	Read only	—	—
	03	Not applicable					0	Read only	—	—
	04	Not applicable					0	Read only	—	—
C	**Setup on EKRP1HB digital I/O PCB**									
	00	Solar priority mode setting					0	0/1	1	—
	01	Alarm output logic					0	0/1	—	—
	02	Bivalent operation status					0	0/1	—	—
	03	Bivalent ON temperature					32 (0)	–13~77 (–25~25)	1.8 (1)	°F (°C)
	04	Bivalent hysteresis					5.4 (3)	3.6~18 (2~10)	1.8 (1)	°F (°C)

First code	Second code	Setting name	Installer setting at variance with default value				Default value	Range	Step	Unit
			Date	Value	Date	Value				
D	**Benefit kWh rate power supply/local shift value weather dependent**									
	00	Switching off heaters					0	0/1/2/3	—	—
	01	Unit connection to benefit kWh rate power supply					0 (OFF)	0/1/2	—	—
	02	Not applicable. Do not change the default value.					0	—	—	—
	03	Local shift value weather dependent					0	0/1/2/3/4	—	—
E	**Unit information readout**									
	00	Software version					Read only	—	—	—
	01	EEPROM version					Read only	—	—	—
	02	Unit model identification					Read only	—	—	—
	03	Liquid refrigerant temperature					Read only	—	—	°F (°C)
	04	Inlet water temperature					Read only	—	—	°F (°C)
F	**Option setup**									
	00	Pump operation					0	0/1	—	—
	01	Space cooling permission temperature					68 (20)	50~95 (10~35)	1.8 (1)	°F (°C)
	02	Bottom plate heater ON temperature					37.4 (3)	37.4~50 (3~10)	1.8 (1)	°F (°C)
	03	Bottom plate heater hysteresis					9 (5)	3.6~9 (2~5)	1.8 (1)	°F (°C)
	04	Functionality of X14A					1	0/1	—	—

(a) Only possible to modify the first 3 minutes after power ON.

TEST RUN AND FINAL CHECK

The installer is obliged to verify correct operation of the indoor and outdoor unit after installation.

Final check

Before switching on the unit, read following recommendations:

- When the complete installation and all necessary settings have been carried out, close all front panels of the unit and refit the indoor unit cover.
- The service panel of the switch box may only be opened by a licensed electrician for maintenance purposes.

Automatic test run

When the unit is put into operation (by pressing the button) for the first time, the system will automatically perform a test run in cooling mode. The test run will take up to 3 minutes, during which no specific indication is given on the user interface.

During the automatic test run, it is important to ensure that the water temperature does not drop below 50°F (10°C), which might activate the freeze-up protection and thereby prevent the test run to finish. Should the water temperature drop below 50°F (10°C), press the ☀/❄ button so the ☀ icon is displayed. This will activate the backup heater during the automatic test run and raise the water temperature sufficiently.

If the automatic test run has ended successfully, the system will automatically resume normal operation.

If there are misconnections or malfunctions, an error code will be displayed on the user interface. To resolve the error codes, see "Error codes" on page 41.

NOTE

When the outdoor unit is put into pump down operation (see the outdoor unit installation manual), the automatic test run flag will be cleared. The next time the system is put into operation, the automatic test run will be executed again.

After finishing automatic test run or power ON/OFF, the compressor will operate in the selected operation mode and continue for certain time (set point on the remote controller is overruled during this operation).

Test run operation (manual)

If required, the installer can perform a manual test run operation at any time to check correct operation of cooling, heating and domestic water heating.

Procedure

1 Push the TEST button 4 times so the **TEST** icon will be displayed.

2 Depending on the indoor unit model, heating operation, cooling operation or both must be tested as follows (when no action is performed, the user interface will return to normal mode after 10 seconds or by pressing the TEST button once):

- To test the heating operation push the ☀/❄ button so the ☀ icon is displayed. To start the test run operation press the button.
- To test the cooling operation push the ☀/❄ button so the ❄ icon is displayed. To start the test run operation press the button.
- To test the domestic water heating operation push the button. The test run operation will start without pressing the button.

3 The test run operation will end automatically after 30 minutes or when reaching the set temperature. The test run operation can be stopped manually by pressing the TEST button once. If there are misconnections or malfunctions, an error code will be displayed on the user interface. Otherwise, the user interface will return to normal operation.

4 To resolve the error codes, see "Error codes" on page 41.

To display the last resolved error code, push the TEST button 1 time. Push the TEST button again 4 times to return to normal mode.

NOTE

It is not possible to perform a test run if a forced operation from the outdoor unit is in progress. Should forced operation be started during a test run, the test run will be aborted.

MAINTENANCE AND SERVICE

In order to ensure optimal availability of the unit, a number of checks and inspections on the unit and the field wiring have to be carried out at regular intervals.

This maintenance should be carried out by your local technician.

To execute the maintenance activities as mentioned below, it is only required to remove the indoor unit cover. See "Opening the indoor unit" on page 9.

Maintenance activities

DANGER: ELECTRIC SHOCK

- Before carrying out any maintenance or repair activity, always switch off the circuit breaker on the supply panel, remove the fuses (or switch off the circuit breakers) or open protection devices of the unit.
- Make sure that before starting any maintenance or repair activity, also the power supply to the outdoor unit is switched off.
- Do not touch live parts for 10 minutes after the power supply is turned off because of high voltage risk.
- The heater of the compressor may operate even in stop mode.
- Please note that some sections of the electric component box are hot.
- Make sure you do not touch a conductive section.
- Do not rinse the indoor unit. This may cause electric shocks or fire.
- When service panels are removed, live parts can be easily touched by accident.
  Never leave the unit unattended during installation or servicing when service panel is removed.

Play it safe!

Touch a metal part by hand (such as the stop valve) in order to eliminate static electricity and to protect the PCB before performing service.

DANGER

Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.

WARNING

- Do not touch the refrigerant pipes during and immediately after operation as the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes. To avoid injury, give the pipes time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.
- Do not touch the internal parts (pump, backup heater, etc.) during and immediately after operation.

  Your hands may suffer burns if you touch the internal parts. To avoid injury, give the internal parts time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.

The described checks must be executed at least **once a year**.

1 Water pressure

Check if the water pressure is above 14.5 psi (1 bar). If necessary add water.

2 Water filter

Clean the water filter.

3 Water pressure relief valve

Check for correct operation of the pressure relief valve by turning the red knob on the valve counter-clockwise:

- If you do not hear a clacking sound, contact your local dealer.
- In case the water keeps running out of the unit, close both the water inlet and outlet shut-off valves first and then contact your local dealer.

4 Pressure relief valve hose

Check that the pressure relief valve hose is positioned appropriately to drain the water.
If the (optional) drain pan kit is installed, make sure that the pressure relief valve hose end is positioned in the drain pan.

5 Backup heater vessel insulation cover

Check that the backup heater insulation cover is fastened tightly around the backup heater vessel.

6 Domestic hot water tank pressure relief valve (field supply)

Applies only to installations with a domestic hot water tank.
Check for correct operation of the pressure relief valve on the domestic hot water tank.

7 Domestic hot water tank booster heater

Applies only to installations with a domestic hot water tank.

It is advisable to remove lime buildup on the booster heater to extend its life span, especially in regions with hard water. To do so, drain the domestic hot water tank, remove the booster heater from the domestic hot water tank and immerse in a bucket (or similar) with lime-removing product for 24 hours.

8 Indoor unit switch box

- Carry out a thorough visual inspection of the switch box and look for obvious defects such as loose connections or defective wiring.
- Check for correct operation of contactors K1M, K2M, K3M, K5M (applications with domestic hot water tank only) and K4M by use of an ohmmeter. All contacts of these contactors must be in open position.

TROUBLESHOOTING

This section provides useful information for diagnosing and correcting certain troubles which may occur in the unit.

This troubleshooting and related corrective actions may only be carried out by your local technician.

General guidelines

Before starting the troubleshooting procedure, carry out a thorough visual inspection of the unit and look for obvious defects such as loose connections or defective wiring.

DANGER

When carrying out an inspection on the switch box of the unit, always make sure that the main switch of the unit is switched off.

When a safety device was activated, stop the unit and find out why the safety device was activated before resetting it. Under no circumstances safety devices may be bridged or changed to a value other than the factory setting. If the cause of the problem cannot be found, call your local dealer.

If the pressure relief valve is not working correctly and is to be replaced, always reconnect the flexible hose attached to the pressure relief valve, to avoid water dripping out of the unit!

NOTE For problems related to the optional solar kit for domestic water heating, refer to the troubleshooting in the installation manual of that kit.

DANGER

Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.

WARNING

- Do not touch the refrigerant pipes during and immediately after operation as the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes. To avoid injury, give the pipes time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.
- Do not touch the internal parts (pump, backup heater, etc.) during and immediately after operation.

  Your hands may suffer burns if you touch the internal parts. To avoid injury, give the internal parts time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.

General symptoms

Symptom 1: The unit is turned on (LED is lit) but the unit is not heating or cooling as expected

POSSIBLE CAUSES	CORRECTIVE ACTION
The temperature setting is not correct.	Check the controller set point.
The water flow is too low.	• Check that all shut off valves of the water circuit are completely open. • Check if the water filter needs cleaning. • Make sure there is no air in the system (purge air). • Check on the manometer that there is sufficient water pressure. The water pressure must be >14.5 psi (>1 bar) (water is cold) • Check that the pump speed setting is on the highest speed. • Make sure that the expansion vessel is not broken. • Check that the resistance in the water circuit is not too high for the pump (refer to "Setting the pump speed" on page 24).
The water volume in the installation is too low.	Make sure that the water volume in the installation is above the minimum required value (refer to "Checking the water volume and expansion vessel pre-pressure" on page 14).

Symptom 2: The unit is turned on but the compressor is not starting (space heating or domestic water heating)

POSSIBLE CAUSES	CORRECTIVE ACTION
The unit must start up out of its operation range (the water temperature is too low).	In case of low water temperature, the system utilizes the backup heater to reach the minimum water temperature first (59°F)(15°C). • Check that the backup heater power supply is correct. • Check that the backup heater thermal fuse is closed. • Check that the backup heater thermal protector is not activated. • Check that the backup heater contactors are not broken.
The benefit kWh rate power supply settings and electrical connections do not match.	If [D-01]=1 or 2, the wiring requires specific installation like illustrated in "Connection to a benefit kWh rate power supply" on page 19. Other correctly installed configurations are possible, but are to be specific for the type of benefit kWh rate power supply type at this specific site.
The benefit kWh rate signal was sent by the electricity company.	Wait for the power to return.

Symptom 3: Pump is making noise (cavitation)

POSSIBLE CAUSES	CORRECTIVE ACTION
There is air in the system.	Purge air.
Water pressure at pump inlet is too low.	• Check on the manometer that there is sufficient water pressure. The water pressure must be >14.5 psi (>1 bar) (water is cold). • Check that the manometer is not broken. • Check that the expansion vessel is not broken. • Check that the setting of the pre-pressure of the expansion vessel is correct (refer to "Setting the pre-pressure of the expansion vessel" on page 15).

Symptom 4: The water pressure relief valve opens

POSSIBLE CAUSES	CORRECTIVE ACTION
The expansion vessel is broken.	Replace the expansion vessel.
The water volume in the installation is too high.	Make sure that the water volume in the installation is under the maximum allowed value (refer to "Checking the water volume and expansion vessel pre-pressure" on page 14).

Symptom 5: The water pressure relief valve leaks

POSSIBLE CAUSES	CORRECTIVE ACTION
Dirt is blocking the water pressure relief valve outlet.	Check for correct operation of the pressure relief valve by turning the red knob on the valve counter clockwise: • If you do not hear a clacking sound, contact your local dealer. • In case the water keeps running out of the unit, close both the water inlet and outlet shut-off valves first and then contact your local dealer.

Symptom 6: The user interface displays "NOT AVAILABLE" when pressing certain buttons

POSSIBLE CAUSES	CORRECTIVE ACTION
The current permission level is set to a level that prevents using the pressed button.	Change the "user permission level" field setting ([0-00], see "Field settings" on page 25.

Symptom 7: Space heating capacity shortage at low outdoor temperatures

POSSIBLE CAUSES	CORRECTIVE ACTION
Backup heater operation is not activated.	Check that the "backup heater operation status" field setting [4-00] is turned on, see "Field settings" on page 25. Check whether or not the thermal protector of the backup heater has been activated (refer to Main components, "Backup heater thermal protector" on page 10 for location of the reset button). Check if booster heater and backup heater are configured to operate simultaneously (field setting [4-01], see "Field settings" on page 25) Check whether or not the thermal fuse of the backup heater is blown (refer to "Main components", "Backup heater thermal fuse" on page 10 for location of the reset button).
The backup heater equilibrium temperature has not been configured correctly.	Raise the 'equilibrium temperature' field setting [5-01] to activate backup heater operation at a higher outdoor temperature.
Too much heat pump capacity is used for heating domestic hot water (applies only to installations with a domestic hot water tank).	Check that the 'space heating priority temperature' field settings are configured appropriately: • Make sure that the 'space heating priority status' field setting [5-02] is enabled. • Raise the 'space heating priority temperature' field setting [5-03] to activate booster heater operation at a higher outdoor temperature.

Error codes

When a safety device is activated, the user interface LED will be flashing, and an error code will be displayed.

A list of all errors and corrective actions can be found in the table below.

Reset the safety by turning the unit OFF and back ON.

Instruction to turn the unit OFF			
User interface mode (heating/cooling ☀/❄)	**Domestic water heating mode (🚿)**	**Push the button**	**Push the 🚿 ⏻ button**
ON	**ON**	1 time	1 time
ON	**OFF**	1 time	—
OFF	**ON**	—	1 time
OFF	**OFF**	—	—

In case this procedure for resetting the safety is not successful, contact your local dealer.

Error code	Failure cause	Corrective action
80	Inlet water temperature thermistor failure (inlet water thermistor broken)	Contact your local dealer.
81	Outlet water temperature thermistor failure (outlet water temperature sensor broken)	Contact your local dealer.
89	Water heat exchanger freeze-up failure (due to water flow too low)	Refer to error code 7H.
	Water heat exchanger freeze-up failure (due to refrigerant shortage)	Contact your local dealer.
7H	Flow failure (water flow too low or no water flow at all, minimum required water flow is 4.23 gallons/min (16 l/min))	• Check that all shut off valves of the water circuit are completely open. • Check if the water filter needs cleaning. • Check that the unit is operating within its operating range (refer to "Technical specifications" on page 43). • Also refer to "Charging water" on page 16. • Make sure there is no air in the system (purge air). • Check on the manometer that there is sufficient water pressure. The water pressure must be >14.5 psi (>1 bar) (water is cold). • Check that the pump speed setting is on the highest speed. • Make sure that the expansion vessel is not broken. • Check that the resistance in the water circuit is not too high for the pump (refer to "Setting the pump speed" on page 24). • If this error occurs at defrost operation (during space heating or domestic water heating), make sure that the backup heater power supply is wired correctly and that fuses are not blown (or circuit breaker is not switched off). • Check that the pump fuse (FU2) is not blown.
8H	Outlet water temperature of indoor unit too high (>149°F)(>65°C)	• Check that the contactor of the electric backup heater is not short circuited. • Check that the outlet water thermistor is giving the correct read out.
A1	Indoor unit PCB defective	Contact your local dealer.
A5	Too low (during cooling operation) or too high (during heating operation) refrigerant temperature (measured by R3T)	Contact your local dealer.
AA	Backup heater thermal protector is open	Reset the thermal protector by pressing the reset button (refer to "Main components" on page 10 for location of the reset button)
	Check the reset button of the thermal protector. If both the thermal protector and the controller are reset, but the AA error code persists, the backup heater thermal fuse has blown.	Contact your local dealer.
AC	Booster heater thermal protector is open (applies only to installations with a domestic hot water tank)	Reset the thermal protector
C0	Flow switch failure (flow switch remains closed while pump is stopped)	Check that the flow switch is not clogged with dirt.
C4	Heat exchanger thermistor failure (heat exchanger temperature sensor broken)	Contact your local dealer.
E1	Outdoor unit PCB defective	Contact your local dealer.
E3	Abnormal high pressure	Check that the unit is operating within its operating range (refer to "Technical specifications" on page 43). Contact your local dealer.
E4	Actuation of low pressure sensor	Check that the unit is operating within its operating range (refer to "Technical specifications" on page 43). Contact your local dealer.
E5	Overload activation of compressor	Check that the unit is operating within its operating range (refer to "Technical specifications" on page 43). Contact your local dealer.
E7	Fan lock failure (fan is locked)	Check if the fan is not obstructed by dirt. If the fan is not obstructed, contact your local dealer.
E9	Malfunction of electronic expansion valve	Contact your local dealer.
EC	Domestic hot water temperature too high (>192.2°F)(>89°C)	• Check that the contactor of the electric booster heater is not short circuited. • Check that the domestic hot water thermistor is giving the correct read out.
F3	Too high discharge temperature (e.g. due to outdoor coil blockage)	Clean the outdoor coil. If the coil is clean, contact your local dealer.
H3	Malfunctioning HPS system	Contact your local dealer.
H9	Outdoor temperature thermistor failure (outdoor thermistor is broken)	Contact your local dealer.
HC	Domestic hot water tank thermistor failure	Contact your local dealer.
J1	Malfunction of pressure sensor	Contact your local dealer.
J3	Discharge pipe thermistor failure	Contact your local dealer.
J5	Suction pipe outdoor unit thermistor failure	Contact your local dealer.
J6	Aircoil thermistor frost detection failure	Contact your local dealer.
J7	Aircoil thermistor mean temperature failure	Contact your local dealer.
J8	Liquid pipe outdoor unit thermistor failure	Contact your local dealer.
L4	Electric component failure	Contact your local dealer.
L5	Electric component failure	Contact your local dealer.
L8	Electric component failure	Contact your local dealer.
L9	Electric component failure	Contact your local dealer.
LC	Electric component failure	Contact your local dealer.
P1	PCB failure	Contact your local dealer.
P4	Electric component failure	Contact your local dealer.

Error code	Failure cause	Corrective action
PJ	Failure of capacity setting	Contact your local dealer.
U0	Refrigerant failure (due to refrigerant leak)	Contact your local dealer.
U2	Main circuit voltage failure	Contact your local dealer.
U4	Communication failure	Contact your local dealer.
U5	Communication failure	Contact your local dealer.
U7	Communication failure	Contact your local dealer.
U8	Communication failure	Contact your local dealer.

General

		Heating/cooling models (EKHBX)	Heating only models (EKHBH)
Nominal capacity			
• cooling		Refer to the Technical Data	
• heating		Refer to the Technical Data	
Dimensions H x W x D	**(mm)**	922 x 502 x 361	922 x 502 x 361
	(inch)	36.3 x 19.8 x 14.2	36.3 x 19.8 x 14.2
Weight			
• machine weight	(kg)	55	55
	(lbs)	123	123
• operation weight	(kg)	69	69
	(lbs)	152	152
Connections			
• water inlet/outlet		1-1/4" MBSP[(a)]	1-1/4" MBSP[(a)]
• water drain		hose nipple	hose nipple
• refrigerant liquid side		Ø3/8 inch (Ø9.5 mm)	Ø3/8 inch (Ø9.5 mm)
• refrigerant gas side		Ø5/8 inch (Ø15.9 mm)	Ø5/8 inch (Ø15.9 mm)
Expansion vessel			
• volume	(l)	10	10
	(gallons)	2.6	2.6
• maximum working pressure (MWP)	(bar)	3	3
	(psi)	43.5	43.5
Pump			
• type		water cooled	water cooled
• no. of speed		3	3
Sound pressure level		Refer to technical data	Refer to technical data
Internal water volume	**(l)**	5.5	5.5
	(gallons)	1.45	1.45
Pressure relief valve water circuit	**(bar)**	3	3
	(psi)	43.5	43.5
Operation range - water side			
• heating	(°F)	+59~+131	+59~+131
	(°C)	+15~+55	+15~+55
• cooling	(°F)	+41~+71.6	—
	(°C)	+5~+22	—
Operation range - air side			
• heating	(°F)	–4~+95	–4~+95
	(°C)	–20~+35	–20~+35
• cooling	(°F)	+50~+114.8	—
	(°C)	+10~+46	—
• domestic hot water by heat pump	(°F)	–4~+95	–4~+95
	(°C)	–20~+35	–20~+35

(a) MBSP = Male British Standard Pipe

Electrical specifications

	Heating/cooling models (EKHBX)	Heating only models (EKHBH)
Standard unit (power supply via outdoor unit)		
• power supply	230 V 50 Hz 1P	
Backup heater		
• power supply	See "Connection of the backup heater power supply" on page 18	
• maximum running current	See "Connection of the backup heater power supply" on page 18	

OPERATION MANUAL

Indoor unit for air to water heat pump system and options

Operation manual
Indoor unit for air to water heat pump system and options

English

Manuel d'utilisation
Unité intérieure pour système de pompe à chaleur air à eau et options

Français

Manual de operación
Unidad interior para bomba de calor de aire-agua y elementos opcionales

Español

EKHBH054BA
EKHBX054BA

CONTENTS

READ THIS MANUAL ATTENTIVELY BEFORE STARTING UP THE UNIT. DO NOT THROW IT AWAY. KEEP IT IN YOUR FILES FOR FUTURE REFERENCE.

The English text is the original instruction. Other languages are translations of the original instructions.

This appliance is not intended for use by persons, including children, with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.
Children should be supervised to ensure that they do not play with the appliance.

Before operating the unit, make sure the installation has been carried out correctly by a professional Daikin dealer.

If you feel unsure about operation, contact your Daikin dealer for advice and information.

INTRODUCTION

This manual

This manual describes how to start up and switch off the unit, set parameters and configure the schedule timer by means of the controller, maintain the unit and solve operational problems.

General information

The unit is the indoor part of the air to water ERLQ heat pumps. These units are designed for wall mounted indoor installation. The units can be combined with Daikin fan coil units, floor heating applications, low temperature radiators, Daikin domestic water heating applications and Daikin solar kit for domestic hot water applications.

Heating/cooling units and heating only units

The unit range consists of two main versions: a heating/cooling (EKHBX) version and a heating only (EKHBH) version.

Both versions are delivered with an integrated backup heater for additional heating capacity during cold outdoor temperatures. The backup heater also serves as a backup in case of malfunctioning of the outdoor unit. The backup heater models are available for a heating capacity of 3 and 6 kW depending on the heating capacity.

Indoor unit model	Backup heater capacity	Backup heater nominal voltage
EKHB*054BA3VJU	3 kW	1x 230 V
EKHB*054BA3VJU	6 kW	1x 230 V

Domestic hot water tank (option)

An optional EKHW* domestic hot water tank with integrated 3 kW electrical booster heater can be connected to the indoor unit. The domestic hot water tank is available in two sizes: 50 and 80 gallons (200 and 300 litre).

Solar kit for domestic hot water tank (option)

For information concerning the EKSOLHW solar kit, refer to the installation manual of that kit.

Remote thermostat kit (option)

An optional room thermostat EKRTWA can be connected to the indoor unit. Refer to the operation manual of the room thermostat for more information.

Safety considerations

The precautions listed here are divided into the following four types. They all cover very important topics, so be sure to follow them carefully.

Meanings of **DANGER**, **WARNING**, **CAUTION** and **NOTE** symbols.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE

Indicates situations that may result in equipment or property-damage accidents only.

Danger

- Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.
- Do not touch any switch with wet fingers. Touching a switch with wet fingers can cause electrical shock.

Warning

- Never directly touch any accidental leaking refrigerant. This could result in severe wounds caused by frostbite.
- Do not touch the refrigerant pipes during and immediately after operation as the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes. To avoid injury, give the pipes time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.

OPERATING THE UNIT

INTRODUCTION

The heat pump system is designed to provide you a comfortable indoor climate for many years at low energy consumption.

To get the most comfort with the lowest energy consumption out of your system, it is very important to observe the items listed below.

Defining possible schedule timer actions for each day and filling out the form at the very end of this manual can help you minimize the energy consumption. Ask your installer for support if required.

- Make sure the heat pump system works at the lowest possible hot water temperature required to heat your house.

  To optimize this, make sure the weather dependent set point is used and configured to match the installation environment. Refer to "Field settings" on page 11.
- It is advised to install the room thermostat connected to the indoor unit. This will prevent excessive space heating and will stop the outdoor unit and the indoor circulation pump when the room temperature is above the thermostat set point.
- Next recommendations only apply to installations with an optional domestic hot water tank.
  - Make sure the domestic hot water is only heated up to the domestic hot water temperature you require.
    Start with a low domestic hot water temperature set point (e.g. 113°F (45°C)), and only increase if you feel that the domestic hot water supply temperature is not sufficient.
  - Make sure the domestic water heating by booster heater only start 1 to 2 hours before you expect domestic hot water usage.
    In case you only need a lot of domestic hot water in the evening or in the morning, only allow domestic water heating by booster heater during early morning and early evening. Also keep hours with low electricity cost tariffs in mind.
    To do this, program both the domestic water heating and booster heating schedule timer. Refer to Programming in chapter "Programming and consulting the schedule timer" on page 8.
  - If the domestic hot water is not used for two weeks or more, a quantity of hydrogen gas which is highly flammable may accumulate in the domestic hot water tank. To dissipate this gas safely, it is recommended that a hot tap be turned on for several minutes at a sink, basin, or bath, but not at a dishwasher, clothes washer or other appliance. During this procedure there must be no smoking, open flame or any electrical appliance operating nearby. If hydrogen is discharged through the tap, it will probably make a sound as of air escaping.

OPERATING THE DIGITAL CONTROLLER

Operating the EKHB* unit comes down to operating the digital controller.

CAUTION

Never let the digital controller get wet. This may cause an electric shock or fire.

Never press the buttons of the digital controller with a hard, pointed object. This may damage the digital controller.

Never inspect or service the digital controller yourself, ask a qualified service person to do this.

Features and functions

The digital controller is a state of the art controller that offers full control over your installation. It can control a heating/cooling and a heating only installation.

Both installations are available in multiple versions which vary in capacity, electrical supply and installed equipment (with an optional domestic hot water tank with a booster heater).

- Descriptions in this manual that apply to a specific installation or that depend on the installed equipment, are marked with an asterisk (*).
- Some functions described in this manual may not be available or should not be available. Ask your installer or your local dealer for more information on permission levels.

Basic controller functions

The basic controller functions are:

- Turning the unit ON/OFF.
- Operation mode change-over:
  - space heating (refer to page 5),
  - space cooling (refer to page 5) (*),
  - domestic water heating (refer to page 5) (*).
- Selection of features:
  - quiet mode (refer to page 5),
  - weather dependent control (refer to page 6).
- Temperature set point adjustment (refer to page 6).

(*) The functions 'space cooling' and 'domestic water heating' can only be selected when the corresponding equipment is installed.

The digital controller supports a power cut off of maximum 2 hours. When autorestart is enabled (see "Field settings" on page 11) this allows a power supply shut down of 2 hours without user intervention (e.g. benefit kWh rate power supply).

Clock function

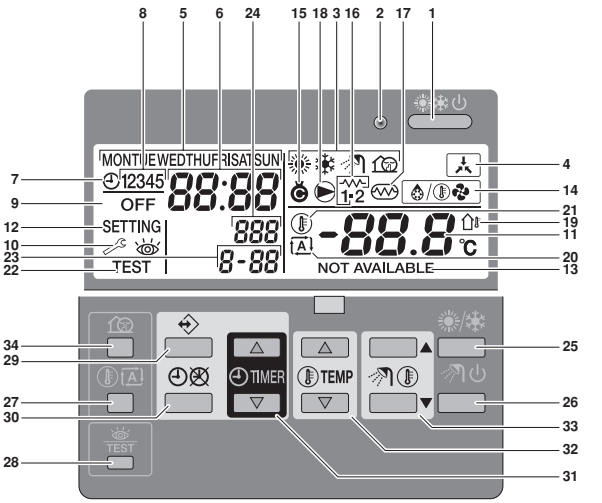
The clock functions are:

- 24 hour real time clock.
- Day of the week indicator.

Schedule timer function

The schedule timer function allows the user to schedule the operation of the installation according to a daily or a weekly program.

Name and function of buttons and icons



1. HEATING/COOLING ON/OFF BUTTON

The ON/OFF button starts or stops the heating or cooling function of the unit.

When the unit is connected with an external room thermostat, this button is not operable and the icon is shown.

Pressing the ON/OFF button consecutively too many times may cause malfunction of the system (maximum 20 times per hour).

Remark that pushing the button has no influence on the domestic water heating. Domestic water heating is only switched on or off by means of the button.

2. OPERATION LED

The operation LED is lit during space heating or space cooling operation. The LED blinks if a malfunction occurs. When the LED is OFF, space heating or space cooling are inactive while the other operation modes can still be active.

3. OPERATION MODE ICONS

These icons indicate the current operation mode(s): space heating, space cooling, domestic water heating or quiet mode. Within limits, different modes can be combined, e.g. space heating and domestic water heating. The corresponding mode icons will be displayed simultaneously.

In a heating only installation, the icon will never be displayed.

If the domestic hot water tank is not installed, the icon will never be displayed.

If the solar option is installed and active, the icon will be blinking.

4. EXTERNAL CONTROL ICON

This icon indicates that the room thermostat (optional) with higher priority is controlling your installation. This external room thermostat can start and stop the space heating/cooling operation and change the operation mode (heating/cooling).

When the external room thermostat with a higher priority is connected, the schedule timer for space heating and space cooling will not function.

When the benefit kWh power rate signal is sent, the centralised control indication will flash to indicate that benefit kWh power rate is active.

5. DAY OF THE WEEK INDICATOR MONTUEWEDTHUFRISATSUN

This indicator shows the current weekday.

When reading or programming the schedule timer, the indicator shows the set day.

6. CLOCK DISPLAY *88:88*

   The clock display shows the current time.

   When reading or programming the schedule timer, the clock display shows the action time.

7. SCHEDULE TIMER ICON

   This icon indicates that the schedule timer is enabled.

8. ACTION ICONS 12345

   These icons indicate the programming actions for each day of the schedule timer.

9. OFF ICON **OFF**

   This icon indicates that the OFF action is selected when programming the schedule timer.

10. INSPECTION REQUIRED and

    These icons indicate that inspection is required on the installation. Consult your dealer.

11. SET TEMPERATURE DISPLAY *-88.8*

    The display shows the current space heating/cooling set temperature of the installation in °C.

12. SETTING SETTING

    Not used. For installation purposes only.

13. NOT AVAILABLE NOT AVAILABLE

    This icon is displayed whenever a non-installed option is addressed or a function is not available.

14. DEFROST/STARTUP MODE ICON

    This icon indicates that the defrost/startup mode is active.

15. COMPRESSOR ICON

    This icon indicates that the compressor in the outdoor unit of the installation is active.

16. BACKUP HEATER STEP ONE OR STEP TWO

    These icons indicate that the backup heater is operating on low capacity ( ) or on high capacity ( ). The backup heater provides extra heating capacity in case of low ambient outdoor temperature (high heating load).

17. BOOSTER HEATER ICON

    This icon indicates that the booster heater is active. The booster heater provides auxiliary heating for the domestic hot water tank.

    The booster heater is located in the domestic hot water tank.

    The icon is not used when the domestic hot water tank is not installed.

18. PUMP ICON

    This icon indicates that the circulation pump is active.

19. OUTDOOR TEMPERATURE DISPLAY

    When this icon is flashing, the outdoor ambient temperature is displayed.

20. WEATHER DEPENDENT SET POINT ICON

    This icon indicates that the controller will adapt the temperature set point automatically, based on the outdoor ambient temperature.

21. TEMPERATURE ICON

    This icon is displayed when the water outlet temperature of the indoor unit, the outdoor ambient temperature and the domestic hot water tank temperature are shown.

    The icon is also displayed when the temperature set point is set in schedule timer programming mode.

22. TEST OPERATION ICON TEST

    This icon indicates that the unit runs in test mode.

23. FIELD SET CODE *8-88*

    This code represents the code from the field set list. Refer to the "Field settings table" on page 14.

24. ERROR CODE *888*

    This code refers to the error code list and is for service purposes only. Refer to the error code list in the installation manual.

25. SPACE HEATING/COOLING BUTTON

    This button allows manual switching between heating or cooling mode (provided the unit is not a heating only unit).

    When the unit is connected with an external room thermostat, this button is not operable and the icon is shown.

26. DOMESTIC WATER HEATING BUTTON

    This button enables or disables heating of the domestic water.

    This button is not used when the domestic hot water tank is not installed.

> Remark that pushing the button has no influence on the domestic water heating. Domestic water heating is only switched on or off by means of the button.

27. WEATHER DEPENDENT SET POINT BUTTON

    This button enables or disables the weather dependent set point function which is available in space heating operation only.

    If the controller is set in permission level 2 or 3 (refer to "Field settings" on page 11), the weather dependent set point button will not be operable.

28. INSPECTION/TEST OPERATION BUTTON

    This button is used for installation purposes and changing field settings. Refer to "Field settings" on page 11.

29. PROGRAMMING BUTTON

    This multi-purpose button is used to program the controller. The function of the button depends on the actual status of the controller or on previous actions carried out by the operator.

30. SCHEDULE TIMER BUTTON /

    The main function of this multi-purpose button is to enable/disable the schedule timer.

    The button is also used to program the controller. The function of the button depends on the actual status of the controller or on previous actions carried out by the operator.

    If the controller is set in permission level 3 (refer to "Field settings" on page 11), the schedule timer button will not be operable.

31. TIME ADJUST BUTTON and

    These multi-purpose buttons are used to adjust the clock, to toggle between temperatures (water outlet temperature of the indoor unit, outdoor ambient temperature and domestic hot water temperature) and in schedule timer programming mode.

32. TEMPERATURE ADJUST BUTTONS and

    These multi-purpose buttons are used to adjust the current set point in normal operation mode or in schedule timer programming mode. In weather dependent set point mode the buttons are used to adjust the shift value. Finally, the buttons are also used to select the weekday while setting the clock.

33. DOMESTIC HOT WATER TEMPERATURE ADJUST BUTTONS and

    These buttons are used to adjust the current set point of the domestic hot water temperature.

    The buttons are not used when the domestic hot water tank is not installed.

34. QUIET MODE BUTTON

    This button enables or disables quiet mode.

    If the controller is set in permission level 2 or 3 (refer to "Field settings" on page 11), the quiet mode button will not be operable.

Setting up the controller

After initial installation, the user can set the clock and day of the week.

The controller is equipped with a schedule timer that enables the user to schedule operations. Setting the clock and day of the week is required to be able to use the schedule timer.

Setting the clock

1 Hold down the ⏲⊗ button for 5 seconds.

The clock read-out and the day of week indicator start flashing.

2 Use the ⏲▲ and ⏲▼ buttons to adjust the clock.

Each time the ⏲▲ or ⏲▼ button is pressed, the time will increase/decrease by 1 minute. Keeping the ⏲▲ or ⏲▼ button pressed will increase/decrease the time by 10 minutes.

3 Use the ▲ or ▼ button to adjust the day of the week.

Each time the ▲ or ▼ button is pressed the next or previous day is displayed.

4 Press the ◈ button to confirm the current set time and day of the week.

To leave this procedure without saving, press the ⏲⊗ button.
If no button is pressed for 5 minutes the clock and day of the week will return to their previous setting.

The clock needs to be set manually. Adjust the setting when switching from summertime to wintertime and vice versa.

Setting the schedule timer

To set the schedule timer, refer to chapter "Programming and consulting the schedule timer" on page 8.

Description of the operation modes

Space heating operation (☀)

In this mode, heating will be activated as required by the water temperature set point. The set point can be set manually (refer to "Manual operation" on page 6) or weather dependent (refer to "Selecting weather dependent set point operation (only in heating mode)" on page 6).

Startup (♨/◑/❄)

At the start of a heating operation, the pump is not started until a certain refrigerant heat exchanger temperature is reached. This guarantees correct startup of the heat pump. During startup, icon ♨/◑/❄ is displayed.

Defrost (♨/◑/❄)

In space heating operation or heat pump domestic water heating operation, freezing of the outdoor heat exchanger may occur due to low outdoor temperature. If this risk occurs, the system goes into defrost operation. It reverses the cycle and takes heat from the indoor system to prevent freezing of the outdoor system. After a maximum of 8 minutes of defrost operation, the system returns to space heating operation.

Space cooling operation (❄)

In this mode, cooling will be activated as required by the water temperature set point.

- The space cooling temperature set point can only be set manually (refer to "Manual operation" on page 6).
- Switching between space heating and space cooling operation can only be done by pressing the ☀/❄ button or by the external room thermostat.
- Space cooling operation is not possible if the installation is a "heating only" installation.

Domestic water heating operation (🚿)

In this mode, the indoor unit will heat up the domestic hot water tank by heat pump when the space heating/space cooling operation has reached its temperature set point or heat pump domestic water heating has a higher demand request than space side (depends on dipswitch setting). When necessary and when allowed by the booster heater schedule timer (refer to "Programming quiet mode, booster heating or domestic water heating" on page 9), the booster heater provides auxiliary heating for the domestic hot water tank.

- In order to provide domestic hot water throughout the day, it is advised to keep the domestic water heating operation on continuously.
- The domestic hot water water temperature set point can only be set manually (refer to "Manual operation" on page 6).
- Any domestic water heating operation is impossible when the domestic hot water tank is not installed.
- When the 🚿 icon is blinking, the domestic hot water is heating up by the solar kit option and not by the indoor unit. Refer to installation manual of the EKSOLHW solar kit.

Powerful domestic water heating operation

In the case of urgent need of domestic hot water, the domestic hot water temperature set point can be reached quickly by using the booster heater. Powerful domestic water heating operation is forcing the booster heater to operate until the domestic hot water temperature set point is reached.

This function remains available in solar operation.

Quiet mode operation (🏠)

Quiet mode operation means that the outdoor unit works at reduced capacity so that the sound produced by the outdoor unit drops. This implies that the indoor heating and cooling capacity will also drop. Beware of this when a certain level of heating is required indoors.

Two quiet modes are available.

Controller operations

Manual operation

In manual operation, the user manually controls the settings of the installation. The last setting remains active until the user changes it or until the schedule timer forces another setting (refer to "Schedule timer operation" on page 7).

As the controller can be used for a wide variety of installations, it is possible to select a function which is not available on your installation. In that case the message NOT AVAILABLE will appear.

Switching on and setting space heating (☼) and space cooling (❄)

1 Use the ☼/❄ button to select space heating (☼) or space cooling (❄).

Icon ☼ or ❄ appears on the display as well as the corresponding water temperature set point.

2 Use the ▲ and ▼ buttons to set the desired water temperature.

- Temperature range for heating: 77°F (25°C) to 131°F (55°C)
  The temperature for heating can be set as low as 59°F (15°C) (see "Field settings" on page 11). However, the temperature for heating should only be set lower than 77°F (25°C) during commissioning of the installation. When set lower than 77°F (25°C), only the backup heater will operate.
  In order to avoid overheating, space heating is not operable when the outdoor ambient temperature rises above a certain temperature (as set through field setting [4-02], refer to "Field settings" on page 11).
- Temperature range for cooling: 41°F (5°C) to 71.6°F (22°C)

CAUTION

The actual operation range depends on the values set on field setting [9].

These values shall be determined based on the application.

In heating mode (☼), the water temperature set point can also be weather dependent (icon A is shown).

This means that the controller calculates the water temperature set point based on the outdoor temperature.

In this case, instead of showing the water temperature set point, the controller shows the "shift value" which can be set by the user. This shift value is the temperature difference between the temperature set point calculated by the controller and the real set point. E.g. a positive shift value means that the real temperature set point will be higher than the calculated set point.

3 Switch on the unit by pushing the button.

The operation LED ○ lights up.

When the unit is connected to an external room thermostat, buttons ☼/❄ and are not operable and the icon is shown. In this case, the external room thermostat switches the unit on or off and determines the operation mode (space heating or space cooling).

Selection and setting of domestic water heating ( )

1 Use the ⏻ button to activate domestic water heating ( ).

Icon appears on the display.

2 Use the ▲ or ▼ button to display the actual temperature set point and subsequently, to set the correct temperature.

The actual temperature set point only appears on the display after pressing one of the buttons ▲ or ▼. If no button is pressed for 5 seconds, the temperature set point will automatically disappear from the display again.

Temperature range for domestic water heating: 86°F (30°C) to 172.4°F (78°C)

3 Press the ⏻ button to deactivate domestic water heating ( ).

Icon disappears from the display.

Remark that pushing the button has no influence on the domestic water heating. Domestic water heating is only switched on or off by means of the ⏻ button.

Selecting powerful domestic water heating operation

1 Press ⏻ for 5 seconds to activate powerful domestic water heating operation.

Icons and start flashing.

Powerful domestic water heating is deactivated automatically when the set point for the domestic hot water is reached.

Selecting quiet mode operation ( )

1 Use the button to activate quiet mode operation ( ).

Icon appears on the display.

If the controller is set in permission level 2 or 3 (refer to "Field settings" on page 11), the button will not be operable.

Selecting weather dependent set point operation (only in heating mode)

1 Press the A button to select weather dependent set point operation.

Icon A appears on the display as well as the shift value. The shift value is not shown in case it is 0.

2 Use the ▲ and ▼ buttons to set the shift value.

Range for the shift value: –9°F (–5°C) to +9°F (+5°C)

Displaying actual temperatures

1 Push the A button for 5 seconds.

The icon and the outgoing water temperature are displayed. The icons and ☼/❄ are flashing.

2 Use the ▲ and ▼ buttons to display:

- The outdoor temperature (icon is flashing).
- The domestic hot water tank temperature (icon is flashing).
- The outgoing water temperature (☼/❄ are flashing).

If no button is pressed for 5 seconds, the controller leaves the display mode.

Schedule timer operation

In schedule timer operation, the installation is controlled by the schedule timer. The actions programmed in the schedule timer will be executed automatically.

The schedule timer always follows the last command until a new command is given. This means that the user can temporarily overrule the last executed programmed command by manual operation (Refer to "Manual operation" on page 6). The schedule timer will regain control over the installation as soon as the next programmed command of the schedule timer occurs.

The schedule timer is enabled (🕘 icon displayed) or disabled (🕘 icon not displayed), by pressing the 🕘⊗ button.

- Only use the 🕘⊗ button to enable or disable the schedule timer. The schedule timer overrules the ❄❄ button. The ❄❄ button only overrules the schedule timer until the next programmed action.
- If the auto restart function is disabled, the schedule timer will not be activated when power returns to the unit after a power supply failure. Press the 🕘⊗ button to enable the schedule timer again.
- When power returns after a power supply failure, the auto restart function reapplies the user interface settings at the time of the power supply failure.

  It is therefore recommended to leave the auto restart function enabled.

- The programmed schedule is time driven. Therefore, it is essential to set the clock and the day of the week correctly. Refer to "Setting the clock" on page 5.
- Manually adjust the clock for summertime and wintertime. Refer to "Setting the clock" on page 5.
- A power failure exceeding 2 hours will reset the clock and the day of the week. The schedule timer will continue operation, but with a disordered clock. Refer to "Setting the clock" on page 5 to adjust the clock and the day of the week.
- The actions programmed in the schedule timer will not be lost after a power failure so that reprogramming the schedule timer is not required.

To set up the SCHEDULE TIMER refer to chapter "Programming and consulting the schedule timer" on page 8.

What can the schedule timer do?

The schedule timer allows the programming of:

1. Space heating and space cooling (refer to "Programming space heating or space cooling" on page 8)
   Switch on the desired mode at a scheduled time, in combination with a set point (weather dependent or manually set). Five actions per weekday can be programmed, totalling 35 actions.

NOTE When the unit is connected to an external room thermostat, the schedule timer for space heating and space cooling is overruled by the external room thermostat.

2. Quiet mode (refer to "Programming quiet mode, booster heating or domestic water heating" on page 9)
   Switch the mode on or off at a scheduled time. Five actions can be programmed per mode. These actions are repeated daily.
3. Booster heating (refer to "Programming quiet mode, booster heating or domestic water heating" on page 9)
   Allow or disallow booster heating at a scheduled time. Five actions can be programmed per mode. These actions are repeated daily.
4. Domestic water heating (refer to "Programming quiet mode, booster heating or domestic water heating" on page 9)
   Switch the mode on or off at a scheduled time. Five actions can be programmed per mode. These actions are repeated daily.

- The programmed actions are not stored according to their timing but according to the time of programming. This means that the action that was programmed first gets action number 1, even though it is executed after other programmed action numbers.
- When the schedule timer switches space heating or space cooling **OFF**, the controller will also be switched off. Note that this has no influence on domestic water heating.

What can the schedule timer NOT do?

The schedule timer can not change the operation mode from space cooling to space heating or vice versa.

How to interpret the programmed actions

To be able to understand the behaviour of your installation when the schedule timer is enabled, it is important to keep in mind that the "last" programmed command overruled the "preceding" programmed command and will remain active until the "next" programmed command occurs.

Example: imagine the actual time is 17:30 and actions are programmed at 13:00, 16:00 and 19:00. The "last" programmed command (16:00) overruled the "previous" programmed command (13:00) and will remain active until the "next" programmed command (19:00) occurs.

So in order to know the actual setting, one should consult the last programmed command. It is clear that the "last" programmed command may date from the day before. Refer to "Consulting programmed actions" on page 10.

During schedule timer operation, someone may have altered the actual settings manually (in other words, the "last" command was overruled manually). The icon 🕘, indicating the schedule timer operation, may still be displayed, giving the impression that the "last" command settings are still active. The "next" programmed command will overrule the altered settings and return to the original program.

Programming and consulting the schedule timer

Getting started

Programming the schedule timer is flexible (you can add, remove or alter programmed actions whenever required) and straightforward (programming steps are limited to a minimum). However, before programming the schedule timer, remind:

- Familiarise yourself with the icons and the buttons. You will need them when programming. Refer to "Name and function of buttons and icons" on page 3.
- Fill out the form at the very end of this manual. This form can help you define the required actions for each day. Keep in mind that:
  - In the space heating/cooling program, 5 actions can be programmed per weekday. The same actions are repeated on a weekly basis.
  - In the domestic water heating, booster heater and quiet mode program, 5 actions can be programmed per mode. The same actions are repeated on a daily basis.
- Take your time to enter all data accurately.
- Try to program the actions in a chronological way: start with action 1 for the first action and end with the highest number for the last action. This is not a requirement but will simplify the interpretation of the program later.
- If 2 or more actions are programmed for the same day and at the same time, only the action with the highest action number will be executed.
- You can always alter, add or remove the programmed actions later.
- When programming heating actions (time and set point), cooling actions are added automatically at the same time but with the predefined default cooling set point. Conversely, when programming cooling actions (time and set point), heating actions are added automatically at the same time but with the default heating set point.

  The set points of these automatically added actions can be adjusted by programming the corresponding mode. This means that after programming heating, you should also program the corresponding cooling set points and vice versa.

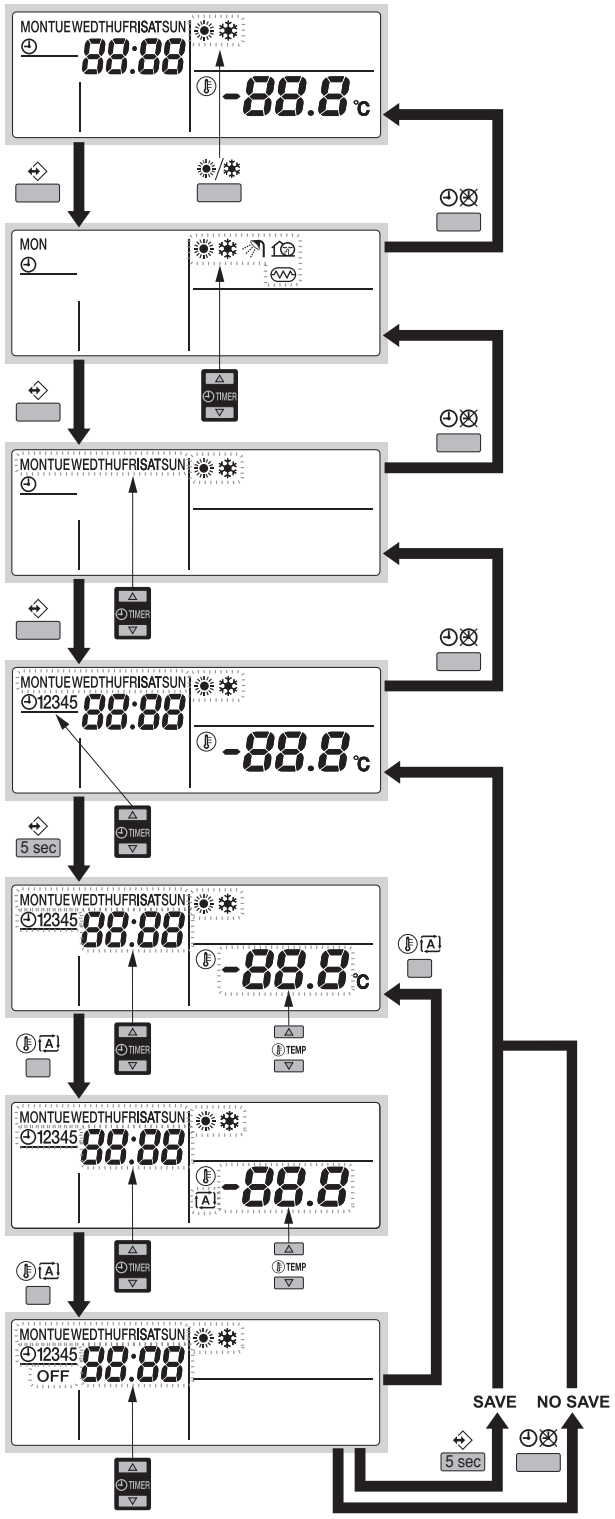
Due to the fact that the schedule timer cannot switch between operation modes (heating or cooling) and the fact that each programmed action implies a heating set point and a cooling set point, the following situations may occur:

- when the schedule timer is active in heating mode, and the mode is changed manually to cooling (by means of the ☀/❄ button), the operation mode will from then on remain cooling and program actions will follow the corresponding cooling set points. Returning to heating mode needs to be carried out manually (by means of the ☀/❄ button).
- when the schedule timer is active in cooling mode, and the mode is changed manually to heating (by means of the ☀/❄ button), the operation mode will from then on remain heating and program actions will follow the corresponding heating set points. Returning to cooling mode needs to be carried out manually (by means of the ☀/❄ button).

The above proves the importance of programming both cooling and heating set points for each action. If you do not program these set points, the predefined default values will be used.

Programming

Programming space heating or space cooling



NOTE

Programming space heating or space cooling are both done in the same way. At the start of the programming procedure space heating or space cooling is selected. After that, you have to return to the start of the programming procedure to program the other operation mode.

Programming space heating or space cooling is carried out as follows:

> Returning to previous steps in the programming procedure without saving modified settings is done by pressing the ⏲⊗ button.

1 Use the ☼/❄ button to select the operation mode (cooling or heating) you want to program.

2 Press the ⇳ button.

The actual mode is blinking.

3 Press the ⇳ button to confirm the selected mode.

The actual day is blinking.

4 Select the day you would like to consult or to program by means of the ⏲▲ and ⏲▼ buttons.

The selected day is blinking.

5 Press the ⇳ button to confirm the selected day.

The first programmed action of the selected day appears.

6 Use the ⏲▲ and ⏲▼ buttons to consult the other programmed actions of that day.

This is called the readout mode. Empty program actions (e.g. 4 and 5) are not displayed.

7 Press the ⇳ button for 5 seconds to enter the programming mode.

8 Use the ⇳ button to select the action number you would like to program or to modify.

9 Use the 🌡Ⓐ button to select:

- **OFF**: to switch heating or cooling and the controller off.
- **-88.8**℃: set the temperature by means of the 🌡▲ and 🌡▼ buttons.
- Ⓐ: to select automatic temperature calculation (only in heating mode).

10 Use the ⏲▲ and ⏲▼ buttons to set the correct action time.

11 Repeat steps 8 to 10 to program the other actions of the selected day.

When all actions have been programmed, make sure that the display shows the highest action number you would like to save.

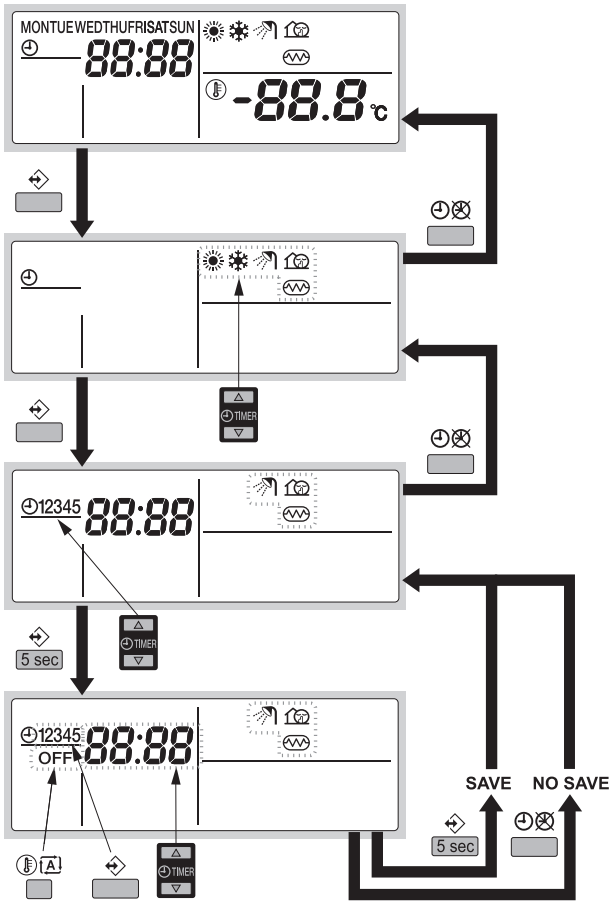
12 Press the ⇳ button for 5 seconds to store the programmed actions.

If the ⇳ button is pressed when action number 3 is displayed, actions 1, 2 and 3 are stored but 4 and 5 are deleted.

You automatically return to step 6.

By pressing the ⏲⊗ button several times, you return to previous steps in this procedure and finally return to normal operation.

Programming quiet mode, booster heating or domestic water heating



Programming domestic water heating, booster heater or quiet mode is carried out as follows:

> Returning to previous steps in the programming procedure without saving modified settings is done by pressing the ⏲⊗ button.

1 Press the ⇳ button.

The actual mode is blinking.

2 Use the ⏲▲ and ⏲▼ buttons to select the mode you want to program (quiet mode 🏠, booster heating 〰 or domestic water heating 🚿).

The selected mode is blinking.

3 Press the ⇳ button to confirm the selected mode.

The first programmed action is displayed.

4 Use the ⏲▲ and ⏲▼ buttons to consult the programmed actions.

This is called the readout mode. Empty program actions (e.g. 4 and 5) are not displayed.

5 Press the ⇳ button for 5 seconds to enter the programming mode.

6 Use the ⇳ button to select the action number you would like to program or to modify.

7 Use the ⏲▲ and ⏲▼ buttons to set the correct action time.

8 Use the 🌡Ⓐ button to select or deselect **OFF** as action.

9 Repeat steps 6 to 8 to program the other actions of the selected mode.

When all actions have been programmed, make sure that the display shows the highest action number you would like to save.

10 Press the ◈ button for 5 seconds to store the programmed actions.

If the ◈ button is pressed when action number 3 is displayed, actions 1, 2 and 3 are stored but 4 and 5 are deleted.

You automatically return to step 4. By pressing the ⏲⊗ button several times, you return to previous steps in this procedure and finally return to normal operation.

Consulting programmed actions

Consulting space heating or space cooling actions

> ⚠ Consulting space heating or space cooling is done in the same way. At the start of the consulting procedure space heating or space cooling is selected. After that, you have to return to the start of the consulting procedure to consult the other operation mode.

Consulting space heating or space cooling is carried out as follows.

> ⚠ Returning to previous steps in this procedure is done by pressing the ⏲⊗ button.

1 Use the ☀/❄ button to select the operation mode (cooling or heating) you want to consult.

2 Press the ◈ button.

The actual mode is blinking.

3 Press the ◈ button to confirm the selected mode.

The actual day is blinking.

4 Select the day you would like to consult by means of the ⏲▲ and ⏲▼ buttons.

The selected day is blinking.

5 Press the ◈ button to confirm the selected day.

The first programmed action of the selected day appears.

6 Use the ⏲▲ and ⏲▼ buttons to consult the other programmed actions of that day.

This is called the readout mode. Empty program actions (e.g. 4 and 5) are not displayed.

By pressing the ⏲⊗ button several times, you return to previous steps in this procedure and finally return to normal operation.

Consulting domestic water heating, booster heater or quiet mode

Consulting domestic water heating, booster heater or quiet mode is carried out as follows.

> ⚠ Returning to previous steps in this procedure is done by pressing the ⏲⊗ button.

1 Press the ◈ button.

The actual mode is blinking.

2 Use the ⏲▲ and ⏲▼ buttons to select the mode you want to consult (quiet mode, booster heating or domestic water heating).

The selected mode is blinking.

3 Press the ◈ button to confirm the selected mode.

The first programmed action is displayed.

4 Use the ⏲▲ and ⏲▼ buttons to consult the programmed actions.

This is called the readout mode. Empty program actions (e.g. 4 and 5) are not displayed.

By pressing the ⏲⊗ button several times, you return to previous steps in this procedure and finally return to normal operation.

Tips and tricks

Programming the next day(s)

After confirming the programmed actions of a specific day (i.e. after pressing the ◈ button for 5 seconds), press the ⏲⊗ button once. You can now select another day by using the ⏲▲ and ⏲▼ buttons and restart consulting and programming.

Copying programmed actions to next day

In heating/cooling program it is possible to copy all programmed actions of a specific day to the next day (e.g. copy all programmed actions from "MON" to "TUE").

To copy programmed actions to the next day, proceed as follows:

1 Press the ◈ button.

The actual mode is blinking.

2 Use the ⏲▲ and ⏲▼ buttons to select the mode you want to program.

The selected mode is blinking.

You can leave programming by pressing the ⏲⊗ button.

3 Press the ◈ button to confirm the selected mode.

The actual day is blinking.

4 Select the day you would like to copy to the next day by means of the ⏲▲ and ⏲▼ buttons.

The selected day is blinking.

You can return to step 2 by pressing the ⏲⊗ button.

5 Press the ◈ and ⏲⊗ buttons simultaneously for 5 seconds.

After 5 seconds the display will show the next day (e.g. "TUE" if "MON" was selected first). This indicates that the day has been copied.

You can return to step 2 by pressing the ⏲⊗ button.

Deleting one or more programmed actions

Deleting one or more programmed actions is done at the same time as storing the programmed actions.

When all actions for one day have been programmed, make sure that the display shows the highest action number you would like to save. By pressing the ◈ button for 5 seconds, you store all actions except those with a higher action number than the one that is displayed.

E.g. when the ◈ button is pressed when action number 3 is displayed, actions 1, 2 and 3 are stored but 4 and 5 are deleted.

Deleting a mode

1 Press the ◈ button.

The actual mode is blinking.

2 Use the ⏲▲ and ⏲▼ buttons to select the mode you want to delete (quiet mode, booster heating or domestic water heating).

The selected mode is blinking.

3 Press the ◈ and ⏲A button simultaneously for 5 seconds to delete the selected mode.

Deleting a day of the week (heating or cooling mode)

1 Use the ☀/❄ button to select the operation mode (cooling or heating) you want to delete.

2 Press the ◈ button.

The actual mode is blinking.

3 Press the ◈ button to confirm the selected mode.

The actual day is blinking.

4 Select the day you would like to delete by means of the ⏲▲ and ⏲▼ buttons.

The selected day is blinking.

5 Press the ◈ and ⏲A button simultaneously for 5 seconds to delete the selected day.

FIELD SETTINGS

NOTE

The default values mentioned in "Field settings table" on page 14 are the values from factory. The actual initial values shall be selected according to your application. These values shall be confirmed by your installer.

CAUTION

The field settings [2] depends on the relevant local laws and regulations.

The field settings [9] depends on the application.

Before changing these settings, the new values shall be confirmed by the installer and/or shall be according to the local laws and regulations.

The indoor unit shall be configured by the installer to match the installation environment (outdoor climate, installed options, etc.) and user demand. However, the field settings mentioned in "Field settings table" on page 14 can be modified to customer preferences. Thereto, a number of so called field settings are available. These field settings are accessible and programmable through the user interface on the indoor unit.

Each field setting is assigned a 3-digit number or code, for example [1-03], which is indicated on the user interface display. The first digit [1] indicates the 'first code' or field setting group. The second and third digit [03] together indicate the 'second code'.

A list of all field settings and default values is given under "Field settings table" on page 14. In this same list, we provided for 2 columns to register the date and value of altered field settings at variance with the default value.

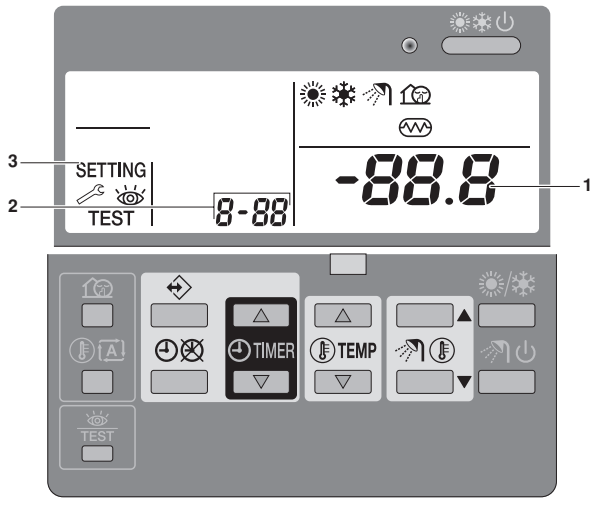
A detailed description of each field setting is given under "Detailed description" on page 11.

Procedure

To change one or more field settings, proceed as follows.

Temperature values displayed on the digital controller (user interface) are in °C.

Temperature values in °C are between brackets. Conversion from °C to °F is for information only.



1 Press the TEST button for a minimum of 5 seconds to enter FIELD SET MODE.
The SETTING icon (3) will be displayed. The current selected field setting code is indicated 8-88 (2), with the set value displayed to the right -88.8 (1).

2 Press the TEMP▲ button to select the appropriate field setting first code.

3 Press the TEMP▼ button to select the appropriate field setting second code.

4 Press the TIMER▲ button and TIMER▼ button to change the set value of the select field setting.

5 Save the new value by pressing the ⊗ button.

6 Repeat step 2 through 4 to change other field settings as required.

7 When finished, press the TEST button to exit FIELD SET MODE.

NOTE

Changes made to a specific field setting are only stored when the ⊗ button is pressed. Navigating to a new field setting code or pressing the TEST button will discard the change made.

- Before shipping, the set values have been set as shown under "Field settings table" on page 14.
- When exiting FIELD SET MODE, "88" may be displayed on the user interface LCD while the unit initialises itself.

Detailed description

[0] User permission level

If required, certain user interface buttons can be made unavailable for the user.

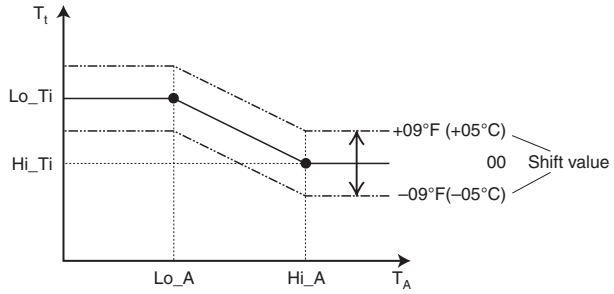
Three permission levels are defined (see the table below). Switching between level 1 and level 2/3 is done by simultaneously pressing buttons TIMER▲ and TIMER▼ immediately followed by simultaneously pressing buttons and , and keeping all 4 buttons pressed for at least 5 seconds (in normal mode). Note that no indication on the user interface is given. When level 2/3 is selected, the actual permission level – either level 2 or level 3 – is determined by the field setting [0-00].

		Permission level		
Button		1	2	3
Quiet mode button		operable	—	—
Weather dependent set point button		operable	—	—
Schedule timer enable/disable button	⊗	operable	operable	—
Programming button		operable	—	—
Time adjust buttons	TIMER▲ TIMER▼	operable	—	—
Inspection/test operation button	TEST	operable	—	—

[1] Weather dependent set point (heating operation only)

The weather dependent set point field settings define the parameters for the weather dependent operation of the unit. When weather dependent operation is active the water temperature is determined automatically depending on the outdoor temperature: colder outdoor temperatures will result in warmer water and vice versa. During weather dependent operation, the user has the possibility to shift up or down the target water temperature by a maximum of 9°F (5°C).

- [1-00] Low ambient temperature (Lo_A): low outdoor temperature.
- [1-01] High ambient temperature (Hi_A): high outdoor temperature.
- [1-02] Set point at low ambient temperature (Lo_Ti): the target outgoing water temperature when the outdoor temperature equals or drops below the low ambient temperature (Lo_A).
  Note that the Lo_Ti value should be higher than Hi_Ti, as for colder outdoor temperatures (i.e. Lo_A) warmer water is required.
- [1-03] Set point at high ambient temperature (Hi_Ti): the target outgoing water temperature when the outdoor temperature equals or rises above the high ambient temperature (Hi_A).
  Note that the Hi_Ti value should be *lower* than Lo_Ti, as for warmer outdoor temperatures (i.e. Hi_A) less warm water suffices.



T_t	Target water temperature
T_A	Ambient (outdoor) temperature
Shift value	= Shift value

[2] Disinfection function

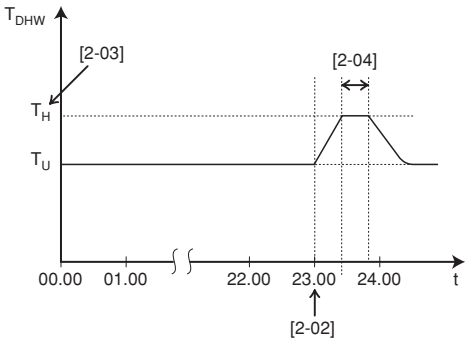
Applies only to installations with a domestic hot water tank.

The disinfection function disinfects the domestic hot water tank by periodically heating the domestic hot water to a specific temperature.

CAUTION

The disinfection function field settings must be configured by the installer according to local laws and regulations.

- [2-00] Operation interval: day(s) of the week at which the domestic hot water should be heated.
- [2-01] Status: defines whether the disinfection function is turned on (1) or off (0).
- [2-02] Start time: time of the day at which the domestic hot water should be heated.
- [2-03] Set point: high water temperature to be reached.
- [2-04] Interval: time period defining how long the set point temperature should be maintained.



T_{DHW}	Domestic hot water temperature
T_U	User set point temperature (as set on the user interface)
T_H	High set point temperature [2-03]
t	Time

WARNING

Be aware that the domestic hot water temperature at the hot water tap will be equal to the value selected in field setting [2-03] after a disinfection operation.

If this high domestic hot water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

[3] Auto restart

When power returns after a power supply failure, the auto restart function reapplies the user interface settings at the time of the power supply failure.

NOTE It is therefore recommended to leave the auto restart function enabled.

Note that with the function disabled the schedule timer will not be activated when power returns to the unit after a power supply failure. Press the ⏲⊗ button to enable the schedule timer again.

- [3-00] Status: defines whether the auto restart function is turned **ON (0)** or **OFF (1)**.

NOTE If the benefit kWh rate power supply is of the type that power supply is interrupted, then always allow the auto restart function.

[4] Space heating off temperature

Space heating off temperature

- [4-02] Space heating off temperature: outdoor temperature above which space heating is turned off, to avoid overheating.

[9] Cooling and heating set point ranges

The purpose of this field setting is to prevent the user from selecting a wrong (i.e., too hot or too cold) leaving water temperature. Thereto the heating temperature set point range and the cooling temperature set point range available to the user can be configured.

CAUTION

- In case of a floor heating application, it is important to limit the maximum leaving water temperature at heating operation according to the specifications of the floor heating installation.
- In case of a floor cooling application, it is important to limit the minimum leaving water temperature at cooling operation (field setting of parameter [9-03]) to 60.8~64.4°F (16~18°C) to prevent condensation on the floor.

- [9-00] Heating set point upper limit: maximum leaving water temperature for heating operation.
- [9-01] Heating set point lower limit: minimum leaving water temperature for heating operation.
- [9-02] Cooling set point upper limit: maximum leaving water temperature for cooling operation.
- [9-03] Cooling set point lower limit: minimum leaving water temperature for cooling operation.

[A] Quiet mode

This field setting allows to select the desired quiet mode. Two quiet modes are available: quiet mode A and quiet mode B.

In quiet mode A, priority is given to the outdoor unit operating quietly under **all** circumstances. Fan and compressor speed (and thus performance) will be limited to a certain percentage of the speed at normal operation. In certain cases, this might result in reduced performance.

In quiet mode B, quiet operation might be overridden when higher performance is required. In certain cases, this might result in less quiet operation of the outdoor unit to meet the requested performance.

- [A-00] Quiet mode type: defines whether quiet mode A (0) or quiet mode B (2) is selected.
- [A-01] Parameter 01: do not change this setting. Leave it set to its default value.

NOTE Do not set other values than the ones mentioned.

[C] Setup on EKRP1HB digital I/O PCB

Solar priority mode

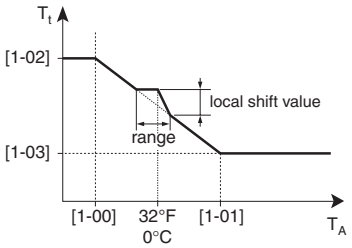
- [C-00] Solar priority mode setting: for information concerning the EKSOLHW solar kit, refer to the installation manual of that kit.

[D] Local shift value weather dependent

Local shift value weather dependent

The local shift value weather dependent field setting is only relevant in case weather dependent set point (see field setting "[1] Weather dependent set point (heating operation only)" on page 12) is selected.

- [D-03] Local shift value weather dependent: determines the shift value of the weather dependent set point around outdoor temperature of 32°F (0°C).



T_t	Target water temperature
T_A	Outdoor temperature
range	Range
local shift value	Local shift value
[1-00], [1-01], [1-02], [1-03]	Applicable field setting of the weather dependent set point [1]

[D-03]	Outdoor temperature range (T_A)	Local shift value
0	—	—
1	28.4°F~35.6°F –2°C~2°C	2
2		4
3	24.8°F~39.2°F –4°C~4°C	2
4		4

[E] Unit information readout

- [E-00] Readout of the software version (example: 23)
- [E-01] Readout of the EEPROM version (example: 23)
- [E-02] Readout of the unit model identification (example: 11)
- [E-03] Readout of the liquid refrigerant temperature
- [E-04] Readout of the inlet water temperature

NOTE [E-03] and [E-04] readouts are not permanently refreshed. Temperature readouts are updated after looping through the field setting first codes again only.

Temperature values displayed on the digital controller (user interface) are in °C.

Temperature values in °C are between brackets. Conversion from °C to °F is for information only.

First code	Second code	Setting name	Installer setting at variance with default value				Default value	Range	Step	Unit
			Date	Value	Date	Value				
0	**User permission level**									
	00	User permission level					3	2/3	1	—
1	**Weather dependent set point**									
	00	Low ambient temperature (Lo_A)					14 (–10)	–4~41 (–20~5)	1.8 (1)	°F (°C)
	01	High ambient temperature (Hi_A)					59 (15)	50~68 (10~20)	1.8 (1)	°F (°C)
	02	Set point at low ambient temperature (Lo_TI)					104 (40)	77~131 (25~55)	1.8 (1)	°F (°C)
	03	Set point at high ambient temperature (Hi_TI)					77 (25)	77~131 (25~55)	1.8 (1)	°F (°C)
2	**Disinfection function**									
	00	Operation interval					Fri	Mon~Sun, All	—	—
	01	Status					1 (ON)	0/1	—	—
	02	Start time					23:00	0:00~23:00	1:00	hour
	03	Set point					158 (70)	104~176 (40~80)	9 (5)	°F (°C)
	04	Interval					10	5~60	5	min
3	**Auto restart**									
	00	Status					0 (ON)	0/1	—	—
4	**Space heating off temperature**									
	00	Installation related setting								
	01	Installation related setting								
	02	Space heating off temperature					95 (35)	57.2~95 (14~35)	1.8 (1)	°F (°C)
	03	Installation related setting								
	04	Installation related setting								
5	**Installation related settings**									
	00	Installation related setting								
	01	Installation related setting								
	02	Installation related setting								
	03	Installation related setting								
	04	Installation related setting								
6	**Installation related settings**									
	00	Installation related setting								
	01	Installation related setting								
	02	Installation related setting								
7	**Installation related settings**									
	00	Installation related setting								
	01	Installation related setting								
	02	Installation related setting								
	03	Installation related setting								
	04	Installation related setting								

First code	Second code	Setting name	Installer setting at variance with default value				Default value	Range	Step	Unit
			Date	Value	Date	Value				
8	**Installation related settings**									
	00	Installation related setting								
	01	Installation related setting								
	02	Installation related setting								
	03	Installation related setting								
	04	Installation related setting								
9	**Cooling and heating set point ranges**									
	00	Heating set point upper limit					131 (55)	98.6~131 (37~55)	1.8 (1)	°F (°C)
	01	Heating set point lower limit					77 (25)	59~98.6 (15~37)	1.8 (1)	°F (°C)
	02	Cooling set point upper limit					71.6 (22)	64.4~71.6 (18~22)	1.8 (1)	°F (°C)
	03	Cooling set point lower limit					41 (5)	41~64.4 (5~18)	1.8 (1)	°F (°C)
	04	Installation related setting								
A	**Quiet mode**									
	00	Quiet mode type					0	0/2	—	—
	01	Parameter 01					3	—	—	—
	02	Not applicable					1	Read only	—	—
	03	Not applicable					0	Read only	—	—
	04	Not applicable					0	Read only	—	—
b	**Not applicable**									
	00	Not applicable					0	Read only	—	—
	01	Not applicable					0	Read only	—	—
	02	Not applicable					0	Read only	—	—
	03	Not applicable					0	Read only	—	—
	04	Not applicable					0	Read only	—	—
C	**Setup on EKRP1HB digital I/O PCB**									
	00	Solar priority mode setting					0	0/1	1	—
	01	Installation related setting								
	02	Installation related setting								
	03	Installation related setting								
	04	Installation related setting								
D	**Local shift value weather dependent**									
	00	Installation related setting								
	01	Installation related setting								
	02	Installation related setting								
	03	Local shift value weather dependent					0	0/1/2/3/4	—	—
E	**Unit information readout**									
	00	Software version					Read only	—	—	—
	01	EEPROM version					Read only	—	—	—
	02	Unit model identification					Read only	—	—	—
	03	Liquid refrigerant temperature					Read only	—	—	°F (°C)
	04	Inlet water temperature					Read only	—	—	°F (°C)

First code	Second code	Setting name	Installer setting at variance with default value				Default value	Range	Step	Unit
			Date	Value	Date	Value				
F	**Installation related settings**									
	00	Installation related setting								
	01	Installation related setting								
	02	Installation related setting								
	03	Installation related setting								
	04	Installation related setting								

MAINTENANCE

Important information regarding the refrigerant used

This product contains fluorinated greenhouse gases covered by the Kyoto Protocol.

Refrigerant type: R410A
GWP(1) value: 1975

(1) GWP = global warming potential

Periodical inspections for refrigerant leaks may be required depending on local laws and regulations. Please contact your local dealer for more information.

Maintenance activities

DANGER

- Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.
- Do not touch any switch with wet fingers. Touching a switch with wet fingers can cause electrical shock.

WARNING

Do not touch the refrigerant pipes during and immediately after operation as the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes. To avoid injury, give the pipes time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.

In order to ensure optimal availability of the unit, a number of checks and inspections on the unit and the field wiring have to be carried out at regular intervals, preferably yearly. This maintenance should be carried out by your local Daikin technician (see installation manual).

The only maintenance which may be required by the operator is:

- keeping the remote controller clean by means of a soft damp cloth,
- checking if the water pressure indicated on the manometer is above 14.5 psi (1 bar).

Only for the optional domestic hot water tank:

- A check for correct operation of the pressure relief valve installed on your domestic hot water tank, has to be carried out at least every 6 months: it is important that the lever on the valve is actuated to prevent accumulation of mineral deposits that may impair valve operation and to confirm that the valve and discharge pipe are not blocked. The lever should be operated slowly and smoothly to avoid a sudden rush of hot water from the discharge pipe.
  Failure to operate the relief valve actuating lever may result in the water heater exploding.
- Continuous leakage of water from the discharge pipe may indicate a problem with the water heater.
- If a discharge pipe is connected to the pressure relief device it must be installed in a continuously downward direction and in a frost-free environment. It must be left open to the atmosphere.

CAUTION

If the supply cord is damaged, it must be replaced by the manufacturer, its agent or similar qualified persons in order to avoid hazards.

Standstill

NOTE

During longer periods of standstill, e.g. during summer with a heating only application, it is very important NOT TO SWITCH OFF THE POWER SUPPLY towards the unit.

Switching off the power supply stops the automatic repetitive movement of the pump in order to prevent it from getting jammed.

TROUBLESHOOTING

The guidelines below might help to solve your problem. If you cannot solve the problem, consult your installer.

POSSIBLE CAUSES	CORRECTIVE ACTIONS
No readings on the remote controller (blank display)	• Check if the mains power is still connected to your installation. • The benefit kWh rate power supply is active (see installation manual).
One of the error codes appears	Consult your local dealer. Refer to the installation manual for a detailed list of error codes.
The schedule timer does work but the programmed actions are executed at the wrong time (e.g. 1 hour too late or too early)	Check if the clock and the day of the week are set correctly, correct if necessary.
The schedule timer is programmed but does not work.	In case the ⏲⊗ icon is not displayed, push the ⏲⊗ button to enable the schedule timer.
Capacity shortage	Consult your local dealer.

DISPOSAL REQUIREMENTS

Dismantling of the unit, treatment of the refrigerant, of oil and of other parts must be done in accordance with relevant local laws and regulations.

Your product is marked with this symbol. This means that electrical and electronic products shall not be mixed with unsorted household waste.

Do not try to dismantle the system yourself: the dismantling of the system, treatment of the refrigerant, of oil and other parts must be done by a qualified installer in accordance with relevant local laws and regulations.

Units must be treated at a specialized treatment facility for re-use, recycling and recovery. By ensuring this product is disposed off correctly, you will help to prevent potential negative consequences for the environment and human health. Please contact the installer or local authority for more information.

INSTALLATION MANUAL

Outdoor unit for air to water heat pump

Installation manual
Outdoor unit for air to water heat pump

English

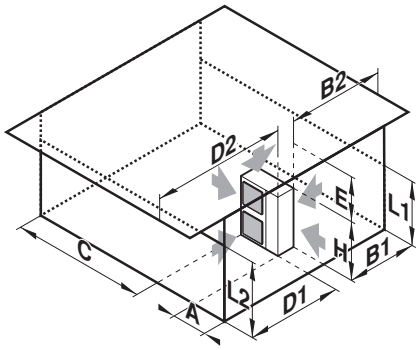
Manuel d'installation
Unité extérieure pour pompe à chaleur air à eau

Français

Manual de instalación
Unidad exterior para bomba de calor de aire-agua

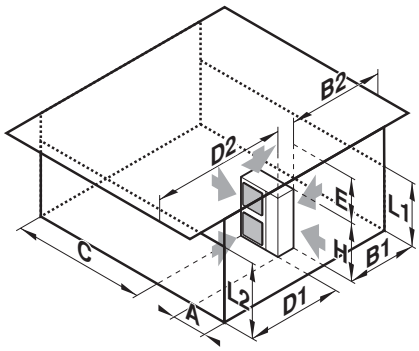
Español

ERLQ036BAVJU
ERLQ048BAVJU
ERLQ054BAVJU



								A	B1	B2	C	D1	D2	E	L1/L2	
	✓								≥4							
	✓		✓	✓				≥4	≥4		≥4					
	✓				✓				≥4				≤20	≥40		
	✓		✓	✓	✓			≥6	≥6		≥6		≤20	≥40		
		✓										≥20				
		✓			✓					≤20		≥20		≥40		
	✓	✓				L1<L2			≥4			≥20				
						L2<L1			≥4			≥20				
	✓	✓			✓	L1<L2	L1≤H		≥10	≤20		≥30		≥40	0<L1≤½H	
												≥40			0<L1≤½H	
							H<L1	L1≤H								1
						L2<L1	L2≤H		≥4			≥40	≥20	≥40	0<L2≤½H	
									≥8						½H<L2≤H	
							H<L2	L2≤H								
	✓		✓	✓				≥8	≥12		≥40					
	✓		✓	✓	✓			≥8	≥12		≥40		≤20	≥40		
		✓										≥40				
		✓			✓					≤20		≥40		≥40		
	✓	✓				L1<L2			≥12			≥40				
						L2<L1			≥10			≥60			0<L2≤½H	
									≥12						½H<L2≤H	
	✓	✓			✓	L1<L2	L1≤H		≥12	≤20		≥40		≥40	0<L1≤½H	
												≥50			½H<L1≤H	1
							H<L1	L1≤H								
						L2<L1	L2≤H		≥10			≥60	≤20	≥40	0<L2≤½H	
									≥12						½H<L2≤H	2
							H<L2	L2≤H								

1A (inch)



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	✓		✓	✓				≥100	≥100		≥100					
	✓				✓				≥100				≤500	≥1000		
	✓		✓	✓	✓			≥150	≥150		≥150		≤500	≥1000		
		✓										≥500				
		✓			✓					≤500		≥500		≥1000		
	✓	✓				L1<L2			≥100			≥500				
						L2<L1			≥100			≥500				
	✓	✓			✓	L1<L2	L1≤H		≥250	≤500		≥750		≥1000	0<L1≤½H	
												≥1000			0<L1≤½H	
							H<L1	L1≤H								1
						L2<L1	L2≤H		≥100			≥1000	≥500	≥1000	0<L2≤½H	
									≥200						½H<L2≤H	
							H<L2	L2≤H								
	✓		✓	✓				≥200	≥300		≥1000					
	✓		✓	✓	✓			≥200	≥300		≥1000		≤500	≥1000		
		✓										≥1000				
		✓			✓					≤500		≥1000		≥1000		
	✓	✓				L1<L2			≥300			≥1000				
						L2<L1			≥250			≥1500			0<L2≤½H	
									≥300						½H<L2≤H	
	✓	✓			✓	L1<L2	L1≤H		≥300	≤500		≥1000		≥1000	0<L1≤½H	
												≥1250			½H<L1≤H	1
							H<L1	L1≤H								
						L2<L1	L2≤H		≥250			≥1500	≤500	≥1000	0<L2≤½H	
									≥300						½H<L2≤H	2
							H<L2	L2≤H								

1B (mm)

CONTENTS

READ THESE INSTRUCTIONS CAREFULLY BEFORE INSTALLATION. KEEP THIS MANUAL IN A HANDY PLACE FOR FUTURE REFERENCE.

IMPROPER INSTALLATION OR ATTACHMENT OF EQUIPMENT OR ACCESSORIES COULD RESULT IN ELECTRIC SHOCK, SHORT-CIRCUIT, LEAKS, FIRE OR OTHER DAMAGE TO THE EQUIPMENT. BE SURE ONLY TO USE ACCESSORIES MADE BY DAIKIN WHICH ARE SPECIFICALLY DESIGNED FOR USE WITH THE EQUIPMENT AND HAVE THEM INSTALLED BY A PROFESSIONAL.

ALL ACTIVITIES DESCRIBED IN THIS MANUAL SHALL BE CARRIED OUT BY A LICENSED TECHNICIAN.

BE SURE TO WEAR ADEQUATE PERSONEL PROTECTION EQUIPMENT (PROTECTION GLOVES, SAFETY GLASSES, ...) WHEN PERFORMING INSTALLATION, MAINTENANCE OR SERVICE TO THE UNIT.

IF UNSURE OF INSTALLATION PROCEDURES OR USE, ALWAYS CONTACT YOUR DAIKIN DEALER FOR ADVICE AND INFORMATION.

The English text is the original instruction. Other languages are translations of the original instructions.

SAFETY CONSIDERATIONS

The precautions listed here are divided into the following four types. They all cover very important topics, so be sure to follow them carefully.

Meanings of **DANGER**, **WARNING**, **CAUTION** and **NOTE** symbols.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE

Indicates situations that may result in equipment or property-damage accidents only.

Danger

- Before touching electric terminal parts, turn off power switch.
- When service panels are removed, live parts can be easily touched by accident.

  Never leave the unit unattended during installation or servicing when the service panel is removed.
- Do not touch water pipes during and immediately after operation as the pipes may be hot. Your hand may suffer burns. To avoid injury, give the piping time to return to normal temperature or be sure to wear proper gloves.

Warning

- Ask your dealer or qualified personnel to carry out installation work. Do not install the machine by yourself.
  Improper installation may result in water leakage, electric shocks or fire.
- Perform installation work in accordance with this installation manual.
  Improper installation may lead to water leakage, electric shocks or fire.
- Consult your local dealer regarding what to do in case of refrigerant leakage. When the unit is to be installed in a small room, it is necessary to take proper measures so that the amount of any leaked refrigerant does not exceed the concentration limit in the event of a leakage. Otherwise, this may lead to an accident due to oxygen depletion.
- Be sure to use only the specified accessories and parts for installation work.
  Failure to use the specified parts may result in water leakage, electric shocks, fire, or the unit falling.
- Install the unit on a foundation that can withstand its weight.
  Insufficient strength may result in the fall of equipment and causing injury.
- Carry out the specified installation work in consideration of strong winds, hurricanes, or earthquakes.
  Improper installation work may result in accidents due to fall of equipment.

- Make certain that all electrical work is carried out by qualified personnel according to the local laws and regulations and this installation manual, using a separate circuit.
  Insufficient capacity of the power supply circuit or improper electrical construction may lead to electric shocks or fire.
- Make sure that all wiring is secure, using the specified wires and ensuring that external forces do not act on the terminal connections or wires.
  Incomplete connection or fixing may cause a fire.
- When wiring between the indoor and outdoor units, and wiring the power supply, form the wires so that the frontside panel can be securely fastened.
  If the frontside panel is not in place, overheat of the terminals, electric shocks or a fire may be caused.
- If refrigerant gas leaks during installation work, ventilate the area immediately.
  Toxic gas may be produced if refrigerant gas comes into contact with fire.
- Do not touch the refrigerant pipes during and immediately after operation as the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes. To avoid injury, give the pipes time to return to normal temperature or, if you must touch them, be sure to wear proper gloves.
- After completing the installation work, check to make sure that there is no leakage of refrigerant gas.
  Toxic gas may be produced if refrigerant gas leaks into the room and comes into contact with a source of fire, such as a fan heater, stove or cooker.
- When planning to relocate former installed units, you must first recover the refrigerant after the pump down operation. Refer to chapter "Pump down operation" on page 10.
- Never directly touch any accidental leaking refrigerant. This could result in severe wounds caused by frostbite.
- Be sure to install a ground fault circuit interrupter in accordance with relevant local laws and regulations. Failure to do so may cause electrical shock and fire.

Caution

- Ground the unit.
  Grounding resistance should be according to local laws and regulations.
  Do not connect the ground wire to gas or water pipes, lightning conductor or telephone ground wire.
  Incomplete grounding may cause electric shocks.

  - Gas pipe.
    Ignition or explosion may occur if the gas leaks.
  - Water pipe.
    Hard vinyl tubes are not effective grounds.
  - Lightning conductor or telephone ground wire.
    Electric potential may rise abnormally if struck by a lightning bolt.
- Install drain piping according to this installation manual to ensure good drainage, and insulate the pipe to prevent condensation.
  Improper drain piping may cause water leakage, and make the furnitures get wet.
- Install the indoor and outdoor units, power wire and connecting wire at least 1 meter away from televisions or radios to prevent image interference or noise.
  (Depending on the radio waves, a distance of 1 meter may not be sufficient to eliminate the noise.)
- Do not rinse the outdoor unit. This may cause electric shocks or fire.
- Do not install the unit in places such as the following:
  - Where there is mist of mineral oil, oil spray or vapour for example a kitchen.
    Plastic parts may deteriorate, and cause them to fall out or water to leak.
  - Where corrosive gas, such as sulphurous acid gas, is produced.
    Corrosion of copper pipes or soldered parts may cause the refrigerant to leak.
  - Where there is machinery which emits electromagnetic waves.
    Electromagnetic waves may disturb the control system, and cause malfunction of the equipment.
  - Where flammable gases may leak, where carbon fiber or ignitable dust is suspended in the air or where volatile flammables, such as thinner or gasoline, are handled.
    Such gases may cause a fire.
  - Where the air contains high levels of salt such as that near the ocean.
  - Where voltage fluctuates a lot, such as that in factories.
  - In vehicles or vessels.
  - Where acidic or alkaline vapour is present.
- Do not allow a child to mount on the outdoor unit or avoid placing any object on the unit. Falling or tumbling may result in injury.
- For use of units in applications with temperature alarm settings it is advised to foresee a delay of 10 minutes for signalling the alarm in case the alarm temperature is exceeded. The unit may stop for several minutes during normal operation for "defrosting the unit", or when in "thermosta-stop" operation.

BEFORE INSTALLATION

Since maximum working pressure is 580 psi (4.0 MPa or 40 bar), pipes of larger wall thickness may be required. Refer to paragraph "Selection of piping material" on page 6.

Precautions for R410A

- The refrigerant requires strict cautions for keeping the system clean, dry and tight.
  - Clean and dry
    Foreign materials (including mineral oils or moisture) should be prevented from getting mixed into the system.
  - Tight
    Read "Precautions on refrigerant piping" on page 6 carefully and follow these procedures correctly.
- Since R410A is a mixed refrigerant, the required additional refrigerant must be charged in its liquid state. (If the refrigerant is in state of gas, its composition changes and the system will not work properly).
- The connected indoor unit must be the EKHBH/X016 unit designed exclusively for R410A.

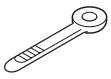
Installation

- For installation of the indoor unit, refer to the indoor unit installation manual.
- Never operate the unit without the thermistor (R3T, R4T) or pressure sensors (S1NPH, S1PH), burning of the compressor may result.
- Be sure to confirm the model name and the serial no. of the outer (front) plates when attaching/detaching the plates to avoid mistakes.
- When closing the service panels, take care that the tightening torque does not exceed 3.03 lbs•ft (4.1 N•m).

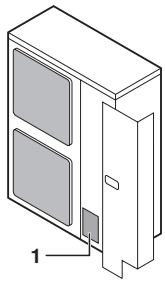
NOTE An ERLQ0***BA** outdoor unit can only be connected to an EKHBH/X016**BA** indoor unit (bottom plate heater at outdoor unit has to be controlled by indoor unit).

Accessories

Check if the following accessories are included with the unit

Installation manual	1	
Cable tie	2	

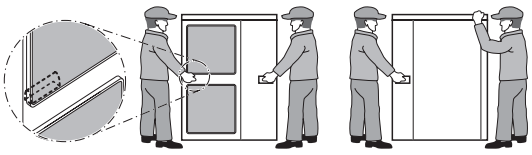
See the figure below for the location of the accessories.



1 Accessories

Handling

As shown in the figure below, slowly move the unit by grabbing the left and right grips. Position your hands on the corner instead of grabbing the air inlet to avoid deforming the casing.



To avoid injury, do not touch the air inlet or aluminium fins of the unit.

SELECTING INSTALLATION SITE

CAUTION

- Make sure to provide for adequate measures in order to prevent that the outdoor unit be used as a shelter by small animals.
- Small animals making contact with electrical parts can cause malfunctions, smoke or fire. Please instruct the customer to keep the area around the unit clean.

1 Select an installation site where the following conditions are satisfied and that meets with your customer's approval.

- Places which are well-ventilated.
- Places where the unit does not bother next-door neighbours.
- Safe places which can withstand the unit's weight and vibration and where the unit can be installed level.
- Places where there is no possibility of flammable gas or product leak.
- The equipment is not intended for use in a potentially explosive atmosphere.
- Places where servicing space can be well ensured.
- Places where the indoor and outdoor units' piping and wiring lengths come within the allowable ranges.
- Places where water leaking from the unit cannot cause damage to the location (e.g. in case of a blocked drain pipe).
- Places where the rain can be avoided as much as possible.
- Do not install the unit in places often used as work place. In case of construction works (e.g. grinding works) where a lot of dust is created, the unit must be covered.
- Do not place any objects or equipment on top of the unit (top plate).
- Do not climb, sit or stand on top of the unit,
- Be sure that sufficient precautions are taken, in accordance with relevant local laws and regulations, in case of refrigerant leakage.

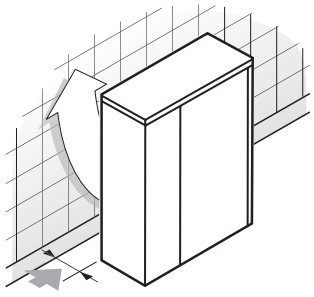
2 When installing the unit in a place exposed to strong wind, pay special attention to the following.

Strong winds of 16.40 ft/sec (5 m/sec) or more blowing against the outdoor unit's air outlet causes short circuit (suction of discharge air), and this may have the following consequences:

- Deterioration of the operational capacity.
- Frequent frost acceleration in heating operation.
- Disruption of operation due to rise of high pressure.
- When a strong wind blows continuously on the face of the unit, the fan can start rotating very fast until it breaks.

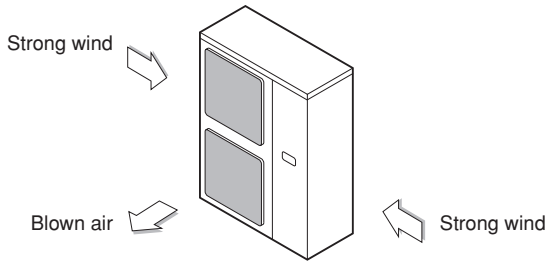
Refer to the figures for installation of this unit in a place where the wind direction can be foreseen.

- Turn the air outlet side toward the building's wall, fence or screen.



➪ Make sure there is enough room to do the installation

- Set the outlet side at a right angle to the direction of the wind.



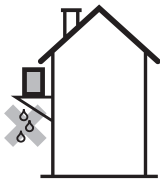
3 Prepare a water drainage channel around the foundation, to drain waste water from around the unit.

4 If the water drainage of the unit is not easy, please build up the unit on a foundation of concrete blocks, etc. (the height of the foundation should be maximum 5.9 inch (150 mm)).

5 If you install the unit on a frame, please install a waterproof plate within 5.9 inch (150 mm) of the underside of the unit in order to prevent the invasion of water from the lower direction.

6 When installing the unit in a place frequently exposed to snow, pay special attention to elevate the foundation as high as possible.

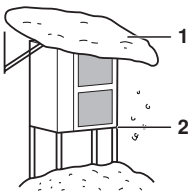
7 If you install the unit on a building frame, please install a waterproof plate (field supply) (within 5.9 inch (150 mm) of the underside of the unit) or use a drain kit in order to avoid the drainwater dripping. (See figure).



Selecting a location in cold climates

NOTE When operating the outdoor unit in a low outdoor ambient temperature, be sure to follow the instructions described below.

- To prevent exposure to wind, install the outdoor unit with its suction side facing the wall.
- Never install the outdoor unit at a site where the suction side may be exposed directly to wind.
- To prevent exposure to wind, install a baffle plate on the air discharge side of the outdoor unit.
- In heavy snowfall areas it is very important to select an installation site where the snow will not affect the unit. If lateral snowfall is possible, make sure that the heat exchanger coil is not affected by the snow (if necessary construct a lateral canopy).

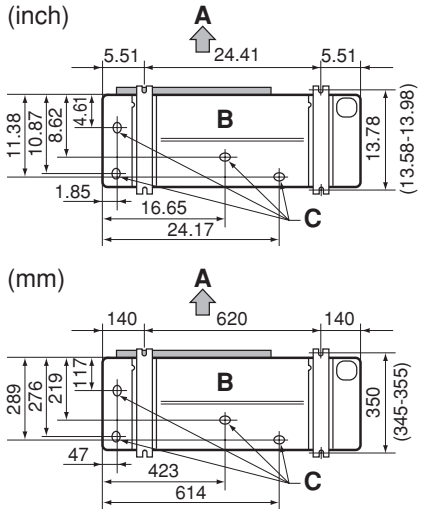


1 Construct a large canopy.

2 Construct a pedestal. Install the unit high enough off the ground to prevent burying in snow.

PRECAUTIONS ON INSTALLATION

- Check the strength and level of the installation ground so that the unit will not cause any operating vibration or noise after installation.
- In accordance with the foundation drawing in the figure, fix the unit securely by means of the foundation bolts. (Prepare four sets of 1/2 inch (M12) foundation bolts, nuts and washers each which are available on the market.)
- It is best to screw in the foundation bolts until their length are 0.79 inch (20 mm) from the foundation surface.



A Discharge side

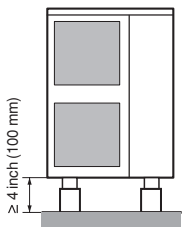
B Bottom view

C Drain hole

Drain work

- Make sure the drain works properly.
- Draining of the outdoor unit is field supply.
- Drain holes may not be made smaller with a build up of ice on the bottom plate as a possible result.

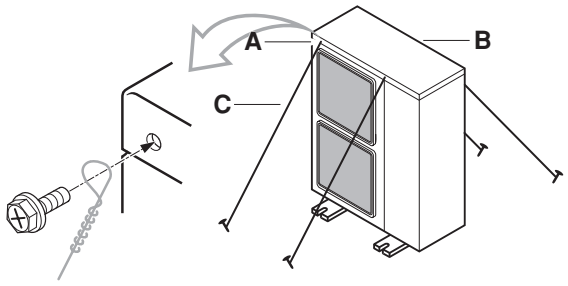
NOTE If drain holes of the outdoor unit are covered by a mounting base or by floor surface, raise the unit in order to provide a free space of more than 4 inch (100 mm) under the outdoor unit.



Installation method for prevention of falling over

If it is necessary to prevent the unit from falling over, install as shown in the figure.

- prepare all 4 wires as indicated in the drawing
- unscrew the top plate at the 4 locations indicated A and B
- put the screws through the nooses and screw them back tight



A Location of the 2 fixation holes on the front side of the unit

B Location of the 2 fixation holes on the rear side of the unit

C Wires: field supply

INSTALLATION SERVICING SPACE

The numerical figures used in figure 1A represent the dimensions in inch. For dimensions in mm, see figure 1B.

(Refer to "Precautions on installation" on page 4)

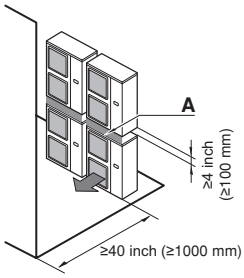
Precaution

(A) In case of non-stacked installation figure 1A and figure 1B

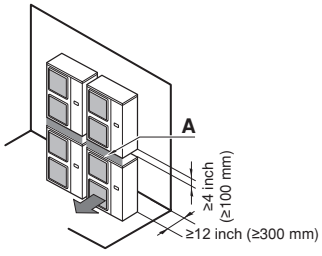
	Suction side obstacle	✓	Obstacle is present
	Discharge side obstacle	1	In these cases, close the bottom of the installation frame to prevent the discharged air from being bypassed
	Left side obstacle		
	Right side obstacle	2	In these cases, only 2 units can be installed.
	Top side obstacle		This situation is not allowed

(B) In case of stacked installation

1. In case obstacles exist in front of the outlet side.



2. In case obstacles exist in front of the air inlet.

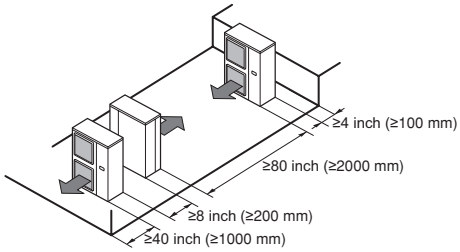


Do not stack more than one unit.

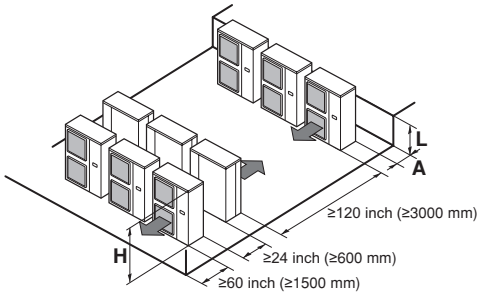
About 4 inch (100 mm) is required as the dimension for laying the upper outdoor unit's drain pipe. Get the portion A sealed so that air from the outlet does not bypass.

(C) In case of multiple-row installation (for roof top use, etc.)

1. In case of installing one unit per row.



2. In case of installing multiple units (2 units or more) in lateral connection per row.



Relation of dimensions of H, A and L are shown in the table below.

	L	A
L≤H	0<L≤1/2H	10 inch (250 mm)
	1/2H<L	12 inch (300 mm)
H<L	Installation not allowed	

REFRIGERANT PIPE SIZE AND ALLOWABLE PIPE LENGTH

- Piping and other pressure containing parts shall comply with the applicable local laws and regulations and shall be suitable for refrigerant. Use phosphoric acid deoxidised seamless copper for refrigerant.
- Installation shall be done by a licensed refrigerant technician, the choice of materials and installation shall comply with local laws and regulations.

To persons in charge of piping work:

- Be sure to open the stop valve after piping installing and vacuming is complete. (Running the system with the valve closed may break the compressor.)
- It is forbidden to discharge refrigerant into the atmosphere. Collect the refrigerant in accordance with the freon collection and destruction law.

Selection of piping material

- Construction material: phosphoric acid deoxidised seamless copper for refrigerant.
- Temper grade: use piping with temper grade in function of the pipe diameter as listed in table below.
- The pipe thickness of the refrigerant piping should comply with relevant local laws and regulations. The minimal pipe thickness for R410A piping must be in accordance with the table below.

Pipe Ø	Temper grade of piping material	Minimal thickness
3/8 inch (9.5 mm)	O	0.03 inch (0.80 mm)
5/8 inch (15.9 mm)	O	0.04 inch (1.00 mm)

O=Annealed

Refrigerant pipe size

The pipes between outdoor unit and indoor unit should have the same size as the outdoor connections.

	Refrigerant pipe size
Gas pipe	Ø5/8 inch (15.9 mm)
Liquid pipe	Ø3/8 inch (9.5 mm)

Allowable pipe length and height difference

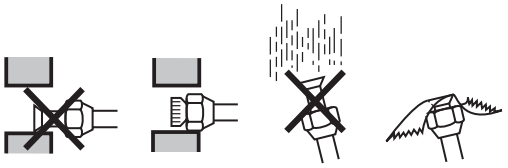
See the table below concerning lengths and heights. Refer to figure 2. Assume that the longest line in the figure corresponds with the actual longest pipe, and the highest unit in the figure corresponds with the actual highest unit.

Allowable pipe length	
Maximum total one-way piping length[a]	
L	246 ft (312 ft) (75 m (95 m))
Maximum height between indoor and outdoor	
H	98 ft (30 m)
Chargeless length	
L	≤98 ft (≤30 m)

(a) Parenthesized figure represents the equivalent length.

PRECAUTIONS ON REFRIGERANT PIPING

- Do not allow anything other than the designated refrigerant to get mixed into the freezing cycle, such as air, etc. If any refrigerant gas leaks while working on the unit, ventilate the room thoroughly right away.
- Use R410A only when adding refrigerant
  Installation tools:
  Make sure to use installation tools (gauge manifold charge hose, etc.) that are exclusively used for R410A installations to withstand the pressure and to prevent foreign materials (e.g. mineral oils and moisture) from mixing into the system.
  Vacuum pump:
  Use a 2-stage vacuum pump with a non-return valve
  Make sure the pump oil does not flow oppositely into the system while the pump is not working.
  Use a vacuum pump which can evacuate to –14.6 psi [–100.7 kPa (5 Torr absolute, –755 mm Hg)].
- In order to prevent dirt, liquid or dust from entering the piping, cure the piping with a pinch or taping.



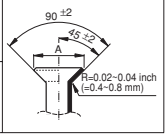
Place	Installation period	Protection method
Outdoor unit	More than a month	Pinch the pipe
	Less than a month	Pinch or tape the pipe
Indoor unit	Regardless of the period	

Great caution is needed when passing copper tubes through walls.

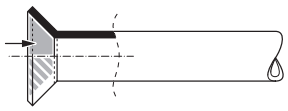
- Piping should be mounted so that the flare is not subjected to mechanical stress.

Flaring guidelines

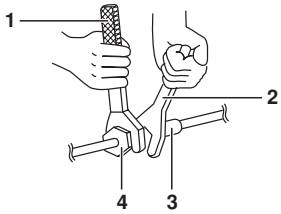
- Flares should not be re-used. New ones should be made in order to prevent leaks.
- Use a pipe cutter and flare tool suitable for the refrigerant used.
- Only use the flare nuts included with the unit. Using different flare nuts may cause the refrigerant to leak.
- Please refer to the table for flaring dimensions and tightening torques (too much tightening will result in splitting the flare).

Piping size	Tightening torque	Flare dimensions A	Flare shape
Ø3/8 inch (9.5 mm)	24.34~28.76 lbs•ft (33~39 N•m)	0.50~0.52 inch (12.8~13.2 mm)	
Ø5/8 inch (15.9 mm)	46.47~55.32 lbs•ft (63~75 N•m)	0.76~0.78 inch (19.4~19.7 mm)	

- When connecting the flare nut, coat the flare inner surface with ether oil or with ester oil and initially tighten 3 or 4 turns by hand before tightening firmly.



- When loosening a flare nut, always use two wrenches together. When connecting the piping, always use a spanner and torque wrench together to tighten the flare nut to prevent flare nut cracking and leaks.



1	Torque wrench
2	Spanner
3	Piping union
4	Flare nut

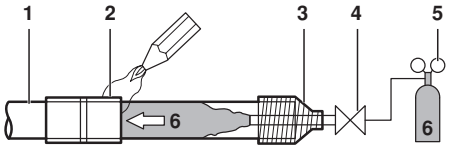
Not recommended, but in case of emergency
Should you be forced to connect the piping without a torque wrench, follow the following installation method:

- Tighten the flare nut using a spanner until the tightening torque suddenly increases.
- From that position further tighten the flare nut the angle listed below:

Piping size	Further tightening angle (degrees)	Recommended arm length of spanner
Ø3/8 inch (9.5 mm)	60~90	±8 inch (200 mm)
Ø5/8 inch (15.9 mm)	30~60	±12 inch (300 mm)

Brazing guidelines

- Make sure to blow through with nitrogen when brazing.
  Blowing through with nitrogen prevents the creation of large quantities of oxidized film on the inside of the piping. An oxidized film adversely affects valves and compressors in the refrigerating system and prevents proper operation.
- The nitrogen pressure should be set to 2.9 psi (0.02 MPa) (i.e., just enough so it can be felt on the skin) with a pressure-reducing valve.



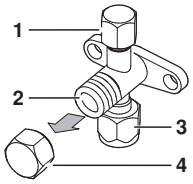
1	Refrigerant piping
2	Part to be brazed
3	Taping
4	Manual valve
5	Pressure-reducing valve
6	Nitrogen

- Do not use anti-oxidants when brazing the pipe joints.
  Residue can clog pipes and break equipment.
- Do not use flux when brazing copper-to-copper refrigerant piping. Use phosphor copper brazing filler alloy (BCuP) which does not require flux.
- Flux has an extremely harmful influence on refrigerant piping systems. For instance, if chlorine based flux is used, it will cause pipe corrosion or, in particular, if the flux contains fluorine, it will deteriorate the refrigerant oil.

Stop valve operation

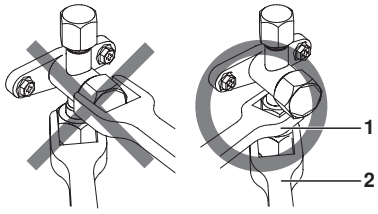
Cautions on handling the stop valve

- Make sure to keep both stop valves open during operation.
- The figure below shows the name of each part required in handling the stop valve.



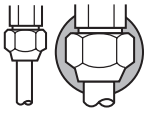
1	Service port and service port cap
2	Valve stem
3	Field piping connection
4	Stem cap

- The stop valve is factory closed.
- Do not apply excessive force to the valve stem. Doing so may break the valve body.
- Since the stop valve mounting plate may be deformed if only a torque wrench is used to loosen or tighten the flare nut, always make sure to secure the stop valve with a spanner, then loosen or tighten the flare nut with a torque wrench.
  Do not place the spanner on the stem cap, as this could cause a refrigerant leak.



1	Spanner
2	Torque wrench

- When it is expected that the operating pressure will be low (for example, when cooling will be performed while the outside air temperature is low), sufficiently seal the flare nut in the stop valve on the gas line with silicon sealant to prevent freezing.



Silicon sealant
(Make sure there is no gap)

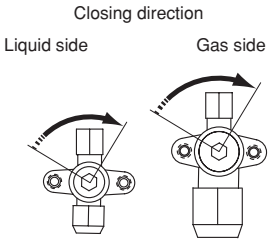
Opening/closing the stop valve

Opening the stop valve

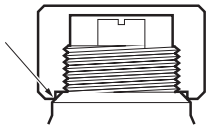
1. Remove the valve cover.
2. Insert a hexagon wrench (liquid side: 0.15 inch [close to 5/32] (4 mm)/gas side: 0.23 inch [close to 7/32] (6 mm)) into the valve stem and turn the valve stem counterclockwise.
3. When the valve stem cannot be turned any further, stop turning. The valve is now open.

Closing the stop valve

1. Remove the valve cover.
2. Insert a hexagon wrench (liquid side: 0.15 inch [close to 5/32] (4 mm)/gas side: 0.23 inch [close to 7/32] (6 mm)) into the valve stem and turn the valve stem clockwise.
3. When the valve stem cannot be turned any further, stop turning. The valve is now closed.



Cautions on handling the stem cap



- The stem cap is sealed where indicated by the arrow. Take care not to damage it.
- After handling the stop valve, make sure to tighten the stem cap securely. For the tightening torque, refer to the table below.
- Check for refrigerant leaks after tightening the stem cap.

Cautions on handling the service port

- Always use a charge hose equipped with a valve depressor pin, since the service port is a Schrader type valve.
- After handling the service port, make sure to tighten the service port cap securely. For the tightening torque, refer to the table below.
- Check for refrigerant leaks after tightening the service port cap.

Tightening torques

Item	Tightening torque
Stem cap, liquid side	9.96~12.17 lbs•ft (13.5~16.5 N•m)
Stem cap, gas side	16.60~20.28 lbs•ft (22.5~27.5 N•m)
Service port cap	8.48~10.25 lbs•ft (11.5~13.9 N•m)

REFRIGERANT PIPING

- Field pipes can be installed in four directions.

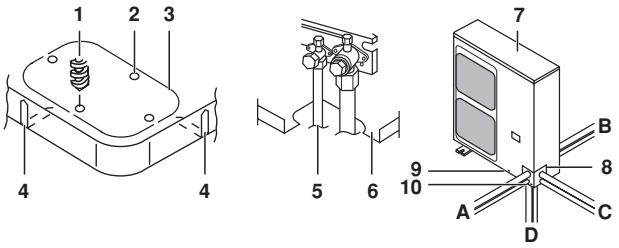
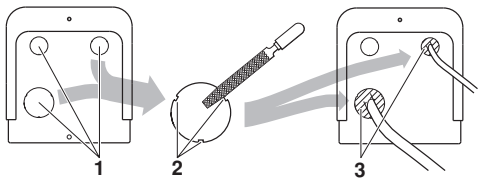


Figure - Field pipes in four directions

1	Drill
2	Centre area around knockout hole
3	Knockout hole
4	Slit
5	Connecting pipe
6	Bottom frame
7	Front plate
8	Pipe outlet plate
9	Screw front plate
10	Pipe outlet plate screw
A	Forward
B	Backward
C	Sideways
D	Downward

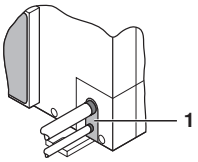
- Cutting out the two slits makes it possible to install as shown in the figure "Field pipes in four directions".
  (Use a metal saw to cut out the slits.)
- To install the connecting pipe to the unit in a downward direction, make a knockout hole by penetrating the centre area around the knockout hole using a Ø15/64 inch (6 mm) drill. (See figure "Field pipes in four directions".)
- After knocking out the knock-out, it is recommended to apply repair paint to the edge and the surrounding end surfaces to prevent rusting.
- When passing electrical wiring through the knock holes, remove any burrs from the knock holes and wrap the wiring with protective tape to prevent damage.
- If there is any possibility that small animals enter the system through the knock holes, plug the holes with packing materials (to be prepared on-site).



Preventing foreign objects from entering

1	Knockout hole
2	Burr
3	Packing materials

Plug the pipe through-holes with putty or insulating material (procured locally) to stop up all gaps, as shown in the figure.



1	Putty or insulating material (produced locally)

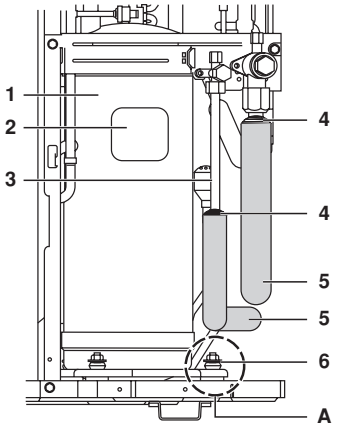
Insects or small animals entering the outdoor unit may cause a short circuit in the electrical box.

Precautions when connecting field piping and regarding insulation

- Be careful not to let the indoor and outdoor piping come into contact with the compressor terminal cover.
  If the liquid-side piping insulation might come into contact with it, adjust the height as shown in the figure below. Also, make sure the field piping does not touch the bolts or outer panels of the compressor.
- When the outdoor unit is installed above the indoor unit the following can occur:
  The condensated water on the stop valve can move to the indoor unit. To avoid this, please cover the stop valve with sealing material.
- If the temperature is higher than 86°F (30°C) and the humidity is higher than RH 80%, then the thickness of the sealing materials should be at least 0.78 inch (20 mm) in order to avoid condensation on the surface of the sealing.
- Be sure to insulate the liquid and gas-side field piping.

  Any exposed piping may cause condensation or burns if touched.

  (The highest temperature that the gas-side piping can reach is around 248°F (120°C), so be sure to use insulating material which is heat resistant.)



1	Compressor
2	Terminal cover
3	Indoor and outdoor field piping
4	Corking, etc.
5	Insulation material
6	Bolts
A	Be careful with pipe, bolt and outer panel connections

Cautions for necessity of a trap

Since there is fear of the oil held inside the riser piping flowing back into the compressor when stopped and causing liquid compression phenomenon, or cases of deterioration of oil return, it will be necessary to provide a trap at an appropriate place in the riser gas piping.

- Trap installation spacing. (See figure 4)

  A Outdoor unit
  B Indoor unit
  C Gas piping
  D Liquid piping
  E Oiltrap
  H Install trap at each difference in height of 33 ft (10 m).

- A trap is not necessary when the outdoor unit is installed in a higher position than the indoor unit.

LEAK TEST AND VACUUM DRYING

When all piping work is complete and the outdoor unit is connected to the indoor unit, it is necessary to (a) check for any leakages in the refrigerant piping and (b) to perform vacuum drying to remove all moisture in the refrigerant piping.

If there is a possibility of moisture being present in the refrigerant piping (for example, rainwater may have entered the piping), first carry out the vacuum drying procedure below until all moisture has been removed.

General guidelines

- All piping inside the unit has been factory tested for leaks.
- Use a 2-stage vacuum pump with a non-return valve which can evacuate to a gauge pressure of –14.6 psi [–100.7 kPa (5 Torr absolute, –755 mm Hg)].
- Connect the vacuum pump to **both** the service port of the gas stop valve and the liquid stop valve to increase efficiency.

NOTE

- Do not purge the air with refrigerants. Use a vacuum pump to evacuate the installation. No additional refrigerant is provided for air purging.
- Make sure that the gas stop valve and liquid stop valve are firmly closed before performing the leak test or vacuum drying.

Setup

(See figure 5)

1 Pressure gauge
2 Nitrogen
3 Refrigerant
4 Weighing machine
5 Vacuum pump
6 Stop valve

Leak test

The leak test must satisfy specification EN 378-2.

1 Vacuum leak test

1.1 Evacuate the system from the liquid and gas piping to –14.6 psi [–100.7 kPa (5 Torr absolute)].

1.2 Once reached, turn off the vacuum pump and check that the pressure does not rise for at least 1 minute.

1.3 Should the pressure rise, the system may either contain moisture (see vacuum drying below) or have leaks.

2 Pressure leak test

2.1 Break the vacuum by pressurizing with nitrogen gas to a minimum gauge pressure of 29 psi [0.2 MPa (2 bar)].
Never set the gauge pressure higher than the maximum operation pressure of the unit, i.e. 580 psi [4.0 MPa (40 bar)].

2.2 Test for leaks by applying a bubble test solution to all piping connections.

Make sure to use a recommended bubble test solution from your wholesaler.
Do not use soap water, which may cause cracking of flare nuts (soap water may contain salt, which absorbs moisture that will freeze when the piping gets cold), and/or lead to corrosion of flared joints (soap water may contain ammonia which causes a corrosive effect between the brass flare nut and the copper flare).

2.3 Discharge all nitrogen gas.

Vacuum drying

To remove all moisture from the system, proceed as follows:

1. Evacuate the system for at least 2 hours to a target vacuum of –14.6 psi [–100.7 kPa (5 Torr absolute)].

2. Check that, with the vacuum pump turned off, the target vacuum is maintained for at least 1 hour.

3. Should you fail to reach the target vacuum within 2 hours or maintain the vacuum for 1 hour, the system may contain too much moisture.

4. In that case, break the vacuum by pressurizing with nitrogen gas to a gauge pressure of 7.3 psi [0.05 MPa (0.5 bar)] and repeat steps 1 to 3 until all moisture has been removed.

5. The stop valves can now be opened, and/or additional refrigerant can be charged (see "Charging refrigerant" on page 10).

After opening the stop valve, it is possible that the pressure in the refrigerant piping does not rise. This might be caused by e.g. the closed state of the expansion valve in the outdoor unit circuit, but does not present any problem for correct operation of the unit.

CHARGING REFRIGERANT

To avoid compressor breakdown. Do not charge the refrigerant more than the specified amount.

- This outdoor unit is factory charged with refrigerant and depending on pipe sizes and pipe lengths some systems require additional charging of refrigerant. See "Calculating the additional refrigerant charge" on page 10.
- In case re-charge is required, refer to "Complete recharging" on page 10.

Precautions and general guidelines

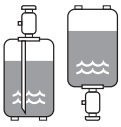
- When servicing the unit requires the refrigerant system to be opened, treatment and evacuation of refrigerant must be done in accordance with relevant local laws and national regulations.
- Refrigerant can not be charged until field wiring has been completed.
- Refrigerant may only be charged after performing the leak test and vacuum drying (see "Leak test and vacuum drying" on page 9).
- When charging a system, care shall be taken that its maximum permissible charge is never exceeded, in view of the danger of liquid hammer.
- Charging with an unsuitable substance may cause explosions and accidents, so always ensure that the appropriate refrigerant (R410A) is charged.
- Refrigerant cylinders shall be opened slowly.
- Always use protective gloves and protect your eyes when charging refrigerant.

DANGER

When the power is on, please close the front panel when leaving the unit unattended.

- This unit requires additional charging of refrigerant according to the length of refrigerant piping connected at the site.
- Make sure to charge the refrigerant in liquid state to the liquid pipe. Since R410A is a mixed refrigerant, its composition changes if charged in its gaseous state and normal system operation would then no longer be assured.
- Before charging, check whether the refrigerant cylinder has a syphon attached or not and position the cylinder accordingly.

Filling using a cylinder with a siphon attached
Charge the liquid refrigerant with the cylinder in upright position.



Filling using a cylinder without a siphon attached
Charge the liquid refrigerant with the cylinder in up-side-down position.

Calculating the additional refrigerant charge

Piping length is the one way length of gas or liquid piping whichever is the longest.

It is not necessary to charge additionally if the piping length is under 98.43 ft (30 m).
However, if the piping length is under 16.40 ft (5 m), a complete recharging of the unit is required. Refer to "Complete recharging" on page 10.

If the piping length is over 98.43 ft (30 m) please determine the additional amount of refrigerant to be charged using table 1 or table 2 in function of unit of measurements.

Table 1: Additional charging of refrigerant <unit: lbs>

Refrigerant piping length		
9.84~16.40 ft	**16.40~98.43 ft**	**98.43~131.23 ft**
(a)	(b)	1.10
131.23~164.04 ft	**164.04~196.85 ft**	**196.85~246.06 ft**
2.20	3.31	4.41

(a) Recharge required, refer to "Complete recharging" on page 10
(b) Additional charge not required

Table 2: Additional charging of refrigerant <unit: kg>

Refrigerant piping length					
3~5 m	**5~30 m**	**30~40 m**	**40~50 m**	**50~60 m**	**60~75 m**
(a)	(b)	0.5	1.0	1.5	2.0

(a) Recharge required, refer to "Complete recharging" on page 10
(b) Additional charge not required

Complete recharging

Before recharging, make sure to execute vacuum drying of the internal piping of the unit as well. To do so, use the internal service port of the unit. Do NOT use the service ports located on the stop valve (see "Stop valve operation" on page 7), since vacuum drying can not be performed properly from these ports.
Outdoor units have 1 port on the piping. It is between the heat exchanger and the 4-way valve.

In case complete recharging is required (after a leak, etc.), refer to table 3 or table 4 in function of unit of measurement to determine the necessary amount of refrigerant.

Table 3: Total charging amount <unit: lbs>

Refrigerant piping length (ft)			
9.84~32.81 ft	**32.81~65.62 ft**	**65.62~98.43 ft**	**98.43~131.23 ft**
5.95	7.05	8.16	9.26
131.23~164.04 ft	**164.04~196.85 ft**	**196.85~246.06 ft**	
10.36	11.46	12.57	

Table 4: Total charging amount <unit: kg>

Refrigerant piping length						
3~10 m	**10~20 m**	**20~30 m**	**30~40 m**	**40~50 m**	**50~60 m**	**60~75 m**
2.7	3.2	3.7	4.2	4.7	5.2	5.7

PUMP DOWN OPERATION

This unit is equipped with an automatic pump down operation which will collect all refrigerant from the field piping and indoor unit in the outdoor unit. To protect the environment, make sure to perform the following pump down operation when relocating or disposing of the unit.

NOTE For more details, refer to the applicable service manual.

WARNING

The outdoor unit is equipped with a low pressure switch or a low pressure sensor to protect the compressor by switching it off. Never short-circuit the low pressure switch during pump down operation!

1. Turn on the main power supply switch.
2. Make sure the liquid stop valve and the gas stop valve are open (see "Stop valve operation" on page 7).
3. Press the pump down button (BS4) on the PCB of the outdoor unit for at least 8 seconds.
4. The compressor and outdoor unit fan will start operating automatically.

5. Once operation stops (after 3 to 5 minutes), close the liquid stop valve and the gas stop valve.
6. The pump down operation is now finished. The remote controller may display "U4" and the indoor pump may continue operating for about 30 seconds. This is not a malfunction. Even when the ON button on the remote controller is pressed, the unit will not start to operate. To restart operation of the unit turn off the main power supply switch and turn it on again.
7. Turn off the main power supply switch.

WARNING

Make sure to re-open both stop valves before restarting operation of the unit.

ELECTRICAL WIRING WORK

- All wiring must be performed by an authorized electrician.
- All components procured on the site and all electric construction shall comply with the applicable local laws and regulations.

DANGER

High voltage

To avoid electrical shock, make sure to disconnect the power supply 1 minute or more before servicing the electrical parts. Even after 1 minute, always measure the voltage at the terminals of main circuit capacitors or electrical parts and, before touching, make sure that those voltages are 50 V DC or less.

To persons in charge of electrical wiring work:

Do not operate the unit until the refrigerant piping is complete. (Running it before the piping is ready will break the compressor.)

Precautions on electrical wiring work

DANGER

Before obtaining access to terminal devices, all supply circuits must be interrupted.

- Use only copper wires.
- A main switch or other means for disconnection, having a contact separation in all poles, must be incorporated in the fixed wiring in accordance with relevant local laws and national regulations.
  Do not turn on the main switch until all the wiring is completed.
- Never squeeze bundled cables into a unit.
- Fix cables so that cables do not make contact with the pipes (especially on high pressure side).
- Secure the electrical wiring with cable ties as shown in the figure below so that it does not come in contact with the piping, particularly on the high-pressure side.
  Make sure no external pressure is applied to the terminal connectors.
- Be sure to install a ground fault circuit interrupter in accordance with relevant local laws and regulations. Failure to do so may cause electrical shock.
- When installing the ground fault circuit interrupter make sure that it is compatible with the inverter (resistant to high frequency electrical noise) to avoid unnecessary opening of the ground fault circuit interrupter.

  WARNING

  The ground fault circuit interrupter must be a high speed type breaker of 30 mA (<0.1 seconds).

- As this unit is equipped with an inverter, installing a phase advancing capacitor not only will deteriorate power factor improvement effect, but also may cause capacitor abnormal heating accident due to high-frequency waves. Therefore, never install a phase advancing capacitor.

CAUTION

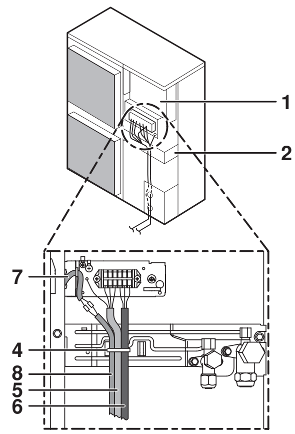
Be sure to install the required fuses or circuit breakers.

Secure the wiring in the order shown below.

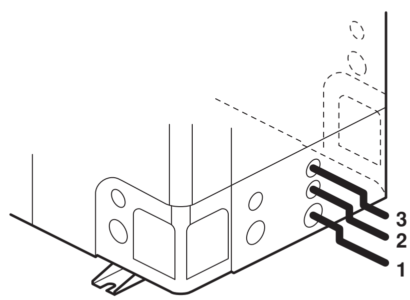
1 Secure the ground wire to the stop valve attachment plate so that it does not slide.

2 Secure the ground wire to the stop valve attachment plate one more time along with the electric wiring and the inter-unit wiring.

- Lay the electrical wiring so that the front cover does not rise up when doing wiring work and attach the front cover securely.



1	Switch box
2	Stop valve mounting plate
3	Ground
4	Cable tie
5	Wiring between units
6	Power supply and ground wiring
7	Bottom plate heater cable
8	Power supply of bottom plate heater (from indoor unit)



1	Power supply and ground wiring
2	Wiring between unit
3	Power supply of bottom plate heater (from indoor unit)

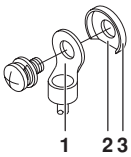
- When cables are routed from the unit, a protection sleeve for the conduits (PG-insertions) can be inserted at the knock-out hole. (See figure 3)

1	Wire
2	Bush
3	Nut
4	Frame
5	Hose
A	Inside
B	Outside

  When you do not use a wire conduit, be sure to protect the wires with vinyl tubes to prevent the edge of the knock-out hole from cutting the wires.
- Follow the electric wiring diagram for electrical wiring works.
- Form the wires and fix the cover firmly so that the cover may be fit in properly.
- For field wiring use appropriate wire conduits according to local laws and regulations.

Precautions on wiring of power supply and inter-unit wiring

- Use a round crimp-style terminal for connection to the power supply terminal board. In case it cannot be used due to unavoidable reasons, be sure to observe the following instruction.



1 Round pressure terminal
2 Cut out section
3 Cup washer

  - Do not connect wires of different gauge to the same power supply terminal. (Looseness in the connection may cause overheating.)
  - When connecting wires of the same gauge, connect them according to the below figure.

- Use the correct screwdriver to tighten the terminal screws. Small screwdrivers can damage the screw head and prevent appropriate tightening.
- Over-tightening the terminal screws can damage the screws.
- See the table below for tightening torques for the terminal screws.

Tightening torque	
M4 (X1M)	0.89~1.33 lbs•ft (1.2~1.8 N•m)
M5 (X1M)	1.48~2.21 lbs•ft (2.0~3.0 N•m)
M5 (ground)	2.21~2.95 lbs•ft (3.0~4.0 N•m)

- Refer to the installation manual attached to the indoor unit for wiring of indoor unit, etc.
- Attach an ground fault circuit interrupter and fuse or circuit breaker to the power supply line. (See figure 6)

1 Ground fault circuit interrupter
2 Fuse or circuit breaker
3 Remote controller

- In wiring, make certain that prescribed wires are used, carry out complete connections, and fix the wires so that outside forces are not applied to the terminals.

Specifications of standard wiring components

	ERLQ_VJU	
Phase and frequency	2~ 60 Hz	2~ 60 Hz
Voltage	208 V	230 V
Maxilum overcurrent protection	30 A	30 A
Minimum circuit amps[(a)]	26.5 A	26.5 A
Wire type of wiring between the units	Minimum cable section of AWG14 (2.5 mm^2) and applicable for 230 V	

(a) Stated values are maximum values (see electrical data of combination with indoor unit for exact values).

NOTE Select all cables and wire sizes in accordance with relevant local laws and regulations.

After finishing the electrical work, confirm that each electric part and terminal inside the electric part box is connected securely.

The wiring diagram can be found on the inside of the front plate of the unit.

TEST OPERATION

DANGER
Never leave the unit unattended during installation or servicing. When the service panel is removed live parts can be easily touched by accident.

NOTE Note that during the first running period of the unit, required power input may be higher than stated on the nameplate of the unit. This phenomenon originates from the compressor that needs elapse of a 50 hours run in period before reaching smooth operation and stable power consumption.

Pre-run checks

Items to check	
Electrical wiring Inter-unit wiring Ground wire	■ Is the wiring as mentioned on the wiring diagram? Make sure no wiring has been forgotten and that there are no missing phases or reverse phases. ■ Is the unit properly grounded? ■ Is the wiring between units connected in series correct? ■ Are any of the wiring attachment screws loose? ■ Is the insulation resistance at least 1 MΩ? - Use a 500 V mega-tester when measuring insulation. - Do not use a mega-tester for low-voltage circuits.
Refrigerant piping	■ Is the size of the piping appropriate? ■ Is the insulation material for the piping attached securely? Are both the liquid and gas pipes insulated? ■ Are the stop valves for both the liquid side and the gas side open?
Extra refrigerant	■ Did you write down the extra refrigerant and the refrigerant piping length?

- Be sure to perform a test run.
- Be sure to fully open the liquid-side and gas-side stop valves. If you operate the unit with stop valves closed, the compressor will break down.
- Be sure to execute the first test run of the installation in cooling mode operation.
- Never leave the unit unattended with an open front panel during test run.
- To protect the compressor, make sure to turn on the power supply 6 hours before starting operation.
- During tests never pressurize the applications with a pressure higher than the maximum allowable pressure (indicated on the name plate of the unit).

Test run

Carry out the test run in accordance with the indoor installation manual to ensure that all functions and parts are working properly.

Failure diagnosis at the moment of first installation

- In case nothing is displayed on the remote controller (the current set temperature does not display), check for any of the following abnormalities before you can diagnose possible malfunction codes.
  - Disconnection or wiring error (between power supply and outdoor unit, between outdoor unit and indoor units, between indoor unit and remote controller).
  - The fuse on the outdoor unit PCB may have run out.
- If the remote controller shows *"E3"*, *"E4"* or *"L8"* as an error code, there is a possibility that either the stop valves are closed, or that air inlet or air outlet are blocked.
- If the error code *"U2"* is displayed on the remote controller, check for voltage imbalance.
- If the error code *"L4"* is displayed on the remote controller, it is possible that air inlet or air outlet are blocked.

MAINTENANCE AND SERVICING

Service precautions

WARNING: ELECTRIC SHOCK

Caution when performing service to inverter equipment

DANGER

- Do not touch live parts for 10 minutes after the power supply is turned off because of high voltage risk.
- Make sure that the power supply is turned off before performing the maintenance work. The heater of the compressor may operate even in stop mode.

- Please note that some sections of the electric component box are extremely hot.
- In order to prevent damage to the PCB, first eliminate static electricity by touching a metal part (e.g. stop valve) with your hand. Then pull out the connector.
- After measuring the residual voltage, pull out the outdoor fan connector.
- Make sure you do not touch a conductive section.
- The outdoor fan may rotate due to strong backblow wind, causing the capacitor to charge. This may result in an electric shock.

After maintenance, make sure the outdoor fan connector is connected again. Otherwise, the unit may break down.

Play it safe!

Touch a metal part by hand (such as the stop valve) in order to eliminate static electricity and to protect the PCB before performing service.

Service mode operation

Refer to the service manual to carry out any service mode operation.

DISPOSAL REQUIREMENTS

Dismantling of the unit, treatment of the refrigerant, of oil and of other parts must be done in accordance with relevant local laws and national regulation.

UNIT SPECIFICATIONS

Technical specifications

Casing material	Painted galvanised steel
Dimensions h x w x d	46.06 x 35.43 x 12.60 inch (1170 x 900 x 320 mm)
Weight ERHQ/ERLQ	227/231 lbs (103/105 kg)
Operation range	
• cooling (min./max.)	50/115°F (10/46°C)
• heating (min./max.)	–4/95°F (–20/35°C)
• domestic hot water (min./max.)	–4/95°F (–20/35°C)
Refrigerant oil	Daphne FVC68D
Piping connection	
• liquid	3/8 inch (9.52 mm)
• gas	5/8 inch (15.9 mm)

Electrical specifications

Phase	2~	2~
Frequency	60 Hz	60 Hz
Voltage	230	208
Voltage range		
• minimum	207 V	187 V
• maximum	253 V	229 V

WIRING DIAGRAM

-●-	: Connection
-○-	: Terminal
○	: Wire clamp
□□□	: Terminal strip
⊡	: Connector
-◖-	: Connector
▪▪▪	: Field wiring
⏚	: Protective ground screw
⏚	: Noiseless ground

L	: Live
N	: Neutral

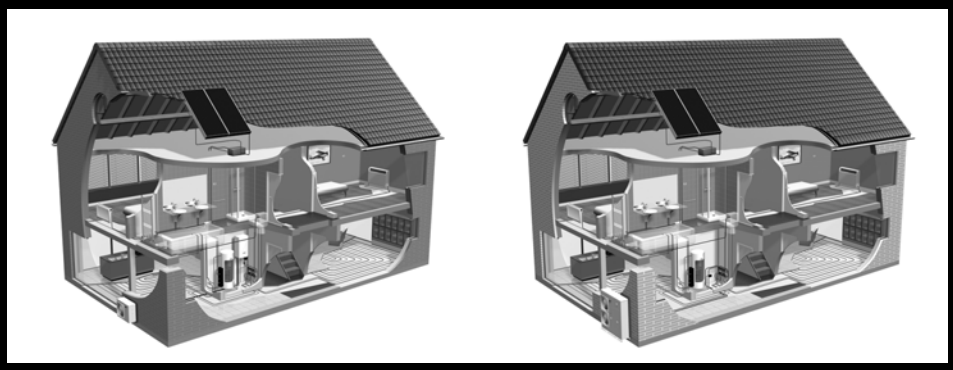
BLK	: Black
BLU	: Blue
BRN	: Brown
GRN	: Green
ORG	: Orange
RED	: Red
WHT	: White
YLW	: Yellow

NOTE 1	This wiring diagram only applies to the outdoor unit
NOTE 4	Refer to the option manual for connecting wiring to X6A
NOTE 5	Refer to the wiring diagram sticker (on back of front panel) on how to use BS1~BS4 and DS1 switch
NOTE 6	Do not operate the unit by short-circuiting protection device S1PH
NOTE 8	Confirm the method of setting the selector switches (DS1) by service manual. Factory setting of all switches: 'OFF'
NOTE 9	Option: Option Wiring depending on model: Wiring depending on model

A1P~A4P..... Printed circuit board
BS1~BS4..... Push button switch
C1~C4..... Capacitor
DS1 ..... DIP switch
E1H ..... Bottom plate heater
E1HC..... Crankcase heater
F1U~F8U..... Fuse
HAP (A1P)..... Service monitor (green)
H1P~H7P (A2P)..... Service monitor (orange)
K1R~K4R ..... Magnetic relay
K10R, K11R ..... Magnetic relay
L1R..... Reactor
M1C..... Motor (compressor)
M1F ..... Motor (fan) (upper)
M2F ..... Motor (fan) (lower)
PS ..... Switching power supply
Q1DI..... Ground fault circuit interrupter (field supply)
R1,R2 ..... Resistor
R1T ..... Thermistor (air)
R2T ..... Thermistor (discharge)
R3T..... Thermistor (suction pipe)
R4T..... Thermistor (heat exchanger)
R5T..... Thermistor (heat exchanger middle)
R6T..... Thermistor (liquid)
R10T..... Thermistor (fin)
RC ..... Signal receiver circuit
S1NPH..... Pressure sensor
S1PH ..... Pressure switch (high)
TC..... Signal transmission circuit
V1R..... Power module
V2R, V3R..... Diode module
V1T ..... Insulated gate bipolar transistor
X1M ..... Terminal strip
X1Y..... Connector
X6A..... Connector (option)
Y1E..... Expansion valve
Y1S..... Solenoid valve (4-way valve)
Z1C~Z3C..... Noise filter
Z1F~Z4F..... Noise filter

DACA-EEDEN09-720

Engineering Data



DaikinAltherma

R-410A

altherma

Daikin Altherma Engineering Data

Part 1: Overview

Part 2: ERLQ036_048_054BAVJU Split Type

Part 3: EKHBH054BA Hydrobox

Part 4: EDLQ / EBLQ_036_048_054 Monobloc

Part 5: EKHWS050_080BA3VJU Domestic Hot Water

Part 6: Options

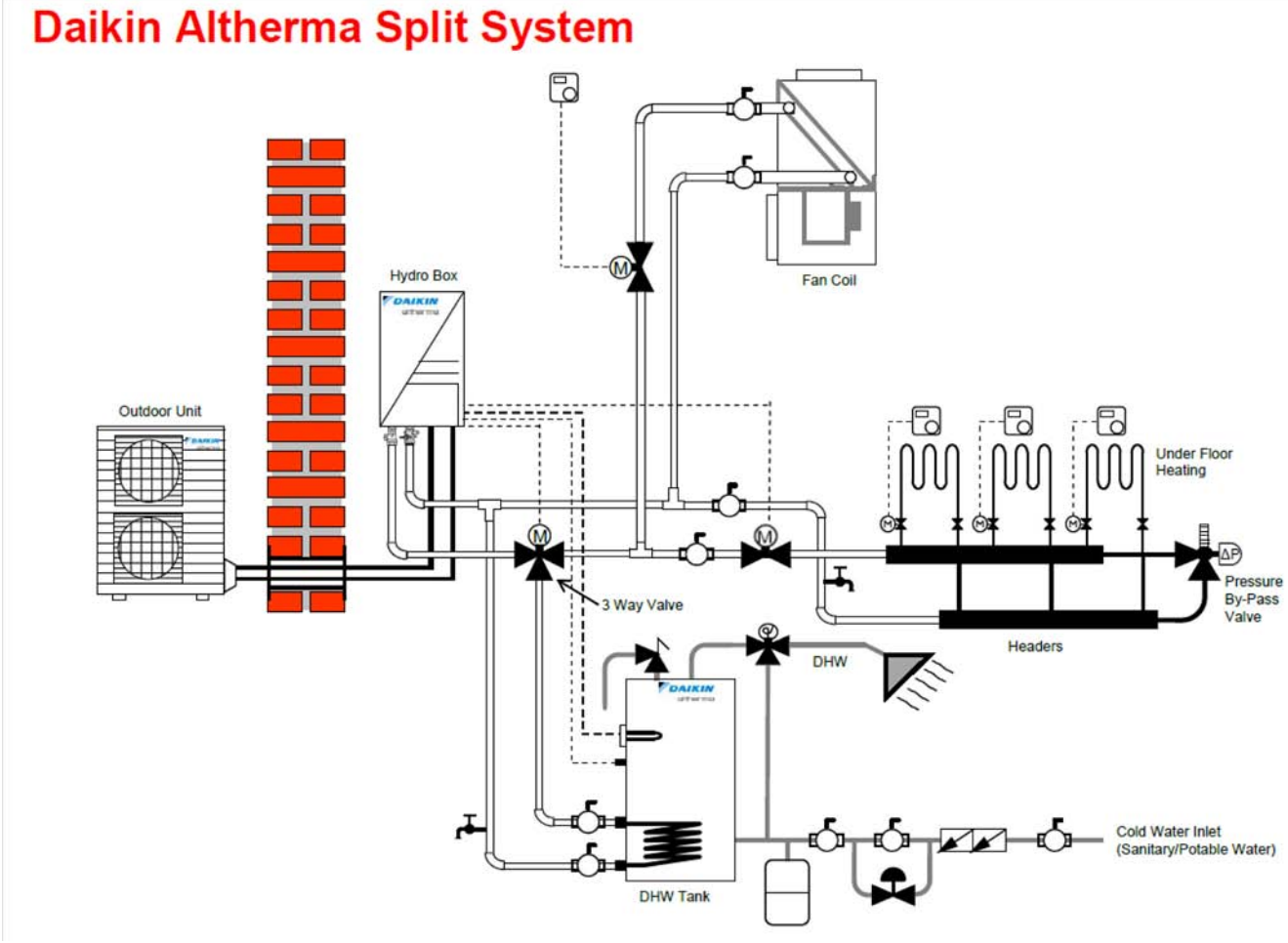
Part 7: Appendix - Field Settings Overview

1. Daikin Altherma Overview

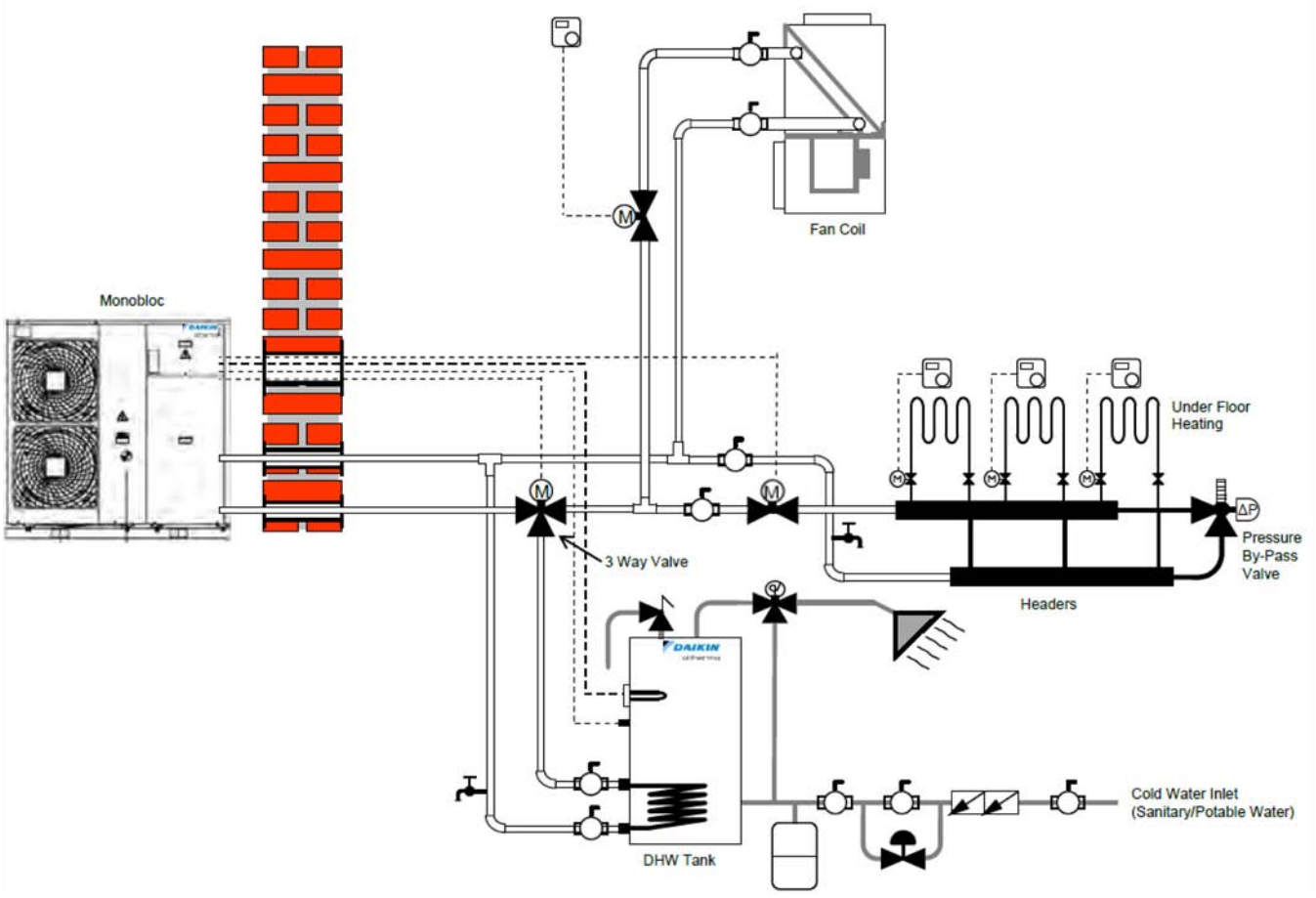
1.1 Daikin Altherma Split System

Daikin Altherma is a Total Comfort air-to-water heat pump system that utilizes an outdoor R-410A heat pump system, with Inverter controlled compressor, to extract heat from the outdoor air and transfers this heat through refrigerant piping to a refrigerant-to-water cupro-nickel brazed plate heat exchanger in the hydrobox (indoor unit on split system and incorporated in the outdoor unit on the monobloc). The hydrobox circulates the heated water through low temperature heat emitters (low temperature radiators, floor heating systems and fan coil units) and also provides domestic hot water (DHW) with the optional DHW tank (316L stainless steel heat exchanger and tank). The heat pump version of the hydrobox can reverse the cycle and provide chilled water for cooling through fan coil units (fan coil units for cooling are field supplied and must have a condensate drain pan). Daikin Altherma can heat spaces, produces domestic hot water and with the heat pump version hydrobox or monobloc can cool spaces.

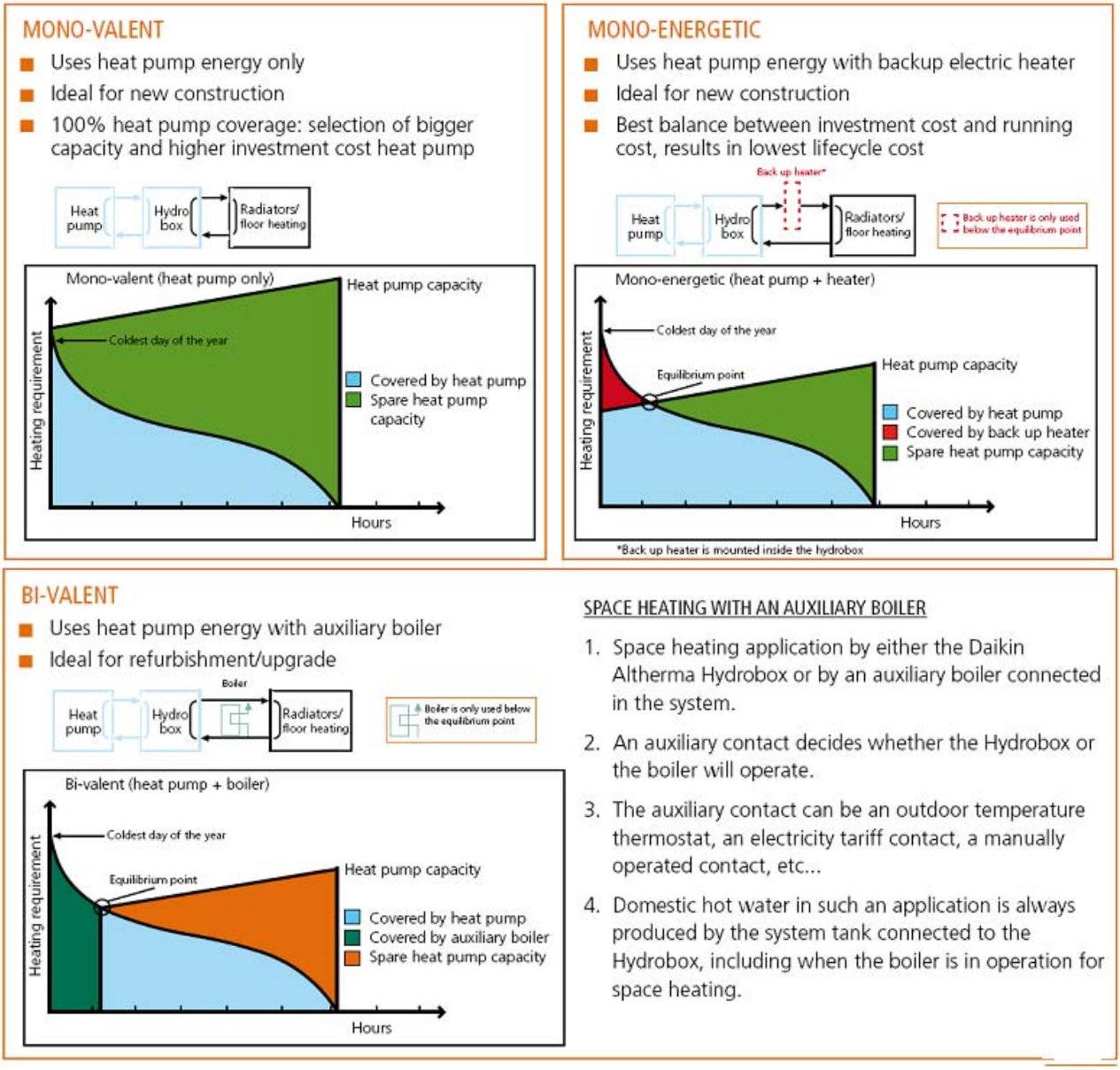
The high coefficient of performance (COP) of the Daikin Altherma heat pump is largely attributed to the Daikin inverter principle. An integrated frequency converter adjusts the rotational speed of the compressor to suit the heating (cooling) demand. The system seldom operates at full capacity and maximizes efficiency by controlling the compressor rpm.



1.2 Daikin Altherma Monobloc System



1.3 System Configurations



Selection Conditions
Typical conditions for the heating LWT are:

86 to 95° F (at design conditions) for floor heating

86 to 113° F (at design conditions) for fan coil units

104 to 122° F (at design conditions) for low temperature radiators

2. The Basics of Daikin Altherma

2.1 Air-to-Water Heat Pump

DAIKIN altherma

AIR-TO-WATER HEAT PUMP

THE BASICS

The system consists of 5 components which together to provide the ideal comfort and water temperature.

1A / OUTDOOR UNIT : AN EFFICIENT USE OF ENERGY FROM THE AIR

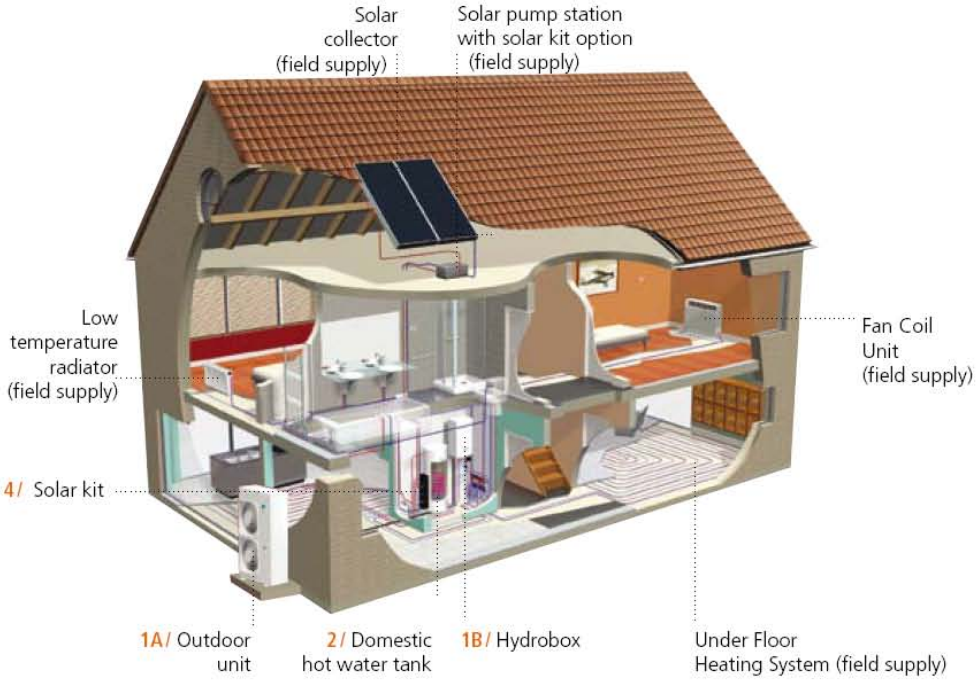
Daikin Altherma uses a natural source of energy. The outdoor unit extracts heat from the outside air and transfers it inside through refrigerant piping to supply heating. The compact outdoor unit is easily installed and, as no drilling or excavation work is required, it can also be installed in condos and apartments.

1B / HYDROBOX : THE HEART OF THE DAIKIN ALTHERMA SYSTEM

The hydrobox heats the water that circulates through low temperature radiators, floor heating systems or fan coil units and also provides domestic hot water. If you opt for the combination of heating and cooling, then the hydrobox can also reverse the cycle to provide lower water temperatures and thus cooling to the home.

2 / DOMESTIC HOT WATER TANK : FOR LOW ENERGY CONSUMPTION

As for your domestic hot water, Daikin Altherma is just as clever. The unique lay-out and special placement of the system components maximize energy efficiency. The water inside the storage tank is primarily warmed up by thermal energy from the outside air, thanks to a heat exchanger connected to the heat pump. However, an additional electrical heating element in the domestic water tank can take care of extra heat required in the shower, tub or sink. At necessary intervals the water is automatically heated to 158°F or more to prevent the risk of bacteria growth. With Daikin Altherma, delightfully warm and perfectly safe water can be enjoyed at all times. Depending on the daily consumption of hot water, Daikin Altherma domestic hot water tanks are available in two different sizes.



3 / MONOBLOC OUTDOOR UNIT: ALL IN ONE

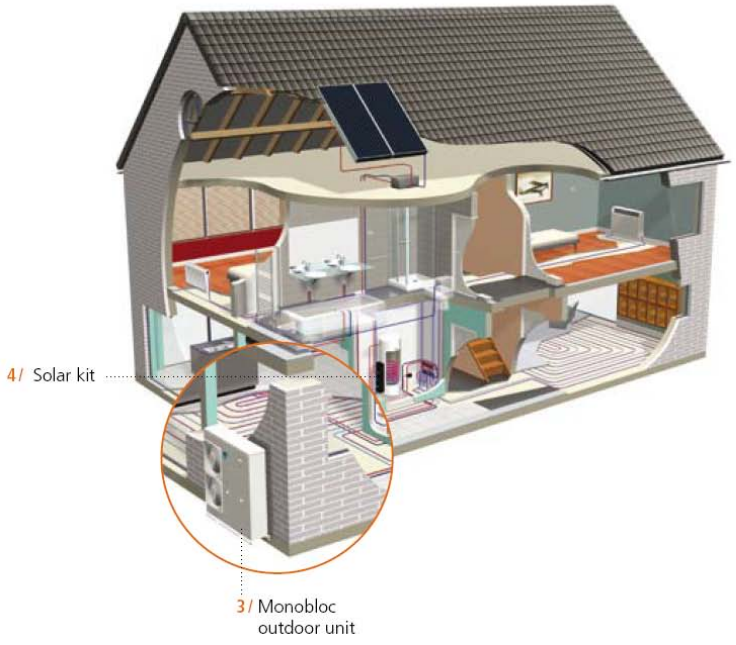
In addition to Daikin Altherma Split type systems, Daikin has a monobloc version in which the hydrobox components are located within the outdoor unit. In this new system, the water pipes, rather than refrigerant lines, run indoors from the outdoor unit, making installation much quicker and easier for the installer.

4 / SOLAR KIT

The solar kit provides the transfer of solar heat to the Daikin Altherma hot water tank via an external heat exchanger. In contrast to tanks with two heat exchangers, this system allows the entire content of the tank to be efficiently heated with solar heat and, if necessary, with heat pump energy.

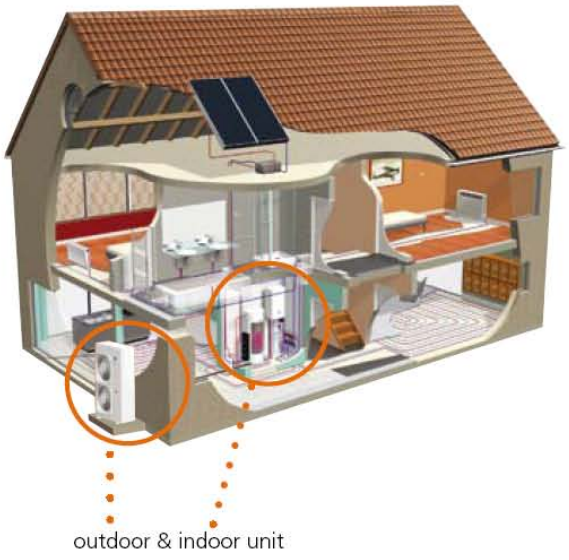
5 / ROOM THERMOSTAT

With the wired room thermostat, the ideal temperature can be easily, quickly and conveniently regulated.



2.2 Split Type

Daikin offers you the choice between a Daikin Altherma system with an outdoor unit and indoor unit, or a Daikin Altherma Monobloc System, in which the hydrobox components are located within the outdoor unit.

	DAIKIN ALTHERMA SPLIT TYPE
Application	Heating and (optional) cooling (+ domestic hot water) 
Heat pump type	Outdoor (compressor) unit + Indoor (hydronic parts) unit
R-410A refrigerant piping	Between outdoor unit and indoor unit
H_2O piping	Between indoor unit and indoor heating appliances
Installer's advantages	No extra insulation of H_2O piping required to protect from freezing up

The Split system can be combined with
- Under floor heating
- Fan coil units
- Low temperature radiators to provide your customers the comfort they require.

In addition, the Split system can be connected to
- A domestic hot water tank to supply your customer's hot water needs
- Solar collectors, with optional solar kit, to compliment the production of hot water
- A room thermostat, to regulate the ideal temperature easily, quickly and conveniently.

2.3 Monobloc

	DAIKIN ALTHERMA MONOBLOC
Application	Heating and (optional) cooling (+ domestic hot water)
Heat pump type	Outdoor unit only (compressor and hydronic parts combined)
R-410A refrigerant piping	Inside outdoor unit
H_2O piping	Between outdoor unit and heating terminal units
Installer's advantages	Only H_2O piping needed to install the system

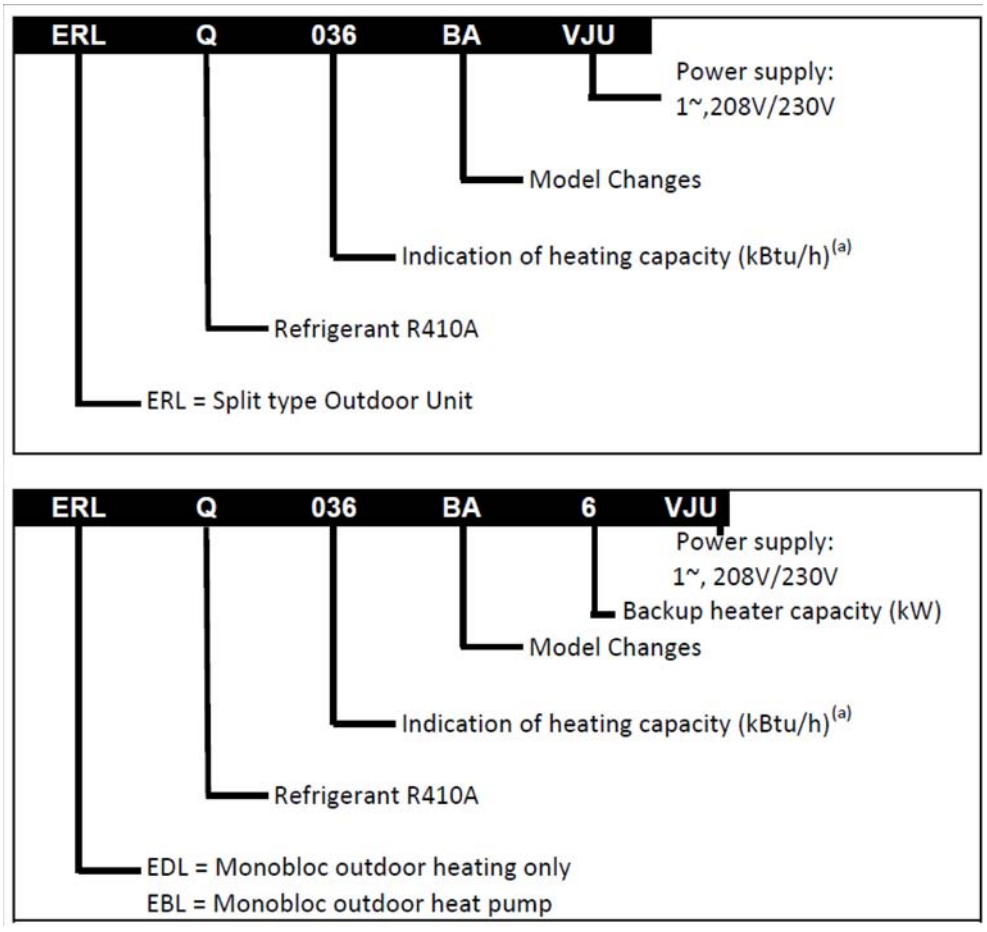
monobloc outdoor unit

The monobloc system can be combined with
- Under floor heating
- Fan coil units
- Low temperature radiators to provide your customer the comfort they require.

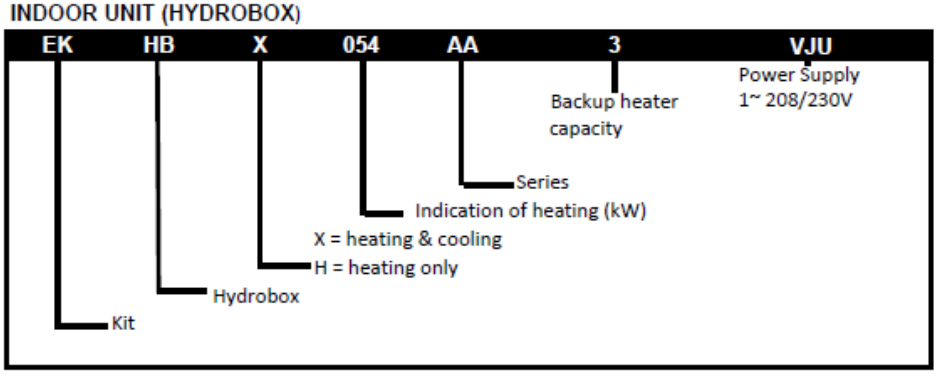
In addition, the monobloc system can be connected to
- A domestic hot water tank to supply your customer's hot water needs
- Solar collectors, with optional solar kit, to compliment the production of hot water
- A room thermostat, to regulate the ideal temperature easily, quickly and conveniently.

3. Model Indentification

3.1 Outdoor Units

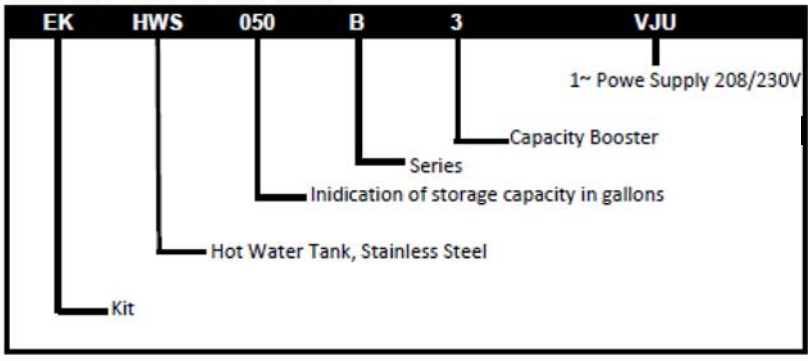


3.2 Indoor Units

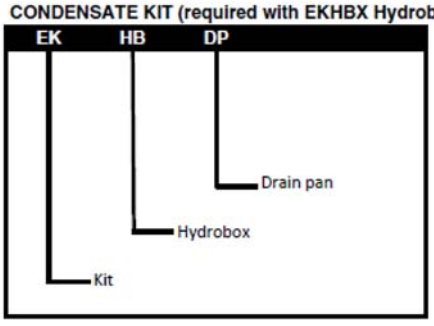


3.3 Options

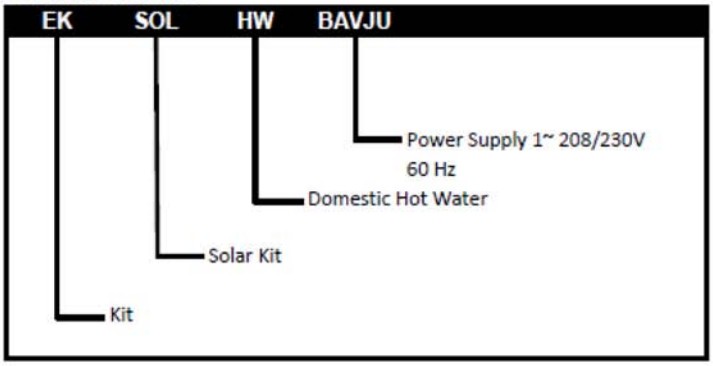
DOMESTIC HOT WATER TANK



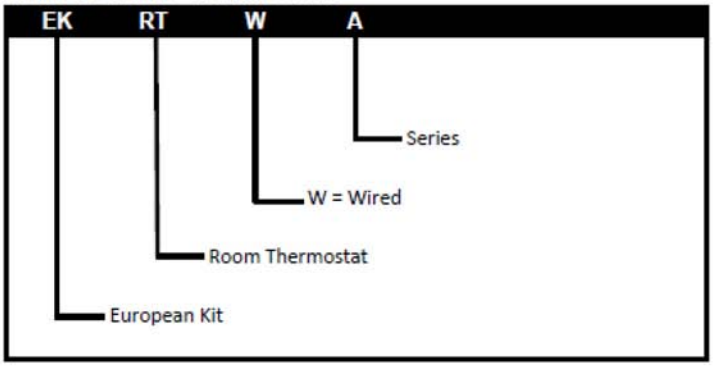
CONDENSATE KIT (required with EKHBX Hydrobox)



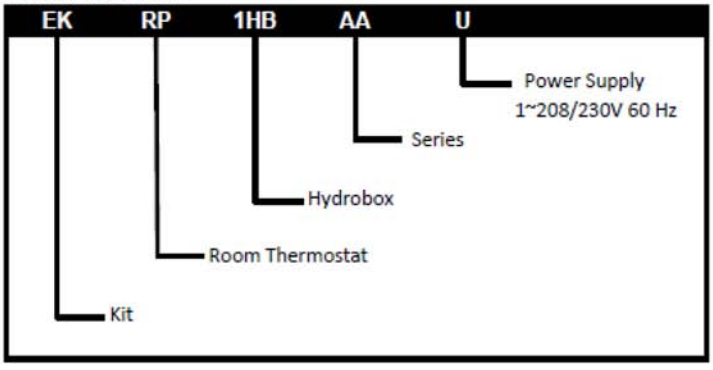
SOLAR PUMP KIT



REMOTE WIRED THERMOSTAT



DIGITAL I/O PCB



4. System and Design Recommendations

Daikin Altherma System Design and Operation Recommendations

Three (3) steps for a good design:

1) Accurate calculations of heat losses (transmission and ventilation losses).
2) Selection of Daikin Altherma based on heat loss calculation and preferably for low water temperature application (95°F/35°C to 104°F/40°C). Use the available Daikin Altherma selection and software tools (use Daikin Altherma Checklist for selection inputs).
3) Selection of heat emitters should be based on operating temperature, flow rate, and heat output characteristics.

Design hint: If the heat losses exceed the single total Altherma capacity at design ambient conditions, multiple Altherma system may be used in unison to aid greater DHW consumption or larger heating loads in single zones. For multiple zones it is highly recommended to utilize multiple (separate) systems. Daikin Altherma can also be applied using an auxiliary boiler connected in parallel (Bi-Valent application)

Recommended Altherma leaving water temperature (LWT) selections conditions:

Typical conditions for the heating LWT are:

86°F/30°C to 95°F/35°C (at design conditions) for floor heating
86°F/30°C to 113°F/45°C (at design conditions) for fan coil units
104°F/40°C to 122°F/50°C (at design conditions) for low temperature radiators

Operating the System:

To get the most comfort with the lowest energy consumption with Daikin Altherma, it is very important to observe the following items:

- Define possible schedule timer actions for each day by filling out the form at the end of the operation manual can help minimize energy consumption.
- Make sure the heat pump system works at the lowest possible hot water temperature to heat the home. To optimize this, make sure the weather dependent set point (outdoor reset) is used and configured to match the installation environment (use the available selection and software tool).

- It is advised to install the Daikin room thermostat (EKRTWA) connected to the hydrobox section. This will prevent excessive space heating and will stop the outdoor unit and circulator pump when the room temperature is above the thermostat set point.

Next recommendations apply to installations with an optional domestic hot water (DHW) tank:

- Make sure the DHW is only heated up to the temperature required.
- Make sure the DHW heating by the booster heater located in the DHW tank is enabled 1 to 2 hours before the expected DHW usage (refer to the DHW heating and booster heating schedule timer programming in the operation manual).

Refer to combination overview and component selection on the following pages:

Quote #: ☐

Daikin Altherma Checklist

Low Temperature Mode

Job Name: _____ **Date:** _____

Customer: _____ **Required by:** _____

Contact: _____ _____ **PO:** _____

A) Sizing Information:

Outdoor Temperature Where Heat Loss = Zero: _____ Night Setback Temperature: _____

Heat Loss: _____ Btu/h Heating Months: _____

Heat Gain (if cooling): _____ Btu/h Total Area _____ Square Feet

Energy Cost: Electricity____kW; Gas____Therm; Oil____gal Peak / Standard Demand Charge Period_____

Details: _____

B) System Selection:

System Layout:

☐ Split System (R410A piping to indoor hydrobox)

☐ Monobloc (packaged unit) (H_2O piping to inside) (Includes 6 kW 2-stage backup heater)

System Type:

Backup heater selection is not applicable to Monobloc

☐ Heating Only EKHBH-Split System / EDLQ-Monobloc

☐ Heat Pump (Heating & Cooling) EKHBX-Split System / EBLQ-Monobloc

☐ 3 kW Backup heat capacity ☐ 6kW Backup heat capacity 2-stage

System Criteria:

☐ Heating (LWT _____°F/°C) (Maximum temperature 131°F / 55°C)

☐ Cooling (LWT _____°F/°C) (EKBDHP Condensate Kit Required)

☐ DHW (Water Temp _____°F/°C)

System Source:

☐ 100% Heat Pump (Mono-Valent)

☐ Heat Pump w/Electric Heater (Mono-Energetic)

☐ Heat Pump with Auxiliary Boiler (Bi-Valent)

Heat Emitters: Dual Setpoint Temperature:_____high_____low

Type	Heat or Cool	Capacity Btu/h	CFM-Fan Coil	Additional Heat EmitterSpecifications
Radiant Floor				
86 to 95°F / 30 to 35°C				
Fan Coil				
86 to 113°F / 30 to 45°C				
Low Temp Radiators				
104 to 122°F / 40 to 50°C				

Domestic Hot Water:

☐ 50 Gallon (Integrated 3kW booster heater)

☐ 80 Gallon (Integrated 3kW booster heater)

☐ Optional Solar Kit (connection kit to storage tank only)

Solar Option:

☐ Storage Tank Connection Kit (connection kit to storage tank only)

☐ Control Board Interface (PCB)

Thermostats:

☐ Daikin Thermostat (EKRTWA) (Wired to hydro box)

☐ Zone Thermostats (by others)

☐ Room Thermostat (by others) (Wired to hydro box) Must have 6 min. run time

Notes:

☐ Order # _____ ☐ Date_____ ☐ Person_____

Version 3 (2009)

5. Combination Overview

Daikin Altherma Split System Combination Overview		Hydrobox Heating Only		Hydrobox Heat Pump (Reversible)	
		EKHBH054BA3VJU	EKHBH054BA6VJU	EKHBX054BA3VJU	EKHBX054BA6VJU
Outdoor Unit	ERLQ036BAVJU	X	X	X	X
	ERLQ048BAVJU	X	X	X	X
	ERLQ054BAVJU	X	X	X	X
DHW Tank (50 gal)	EKHWS050BA3VJU	X	X	X	X
DHW Tank (80 gal)	EKHWS080BA3VJU	X	X	X	X
Digital I/O PCB	EKRP1HBAAU	1	1	1	1
Solar Pump Kit	EKSOLHWBAVJU	2	2	2	2
Wired Thermostat	EKRTWA	X	X	X	X
Condensate Kit	EKHBDP	N/A	N/A	3	3

Daikin Altherma Monobloc Combination Overview		Monobloc Heating Only			Monobloc Heat Pump (Reversible)		
		EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU	EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
DHW Tank (50 gal)	EKHWS050BA3VJU	X	X	X	X	X	X
DHW Tank (80 gal)	EKHWS080BA3VJU	X	X	X	X	X	X
Digital I/O PCB	EKRP1HBAAU	1	1	1	1	1	1
Solar Pump Kit	EKSOLHWBAVJU	2	2	2	2	2	2
Wired Thermostat	EKRTWA	X	X	X	X	X	X
Condensate Kit	EKHBDP	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

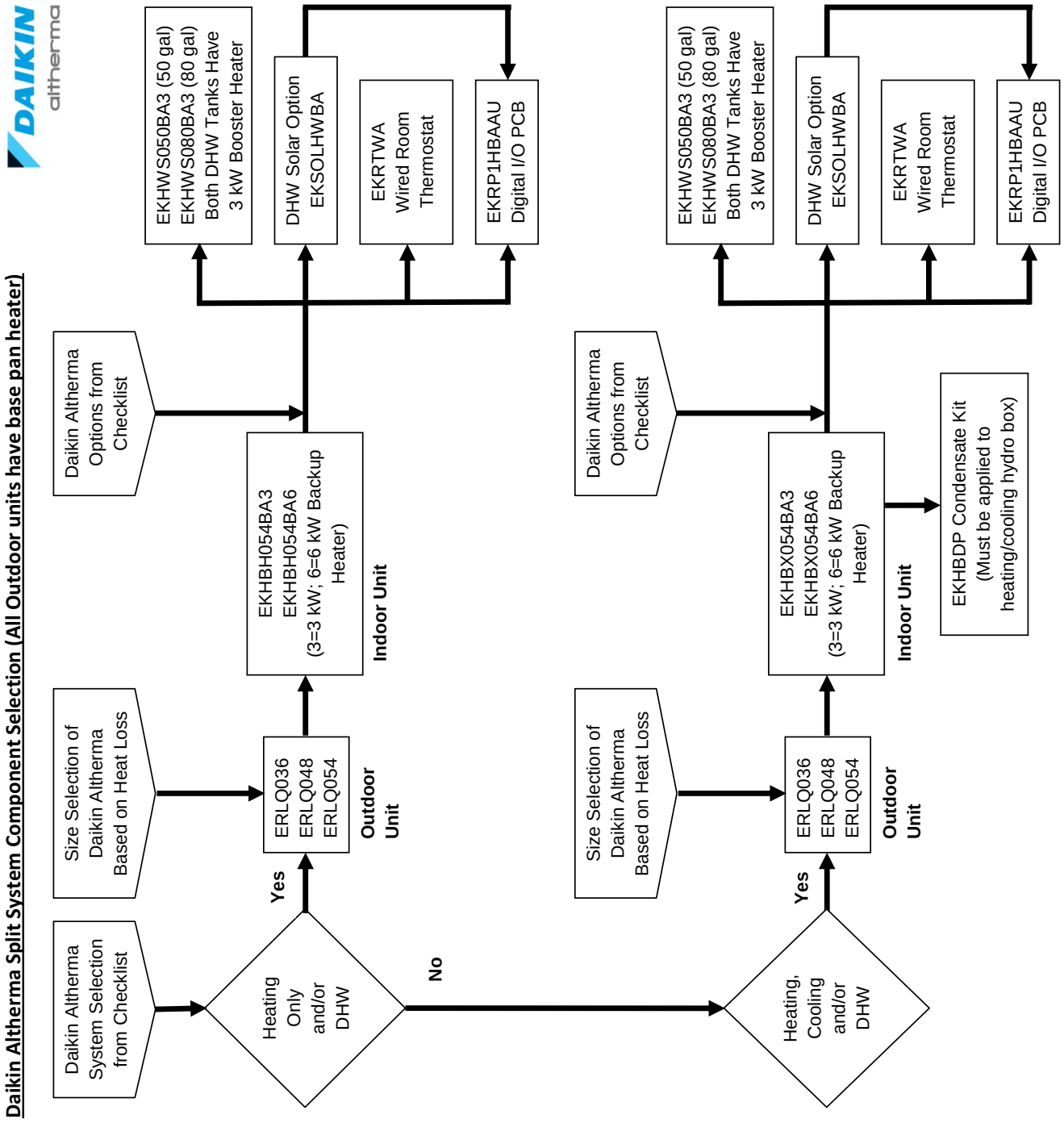
X - Can be applied

1 - Applied with Solar Pump Kit (DHW solar priority); alarm output; Bi-Valent operation (auxiliary boiler)

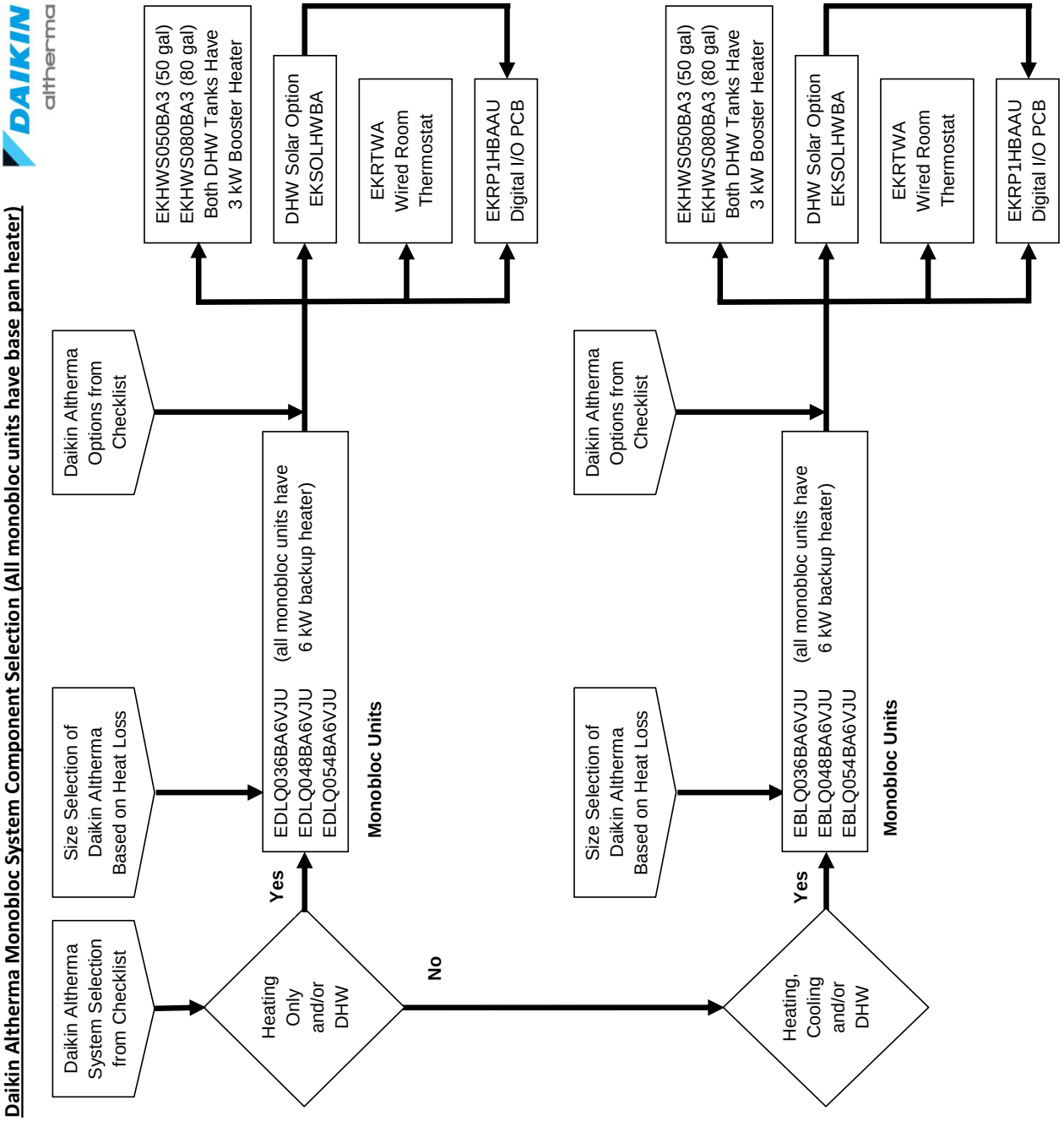
2 - Can be applied with DHW Tank (thermal solar panels and pump station to be field supplied)

3 - Must be applied with Heat Pump Hydrobox

6. Split System Component Selection



7. Monobloc Component Selection



1. ERLQ - Split System Outdoor Unit

1.1 Features

- Inverter operated compressor
- Single phase large capacity outdoor unit (036, 048, 054)
- Cost effective alternative to a fossil fuel boiler
- Low energy bills and low CO2 emissions
- Easy to install
- Total solution for year round comfort
- Anti-corrosion treatment on outdoor coil
- Bottom base pan heater to improve water drainage during defrost

ERLQ outdoor units are combined with an indoor hydrobox; a heating-only hydrobox version (EKHBH), and a heat pump (heating & cooling) hydrobox version (EKHBX). Both hydrobox versions can be applied with an optional domestic hot water tank (EKHWS) and optional solar pump kit (EKSOLHW)

2. Specifications - Split System

2-1 NOMINAL CAPACITY AND NOMINAL INPUT				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
For combination indoor units + outdoor units	Indoor Units			EKHBH054BA (Heating Only)		
Condition (Floor Heating)	Heating capacity	Nominal	kBTU/hr (kW)	38.2 (11.2)	47.8 (14.0)	54.6 (16.0)
	Heating PI	Nominal	kW	2.58	3.30	3.97
	COP	Nominal		4.34	4.24	4.03
Condition 2 (Fan Coil)	Heating capacity	Nominal	kBTU/hr (kW)	35.3 (10.3)	44.8 (13.1)	51.8 (15.2)
	Heating PI	Nominal	kW	3.18	4.00	4.79
	COP	Nominal		3.24	3.28	3.17
For combination indoor units + outdoor units	Indoor Units			EKHBX054BA (Reversible)		
Condition 1 (Floor Heating)	Heating capacity	Nominal	kBTU/hr (kW)	38.2 (11.2)	47.8 (14.0)	54.6 (16.0)
	Cooling capacity	Nominal	kBTU/hr (kW)	47.6 (13.9)	59.1 (17.3)	60.6 (17.8)
	Heating PI	Nominal	kW	2.58	3.30	3.97
	Cooling PI	Nominal	kW	3.91	5.94	6.94
	COP	Nominal		4.34	4.24	4.03
	EER	Nominal		12.17	9.95	8.73
Condition 2 (Fan Coil)	Heating capacity	Nominal	kBTU/hr (kW)	35.3 (10.3)	44.8 (13.1)	51.8 (15.2)
	Cooling capacity	Nominal	kBTU/hr (kW)	34.1 (10.0)	42.7 (12.5)	44.7 (13.1)
	Heating PI	Nominal	kW	3.18	4.00	4.79
	Cooling PI	Nominal	kW	3.72	5.41	6.08
	COP	Nominal		3.24	3.28	3.17
	EER	Nominal		9.17	7.89	7.35
Notes				Condition 1: cooling Ta 95°F (35°C) - LWE 64.4°F (18°C) - heating Ta DB/WB 44.6/42.8°F (7/6°C - LWC 95°F (35°C) (ΔT = 9°F (5°C)		
				Condition 2: cooling Ta 95°F (35°C) - LWE 45°F (7°C) (ΔT = 9°F (5°C) - heating Ta DB/WB 44.6/42.8°F (7/6°C) - LWC 113°F (45°C) (ΔT = 9°F (5°C)		

2-2 TECHNICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Casing	Colour			Ivory white		
	Material			Painted galvanised steel plate		
Dimensions	Unit	Height	in (mm)	46" (1,170 mm)		
		Width	in (mm)	35.4" (900 mm)	35.4" (900 mm)	35.4" (900 mm)
		Depth	in (mm)	12-1/2" (320 mm)	12-1/2" (320 mm)	12-1/2" (320 mm)
	Packing	Height	in (mm)	53" (1,349 mm)		
		Width	in (mm)	38-1/2" (980 mm)	38-1/2" (980 mm)	38-1/2" (980 mm)
		Depth	in (mm)	16-1/2" (420 mm)	16-1/2" (420 mm)	16-1/2" (420 mm)
Weight	Unit		lb (kg)	227 lb (103 kg)	227 lb (103 kg)	227 lb (103 kg)
	Packed Unit		lb (kg)	251.3 lb (114 kg)	251.3 lb (114 kg)	251.3 lb (114 kg)
Packing	Material			EPS		
				Carton		
				Wood		
				PP (Straps)		
	Weight		lb (kg)	24.3 lb (11 kg)	24.3 lb (11 kg)	24.3 lb (11 kg)

2-2 TECHNICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Heat Exchanger	Dimensions	Length	in (mm)	33-3/4" (857 mm)	33-3/4" (857 mm)	33-3/4" (857 mm)
		Nr of Rows		2	2	2
		Fin Pitch	in (mm)	1/16" (1.4 mm)	1/16" (1.4 mm)	1/16" (1.4 mm)
		Nr of Passes		6	6	6
		Face Area	ft² (m²)	3.22 ft² (0.98 m²)	3.22 ft² (0.98 m²)	3.22 ft² (0.98 m²)
		# of Stages		52	52	52
	Tube type			Hi-XSS(8)		
	Fin	Type		WF fin		
		Treatment		Anti-corrosion treatment (PE)		
Fan	Type			Propeller		
	Quantity			2	2	2
Air Flow Rate (nominal at 230V)	Heating	High	cfm (m³/min)	3178 cfm (90 m³/min)	3178 cfm (90 m³/min)	3178 cfm (90 m³/min)
	Cooling	High	cfm (m³/min)	3355 cfm (96 m³/min)	3531 cfm (100 m³/min)	3426 cfm (97 m³/min)
Fan	Discharge direction			Horizontal		
	Motor	Quantity		2	2	2
		Model		Brushless DC motor		
Motor	Speed (nominal)	Steps		8	8	8
		Heating	rpm	760	760	760
		Cooling	rpm	800	850	830
Fan	Motor	Output	W	70 each	70 each	70 each
		Drive		Direct drive		
Compressor	Quantity			1	1	1
	Motor	Model		JT100G-VD		
		Type		Hermetically sealed scroll compressor		
		Motor Output	W	2,200		
		Starting Method		Inverter driven		
Motor	Crankcase Heater	Output	W	33	33	33
Ambient Operation Range	Heating	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	95 (35)	95 (35)	95 (35)
	Cooling	Min	°F (°C)	50 (10)	50 (10)	50 (10)
		Max	°F (°C)	114.8 (46)	114.8 (46)	114.8 (46)
	Sanitary water	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	109.4 (43) 95 (35) HP / 109.4 (43) BH	109.4 (43) 95 (35) HP / 109.4 (43) BH)	109.4 (43) 95 (35) HP / 109.4 (43) BH
Sound Level (nominal) *1	Heating	Sound Power	dBA	64	64	66
		Sound Pressure	dBA	49	51	53
	Cooling	Sound Power	dBA	64	66	69
		Sound Pressure	dBA	50	52	54
Sound Level (Night quiet)	Heating	Sound Pressure	dBA	42	42	43
	Cooling	Sound Pressure	dBA	45	45	46
Refrigerant	Type			R-410A		
	Charge		oz (kg)	8.2 lb (3.7 kg)	8.2 lb (3.7 kg)	8.2 lb (3.7 kg)
	Control			Expansion valve(electronic type)		
	Nr of Circuits			1	1	1
Refrigerant Oil	Type			Daphne FVC68D		
	Charged Volume		g (l)	1.06 g (1.0 l)	1.06 g (1.0 l)	1.06 g (1.0 l)

2-2 TECHNICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Piping connections	Liquid (OD)	Quantity		1	1	1
		Type		Flare connection		
		Diameter (OD)	in (mm)	3/8" (9.52 mm)		
	Gas	Quantity		1	1	1
		Type		Flare connection		
		Diameter (OD)	in (mm)	5/8" (15.9 mm)		
	Drain	Quantity		3	3	3
		Type		Hole		
		Diameter (OD)	in (mm)	1-1/32" (26 mm)	1-1/32" (26 mm)	1-1/32" (26 mm)
	Piping Length	Minimum	ft (m)*2	16.4 ft (5 m)	16.4 ft (5 m)	16.4 ft (5 m)
		Maximum	ft (m)	246 ft (75 m)	246 ft (75 m)	246 ft (75 m)
		Equivalent	ft (m)	312 ft (95 m)	312 ft (95 m)	312 ft (95 m)
		Chargeless	ft (m)	98.4 ft (30 m)	98.4 ft (30 m)	98.4 ft (30 m)
	Additional Refrigerant Charge		kg	See installation manual outdoor unit		
	Installation height difference	Maximum	ft (m)	98.4 ft (30 m)	98.4 ft (30 m)	98.4 ft (30 m)
	Heat Insulation			Both liquid and gas pipes		
Defrost Method				Pressure equalizing		
Defrost Control				Sensor for outdoor heat exchanger temperature		
Capacity Control Method				Inverter controlled		
Safety Devices				Fan motor thermal protector		
				Fuse		
				High pressure switch		
Standard Accessories	Item			Tie-wraps		
	Quantity			2	2	2
	Item			Installation manual		
	Quantity			1	1	1
Notes				(*1) The sound pressure level is measured via a microphone at a certain distance from the unit. It is a relative value depending on the distance and acoustic environment. Refer to sound spectrum drawing for more information.		
				(*2) Down to 10 ft. (3 m) with recharging of the outdoor unit. Refer to the installation manual of the outdoor unit.		

2-3 ELECTRICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Power Supply	Name			VJU	VJU	VJU
	Phase			1~	1~	1~
	Frequency		Hz	60	60	60
	Voltage		V	208-230	208-230	208-230
	Voltage range	Minimum	V	-10%	-10%	-10%
		Maximum	V	+10%	+10%	+10%
	Compressor	Rated Load Amps (RLA)	A	23.4	23.4	23.4
		Full Load Amps (FLA)	A	26.5	26.5	26.5
Current	Total	Minimum Current Protection (MCA)	A	26.5	26.5	26.5
		Maximum Current Protection (MOP)	A	30	30	30
Wiring Connections	For Power Supply	Remark		See installation manual outdoor unit		
	For Connection with Indoor	Remark		See installation manual outdoor unit		
Power Supply Intake				Outdoor Unit Only		
Notes				Standard for Safety Heating and Cooling Equipment; UL1995/CSA (U&C) C22.2 #236.		

3. Capacity Tables - Split System

3.1 Heating

MAXIMUM HEATING CAPACITY - PEAK VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	Cop	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP
ERLQ036BAVJU	-4/-20	19.30	7.01	**2.75**	18.70	8.00	**2.34**	15.60	9.42	**1.66**									
	5/-15	22.10	8.02	**2.76**	21.30	8.74	**2.44**	21.10	9.60	**2.20**									
	19/-7.2	27.40	8.09	**3.39**	26.40	8.84	**2.99**	26.00	9.73	**2.67**	25.60	10.77	**2.38**						
	25/-3.9	31.30	8.07	**3.88**	30.20	8.86	**3.41**	29.70	9.78	**3.04**	29.20	10.80	**2.70**	27.90	11.91	**2.34**			
	36/2.2	34.80	8.02	**4.34**	33.50	8.84	**3.79**	33.00	9.77	**3.38**	32.50	10.85	**3.00**	31.10	11.94	**2.60**	29.80	13.26	**2.25**
	45/7.2	39.50	7.95	**4.97**	35.20	8.80	**4.00**	36.70	9.78	**3.75**	35.30	10.84	**3.26**	33.90	12.07	**2.81**	32.50	13.44	**2.42**
	54/12.2	44.80	7.85	**5.71**	43.20	8.70	**4.97**	41.70	9.69	**4.30**	40.10	10.79	**3.72**	38.60	12.04	**3.21**	37.10	13.42	**2.76**
	59/15	48.20	7.77	**6.20**	46.50	8.05	**5.78**	44.90	9.63	**4.66**	43.30	10.74	**4.03**	41.70	12.00	**3.48**	40.10	13.40	**2.99**
	68/20	54.30	7.64	**7.11**	52.50	8.51	**6.17**	50.70	9.49	**5.34**	49.00	10.64	**4.61**	47.20	11.01	**4.29**	45.40	13.33	**3.41**
ERLQ048BAVJU	-4/-20	24.70	9.74	**2.54**	24.40	10.60	**2.30**												
	5/-15	27.00	9.93	**2.72**	27.30	10.82	**2.52**	26.80	11.84	**2.26**									
	19/-7.2	34.30	10.10	**3.40**	33.40	11.03	**3.03**	32.40	12.12	**2.67**	31.60	13.34	**2.37**						
	25/-3.9	39.10	10.20	**3.83**	37.90	11.12	**3.41**	37.70	12.25	**3.08**	36.40	13.16	**2.77**	35.30	14.52	**2.43**			
	36/2.2	43.30	10.20	**4.25**	42.00	11.19	**3.75**	41.70	12.32	**3.38**	40.30	13.24	**3.04**	39.00	14.83	**2.63**	37.80	16.16	**2.34**
	45/7.2	49.20	10.25	**4.80**	47.80	11.25	**4.25**	48.20	12.38	**3.89**	44.80	13.65	**3.28**	43.30	15.09	**2.87**	41.90	16.69	**2.51**
	54/12.2	55.80	10.25	**5.44**	54.10	11.26	**4.80**	52.40	12.40	**4.23**	50.70	13.71	**3.70**	49.10	15.17	**3.24**	47.50	16.78	**2.83**
	59/15	60.10	10.27	**5.85**	58.20	11.27	**5.16**	56.40	12.44	**4.53**	54.70	13.74	**3.98**	52.90	15.20	**3.48**	51.20	16.82	**3.04**
	68/20	67.80	10.30	**6.58**	65.80	11.32	**5.81**	63.80	12.48	**5.11**	61.80	13.79	**4.48**	59.90	15.28	**3.92**	57.90	16.89	**3.43**
ERLQ054BAVJU	-4/-20	28.50	11.53	**2.47**	28.40	12.52	**2.27**												
	5/-15	32.00	11.78	**2.72**	31.80	12.81	**2.48**	31.70	14.00	**2.26**									
	19/-7.2	39.00	12.00	**3.25**	38.40	13.13	**2.92**	37.80	14.40	**2.63**	37.20	15.82	**2.35**						
	25/-3.9	44.40	12.22	**3.63**	43.50	13.31	**3.27**	42.80	14.57	**2.94**	41.70	16.04	**2.60**	40.90	17.67	**2.31**			
	36/2.2	49.10	12.31	**3.99**	48.00	13.43	**3.57**	47.00	14.72	**3.19**	45.90	16.19	**2.84**	44.90	17.84	**2.52**	40.60	18.67	**2.17**
	45/7.2	55.00	12.43	**4.42**	54.60	13.55	**4.03**	53.10	14.87	**3.57**	51.80	16.35	**3.17**	50.50	18.02	**2.80**	45.70	18.85	**2.42**
	54/12.2	63.20	12.57	**5.03**	61.70	13.71	**4.50**	60.10	15.01	**4.00**	58.00	16.51	**3.51**	57.00	18.19	**3.13**	51.60	19.01	**2.71**
	59/15	68.10	12.65	**5.38**	68.40	13.82	**4.95**	64.70	15.12	**4.28**	63.00	16.61	**3.79**	61.30	18.29	**3.35**	55.50	20.12	**2.76**
	68/20	76.00	12.05	**6.31**	75.00	13.99	**5.36**	73.10	15.31	**4.77**	71.10	16.60	**4.28**	69.20	18.48	**3.74**	63.70	20.20	**3.15**

Peak value does not include capacity drop during frosting and defrosting periods.

MAXIMUM HEATING CAPACITY - INTEGRATED VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP
ERLQ036BAVJU	-4/-20	17.20	7.93	**2.17**	16.70	8.01	**2.08**	16.50	9.43	**1.75**									
	5/-15	19.70	8.04	**2.45**	19.00	8.75	**2.17**	18.70	9.62	**1.94**									
	19/-7.2	23.50	8.11	**2.90**	22.00	8.87	**2.48**	22.30	9.76	**2.28**	21.90	10.80	**2.03**						
	25/-3.9	25.40	7.66	**3.32**	24.40	8.41	**2.90**	24.10	9.27	**2.60**	23.70	10.26	**2.31**	22.60	11.28	**2.00**			
	36/2.2	27.80	7.81	**3.56**	26.80	8.60	**3.12**	28.00	9.49	**2.95**	26.00	10.54	**2.47**	24.90	11.80	**2.11**	23.80	12.89	**1.85**
	45/7.2	39.50	7.95	**4.97**	38.20	8.80	**4.34**	38.70	9.76	**3.97**	35.30	10.84	**3.26**	33.90	12.07	**2.81**	32.50	13.44	**2.42**
	54/12.2	44.80	7.85	**5.71**	43.20	8.70	**4.97**	41.70	9.69	**4.30**	40.10	10.79	**3.72**	38.60	12.04	**3.21**	37.10	13.42	**2.76**
	59/15	48.20	7.77	**6.20**	46.50	8.05	**5.78**	44.00	9.63	**4.57**	43.30	10.74	**4.03**	41.70	12.00	**3.48**	40.10	13.40	**2.99**
	68/20	54.30	7.84	**6.93**	52.50	8.51	**6.17**	50.70	9.49	**5.34**	49.00	10.64	**4.61**	47.20	11.91	**3.96**	45.40	13.33	**3.41**
ERLQ048BAVJU	-4/-20	22.00	9.76	**2.25**	21.70	10.62	**2.04**												
	5/-15	24.90	9.95	**2.50**	24.30	10.84	**2.24**	23.80	11.86	**2.01**									
	19/-7.2	27.50	10.13	**2.71**	26.80	11.08	**2.42**	28.00	12.15	**2.30**	25.30	13.37	**1.89**						
	25/-3.9	31.50	9.64	**3.27**	30.70	10.53	**2.92**	30.50	11.55	**2.64**	29.50	12.44	**2.37**	28.60	13.73	**2.08**			
	36/2.2	34.20	9.90	**3.45**	33.10	10.82	**3.06**	32.90	11.92	**2.76**	31.80	12.83	**2.48**	30.50	14.18	**2.15**	29.80	15.67	**1.90**
	45/7.2	49.20	10.25	**4.80**	47.80	11.25	**4.25**	46.20	12.36	**3.74**	44.80	13.65	**3.28**	43.30	15.09	**2.87**	41.90	16.59	**2.53**
	54/12.2	55.80	10.25	**5.44**	54.10	11.26	**4.80**	52.40	12.40	**4.23**	50.70	13.71	**3.70**	49.10	15.17	**3.24**	47.50	16.78	**2.83**
	59/15	60.10	10.27	**5.85**	58.20	11.27	**5.16**	56.40	12.44	**4.53**	54.70	13.74	**3.98**	52.90	15.20	**3.48**	51.20	16.82	**3.04**
	68/20	67.80	10.30	**6.58**	65.80	11.32	**5.81**	63.80	12.48	**5.11**	61.80	13.79	**4.48**	59.90	15.28	**3.92**	57.90	16.89	**3.43**
ERLQ054BAVJU	-4/-20	25.40	11.55	**2.20**	25.20	12.54	**2.01**												
	5/-15	28.50	11.80	**2.42**	28.30	12.02	**2.35**	28.20	14.02	**2.01**									
	19/-7.2	30.40	11.82	**2.57**	29.90	12.05	**2.48**	29.40	14.08	**2.09**	29.00	15.48	**1.87**						
	25/-3.9	35.90	11.53	**3.11**	35.20	12.56	**2.80**	34.50	13.76	**2.51**	33.80	15.14	**2.23**	33.10	16.08	**2.06**			
	36/2.2	37.90	11.16	**3.40**	37.10	12.18	**3.05**	38.30	13.34	**2.87**	35.50	14.88	**2.39**	34.70	16.16	**2.15**	31.40	16.05	**1.96**
	45/7.2	55.80	12.43	**4.49**	54.50	13.55	**4.02**	53.10	14.87	**3.57**	51.80	16.35	**3.17**	50.50	18.02	**2.80**	45.70	18.85	**2.42**
	54/12.2	63.20	12.57	**5.03**	61.70	13.71	**4.50**	60.10	15.01	**4.00**	58.60	16.51	**3.55**	57.00	18.19	**3.13**	51.80	19.01	**2.72**
	59/15	68.10	12.58	**5.41**	68.40	13.82	**4.95**	64.70	15.12	**4.28**	63.00	16.61	**3.79**	61.30	18.29	**3.35**	56.50	20.12	**2.81**
	68/20	78.90	12.65	**6.24**	75.00	13.99	**5.36**	73.10	15.31	**4.77**	71.10	18.80	**3.78**	69.20	18.48	**3.74**	63.70	20.28	**3.14**

Integrated value takes into consideration the capacity drop during frosting and defrosting periods.

3.2 Cooling

MAXIMUM COOLING CAPACITY

MODEL	T_{amb} (°F/°C)	60/15.6			77/25			86/30			95/35			104/40			113/45		
	LWE (°F/°C)	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	
ERLQ036BAVJU	45/7.2	39.90	2.68	**14.89**	38.10	2.98	**12.79**	36.10	3.33	**10.84**	34.10	3.72	**9.17**	32.00	4.15	**7.71**	29.90	4.63	**6.46**
	50/10	43.90	2.70	**16.26**	41.90	3.01	**13.92**	39.70	3.37	**11.78**	37.00	3.77	**9.81**	35.30	4.21	**8.38**	32.90	4.70	**7.00**
	55/12.8	48.00	2.72	**17.65**	45.80	3.04	**15.07**	43.50	3.41	**12.76**	41.20	3.82	**10.79**	38.70	4.27	**9.06**	36.20	4.77	**7.59**
	59/15	50.90	2.73	**18.64**	48.60	3.06	**15.88**	46.20	3.44	**13.43**	43.70	3.85	**11.35**	41.10	4.32	**9.51**	36.50	4.82	**7.57**
	64/17.8	55.30	2.75	**20.11**	52.80	3.10	**17.03**	50.20	3.48	**14.43**	47.60	3.91	**12.17**	44.80	4.36	**10.28**	42.00	4.90	**8.57**
	72/22.2	61.50	2.79	**22.04**	55.70	3.15	**17.68**	55.00	3.55	**15.49**	53.00	3.99	**13.28**	50.00	4.48	**11.16**	45.40	4.08	**11.13**
ERLQ048BAVJU	45/7.2	49.60	3.98	**12.46**	47.50	4.40	**10.80**	45.20	4.87	**9.28**	42.70	5.41	**7.89**	39.90	6.02	**6.63**	37.80	6.04	**6.26**
	50/10	54.60	4.08	**13.38**	52.30	4.50	**11.62**	49.70	4.99	**9.96**	45.00	5.54	**8.12**	43.90	6.16	**7.13**	38.20	5.58	**6.85**
	55/12.8	59.90	4.18	**14.33**	57.20	4.82	**11.87**	54.40	5.12	**10.63**	51.30	5.65	**9.08**	48.00	6.31	**7.61**	40.70	5.16	**7.89**
	59/15	63.50	4.25	**14.94**	60.70	4.70	**12.91**	57.60	5.21	**11.06**	54.40	5.78	**9.41**	50.90	6.41	**7.94**	41.60	4.91	**8.47**
	64/17.8	69.10	4.37	**15.81**	65.90	4.83	**13.64**	62.60	5.38	**11.64**	59.10	5.94	**9.95**	55.40	6.58	**8.42**	44.00	4.54	**9.69**
	72/22.2	70.80	4.58	**15.46**	73.30	5.03	**14.57**	69.60	5.57	**12.50**	65.70	6.18	**10.63**	58.10	5.49	**10.58**	45.40	4.08	**11.13**
ERLQ054BAVJU	45/7.2	52.30	4.50	**11.62**	50.10	4.97	**10.08**	47.60	5.60	**8.50**	44.70	6.08	**7.35**	41.50	6.71	**6.18**	37.60	6.04	**6.23**
	50/10	57.70	4.63	**12.46**	55.10	5.11	**10.78**	52.20	5.65	**9.24**	49.00	6.23	**7.87**	45.50	6.87	**6.62**	38.20	5.58	**6.85**
	55/12.8	63.20	4.77	**13.25**	60.30	5.27	**11.44**	57.10	5.81	**9.83**	53.60	6.41	**8.36**	49.80	7.06	**7.05**	40.70	5.16	**7.89**
	59/15	67.00	4.87	**13.76**	63.90	5.37	**11.90**	60.50	5.92	**10.22**	55.60	6.52	**8.53**	52.70	7.18	**7.34**	41.80	4.91	**8.51**
	64/17.8	71.70	5.19	**13.82**	68.30	5.72	**11.94**	64.60	6.30	**10.25**	60.60	6.94	**8.73**	56.00	6.83	**8.20**	44.00	4.54	**9.69**
	72/22.2	79.70	5.50	**14.49**	75.80	6.05	**12.53**	71.70	6.65	**10.78**	67.30	7.30	**9.22**	58.10	5.49	**10.58**	45.40	4.06	**11.18**

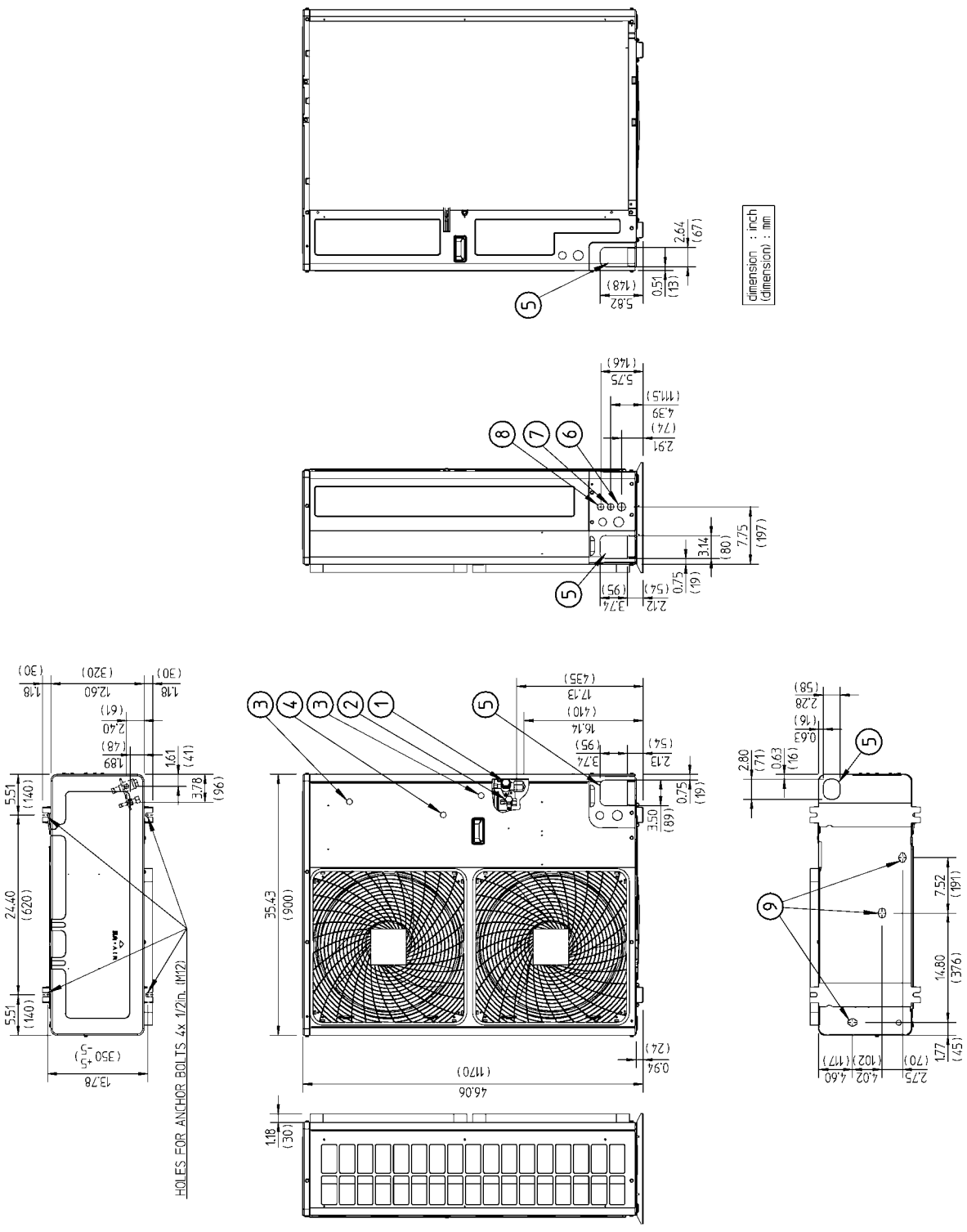
Symbols:

CC Cooling Capacity @ maximum operating frequency, BTU/h
HC Heating Capacity @ maximum operating frequency, BTU/h
PI Cooling Power Input (kW), Heating Power Input (kBTU/h measured according to Eurovent 6/C003-2006 (kW)/EN14511
LWE Leaving Water evaporator temperature (Cooling)
LWC Leaving Water condenser temperature (Heating)
Tamb Outdoor Ambient temperature, RH = 85%

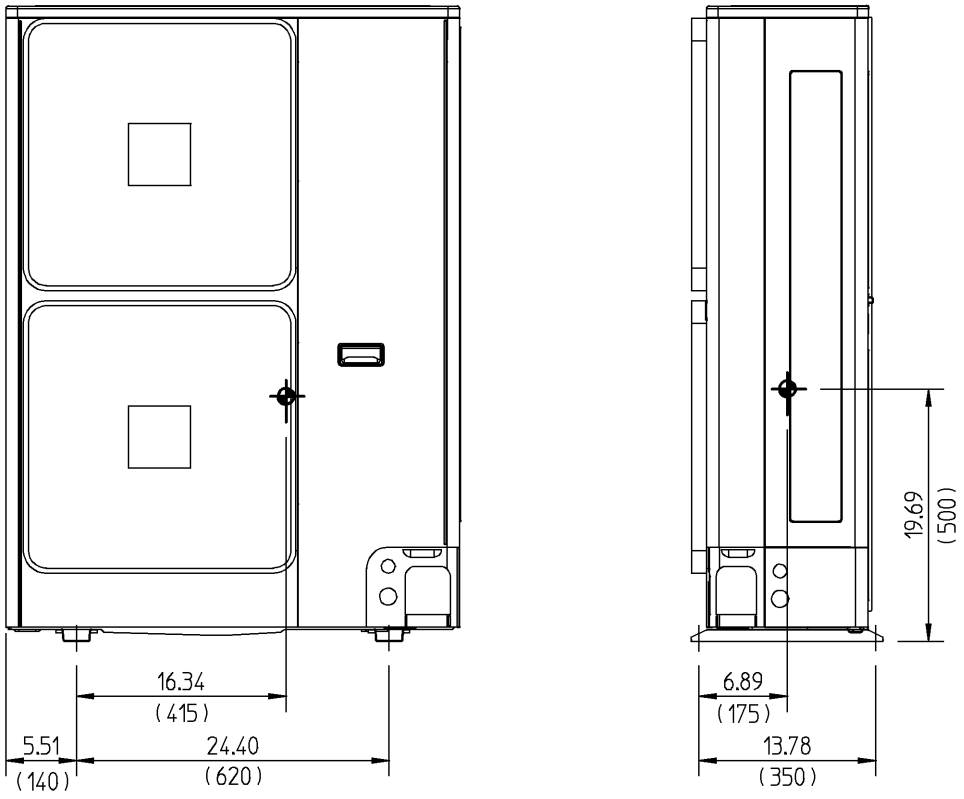
Conditions:

Cooling Capacity BTU/h and valid for chilled water range ΔT = 5-15^{0}F (3-8^{0}C)
Heating Capacity is according to Eurovent 6/C/003-2006 (kW) and valid for heating water range ΔT = 5-15^{0}F (3-8^{0}C)
Power Input is total of indoor and outdoor unit, except the circulation pump; (90W per EN14511)

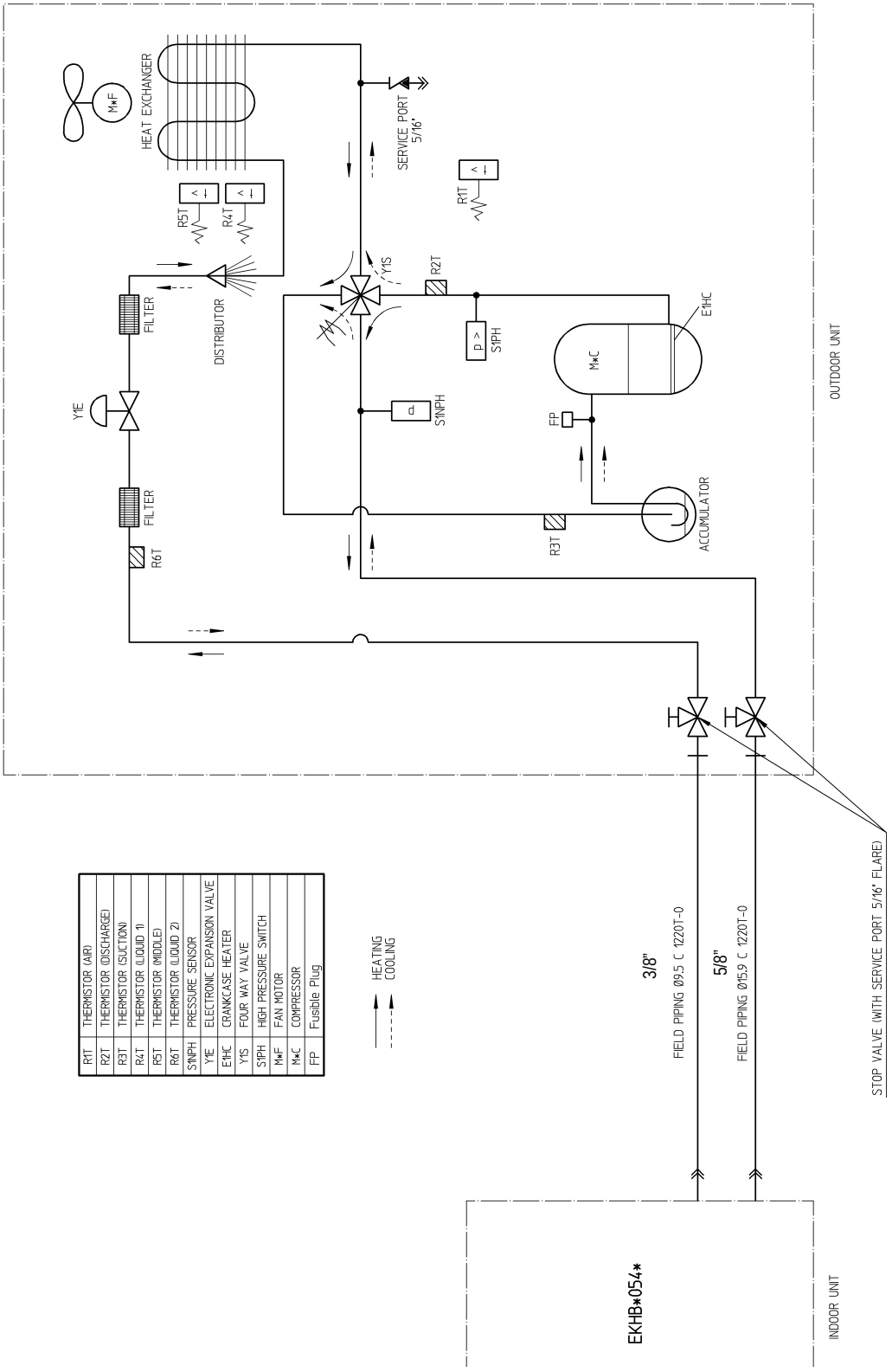
4. Dimensional Drawing - Split System



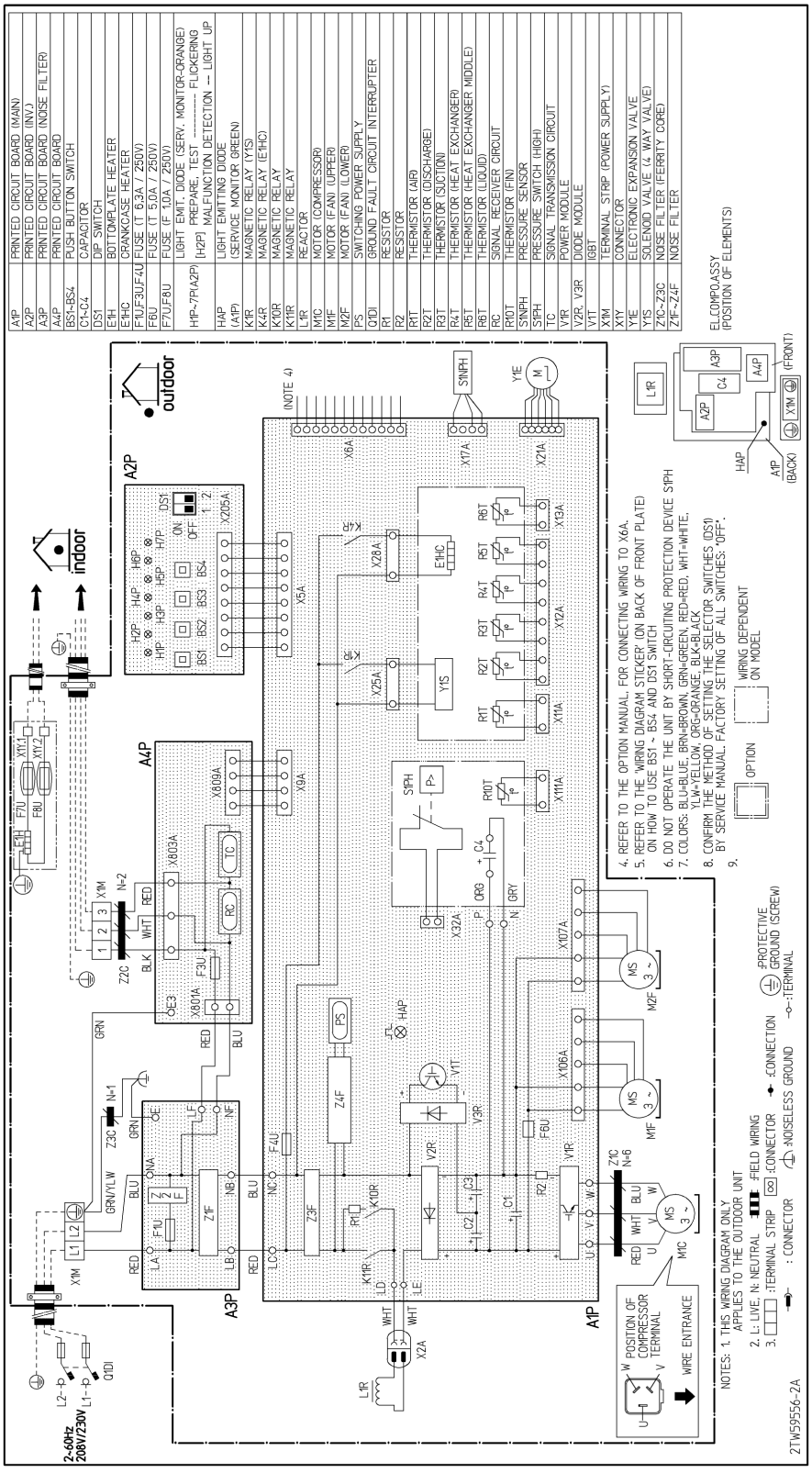
5. Center of Gravity - Split System



6. Piping Diagram - Split System

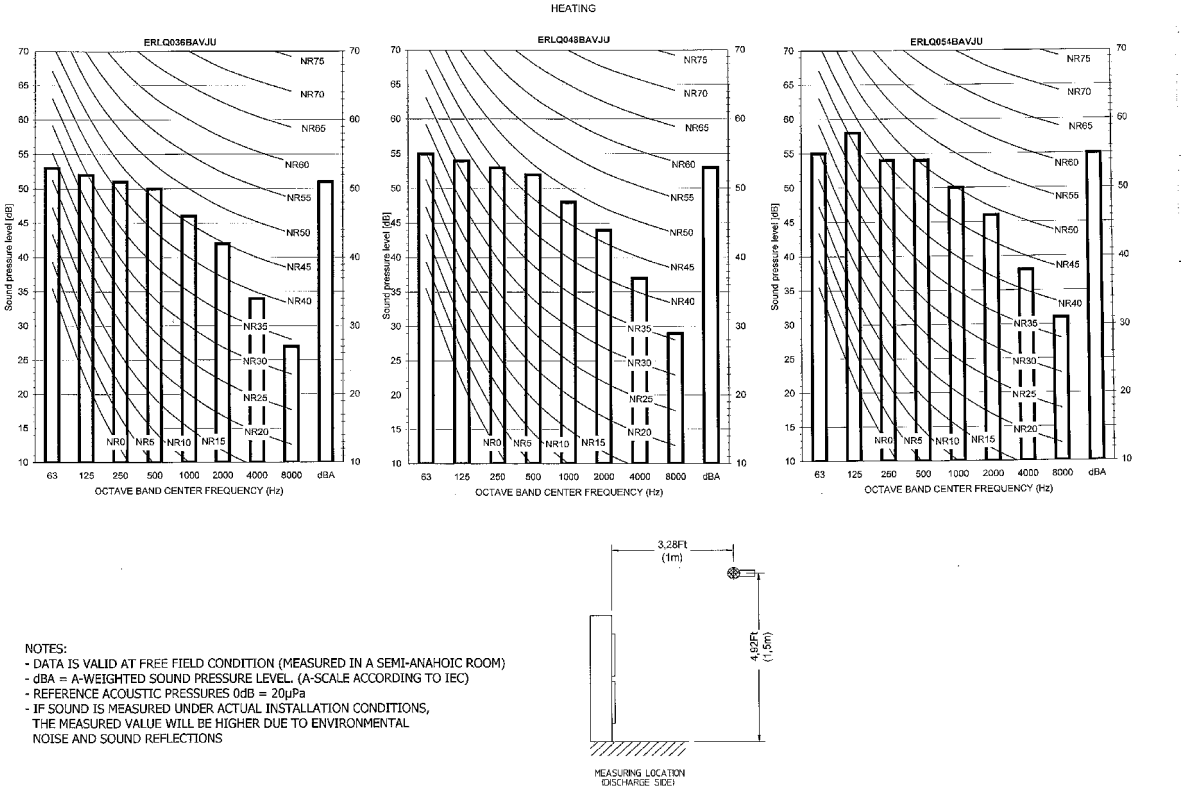


7. Wiring Diagram - Split Sytem



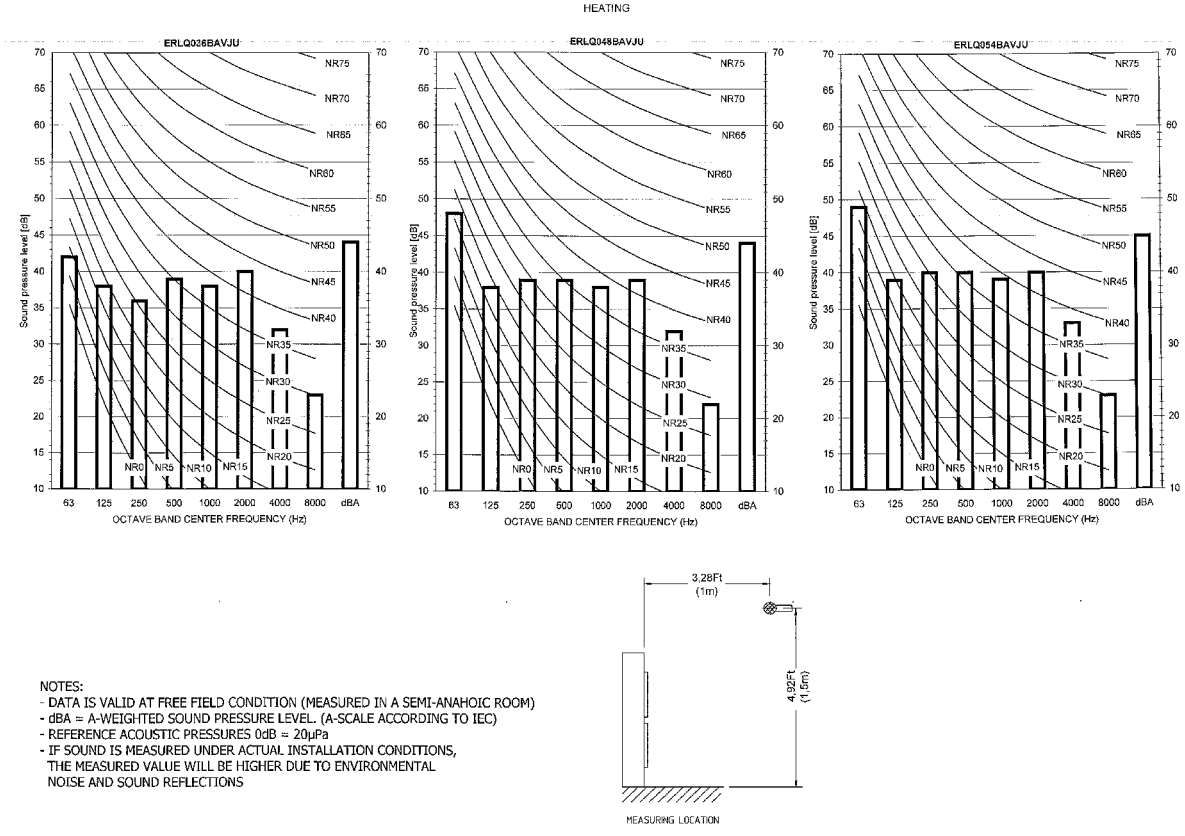
8. Sound Data - Split System

Normal Operation:



NOTES:
- DATA IS VALID AT FREE FIELD CONDITION (MEASURED IN A SEMI-ANAHOIC ROOM)
- dBA = A-WEIGHTED SOUND PRESSURE LEVEL. (A-SCALE ACCORDING TO IEC)
- REFERENCE ACOUSTIC PRESSURES 0dB = 20μPa
- IF SOUND IS MEASURED UNDER ACTUAL INSTALLATION CONDITIONS, THE MEASURED VALUE WILL BE HIGHER DUE TO ENVIRONMENTAL NOISE AND SOUND REFLECTIONS

Night Quiet Operation:



NOTES:
- DATA IS VALID AT FREE FIELD CONDITION (MEASURED IN A SEMI-ANAHOIC ROOM)
- dBA = A-WEIGHTED SOUND PRESSURE LEVEL. (A-SCALE ACCORDING TO IEC)
- REFERENCE ACOUSTIC PRESSURES 0dB = 20μPa
- IF SOUND IS MEASURED UNDER ACTUAL INSTALLATION CONDITIONS, THE MEASURED VALUE WILL BE HIGHER DUE TO ENVIRONMENTAL NOISE AND SOUND REFLECTIONS

9. Installation - Split System

9.1 Installation Location

- The equipment is not is not intended for use in a potentially explosive atmosphere.
- Choose a place solid enough to bear the weight and vibration of the unit, where operation sounds will not be amplified.
- Locate the unit so that operation sounds and discharged hot/cold air will not bother neighbors.
- Avoid places such as bedrooms so that operation sounds are not a problem.
- Allow sufficient space for carrying the unit into and out of the site.
- Ensure there is sufficient space for air passage and a lack of obstructions around the air inlet and the air outlet.
- The site must be free from the possibility of flammable gas leakage in any nearby area.
- Install units, power cable, and inter-unit cables at least 10 feet (3 m) away from televisions and radios to prevent interference.
- Depending on radio wave conditions, electromagnetic interference may still occur even if installed more than 10 ft. (3 m) away.
- In coastal areas or other places with salty atmosphere of sulfate gas, corrosion my shorten the life of the outdoor unit.
- Since condensate flows out of the outdoor unit, do not place anything under the unit that must be kept from moisture.

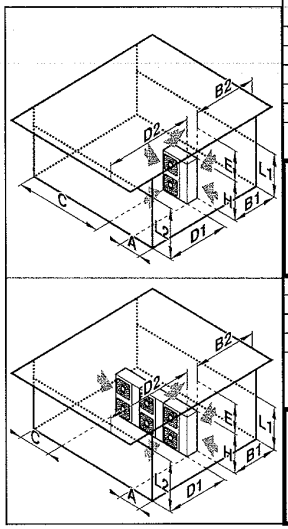
IN COLD CLIMATES:

- To prevent exposure to wind, install the outdoor unit with its suction side facing the wall.
- Never install the outdoor unit at a site where the suction side may be exposed directly to wind.
- To prevent exposure to wind, install a baffle plate on the air discharge side of the outdoor unit.
- Unit should be installed with a minimum of 4” (10 cm) free space below the unit’s bottom plate at all condition, e.g., heavy snowfall (construct a pedestal if necessary).
- In heavy snowfall areas, it is very important to select an installation site where the snow will not affect the unit. If lateral snowfall is possible, make sure the heat exchanger coil is not affected by the snow (construct a lateral canopy if necessary). See Figure 1:

Figure 1: construction of canopy and pedestal

9.2 Installation Space

A. NON STACKED INSTALLATION



↙	↗	↘	↖	↓			A	B1	B2	C	D1	D2	E	L1/L2	
✓								≥4 [100]							
✓		✓	✓				≥4[100]	≥4 [100]		≥4 [100]					
✓				✓				≥4 [100]				≤20 [500]	≥40 [1000]		
✓		✓	✓	✓			≥6[150]	≥6 [150]		≥6 [150]		≤20 [500]	≥40 [1000]		
	✓										≥20 [500]				
	✓			✓					≤20[500]		≥20 [500]		≥40 [1000]		
✓	✓				L1<L2			≥4 [100]			≥20 [500]				
					L2<L1			≥4 [100]			≥20 [500]				
✓	✓			✓	L1<L2	L1≤H		≥10 [250]	≤20 [500]		≥30 [750]		≥40 [1000]	0<L1≤1/2H	
											≥40 [1000]			0<L1≤1/2H	
						H<L1					L1≤H				1
					L2<L1	L2≤H		≥4 [100]			≥40 [1000]	≥20 [500]	≥40 [1000]	0<L2≤1/2H	
								≥8 [200]						1/2H<L2≤H	
						H<L2					L2≤H				
✓		✓	✓				≥8 [200]	≥12 [300]		≥40 [1000]					
✓		✓	✓	✓			≥8 [200]	≥12 [300]		≥40 [1000]		≤20[500]	≥40 [1000]		
	✓										≥40 [1000]				
	✓			✓					≤20[500]		≥40 [1000]		≥40 [1000]		
✓	✓				L1<L2			≥12 [300]			≥40 [1000]				
					L2<L1			≥10 [250]			≥60 [1500]			0<L2≤1/2H	
								≥12 [300]						1/2H<L2≤H	
✓	✓			✓	L1<L2	L1≤H		≥12 [300]	≤20 [500]		≥40 [1000]		≥40 [1000]	0<L1≤1/2H	
											≥50 [1250]			1/2H<L1≤H	1
						H<L1					L1≤H				
					L2<L1	L2≤H		≥10 [250]			≥60 [1500]	≤20 [500]	≥40 [1000]	0<L2≤1/2H	
								≥12 [300]						1/2H<L2≤H	2
						H<L2					L2≤H				

LEGEND (Unit: Inch [mm])

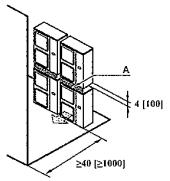
- ↙ Suction side obstacle
- ↗ Discharge side obstacle
- ↘ Left side obstacle
- ↖ Right side obstacle
- ↓ Top side obstacle
- ✓ Obstacle is present
- This situation is not allowed

1 In these cases, close bottom of the installation frame to prevent discharged air from being bypassed

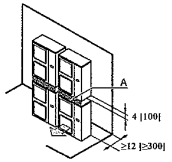
2 In these cases, only 2 units can be installed

B. STACKED INSTALLATION

1. OBSTACLES EXIST IN FRONT OF THE OUTLET SIDE



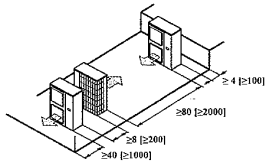
2. OBSTACLES EXIST IN FRONT OF THE AIR INLET



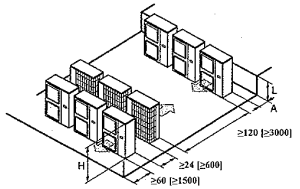
Do not stack more than one unit.
About 4 in. (100mm) is required as the dimension for laying the upper outdoor unit's drain pipe.
Get the portion A sealed so that air from the outlet does not bypass.

C. MULTIPLE-ROW INSTALLATION

1. INSTALLATION OF ONE UNIT PER ROW



2. INSTALLING MULTIPLE UNITS (2 units or more) IN LATERAL CONNECTION PER ROW

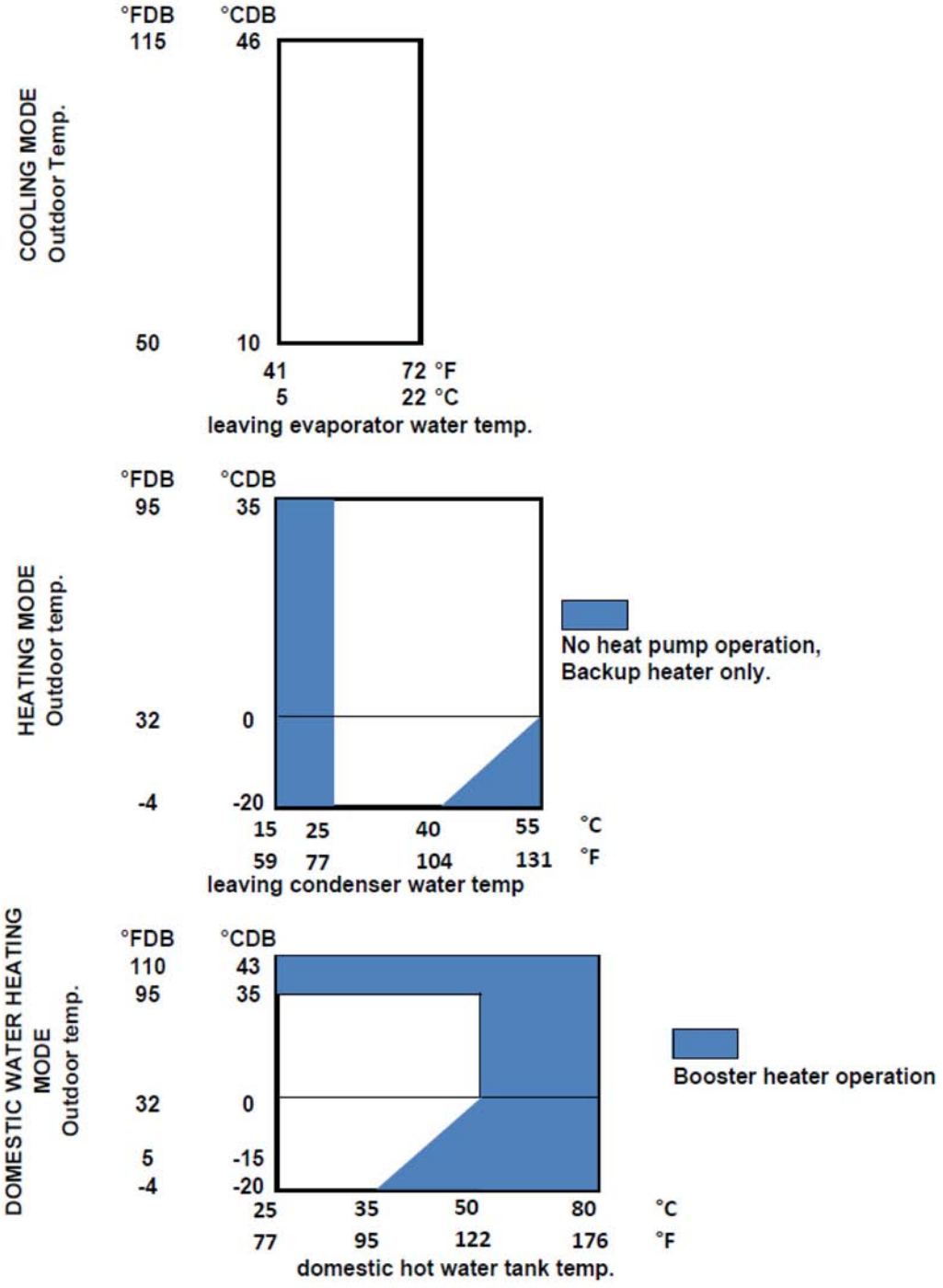


Relation of dimensions of H, A and L are shown in the table below.

	L	A
L ≤ H	0<L≤1/2H	10 [250]
	1/2H < L	12 [300]
H < L	Installation not allowed	

Installation - Split System

10. Operation Range - Split System



1. EKHBH054BA - Hydrobox

1.1 Features

- Heating only - **EKHBH054BA**
- Heat Pump (heating & cooling) - **EKHBX054BA**
- Large capacity indoor unit
- Cost effective alternative to a fossil fuel boiler
- Low energy bills and low CO_2 emissions
- Interface control with field selectable options that include dual set point (heating & cooling), Quiet Mode, DHW priority settings, schedule timer.
- Easy to install
- Total solution for year round comfort
- Apply with split system outdoor unit (ERLQ)
- Select from 2 sizes of integrated backup heat 3kW (single stage) or 6 kW (2-stage)

The hydrobox is the indoor part of the air-to-water ERLQ outdoor heat pump. These units are designed for wall-mounted indoor installation. The units can be combined with fan coil units, floor heating applications, low temperature radiators, optional Daikin Domestic Hot Water Tanks, and optional Daikin Solar Kits for domestic hot water applications.

The unit range consists of two main versions: a heating/cooling version (EKHBX) and a heating-only version (EKHBH). Both versions are delivered with an integrated backup heater for additional heating during cold outdoor temperatures. The backup heater also serves as a backup if malfunctioning of the outdoor unit should occur. The backup heater models are available for a heating capacity of 3kW and 6kW.

2. Specifications - Hydrobox

2-1 TECHNICAL SPECIFICATIONS

					EKHBH*			EKHBX*			
					EKHBH054BA*			EKHBX054BA*			
Outdoor units					ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU	ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Nominal input (Indoor only without electric heater)					208-230V / 1 ph / 60Hz					
Casing		Color			Neutral White RAL9010					
		Material			Epoxy polyester painted galvanized steel					
Dimensions	Packing	Height		in (mm)	49.23 (1225)					
		Width		in (mm)	25.98 (660)					
		Depth		in (mm)	24.02 (610)					
	Unit	Height		in (mm)	36.30 (922)					
		Width		in (mm)	19.76 (502)					
		Depth		in (mm)	14.21 (361)					
Weight of unit	Machine net weight			lbs (kg)	123 (55)					
	Packed machine weight			lbs (kg)	152 (69)					
Weight of packing materials	Material				EPS, Wood, Carton, PP (straps)					
	Weight			lbs (kg)	29 (14)					
Main Components	Pump	Type			water cooled					
		no. of speeds			3					
		Nominal ESP unit	Cooling	psi (kPa)	–	–	–	8.04 (55.4)	6.53 (45.0)	6.13 (42.3)
			Heating	psi (kPa)	7.34 (50.7)	5.48 (37.8)	3.92 (27.1)	7.34 (50.7)	5.48 (37.8)	3.92 (27.1)
		Power Input		W	210					
	Water Side Heat Exchanger	Type			Brazed Plate					
		Quantity			1					
		Water volume		gal/m (l/min)	0.27 (1.01)					
		Water flow rate Min.		gal/m (l/min)	4.23 (16)					
		Water flow rate Nom.	Cooling (2)	gal/m (l/min)	–	–	–	7.58 (28.7)	9.45 (35.8)	9.90 (37.5)
			Heating (3)	gal/m (l/min)	8.47 (32.1)	10.59 (40.1)	12.12 (45.9)	8.47 (32.1)	10.59 (40.1)	12.12 (45.9)
		Water flow rate Max.	Cooling	gal/min (l/min)	15.3 (58)					
			Heating	gal/min (l/min)	15.3 (58)					
		Insulation material			Polyurethane foam					
	Expansion vessel	Volume		gal/min (l/min	2.64 (10)					
		Max. water pressure		psi (bar	43.5 (3)					
		Pre pressure		psi (bar)	14.3 (1)					
	Water Filter	Diameter perforations		inch (mm)	0.039 (1)					
		Material			brass					

2-1 TECHNICAL SPECIFICATIONS

Water Circuit	Piping Connections			G 1-1/4 (MALE) BSP	
	Piping		in (mm)	1-1/4 (31.8) BSP	
	Safety valve		psi (bar)	43.5 (3)	
	Manometer			Yes	
	Drain valve / Fill valve			Yes	
	Shut-off valve			Yes	
	Air Purge valve			Yes	
	Total water volume (6)		gal (l)	1.45 (5.5)	
Refrig. Circuit	Gas side		in (mm)	5/8 (15.9)	
	Liquid side		in (mm)	3/8 (9.52)	
Sound Level	Sound Pressure (4)	Heating	dBA	28	
	Sound power		dBA	–	
Operation range	Ambient	Cooling	°F (°C)	–	50 ~ 114.8 (10 ~ 46)
		Heating	°F (°C)	-4 ~ 95 (-20 ~ 35)	-4 ~ 95 (-20 ~ 35)
	Waterside	Heating	°F (°C)	–	41 ~ 76.6 (5 ~22)
		Heating (5)	°F (°C)	59 ~ 131 (15 ~ 55)	59 ~ 131 (15 ~ 55)

NOTES:

* (1) With option kit EKHBDP installed: Height = 36.85" (936 mm)
* (2) Tamb 95°F (35°C) – LWE 44.6°F (7 C) (DT = 9°F (5°C)
* (3) DB/WB 44.6°F/42.8 F (7°C/6°C) – LWC 95°F (35°C) (DT = 9°F (5°C)
* (4) The sound pressure level is measured via a microphone at 3.23 ft (1 m) from the unit. It is a relative value, depending on the distance and acoustic environment. The sound pressure level mentioned is valid for pump medium speed.
* (5) 59°F~77°F (15°C~25°C): BUH only, no heat pump operation = during commissioning
* (6) Including piping + PHE + backup heater / excluding expansion vessel

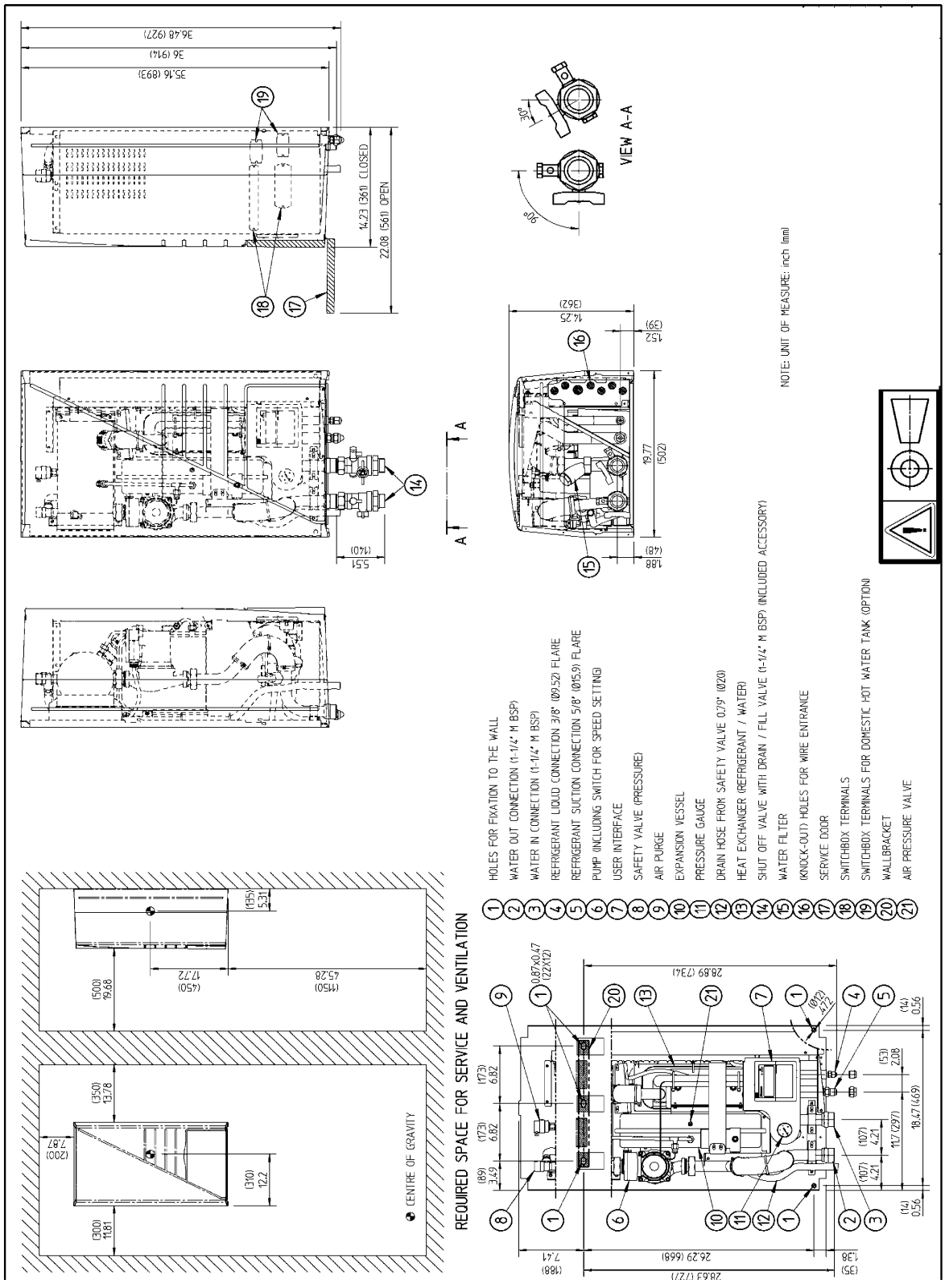
Electrical Specifiations

Electric heater (optional)	Type				3VJU	6VJU
	Power supply (1),(2)	Phase			1~	1~
		Frequency		Hz	60	60
		Voltage		V	208/230	208/230
	Current	Minimum Circuit Amps (MCA)		A	14.3	28.6
		Maximum Overcurrent Protection (MOP)		A	20	30
Voltage range	Minimum			V	187	
	Maximum			V	253	
Wiring connections	for power supply backup heater	quantity of wires			3G	
		type of wires			Note (3)	
	for power supply connection to optional domestic hot water tank + Q2L	quantity of wires			3G	
		type of wires			Note (3) & (4)	
	for connection with RST	quantity of wires			Note (7)	
		type of wires			Note (7)	
	for connection with A3P	quantity of wires			Note (6)	
		type of wires			Note (3) & (5)	
	for connection with M2S	quantity of wires			3G	
		type of wires			Note (3) & (5)	
	for connection with M3S	quantity of wires			3G or 4G	
		type of wires			Note (3) & (5)	
	for connection of bottom plate heater	quantity of wires			2	
		type of wires			Note (3)	

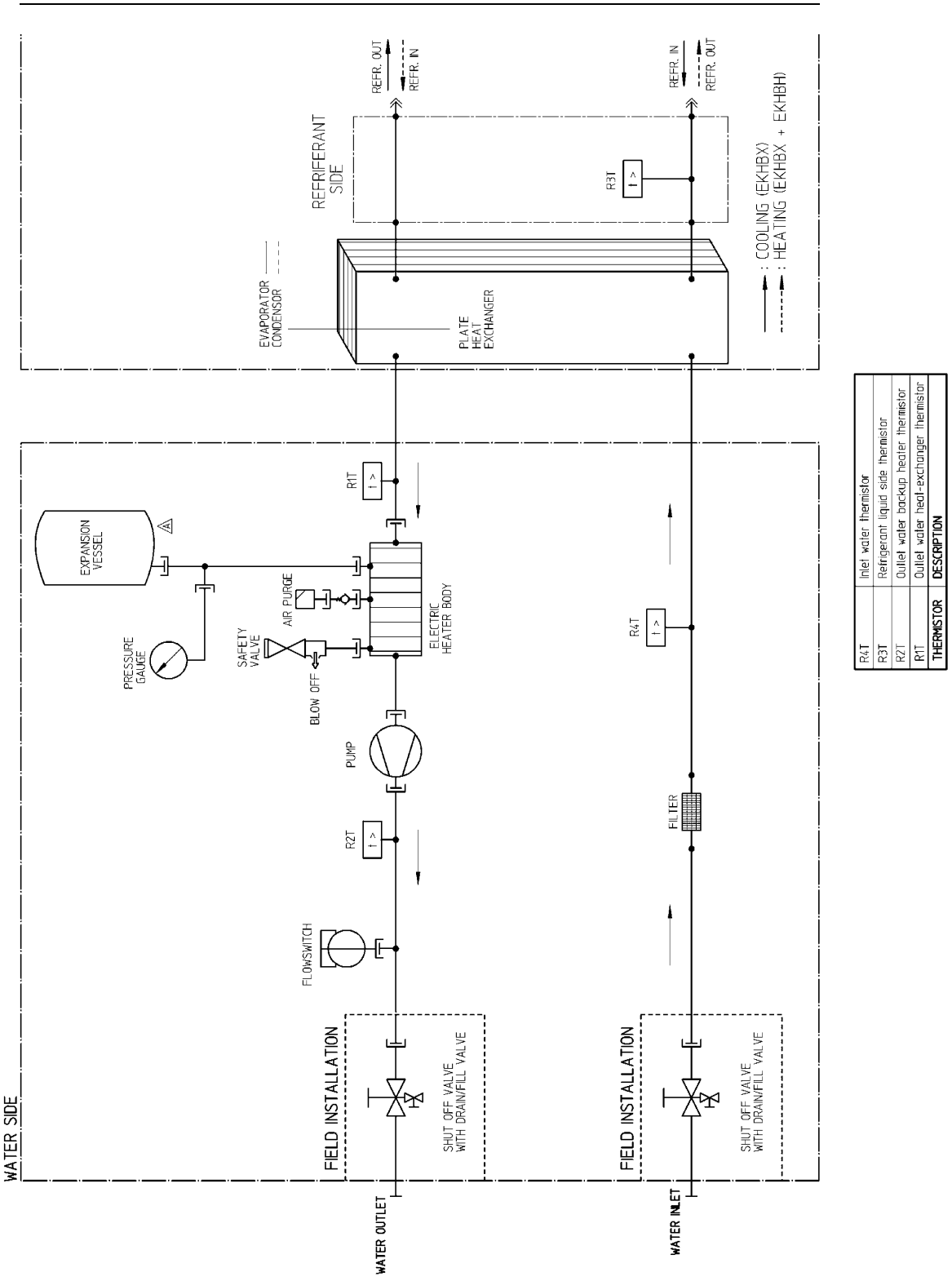
NOTES

* (1) Above mentioned power supply of hydrobox is fro backup heater only. The Switch box & pump of the hydrobox are supplied via the outdoor unit. The optional domestic hot water tank has a separate power supply.
* (2) Optional electric heater has 2 capacity steps except for the 3VJU model which has only 1 capacity step.
* (3) Select diameter and type according to local laws and regulations.
* (4) For more details of the voltage range and current, refer to installation manual EKHBH/X054BA*
* (5) Voltage: 24V / Maximum current: 100mA / Minimum AWG 18 (0.77MM^2)
* (6) Depends on thermostat type; refer to Installation Manual for EKHBH/X054BA*
* (7) Wire included in Option EKHWS*

3. Dimensional Dwg. & Center of Gravity- Hydrobox

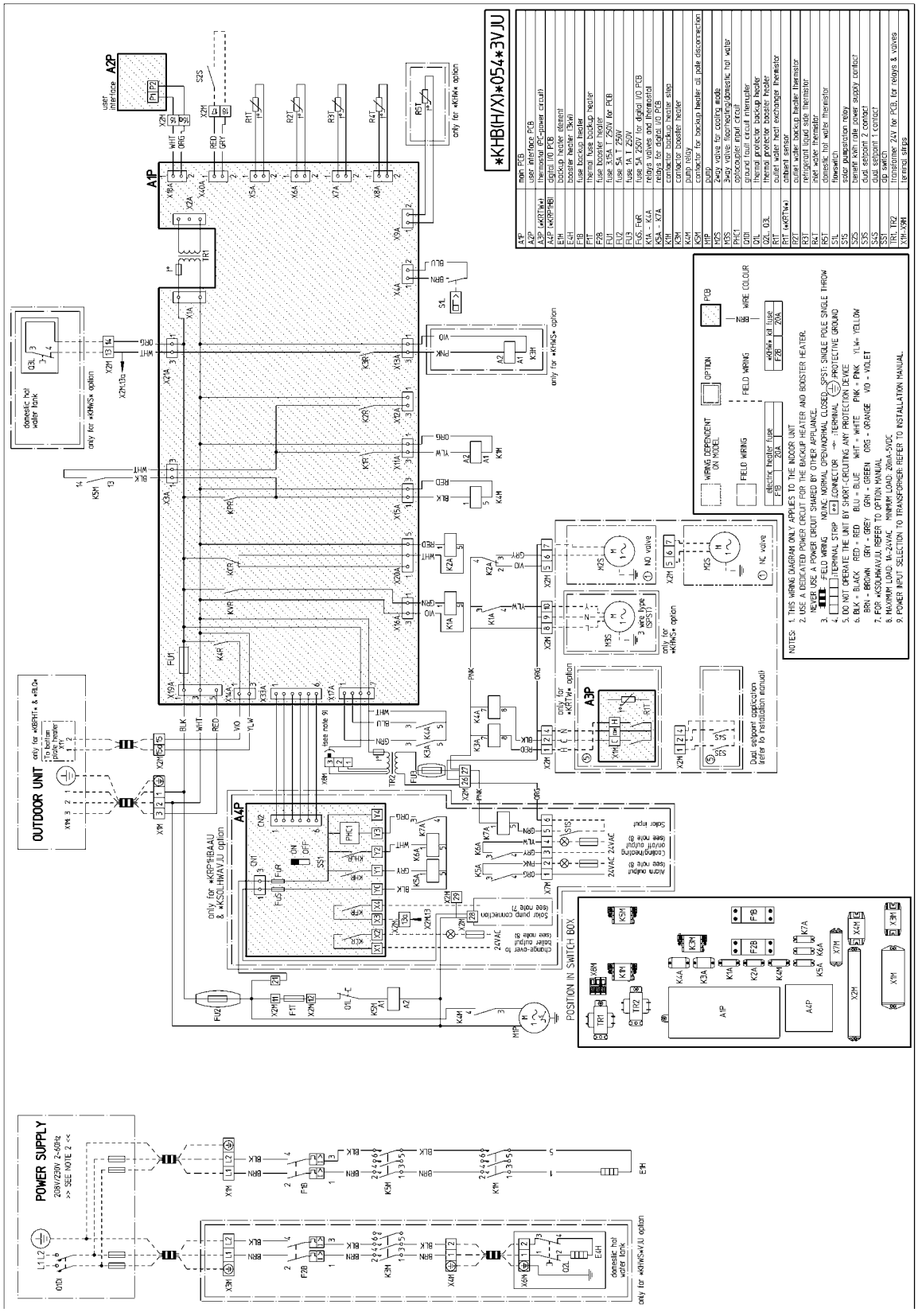


4. Piping Diagram - Hydrobox

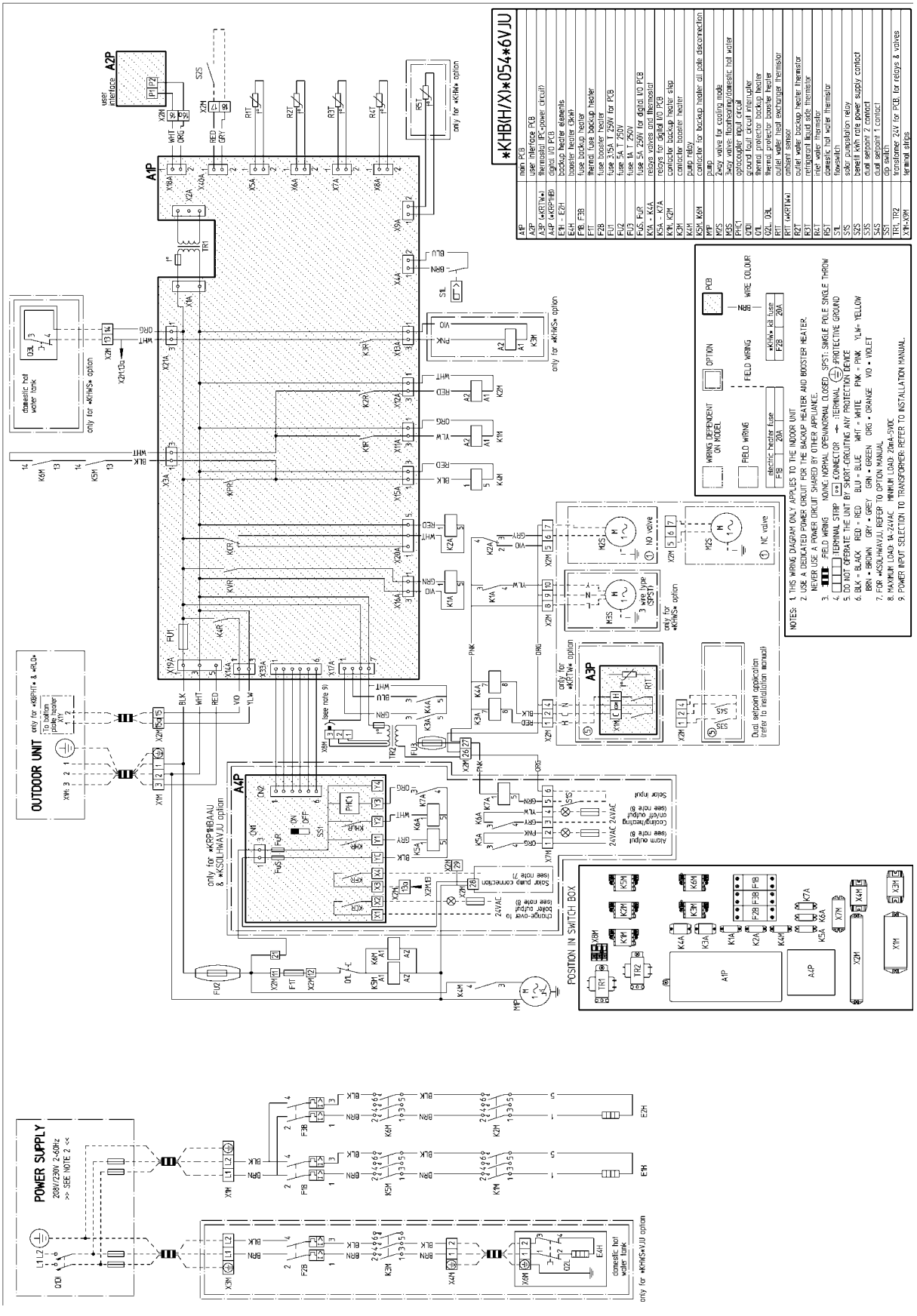


5. Wiring Diagram - Hydrobox

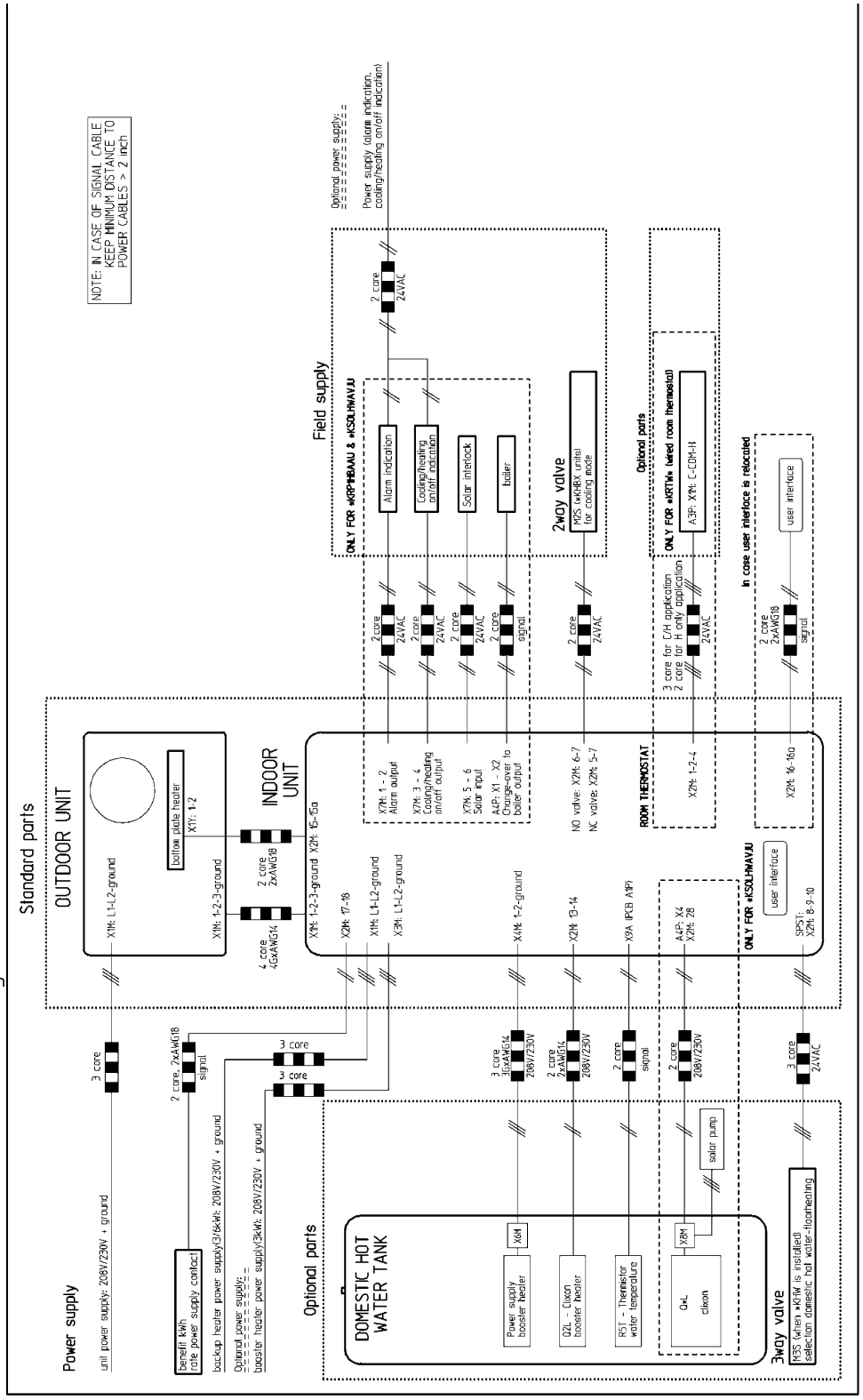
5.1 EKHB(H/X)054BA3VJU



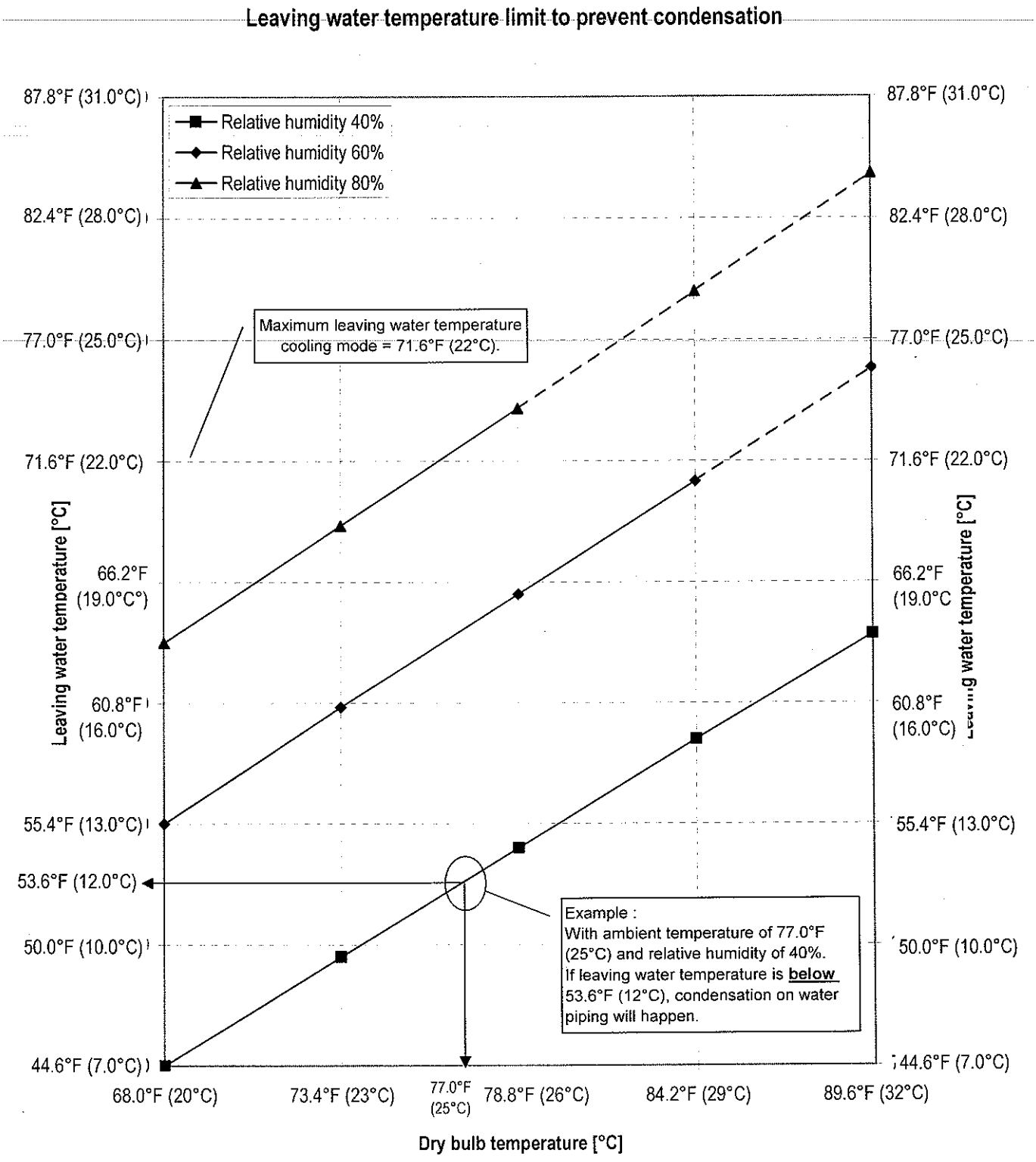
5.2 EKHB(H/X)054BA6VJU



6. External Connection Diagram - Hydrobox



7. Condensate Instructions - Hydrobox



1. Refer to psychometric chart for more information.
2. If condensation is expected, installation of EKHBDP - drainpan kit must be considered.

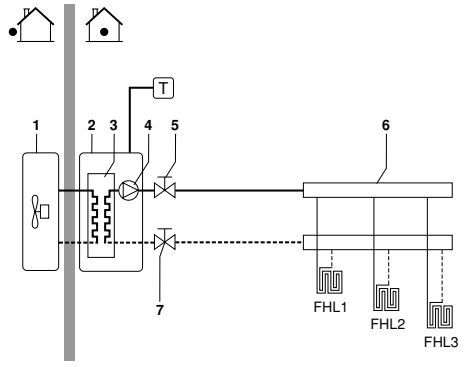
8. Application Examples - Hydrobox

TYPICAL APPLICATION EXAMPLES

The application examples given below are for illustration purposes only.

Application 1

Space heating only application with the room thermostat connected to the indoor unit.



1	Outdoor unit	**6**	Collector (field supply)
2	Indoor unit	**7**	Shut-off valve
3	Heat exchanger	**FHL1..3**	Floor heating loop
4	Pump	**T**	Room thermostat (optional)
5	Shut-off valve		

Pump operation and space heating

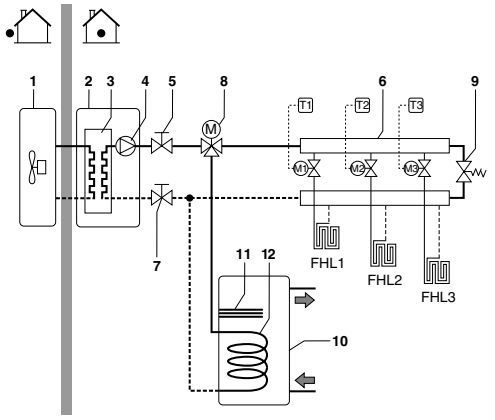
When the room thermostat (T) is connected to the indoor unit, the pump (4) will operate when there is a heating request from the room thermostat, and the outdoor unit will start operating to achieve the target leaving water temperature as set on the user interface.

When the room temperature is above the thermostat set point, the outdoor unit and pump will stop operating.

Make sure to connect the thermostat wires to the correct terminals (see "Connection of the thermostat cable" on page 18) and to configure the DIP switch toggle switches correctly (see "Room thermostat installation configuration" on page 22).

Application 2

Space heating only application without room thermostat connected to the indoor unit. The temperature in each room is controlled by a valve on each water circuit. Domestic hot water is provided through the domestic hot water tank which is connected to the indoor unit.



1	Outdoor unit	**9**	By-pass valve (field supply)
2	Indoor unit		
3	Heat exchanger	**10**	Domestic hot water tank (optional)
4	Pump		
5	Shut-off valve	**11**	Booster heater
6	Collector (field supply)	**12**	Heat exchanger coil
7	Shut-off valve	**FHL1..3**	Floor heating loop
8	Motorised 3-way valve (delivered with domestic hot water tank)	**T1..3**	Individual room thermostat (optional)
		M1..3	Individual motorised valve to control loop FHL1 (field supply)

Pump operation

With no thermostat connected to the indoor unit (2), the pump (4) can be configured to operate either as long as the indoor unit is on, or until the required water temperature is reached.

NOTE Details on pump configuration can be found under "Pump operation configuration" on page 23.

Space heating

The outdoor unit (1) will operate to achieve the target leaving water temperature as set on the user interface.

NOTE When circulation in each space heating loop (FHL1..3) is controlled by remotely controlled valves (M1..3), it is important to provide a by-pass valve (9) to avoid the flow switch safety device from being activated.

The by-pass valve should be selected as such that at all time the minimum water flow as mentioned under "Water pipework" on page 14 is guaranteed.

It is recommended to select a pressure difference controlled by-pass valve.

1	Outdoor unit	**14**	Motorised 2-way valve for activation of the room thermostat (field supply)
2	Indoor unit		
3	Heat exchanger		
4	Pump	**FCU1..3**	Fan coil unit with thermostat (optional)
5	Shut-off valve		
6	Collector (field supply)	**FHL1..3**	Floor heating loop
7	Shut-off valve	**T**	Heating only room thermostat (optional)
9	By-pass valve (field supply)		
13	Motorised 2-way valve to shut off the floor heating loops during cooling operation (field supply)	**T4..6**	Individual room thermostat for fan coil heated/cooled room (optional)

Pump operation

With no thermostat connected to the indoor unit (2), the pump (4) can be configured to operate either as long as the indoor unit is on, or until the required water temperature is reached.

NOTE Details on pump configuration can be found under "Pump operation configuration" on page 23.

Space heating and cooling

According to the season, the customer will select heating or cooling through the user interface on the indoor unit.

The outdoor unit (1) will operate in heating mode or cooling mode to achieve the target leaving water temperature.

With the unit in heating mode, the 2-way valve (13) is open. Hot water is provided to both the fan coil units and the floor heating loops.

With the unit in cooling mode, the 2-way valve (13) is closed to prevent cold water running through the floor heating loops (FHL).

When closing several loops in the system by remotely controlled valves, it might be required to install a by-pass valve (9) to avoid the flow switch safety device from being activated. See also "Application 2" on page 4.

Wiring of the 2-way valve (13) is different for a NC (normal closed) valve and a NO (normal open) valve! Make sure to connect to the correct terminal numbers as detailed on the wiring diagram.

The ON/OFF setting of the heating/cooling operation is done by the user interface on the indoor unit.

Application 5

Space heating with an auxiliary boiler (alternating operation)

Space heating application by either the Daikin indoor unit or by an auxiliary boiler connected in the system. The decision whether either the EKHB indoor unit or the boiler will operate can be achieved by an auxiliary contact or an EKHB* indoor controlled contact.*

The auxiliary contact can e.g. be an outdoor temperature thermostat, an electricity tariff contact, a manually operated contact, etc. See "Field wiring configuration A" on page 7.

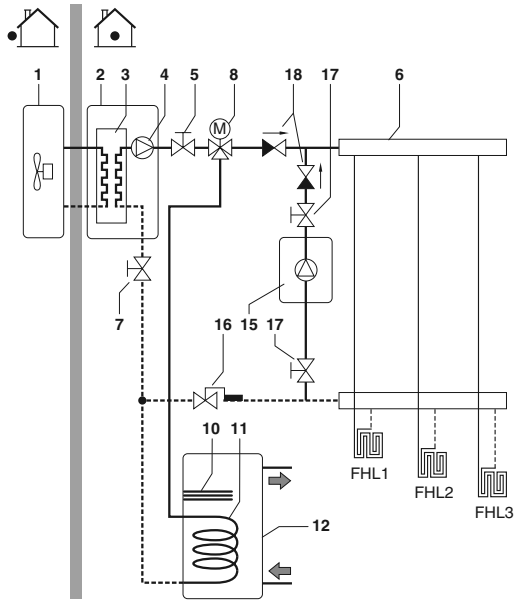
The EKHB indoor unit controlled contact (also called 'permission signal for the auxiliary boiler") is determined by the outdoor temperature (thermistor located at the outdoor unit). See "Field wiring configuration B" on page 7.*

Bivalent operation is only possible for space heating operation, **not** for the domestic water heating operation. Domestic hot water in such an application is always provided by the domestic hot water tank which is connected to the Daikin indoor unit.

The auxiliary boiler must be integrated in the piping work and in the field wiring according to the illustrations below.

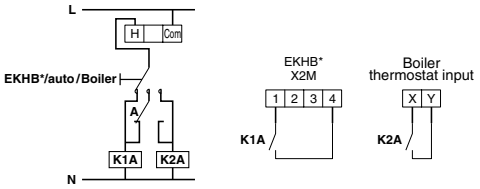
CAUTION

- Be sure that the boiler and the integration of the boiler in the system is in accordance with relevant local laws and regulations.
- Daikin can not be put responsible for incorrect or unsafe situations in the boiler system.



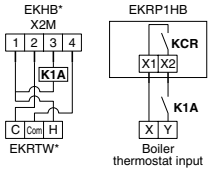
1	Outdoor unit	**11**	Heat exchanger coil
2	Indoor unit	**12**	Domestic hot water tank (optional)
3	Heat exchanger		
4	Pump	**15**	Boiler (field supply)
5	Shut-off valve	**16**	Aquastat valve (field supply)
6	Collector (field supply)		
7	Shut-off valve	**17**	Shut-off valve (field supply)
8	Motorised 3-way valve (delivered with the domestic hot water tank)	**18**	Non-return valve (field supply)
		FHL1...3	Floor heating loop (field supply)
10	Booster heater		

Field wiring configuration A



Boiler thermostat input	Boiler thermostat input
A	Auxiliary contact (normal closed)
H	Heating demand room thermostat (optional)
K1A	Auxiliary relay for activation of EKHB* unit (field supply)
K2A	Auxiliary relay for activation of boiler (field supply)

Field wiring configuration B



Boiler thermostat input	Boiler thermostat input
C	Cooling demand room thermostat (optional)
H	Heating demand room thermostat (optional)
Com	Common room thermostat (optional)
K1A	Auxiliary relay for activation of bolier unit (field supply)
KCR	Permission signal for the auxiliary boiler

Operation

■ **Configuration A**

When the room thermostat requests heating, either the EKHB* unit or the boiler starts operating, depending on the position of the auxiliary contact (A).

■ **Configuration B**

When the room thermostat requests heating, either the EKHB* unit or the boiler starts operating, depending on the outdoor temperature (status of "permission signal for the auxiliary boiler").

When the permission is given towards the boiler, the space heating operation by the EKHB* unit will be automatically switched off.

For more details see field setting [C-02~C-04].

NOTE

■ **Configuration A**
Make sure that auxiliary contact (A) has sufficient differential or time delay so as to avoid frequent changeover between the EKHB* unit and the boiler. If the auxiliary contact (A) is an outdoor temperature thermostat, make sure to install the thermostat in the shade, so that it is not influenced or turned ON/OFF by the sun.

Configuration B
Make sure that the bivalent hysteresis [C-04] has sufficient differential to avoid frequent changeover between the EKHB* unit and the boiler. As the outdoor temperature is measured via the outdoor unit, air thermistor make sure to install the outdoor unit in the shade, so that it is not influenced by the sun.

Frequent switching may cause corrosion of the boiler in an early stage. Contact the manufacturer of the boiler.

■ During heating operation of the EKHB* unit, the unit will operate so as to achieve the target leaving water temperature as set on the user interface. When weather dependent operation is active, the water temperature is determined automatically depending on the outdoor temperature.

During heating operation of the boiler, the boiler will operate so as to achieve the target leaving water temperature as set on the boiler controller.

Never set the target leaving water temperature set point on the boiler controller above 131°F (55°C).

■ Make sure to only have 1 expansion vessel in the water circuit. An expansion vessel is already premounted in the Daikin indoor unit.

NOTE

Make sure to configure the DIP switch SS2-3 on the PCB of the EKHB* switchbox correctly. Refer to "Room thermostat installation configuration" on page 22.

For configuration B: Make sure to configure the field settings [C-02, C-03 and C-04] correctly. Refer to "Bivalent operation" on page 32.

CAUTION

Make sure that return water to the EKHB* heat exchanger never exceeds 131°F (55°C).

For this reason, never put the target leaving water temperature set point on the boiler controller above 131°F (55°C) and install an aquastat(a) valve in the return water flow of the EKHB* unit.

Make sure that the non-return valves (field supply) are correctly installed in the system.

Make sure that the room thermostat (th) is not frequently turned ON/OFF.

Daikin shall not be held liable for any damage resulting from failure to observe this rule.

(a) The aquastat valve must be set for 131°F (55°C) and must operate to close the return water flow to the unit when the measured temperature exceeds 131°F (55°C). When the temperature drops to a lower level, the aquastat valve must operate to open the return water flow to the EKHB* unit again.

Manual permission towards the EKHB* unit on the boiler.

In case only the EKHB* unit should operate in space heating mode, disable the bivalent operation via setting [C-02].

In case only the boiler should operate in space heating mode, increase the bivalent ON temperature [C-03] to 77°F (25°C).

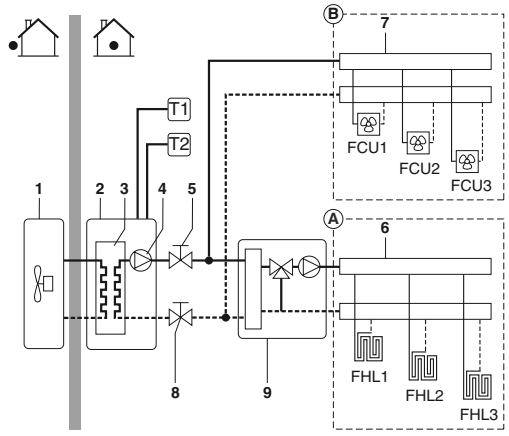
Application 6

Space heating with room thermostat application through floor heating loops and fan coil units. The floor heating loops and fan coil units require different operating water temperatures.

The floor heating loops require a lower water temperature in heating mode compared to fan coil units. To achive these two set points, a mixing station is used to adapt the water temperature according to requirements of the floor heating loops. The fan coil units are directly connected to the indoor unit water circuit and the floor heating loops after the mixing station. The control of this mixing station is not done by the indoor unit.

The operation and configuration of the field water circuit is the responsibility of the installer.

Daikin only offers a dual set point control function. By this function two set points can be generated. Depending on the required water temperature (floor heating loops and/or fan coil units are required) first set point or second set point can be activated.



1	Outdoor unit	**8**	Shut-off valve
2	Indoor unit	**9**	Mixing station (field supply)
3	Heat exchanger	**T1**	Room thermostat for zone A (optional)
4	Pump		
5	Shut-off valve	**T2**	Room thermostat for zone B (optional)
6	Collector zone A (field supply)	**FCU1..3**	Fan coil unit (optional)
7	Collector zone B (field supply)	**FHL1...3**	Floor heating loop (field supply)

The advantage of the dual set point control is that the heat pump will/can operate at the lowest required leaving water temperature when only floor heating is required. Higher leaving water temperatures are only required in case fan coil units are operating.
This results in a better performance of the heat pump.

Pump operation and space heating

When the room thermostat for the floor heating loop (T1) and the fan coil units (T2) are connected to the indoor unit, the pump (4) will operate when there is a request for heating from T1 and/or T2. The outdoor unit will start operating to achieve the target leaving water temperature. The target leaving water temperature depends on which room thermostat is requesting heating.

	Set point	Field setting	Thermo status			
Zone A	First	UI	ON	OFF	ON	OFF
Zone B	Second	[7-03]	OFF	ON	ON	OFF
Resulting water temperature			UI	[7-03]	[7-03]	—
Result pump operation			ON	ON	ON	OFF

When the room temperature of both zones is above the thermostat set point, the outdoor unit and pump will stop operating.

NOTE

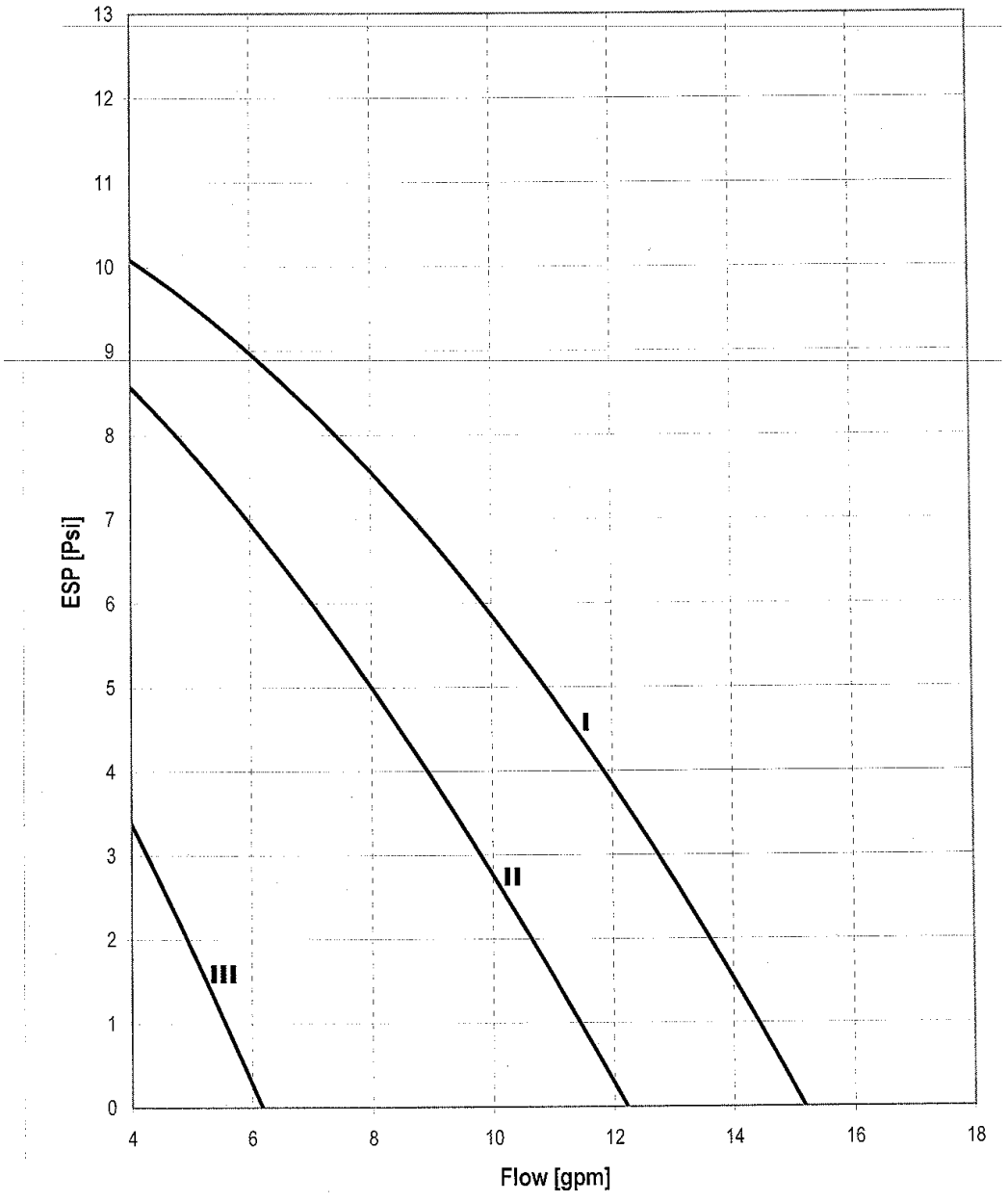
- Make sure to connect the thermostat wires to the correct terminals (see "Overview of the indoor unit" on page 9).
- Make sure to configure the field settings [7-02], [7-03] and [7-04] correctly. Refer to "Dual set point control" on page 29.
- Make sure to configure the DIP switch SS2-3 on the PCB of the EKHBH switch box correctly. Refer to "Room thermostat installation configuration" on page 22.

NOTE

- The request signals for space heating can be implemented in two different ways (installer choice).
  - Thermo ON/OFF signal from room thermostat
  - Status signal (active/not active) from the mixing station
- It is the installers responsibility to make sure no unwanted situations can occur (e.g. too high water temperatures towards floor heating loops, etc.)
- Daikin does not offer any type of mixing station. Dual set point control only provides the possibility to use two set points.
- When only zone A request heating, zone B will be fed with water at a temperature equal to the first set point.
  This can lead to unwanted heating of zone B.
- When only zone B request heating, the mixing station will be fed with water at a temperature equal to the second set point.
  Depending on the control of the mixing station, the floor heating loop can still receive water at a temperature equal to set point of the mixing station.

Be aware that the actual water temperature through the floor heating loops depends on the control and setting of the mixing station.

9. Hydronic Performance - Hydrobox

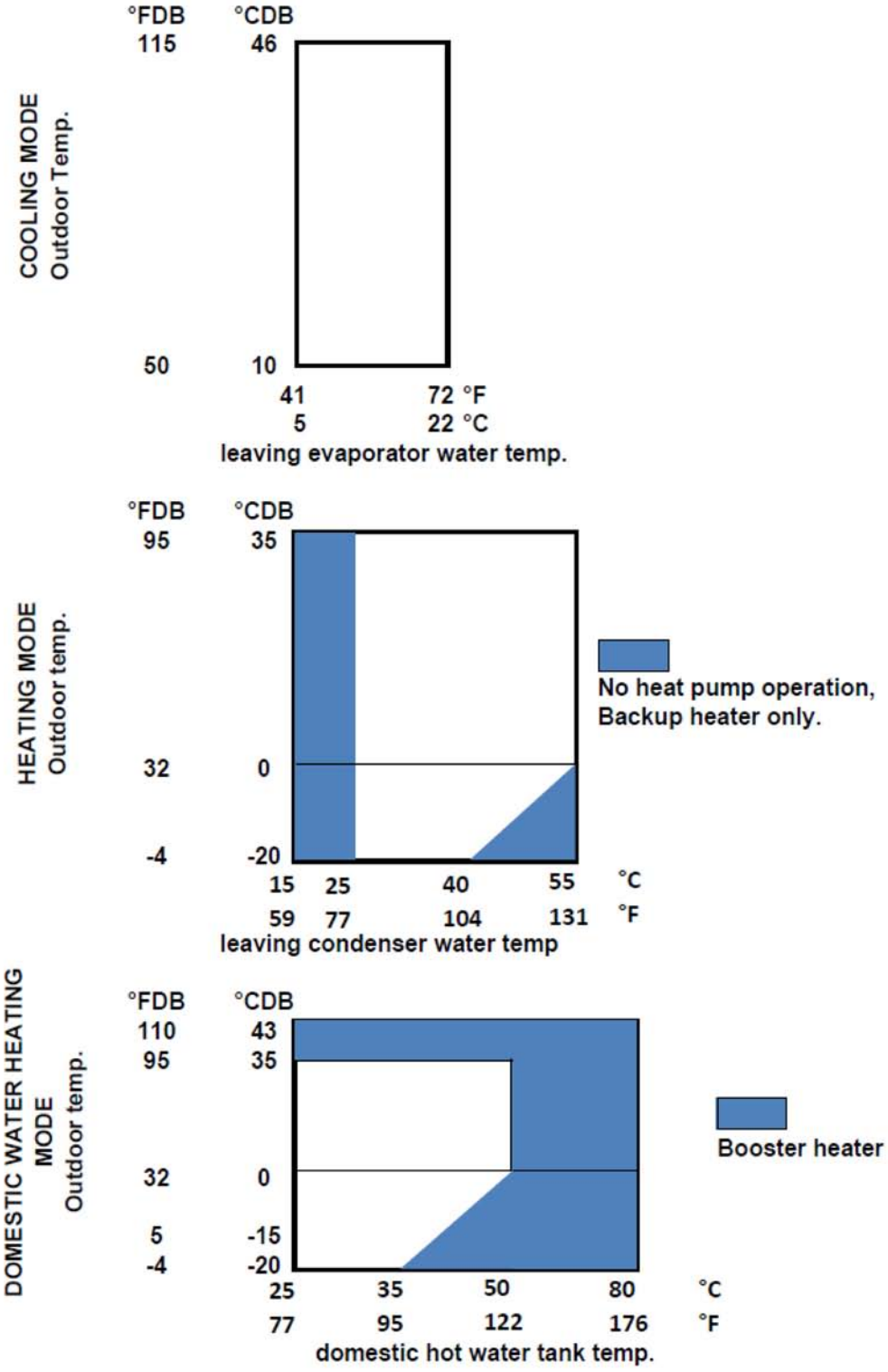


I high speed
II medium speed
III low speed
ESP : external static pressure
Flow : waterflow through the unit

IMPERIAL UNITS OF MEASURE

Caution :
Selecting a flow outside the curves can cause damage to or malfunction of the unit. See also minimum and maximum allowed water flowrange in the technical specifications.

10. Operation Range - Hydrobox



1. Monobloc - EDLQ / EBLQ

1.1 Features

- Heating only (EDLQ) and reversible (EBLQ) monobloc with base pan heater
- Inverter operated compressor
- H2O piping between outdoor unit and indoor heating appliances
- Freeze protection of hydronic parts
- Cost effective alternative to a fossil fuel boiler
- Interface control with field selectable options that include dual setpoint (heating & cooling), quiet mode, DHW priority settings, and schedule timer.
- Low energy bills and low CO2 emissions
- Easy to install
- Total solution for year round comfort
- Anti-corrosion treatment on outdoor coil

Monobloc

The monobloc unit is designed for outdoor installations. These units are used for both heating and cooling applications and can be combined with fan coil units, floor heating applications, low temperature radiators, optional Daikin domestic hot water tank, and optional Daikin solar kit.

The unit range consists of two main versions: a heating only version (EDLQ) and a heating/cooling version (EBLQ). Both versions are delivered with an integrated backup heater for additional heating capacity during cold outdoor temperatures. The backup heater also sesrves as a backup in the event malfunctioning of the unit occurs, along with freeze protection of the outside water piping during winter climates.

2. Specifications – EDLQ – Heat Only

2-1 NOMINAL CAPACITY AND NOMINAL INPUT				EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU
Condition 1 (Floor heating)	Heating capacity	Nominal	kBTU/hr	38.21	47.77	54.59
	Heating PI	Nominal	kW	2.53	3.33	3.93
	COP	Nominal		4.42	4.2	4.07
Condition 2 (Fan Coil)	Heating capacity	Nominal	kBTU/hr	37.07	44.17	51.39
	Heating PI	Nominal	kW	3.43	3.98	4.75
	COP	Nominal		3.25	3.25	3.17
Notes				Condition 1: heating Ta DB/WB 44.6 / 42.8°F (7°C/6°C) - LWC 95°F (35°C) ΔT=9°F (5°C)		
				Condition 2: heating Ta DB/WB 44.6 / 42.8°F (7°C/6°C) - LWC 113°F (45°C) (ΔT=9°F (5°C))		

2-2 TECHNICAL SPECIFICATIONS				EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU
Casing	Colour			Ivory white		
	Material			Painted galvanised steel		
Dimensions	Unit	Height	in (mm)	55-7/8 (1,418)		
		Width	in (mm)	56-1/2 (1,435)		
		Depth	in (mm)	15-1/32 (382)	15-1/32 (382)	15-1/32 (382)
	Packing	Height	in (mm)	61-1/4 (1,557)		
		Width	in (mm)	59-1/16 (1,500)		
		Depth	in (mm)	16-7/8 (430)	16-7/8 (430)	16-7/8 (430)
Weight	Unit		lb (kg)	397 (180)	397 (180)	397b (180)
	Packed unit		lb (kg)	441 (200)	441 (200)	441 (200)
Packing	Material			Wood		
				Carton		
				Plastic foil		
	Weight		lb (kg)	44 lb (20)	44 lb (20)	44 lb (20)
Operation Range (2, 4)	Heating - Ambient	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	95 (35)	95 (35)	95 (35)
	Heating - Waterside	Min	°F (°C)	59 (15)	59 (15)	59 (15)
		Max	°F (°C)	131 (55)	131 (55)	131 (55)
	Domestic hot water -Ambient	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	109.4 (43)	109.4 (43)	109.4 (43)
	Domestic hot water - Waterside	Min	°F (°C)	77 (25)	77 (25)	77 (25)
		Max	°F (°C)	176 (80)	176 (80)	176 (80)
Sound Level (1) (nominal)	Heating	Sound Power	dBA	64	64	66
		Sound Pressure	dBA	51	51	52
Sound Level (Night quiet)	Heating	Sound Pressure	dBA	42	42	43
Refrigerant	Type			R-410A		
	Charge		lb (kg)	6.5 (2.95)	6.5 (2.95)	6.5 (2.95)
	Control			Electronic expansion valve		
	Nr of Circuits			1	1	1
Refrigerant Oil	Type			Daphne FVC68D		
	Charged Volume		oz (l)	34 (1.0 l)	34 (1.0 l)	34 (1.0 l)
Defrost Method				Pressure equalising		
Defrost Control				Sensor for outdoor heat exchanger temperature		
Capacity Control Method				Inverter controlled		
Safety Devices				High pressure switch		
				Fan motor thermal protector		
				Fuse		

2-2 TECHNICAL SPECIFICATIONS	EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU

Notes

(1) The sound pressure level is measured via a microphone at a certain distance from the unit. It is a relative value depending on the distance and acoustic environment. Refer to sound spectrum drawing for more information.

(2) 59°–77°F (15°–25°C): BUH only, no heat pump operation = during commisioning

(5) including piping + PHE + back-up heater / excluding expansion vessel

(4) E(D)(B)L* model can reach -4°F (-20°C)

2-3 MAIN COMPONENTS				EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU
Air heat exchanger	Specifications	Length	in (mm)	33-3/4 (857)	33-3/4 (857)	33-3/4 (857)
		Nr of Rows		2	2	2
		Fin pitch	in (mm)	1/16 (1.4)	1/16 (1.4)	1/16 (1.4)
		Nr of Passes		5	5	5
		Face area	ft² (m²)	12.17 (1.131)	12.17 (1.131)	12.17 (1.131)
		Nr of Stages		60	60	60
	Tube type			Hi-XSS		
	Fin	Type		WF fin		
		Treatment		Anti-corrosion treatment (PE)		
Fan	Type			Propeller		
	Quantity			2	2	2
Air Flow Rate (nominal at 230V)	Heating	High	cfm (m³/min)	3178 (90)	3178 (90)	3178 (90)
Fan	Discharge direction			Horizontal		
	Motor	Quantity		2	2	2
		Model		Brushless DC		
Motor	Speed (nominal)	Steps		8	8	8
		Heating	rpm	760	760	760
Fan	Motor	Output	W	70	70	70
		Drive		Direct drive		
Compressor	Quantity			1	1	1
	Motor	Model		JT100G-VD		
		Type		Hermetically sealed scroll compressor		
		Motor Output	W	2,200		
		Starting Method		Inverter driven		
Motor	Crankcase Heater	Output	W	33	33	33
Pump	Type			Water cooled		
	Nr. of speed			2	2	2
	Nominal ESP unit	Heating	PSI (kPa)	7.61 PSI (52.5 kPa)	6.31 PSI (43.5 kPa)	5 PSI (35 kPa)
	Power input		W	210	210	210
Water side Heat exchanger	Type			Brazed plate		
	Quantity			1	1	1
	Water volume		gal (l)	0.27 (1.01)	0.27 (1.01)	0.27 (1.01)
	Water flow rate Min.		gpm (l/min)	4.23 (16)	4.23 (16)	4.23 (16)
	Water flow rate Nom.	Heating	gpm (l/min)	8.5 (32.1)	10.6 (40.1)	12.1 (45.9)
	Water flow rate Max.		gpm (l/min)	15.3 (58)	15.3 (58)	15.3 (58)
	Insulation material			Foamed synthetic elastomer		
Expansion vessel	Volume		gal (l)	2.64 (10)	2.64 (10)	2.64 (10)
	Maximum water pressure		PSI (bar)	43.5 (3)	43.5 (3)	43.5 (3)
	Pre pressure		PSI (bar)	14.5 (1.0)	14.5 (1.0)	14.5 (1.0)
Water filter	Diameter perforations		in (mm)	1/32 (1)	1/32 (1)	1/32 (1)
	Material			Brass		

2-3 MAIN COMPONENTS			EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU
Water circuit	Piping connections	inch	1-1/4 BSPP male		
	Piping	inch	1-1/4		
	Safety valve	PSI (bar)	43.5 (3)	43.5 (3)	43.5 (3)
	Manometer (Pressure Gauge)		Yes		
	Drain valve / Fill valve		yes		
	Shut off valve		yes		
	Air purge valve		yes		
	Total water volume (3)	gal (l)	145 (5.5)	145 (5.5)	145 (5.5)

2-4 ELECTRICAL SPECIFICATIONS					EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU
Power supply compressor component	Main Power	Name			VJ		
		Phase			1	1	1
		Frequency		Hz	60	60	60
		Voltage		V	208/230	208/230	208/230
Voltage Range		Minimum		V	-10%		
		Maximum		V	+10%		
Current		Compressor	Rated Load Amps (RLA)	A	23.4	23.4	23.4
		Total	Full Load Amps (FLA)	A	26.5	26.5	26.5
			MCA	A	26.5	26.5	26.5
			MOP	A	30	30	30
	Wiring connections	For power supply compressor component			Installation Instruction		
Power supply hydronic component	Current back-up heater	Type			Electric 6kW		
Current back-up heater	Power Supply	Phase			1~		
		Frequency		Hz	60	60	60
		Voltage		V	208/230	208/230	208/230
	Current	Minimum Circuit Amps (MCA)		A	28.6	28.6	28.6
		Maximum Overcurrent Protection (MOP)		A	30	30	30

2-4 ELECTRICAL SPECIFICATIONS					EDLQ036BA6VJU	EDLQ048BA6VJU	EDLQ054BA6VJU
Power supply hydronic component	Voltage range	Minimum		V	-10%		
		Maximum		V	+10%		
	Wiring connections	Connection type			for power supply hydraulic compartment		
		Quantity of wires			2G		
		Type of wires			Select diameter and type according to national and local regulations		
		Connection type			for power supply connection to optional sanitary tank + Q2L		
		Quantity of wires			3G		
		Type of wires			Select diameter and type according to national and local regulations		
		Type of wires			For more details on voltage range and current refer to installation manual.		
		Connection type			for connection with R5T		
		Quantity of wires			Wire included in option EKHWS*		
		Type of wires			Wire included in option EKHWS*		
		Connection type			for connection with A3P		
		Quantity of wires			Depends on thermostat type, refer to installation manual		
		Type of wires			Select diameter and type according to national and local regulations		
		Type of wires			For more details on voltage range and current refer to installation manual.		
		Connection type			for connection with M2S		
		Quantity of wires			3G		
		Type of wires			Select diameter and type according to national and local regulations		
		Type of wires			For more details on voltage range and current refer to installation manual.		
		Connection type			for connection with M3S		
		Quantity of wires			3G or 4G		
		Type of wires			Select diameter and type according to national and local regulations		
		Type of wires			For more details on voltage range and current refer to installation manual.		
	Notes				Power supply compressor compartment is for compressor, fan, pump and controller		
					Power supply hydraulic compartment is for the electric heater. The optional domestic warm water tank has a separate power supply.		
					Installer can reduce capacity of the heater from 20,491 to 10,245 BTU/hr (6 to 3kW). The current is then reduced from 26 to 13A. Instructions see installation manual.		
					Installer can reduce capacity of the heater from 20,491 to 11,953 BTU/hr (6 to 3kW). The current is then reduced from 8.7 to 5A. Instructions see installation manual.		
					Standard for safety heating and cooling equipment: UL1995/CSA (U&C) C22.2 #236		

3. Capacity Tables – EDLQ – Heat Only

MAXIMUM HEATING CAPACITY - PEAK VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	
E(D/B)LQ036BA6VJU	-4/-20	20.00	7.93	**2.52**	18.81	8.63	**2.18**												
	5/-15	22.61	8.04	**2.81**	21.25	8.76	**2.43**	20.78	9.61	**2.16**									
	19/-7.2	27.75	8.12	**3.42**	26.15	8.68	**3.01**	25.02	9.77	**2.56**	24.96	11.34	**2.20**						
	25/-3.9	31.66	8.12	**3.90**	29.90	8.90	**3.36**	29.38	9.81	**2.99**	28.70	11.41	**2.52**	27.66	12.65	**2.19**			
	36/2.2	35.22	8.08	**4.36**	33.34	8.89	**3.75**	32.83	9.82	**3.34**	32.15	11.43	**2.81**	31.06	12.69	**2.45**	29.02	14.10	**2.06**
	45/7.2	40.25	8.02	**5.02**	39.21	8.84	**4.44**	37.74	9.79	**3.85**	37.07	11.42	**3.25**	35.94	12.71	**2.83**	33.71	14.13	**2.39**
	54/12.2	43.65	7.80	**5.60**	41.57	8.62	**4.82**	41.17	9.58	**4.30**	40.57	11.21	**3.62**	39.47	12.50	**3.16**	37.16	13.92	**2.67**
	59/15	47.22	7.72	**6.12**	45.03	8.55	**5.27**	44.69	9.52	**4.69**	44.11	11.16	**3.95**	43.00	12.46	**3.45**	40.57	13.89	**2.92**
	68/20	53.68	7.58	**7.08**	51.33	8.41	**6.10**	51.07	9.40	**5.43**	50.57	11.06	**4.57**	45.01	12.36	**3.64**	45.45	13.81	**3.29**
E(D/B)LQ048BA6VJU	-4/-20	25.32	9.95	**2.54**	24.58	10.82	**2.27**												
	5/-15	28.29	10.15	**2.79**	27.29	11.03	**2.47**	26.34	12.07	**2.18**									
	19/-7.2	34.37	10.35	**3.32**	33.00	11.28	**2.93**	31.66	12.36	**2.56**	30.96	13.42	**2.31**						
	25/-3.9	39.11	10.44	**3.75**	37.52	11.39	**3.29**	35.95	12.49	**2.88**	35.11	13.58	**2.59**	34.57	14.97	**2.31**			
	36/2.2	43.50	10.48	**4.15**	41.72	11.45	**3.64**	39.98	12.57	**3.18**	39.02	13.67	**2.85**	38.40	15.08	**2.55**	36.62	16.64	**2.20**
	45/7.2	49.77	10.52	**4.73**	47.77	11.37	**4.20**	45.79	12.55	**3.65**	44.70	13.77	**3.25**	43.99	15.20	**2.89**	41.96	16.75	**2.51**
	54/12.2	52.69	10.21	**5.16**	50.62	11.18	**4.53**	48.57	12.31	**3.95**	47.45	13.42	**3.54**	46.73	14.83	**3.15**	44.60	16.38	**2.72**
	59/15	57.09	10.21	**5.59**	54.90	11.19	**4.91**	52.71	12.32	**4.28**	51.53	13.44	**3.83**	50.78	14.86	**3.42**	48.50	16.42	**2.95**
	68/20	65.14	10.22	**6.37**	62.72	11.20	**5.60**	60.30	12.34	**4.89**	59.03	13.47	**4.38**	50.58	14.89	**3.40**	54.08	16.46	**3.29**
E(D/B)LQ054BA6VJU	-4/-20	28.90	11.60	**2.49**	28.45	12.59	**2.26**												
	5/-15	32.20	11.83	**2.72**	31.42	12.86	**2.44**	30.68	14.05	**2.18**									
	19/-7.2	39.03	12.12	**3.22**	37.80	13.19	**2.87**	36.60	14.44	**2.53**	35.94	15.69	**2.29**						
	25/-3.9	44.41	12.27	**3.62**	42.91	13.36	**3.21**	41.43	14.83	**2.79**	40.58	15.91	**2.55**	39.07	17.52	**2.23**			
	36/2.2	49.40	12.37	**3.99**	47.69	13.48	**3.54**	45.99	14.77	**3.11**	44.96	16.05	**2.80**	43.24	17.68	**2.45**	41.51	19.49	**2.13**
	45/7.2	56.57	12.49	**4.53**	54.59	13.42	**4.07**	52.61	14.92	**3.53**	51.39	16.22	**3.17**	49.37	17.86	**2.76**	47.34	19.69	**2.40**
	54/12.2	58.99	12.18	**4.84**	56.94	13.28	**4.29**	54.88	14.57	**3.77**	53.60	15.85	**3.38**	51.48	17.46	**2.95**	49.35	19.25	**2.56**
	59/15	63.98	12.24	**5.23**	61.77	13.35	**4.63**	59.55	14.63	**4.07**	58.18	15.92	**3.65**	55.09	17.54	**3.14**	53.59	19.33	**2.77**
	68/20	73.10	12.37	**5.91**	70.64	13.47	**5.24**	68.16	14.76	**4.62**	66.63	16.06	**4.15**	64.05	17.68	**3.62**	61.45	19.47	**3.16**

Peak value does not include capacity drop during frosting and defrosting periods.

MAXIMUM HEATING CAPACITY - INTEGRATED VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP
E(D/B)LQ036BA6VJU	-4/-20	16.93	7.81	**2.17**	15.92	8.49	**1.88**												
	5/-15	19.14	7.91	**2.42**	17.99	8.62	**2.09**	17.59	9.45	**1.86**									
	19/-7.2	23.49	7.99	**2.94**	22.14	8.74	**2.53**	21.69	9.81	**2.21**	21.13	11.14	**1.90**						
	25/-3.9	26.27	7.84	**3.35**	24.82	8.60	**2.89**	24.38	9.47	**2.57**	23.82	11.00	**2.17**	22.95	12.20	**1.88**			
	36/2.2	29.23	7.81	**3.74**	27.67	8.58	**3.22**	27.25	9.47	**2.88**	26.88	11.02	**2.44**	25.78	12.23	**2.11**	24.09	13.59	**1.77**
	45/7.2	40.25	8.02	**5.02**	38.21	8.64	**4.42**	37.74	9.79	**3.85**	37.07	11.42	**3.25**	35.94	12.71	**2.83**	33.71	14.13	**2.39**
	54/12.2	43.66	7.80	**5.60**	41.57	8.62	**4.82**	41.17	9.58	**4.30**	40.57	11.21	**3.62**	39.47	12.50	**3.16**	37.16	13.92	**2.67**
	59/15	47.22	7.72	**6.12**	45.03	8.55	**5.27**	44.59	9.52	**4.68**	44.11	11.16	**3.95**	43.00	12.46	**3.45**	40.57	13.80	**2.94**
	68/20	53.68	7.58	**7.08**	51.33	8.41	**6.10**	51.07	9.40	**5.43**	50.57	11.06	**4.57**	48.01	12.36	**3.88**	45.45	13.81	**3.29**
E(D/B)LQ048BA6VJU	-4/-20	21.54	9.69	**2.22**	20.91	10.52	**1.99**												
	5/-15	24.07	9.87	**2.44**	23.21	10.73	**2.16**	22.40	11.73	**1.91**									
	19/-7.2	29.24	10.06	**2.91**	28.07	10.96	**2.56**	26.93	12.01	**2.24**	26.34	13.04	**2.02**						
	25/-3.9	31.09	9.51	**3.27**	29.83	10.37	**2.88**	28.58	11.30	**2.53**	27.91	12.36	**2.26**	27.48	13.62	**2.02**			
	36/2.2	34.58	9.53	**3.63**	33.17	10.42	**3.18**	31.78	11.44	**2.78**	31.02	12.44	**2.49**	30.52	13.71	**2.23**	29.12	15.13	**1.92**
	45/7.2	49.77	10.52	**4.73**	47.77	11.37	**4.20**	45.79	12.65	**3.62**	44.70	13.77	**3.25**	43.99	15.20	**2.89**	41.96	16.78	**2.50**
	54/12.2	52.69	10.21	**5.16**	50.02	11.18	**4.47**	48.57	12.31	**3.95**	47.45	13.42	**3.54**	46.73	14.83	**3.15**	44.60	16.38	**2.72**
	59/15	57.09	10.21	**5.59**	54.90	11.19	**4.91**	52.71	12.32	**4.28**	51.53	13.44	**3.83**	50.78	14.86	**3.42**	48.50	16.42	**2.95**
	68/20	65.14	10.22	**6.37**	62.72	11.20	**5.60**	60.30	12.34	**4.89**	59.03	13.47	**4.38**	56.58	14.89	**3.80**	54.08	16.46	**3.29**
E(D/B)LQ054BA6VJU	-4/-20	23.88	11.30	**2.11**	23.50	12.26	**1.92**												
	5/-15	26.60	11.52	**2.31**	25.96	12.52	**2.07**	25.35	13.69	**1.85**									
	19/-7.2	32.25	11.79	**2.74**	31.23	12.83	**2.43**	30.24	14.05	**2.15**	29.69	15.26	**1.95**						
	25/-3.9	33.97	10.97	**3.10**	32.63	11.95	**2.73**	31.70	13.09	**2.42**	31.03	14.23	**2.18**	29.89	15.67	**1.91**			
	36/2.2	37.79	11.04	**3.42**	36.48	12.03	**3.03**	35.19	13.19	**2.67**	34.40	14.34	**2.40**	33.08	15.80	**2.09**	31.75	17.42	**1.82**
	45/7.2	56.57	12.49	**4.53**	54.59	13.42	**4.07**	52.61	14.92	**3.53**	51.39	16.22	**3.17**	49.37	17.86	**2.76**	47.34	19.59	**2.42**
	54/12.2	58.99	12.18	**4.84**	58.94	13.26	**4.44**	54.88	14.57	**3.77**	53.60	15.85	**3.38**	51.46	17.46	**2.95**	49.35	19.25	**2.56**
	59/15	63.98	12.24	**5.23**	61.77	13.35	**4.63**	59.55	14.63	**4.07**	58.18	15.92	**3.65**	55.89	17.54	**3.19**	53.59	19.33	**2.77**
	68/20	73.10	12.37	**5.91**	70.64	13.47	**5.24**	68.15	14.76	**4.62**	66.63	16.06	**4.15**	64.05	17.68	**3.62**	61.45	19.47	**3.16**

Integrated value takes into consideration the capacity drop during frosting and defrosting periods.

4. Specifications – EBLQ Heat Pump

4-1 NOMINAL CAPACITY AND NOMINAL INPUT				EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
Condition 1 (Floor Heating)	Heating capacity	Nominal	kBTU/hr	38.21	47.77	54.59
	Cooling capacity	Nominal	kBTU/hr	43.83	54.57	57.07
	Heating PI	Nominal	kW	2.53	3.33	3.93
	Cooling PI	Nominal	kW	3.91	5.79	6.43
	COP	Nominal		4.54	4.37	4.22
	EER	Nominal		11.21	9.42	8.88
Condition 2 (Fan Coil)	Heating capacity	Nominal	kBTU/hr	37.07	44.17	51.39
	Cooling capacity	Nominal	kBTU/hr	34.17	42.69 (12.50)	44.74 (13.10)
	Heating PI	Nominal	kW	3.43	3.98	4.75
	Cooling PI	Nominal	kW	3.72	5.42	5.97
	COP	Nominal		3.37	3.35	3.26
	EER	Nominal		9.17	7.87	7.49
Notes				Condition 1: cooling Ta 95°F (35°C) - LWE 64.4°F (18°C) (ΔT=41°F (5°C); heating Ta DB/WB 44.6 / 42.8°F (7°C/6°C) - LWC 95°F (35°C) ΔT=41°F (5°C)		
				Condition 2: cooling Ta 95°F (35°C) - LWE 7°C (ΔT=5°C); heating Ta DB/WB 44.6 / 42.8°F (7°C/ 6°C) - LWC 113°F (45°C) (ΔT=41°F (5°C))		

4-2 TECHNICAL SPECIFICATIONS				EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
Casing	Colour			Ivory white		
	Material			Painted galvanised steel		
Dimensions	Unit	Height	in (mm)	55-7/8 (1,418)		
		Width	in (mm)	56-1/2 (mm)		
		Depth	in (mm)	15-1/32 (382)	15-1/32 (382)	15-1/32 (382)
	Packing	Height	in (mm)	61-1/4 (1,557)		
		Width	in (mm)	59-1/16 (1,500)		
		Depth	in (mm)	16-7/8 (430)	16-7/8 (430)	16-7/8 (430)
Weight	Unit		lb (kg)	397 (180)	397 (180)	397 (180)
	Packed unit		lb (kg)	441 (200)	441 (200)	441 (200)
Packing	Material			Wood		
				Carton		
				Plastic foil		
	Weight		lb (kg)	44 (20)	44 (20)	44 (20)
Operation Range (2 ,4)	Heating - Ambient	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	95 (35)	95 (35)	95 (35)
	Heating - Waterside	Min	°F (°C)	59 (15)	59 (15)	59 (15)
		Max	°F (°C)	131 (55)	131 (55)	131 (55)
	Cooling - Ambient	Min	°F (°C)	50 (10)	50 (10)	50 (10)
		Max	°F (°C)	114.8 (46)	114.8 (46)	114.8 (46)
	Cooling - Waterside	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	71.6 (22)	71.6 (22)	71.6 (22)
	Domestic hot water -Ambient	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	109.4 (43)	109.4 (43)	109.4 (43)
	Domestic hot water - Waterside	Min	°F (°C)	77 (25)	77 (25)	77 (25)
		Max	°F (°C)	176 (80)	176 (80)	176 (80)
Sound Level (nominal) (1)	Heating	Sound Power	dBA	64	64	66
		Sound Pressure	dBA	51	51	52
	Cooling	Sound Power	dBA	65	66	69
		Sound Pressure	dBA	50	52	54

4-2 TECHNICAL SPECIFICATIONS				EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
Sound Level (Night quiet)	Heating	Sound Pressure	dBA	42	42	43
	Cooling	Sound Pressure	dBA	45	45	46
Refrigerant	Type			R-410A		
	Charge		lb (kg)	6.5 (2.95)	6.5 (2.95)	6.5 (2.95)
	Control			Electronic expansion valve		
	Nr of Circuits			1	1	1
Refrigerant Oil	Type			Daphne FVC68D		
	Charged Volume		oz (l)	34 oz (1.0 l)	34 oz (1.0 l)	34 oz (1.0 l)
Defrost Method				Pressure equalising		
Defrost Control				Sensor for outdoor heat exchanger temperature		
Capacity Control Method				Inverter controlled		
Safety Devices				High pressure switch		
				Fan motor thermal protector		
				Fuse		

Notes

(1) The sound pressure level is measured via a microphone at a certain distance from the unit. It is a relative value depending on the distance and acoustic environment. Refer to sound spectrum drawing for more information.

(2) 15°-25°C: BUH only, no heat pump operation = during commisioning

(3) Including piping + PHE + back-up heater / excluding expansion vessel

(4) E(D)(B)L* model can reach -4°F (-20°C)

4-3 MAIN COMPONENTS				EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
Air heat exchanger	Specifications	Length	in (mm)	33-3/4 (857)	33-3/4 (857)	33-3/4 (857)
		Nr of Rows		2	2	2
		Fin pitch	in (mm)	1/16 (1.4)	1/16 (1.4)	1/16 (1.4)
		Nr of Passes		5	5	5
		Face area	ft² (m²)	12.17 (1.131)	12.17 (1.131)	12.17 (1.131)
		Nr of Stages		60	60	60
	Tube type			Hi-XSS		
	Fin	Type		WF fin		
		Treatment		Anti-corrosion treatment (PE)		
Fan	Type			Propeller		
	Quantity			2	2	2
Air Flow Rate (nominal at 230V)	Heating	High	cfm (m³/min)	3178 (90)	3178 (90)	3178 (90)
	Cooling	High	cfm (m³/min)	3390 (96)	3531 (100)	3426 (97)
Fan	Discharge direction			Horizontal		
	Motor	Quantity		2	2	2
		Model		Brushless DC		
Motor	Speed (nominal)	Steps		8	8	8
		Heating	rpm	760	760	760
		Cooling	rpm	780	780	780
Fan	Motor	Output	W	70	70	70
		Drive		Direct drive		
Compressor	Quantity			1	1	1
	Motor	Model		JT100G-VD		
		Type		Hermetically sealed scroll compressor		
		Motor Output	W	2,200		
		Starting Method		Inverter driven		
Motor	Crankcase Heater	Output	W	33	33	33

4-3 MAIN COMPONENTS				EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
Pump	Type			Water cooled		
	Nr. of speed			2	2	2
	Nominal ESP unit	Heating	PSI (kPa)	7.61 (52.5)	6.31 (43.5)	5 (35)
		Cooling	PSI (kPa)	8.11 (55.9)	7.12 (49.1)	6.79 (46.8)
	Power input		W	210	210	210
Water side Heat exchanger	Type			Brazed plate		
	Quantity			1	1	1
	Water volume (3)		gal (l)	0.27 (1.01)	0.27 (1.01)	0.27 (1.01)
	Water flow rate Min.		gpm/min (l/min)	423 (16)	423 (16)	423 (16)
	Water flow rate Nom.	Heating	gpm/min (l/min)	848 (32.1)	10.49 (40.1)	12.13 (45.9)
		Cooling	gpm/min (l/min)	9.72 (36.8)	12.13 (45.9)	12.68 (48)
	Water flow rate Max.		gpm/min (l/min)	15.32 (58)	15.32 (58)	15.32 (58)
	Insulation material			Foamed synthetic elastomer		
Expansion vessel	Volume		gal (l)	2.64 (10)	2.64 (10)	2.64 (10)
	Maximum water pressure		PSI (bar)	43.5 (3)	43.5 (3)	43.5 (3)
	Pre pressure		PSI (bar)	14.5 (1.0)	14.5 (1.0)	14.5 (1.0)
Water filter	Diameter perforations		in (mm)	1/32 (1)	1/32 (1)	1/32 (1)
	Material			Brass		
Water circuit	Piping connections		inch	1-1/4 (MALE) BSP		
	Piping		inch	1-1/4		
	Safety valve		PSI (bar)	43.5 (3)	43.5 (3)	43.5 (3)
	Manometer			Yes		
	Drain valve / Fill valve			yes		
	Shut off valve			yes		
	Air purge valve			yes		
	Total water volume (3)		gal (l)	145 (5.5)	145 (5.5)	145 (5.5)

4-4 ELECTRICAL SPECIFICATIONS				EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
Power supply compressor component	Main Power	Name		VJ		
		Phase		1	1	1
		Frequency	Hz	60	60	60
		Voltage	V	208/230	208/230	208/230
	Voltage range	Minimum	V	-10%		
		Maximum	V	+10%		
	Current	Rated Load Amps (RLA)	A	23.4	23.4	23.4
		Full Load Amps (FLA)	A	26.5	26.5	26.5
		MCA	A	26.5	26.5	26.5
		MOP	A	30	30	30
	Wiring connections	For power supply compressor component		Installation Instruction		
Power supply hydraulic component	Current back-up heater	Type		Electric 6kW		
Current back-up heater	Power Supply	Phase		1~		
		Frequency	Hz	60	60	60
		Voltage	V	208/230	208/230	208/230
	Current	Minimum Circuit Amps (MCA)	A	28.6	28.6	28.6
		Maximum Overcurrent Protection (MOP)	A	30	30	30

4-4 ELECTRICAL SPECIFICATIONS				EBLQ036BA6VJU	EBLQ048BA6VJU	EBLQ054BA6VJU
Power supply hydronic component	Voltage range	Minimum	V	-10%		
		Maximum	V	+10%		
	Wiring connections	Connection type		for power supply hydraulic compartment		
		Quantity of wires		3G		
		Type of wires		Select diameter and type according to national and local regulations		
		Connection type		for power supply connection to optional sanitary tank + Q2L		
		Quantity of wires		3G		
		Type of wires		Select diameter and type according to national and local regulations		
		Type of wires		For more details on voltage range and current refer to installation manual		
		Connection type		for connection with R5T		
		Quantity of wires		Wire included in option EKHWS*		
		Type of wires		Wire included in option EKHWS*		
		Connection type		for connection with A3P		
		Quantity of wires		Depends on thermostat type, refer to installation manual		
		Type of wires		Select diameter and type according to national and local regulations		
		Type of wires		For more details on voltage range and current refer to installation manual.		
		Connection type		for connection with M2S		
		Quantity of wires		3G		
		Type of wires		Select diameter and type according to national and local regulations		
		Type of wires		For more details on voltage range and current refer to installation manual.		
		Connection type		for connection with M3S		
		Quantity of wires		3G or 4G		
		Type of wires		Select diameter and type according to national and local regulations		
		Type of wires		For more details on voltage range and current refer to installation manual.		
	Notes			Power supply compressor compartment is for compressor, fan, pump and controller		
				Installer can reduce capacity of the heater from 20,491 to 10,245 BTU/hr (6 to 3kW). The current is then reduced from 26 to 13A. Instructions see installation manual.		
				Installer can reduce capacity of the heater from 6 to 3.5kW. The current is then reduced from 8.7 to 5A. Instructions see installation manual.		
				Power supply hydraulic compartment is for the electric heater. The optional domestic warm water tank has a separate power supply.		
				Standard for safety heating & cooling equipment; UL1995 / CSA (U&C) C22.2 #236		

5. Capacity Tables – EBLQ – Heating

MAXIMUM HEATING CAPACITY - PEAK VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	
E(D/B)LQ036BA6VJU	-4/-20	20.00	7.93	**2.52**	18.81	8.63	**2.18**												
	5/-15	22.61	8.04	**2.81**	21.25	8.76	**2.43**	20.78	9.61	**2.16**									
	19/-7.2	27.75	8.12	**3.42**	26.15	8.68	**3.01**	25.02	9.77	**2.56**	24.96	11.34	**2.20**						
	25/-3.9	31.66	8.12	**3.90**	29.90	8.90	**3.36**	29.38	9.81	**2.99**	28.70	11.41	**2.52**	27.66	12.65	**2.19**			
	36/2.2	35.22	8.08	**4.36**	33.34	8.89	**3.75**	32.83	9.82	**3.34**	32.15	11.43	**2.81**	31.06	12.69	**2.45**	29.02	14.10	**2.06**
	45/7.2	40.25	8.02	**5.02**	39.21	8.84	**4.44**	37.74	9.79	**3.85**	37.07	11.42	**3.25**	35.94	12.71	**2.83**	33.71	14.13	**2.39**
	54/12.2	43.65	7.80	**5.60**	41.57	8.62	**4.82**	41.17	9.58	**4.30**	40.57	11.21	**3.62**	39.47	12.50	**3.16**	37.16	13.92	**2.67**
	59/15	47.22	7.72	**6.12**	45.03	8.55	**5.27**	44.69	9.52	**4.69**	44.11	11.16	**3.95**	43.00	12.46	**3.45**	40.57	13.89	**2.92**
	68/20	53.68	7.58	**7.08**	51.33	8.41	**6.10**	51.07	9.40	**5.43**	50.57	11.06	**4.57**	45.01	12.36	**3.64**	45.45	13.81	**3.29**
E(D/B)LQ048BA6VJU	-4/-20	25.32	9.95	**2.54**	24.58	10.82	**2.27**												
	5/-15	28.29	10.15	**2.79**	27.29	11.03	**2.47**	26.34	12.07	**2.18**									
	19/-7.2	34.37	10.35	**3.32**	33.00	11.28	**2.93**	31.66	12.36	**2.56**	30.96	13.42	**2.31**						
	25/-3.9	39.11	10.44	**3.75**	37.52	11.39	**3.29**	35.95	12.49	**2.88**	35.11	13.58	**2.59**	34.57	14.97	**2.31**			
	36/2.2	43.50	10.48	**4.15**	41.72	11.45	**3.64**	39.98	12.57	**3.18**	39.02	13.67	**2.85**	38.40	15.08	**2.55**	36.62	16.64	**2.20**
	45/7.2	49.77	10.52	**4.73**	47.77	11.37	**4.20**	45.79	12.55	**3.65**	44.70	13.77	**3.25**	43.99	15.20	**2.89**	41.96	16.75	**2.51**
	54/12.2	52.69	10.21	**5.16**	50.62	11.18	**4.53**	48.57	12.31	**3.95**	47.45	13.42	**3.54**	46.73	14.83	**3.15**	44.60	16.38	**2.72**
	59/15	57.09	10.21	**5.59**	54.90	11.19	**4.91**	52.71	12.32	**4.28**	51.53	13.44	**3.83**	50.78	14.86	**3.42**	48.50	16.42	**2.95**
	68/20	65.14	10.22	**6.37**	62.72	11.20	**5.60**	60.30	12.34	**4.89**	59.03	13.47	**4.38**	50.58	14.89	**3.40**	54.08	16.46	**3.29**
E(D/B)LQ054BA6VJU	-4/-20	28.90	11.60	**2.49**	28.45	12.59	**2.26**												
	5/-15	32.20	11.83	**2.72**	31.42	12.86	**2.44**	30.68	14.05	**2.18**									
	19/-7.2	39.03	12.12	**3.22**	37.80	13.19	**2.87**	36.60	14.44	**2.53**	35.94	15.69	**2.29**						
	25/-3.9	44.41	12.27	**3.62**	42.91	13.36	**3.21**	41.43	14.83	**2.79**	40.58	15.91	**2.55**	39.07	17.52	**2.23**			
	36/2.2	49.40	12.37	**3.99**	47.69	13.48	**3.54**	45.99	14.77	**3.11**	44.96	16.05	**2.80**	43.24	17.68	**2.45**	41.51	19.49	**2.13**
	45/7.2	56.57	12.49	**4.53**	54.59	13.42	**4.07**	52.61	14.92	**3.53**	51.39	16.22	**3.17**	49.37	17.86	**2.76**	47.34	19.69	**2.40**
	54/12.2	58.99	12.18	**4.84**	56.94	13.28	**4.29**	54.88	14.57	**3.77**	53.60	15.85	**3.38**	51.48	17.46	**2.95**	49.35	19.25	**2.56**
	59/15	63.98	12.24	**5.23**	61.77	13.35	**4.63**	59.55	14.63	**4.07**	58.18	15.92	**3.65**	55.09	17.54	**3.14**	53.59	19.33	**2.77**
	68/20	73.10	12.37	**5.91**	70.64	13.47	**5.24**	68.16	14.76	**4.62**	66.63	16.06	**4.15**	64.05	17.68	**3.62**	61.45	19.47	**3.16**

Peak value does not include capacity drop during frosting and defrosting periods.

MAXIMUM HEATING CAPACITY - INTEGRATED VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP
E(D/B)LQ036BA6VJU	-4/-20	16.93	7.81	**2.17**	15.92	8.49	**1.88**												
	5/-15	19.14	7.91	**2.42**	17.99	8.62	**2.09**	17.59	9.45	**1.86**									
	19/-7.2	23.49	7.99	**2.94**	22.14	8.74	**2.53**	21.69	9.81	**2.21**	21.13	11.14	**1.90**						
	25/-3.9	26.27	7.84	**3.35**	24.82	8.60	**2.89**	24.38	9.47	**2.57**	23.82	11.00	**2.17**	22.95	12.20	**1.88**			
	36/2.2	29.23	7.81	**3.74**	27.67	8.58	**3.22**	27.25	9.47	**2.88**	26.88	11.02	**2.44**	25.78	12.23	**2.11**	24.09	13.59	**1.77**
	45/7.2	40.25	8.02	**5.02**	38.21	8.64	**4.42**	37.74	9.79	**3.85**	37.07	11.42	**3.25**	35.94	12.71	**2.83**	33.71	14.13	**2.39**
	54/12.2	43.66	7.80	**5.60**	41.57	8.62	**4.82**	41.17	9.58	**4.30**	40.57	11.21	**3.62**	39.47	12.50	**3.16**	37.16	13.92	**2.67**
	59/15	47.22	7.72	**6.12**	45.03	8.55	**5.27**	44.59	9.52	**4.68**	44.11	11.16	**3.95**	43.00	12.46	**3.45**	40.57	13.80	**2.94**
	68/20	53.68	7.58	**7.08**	51.33	8.41	**6.10**	51.07	9.40	**5.43**	50.57	11.06	**4.57**	48.01	12.36	**3.88**	45.45	13.81	**3.29**
E(D/B)LQ048BA6VJU	-4/-20	21.54	9.69	**2.22**	20.91	10.52	**1.99**												
	5/-15	24.07	9.87	**2.44**	23.21	10.73	**2.16**	22.40	11.73	**1.91**									
	19/-7.2	29.24	10.06	**2.91**	28.07	10.96	**2.56**	26.93	12.01	**2.24**	26.34	13.04	**2.02**						
	25/-3.9	31.09	9.51	**3.27**	29.83	10.37	**2.88**	28.58	11.30	**2.53**	27.91	12.36	**2.26**	27.48	13.62	**2.02**			
	36/2.2	34.58	9.53	**3.63**	33.17	10.42	**3.18**	31.78	11.44	**2.78**	31.02	12.44	**2.49**	30.52	13.71	**2.23**	29.12	15.13	**1.92**
	45/7.2	49.77	10.52	**4.73**	47.77	11.37	**4.20**	45.79	12.65	**3.62**	44.70	13.77	**3.25**	43.99	15.20	**2.89**	41.96	16.78	**2.50**
	54/12.2	52.69	10.21	**5.16**	50.02	11.18	**4.47**	48.57	12.31	**3.95**	47.45	13.42	**3.54**	46.73	14.83	**3.15**	44.60	16.38	**2.72**
	59/15	57.09	10.21	**5.59**	54.90	11.19	**4.91**	52.71	12.32	**4.28**	51.53	13.44	**3.83**	50.78	14.86	**3.42**	48.50	16.42	**2.95**
	68/20	65.14	10.22	**6.37**	62.72	11.20	**5.60**	60.30	12.34	**4.89**	59.03	13.47	**4.38**	56.58	14.89	**3.80**	54.08	16.46	**3.29**
E(D/B)LQ054BA6VJU	-4/-20	23.88	11.30	**2.11**	23.50	12.26	**1.92**												
	5/-15	26.60	11.52	**2.31**	25.96	12.52	**2.07**	25.35	13.69	**1.85**									
	19/-7.2	32.25	11.79	**2.74**	31.23	12.83	**2.43**	30.24	14.05	**2.15**	29.69	15.26	**1.95**						
	25/-3.9	33.97	10.97	**3.10**	32.63	11.95	**2.73**	31.70	13.09	**2.42**	31.03	14.23	**2.18**	29.89	15.67	**1.91**			
	36/2.2	37.79	11.04	**3.42**	36.48	12.03	**3.03**	35.19	13.19	**2.67**	34.40	14.34	**2.40**	33.08	15.80	**2.09**	31.75	17.42	**1.82**
	45/7.2	56.57	12.49	**4.53**	54.59	13.42	**4.07**	52.61	14.92	**3.53**	51.39	16.22	**3.17**	49.37	17.86	**2.76**	47.34	19.59	**2.42**
	54/12.2	58.99	12.18	**4.84**	58.94	13.26	**4.44**	54.88	14.57	**3.77**	53.60	15.85	**3.38**	51.46	17.46	**2.95**	49.35	19.25	**2.56**
	59/15	63.98	12.24	**5.23**	61.77	13.35	**4.63**	59.55	14.63	**4.07**	58.18	15.92	**3.65**	55.89	17.54	**3.19**	53.59	19.33	**2.77**
	68/20	73.10	12.37	**5.91**	70.64	13.47	**5.24**	68.15	14.76	**4.62**	66.63	16.06	**4.15**	64.05	17.68	**3.62**	61.45	19.47	**3.16**

Integrated value takes into consideration the capacity drop during frosting and defrosting periods.

6. Capacity Tables – EBLQ – Cooling

MAXIMUM COOLING CAPACITY

MODEL	T_{amb} (°F/°C)	60/15.6			77/25			86/30			95/35			104/40			113/45		
	LWE (°F/°C)	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER
EBLQ036BA6VJU	45/7.2	37.81	2.83	**13.36**	37.49	3.09	**12.13**	36.23	3.39	**10.69**	34.12	3.72	**9.17**	31.27	4.10	**7.63**	27.79	4.51	**6.16**
	50/10	40.16	2.86	**14.04**	39.80	3.13	**12.72**	38.45	3.43	**11.21**	38.21	3.77	**10.14**	33.19	4.15	**8.00**	29.52	4.57	**6.46**
	55/12.8	44.13	2.88	**15.32**	43.72	3.16	**13.84**	42.24	3.47	**12.17**	39.79	3.82	**10.42**	36.50	4.21	**8.67**	32.03	4.78	**6.70**
	59/15	46.87	2.91	**16.11**	46.44	3.19	**14.56**	44.87	3.51	**12.78**	42.28	3.86	**10.95**	38.80	4.24	**9.15**	33.19	4.65	**7.14**
	64/17.8	51.75	2.94	**17.60**	50.01	3.23	**15.48**	47.33	3.55	**13.33**	43.83	3.91	**11.21**	39.61	4.30	**9.21**	33.60	4.31	**7.80**
	72/22.2	57.72	3.00	**19.24**	55.81	3.29	**16.96**	52.86	3.62	**14.60**	49.00	3.98	**12.31**	44.36	4.38	**10.13**	35.22	3.86	**9.12**
EBLQ048BA6VJU	45/7.2	47.31	4.14	**11.43**	46.93	4.51	**10.41**	45.34	4.94	**9.18**	42.65	5.42	**7.87**	37.82	5.20	**7.27**	33.48	5.73	**5.84**
	50/10	50.90	4.22	**12.06**	50.46	4.60	**10.97**	48.73	5.03	**9.69**	45.84	5.52	**8.30**	40.68	5.29	**7.69**	36.03	5.82	**6.19**
	55/12.8	55.89	4.30	**13.00**	55.39	4.69	**11.81**	53.49	5.13	**10.43**	50.32	5.62	**8.95**	44.68	5.38	**8.30**	37.38	5.90	**6.34**
	59/15	59.32	4.35	**13.64**	58.78	4.75	**12.37**	56.77	5.20	**10.92**	53.44	5.69	**9.39**	47.47	5.45	**8.71**	38.74	5.76	**6.73**
	64/17.8	64.55	4.45	**14.51**	62.37	4.85	**12.86**	59.01	5.29	**11.16**	54.57	5.79	**9.42**	47.75	5.54	**8.62**	39.21	5.33	**7.36**
	72/22.2	71.89	4.59	**15.66**	69.50	5.00	**13.90**	65.80	5.45	**12.07**	60.92	5.95	**10.24**	53.38	5.68	**9.40**	41.10	4.76	**8.63**
EBLQ054BA6VJU	45/7.2	49.55	4.58	**10.82**	49.27	5.00	**9.85**	47.61	5.46	**8.72**	44.70	5.97	**7.49**	39.46	5.70	**6.92**	33.57	5.60	**5.99**
	50/10	53.38	4.68	**11.41**	52.99	5.11	**10.37**	51.15	5.58	**9.17**	48.01	6.09	**7.88**	42.40	5.81	**7.30**	36.12	5.69	**6.35**
	55/12.8	58.66	4.79	**12.25**	58.17	5.23	**11.12**	56.13	5.70	**9.85**	52.68	6.22	**8.47**	46.56	5.92	**7.86**	37.47	5.77	**6.49**
	59/15	62.29	4.87	**12.79**	61.74	5.31	**11.63**	59.56	5.78	**10.30**	55.91	6.30	**8.87**	49.45	5.99	**8.26**	38.83	5.63	**6.90**
	64/17.8	67.80	5.00	**13.56**	65.51	5.43	**12.06**	61.83	5.91	**10.46**	57.07	6.43	**8.88**	49.72	6.10	**8.15**	39.30	5.21	**7.54**
	72/22.2	75.53	5.19	**14.55**	72.97	5.63	**12.96**	68.95	6.10	**11.30**	63.66	6.62	**9.62**	55.55	6.28	**8.85**	41.20	4.60	**8.96**

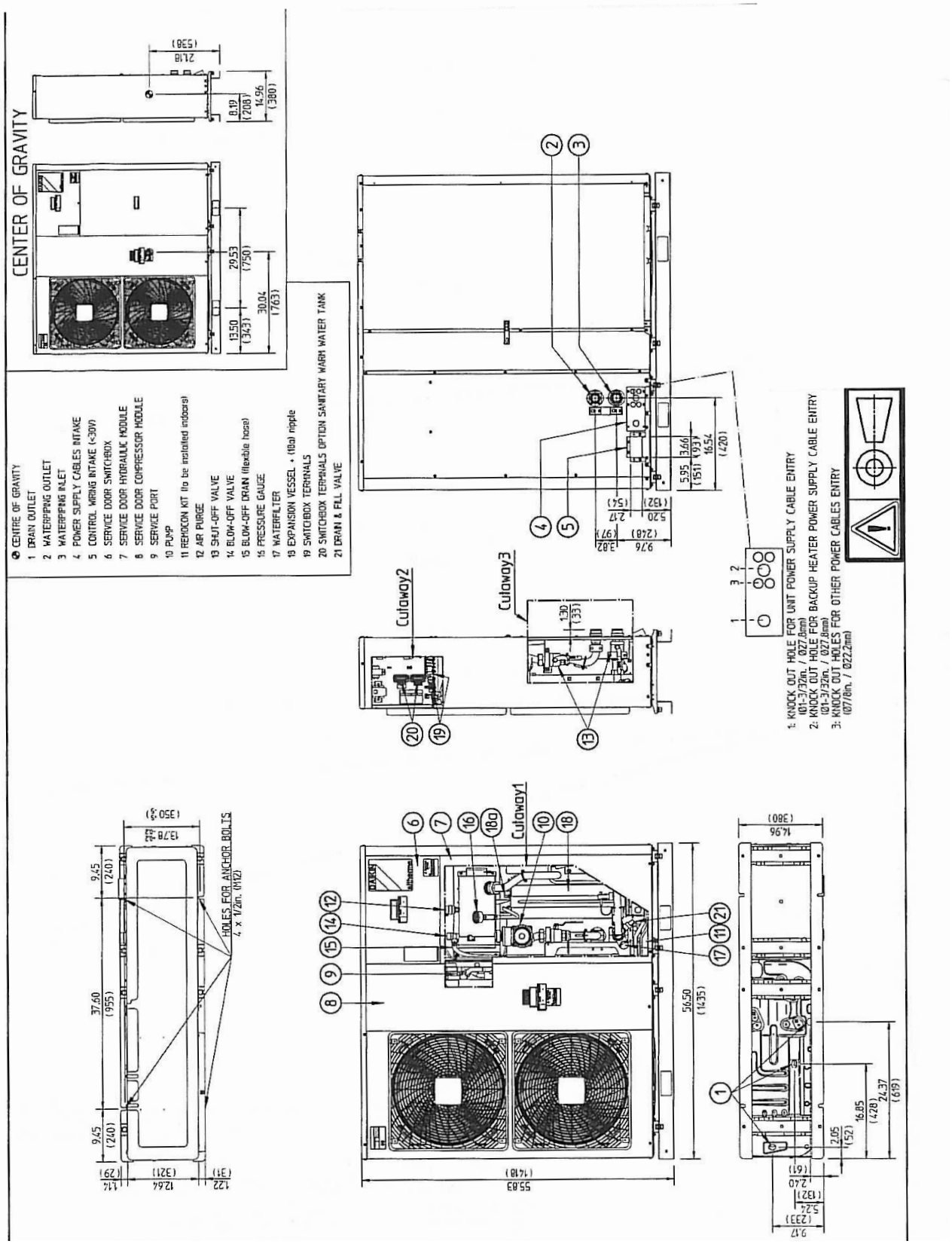
Symbols:

CC Cooling Capacity @ maximum operating frequency, BTU/h
HC Heating Capacity @ maximum operating frequency, BTU/h
PI Cooling Power Input (kW), Heating Power Input (kBTU/h measured according to Eurovent 6/C003-2006 (kW)/EN14511
LWE Leaving Water evaporator temperature (Cooling)
LWC Leaving Water condenser temperature (Heating)
Tamb Outdoor Ambient temperature, RH = 85%

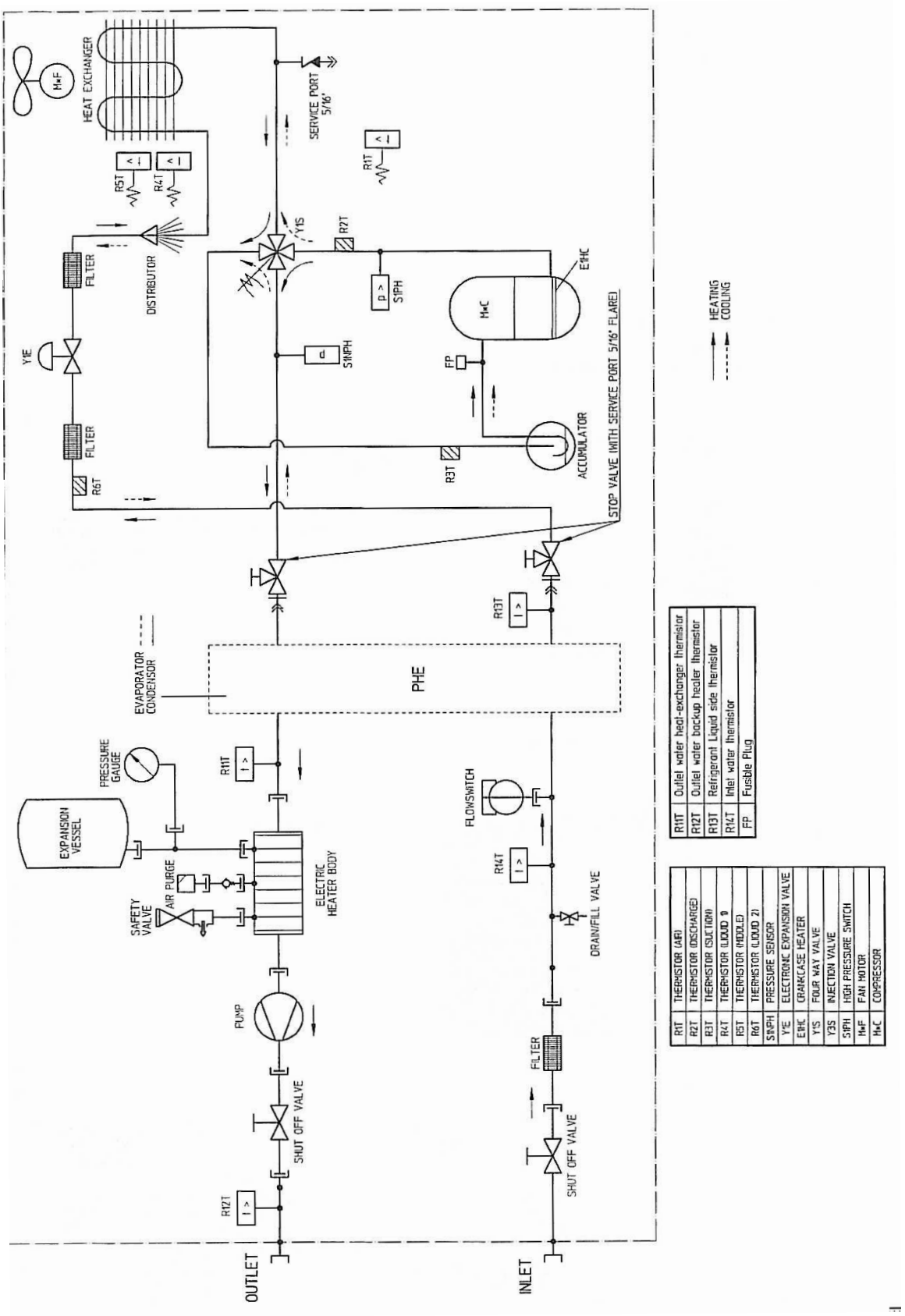
Conditions:

Cooling Capacity BTU/h and valid for chilled water range ΔT = 5-15^{0}F (3-8^{0}C)
Heating Capacity is according to Eurovent 6/C/003-2006 (kW) and valid for heating water range ΔT = 5-15^{0}F (3-8^{0}C)
Power Input is total of indoor and outdoor unit, except the circulation pump; (90W per EN14511)

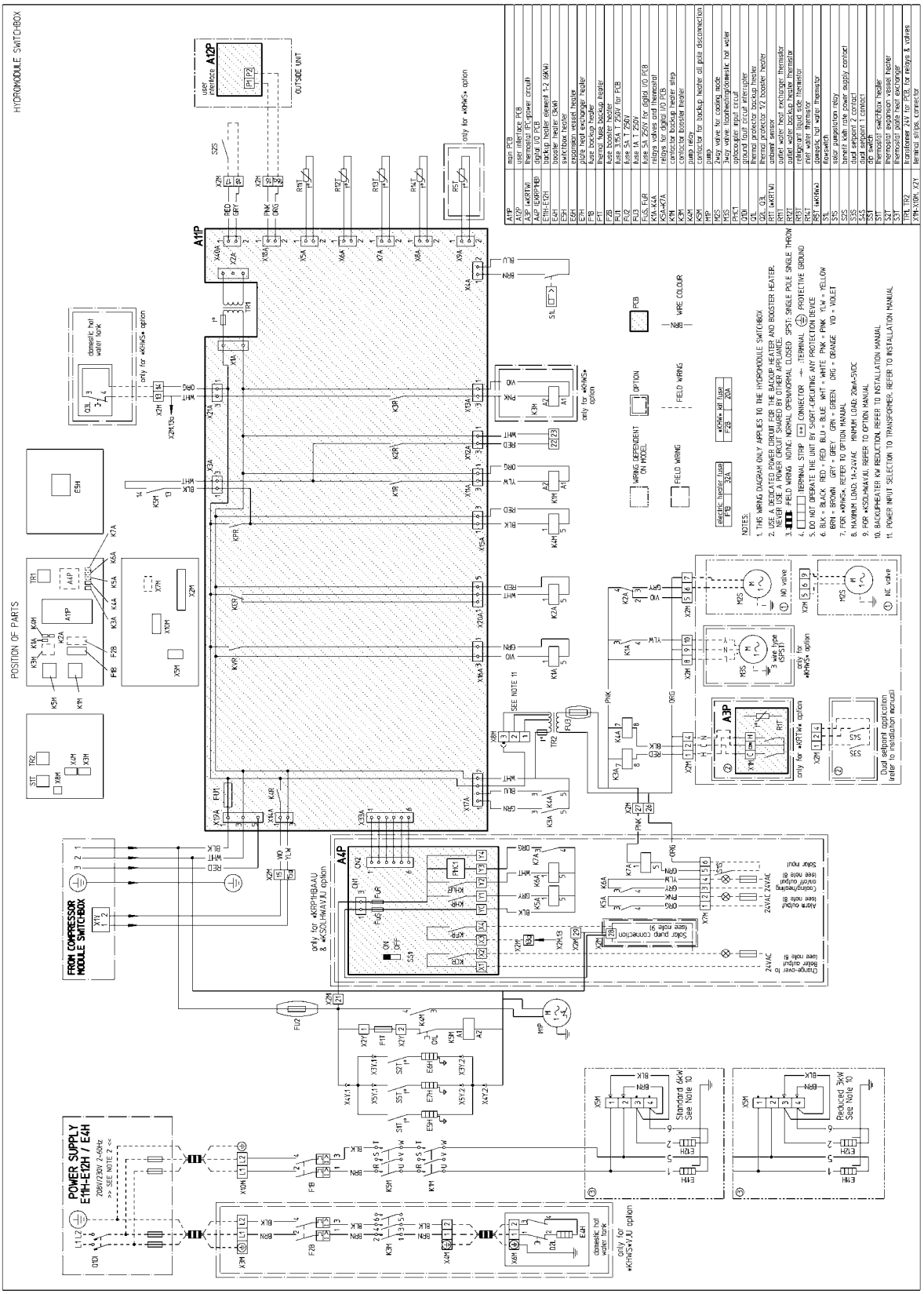
7. Dimensional Drwg. & Center of Gravity - Monobloc



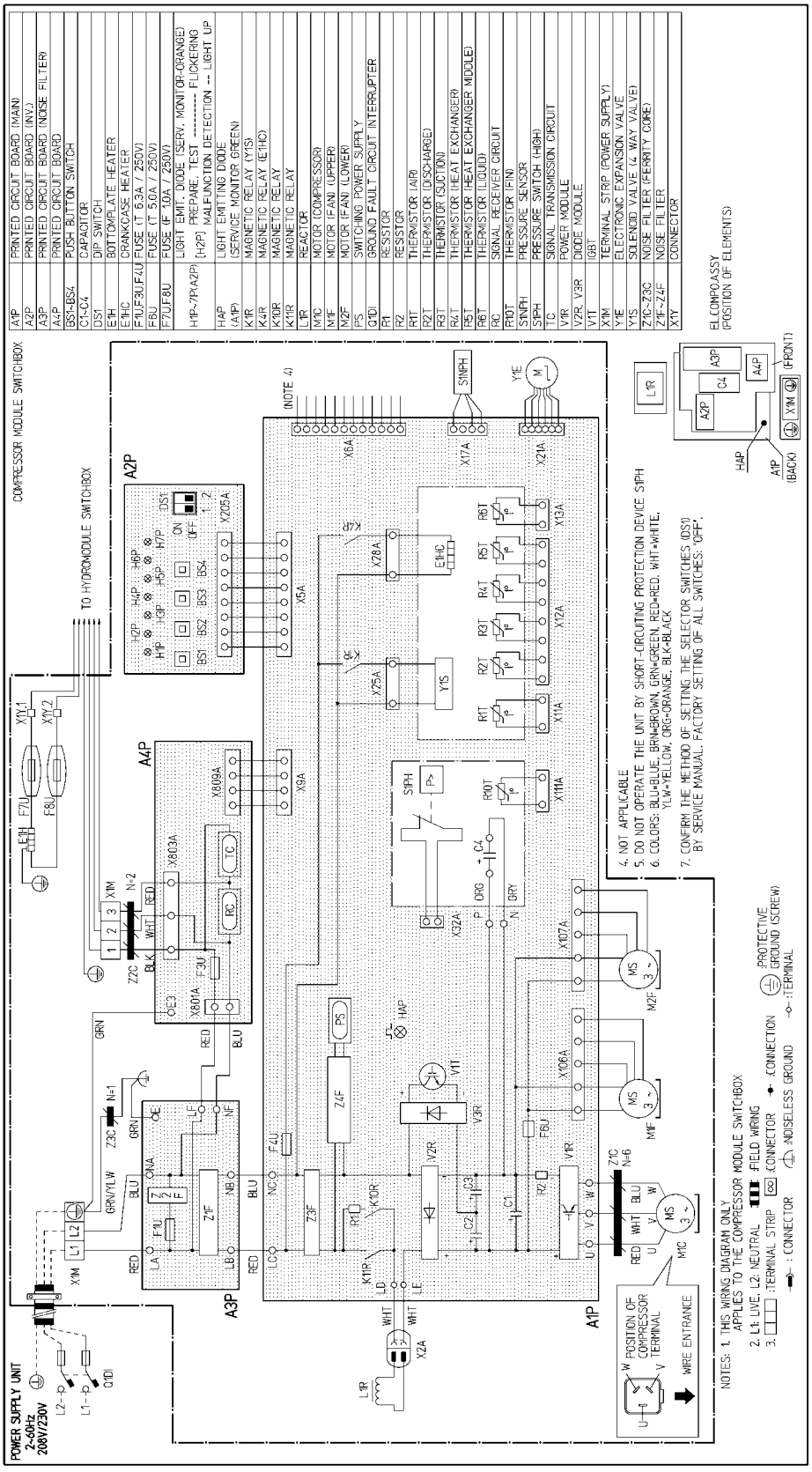
8. Piping Diagram - Monobloc



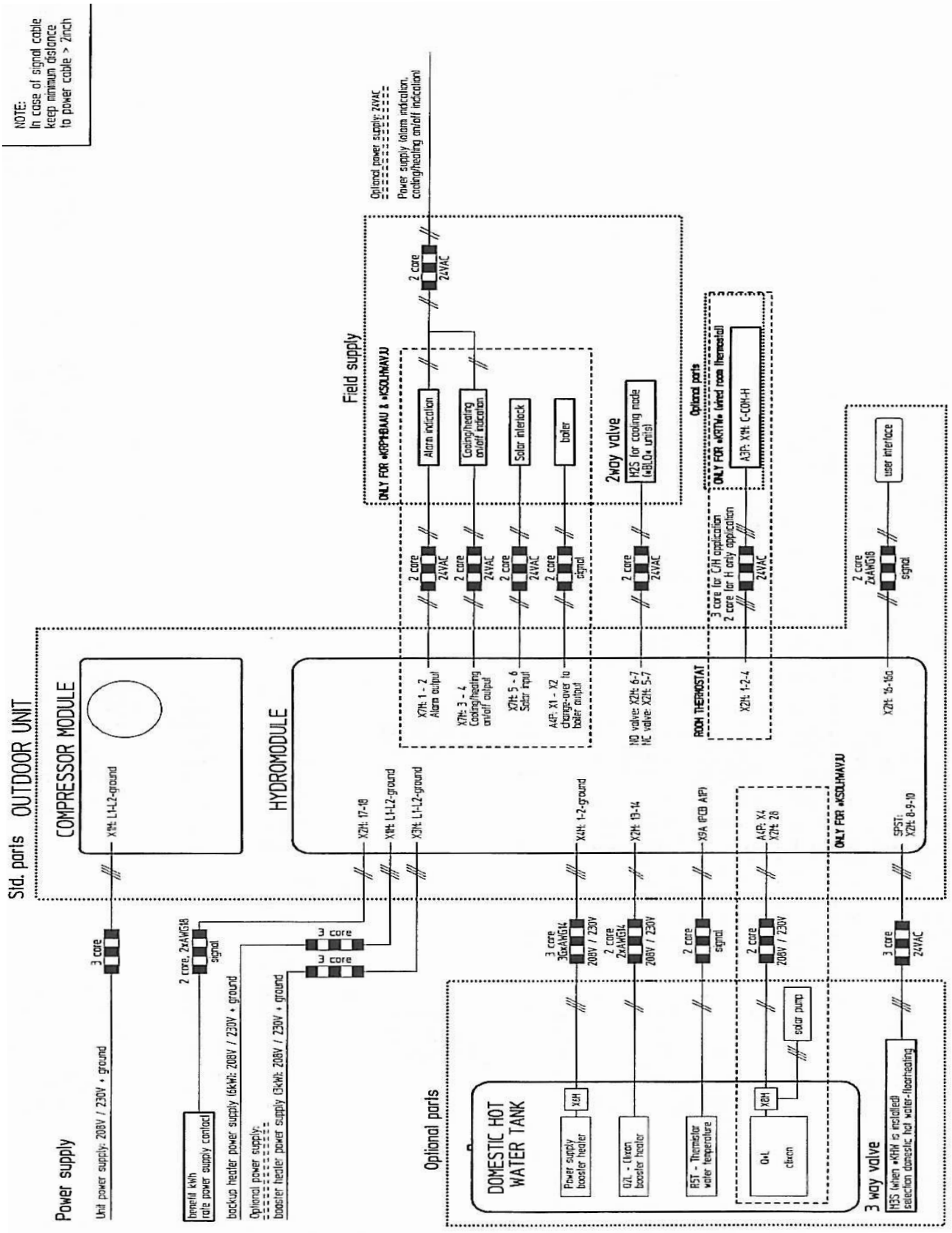
9. Wiring Diagram - Monobloc



9.1 Wiring Diagram

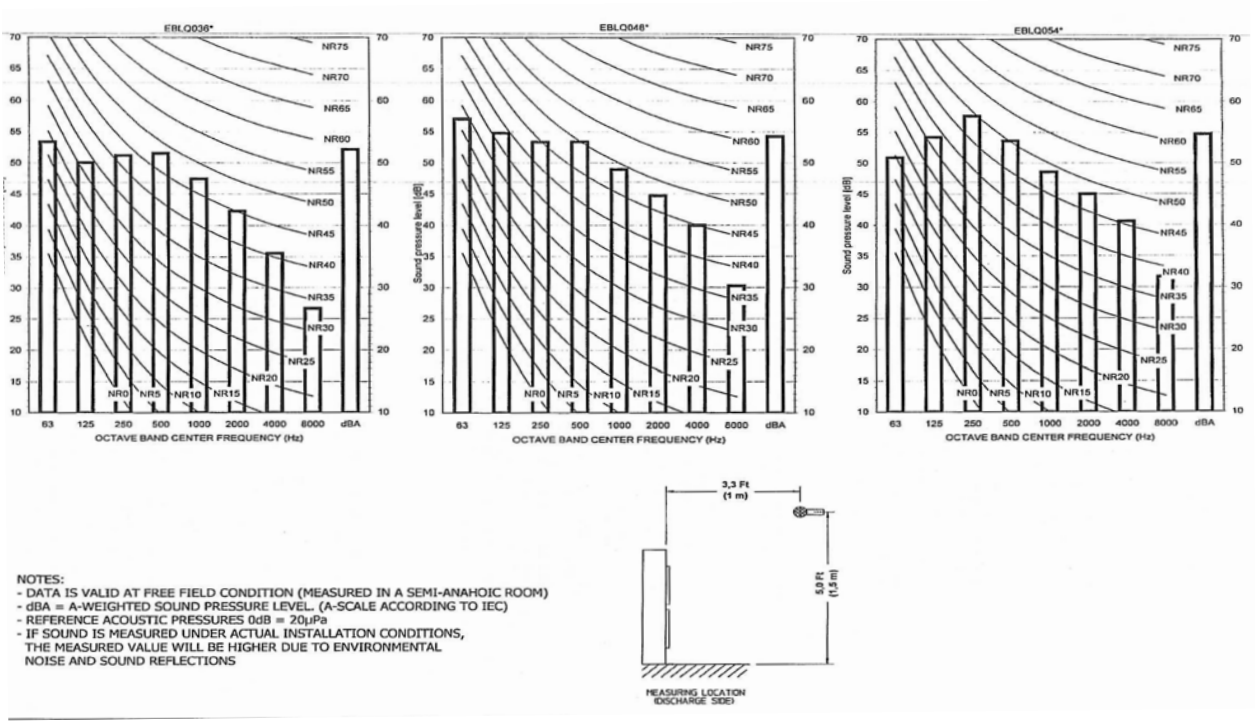


9.2 External Connection Diagram - Monobloc



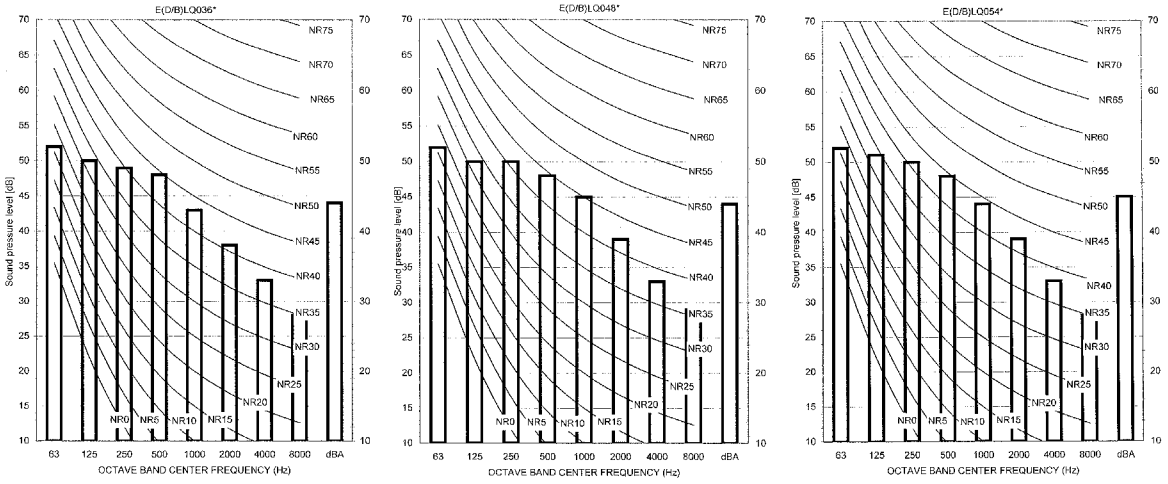
10. Sound Data - Monobloc

10.1 Sound Pressure Spectrum - Normal Operation



NOTES:
- DATA IS VALID AT FREE FIELD CONDITION (MEASURED IN A SEMI-ANAHOIC ROOM)
- dBA = A-WEIGHTED SOUND PRESSURE LEVEL. (A-SCALE ACCORDING TO IEC)
- REFERENCE ACOUSTIC PRESSURES 0dB = 20µPa
- IF SOUND IS MEASURED UNDER ACTUAL INSTALLATION CONDITIONS, THE MEASURED VALUE WILL BE HIGHER DUE TO ENVIRONMENTAL NOISE AND SOUND REFLECTIONS

10.2 Sound Pressure Night Quiet Mode



NOTES:
- DATA IS VALID AT FREE FIELD CONDITION (MEASURED IN A SEMI-ANAHOIC ROOM)
- dBA = A-WEIGHTED SOUND PRESSURE LEVEL. (A-SCALE ACCORDING TO IEC)
- REFERENCE ACOUSTIC PRESSURES 0dB = 20µPa
- IF SOUND IS MEASURED UNDER ACTUAL INSTALLATION CONDITIONS, THE MEASURED VALUE WILL BE HIGHER DUE TO ENVIRONMENTAL NOISE AND SOUND REFLECTIONS

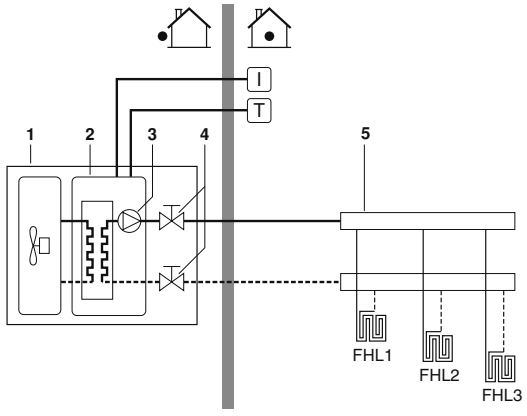
11. Application Examples - Monobloc

TYPICAL APPLICATION EXAMPLES

The application examples given below are for illustration purposes only.

Application 1

Space heating only application with a room thermostat connected to the unit.



1	Unit	**FHL1..3**	Floor heating loop (field supply)
2	Heat exchanger		
3	Pump	**T**	Room thermostat (optional)
4	Shut-off valve		
5	Collector (field supply)	**I**	User interface

Unit operation and space heating

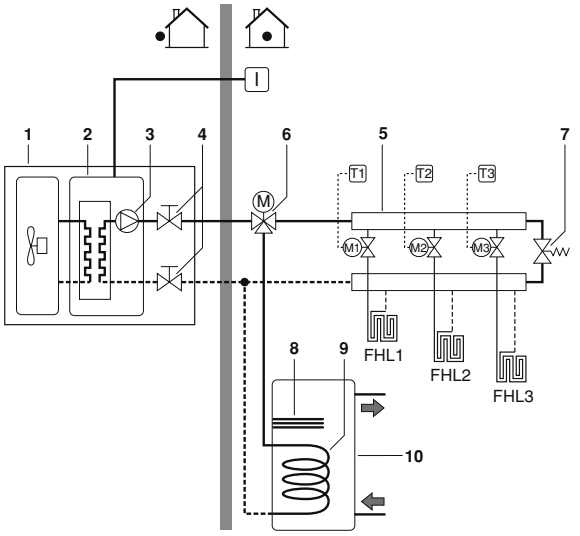
When a room thermostat (T) is connected to the unit and when there is a heating request from the room thermostat, the unit will start operating to achieve the target leaving water temperature as set on the user interface.

When the room temperature is above the thermostat set point, the unit will stop operating.

Make sure to connect the thermostat wires to the correct terminals (see "Connection of the thermostat cable" on page 20) and to configure the DIP switch toggle switches correctly (see "Room thermostat installation configuration" on page 23).

Application 2

Space heating only application without room thermostat connected to the unit. The temperature in each room is controlled by a valve on each water circuit. Domestic hot water is provided through the domestic hot water tank which is connected to the unit.



1	Unit	**9**	Heat exchanger coil
2	Heat exchanger	**10**	Domestic hot water tank (optional)
3	Pump		
4	Shut-off valve	**FHL1..3**	Floor heating loop (field supply)
5	Collector (field supply)		
6	Motorised 3-way valve (optional)	**T1..3**	Individual room thermostat (field supply)
7	By-pass valve (field supply)	**M1..3**	Individual motorised valve to control loop FHL1 (field supply)
8	Booster heater		
		I	User interface

Pump operation

With no thermostat connected to the unit (1), the pump (3) can be configured to operate either as long as the unit is on, or until the required water temperature is reached.

NOTE Details on pump configuration can be found under "Pump operation configuration" on page 23.

Space heating

The unit (1) will operate to achieve the target leaving water temperature as set on the user interface.

When circulation in each space heating loop (FHL1..3) is controlled by remotely controlled valves (M1..3), it is important to provide a by-pass valve (7) to avoid the flow switch safety device from being activated.

The by-pass valve should be selected as such that at all time the minimum water flow as mentioned under "Water pipework" on page 13 is guaranteed.

Domestic water heating

When domestic water heating mode is enabled (either manually by the user, or automatically through a schedule timer) the target domestic hot water temperature will be achieved by a combination of the heat exchanger coil and the electrical booster heater.

When the domestic hot water temperature is below the user configured set point, the 3-way valve will be activated to heat the domestic water by means of the heat pump. In case of large domestic hot water demand or a high domestic hot water temperature setting, the booster heater (8) can provide auxiliary heating.

It is possible to connect either a 2-wire or a 3-wire 3-way valve (6). Make sure to fit the 3-way valve correctly. For more details, refer to "Wiring the 3-way valve" on page 20.

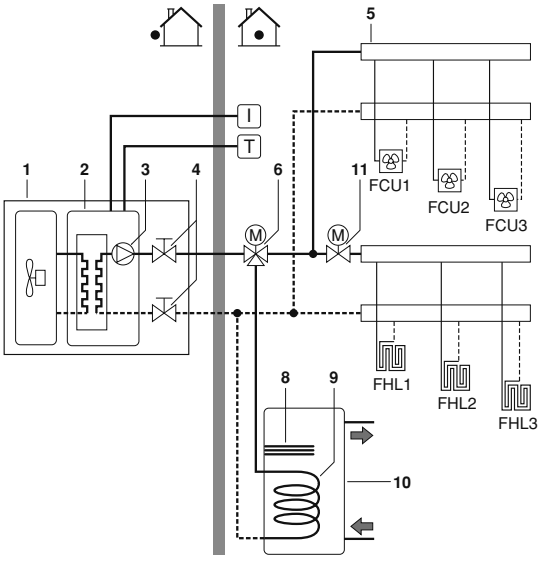
NOTE

The unit can be configured so that at low outdoor temperatures the domestic water is exclusively heated by the booster heater. This assures that the full capacity of the heat pump is available for space heating.

Details on domestic hot water tank configuration for low outdoor temperatures can be found under "Field settings" on page 25, field settings [5-02] to [5-04].

Application 3

*Space cooling and heating application with a **room thermostat suitable for heating/cooling changeover** connected to the unit. Heating is provided through floor heating loops and fan coil units. Cooling is provided through the fan coil units only.*
Domestic hot water is provided through the domestic hot water tank which is connected to the unit.



1	Unit	**10**	Domestic hot water tank
2	Heat exchanger	**11**	Motorised 2-way valve (field supply)
3	Pump		
4	Shut-off valve	**FCU1..3**	Fan coil unit (field supply)
5	Collector (field supply)	**FHL1..3**	Floor heating loop (field supply)
6	Motorised 3-way valve (optional)	**T**	Room thermostat with heating/cooling switch (optional)
8	Booster heater		
9	Heat exchanger coil	**I**	User interface

Pump operation and space heating and cooling

According to the season, the customer will select cooling or heating on the room thermostat (T). This selection is not possible by operating the user interface.

When space heating/cooling is requested by the room thermostat (T), the pump will start operating and the unit (1) will switch to "heating mode"/"cooling mode". The unit (1) will start operating to achieve the target leaving cold/hot water temperature.

In case of cooling mode, the motorised 2-way valve (11) will close as to prevent cold water running through the floor heating loops (FHL).

Make sure to connect the thermostat wires to the correct terminals (see "Connection of the thermostat cable" on page 20) and to configure the DIP switch toggle switches correctly (see "Room thermostat installation configuration" on page 23).

Wiring of the 2-way valve (11) is different for a NC (normal closed) valve and a NO (normal open) valve! Make sure to connect to the correct terminal numbers as detailed on the wiring diagram.

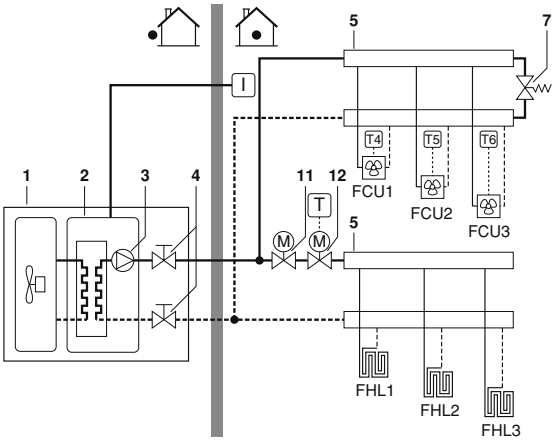
The ON/OFF setting of the heating/cooling operation is done by the room thermostat and cannot be done by the user interface.

Domestic water heating

Domestic water heating is as described under "Application 2" on page 7.

Application 4

*Space cooling and heating application **without a room thermostat connected to the unit**, but with a heating only room thermostat controlling the floor heating and a heating/cooling thermostat controlling the fan coil units. Heating is provided through floor heating loops and fan coil units. Cooling is provided through the fan coil units only.*



1	Unit	**12**	Motorised 2-way valve for activation of the room thermostat (field supply)
2	Heat exchanger		
3	Pump	**FCU1..3**	Fan coil unit with thermostat (field supply)
4	Shut-off valve		
5	Collector (field supply)	**FHL1..3**	Floor heating loop (field supply)
7	By-pass valve (field supply)	**T**	Heating only room thermostat (optional)
11	Motorised 2-way valve to shut off the floor heating loops during cooling operation (field supply)	**T4..6**	Individual room thermostat for fan coil heated/cooled room (optional)

With no thermostat connected to the unit (1), the pump (3) can be configured to operate either as long as the unit is on, or until the required water temperature is reached.

NOTE Details on pump configuration can be found under "Pump operation configuration" on page 23.

Space heating and cooling

According to the season, the customer will select cooling or heating through the user interface.

The unit (1) will operate in cooling mode or heating mode to achieve the target leaving water temperature.

With the unit in heating mode, the 2-way valve (11) is open. Hot water is provided to both the fan coil units and the floor heating loops.

With the unit in cooling mode, the motorised 2-way valve (11) is closed to prevent cold water running through the floor heating loops (FHL).

When closing several loops in the system by remotely controlled valves, it might be required to install a by-pass valve (7) to avoid the flow switch safety device from being activated. See also "Application 2" on page 7.

Wiring of the 2-way valve (11) is different for a NC (normal closed) valve and a NO (normal open) valve! Make sure to connect to the correct terminal numbers as detailed on the wiring diagram.

The ON/OFF setting of the heating/cooling operation is done by the user interface.

Application 5

Space heating with an auxiliary boiler (alternating operation)

Space heating application by either the Daikin unit or by an auxiliary boiler connected in the system. The decision whether either the E(D/B) unit or the boiler will operate can be achieved by an auxiliary contact or an E(D/B)* indoor controlled contact.*

The auxiliary contact can e.g. be an outdoor temperature thermostat, an electricity tariff contact, a manually operated contact, etc. See "Field wiring configuration A" on page 10.

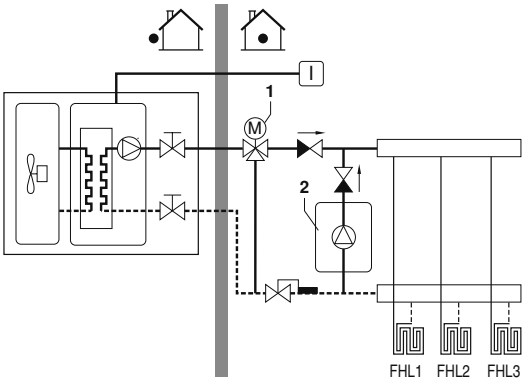
The E(D/B) unit controlled contact (also called 'permission signal for the auxiliary boiler") is determined by the outdoor temperature (thermistor located at the outdoor unit). See "Field wiring configuration B" on page 10.*

Bivalent operation is only possible for space heating operation, **not** for the domestic water heating operation. Domestic hot water in such an application is always provided by the domestic hot water tank which is connected to the Daikin unit.

The auxiliary boiler must be integrated in the piping work and in the field wiring according to the illustrations below.

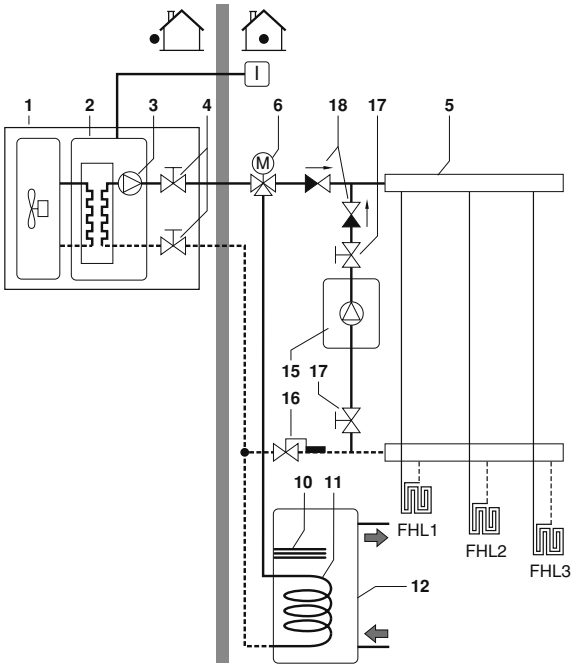
CAUTION

- Be sure that the boiler and the integration of the boiler in the system is in accordance with relevant local laws and regulations.
- Always install a 3-way valve, even if no domestic hot water tank is installed. This to ensure that the freeze protection function (see "[4-04] Freeze protection function" on page 28) can operate when the boiler is active.



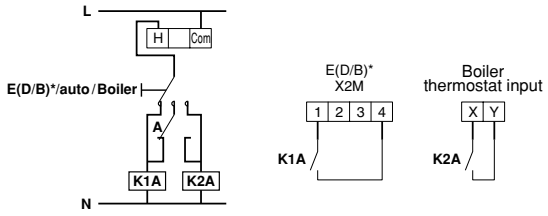
1	Motorised 3-way valve
2	Boiler

- Daikin can not be put responsible for incorrect or unsafe situations in the boiler system.



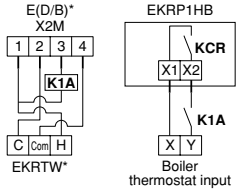
1	Outdoor unit	**12**	Domestic hot water tank (optional)
2	Heat exchanger		
3	Pump	**15**	Boiler (field supply)
4	Shut-off valve	**15**	Aquastat valve (field supply)
5	Collector (field supply)		
6	Motorised 3-way valve (delivered with the domestic hot water tank)	**16**	Shut-off valve (field supply)
		17	Non-return valve (field supply)
10	Booster heater		
11	Heat exchanger coil	**FHL1...3**	Floor heating loop (field supply)

Field wiring configuration A



Boiler thermostat input	Boiler thermostat input
A	Auxiliary contact (normal closed)
H	Heating demand room thermostat (optional)
K1A	Auxiliary relay for activation of E(D/B)* unit (field supply)
K2A	Auxiliary relay for activation of boiler (field supply)

Field wiring configuration B



Boiler thermostat input	Boiler thermostat input
C	Cooling demand room thermostat (optional)
H	Heating demand room thermostat (optional)
Com	Common room thermostat (optional)
K1A	Auxiliary relay for activation of bolier unit (field supply)
KCR	Permission signal for the auxiliary boiler

Operation

■ **Configuration A**

When the room thermostat requests heating, either the E(D/B)* unit or the boiler starts operating, depending on the position of the auxiliary contact (A).

■ **Configuration B**

When the room thermostat requests heating, either the E(D/B)* unit or the boiler starts operating, depending on the outdoor temperature (status of "permission signal for the auxiliary boiler").

When the permission is given towards the boiler, the space heating operation by the E(D/B)* unit will be automatically switched off.

For more details see field setting [C-02~C-04].

NOTE

■ **Configuration A**

Make sure that auxiliary contact (A) has sufficient differential or time delay so as to avoid frequent changeover between the E(D/B)* unit and the boiler. If the auxiliary contact (A) is an outdoor temperature thermostat, make sure to install the thermostat in the shade, so that it is not influenced or turned ON/OFF by the sun.

Configuration B

Make sure that the bivalent hysteresis [C-04] has sufficient differential to avoid frequent changeover between the E(D/B)* unit and the boiler. As the outdoor temperature is measured via the outdoor unit, air thermistor make sure to install the outdoor unit in the shade, so that it is not influenced by the sun.

Frequent switching may cause corrosion of the boiler in an early stage. Contact the manufacturer of the boiler.

■ During heating operation of the E(D/B)* unit, the unit will operate so as to achieve the target leaving water temperature as set on the user interface. When weather dependent operation is active, the water temperature is determined automatically depending on the outdoor temperature.

During heating operation of the boiler, the boiler will operate so as to achieve the target leaving water temperature as set on the boiler controller.

Never set the target leaving water temperature set point on the boiler controller above 131°F (55°C).

■ Make sure to only have 1 expansion vessel in the water circuit. An expansion vessel is already premounted in the Daikin unit.

NOTE

Make sure to configure the DIP switch SS2-3 on the PCB of the E(D/B)* switchbox correctly. Refer to "Room thermostat installation configuration" on page 23.

For configuration B: Make sure to configure the field settings [C-02, C-03 and C-04] correctly. Refer to "Bivalent operation" on page 33.

CAUTION

Make sure that return water to the E(D/B)* heat exchanger never exceeds 131°F (55°C).

For this reason, never put the target leaving water temperature set point on the boiler controller above 131°F (55°C) and install an aquastat[(a)] valve in the return water flow of the E(D/B)* unit.

Make sure that the non-return valves (field supply) are correctly installed in the system.

Make sure that the room thermostat (th) is not frequently turned ON/OFF.

Daikin shall not be held liable for any damage resulting from failure to observe this rule.

(a) The aquastat valve must be set for 131°F (55°C) and must operate to close the return water flow to the unit when the measured temperature exceeds 131°F (55°C). When the temperature drops to a lower level, the aquastat valve must operate to open the return water flow to the E(D/B)* unit again.

Manual permission towards the E(D/B)* unit on the boiler.

In case only the E(D/B)* unit should operate in space heating mode, disable the bivalent operation via setting [C-02].

In case only the boiler should operate in space heating mode, increase the bivalent ON temperature [C-03] to 77°F (25°C).

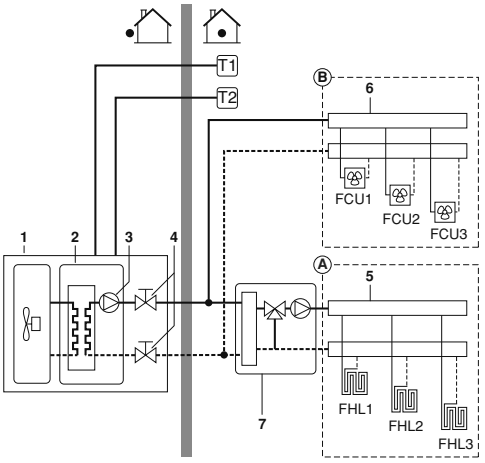
Application 6

Space heating with room thermostat application through floor heating loops and fan coil units. The floor heating loops and fan coil units require different operating water temperatures.

The floor heating loops require a lower water temperature in heating mode compared to fan coil units. To achive these two set points, a mixing station is used to adapt the water temperature according to requirements of the floor heating loops. The fan coil units are directly connected to the unit water circuit and the floor heating loops after the mixing station. The control of this mixing station is not done by the unit.

The operation and configuration of the field water circuit is the responsibility of the installer.

Daikin only offers a dual set point control function. By this function two set points can be generated. Depending on the required water temperature (floor heating loops and/or fan coil units are required) first set point or second set point can be activated.



1	Outdoor unit	**7**	Mixing station (field supply)
2	Heat exchanger	**T1**	Room thermostat for zone A (optional)
3	Pump		
4	Shut-off valve	**T2**	Room thermostat for zone B (optional)
5	Collector zone A (field supply)	**FCU1..3**	Fan coil unit (optional)
6	Collector zone B (field supply)	**FHL1...3**	Floor heating loop (field supply)

The advantage of the dual set point control is that the heat pump will/can operate at the lowest required leaving water temperature when only floor heating is required. Higher leaving water temperatures are only required in case fan coil units are operating.
This results in a better performance of the heat pump.

Pump operation and space heating

When the room thermostat for the floor heating loop (T1) and the fan coil units (T2) are connected to the indoor unit, the pump (4) will operate when there is a request for heating from T1 and/or T2. The outdoor unit will start operating to achieve the target leaving water temperature. The target leaving water temperature depends on which room thermostat is requesting heating.

	Set point	Field setting	Thermo status			
Zone A	First	UI	ON	OFF	ON	OFF
Zone B	Second	[7-03]	OFF	ON	ON	OFF
Resulting water temperature			UI	[7-03]	[7-03]	—
Result pump operation			ON	ON	ON	OFF

When the room temperature of both zones is above the thermostat set point, the outdoor unit and pump will stop operating.

NOTE

- Make sure to connect the thermostat wires to the correct terminals (see "Overview of the unit" on page 11).
- Make sure to configure the field settings [7-02], [7-03] and [7-04] correctly. Refer to "Dual set point control" on page 30.
- Make sure to configure the DIP switch SS2-3 on the PCB of the E(D/B) switch box correctly. Refer to "Room thermostat installation configuration" on page 23.

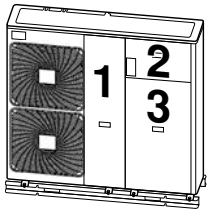
NOTE

- The request signals for space heating can be implemented in two different ways (installer choice).
  - Thermo ON/OFF signal from room thermostat
  - Status signal (active/not active) from the mixing station
- It is the installers responsibility to make sure no unwanted situations can occur (e.g. too high water temperatures towards floor heating loops, etc.)
- Daikin does not offer any type of mixing station. Dual set point control only provides the possibility to use two set points.
- When only zone A request heating, zone B will be fed with water at a temperature equal to the first set point.
  This can lead to unwanted heating of zone B.
- When only zone B request heating, the mixing station will be fed with water at a temperature equal to the second set point.
  Depending on the control of the mixing station, the floor heating loop can still receive water at a temperature equal to set point of the mixing station.

Be aware that the actual water temperature through the floor heating loops depends on the control and setting of the mixing station.

Overview of the unit

Opening the unit



Door 1	gives access to the compressor compartment and electrical parts
Door 2	gives access to the electrical parts of the hydraulic compartment
Door 3	gives access to the hydraulic compartment

Switch off all power supply — i.e. unit power supply and backup heater and domestic hot water tank power supply (if applicable) — before removing doors 1 and 2.

Parts inside the unit can be hot.

12. Installation - Monobloc

12.1 Installation Location

- The equipment is not is not intended for use in a potentially explosive atmosphere.
- Choose a place solid enough to bear the weight and vibration of the unit, where operation sounds will not be amplified.
- Choose a location where the hot/cold air discharged from the unit and the operation sounds will not be bothersome to neighbors or users.
- Avoid places such as bedrooms so that operation sounds are not a problem.
- Allow sufficient space for carrying the unit into and out of the site.
- Ensure there is sufficient space for air passage and a lack of obstructions around the air inlet and the air outlet.
- The site must be free from the possibility of flammable gas leakage in any nearby area.
- Install units, power cable, and inter-unit cables at least 10 feet (3 m) away from televisions and radios to prevent interference.
- Depending on radio wave conditions, electromagnetic interference may still occur even if installed more than 10 ft. (3 m) away.
- In coastal areas or other places with salty atmosphere of sulfate gas, corrosion my shorten the life of the outdoor unit.
- Since condensate flows out of the outdoor unit, do not place anything under the unit that must be kept from moisture.

IN COLD CLIMATES:

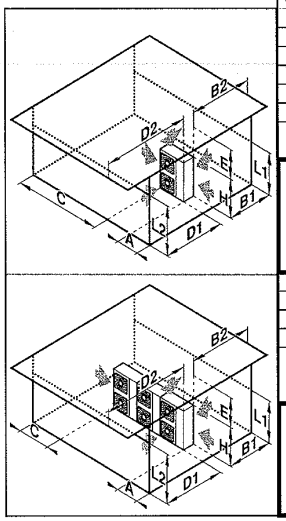
- To prevent exposure to wind, install the outdoor unit with its suction side facing the wall.
- Never install the outdoor unit at a site where the suction side may be exposed directly to wind.
- To prevent exposure to wind, install a baffle plate on the air discharge side of the outdoor unit.
- Unit should be installed with a minimum of 4” (10 cm) free space below the unit’s bottom plate at all condition, e.g., heavy snowfall (construct a pedestal if necessary).
- In heavy snowfall areas, it is very important to select an installation site where the snow will not affect the unit. If lateral snowfall is possible, make sure the heat exchanger coil is not affected by the snow (construct a lateral canopy if necessary). See Figure 1:

1 Construct a large canopy.

2 Construct a pedestal. Install the unit high enough off the ground to prevent burying in snow.

12.2 Installation Space

A. NON STACKED INSTALLATION



↙	↗	↘	↖	↓			A	B1	B2	C	D1	D2	E	L1/L2	
✓								≥4 [100]							
✓		✓	✓				≥4[100]	≥4 [100]		≥4 [100]					
✓				✓				≥4 [100]				≤20 [500]	≥40 [1000]		
✓		✓	✓	✓			≥6[150]	≥6 [150]		≥6 [150]		≤20 [500]	≥40 [1000]		
	✓										≥20 [500]				
	✓			✓					≤20[500]		≥20 [500]		≥40 [1000]		
✓	✓				L1<L2			≥4 [100]			≥20 [500]				
					L2<L1			≥4 [100]			≥20 [500]				
					L1<L2	L1≤H		≥10 [250]	≤20 [500]		≥30 [750]		≥40 [1000]	0<L1≤1/2H	
											≥40 [1000]			0<L1≤1/2H	
						H<L1					L1≤H				
✓	✓			✓	L2<L1	L2≤H		≥4 [100]			≥40 [1000]	≥20 [500]	≥40 [1000]	0<L2≤1/2H	1
								≥8 [200]						1/2H<L2≤H	
						H<L2					L2≤H				
✓		✓	✓				≥8 [200]	≥12 [300]		≥40 [1000]					
✓		✓	✓	✓			≥8 [200]	≥12 [300]		≥40 [1000]		≤20[500]	≥40 [1000]		
	✓										≥40 [1000]				
	✓			✓					≤20[500]		≥40 [1000]		≥40 [1000]		
					L1<L2			≥12 [300]			≥40 [1000]				
✓	✓				L2<L1			≥10 [250]			≥60 [1500]			0<L2≤1/2H	
								≥12 [300]						1/2H<L2≤H	
					L1<L2	L1≤H		≥12 [300]	≤20 [500]		≥40 [1000]		≥40 [1000]	0<L1≤1/2H	
											≥50 [1250]			1/2H<L1≤H	1
						H<L1					L1≤H				
✓	✓			✓				≥10 [250]						0<L2≤1/2H	
					L2<L1	L2≤H		≥12 [300]			≥60 [1500]	≤20 [500]	≥40 [1000]	1/2H<L2≤H	2
						H<L2					L2≤H				

LEGEND (Unit: Inch [mm])

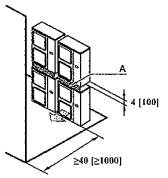
- ↙ Suction side obstacle
- ↗ Discharge side obstacle
- ↘ Left side obstacle
- ↖ Right side obstacle
- ↓ Top side obstacle
- ✓ Obstacle is present
- This situation is not allowed

1 In these cases, close bottom of the installation frame to prevent discharged air from being bypassed

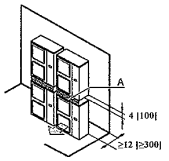
2 In these cases, only 2 units can be installed

B. STACKED INSTALLATION

1. OBSTACLES EXIST IN FRONT OF THE OUTLET SIDE



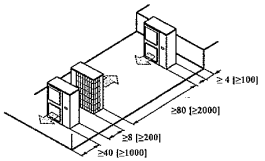
2. OBSTACLES EXIST IN FRONT OF THE AIR INLET



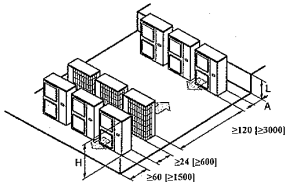
Do not stack more than one unit.
About 4 in. (100mm) is required as the dimension for laying the upper outdoor unit's drain pipe.
Get the portion A sealed so that air from the outlet does not bypass.

C. MULTIPLE-ROW INSTALLATION

1. INSTALLATION OF ONE UNIT PER ROW



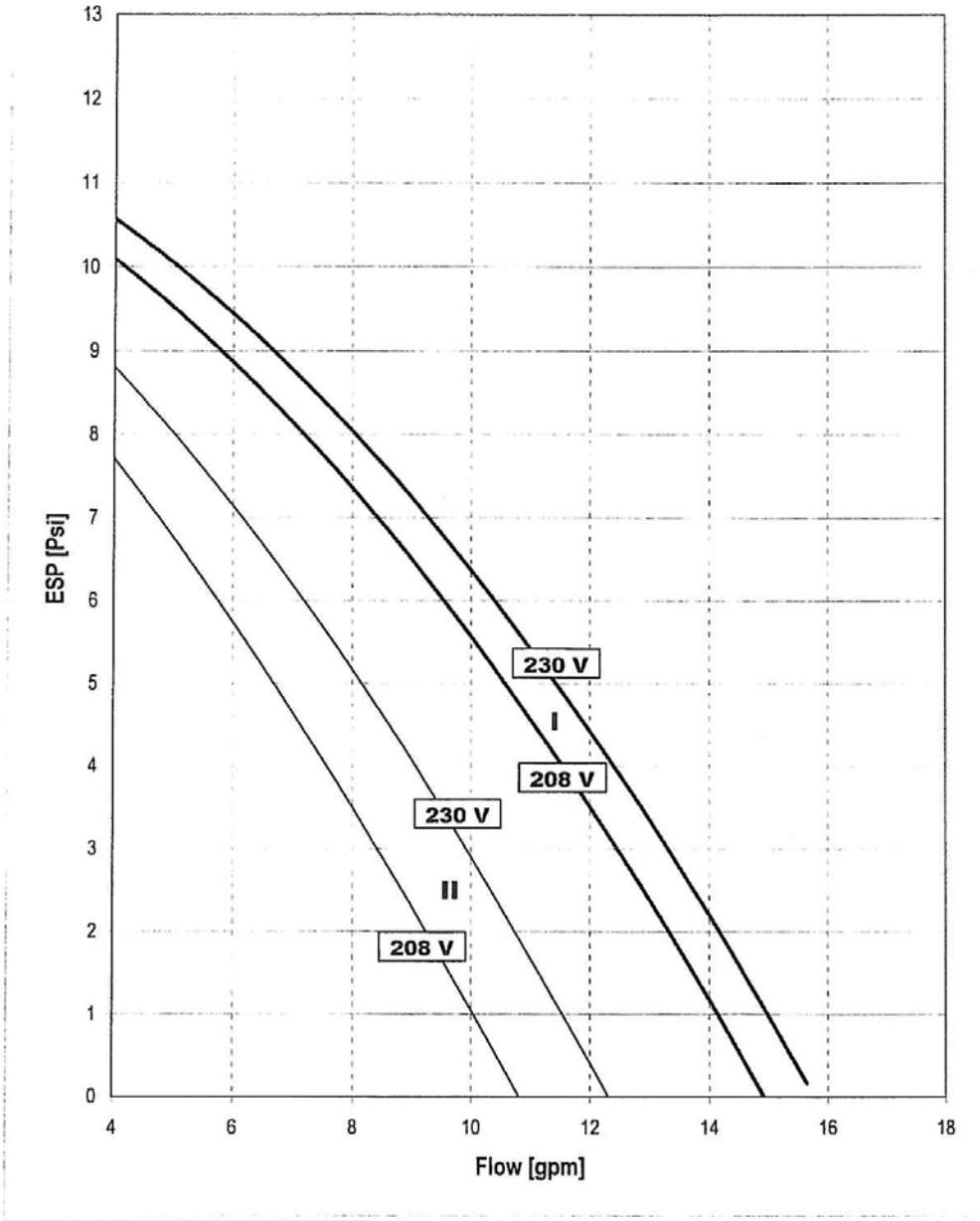
2. INSTALLING MULTIPLE UNITS (2 units or more) IN LATERAL CONNECTION PER ROW



Relation of dimensions of H, A and L are shown in the table below.

	L	A
L ≤ H	0<L≤1/2H	10 [250]
	1/2H < L	12 [300]
H < L	Installation not allowed	

13. Hydronic Performance - Monobloc

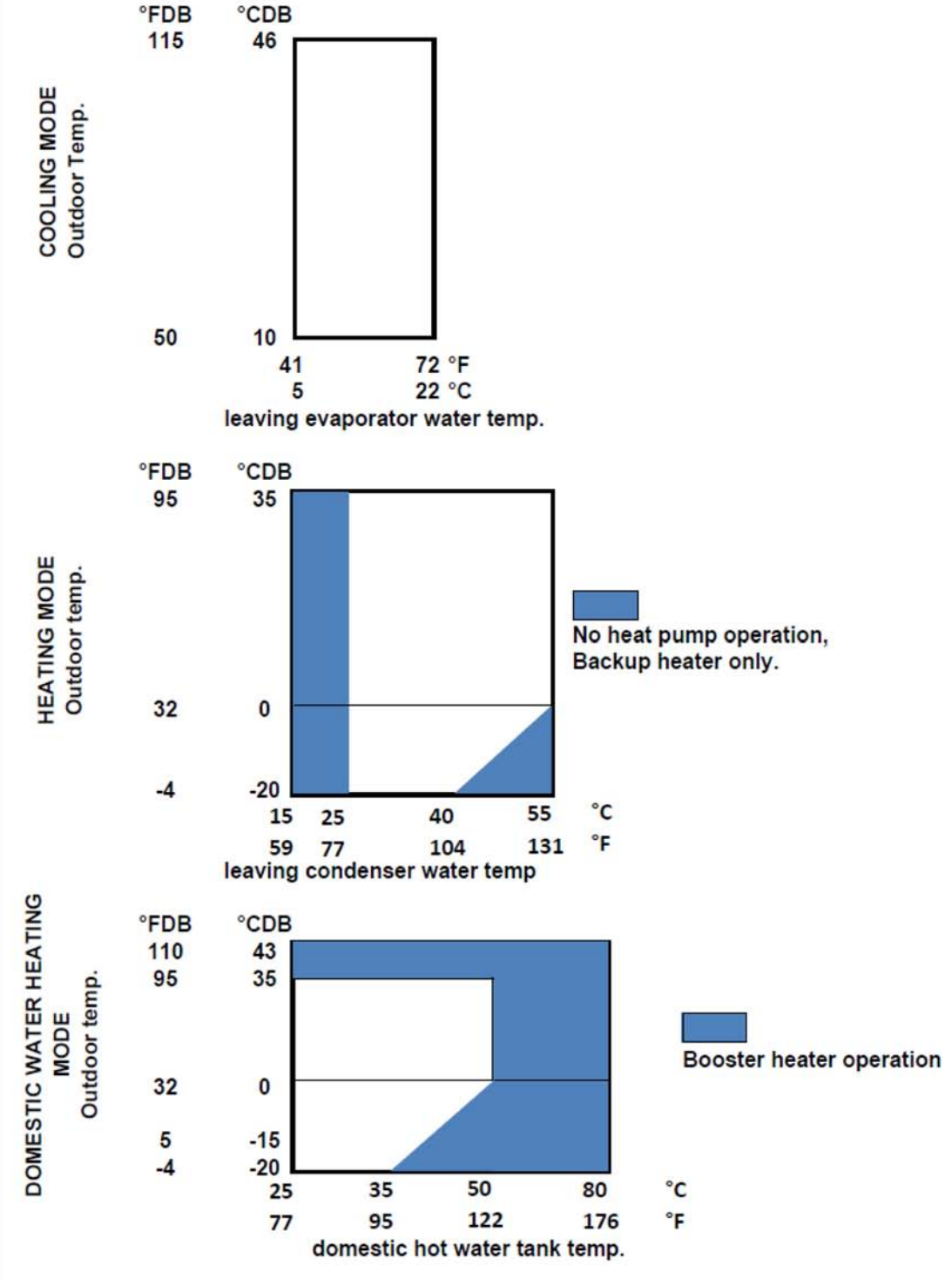


I high speed
II medium speed
ESP : external static pressure
Flow : waterflow through the unit

IMPERIAL UNITS OF MEASURE

Caution :
Selecting a flow outside the curves can cause damage to or malfunction of the unit. See also minimum and maximum allowed water flowrange in the technical specifications.

14. Operation Range - Monobloc



1. Domestic Hot Water Tank

1.1 Features

- Stainless steel domestic hot water tank & heat exchanger
- Integrated 3kW electric booster heater
- Two sizes (50 gal & 80 gal)
- 3-way valve included

Domestic Hot Water (DHW) Tank

The EKHWS domestic hot water tank with integrated 3 kW electric booster heater can be connected to both the split system hydrobox or monobloc. The domestic hot water tank is available in two sizes: 50 gallon (200 liter) or 80 gallon (300 liter). These domestic hot water tanks are for floor-standing indoor installations.

2. Specifications - DHW

2-1 TECHNICAL SPECIFICATIONS				EKHWS050BA3VJU	EKHWS080BA3VJU
Casing	Color			Neutral white	
	Material			Epoxy-coated mild steel	
Dimensions	Packing	Height	in (mm)	47-1/4 (1,200)	65 (1,650)
		Width	in (mm)	23-5/8 (600)	23-5/8 (600)
		Depth	in (mm)	23-5/8 (600)	23-5/8 (600)
	Unit	Height	in (mm)	45-3/8 (1,150)	63 (1,600)
		Width	in (mm)	22-7/8 (580)	22-7/8 (580)
		Depth	in (mm)	22-7/8 (580)	22-7/8 (580)
Weight	Unit		lb (kg)	99.2 (45)	130 (59)
	Packed Unit		lb (kg)	112.4 (51)	145.5 (66)
Packing	Material			EPS	
				Carton	
	Weight		lb (kg)	8.81 (4)	11 (5)
Main components	Tank	Water volume	gal (l)	50 (200)	80 (300)
		Material		Stainless steel 316LSS	
		Max. temperature	°F (°C)	185 (85)	185 (85)
		Max. water pressure	PSI (bar)	145 (10)	145 (10)
Tank	Insulation	Material		Polyurethane foam	
		Min. thickness	in (mm)	1-5/8 (40)	1-5/8 (40)
Main components	Heat exchanger	Quantity		1	1
		Material		Stainless steel 316LSS	
	Booster heater	Quantity		1	1
		Capacity	BTU/hr (kW)	10,255 (3)	10,255 (3)
	3-Way Valve	Coefficient of flow at 14.5 PSI (1 bar)	gpm (m^3/h)	44 (10)	44 (10)
		Inlet	inch	Rp1	
		Outlet	inch	2xRp1	
Temperature sensor	Cable length		ft (m)	39.4 (12)	39.4 (12)
Piping connections	Water inlet H/E Diameter		inch (BSPP)	G 3/4 (female)	
	Water outlet H/E Diameter		inch (BSPP)	G 3/4 (female)	
	Cold water in Diameter		inch (BSPP)	G 3/4 (female)	
	Hot water out Diameter		inch (BSPP)	G 3/4 (female)	
	Recirculation connection		inch (BSPP)	G 3/4 (female)	

2-2 ELECTRICAL SPECIFICATIONS				EKHWS050BA3VJU	EKHWS080BA3VJU
Unit	Power Supply	Phase		1~	1~
		Frequency	Hz	60	60
		Voltage	V	208/230	208/230
	Current	Minimum Circuit Amps (MCA)	A	14.3	14.3
		Maximum Overcurrent Protection (MOP)	A	20	20

3. Domestic Hot Water Basic Performance Overview

The Daikin Altherma heat pump in combination with the optional domestic hot water tank provides hot water for household usage (Altherma TW DHW).

The following data provides information to select the proper sized domestic hot water tank to ensure maximum comfort and efficiency.

(1) Domestic hot water volume:

The volume of hot water available for domestic usage depends on the physical volume of the tank, the domestic hot water setpoint temperature, and the temperature spreading in the tank. Therefore the *equivalent hot water volume* is termed **EHWV**.

Definition EHWV = The volume of hot water available for domestic usage at a temperature of 104° (40°C), which is considered a comfortable domestic hot water temperature.

Tank	Setpoint temp °F (°C)	EHWV gal (l)	Usage Pattern		
			Modest	Medium	High
50 gal (200 l)	131 (55)	42 (160)			
	149 (65)	53 (200)	+	–	–
	167 (75)	63 (240)	++	+	–
80 gal (300 l)	131 (55)	78 (205)	++	++	–
	149 (65)	102 (385)	++	++	–
	167 (75)	102 (435)	++	++	+

Grade: ++ excessive availability of domestic hot water
+ sufficient availability of domestic hot water
– temporary shortage of domestic hot water can occur

Usage Pattern: Modest: Daily demand up to 58 gal (220 l) = typical 2-person usage pattern
Medium: Daily demand up to 85 gal (325 l) = typcial 3 - 4 person usage pattern
High: Daily demand up to 145 gal (550 l) = typical 4 - 6 person usage pattern

(2) Heat up time:

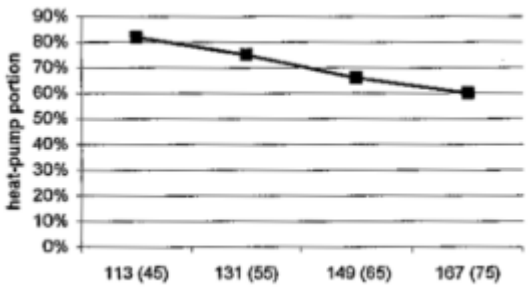
Definition of ***Heat-Up Time***: The time required to reheat the domestic hot water tank to 131 F (55 C) after tapping a certain volume of hot water. NOTE: Changing the field settings (see installation manual) can influence the heat-up time.

Tank	Setpoint °F (°C)	Heat up time for 39 gal (150 l) bath (min)	Heat up time for 13 gal (50 l) bath (min)
50 gal (200 l)	131 (55)	60	40
80 gal (300 l)	131 (55)	50	30

Conditions for testing: Ta =44.6°CDB / 42.8°FWB, Troom =68°F, Tstart = 50°F, outdoor unit type: ERLQ054*VJU
Conditions for testing: Ta = 7°CDB / 6 °CWB, Troom = 20°C, Tstart = 10°C, outdoor unit type: ERLQ054*VJU

(3) Efficiency of domestic hot water production:

In the Daikin Altherma system, both the heat pump and the electric booster heater supply the energy to produce domestic hot water. The higher the portion of energy supplied by the heat pump, the more energy efficient the system is. Lowering the setpoint temperature increases the portion of energy supplied by the heat pump and thus the efficiency of the system. The percentage of energy supplied by the heat pump in relation to total energy need for domestic hot water is displayed in the following graph:



Conditions:

Simulation of daily real-life conditions based upon medium usage.

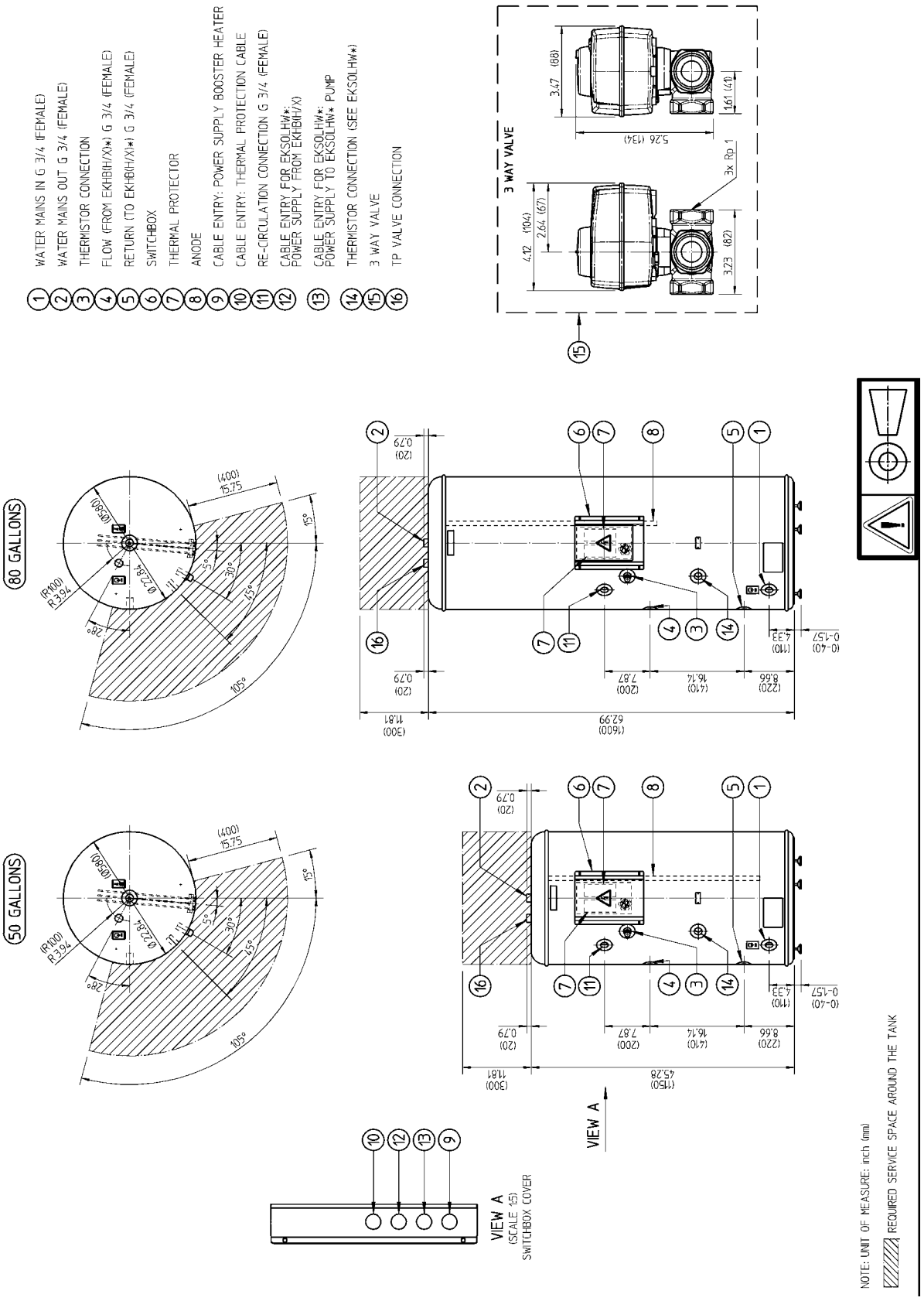
Outdoor temp: 44.6°FDB /42.8° FWB (7°CDB/ 6°CWB)

Room temp: 68 F (20 C)

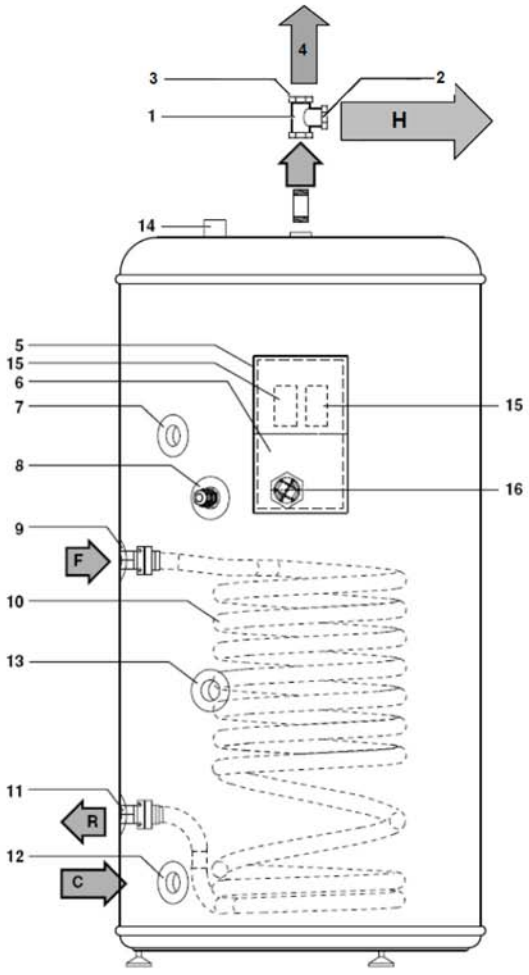
Tank Type: 50 gal (200 l)

Field Settings: Default field settings (see Installation Manual)

4. Dimensional Drawing & Center of Gravity - DHW



4.1 Domestic Hot Water Tank Summary

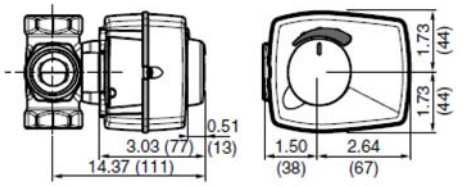


1	Field supply
2	Hot water connection (H)
3	Pressure relief valve connection
4	Pressure relief valve (field supply)
5	Electrical box
6	Electrical box lid
7	Recirculation hole
8	Thermistor socket
9	Flow inlet connection (F) (from the main unit)
10	Heat exchanger coil
11	Return outlet connection (R) (to the main unit)
12	Cold water connection (C)
13	Threaded thermistor hole for use with the solar kit option. Refer to the installation manual EKSOLHW*.
14	Temperature and pressure relief valve connection
15	Thermal protectors (Q2L, Q3L)
16	Booster heater
⇨	Flow direction

5. Three-Way Valve Summary

Connecting the 3-way valve

1 Refer to the figure below before making the connection. Values between brackets are the conversion from inch to mm.



2 Installation position.

It is advised to connect the 3-way valve as close as possible to the unit. It can be installed in accordance with one of the following four configurations.

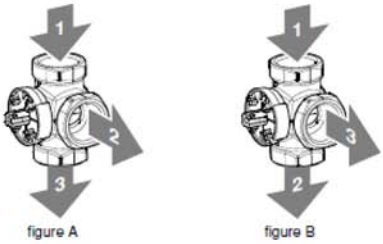


figure A

figure B

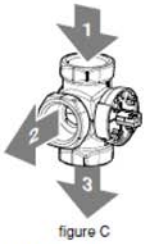


figure C

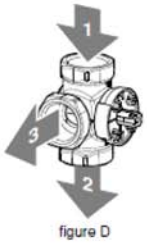
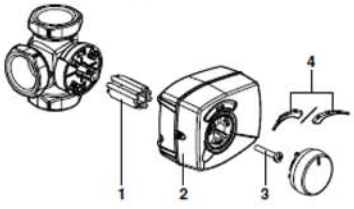


figure D

1 From indoor unit
2 To domestic hot water tank
3 To room heating

3 Unpack the 3-way valve body and 3-way valve motor.

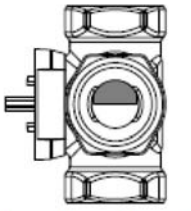
Verify that following accessories are provided with the motor.

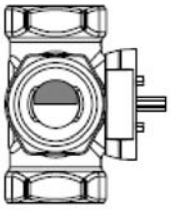


1 Sleeve
2 Valve motor cover
3 Screw
4 Scale

4 Install the 3-way valve body in the pipework.

- Make sure the shaft will be positioned in such a way that the motor can be mounted and replaced.
- Put the sleeve on the valve and turn the valve to the middle position of the scale plate.
  Check that the valve is positioned as in the figure below. It shall be blocking the outlet connection to the domestic hot water for 50% and the outlet connection to the room heating also for 50%.


Installation in accordance with figure A and figure B


Installation in accordance with figure C and figure D

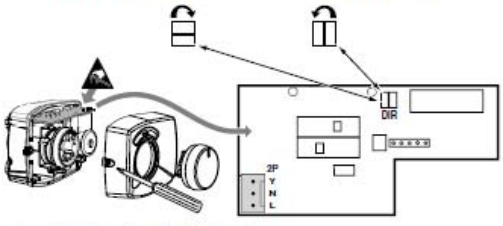
NOTE If the valve is not positioned in this way before mounting the motor, the valve will give way to both domestic water and room heating during operation.

5 When installing in accordance with figure A or figure D, open the valve motor cover by loosening the screw and change the jumper so as to change the rotation direction of the valve.

By default the jumper is factory set to apply for installation in accordance with figure B and figure C.

Installation in accordance with figure A and figure D

Installation in accordance with figure B and figure C



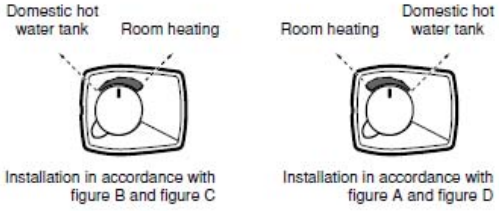
Rotation direction of the valve

6 Push the motor on the motor sleeve.

Make sure not to rotate the sleeve during this action, so as to maintain the valve position as set during step 4.

7

8 Put the scale on the valve as shown below.

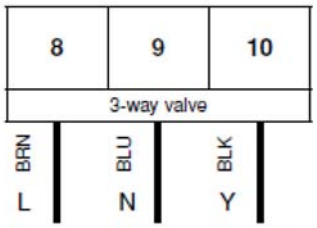


Installation in accordance with figure B and figure C

Installation in accordance with figure A and figure D

9 Make sure to firmly fix the power supply cord onto the 3-way valve body with a field supplied cable tie like in illustration below.

10 Perform the wiring in the unit in accordance with the following figure:



Refer also to the drawing on page 8.

11 Connect the water inlet and water outlet.

12 Connect the hot and cold water supply tubes.

13 Connect the pressure relief valve (field supply, opening pressure maximum 145 psi (10 bar)) and drain.

CAUTION

If a discharge pipe is connected to the pressure relief device it must be installed in a continuously downward direction and in a frost-free environment. It must be left open to the atmosphere.

Options

1. Solar Kit (EKSOLHWBAVJU) - Features

- Connectable to solar collectors
- Easy connection to EKHWS* DHW tanks
- Enables DHW heating by means of the sun

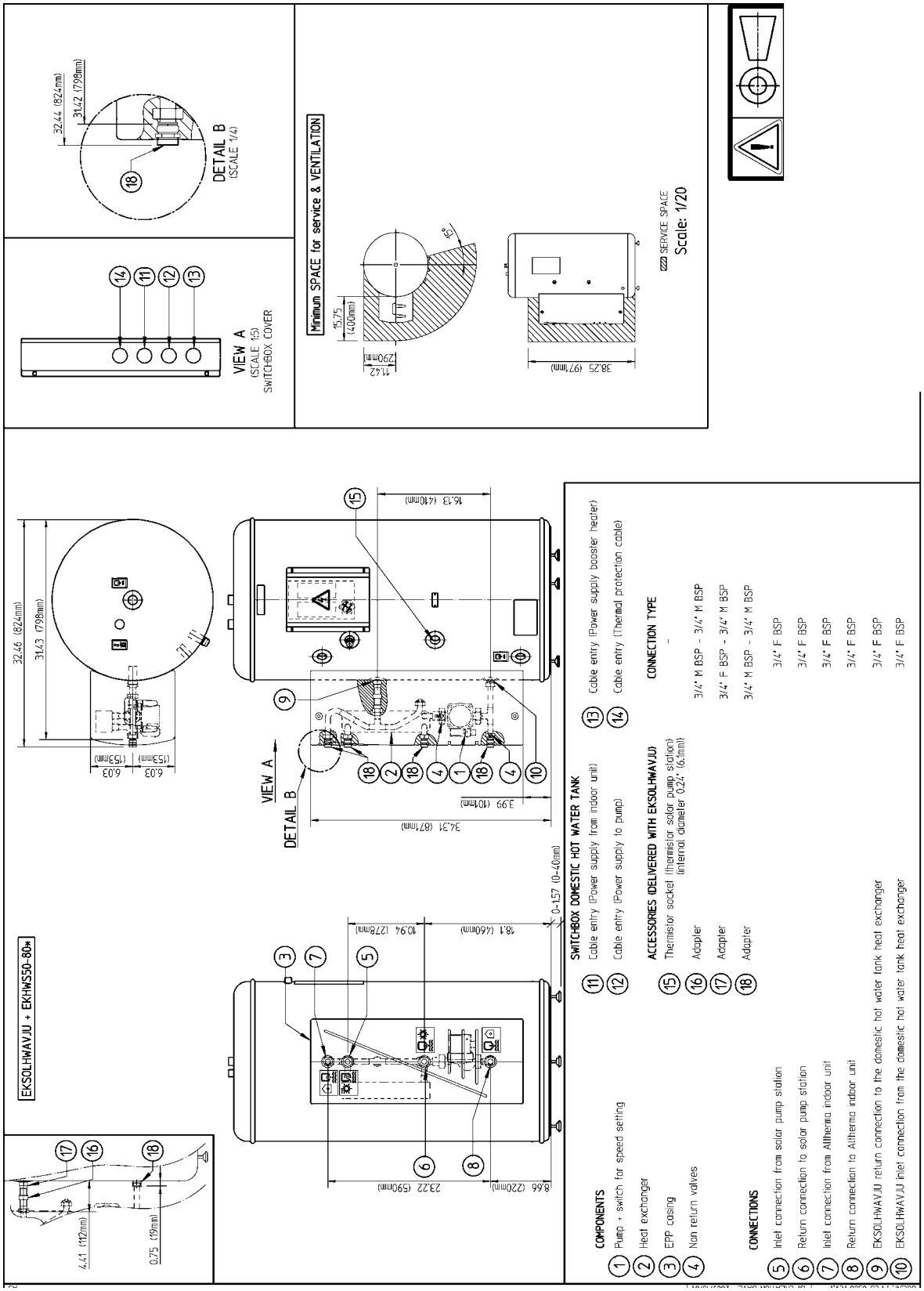
The solar kit is to be connected to the Daikin domestic hot water tank. The solar kit will enables domestic hot water to be heated by the sun when it is available. The solar kit intergrates the field-supplied solar thermal panels with the pump station and the Daikin domestic hot water tank.

1.1 Specifications – Solar Kit

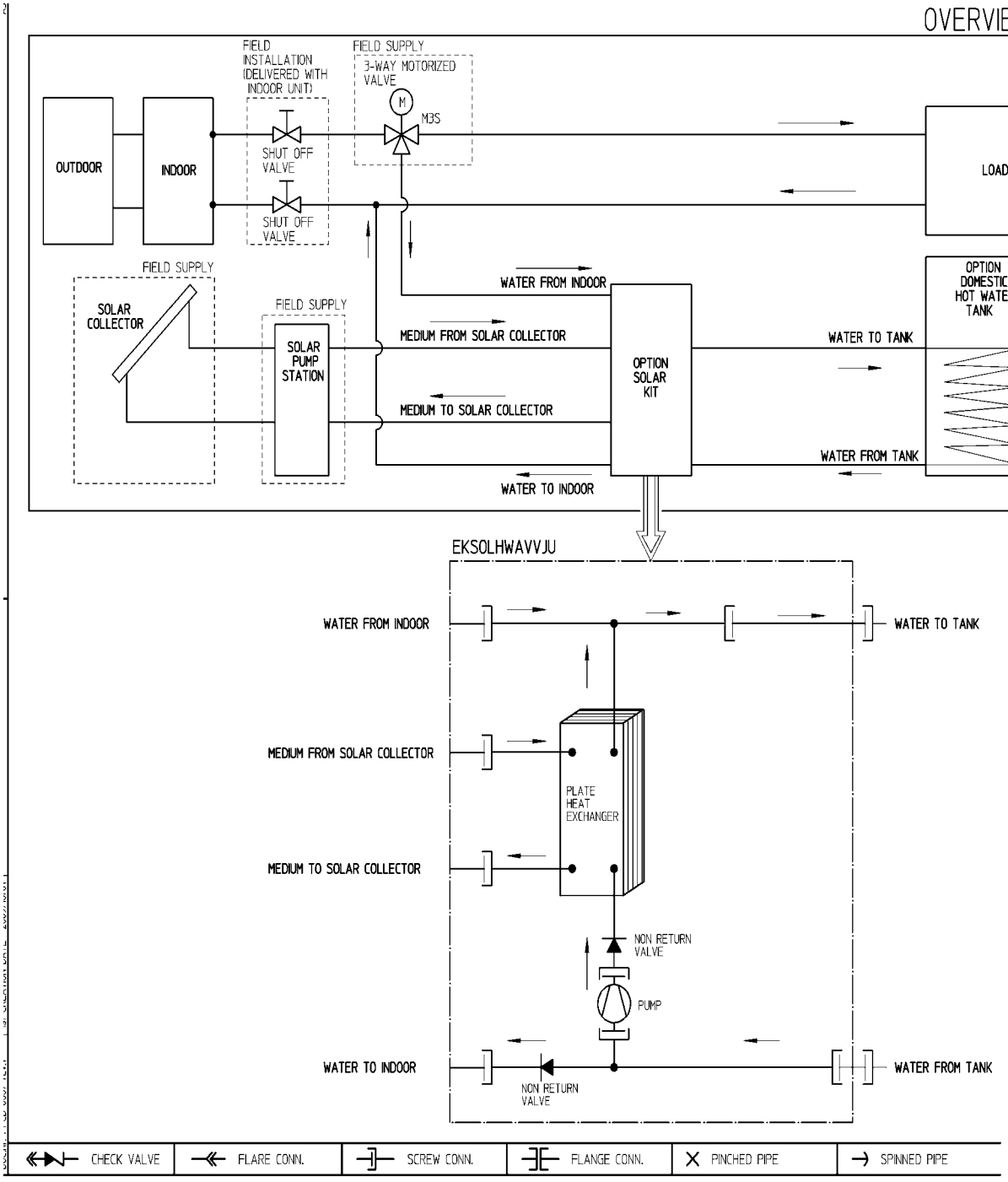
2-1 TECHNICAL SPECIFICATIONS				EKSOLHWBAVJU
Dimensions	Packing	Height	in (mm)	31-3/8 (795)
		Width	in (mm)	13-1/2 (340)
		Depth	in (mm)	11-5/8 (295)
	Unit	Height	in (mm)	30-3/8 (770)
		Width	in (mm)	12-1/8 (305)
		Depth	in (mm)	10-3/4 (270)
Weight	Unit		lb (kg)	17.6 (8)
	Packed Unit		lb (kg)	19.8 (9)
Packing	Material			Carton
	Weight		lb (kg)	1
Heat Exchanger	Type			Brazed plate
	Pressure drop	Solar side	PSI (kPa)	3.12 (21.5)
	Maximum inlet temperature	Solar side	°F (°C)	230°F (110°C)
	Capacity		W/K	1,400
	Logarithmic mean temperature difference (LMTD)		K	5
Pump	Type			water cooled
	Number of speeds			3
	Power input		W	46
Sound	Sound Pressure		dBA	27
Water circuit	Piping connections diameter		inch FBSP	3/4
Insulation material				EPP
Ambient temperature	Maximum		°F (°C)	95 (35)
	Minimum		°F (°C)	1

2-2 ELECTRICAL SPECIFICATIONS				EKSOLHWBAVJU
Unit	Power Supply	Phase		1~
		Frequency	Hz	60
		Voltage	V	208/230
Voltage range	Minimum			-10%
	Maximum			+10%
Power Supply Intake				indoor unit

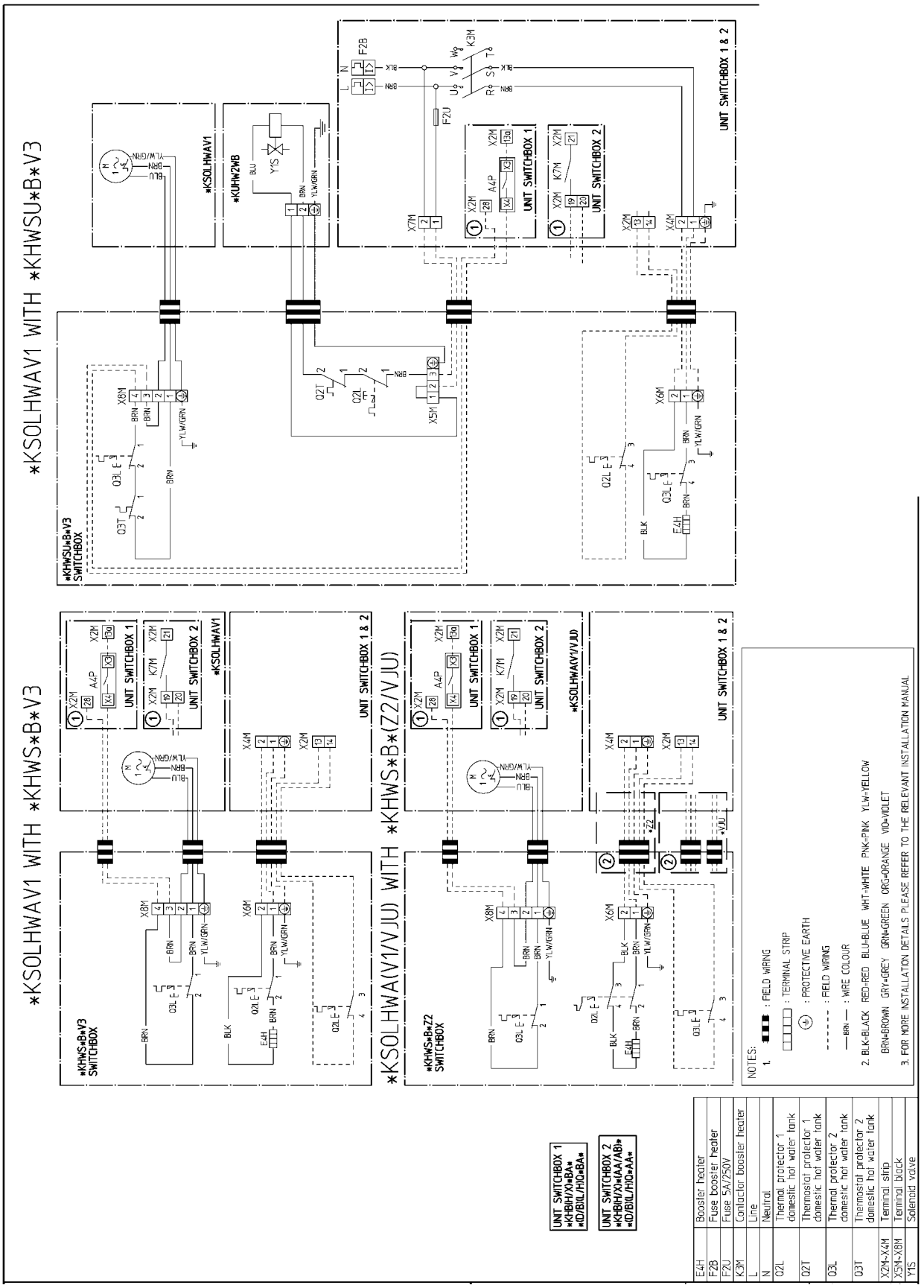
1.2 Dimensional Drwg. & Center of Gravity - Solar Kit



1.3 Piping Diagram - Solar Kit



1.4 Wiring Diagram - Solar Kit



2. Room Thermostat – EKRTWA

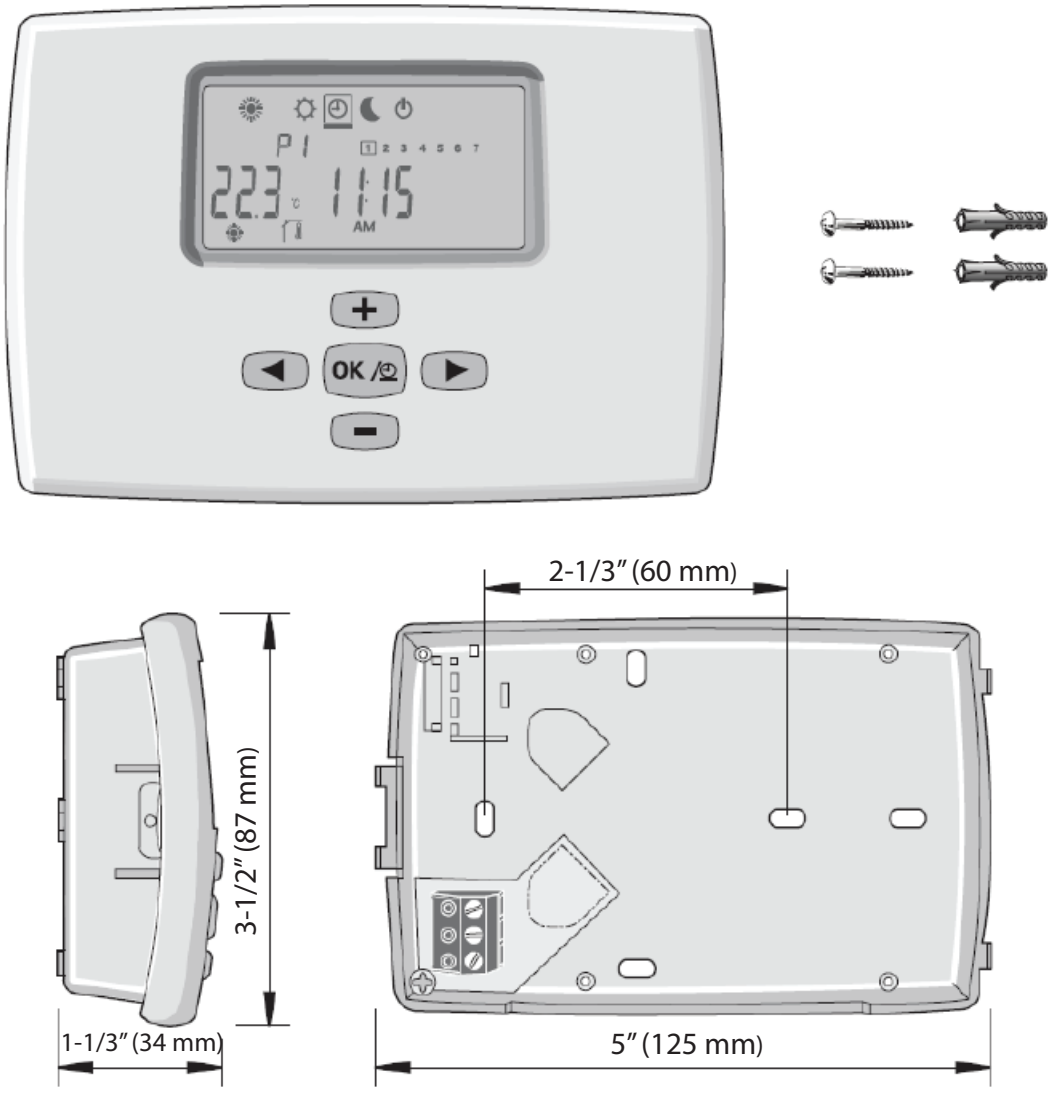
Functions	Wired room thermostat EKRTWA
Heating only	✓
Heating and cooling	✓
Comfort function mode	✓
Reduced function mode	✓
Scheduled function mode	✓
Number of setpoint changes	12/day
Holiday function mode	✓
Off function	✓
Setpoint limitation	✓
Keylock function	✓

2.1 Specifications - Room Thermostat

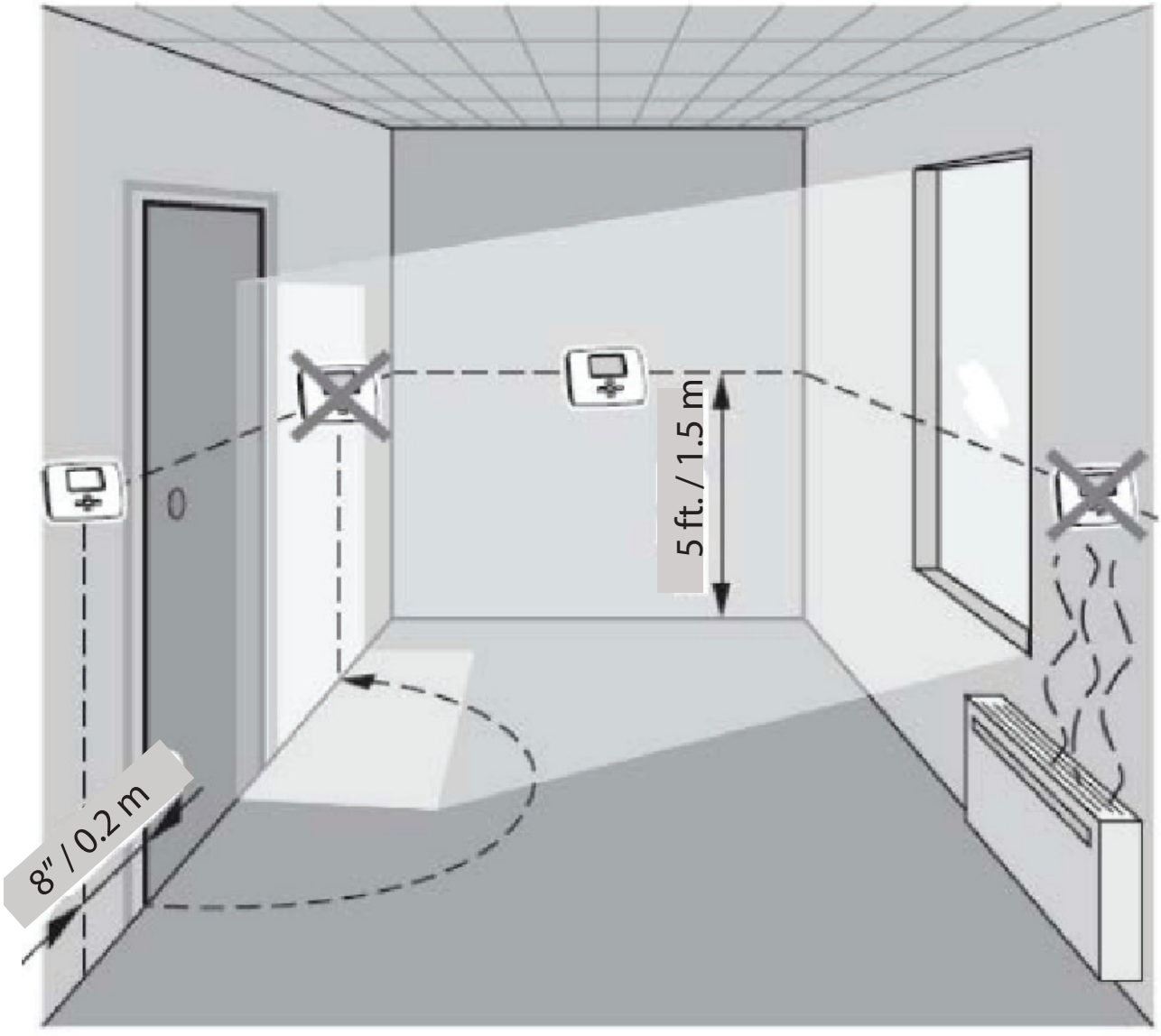
4-1 TECHNICAL SPECIFICATIONS				EKRTW
Dimensions	Unit	Height	in (mm)	3-1/2 (87)
		Width	in (mm)	5 (125)
		Depth	in (mm)	1-3/8 (34)
	Packing	Height	in (mm)	2-5/8 (65)
		Width	in (mm)	7 (175)
		Depth	in (mm)	4 (100)
Weight	Unit	Net	oz (g)	7.6 (215)
		Gross	oz (g)	15.5 oz (440 g)
Packing	Material			Carton
	Weight		oz (g)	2 (55)
Ambient temperature	Storage		°F (°C)	-4~140 (-20~60)
	Operation		°F (°C)	32~122 (0~50)
Temperature setting range	Heating		°F (°C)	39.2–98.6 (4–37)
	Cooling		°F (°C)	39.2–98.6 (4–37)
Temperature setting resolution			°F (°C)	32.9 (0.5)
Clock				Yes
Regulation function				Proportional band
Features	Item			Heating only
				Heating and cooling
				Comfort function mode (= comfort setpoint)
				Reduced function mode (=night setback setpoint)
				Scheduled function mode(= schedule timer)
				Number of setpoint changes
	Note			12/day
	Item			Holiday function mode
				Off function (with integrated frost protection)
				Setpoint limitation
				Keylock function

4-2 ELECTRICAL SPECIFICATIONS			EKRTW
Power Supply	Voltage		battery powered 3* AA-LR6 (alkaline)
Connection			Wired
Output relays			Maximum load 1A - 24 VAC

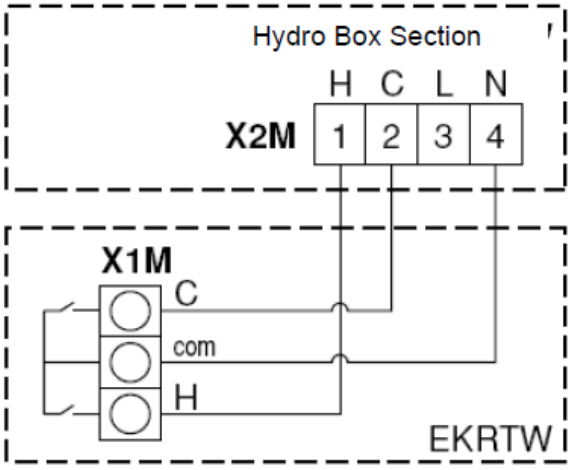
2.2 Dimensions - Room Thermostat



2.3 Application Example - Room Thermostat



2.4 Wiring Connection - Room Thermostat



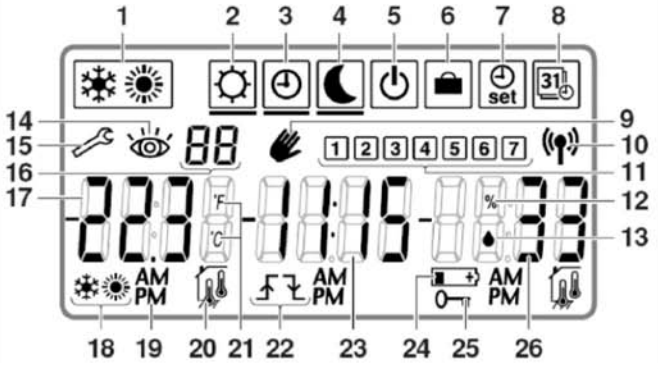
Use field supplied 18 gauge wires to connect thermostat to hydro box section terminals

H	Heating demand
C	Cooling demand

For heating-only applications, wire 2-C is not to be installed.

2.5 User Display - Room Thermostat

1	Cooling/heating mode selection
2	Comfort function mode
3	Schedule timer function mode
4	Reduced function mode
5	OFF function mode (with integrated frost protection)
6	Holiday function mode
7	Schedule timer setting menu
8	Date and clock setting menu
9	Manual override of the scheduled mode
10	Active wireless communication between thermostat and its receiver
11	Day of the week
12	Percentage sign for humidity indication
13	Not used.
14	Error occurred: intervention needed.
15	Active user or installation menu or error occurred. Refer to "Troubleshooting" on page 16.
16	Selected program (schedule timer) or code
17	Room temperature or setpoint (when flashing)



18	Thermostat ON (heating or cooling requested)
19	AM - PM indication
20	Room or floor temperature symbol. Floor temperature symbol is flashing if floor protection function is active.
21	Degrees type indication (°C or °F)
22	When manually overriding a schedule or when consulting the active scheduled setpoints by pressing (+) or (−), the current and next setpoint together with the starting hour of the next action are displayed. • ⌐ is shown in case the next action setpoint goes up. • ¬ is shown in case the next action setpoint goes down. • ⌐¬ is shown in case the setpoints are equal.
23	Actual time
24	"Low batteries" indication
25	Key lock function
26	Humidity indication or indication of next scheduled temperature setpoint

2.6 Functional Summary - Room Thermostat

- Room temperature control, base on the measurements of the internal sensor.
- Cooling and heating mode, with possibility to disable cooling function if not required.
- Automatic daylight-saving time change.
- Battery driven so no external power required.

The thermostats are preprogrammed with a set of 5 modes:

In the Comfort mode, the temperature is kept fixed at an adjustable set value. Default values are 70^{O}F (21^{O}C) in heating mode and 75^{O}F (24^{O}C) in cooling mode.

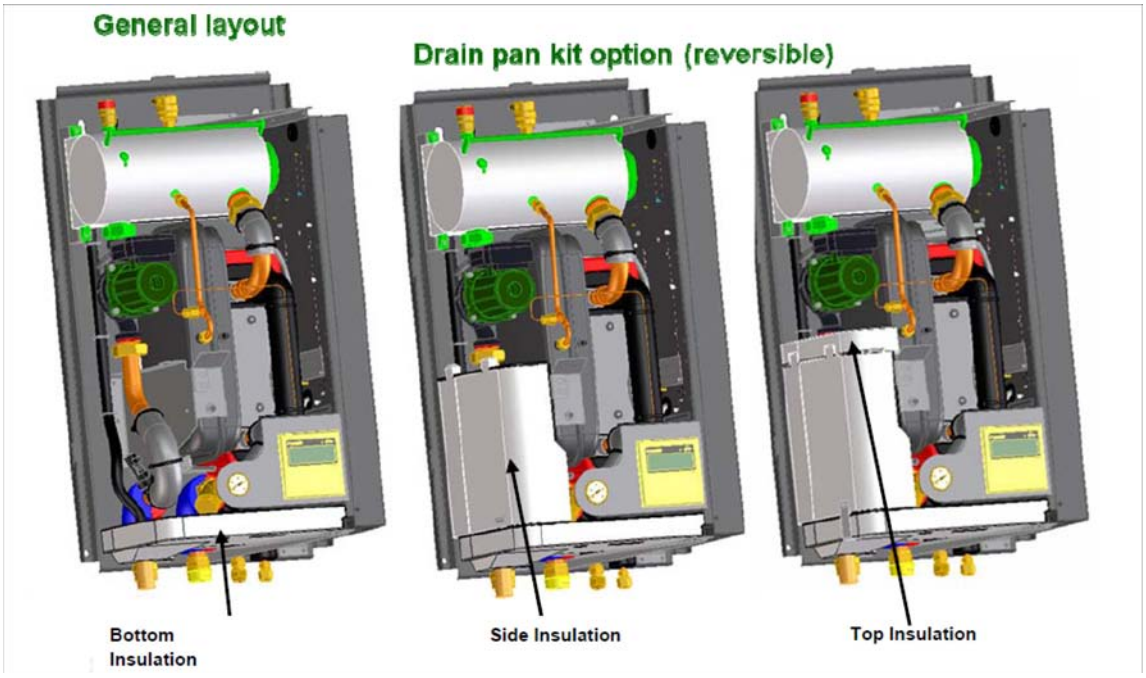
In the Reduced mode, the temperature is kept fixed at an adjustable set value. Default values are 62.5^{O}F (17^{O}C) in heating mode and 82.5^{O}F (28^{O}C) in cooling mode.

In the Off mode, the thermostat is still active as a frost protection which keeps the temperature above 39^{O}F (4^{O}C).

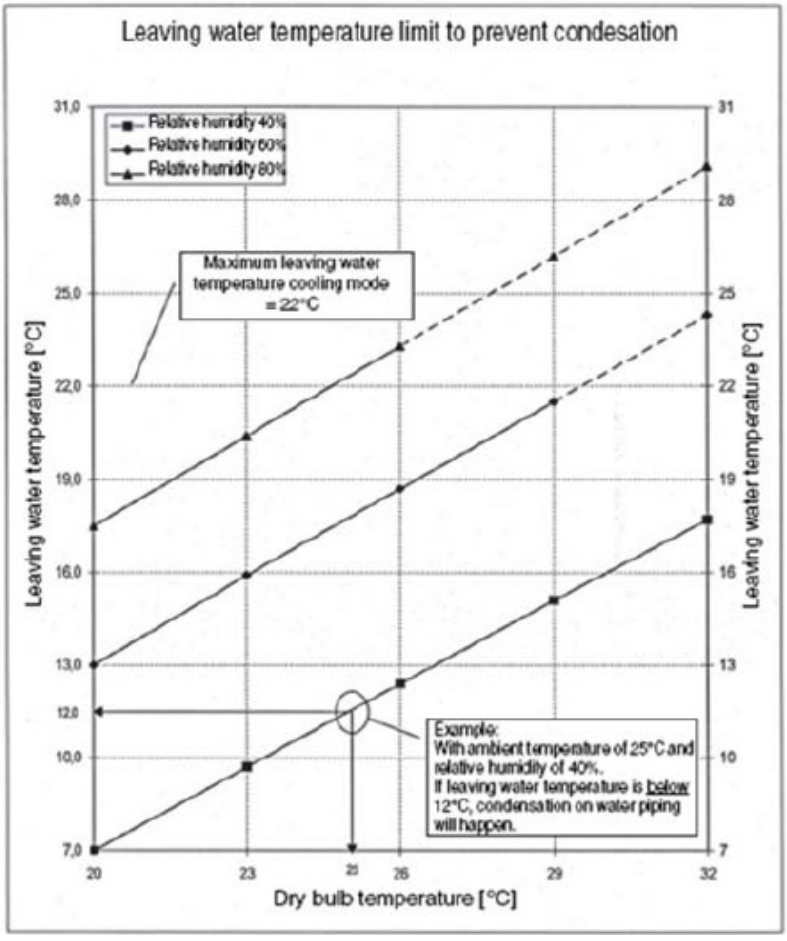
In the Holiday mode, the temperature is kept fixed at an adjustable set value. Default values are 57^{O}F (14^{O}C) in heating mode and 86^{O}F (30^{O}C) in cooling mode for a programmed duration.

In the Schedule mode, the temperature is adjusted in accordance with a pre-planned schedule of either of the preprogrammed standard schedules, or one of the 2 schedules the user can program on his own. ONe can also choose whether the programmed times are when the heat pump starts adjusting temperatures or at what time the temperatures are to be reached.

3. Condensate Kit – EKHBDP

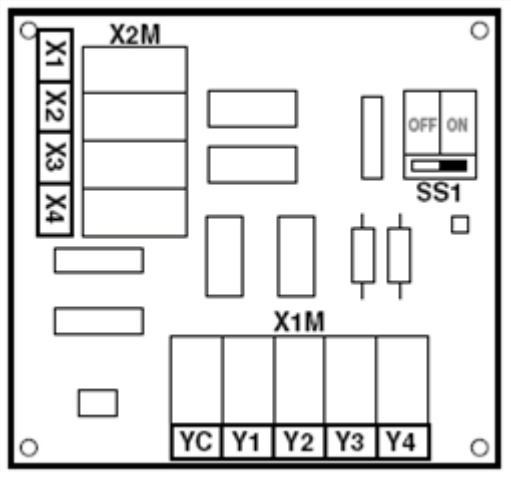


NOTE: Condensate Kit must be used with EKHBX054* Heat Pump Hydrobox



4. Digital I/O PCB Kit – EKRP1HBAAU

- An optional EKRP1HB digital I/O PCB can be connected to the indoor hydrobox or the outdoor monobloc unit and allows:
- Remote Alarm Output
- Bivalent operation (permission signal for the auxiliary boiler)
- Solar DHW priority mode
- Refer to the operation manual of the indoor unit and to the installation manual of the digital I/O PCB for more information.
- Refer to the wiring diagram or connection diagram for connecting this PCB to the unit



Appendix - Field Settings

1. Field Settings Overview

The unit shall be configured by the installer to match the installation environment (outdoor climate, installed options, etc.) and user demand. Thereto, a number of so called field settings are available. These field settings are accessible and programmable through the user interface.

Each field setting is assigned a 3-digit number or code, for example [5-03], which is indicated on the user interface display. The first digit [5] indicates the 'first code' or field setting group. The second and third digit [03] together indicate the 'second code'.

A list of all field settings and default values is given under "Field settings table" on page 35. In this same list, we provided for 2 columns to register the date and value of altered field settings at variance with the default value.

A detailed description of each field setting is given under "Detailed description" on page 26.

Procedure

To change one or more field settings, proceed as follows.

⚠ Temperature values displayed on the digital controller (user interface) are in °C.

Temperature values in °C are between brackets. Conversion from °C to °F is for information only.

1 Press the button for a minimum of 5 seconds to enter FIELD SET MODE.
The SETTING icon (3) will be displayed. The current selected field setting code is indicated *8-88* (2), with the set value displayed to the right *-88.8* (1).

2 Press the TEMP▲ button to select the appropriate field setting first code.

3 Press the TEMP▼ button to select the appropriate field setting second code.

4 Press the TIMER▲ button and TIMER▼ button to change the set value of the select field setting.

5 Save the new value by pressing the ⊗ button.

6 Repeat step 2 through 4 to change other field settings as required.

7 When finished, press the button to exit FIELD SET MODE.

NOTE Changes made to a specific field setting are only stored when the ⊗ button is pressed. Navigating to a new field setting code or pressing the button will discard the change made.

NOTE

- Before shipping, the set values have been set as shown under "Field settings table" on page 35.
- When exiting FIELD SET MODE, "88" may be displayed on the user interface LCD while the unit initialises itself.

Detailed description

[0] User permission level

If required, certain user interface buttons can be made unavailable for the user.

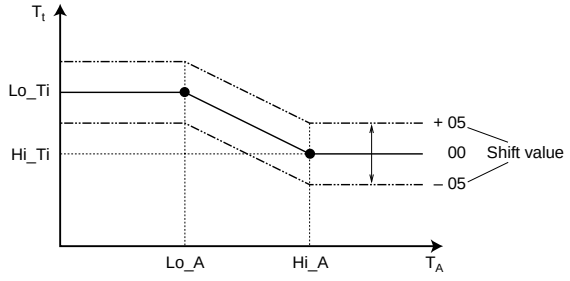
Three permission levels are defined (see the table below). Switching between level 1 and level 2/3 is done by simultaneously pressing buttons TIMER ▲ and TIMER ▼ immediately followed by simultaneously pressing buttons and , and keeping all 4 buttons pressed for at least 5 seconds (in normal mode). Note that no indication on the user interface is given. When level 2/3 is selected, the actual permission level — either level 2 or level 3 — is determined by the field setting [0-00].

		Permission level		
Button		**1**	**2**	**3**
Quiet mode button		operable	—	—
Weather dependent set point button		operable	—	—
Schedule timer enable/disable button		operable	operable	—
Programming button		operable	—	—
Time adjust buttons	TIMER ▲ TIMER ▼	operable	—	—
Inspection/test operation button	TEST	operable	—	—

[1] Weather dependent set point (heating operation only)

The weather dependent set point field settings define the parameters for the weather dependent operation of the unit. When weather dependent operation is active the water temperature is determined automatically depending on the outdoor temperature: colder outdoor temperatures will result in warmer water and vice versa. During weather dependent operation, the user has the possibility to shift up or down the target water temperature by a maximum of 41°F (5°C). See the operation manual for more details on weather dependent operation.

- [1-00] Low ambient temperature (Lo_A): low outdoor temperature.
- [1-01] High ambient temperature (Hi_A): high outdoor temperature.
- [1-02] Set point at low ambient temperature (Lo_Ti): the target outgoing water temperature when the outdoor temperature equals or drops below the low ambient temperature (Lo_A).
  Note that the Lo_Ti value should be *higher* than Hi_Ti, as for colder outdoor temperatures (i.e. Lo_A) warmer water is required.
- [1-03] Set point at high ambient temperature (Hi_Ti): the target outgoing water temperature when the outdoor temperature equals or rises above the high ambient temperature (Hi_A).
  Note that the Hi_Ti value should be *lower* than Lo_Ti, as for warmer outdoor temperatures (i.e. Hi_A) less warm water suffices.



T_t Target water temperature

T_A Ambient (outdoor) temperature

Shift value = Shift value

[2] Disinfection function

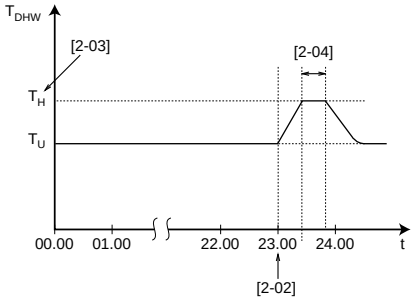
Applies only to installations with a domestic hot water tank.

The disinfection function disinfects the domestic hot water tank by periodically heating the domestic water to a specific temperature.

CAUTION

The disinfection function field settings must be configured by the installer according to local laws and regulations.

- [2-00] Operation interval: day(s) of the week at which the domestic water should be heated.
- [2-01] Status: defines whether the disinfection function is turned on (1) or off (0).
- [2-02] Start time: time of the day at which the domestic water should be heated.
- [2-03] Set point: high water temperature to be reached.
- [2-04] Interval: time period defining how long the set point temperature should be maintained.



T_{DHW}	Domestic hot water temperature
T_U	User set point temperature (as set on the user interface)
T_H	High set point temperature [2-03]
t	Time

WARNING

Be aware that the domestic hot water temperature at the hot water tap will be equal to the value selected in field setting [2-03] after a disinfection operation.

If this high domestic hot water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

[3] Auto restart

When power returns after a power supply failure, the auto restart function reapplies the user interface settings at the time of the power supply failure.

NOTE It is therefore recommended to leave the auto restart function enabled.

Note that with the function disabled the schedule timer will not be activated when power returns to the unit after a power supply failure. Press the ⏲⊗ button to enable the schedule timer again.

- [3-00] Status: defines whether the auto restart function is turned **ON (0)** or **OFF (1)**.

NOTE If the benefit kWh rate power supply is of the type that power supply is interrupted, then always allow the auto restart function.

[4] Backup heater operation and space heating off temperature

Backup heater operation

The operation of the backup heater can be enabled or disabled, or it can be disabled depending on operation of the booster heater.

- [4-00] Status: defines whether backup heater operation is enabled (1) or disabled (0).

NOTE Even in case the backup heater operation status field setting [4-00] is set to disabled (0), the backup heater can operate during start-up and defrost operation.

- [4-01] Priority: defines whether backup heater and booster heater can operate simultaneously (0), or if the booster heater operation has priority over the backup heater operation (1), or if the backup heater operation has priority over the booster heater operation (2).

NOTE When the priority field setting is set to ON (1), space heating performance of the system might be decreased at low outdoor temperatures, since in case of domestic water heating demand the backup heater will not be available for space heating (space heating will still be provided by the heat pump).

When the priority field setting is set to ON (2), domestic water heating performance of the system might be decreased at low outdoor temperatures, since in case of space heating demand the booster heater will not be available for domestic water heating. However domestic water heating by heat pump will still be available.

When the priority field setting is set to OFF (0), make sure that electrical power consumption does not exceed supply limits.

Space heating off temperature

- [4-02] Space heating off temperature: outdoor temperature above which space heating is turned off, to avoid overheating.

Booster heater operation

Applies only to installations with a domestic hot water tank.

The operation of the booster heater can be enabled or limited depending on outdoor temperature (T_A), domestic hot water temperature (T_{DHW}) or operation mode of the heat pump.

- [4-03] Booster heater operation: defines whether the optional booster heater operation is enabled (1) or has certain limitations (0/2/3).

Explanation of settings of [4-03]

Booster heater will/can only operate if domestic hot water mode is activated ( ).

- [4-03]=0, then booster heater operation is only allowed during "[2] Disinfection function" and "Powerful domestic water heating" (see operation manual).
  This setting is only recommended in case the capacity of the heat pump can cover the heating requirements of the house and domestic hot water over the complete heating season.
  The result of this setting is that the domestic hot water will never be heated by the booster heater except for "[2] Disinfection function" and "Powerful domestic water heating" (see operation manual).

If the booster heater operation is limited ([4-03]=0) and the ambient outdoor temperature T_A is lower than the field setting to which parameter [5-03] is set and [5-02]=1, then the domestic hot water will not be heated.

The consequence of this setting is that the domestic hot water temperature (T_{DHW}) can be maximum the heat pump OFF temperature ($T_{HP\ OFF}$). Refer to setting of [6-00] and [6-01] in "[6]" on page 29.

- [4-03]=1, then booster heater heater operation is only determined by booster heater OFF temperature ($T_{BH\ OFF}$), booster heater ON temperature ($T_{BH\ ON}$) and/or schedule timer. Refer to setting "[7-00]" on page 30 and "[7-01]" on page 30.
- [4-03]=2, then booster heater operation is only allowed if heat pump is out of "operation range" of heat pump domestic water heating mode (T_A<[5-03] or T_A>95°F(35°C)) or domestic hot water temperature is 3.6°F (2°C) lower then the heat pump OFF temperature ($T_{HP\ OFF}$) for domestic hot water mode (T_{DHW}>$T_{HP\ OFF}$–3.6°F(2°C)). (Refer to setting [5-03] on page 28, [6-00] on page 29 and [6-01] on page 29). Results in the most optimum coverage of domestic hot water heated by the pump.
- [4-03]=3, then booster heater operation is the same as setting 1, except that booster heater is OFF when the heat pump is active in domestic hot water mode. The consequence of this functionality is that setting [8-03] is not relevant.
  Results in optimum coverage of domestic hot water heated by heat pump in relation with [8-04].

- When setting [4-03]=1/2/3, the booster heater operation can still be restricted by the schedule timer as well. I.e., when booster heater operation is preferred during certain period of the day. (See operation manual)
- When setting [4-03]=2, the booster heater will be allowed to operate when T_A<[5-03] independent of the status of [5-02]. If bivalent operation is enabled and permission signal for auxiliary boiler is ON, the booster heater will be restricted even when T_A<[5-03]. (See "[C-02]" on page 33).
- Booster heater is always allowed during powerful and disinfection function, except for the period that the backup heater operation is required for safety reasons and [4-02]=1.

- [4-04] Freeze protection function: avoids freezing of the water piping between home and unit. In case of low ambient temperatures it will activate the pump and in case of low water temperatures it will additionally activate the backup heater. Monobloc only.
  Default freeze protection function takes into account freezing of water piping which is insufficiently insulated.
  Basically it means that the pump is activated whenever ambient temperatures become close to freezing, independently of the working temperature.

[5] Equilibrium temperature and space heating priority temperature

Equilibrium temperature — The 'equilibrium temperature' field settings apply to operation of the **backup heater**.
When the equilibrium temperature function is enabled, operation of the backup heater is restricted to low outdoor temperatures, i.e. when the outdoor temperature equals or drops below the specified equilibrium temperature. When the function is disabled, operation of the backup heater is possible at all outdoor temperatures. Enabling this function reduces the working time of the backup heater.

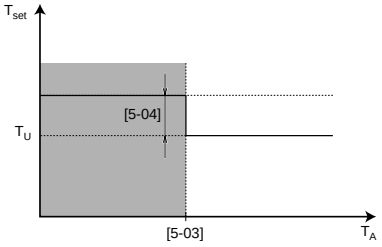
- [5-00] Equilibrium temperature status: specifies whether the equilibrium temperature function is enabled (1) or disabled (0).
- [5-01] Equilibrium temperature: outdoor temperature below which operation of the backup heater is allowed.

Space heating priority temperature — Applies only to installations with a domestic hot water tank. — The 'space heating priority temperature' field settings apply to operation of the 3-way valve and the **booster heater** in the domestic hot water tank.
When the space heating priority function is enabled, it is assured that the full capacity of the heat pump is used for space heating only when the outdoor temperature equals or drops below the specified space heating priority temperature, i.e. low outdoor temperature. In this case the domestic hot water will only be heated by the booster heater.

- [5-02] Space heating priority status: specifies whether space heating priority is enabled (1) or disabled (0).
- [5-03] Space heating priority temperature: outdoor temperature below which the domestic hot water will be heated by the booster heater only, i.e. low outdoor temperature.

If the booster heater operation is limited ([4-03]=0) and the ambient outdoor temperature T_A is lower than the field setting to which parameter [5-03] is set and [5-02]=1, then the domestic hot water will not be heated.

■ [5-04] Set point correction for domestic hot water temperature: set point correction for the desired domestic hot water temperature, to be applied at low outdoor temperature when space heating priority is enabled. The corrected (higher) set point will make sure that the *total* heat capacity of the water in the tank remains approximately unchanged, by compensating for the colder bottom water layer of the tank (because the heat exchanger coil is not operational) with a warmer top layer.



T_{set}	Domestic hot water set point temperature
T_U	User set point (as set on the user interface)
T_A	Ambient (outdoor) temperature
	Space heating priority

WARNING

Be aware that the domestic hot water temperature will be automatically increased with the value selected in field setting [5-04] (if the outdoor temperature drops below field setting [5-03]) compare to the user set point for domestic hot water (T_U). Refer to field setting [5-03], [7-00] and the operation manual to select preferable set point.

If this high domestic hot water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

[6] DT for heat pump domestic water heating mode

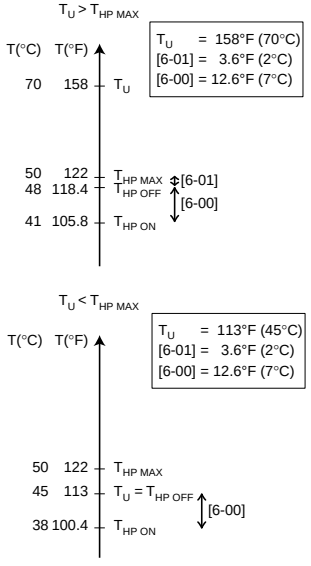
Applies only to installations with a domestic hot water tank.

The 'DT (temperature difference) for heat pump domestic water heating mode' field settings determine the temperatures at which heating of the domestic hot water by the heat pump will be started (i.e., the heat pump ON temperature) and stopped (i.e., the heat pump OFF temperature).
When the domestic hot water temperature drops below the heat pump ON temperature ($T_{HP\ ON}$), heating of the domestic hot water by the heat pump will be started. As soon as the domestic hot water temperature reaches the heat pump OFF temperature ($T_{HP\ OFF}$) or the user set point temperature (T_U), heating of the domestic hot water by the heat pump will be stopped (by switching the 3-way valve).

The heat pump OFF temperature, and the heat pump ON temperature, and its relation with field settings [6-00] and [6-01] are explained in the illustration below.

■ [6-00] Start: temperature difference determining the heat pump ON temperature ($T_{HP\ ON}$). See illustration.

■ [6-01] Stop: temperature difference determining the heat pump OFF temperature ($T_{HP\ OFF}$). See illustration.



T_U	User set point temperature (as set on the user interface)
$T_{HP\ MAX}$	Maximum heat pump temperature at sensor in domestic hot water tank (122°F)(50°C)(depending on T_A)[(a)]
$T_{HP\ OFF}$	Heat pump OFF temperature
$T_{HP\ ON}$	Heat pump ON temperature

(a) 122°F (50°C) = $T_{HP\ MAX}$ at T_A≤77°F (25°C).
118.4°F (48°C) = $T_{HP\ MAX}$ at T_A>77°F (25°C).

The maximum domestic hot water temperature that can be reached with the heat pump is 122°F (50°C). It is advised to select $T_{HP\ OFF}$ not higher than 118.4°F (48°C) in order to improve performance of the heat pump during domestic water heating mode.

When setting [4-03]=0 or 2 special attention to setting [6-00] is recommended. A good balance between the required domestic hot water temperature and heat pump ON temperature ($T_{HP\ ON}$) is a must.

[7] DT for booster heater and dual set point control

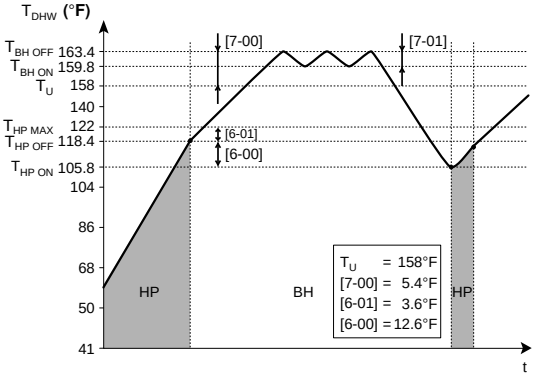
DT for booster heater

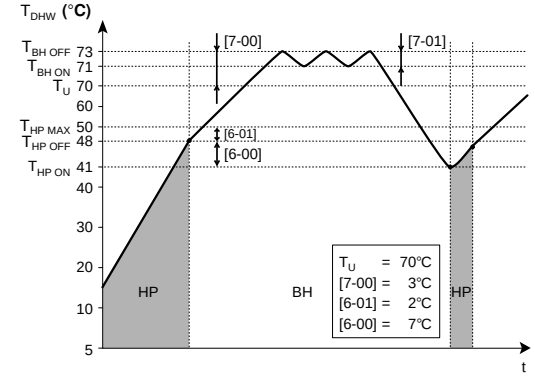
Applies only to installations with a domestic hot water tank.

When the domestic hot water is heated and the domestic hot water set point temperature (as set by the user) has been reached, the booster heater will continue to heat the domestic hot water to a temperature a few degrees above the set point temperature, i.e. the booster heater OFF temperature. These extra degrees are specified by the domestic hot water step length field setting. Correct setting prevents the booster heater from repeatedly turning on and off (i.e. chattering) to maintain the domestic hot water set point temperature. Note: the booster heater will turn back on when the domestic hot water temperature drops [7-01] (field setting) below the booster heater OFF temperature.

If the schedule timer for booster heater (see the operation manual) is active, the booster heater will only operate if allowed by this schedule timer.

■ [7-00] Domestic hot water step length: temperature difference above the domestic hot water set point temperature before the booster heater is turned off.





BH	Booster heater
HP	Heat pump. If heating up time by the heat pump takes too long, auxiliary heating by the booster heater can take place
$T_{BH\ OFF}$	Booster heater OFF temperature (T_U + [7-00])
$T_{BH\ ON}$	Booster heater ON temperature (($T_{BH\ OFF}$ – 4°F) ($T_{BH\ OFF}$ – 2°C))
$T_{HP\ MAX}$	Maximum heat pump temperature at sensor in domestic hot water tank
$T_{HP\ OFF}$	Heat pump OFF temperature ($T_{HP\ MAX}$ – [6-01])
$T_{HP\ ON}$	Heat pump ON temperature ($T_{HP\ OFF}$ – [6-00])
T_{DHW}	Domestic hot water temperature
T_U	User set point temperature (as set on the user interface)
t	Time

WARNING

Be aware that the domestic hot water temperature will be automatically increased (always) with the value selected in field setting [7-00] compare to the user set point for domestic hot water (T_U). Refer to field setting [7-00] and the operation manual to select preferable set point.

If this high water temperature can be a potential risk for human injuries, a mixing valve (field supply) shall be installed at the hot water outlet connection of the domestic hot water tank. This mixing valve shall secure that the hot water temperature at the hot water tap never rise above a set maximum value. This maximum allowable hot water temperature shall be selected according to local laws and regulations.

If the booster heater operation is limited ([4-03]=0), then set point of field setting parameter [7-00] has only meaning for powerful domestic water heating.

■ [7-01] Hysteresis value booster heater: temperature difference determining the booster heater ON temperature ($T_{BH\ ON}$). $T_{BH\ ON} = T_{BH\ OFF} – [7\text{-}01]$

The minimum value for booster heater ON temperature ($T_{BH\ ON}$) is 3.6°F (2°C) (fixed) below heat pump OFF temperature ($T_{HP\ OFF}$).

Dual set point control

Applies only to installations with different heat emitter which require different set points.

Dual set point control makes it possible to generate 2 different set points.

NOTE There is no indication available which set point is active!

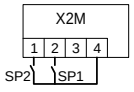
■ [7-02] Dual set point control status: defines whether the dual set point control is enabled (1) or disabled (0).

■ [7-03] Second set point heating: specifies the second set point temperature in heating operation.

■ [7-04] Second set point cooling: specifies the second set point temperature in cooling operation.

NOTE

- The first set point heating/cooling is the set point selected on the user interface.
  - In heating mode the first set point can be a fixed value or weather dependent.
  - In cooling mode the first set point is always a fixed value.
- The second set point heating [7-03] should be linked to the heat emitters which requires the highest set point in heating mode. Example: fan coil unit.
- The second set point cooling [7-04] should be linked to the heat emitters which requires the lowest set point in cooling mode. Example: fain coil unit.
- The actual second set point heating value depends on the selected value of setting [7-03].
  - In case [7-03]=1.8~43.2°F (1~24°C), the actual second set point will be first set point heating increased with [7-03] (the maximum is 131°F (55°C)).
    In this way the second set point heating is linked to the first set point heating.
  - In case [7-03]=77~131°F (25~55°C), the actual second set point heating is equal to [7-03].
- The selection of second set point or first set point is determined by the terminals (X2M: 1, 2, 4).
  The second set point has always priority on the first set point.



SP1 First set point contact

SP2 Second set point contact

When dual set point control is enabled, heating/cooling selection always has to be done on the user interface.

NOTE

It is the responsibility of the installer to make sure no unwanted situations can occur.

It is very important that the water temperature to the floor heating loops never becomes too high in heating mode or never too cold in cooling mode. Failure to observe this rule can result in construction damage or discomfort. For example in cooling mode condensation on the floor can occur when water towards the floor heating loops is too cold (dew point).

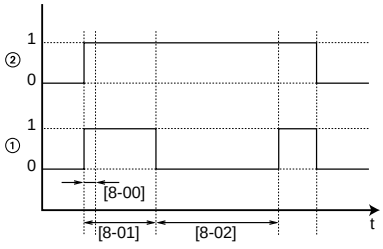
[8] Domestic water heating mode timer

Applies only to installations with a domestic hot water tank.

The 'domestic water heating mode timer' field settings defines the minimum and maximum domestic water heating times, minimum time between two domestic water heating cycles by heat pump, and booster heater delay time.

- [8-00] Minimum running time: specifies the minimum time period during which heat pump domestic water heating mode should be activated, even when the target domestic hot water temperature for heat pump ($T_{HP\ OFF}$) has already been reached.
- [8-01] Maximum running time: specifies the maximum time period during which heat pump domestic water heating mode can be activated, even when the target domestic hot water temperature for heat pump ($T_{HP\ OFF}$) has not yet been reached.
  The actual maximum running time will automatically variate between [8-01] and [8-01]+[8-04] depending on the outdoor temperature. See figure in chapter "[8-04]" on page 32.

  Note that when the unit is configured to work with a room thermostat (refer to "Room thermostat installation configuration" on page 23), the maximum running timer will only be taken into account when there is a request for space cooling or space heating. When there is no request for room cooling or room heating, domestic water heating by the heat pump will continue until the 'heat pump OFF temperature' (see field settings [6] on page 29) is reached. When no room thermostat is installed, the timer is always taken into account.
- [8-02] Anti-recycling time: specifies the minimum required interval between two heat pump domestic water heating mode cycles.
  The actual anti-recycling time will automatically variate between [8-02] and 0 depending on the outdoor temperature. See figure in chapter "[8-04]" on page 32.



1 Domestic water heating (1 = active, 0 = not active)

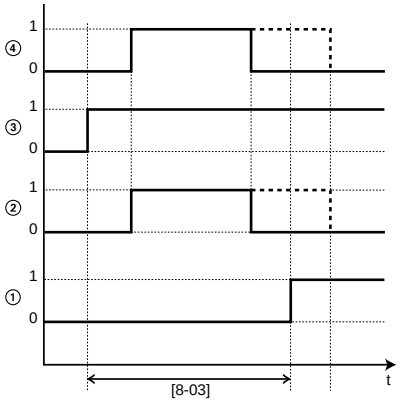
2 Hot water request (1 = request, 0 = no request)

t Time

If the outdoor temperature is higher than the field setting to which parameter [4-02] is set, then field settings of parameters [8-01], [8-02], and [8-04] are not considered.

■ [8-03] Booster heater delay time: specifies the start-up time delay of the booster heater operation when heat pump domestic water heating mode is active.

- When heat pump is active in domestic water heating mode, the delay time of booster heater is [8-03].
- When heat pump is not active in domestic water heating mode, the delay time is 20 min.
- The delay timer starts from booster heater ON temperature ($T_{BH\ ON}$)



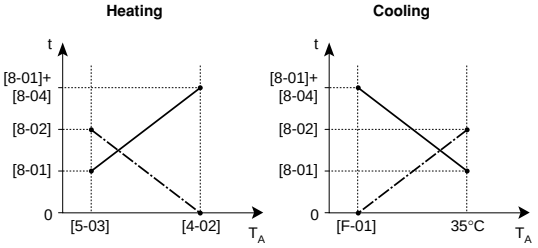
1 Booster heater operation (1 = active, 0 = not active)
2 Heat pump domestic water heating mode (1 = active, 0 = not active)
3 Hot water request for booster heater (1 = request, 0 = no request)
4 Hot water request for heat pump (1 = request, 0 = no request)
t Time

- By adapting the booster heater delay time versus the maximum running time, an optional balance can be found between the energy efficiency and the heat up time.
- However, if the booster heater delay time is set too high, it might take a long time before the domestic hot water reaches its set temperature upon domestic hot water mode request.
- The purpose of [8-03] is to delay the booster heater in relation with the heat pump operation time in domestic water heating mode.
- The setting [8-03] has only meaning if setting [4-03]=1. Setting [4-03]=0/2/3 limits the booster heater automatically in relation to heat pump operation time in domestic water heating mode.
- Take care that [8-03] is always in relation with the maximum running time [8-01].

Example: [4-03]=1

	Energy saving settings	Quick heating settings (default)
[8-01]	20~95 min	30 min
[8-03]	[8-01] + 20 min	20 min

■ [8-04] Additional running time at [4-02]/[F-01]: specifies the additional running time on the maximum running time at outdoor temperature [4-02] or [F-01]. See figure below.



t Time
T_A Ambient (outdoor) temperature
maximum running time
anti-recycle time

The full advantage of [8-04] will be applicable if setting [4-03] is not 1.

[9] The purpose of this field setting is to prevent the user from selecting a wrong (i.e., too hot or too cold) leaving water temperature. Thereto the heating temperature set point range and the cooling temperature set point range available to the user can be configured.

CAUTION

- In case of a floor heating application, it is important to limit the maximum leaving water temperature at heating operation according to the specifications of the floor heating installation.
- In case of a floor cooling application, it is important to limit the minimum leaving water temperature at cooling operation (field setting of parameter [9-03]) to 60.8~64.4°F (16~18°C) to prevent condensation on the floor.

- [9-00] Heating set point upper limit: maximum leaving water temperature for heating operation.
- [9-01] Heating set point lower limit: minimum leaving water temperature for heating operation.
- [9-02] Cooling set point upper limit: maximum leaving water temperature for cooling operation.
- [9-03] Cooling set point lower limit: minimum leaving water temperature for cooling operation.
- [9-04] Overshoot setting: defines how much the water temperature may rise above the set point before the compressor stops. This function is only applicable in heating mode.

[A] Quiet mode

This field setting allows to select the desired quiet mode. Two quiet modes are available: quiet mode A and quiet mode B.

In quiet mode A, priority is given to the unit operating quietly under **all** circumstances. Fan and compressor speed (and thus performance) will be limited to a certain percentage of the speed at normal operation. In certain cases, this might result in reduced performance.

In quiet mode B, quiet operation might be overridden when higher performance is required. In certain cases, this might result in less quiet operation of the unit to meet the requested performance.

- [A-00] Quiet mode type: defines whether quiet mode A (0) or quiet mode B (2) is selected.
- [A-01] Parameter 01: do not change this setting. Leave it set to its default value.

NOTE Do not set other values than the ones mentioned.

[C] Setup on EKRP1HB digital I/O PCB

Solar priority mode

- [C-00] Solar priority mode setting: for information concerning the EKSOLHW solar kit, refer to the installation manual of that kit.

Alarm output logic

- [C-01] Alarm output logic: defines the logic of the alarm output on the EKRP1HB digital I/O PCB.
  [C-01]=0, the alarm output will be powered when an alarm occurs (default).
  [C-01]=1, the alarm output will not be powered when an alarm occurs. This field setting allows for distinction between detection of an alarm and detection of a power failure to the unit.

[C-01]	Alarm	No alarm	No power supply to unit
0 (default)	Closed output	Open output	Open output
1	Open output	Closed output	Open output

Bivalent operation

Applies only to installations with an auxiliary boiler (alternating operation, parallel connected). The purpose of this function is to determine —based on the outdoor temperature— which heating source can/will provide the space heating, either the Daikin unit or an auxiliary boiler.

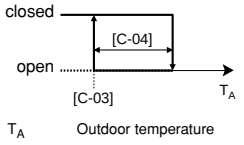
The field setting "bivalent operation" apply only the unit space heating operation and the permission signal for the auxiliary boiler.

When the "bivalent operation" function is enabled, the unit will stop automatically in space heating operation when the outdoor temperature drops below "bivalent ON temperature" and the permission signal for the auxiliary boiler becomes active.

When the bivalent operation function is disabled, the space heating by unit is possible at all outdoor temperatures (see operation ranges) and permission signal for auxiliary boiler is always disactivated.

- [C-02] Bivalent operation status: defines whether bivalent operation is enabled (1) or disabled (0).
- [C-03] Bivalent ON temperature: defines the outdoor temperature below which the permission signal for the auxiliary boiler will be active (closed, KCR on EKRP1HB) and space heating by indoor unit will be stopped.
- [C-04] Bivalent hysteresis: defines the temperature difference between bivalent ON temperature and bivalent OFF temperature.

Permission signal X1–X2 (EKRP1HB)



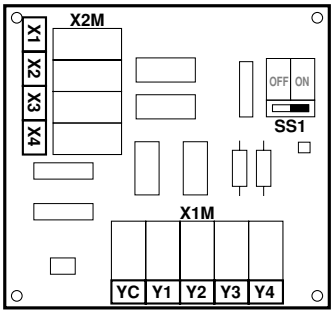
T_A Outdoor temperature

CAUTION

Make sure to observe all rules mentioned in application 5 when bivalent operation function is enabled.

Daikin shall not be held liable for any damage resulting from failure to observe this rule.

- In case the unit is single phase, the combination of setting [4-03]=0/2 with bivalent operation at low outdoor temperature can result in domestic hot water shortage.
- The bivalent operation function has no impact on the domestic water heating mode. The domestic hot water is still and only heated by the unit.
- The permission signal for the auxiliary boiler is located on the EKRP1HB (digital I/O PCB). When it is activated, the contact X1, X2 is closed and open when it is disactivated. See figure for the schematic location of this contact.



[D] Benefit kWh rate power supply/Local shift value weather dependent

Benefit kWh rate power supply

- [D-00] Switching off heaters: Defines which heaters are switched off when the benefit kWh rate signal of the electricity company is received.
  If [D-01]=1 or 2 and the benefit kWh rate signal of the electricity company is received, following devices will be switched off:

[D-00]	Compressor	Back up heater	Booster heater
0 (default)	Forced off	Forced off	Forced off
1	Forced off	Forced off	Permitted
2	Forced off	Permitted	Forced off
3	Forced off	Permitted	Permitted

[D-00] settings 1, 2 and 3 are only meaningful if the benefit kWh rate power supply is of the type that power supply is not interrupted,

Field settings table

Temperature values displayed on the digital controller (user interface) are in °C.

Temperature values in °C are between brackets. Conversion from °C to °F is for information only.

First code	Second code	Setting name	Installer setting at variance with default value				Default value	Range	Step	Unit
			Date	Value	Date	Value				
0	**User permission level**									
	00	User permission level					3	2/3	1	—
1	**Weather dependent set point**									
	00	Low ambient temperature (Lo_A)					14 (–10)	–4~41 (–20~5)	1.8 (1)	°F (°C)
	01	High ambient temperature (Hi_A)					59 (15)	50~68 (10~20)	1.8 (1)	°F (°C)
	02	Set point at low ambient temperature (Lo_TI)					104 (40)	77~131 (25~55)	1.8 (1)	°F (°C)
	03	Set point at high ambient temperature (Hi_TI)					77 (25)	77~131 (25~55)	1.8 (1)	°F (°C)
2	**Disinfection function**									
	00	Operation interval					Fri	Mon~Sun, All	—	—
	01	Status					1 (ON)	0/1	—	—
	02	Start time					23:00	0:00~23:00	1:00	hour
	03	Set point					158 (70)	104~176 (40~80)	9 (5)	°F (°C)
	04	Interval					10	5~60	5	min
3	**Auto restart**									
	00	Status					0 (ON)	0/1	—	—
4	**Backup/booster heater operation and space heating off temperature**									
	00	Status					1 (ON)	0/1	—	—
	01	Priority					0 (OFF)	0/1/2	—	—
	02	Space heating off temperature					95 (35)	57.2~95 (14~35)	1.8 (1)	°F (°C)
	03	Booster heater operation					3	0/1/2/3	—	—
	04	Freeze-up protection function (monobloc only)					0 (active) Read only	—	—	—
5	**Equilibrium temperature and space heating priority temperature**									
	00	Equilibrium temperature status					1 (ON)	0/1	—	—
	01	Equilibrium temperature					32 (0)	5~95 (–15~35)	1.8 (1)	°F (°C)
	02	Space heating priority status					0 (OFF)	0/1	—	—
	03	Space heating priority temperature					32 (0)	5~68 (–15~20)	1.8 (1)	°F (°C)
	04	Set point correction for domestic hot water temperature					18 (10)	0~36 (0~20)	1.8 (1)	°F (°C)
6	**DT for heat pump domestic water heating mode**									
	00	Start					3.6 (2)	3.6~36 (2~20)	1.8 (1)	°F (°C)
	01	Stop					3.6 (2)	0~18 (0~10)	1.8 (1)	°F (°C)
	02	Not applicable					0	Read only	—	—
7	**DT for booster heater and dual set point control**									
	00	Domestic hot water step length					0	0~7.2 (0~4)	1.8 (1)	°F (°C)
	01	Hysteresis value booster heater					3.6 (2)	3.6~72 (2~40)	1.8 (1)	°F (°C)
	02	Dual set point control status					0	0/1	—	—
	03	Second set point heating					18 (10)	1.8~43.2 / 77~131 (1~24 / 25~55)	1.8 (1)	°F (°C)
	04	Second set point cooling					44.6 (7)	41~71.6 (5~22)	1.8 (1)	°F (°C)
8	**Domestic water heating mode timer**									
	00	Minimum running time					5	0~20	1	min
	01	Maximum running time					30	5~60	5	min
	02	Anti-recycling time					3	0~10	0.5	hour
	03	Booster heater delay time					50	20~95	5	min
	04	Additional running time at [4-02]/[F-01]					95	0~95	5	min

First code	Second code	Setting name	Installer setting at variance with default value Date	Value	Date	Value	Default value	Range	Step	Unit
9	**Cooling and heating set point ranges**									
	00	Heating set point upper limit					131 (55)	98.6~131 (37~55)	1.8 (1)	°F (°C)
	01	Heating set point lower limit					77 (25)	59~98.6 (15~37)	1.8 (1)	°F (°C)
	02	Cooling set point upper limit					71.6 (22)	64.4~71.6 (18~22)	1.8 (1)	°F (°C)
	03	Cooling set point lower limit					41 (5)	41~64.4 (5~18)	1.8 (1)	°F (°C)
	04	Overshoot setting[(a)]					1.8 (1)	1.8~7.2 (1~4)	1.8 (1)	°F (°C)
A	**Quiet mode**									
	00	Quiet mode type					0	0/2	—	—
	01	Parameter 01					3	—	—	—
	02	Not applicable					1	Read only	—	—
	03	Not applicable					0	Read only	—	—
	04	Not applicable					0	Read only	—	—
b	Not applicable									
	00	Not applicable					0	Read only	—	—
	01	Not applicable					0	Read only	—	—
	02	Not applicable					0	Read only	—	—
	03	Not applicable					0	Read only	—	—
	04	Not applicable					0	Read only	—	—
C	**Setup on EKRP1HB digital I/O PCB**									
	00	Solar priority mode setting					0	0/1	1	—
	01	Alarm output logic					0	0/1	—	—
	02	Bivalent operation status					0	0/1	—	—
	03	Bivalent ON temperature					32 (0)	–13~77 (–25~25)	1.8 (1)	°F (°C)
	04	Bivalent hysteresis					5.4 (3)	3.6~18 (2~10)	1.8 (1)	°F (°C)
D	**Benefit kWh rate power supply/local shift value weather dependent**									
	00	Switching off heaters					0	0/1/2/3	—	—
	01	Unit connection to benefit kWh ate power supply					0 (OFF)	0/1/2	—	—
	02	Not applicable. Do not change the default value.					0	—	—	—
	03	Local shift value weather dependent					0	0/1/2/3/4	—	—
E	**Unit information readout**									
	00	Software version					Read only	—	—	—
	01	EEPROM version					Read only	—	—	—
	02	Unit model identificatio					Read only	—	—	—
	03	Liquid refrigerant temperature					Read only	—	—	°F (°C)
	04	Inlet water temperature					Read only	—	—	°F (°C)
F	**Option setup**									
	00	Pump operation					0	0/1	—	—
	01	Space cooling permission temperature					68 (20)	50~95 (10~35)	1.8 (1)	°F (°C)
	02	Bottom plate heater ON temperature					37.4 (3)	37.4~50 (3~10)	1.8 (1)	°F (°C)
	03	Bottom plate heater hysteresis					9 (5)	3.6~9 (2~5)	1.8 (1)	°F (°C)
	04	Functionality of X14A					1	0/1	—	—

(a) Only possible to modify the first 3 mi utes after power ON.

Daikin's unique position as a manufacturer of air conditioning equipment, compressors and refrigerants has led to its close involvement in environmental issues. For several years, Daikin has had the intention of becoming a leader in the the provision of products that have limited impact on the environment. This challenge demands the eco design and development of a wide range of products and an energy management system, resulting in energy conservation and reduction of waste.

ISO14001 assures an effective environmental management system in order to help protect human health and the environment from the potential impact of our activities, products, and services and to assist in maintaining and improving the quality of the environment.

Daikin Europe N.V. is approved by LRQA for its Quality Management System in accordance with the ISO9001 standard. ISO9001 pertains to quality assurance regarding design, development, and manufacturing, as well as to services related to the product.

Daikin units comply with the European regulations that guarantee the safety of the product.

DAIKIN EUROPE N.V.
Naamloze Vennootschap
Zandvoordestraat 300
B-8400 Oostende, Belgium
www.daikin.eu
BTW: BE 0412 120 336
RPR Oostende

DAIKIN AC (AMERICAS), INC.
1645 Wallace Drive, Suite 110
Carrollton, TX 75006
info@daikinac.com
www.daikinac.com

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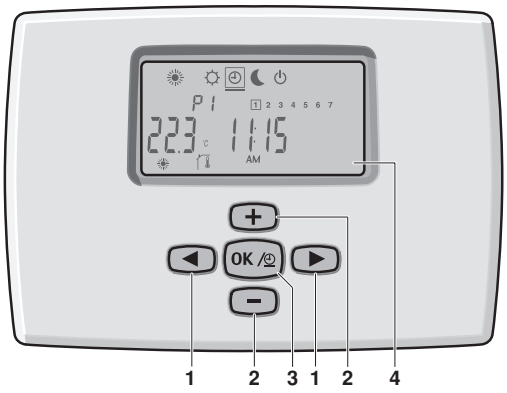
DAIKIN

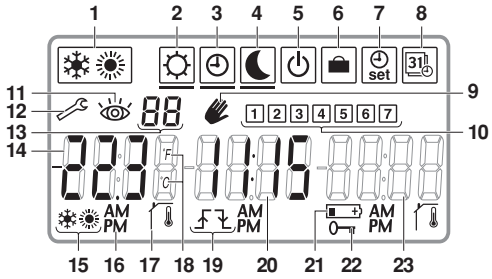
OPERATION MANUAL

Room thermostat

EKRTWA



1



2

THANK YOU FOR PURCHASING THIS THERMOSTAT. READ THE MANUAL ATTENTIVELY BEFORE USING THE INSTALLATION. AFTER READING THE MANUAL, STORE IT IN A SAFE PLACE FOR FUTURE USE.

The English text is the original instruction. Other languages are translations of the original instructions.

WARNINGS

- Never let the thermostat get wet, this may cause an electric shock or fire.
- Never press the buttons of the thermostat with a hard, pointed object. The thermostat may be damaged.
- Never inspect or service the thermostat yourself, ask a qualified service person to do this.

Contents

1. Main features

The EKRTWA is a state of the art programmable electronic thermostat, which regulates your Daikin system, where comfort, simplicity and energy saving go hand in hand. It is the wired room thermostat option kit, mainly used for new installations.

The main features are:

- Room temperature control, based on the measurements of the internal sensor.
- Cooling and heating mode (with possibility to disable cooling function if not required).
- Off function (with integrated frost protection).
- Comfort and reduced function modes, using the comfort and reduced setpoint respectively.
- Holiday function mode.
- Weekly schedule timer with 2 custom (U1+U2) and 5 predefined (P1~P5) schedules.
  - The predefined schedules use the comfort and reduced setpoints of the comfort or reduced function mode.
  - The custom schedules use independent, programmed setpoints (up to 12 setpoints per day).
  - You can lock the schedule timer which allows a temporary override with the comfort or reduced setpoint by means of a single key push.
  - It is possible to link a custom schedule to cooling and heating mode.
  - Comfort startup control. The schedule timer will automatically start up in advance, trying to reach the programmed setpoint at the programmed time.
- Clock (with day and month).
- Key lock function.
- Automatic daylight saving time change.
- Setpoint limitation. Your installer has the possibility to modify the lower and upper limit of the setpoints. Refer to “Setting up codes in the installer menu” (code Gr12+Gr13) in the installation manual.

2. Buttons on front cover and LCD

Refer to figure 1 at the inside of the front cover.

1	Left and right buttons (◁ and ▷). Used to select modes.
2	Up and down buttons (+ or −). Used to change values.
3	OK - Schedule timer button (OK/⏲). Used to: - confirm setpoints or save selections - enable/disable locked schedule timer
4	LCD

Refer to figure 2 at the inside of the front cover.

1	Cooling/heating mode selection
2	Comfort function mode
3	Schedule timer function mode
4	Reduced function mode
5	OFF function mode (with integrated frost protection)
6	Holiday function mode
7	Schedule timer setting menu
8	Date and clock setting menu
9	Manual override of scheduled mode
10	Day of the week
11	Error occurred: intervention needed
12	Active user or installation menu or error occurred. Refer to "Troubleshooting" on page 18.
13	Selected program (schedule timer) or code
14	Room temperature or setpoint (when flashing)
15	Thermostat ON (heating or cooling requested)

16	AM - PM indication
17	Room temperature symbol
18	Degrees type indication (°C or °F)
19	When manually overriding a schedule or when consulting the active scheduled setpoints by pressing ⊕ or ⊖, the current and next setpoint together with the starting hour of the next action are displayed. • ↑ is shown in case the next action setpoint goes up. • ↓ is shown in case the next action setpoint goes down. • ↑↓ is shown in case the setpoints are equal.
20	Actual time
21	“Low batteries” indication
22	Key lock function
23	Next scheduled temperature setpoint

3. Getting started

3.1. Setting the clock and date

After installation you first need to set the clock before you can actually use the thermostat.

1 Activate the advanced mode by pressing ▷ during 5 seconds in OFF mode (⏻).
Refer also to "Description of the function modes and menus" on page 7.

2 Navigate to the date and clock setting menu (📅) by pressing ▷ and then press OK/⎚.

3 Set the hour, minutes, day of the week (1 = Monday, 2 = Tuesday,...), day, month and year by pressing + or − and confirm each time by pressing OK/⎚.
The value that you modify flashes.

3.2. Setting the desired mode: heating or cooling

NOTE This is only possible if cooling mode is available.

1 Press ◁ to go to comfort mode (☼).

2 Press ◁ during 5 seconds to go to the heating/cooling selection mode.

3 Press ◁ or ▷ to switch to the desired mode.
❄ or ☀ is flashing.

4 Press OK/⎚ to save your selection.
The thermostat returns to the schedule timer mode (⏲).

3.3. Setting the desired setpoint

1 Navigate to the comfort mode ☼ by pressing ◁ or ▷ to set the comfort setpoint.
Refer also to "Description of the function modes and menus" on page 7.

2 Raise or drop the setpoint by pressing + or −.
The current setpoint flashes.

3 Press OK/⊡ to save your settings.
The room temperature is displayed (🌡).

4. Description of the function modes and menus

4.1. Modes in the standard menu

Press ◁ or ▷ to switch to the desired mode.

The ☐ cursor will move.

Icon	Description
	Comfort mode. Use this mode for a fixed temperature on comfort level (comfort setpoint default on 21.0°C/70.0°F in heating mode, 24.0°C/75.5°F in cooling mode).
	Schedule timer mode. Use this mode to let your installation be controlled by the schedule timer. The actions programmed in the schedule timer will be executed automatically according to the actual time. This function mode uses the scheduled temperature setpoint. The functionality of the locked/unlocked schedule timer mode is explained in "Manually overriding a schedule" on page 11. It is advised to lock the schedule timer mode by pressing OK/⊘. A line will appear underneath the icon ( ).
	Reduced mode. Use this mode for a fixed temperature on reduced level (reduced setpoint default on 17.0°C/63.0°F in heating mode, 28.0°C/82.5°F in cooling mode).
	OFF mode. Use this mode to switch off your installation. Integrated frost protection remains activated (frost protection default on 4.0°C/39.5°F).

4.2. Modes and menus in the advanced menu

To activate advanced modes, navigate to OFF mode (⏻) and press ▷ during 5 seconds.

Icon	Description
	Holiday mode. Use this mode to set a fixed temperature during a long absence. To exit the holiday mode, set the duration to "no". Refer to "Using the holiday mode" on page 14.
	Schedule timer setting menu. Use this menu to choose a factory-defined schedule or create a custom one.
	Date and clock setting menu. Use this menu to set date and time.

5. Using the thermostat

5.1. Using the key lock function

Activate or deactivate the key lock function by pressing and at the same time.

5.2. Activating the schedule timer

For full comfort with limitation of energy consumption you can pick an ideal schedule for each day. This makes sure the temperature is in the comfort mode when you are at home and that the temperature is automatically reduced at times you are sleeping, at work and so on.

1 If needed, activate the advanced mode by pressing during 5 seconds in OFF mode ( ).

2 Navigate to the Schedule timer setting menu ( ) by pressing .

3 Select the desired schedule by pressing or .
When pressing the next schedule is shown. When pressing the previous schedule is shown.
The possible schedules are: 2 user-defined (U1+U2) and 5 factory-defined (P1~P5).
The factory-defined schedules are described in "APPENDIX: factory-defined programs" on page 20. For the user-defined schedules, refer to "Setting up a user-defined schedule" on page 12.

4 Activate the selected schedule by pressing .
Press to exit the schedule.
Press and to consult the programmed actions, press and to consult the other days (if already programmed).

5 Navigate to the schedule timer function mode ( ) by pressing .

6 Optionally, press to lock the schedule timer mode ( ).

NOTE For your optimum comfort, the schedule timer can be set to start up in advance (120 minutes, code 2r02, for 4.0° setpoint difference), trying to reach the programmed setpoint at the programmed time. This control can be enabled or disabled by means of code 2r01 in the user menu. Refer to "Setting up codes in the user menu" on page 15.

5.3. Manually overriding a schedule

There are 2 ways of overriding a schedule:

- **A temporary override in locked schedule timer mode ( )**
  Temporarily choose the comfort or reduced setpoint by pressing 1 button only: ◁ or ▷. The cursor "_" will move.
  - comfort setpoint: ☼ and ✋ are displayed.
  - reduced setpoint: ☾ and ✋ are displayed.
- **A temporary override of the setpoint in schedule timer mode**
  Press + or − to modify the setpoint in steps of 0.5°C/0.5°F. Save a new, manual setpoint by pressing OK or by waiting 5 seconds.
  ✋ is displayed.

Locking and unlocking the schedule timer mode is performed by pressing OK. The locked schedule timer mode displays as . The unlocked schedule timer mode displays as .

NOTE By default the manual override is active until the next scheduled action. You can change this behavior by means of user code 03: the manual override will then only be active for 1 hour. Refer to "Setting up codes in the user menu" on page 15.

5.4. Setting up a user-defined schedule (U1 and U2)

Within the user-defined schedule each day can be programmed individually and 12 actions (setpoints) are possible per day.

- First decide upon the temperature scale you prefer (°C/°F) by setting up code 1-01 as decribed in "Setting up codes in the user menu" on page 15.
- At all times you can press ◁ to go back 1 step. Pressing ▷ goes to the next step.

1 If needed, activate the advanced mode by pressing ▷ during 5 seconds in OFF mode (⏻).

2 Navigate to the schedule timer setting menu (SET) by pressing ▷.

3 Press + or − until U1 or U2 flashes and press OK to confirm.

4 Press ◁ or ▷ to move to the day you want to program and press + to select or − to deselect it.
You can program multiple days at once by selecting them.

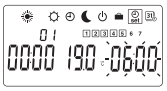
5 Press OK to confirm.

6 Press + or − to adjust the setpoint of the first action.
The first action starts at 0000 and lasts until the end time which you set up in the next step.

7 Press [OK] to confirm.

8 Press [+] or [−] to adjust the end time of this action. Programming a day is finished when the end time of the last scheduled action is set to 23:59. You can quickly set the time to 23:59 by pressing [▷].

9 Press [OK] to confirm.



10 Repeat step 6 till 9 for the next scheduled actions of this day.

11 To program the remaining days, repeat above steps. Do this for all days of the week.

NOTE Once programmed you can only modify programmed actions one by one and no additional actions can be added.

You can clear a user-defined schedule again by selecting it (U1 or U2 should be flashing) and then pressing [◁] during 10 seconds. "CLr U1" or "CLr U2" appears on the LCD to confirm the schedule is cleared.

Your installer can link a custom schedule to cooling and heating mode. Refer to "Setting up of codes in the installer menu" (code Br01) in the installation manual.

5.5. Using the holiday mode

Use the holiday mode to set a fixed setpoint during a long absence. The default holiday setpoint for heating is 14.0°C/57.5°F, for cooling 30.0°C/86.0°F.

1 If needed, activate the advanced mode by pressing ▷ during 5 seconds in OFF mode (⏲).

2 Press ▷ to navigate to holiday mode (🧳).

3 Press + or − to adjust the duration (H = hours, d = days).
To exit the holiday mode, set the duration to "no".

4 Press OK to confirm.

5 Press + or − to adjust the holiday setpoint.

6 Save this new setpoint by pressing OK or by waiting 5 seconds.
The holiday setpoint will be kept for the programmed duration. The duration is shown and counts down. In case the duration becomes less than 1H, the remaining minutes are shown (example: 59'). After the programmed duration the thermostat will go back to the schedule timer mode (⏲).

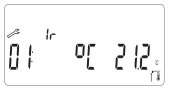
6. Setting up codes in the user menu

NOTE As a consequence of a customized configuration, it is not abnormal that some codes are no longer accessible.

1 Activate the advanced mode by pressing ▷ during 5 seconds in OFF mode (⏻).

2 Navigate to the date and clock setting menu (31 Mon) by pressing ▷.

3 Press ▷ during 5 seconds.
🔧 is displayed next to Ir.



4 Press ◁ or ▷ to consult the current settings of the codes.

5 To modify codes, press ⊕, ⊖ or OK/⊡.

6 Press ⊕ or ⊖ to increase or decrease the code value by 1 step.

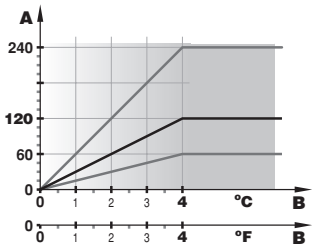
7 Press OK/⊡ to save your selection.
You can exit this user code menu by going to the "End" code and pressing OK/⊡.
To put a code back to its default value, press ⊕ and ⊖ at the same time.

Following codes can be consulted or changed in the user menu:

1st code	2nd code	Description	Default	Range	Step
1r	01 + 🌡	Degrees type. Current room temperature is displayed. Refer also to note below.	°C	°C/°F	—
	02	Choice of hour control. Actual time is displayed.	24H	12H/24H	—
	03	Always enable advanced menu? (no = standard menu enabled)	no	YES/no	—
2r	01	Enable comfort startup control?	no	YES/no	—
	02	Comfort control speed: time for temp. difference of 4°. Refer also to note below.	120	060~240	1min.
	03	Schedule timer override: only 1 hour active? (no = until next action)	no	YES/no	—
3r	01	Showing software version	—	—	—

NOTE

- In case the 1r01 code is modified after having user-defined schedules programmed, the U1 and U2 user-defined schedules are cleared.
- Code 2r02: Refer to diagram below for clarification of the comfort control speed.



A minutes

B setpoint difference

7. Troubleshooting

The guidelines below might help to solve your problem. If you cannot remedy the problem, consult your installer.

7.1. No readings on the LCD (display blank)

Batteries are empty. Replace batteries. Refer to "Replacing batteries" on page 19.

7.2. Buttons on front cover do not react

If 0⊸ is flashing when pressing a button on the front cover it means the key lock is activated. Press ⊕ and ⊖ at the same time to deactivate it.

7.3. Schedule timer starts up too early

The schedule timer by default starts up in advance, trying to reach the programmed setpoint at the programmed time. If desired, disable this function by means of code 2r01 in the user menu.

7.4. Clock and date are flashing on the thermostat LCD

The clock and date are flashing before first use or after replacement of batteries. Set clock and date as described in “Setting the clock and date” on page 5.

7.5. User-defined schedule does not react

The 1r01 code was modified after programming the user-defined schedules. Re-program the schedules as described in "Setting up a user-defined schedule" on page 12.

7.6. Error codes on the thermostat LCD

Error codes are displayed next to the flashing icons 🔧 👁.

Error code	Failure cause	Corrective action
⚠	Broken integrated temperature sensor.	Contact your local dealer.

8. Maintenance

8.1. Replacing batteries

When the “low battery” icon flashes, batteries need to be replaced.

Once the icon flashes, you still have ±30 days to replace them before the thermostat completely shuts down.

With normal operation conditions the battery lifetime is ±2 years.

1 At the left of the thermostat, gently push the lid.

2 Remove the front cover by pulling it towards you.

3 Remove the old batteries and insert new ones.

4 Put the thermostat cover back in place until it clicks.

Only use alkaline batteries of type AA.LR6. Refer also to the technical characteristics in the installation manual.

8.2. Disposal requirements

The batteries supplied with the thermostat are marked with this symbol.

This means that the batteries shall not be mixed with unsorted household waste.

If a chemical symbol is printed beneath the symbol, this means that the battery contains a heavy metal above a certain concentration. Possible chemical symbols are:

- Pb: lead (>0.004%).

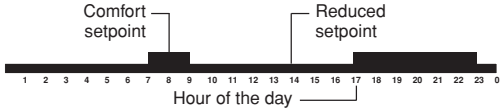
Waste batteries must be treated at a specialized treatment facility for re-use.

By ensuring waste batteries are disposed of correctly, you will help to prevent potential negative consequences for the environment and human health.

9. APPENDIX: factory-defined programs

There are 5 factory-defined programs (P1~P5) for standard situations. If none of them matches your needs, create a custom one (refer to "Setting up a user-defined schedule" on page 12). The comfort setpoint can be changed in the comfort mode ☼, the reduced setpoint can be changed in the reduced mode ☾.

Legend:



Comfort setpoint	by default 21.0°C/70.0°F in heating mode (24.0°C/75.5°F in cooling mode)
Reduced setpoint	by default 17.0°C/63.0°F in heating mode (28.0°C/82.5°F in cooling mode)
Day 1 ~ 5	days of the week (week starts on Monday)
Day 6 + 7	days of the weekend

Refer to the very end of this manual for graphical 24-hour representations of the 5 factory-defined programs like listed below.

- P1 Residential (morning, evening and weekend)
- P2 Residential (morning, noon, evening and weekend)
- P3 7-19h office
- P4 Weekend (secondary house)
- P5 Weekend (shop)

1. EKHBH054BA - Hydrobox

1.1 Features

- Heating only - **EKHBH054BA**
- Heat Pump (heating & cooling) - **EKHBX054BA**
- Large capacity indoor unit
- Cost effective alternative to a fossil fuel boiler
- Low energy bills and low CO_2 emissions
- Interface control with field selectable options that include dual set point (heating & cooling), Quiet Mode, DHW priority settings, schedule timer.
- Easy to install
- Total solution for year round comfort
- Apply with split system outdoor unit (ERLQ)
- Select from 2 sizes of integrated backup heat 3kW (single stage) or 6 kW (2-stage)

The hydrobox is the indoor part of the air-to-water ERLQ outdoor heat pump. These units are designed for wall-mounted indoor installation. The units can be combined with fan coil units, floor heating applications, low temperature radiators, optional Daikin Domestic Hot Water Tanks, and optional Daikin Solar Kits for domestic hot water applications.

The unit range consists of two main versions: a heating/cooling version (EKHBX) and a heating-only version (EKHBH). Both versions are delivered with an integrated backup heater for additional heating during cold outdoor temperatures. The backup heater also serves as a backup if malfunctioning of the outdoor unit should occur. The backup heater models are available for a heating capacity of 3kW and 6kW.

2. Specifications - Hydrobox

2-1 TECHNICAL SPECIFICATIONS

					EKHBH*			EKHBX*		
					EKHBH054BA*			EKHBX054BA*		
Outdoor units					ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU	ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Nominal input (Indoor only without electric heater)					208-230V / 1 ph / 60Hz					
Casing		Color			Neutral White RAL9010					
		Material			Epoxy polyester painted galvanized steel					
Dimensions	Packing	Height		in (mm)	49.23 (1225)					
		Width		in (mm)	25.98 (660)					
		Depth		in (mm)	24.02 (610)					
	Unit	Height		in (mm)	36.30 (922)					
		Width		in (mm)	19.76 (502)					
		Depth		in (mm)	14.21 (361)					
Weight of unit	Machine net weight			lbs (kg)	123 (55)					
	Packed machine weight			lbs (kg)	152 (69)					
Weight of packing materials	Material				EPS, Wood, Carton, PP (straps)					
	Weight			lbs (kg)	29 (14)					
Main Components	Pump	Type			water cooled					
		no. of speeds			3					
		Nominal ESP unit	Cooling	psi (kPa)	–	–	–	8.04 (55.4)	6.53 (45.0)	6.13 (42.3)
			Heating	psi (kPa)	7.34 (50.7)	5.48 (37.8)	3.92 (27.1)	7.34 (50.7)	5.48 (37.8)	3.92 (27.1)
		Power Input		W	210					
	Water Side Heat Exchanger	Type			Brazed Plate					
		Quantity			1					
		Water volume		gal/m (l/min)	0.27 (1.01)					
		Water flow rate Min.		gal/m (l/min)	4.23 (16)					
		Water flow rate Nom.	Cooling (2)	gal/m (l/min)	–	–	–	7.58 (28.7)	9.45 (35.8)	9.90 (37.5)
			Heating (3)	gal/m (l/min)	8.47 (32.1)	10.59 (40.1)	12.12 (45.9)	8.47 (32.1)	10.59 (40.1)	12.12 (45.9)
		Water flow rate Max.	Cooling	gal/min (l/min)	15.3 (58)					
			Heating	gal/min (l/min)	15.3 (58)					
		Insulation material			Polyurethane foam					
	Expansion vessel	Volume		gal/min (l/min	2.64 (10)					
		Max. water pressure		psi (bar	43.5 (3)					
		Pre pressure		psi (bar)	14.3 (1)					
	Water Filter	Diameter perforations		inch (mm)	0.039 (1)					
		Material			brass					

2-1 TECHNICAL SPECIFICATIONS

Water Circuit	Piping Connections			G 1-1/4 (MALE) BSP	
	Piping		in (mm)	1-1/4 (31.8) BSP	
	Safety valve		psi (bar)	43.5 (3)	
	Manometer			Yes	
	Drain valve / Fill valve			Yes	
	Shut-off valve			Yes	
	Air Purge valve			Yes	
	Total water volume (6)		gal (l)	1.45 (5.5)	
Refrig. Circuit	Gas side		in (mm)	5/8 (15.9)	
	Liquid side		in (mm)	3/8 (9.52)	
Sound Level	Sound Pressure (4)	Heating	dBA	28	
	Sound power		dBA	–	
Operation range	Ambient	Cooling	°F (°C)	–	50 ~ 114.8 (10 ~ 46)
		Heating	°F (°C)	-4 ~ 95 (-20 ~ 35)	-4 ~ 95 (-20 ~ 35)
	Waterside	Heating	°F (°C)	–	41 ~ 76.6 (5 ~22)
		Heating (5)	°F (°C)	59 ~ 131 (15 ~ 55)	59 ~ 131 (15 ~ 55)

NOTES:

* (1) With option kit EKHBDP installed: Height = 36.85" (936 mm)
* (2) Tamb 95°F (35°C) – LWE 44.6°F (7 C) (DT = 9°F (5°C)
* (3) DB/WB 44.6°F/42.8 F (7°C/6°C) – LWC 95°F (35°C) (DT = 9°F (5°C)
* (4) The sound pressure level is measured via a microphone at 3.23 ft (1 m) from the unit. It is a relative value, depending on the distance and acoustic environment. The sound pressure level mentioned is valid for pump medium speed.
* (5) 59°F~77°F (15°C~25°C): BUH only, no heat pump operation = during commissioning
* (6) Including piping + PHE + backup heater / excluding expansion vessel

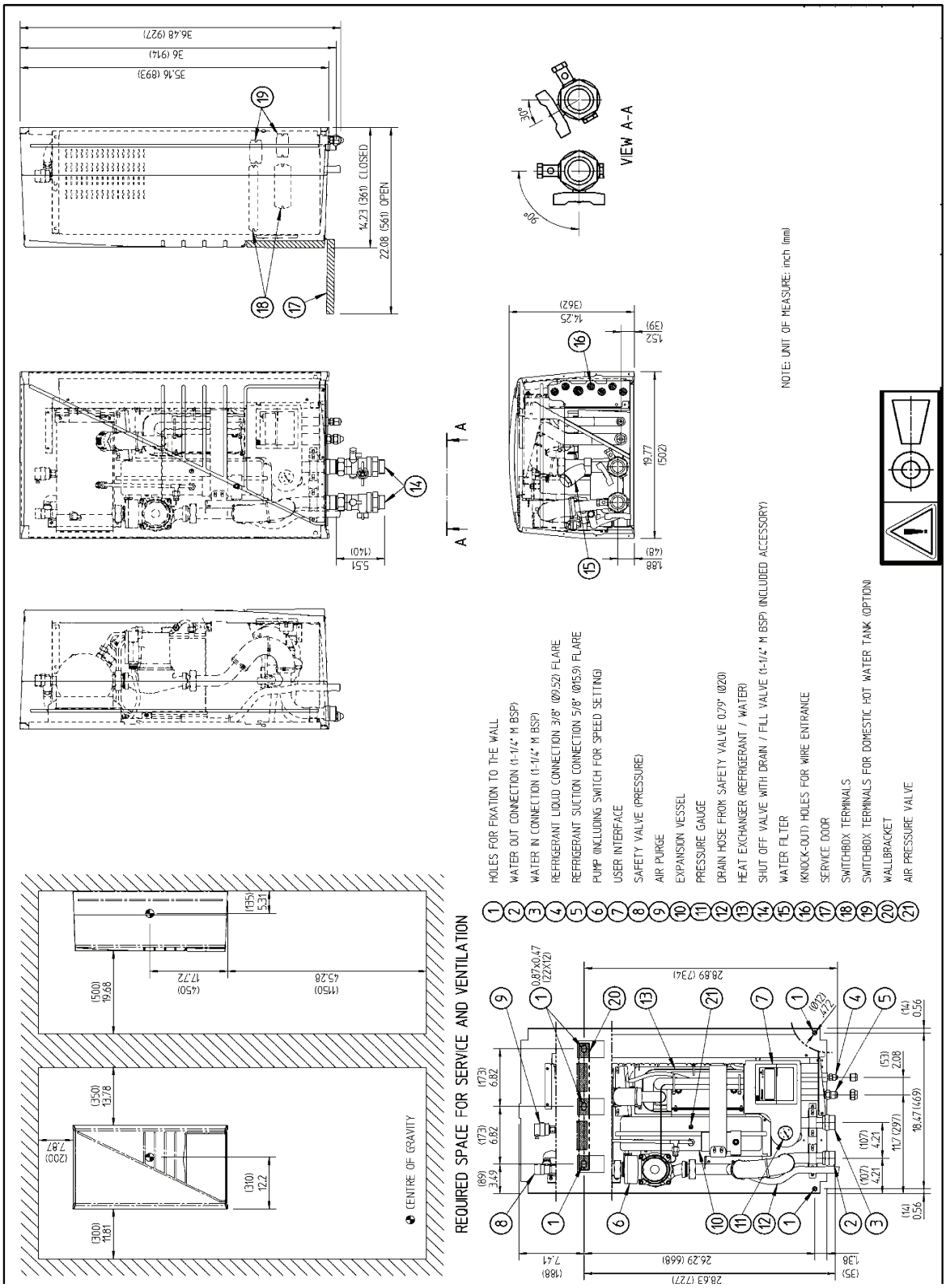
Electrical Specifiations

Electric heater (optional)	Type				3VJU	6VJU
	Power supply (1),(2)	Phase			1~	1~
		Frequency		Hz	60	60
		Voltage		V	208/230	208/230
	Current	Minimum Circuit Amps (MCA)		A	14.3	28.6
		Maximum Overcurrent Protection (MOP)		A	20	30
Voltage range	Minimum			V	187	
	Maximum			V	253	
Wiring connections	for power supply backup heater	quantity of wires			3G	
		type of wires			Note (3)	
	for power supply connection to optional domestic hot water tank + Q2L	quantity of wires			3G	
		type of wires			Note (3) & (4)	
	for connection with RST	quantity of wires			Note (7)	
		type of wires			Note (7)	
	for connection with A3P	quantity of wires			Note (6)	
		type of wires			Note (3) & (5)	
	for connection with M2S	quantity of wires			3G	
		type of wires			Note (3) & (5)	
	for connection with M3S	quantity of wires			3G or 4G	
		type of wires			Note (3) & (5)	
	for connection of bottom plate heater	quantity of wires			2	
		type of wires			Note (3)	

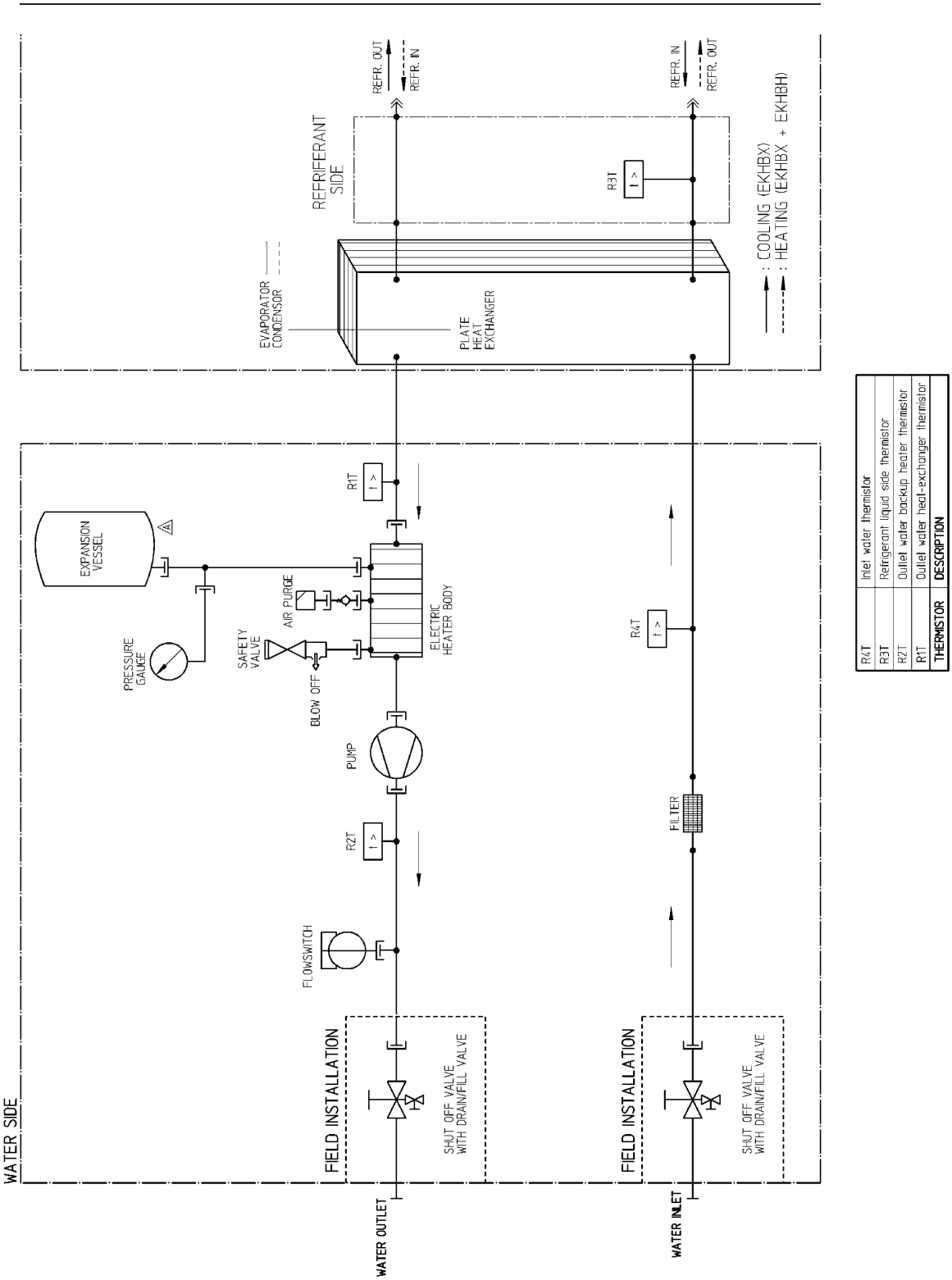
NOTES

* (1) Above mentioned power supply of hydrobox is fro backup heater only. The Switch box & pump of the hydrobox are supplied via the outdoor unit. The optional domestic hot water tank has a separate power supply.
* (2) Optional electric heater has 2 capacity steps except for the 3VJU model which has only 1 capacity step.
* (3) Select diameter and type according to local laws and regulations.
* (4) For more details of the voltage range and current, refer to installation manual EKHBH/X054BA*
* (5) Voltage: 24V / Maximum current: 100mA / Minimum AWG 18 (0.77MM^2)
* (6) Depends on thermostat type; refer to Installation Manual for EKHBH/X054BA*
* (7) Wire included in Option EKHWS*

3. Dimensional Dwg. & Center of Gravity- Hydrobox

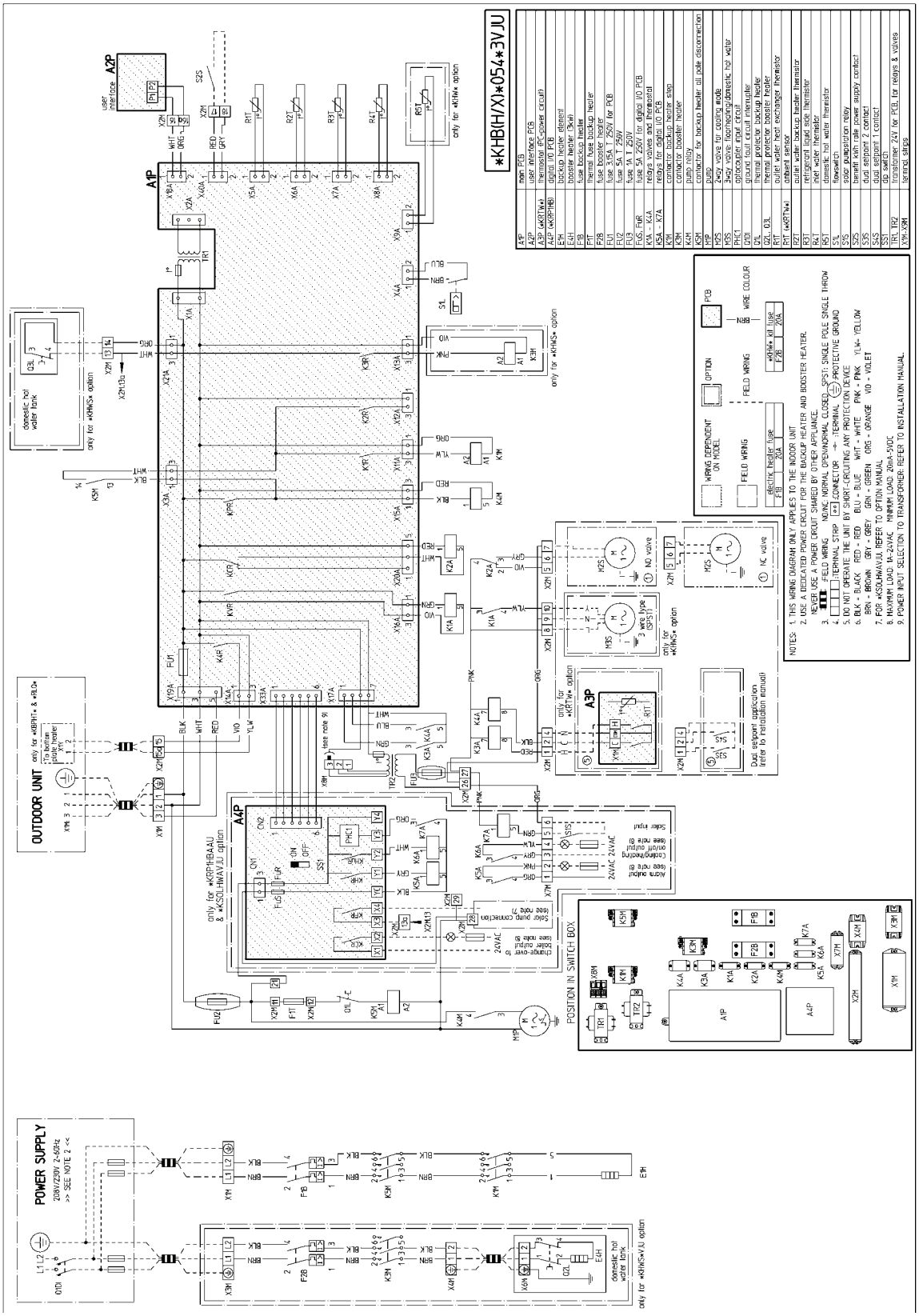


4. Piping Diagram - Hydrobox

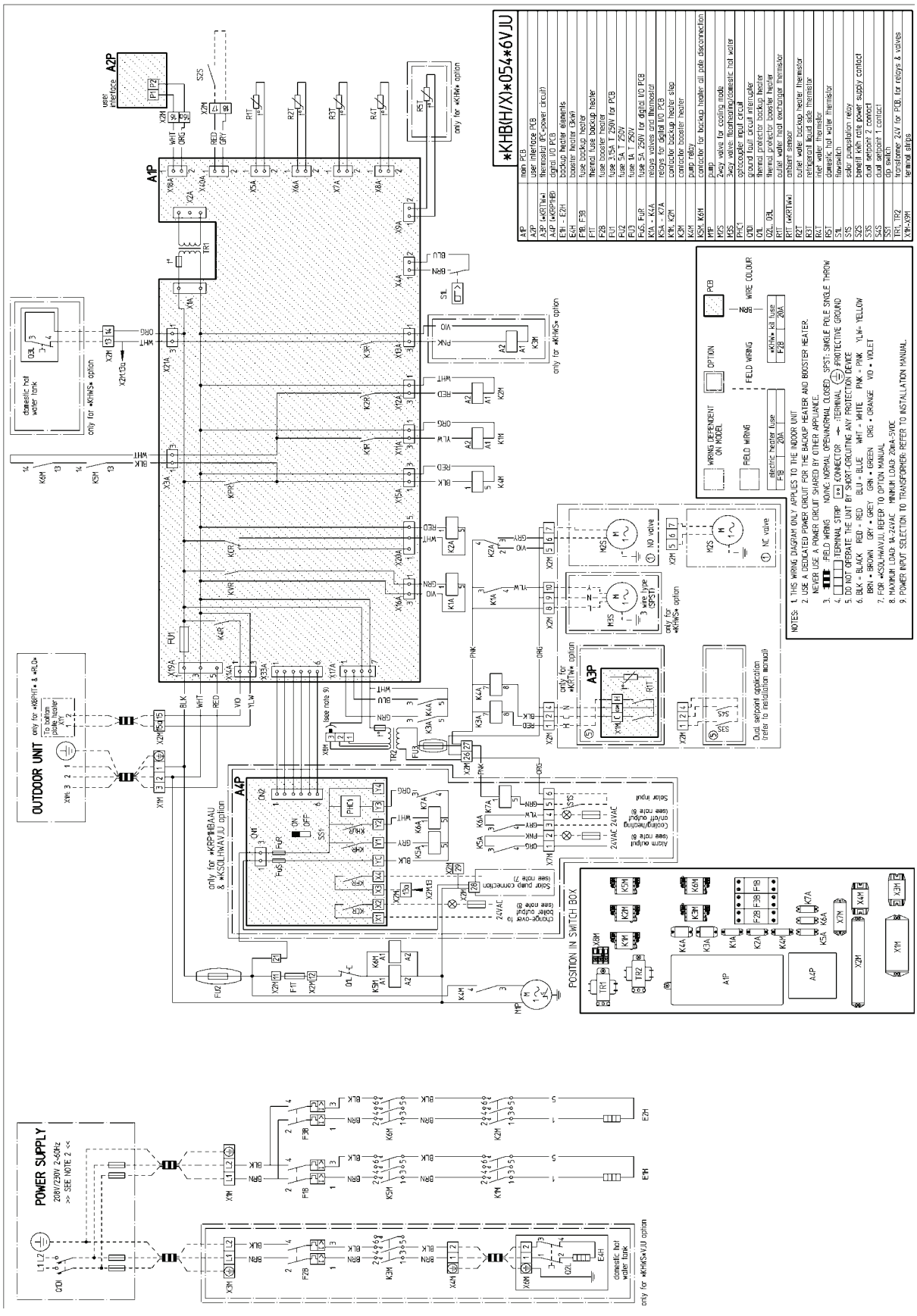


5. Wiring Diagram - Hydrobox

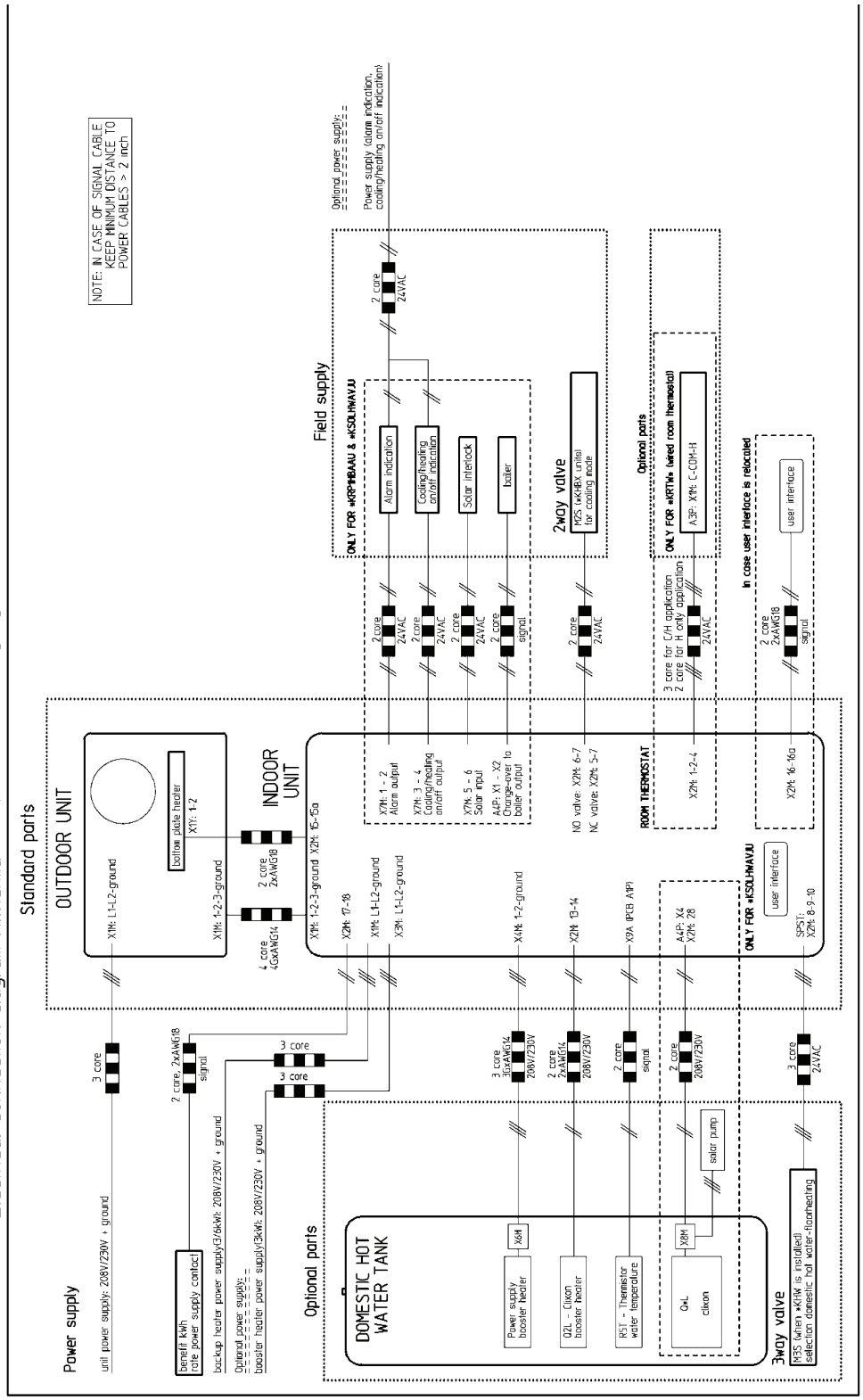
5.1 EKHB(H/X)054BA3VJU



5.2 EKHB(H/X)054BA6VJU



6. External Connection Diagram - Hydrobox



1. ERLQ - Split System Outdoor Unit

1.1 Features

- Inverter operated compressor
- Single phase large capacity outdoor unit (036, 048, 054)
- Cost effective alternative to a fossil fuel boiler
- Low energy bills and low CO2 emissions
- Easy to install
- Total solution for year round comfort
- Anti-corrosion treatment on outdoor coil
- Bottom base pan heater to improve water drainage during defrost

ERLQ outdoor units are combined with an indoor hydrobox; a heating-only hydrobox version (EKHBH), and a heat pump (heating & cooling) hydrobox version (EKHBX). Both hydrobox versions can be applied with an optional domestic hot water tank (EKHWS) and optional solar pump kit (EKSOLHW)

2. Specifications - Split System

2-1 NOMINAL CAPACITY AND NOMINAL INPUT				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
For combination indoor units + outdoor units	Indoor Units			EKHBH054BA (Heating Only)		
Condition (Floor Heating)	Heating capacity	Nominal	kBTU/hr (kW)	38.2 (11.2)	47.8 (14.0)	54.6 (16.0)
	Heating PI	Nominal	kW	2.58	3.30	3.97
	COP	Nominal		4.34	4.24	4.03
Condition 2 (Fan Coil)	Heating capacity	Nominal	kBTU/hr (kW)	35.3 (10.3)	44.8 (13.1)	51.8 (15.2)
	Heating PI	Nominal	kW	3.18	4.00	4.79
	COP	Nominal		3.24	3.28	3.17
For combination indoor units + outdoor units	Indoor Units			EKHBX054BA (Reversible)		
Condition 1 (Floor Heating)	Heating capacity	Nominal	kBTU/hr (kW)	38.2 (11.2)	47.8 (14.0)	54.6 (16.0)
	Cooling capacity	Nominal	kBTU/hr (kW)	47.6 (13.9)	59.1 (17.3)	60.6 (17.8)
	Heating PI	Nominal	kW	2.58	3.30	3.97
	Cooling PI	Nominal	kW	3.91	5.94	6.94
	COP	Nominal		4.34	4.24	4.03
	EER	Nominal		12.17	9.95	8.73
Condition 2 (Fan Coil)	Heating capacity	Nominal	kBTU/hr (kW)	35.3 (10.3)	44.8 (13.1)	51.8 (15.2)
	Cooling capacity	Nominal	kBTU/hr (kW)	34.1 (10.0)	42.7 (12.5)	44.7 (13.1)
	Heating PI	Nominal	kW	3.18	4.00	4.79
	Cooling PI	Nominal	kW	3.72	5.41	6.08
	COP	Nominal		3.24	3.28	3.17
	EER	Nominal		9.17	7.89	7.35
Notes				Condition 1: cooling Ta 95°F (35°C) - LWE 64.4°F (18°C) - heating Ta DB/WB 44.6/42.8°F (7/6°C - LWC 95°F (35°C) (ΔT = 9°F (5°C)		
				Condition 2: cooling Ta 95°F (35°C) - LWE 45°F (7°C) (ΔT = 9°F (5°C) - heating Ta DB/WB 44.6/42.8°F (7/6°C) - LWC 113°F (45°C) (ΔT = 9°F (5°C)		

2-2 TECHNICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Casing	Colour			Ivory white		
	Material			Painted galvanised steel plate		
Dimensions	Unit	Height	in (mm)	46" (1,170 mm)		
		Width	in (mm)	35.4" (900 mm)	35.4" (900 mm)	35.4" (900 mm)
		Depth	in (mm)	12-1/2" (320 mm)	12-1/2" (320 mm)	12-1/2" (320 mm)
	Packing	Height	in (mm)	53" (1,349 mm)		
		Width	in (mm)	38-1/2" (980 mm)	38-1/2" (980 mm)	38-1/2" (980 mm)
		Depth	in (mm)	16-1/2" (420 mm)	16-1/2" (420 mm)	16-1/2" (420 mm)
Weight	Unit		lb (kg)	227 lb (103 kg)	227 lb (103 kg)	227 lb (103 kg)
	Packed Unit		lb (kg)	251.3 lb (114 kg)	251.3 lb (114 kg)	251.3 lb (114 kg)
Packing	Material			EPS		
				Carton		
				Wood		
				PP (Straps)		
	Weight		lb (kg)	24.3 lb (11 kg)	24.3 lb (11 kg)	24.3 lb (11 kg)

2-2 TECHNICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Heat Exchanger	Dimensions	Length	in (mm)	33-3/4" (857 mm)	33-3/4" (857 mm)	33-3/4" (857 mm)
		Nr of Rows		2	2	2
		Fin Pitch	in (mm)	1/16" (1.4 mm)	1/16" (1.4 mm)	1/16" (1.4 mm)
		Nr of Passes		6	6	6
		Face Area	ft² (m²)	3.22 ft² (0.98 m²)	3.22 ft² (0.98 m²)	3.22 ft² (0.98 m²)
		# of Stages		52	52	52
	Tube type			Hi-XSS(8)		
	Fin	Type		WF fin		
		Treatment		Anti-corrosion treatment (PE)		
Fan	Type			Propeller		
	Quantity			2	2	2
Air Flow Rate (nominal at 230V)	Heating	High	cfm (m³/min)	3178 cfm (90 m³/min)	3178 cfm (90 m³/min)	3178 cfm (90 m³/min)
	Cooling	High	cfm (m³/min)	3355 cfm (96 m³/min)	3531 cfm (100 m³/min)	3426 cfm (97 m³/min)
Fan	Discharge direction			Horizontal		
	Motor	Quantity		2	2	2
		Model		Brushless DC motor		
Motor	Speed (nominal)	Steps		8	8	8
		Heating	rpm	760	760	760
		Cooling	rpm	800	850	830
Fan	Motor	Output	W	70 each	70 each	70 each
		Drive		Direct drive		
Compressor	Quantity			1	1	1
	Motor	Model		JT100G-VD		
		Type		Hermetically sealed scroll compressor		
		Motor Output	W	2,200		
		Starting Method		Inverter driven		
Motor	Crankcase Heater	Output	W	33	33	33
Ambient Operation Range	Heating	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	95 (35)	95 (35)	95 (35)
	Cooling	Min	°F (°C)	50 (10)	50 (10)	50 (10)
		Max	°F (°C)	114.8 (46)	114.8 (46)	114.8 (46)
	Sanitary water	Min	°F (°C)	-4 (-20)	-4 (-20)	-4 (-20)
		Max	°F (°C)	109.4 (43) 95 (35) HP / 109.4 (43) BH	109.4 (43) 95 (35) HP / 109.4 (43) BH	109.4 (43) 95 (35) HP / 109.4 (43) BH
Sound Level (nominal) *1	Heating	Sound Power	dBA	64	64	66
		Sound Pressure	dBA	49	51	53
	Cooling	Sound Power	dBA	64	66	69
		Sound Pressure	dBA	50	52	54
Sound Level (Night quiet)	Heating	Sound Pressure	dBA	42	42	43
	Cooling	Sound Pressure	dBA	45	45	46
Refrigerant	Type			R-410A		
	Charge		oz (kg)	8.2 lb (3.7 kg)	8.2 lb (3.7 kg)	8.2 lb (3.7 kg)
	Control			Expansion valve(electronic type)		
	Nr of Circuits			1	1	1
Refrigerant Oil	Type			Daphne FVC68D		
	Charged Volume		g (l)	1.06 g (1.0 l)	1.06 g (1.0 l)	1.06 g (1.0 l)

2-2 TECHNICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Piping connections	Liquid (OD)	Quantity		1	1	1
		Type		Flare connection		
		Diameter (OD)	in (mm)	3/8” (9.52 mm)		
	Gas	Quantity		1	1	1
		Type		Flare connection		
		Diameter (OD)	in (mm)	5/8” (15.9 mm)		
	Drain	Quantity		3	3	3
		Type		Hole		
		Diameter (OD)	in (mm)	1-1/32” (26 mm)	1-1/32” (26 mm)	1-1/32” (26 mm)
	Piping Length	Minimum	ft (m)*2	16.4 ft (5 m)	16.4 ft (5 m)	16.4 ft (5 m)
		Maximum	ft (m)	246 ft (75 m)	246 ft (75 m)	246 ft (75 m)
		Equivalent	ft (m)	312 ft (95 m)	312 ft (95 m)	312 ft (95 m)
		Chargeless	ft (m)	98.4 ft (30 m)	98.4 ft (30 m)	98.4 ft (30 m)
	Additional Refrigerant Charge		kg	See installation manual outdoor unit		
	Installation height difference	Maximum	ft (m)	98.4 ft (30 m)	98.4 ft (30 m)	98.4 ft (30 m)
	Heat Insulation			Both liquid and gas pipes		
Defrost Method				Pressure equalizing		
Defrost Control				Sensor for outdoor heat exchanger temperature		
Capacity Control Method				Inverter controlled		
Safety Devices				Fan motor thermal protector		
				Fuse		
				High pressure switch		
Standard Accessories	Item			Tie-wraps		
	Quantity			2	2	2
	Item			Installation manual		
	Quantity			1	1	1
Notes				(*1) The sound pressure level is measured via a microphone at a certain distance from the unit. It is a relative value depending on the distance and acoustic environment. Refer to sound spectrum drawing for more information.		
				(*2) Down to 10 ft. (3 m) with recharging of the outdoor unit. Refer to the installation manual of the outdoor unit.		

2-3 ELECTRICAL SPECIFICATIONS				ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Power Supply	Name			VJU	VJU	VJU
	Phase			1~	1~	1~
	Frequency		Hz	60	60	60
	Voltage		V	208-230	208-230	208-230
	Voltage range	Minimum	V	-10%	-10%	-10%
		Maximum	V	+10%	+10%	+10%
	Compressor	Rated Load Amps (RLA)	A	23.4	23.4	23.4
		Full Load Amps (FLA)	A	26.5	26.5	26.5
Current	Total	Minimum Current Protection (MCA)	A	26.5	26.5	26.5
		Maximum Current Protection (MOP)	A	30	30	30
Wiring Connections	For Power Supply	Remark		See installation manual outdoor unit		
	For Connection with Indoor	Remark		See installation manual outdoor unit		
Power Supply Intake				Outdoor Unit Only		
Notes				Standard for Safety Heating and Cooling Equipment; UL1995/CSA (U&C) C22.2 #236.		

3. Capacity Tables - Split System

3.1 Heating

MAXIMUM HEATING CAPACITY - PEAK VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	Cop	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP
ERLQ036BAVJU	-4/-20	19.30	7.01	2.75	18.70	8.00	2.34	15.60	9.42	1.66									
	5/-15	22.10	8.02	2.76	21.30	8.74	2.44	21.10	9.60	2.20									
	19/-7.2	27.40	8.09	3.39	26.40	8.84	2.99	26.00	9.73	2.67	25.60	10.77	2.38						
	25/-3.9	31.30	8.07	3.88	30.20	8.86	3.41	29.70	9.78	3.04	29.20	10.80	2.70	27.90	11.91	2.34			
	36/2.2	34.80	8.02	4.34	33.50	8.84	3.79	33.00	9.77	3.38	32.50	10.85	3.00	31.10	11.94	2.60	29.80	13.26	2.25
	45/7.2	39.50	7.95	4.97	35.20	8.80	4.00	36.70	9.78	3.75	35.30	10.84	3.26	33.90	12.07	2.81	32.50	13.44	2.42
	54/12.2	44.80	7.85	5.71	43.20	8.70	4.97	41.70	9.69	4.30	40.10	10.79	3.72	38.60	12.04	3.21	37.10	13.42	2.76
	59/15	48.20	7.77	6.20	46.50	8.05	5.78	44.90	9.63	4.66	43.30	10.74	4.03	41.70	12.00	3.48	40.10	13.40	2.99
	68/20	54.30	7.64	7.11	52.50	8.51	6.17	50.70	9.49	5.34	49.00	10.64	4.61	47.20	11.01	4.29	45.40	13.33	3.41
ERLQ048BAVJU	-4/-20	24.70	9.74	2.54	24.40	10.60	2.30												
	5/-15	27.00	9.93	2.72	27.30	10.82	2.52	26.80	11.84	2.26									
	19/-7.2	34.30	10.10	3.40	33.40	11.03	3.03	32.40	12.12	2.67	31.60	13.34	2.37						
	25/-3.9	39.10	10.20	3.83	37.90	11.12	3.41	37.70	12.25	3.08	36.40	13.16	2.77	35.30	14.52	2.43			
	36/2.2	43.30	10.20	4.25	42.00	11.19	3.75	41.70	12.32	3.38	40.30	13.24	3.04	39.00	14.83	2.63	37.80	16.16	2.34
	45/7.2	49.20	10.25	4.80	47.80	11.25	4.25	48.20	12.38	3.89	44.80	13.65	3.28	43.30	15.09	2.87	41.90	16.69	2.51
	54/12.2	55.80	10.25	5.44	54.10	11.26	4.80	52.40	12.40	4.23	50.70	13.71	3.70	49.10	15.17	3.24	47.50	16.78	2.83
	59/15	60.10	10.27	5.85	58.20	11.27	5.16	56.40	12.44	4.53	54.70	13.74	3.98	52.90	15.20	3.48	51.20	16.82	3.04
	68/20	67.80	10.30	6.58	65.80	11.32	5.81	63.80	12.48	5.11	61.80	13.79	4.48	59.90	15.28	3.92	57.90	16.89	3.43
ERLQ054BAVJU	-4/-20	28.50	11.53	2.47	28.40	12.52	2.27												
	5/-15	32.00	11.78	2.72	31.80	12.81	2.48	31.70	14.00	2.26									
	19/-7.2	39.00	12.00	3.25	38.40	13.13	2.92	37.80	14.40	2.63	37.20	15.82	2.35						
	25/-3.9	44.40	12.22	3.63	43.50	13.31	3.27	42.80	14.57	2.94	41.70	16.04	2.60	40.90	17.67	2.31			
	36/2.2	49.10	12.31	3.99	48.00	13.43	3.57	47.00	14.72	3.19	45.90	16.19	2.84	44.90	17.84	2.52	40.60	18.67	2.17
	45/7.2	55.00	12.43	4.42	54.60	13.55	4.03	53.10	14.87	3.57	51.80	16.35	3.17	50.50	18.02	2.80	45.70	18.85	2.42
	54/12.2	63.20	12.57	5.03	61.70	13.71	4.50	60.10	15.01	4.00	58.00	16.51	3.51	57.00	18.19	3.13	51.60	19.01	2.71
	59/15	68.10	12.65	5.38	68.40	13.82	4.95	64.70	15.12	4.28	63.00	16.61	3.79	61.30	18.29	3.35	55.50	20.12	2.76
	68/20	76.00	12.05	6.31	75.00	13.99	5.36	73.10	15.31	4.77	71.10	16.60	4.28	69.20	18.48	3.74	63.70	20.20	3.15

Peak value does not include capacity drop during frosting and defrosting periods.

MAXIMUM HEATING CAPACITY - INTEGRATED VALUE

MODEL	LWC (°F/°C)	86/30			95/35			104/40			113/45			122/50			131/55		
	T_{amb} (°F/°C)	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP	HC kBTU/h	PI (kBTU/h)	COP
ERLQ036BAVJU	-4/-20	17.20	7.93	2.17	16.70	8.01	2.08	16.50	9.43	1.75									
	5/-15	19.70	8.04	2.45	19.00	8.75	2.17	18.70	9.62	1.94									
	19/-7.2	23.50	8.11	2.90	22.00	8.87	2.48	22.30	9.76	2.28	21.90	10.80	2.03						
	25/-3.9	25.40	7.66	3.32	24.40	8.41	2.90	24.10	9.27	2.60	23.70	10.26	2.31	22.60	11.28	2.00			
	36/2.2	27.80	7.81	3.56	26.80	8.60	3.12	28.00	9.49	2.95	26.00	10.54	2.47	24.90	11.80	2.11	23.80	12.89	1.85
	45/7.2	39.50	7.95	4.97	38.20	8.80	4.34	38.70	9.76	3.97	35.30	10.84	3.26	33.90	12.07	2.81	32.50	13.44	2.42
	54/12.2	44.80	7.85	5.71	43.20	8.70	4.97	41.70	9.69	4.30	40.10	10.79	3.72	38.60	12.04	3.21	37.10	13.42	2.76
	59/15	48.20	7.77	6.20	46.50	8.05	5.78	44.00	9.63	4.57	43.30	10.74	4.03	41.70	12.00	3.48	40.10	13.40	2.99
	68/20	54.30	7.84	6.93	52.50	8.51	6.17	50.70	9.49	5.34	49.00	10.64	4.61	47.20	11.91	3.96	45.40	13.33	3.41
ERLQ048BAVJU	-4/-20	22.00	9.76	2.25	21.70	10.62	2.04												
	5/-15	24.90	9.95	2.50	24.30	10.84	2.24	23.80	11.86	2.01									
	19/-7.2	27.50	10.13	2.71	26.80	11.08	2.42	28.00	12.15	2.30	25.30	13.37	1.89						
	25/-3.9	31.50	9.64	3.27	30.70	10.53	2.92	30.50	11.55	2.64	29.50	12.44	2.37	28.60	13.73	2.08			
	36/2.2	34.20	9.90	3.45	33.10	10.82	3.06	32.90	11.92	2.76	31.80	12.83	2.48	30.50	14.18	2.15	29.80	15.67	1.90
	45/7.2	49.20	10.25	4.80	47.80	11.25	4.25	46.20	12.36	3.74	44.80	13.65	3.28	43.30	15.09	2.87	41.90	16.59	2.53
	54/12.2	55.80	10.25	5.44	54.10	11.26	4.80	52.40	12.40	4.23	50.70	13.71	3.70	49.10	15.17	3.24	47.50	16.78	2.83
	59/15	60.10	10.27	5.85	58.20	11.27	5.16	56.40	12.44	4.53	54.70	13.74	3.98	52.90	15.20	3.48	51.20	16.82	3.04
	68/20	67.80	10.30	6.58	65.80	11.32	5.81	63.80	12.48	5.11	61.80	13.79	4.48	59.90	15.28	3.92	57.90	16.89	3.43
ERLQ054BAVJU	-4/-20	25.40	11.55	2.20	25.20	12.54	2.01												
	5/-15	28.50	11.80	2.42	28.30	12.02	2.35	28.20	14.02	2.01									
	19/-7.2	30.40	11.82	2.57	29.90	12.05	2.48	29.40	14.08	2.09	29.00	15.48	1.87						
	25/-3.9	35.90	11.53	3.11	35.20	12.56	2.80	34.50	13.76	2.51	33.80	15.14	2.23	33.10	16.08	2.06			
	36/2.2	37.90	11.16	3.40	37.10	12.18	3.05	38.30	13.34	2.87	35.50	14.88	2.39	34.70	16.16	2.15	31.40	16.05	1.96
	45/7.2	55.80	12.43	4.49	54.50	13.55	4.02	53.10	14.87	3.57	51.80	16.35	3.17	50.50	18.02	2.80	45.70	18.85	2.42
	54/12.2	63.20	12.57	5.03	61.70	13.71	4.50	60.10	15.01	4.00	58.60	16.51	3.55	57.00	18.19	3.13	51.80	19.01	2.72
	59/15	68.10	12.58	5.41	68.40	13.82	4.95	64.70	15.12	4.28	63.00	16.61	3.79	61.30	18.29	3.35	56.50	20.12	2.81
	68/20	78.90	12.65	6.24	75.00	13.99	5.36	73.10	15.31	4.77	71.10	18.80	3.78	69.20	18.48	3.74	63.70	20.28	3.14

Integrated value takes into consideration the capacity drop during frosting and defrosting periods.

3.2 Cooling

MAXIMUM COOLING CAPACITY

MODEL	T_{amb} (°F/°C)	60/15.6			77/25			86/30			95/35			104/40			113/45		
	LWE (°F/°C)	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	EER	CC kBTU/h	PI (kW)	
ERLQ036BAVJU	45/7.2	39.90	2.68	**14.89**	38.10	2.98	**12.79**	36.10	3.33	**10.84**	34.10	3.72	**9.17**	32.00	4.15	**7.71**	29.90	4.63	**6.46**
	50/10	43.90	2.70	**16.26**	41.90	3.01	**13.92**	39.70	3.37	**11.78**	37.00	3.77	**9.81**	35.30	4.21	**8.38**	32.90	4.70	**7.00**
	55/12.8	48.00	2.72	**17.65**	45.80	3.04	**15.07**	43.50	3.41	**12.76**	41.20	3.82	**10.79**	38.70	4.27	**9.06**	36.20	4.77	**7.59**
	59/15	50.90	2.73	**18.64**	48.60	3.06	**15.88**	46.20	3.44	**13.43**	43.70	3.85	**11.35**	41.10	4.32	**9.51**	36.50	4.82	**7.57**
	64/17.8	55.30	2.75	**20.11**	52.80	3.10	**17.03**	50.20	3.48	**14.43**	47.60	3.91	**12.17**	44.80	4.36	**10.28**	42.00	4.90	**8.57**
	72/22.2	61.50	2.79	**22.04**	55.70	3.15	**17.68**	55.00	3.55	**15.49**	53.00	3.99	**13.28**	50.00	4.48	**11.16**	45.40	4.08	**11.13**
ERLQ048BAVJU	45/7.2	49.60	3.98	**12.46**	47.50	4.40	**10.80**	45.20	4.87	**9.28**	42.70	5.41	**7.89**	39.90	6.02	**6.63**	37.80	6.04	**6.26**
	50/10	54.60	4.08	**13.38**	52.30	4.50	**11.62**	49.70	4.99	**9.96**	45.00	5.54	**8.12**	43.90	6.16	**7.13**	38.20	5.58	**6.85**
	55/12.8	59.90	4.18	**14.33**	57.20	4.82	**11.87**	54.40	5.12	**10.63**	51.30	5.65	**9.08**	48.00	6.31	**7.61**	40.70	5.16	**7.89**
	59/15	63.50	4.25	**14.94**	60.70	4.70	**12.91**	57.60	5.21	**11.06**	54.40	5.78	**9.41**	50.90	6.41	**7.94**	41.60	4.91	**8.47**
	64/17.8	69.10	4.37	**15.81**	65.90	4.83	**13.64**	62.60	5.38	**11.64**	59.10	5.94	**9.95**	55.40	6.58	**8.42**	44.00	4.54	**9.69**
	72/22.2	70.80	4.58	**15.46**	73.30	5.03	**14.57**	69.60	5.57	**12.50**	65.70	6.18	**10.63**	58.10	5.49	**10.58**	45.40	4.08	**11.13**
ERLQ054BAVJU	45/7.2	52.30	4.50	**11.62**	50.10	4.97	**10.08**	47.60	5.60	**8.50**	44.70	6.08	**7.35**	41.50	6.71	**6.18**	37.60	6.04	**6.23**
	50/10	57.70	4.63	**12.46**	55.10	5.11	**10.78**	52.20	5.65	**9.24**	49.00	6.23	**7.87**	45.50	6.87	**6.62**	38.20	5.58	**6.85**
	55/12.8	63.20	4.77	**13.25**	60.30	5.27	**11.44**	57.10	5.81	**9.83**	53.60	6.41	**8.36**	49.80	7.06	**7.05**	40.70	5.16	**7.89**
	59/15	67.00	4.87	**13.76**	63.90	5.37	**11.90**	60.50	5.92	**10.22**	55.60	6.52	**8.53**	52.70	7.18	**7.34**	41.80	4.91	**8.51**
	64/17.8	71.70	5.19	**13.82**	68.30	5.72	**11.94**	64.60	6.30	**10.25**	60.60	6.94	**8.73**	56.00	6.83	**8.20**	44.00	4.54	**9.69**
	72/22.2	79.70	5.50	**14.49**	75.80	6.05	**12.53**	71.70	6.65	**10.78**	67.30	7.30	**9.22**	58.10	5.49	**10.58**	45.40	4.06	**11.18**

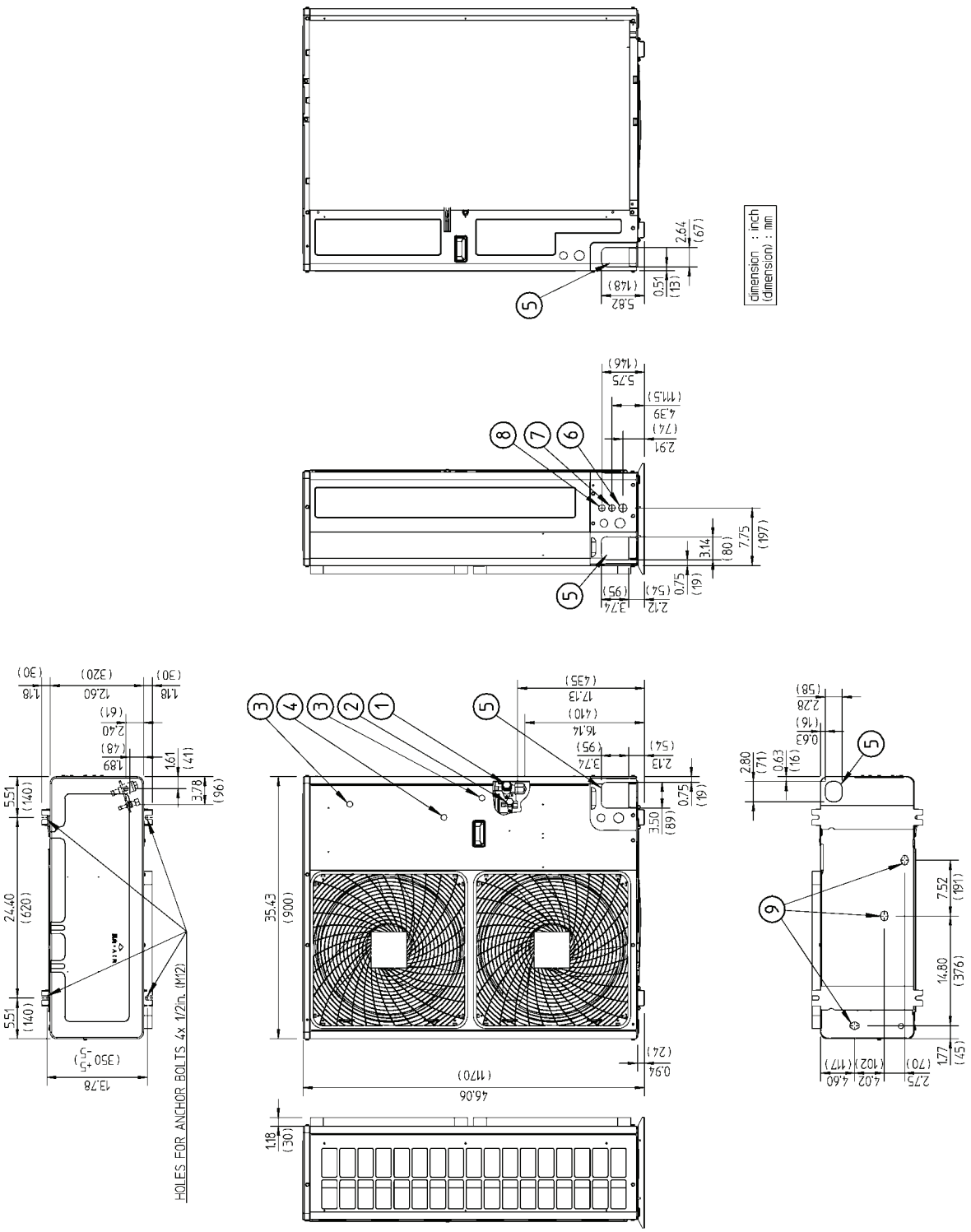
Symbols:

CC Cooling Capacity @ maximum operating frequency, BTU/h
HC Heating Capacity @ maximum operating frequency, BTU/h
PI Cooling Power Input (kW), Heating Power Input (kBTU/h measured according to Eurovent 6/C003-2006 (kW)/EN14511
LWE Leaving Water evaporator temperature (Cooling)
LWC Leaving Water condenser temperature (Heating)
Tamb Outdoor Ambient temperature, RH = 85%

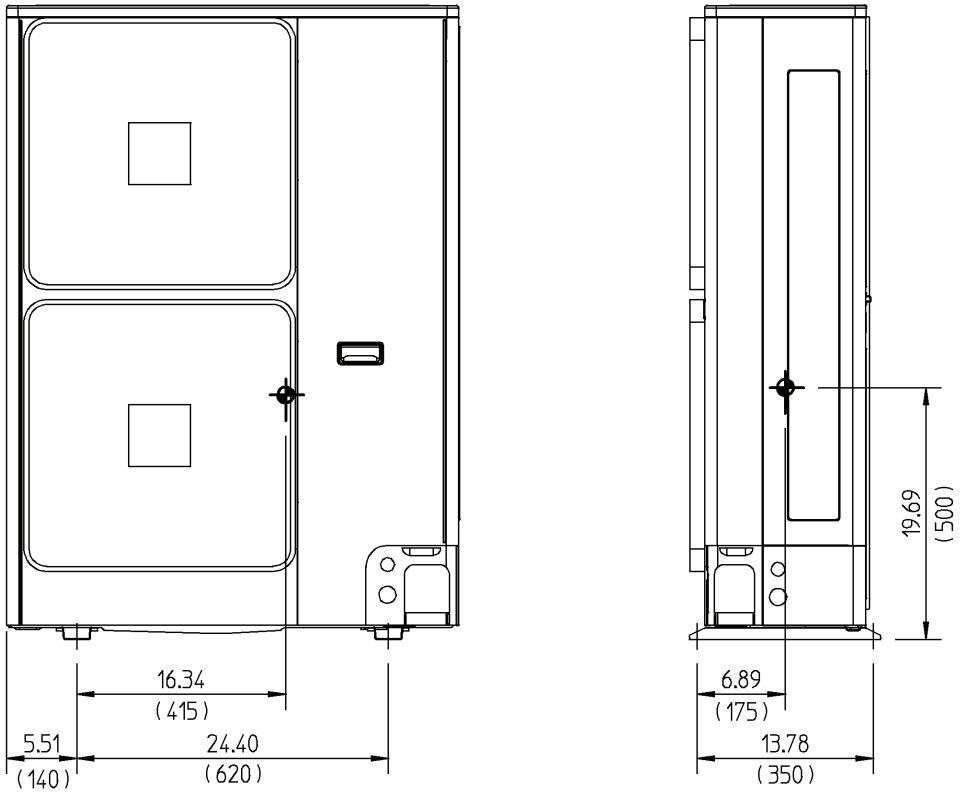
Conditions:

Cooling Capacity BTU/h and valid for chilled water range ΔT = 5-15^{0}F (3-8^{0}C)
Heating Capacity is according to Eurovent 6/C/003-2006 (kW) and valid for heating water range ΔT = 5-15^{0}F (3-8^{0}C)
Power Input is total of indoor and outdoor unit, except the circulation pump; (90W per EN14511)

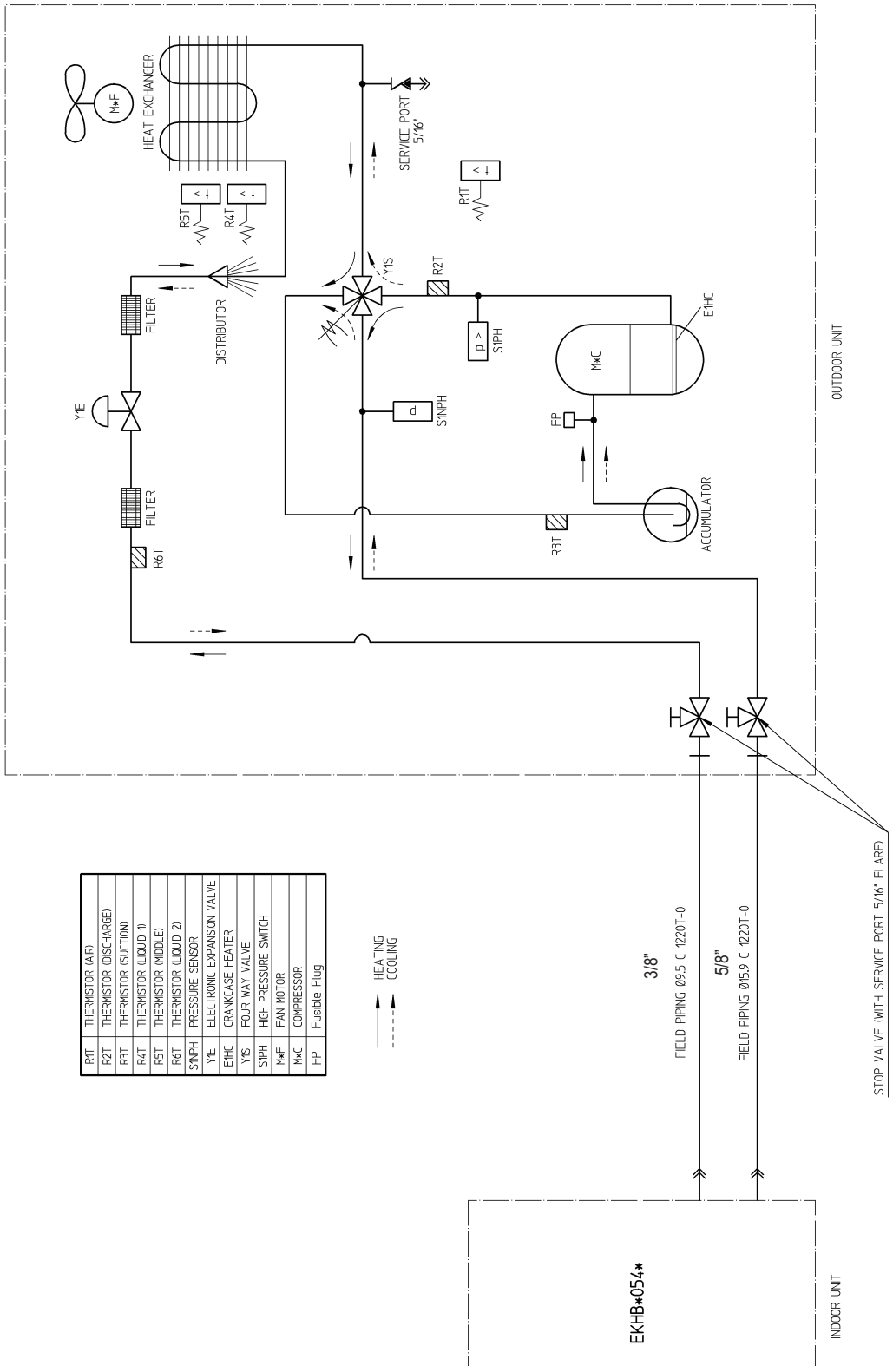
4. Dimensional Drawing - Split System



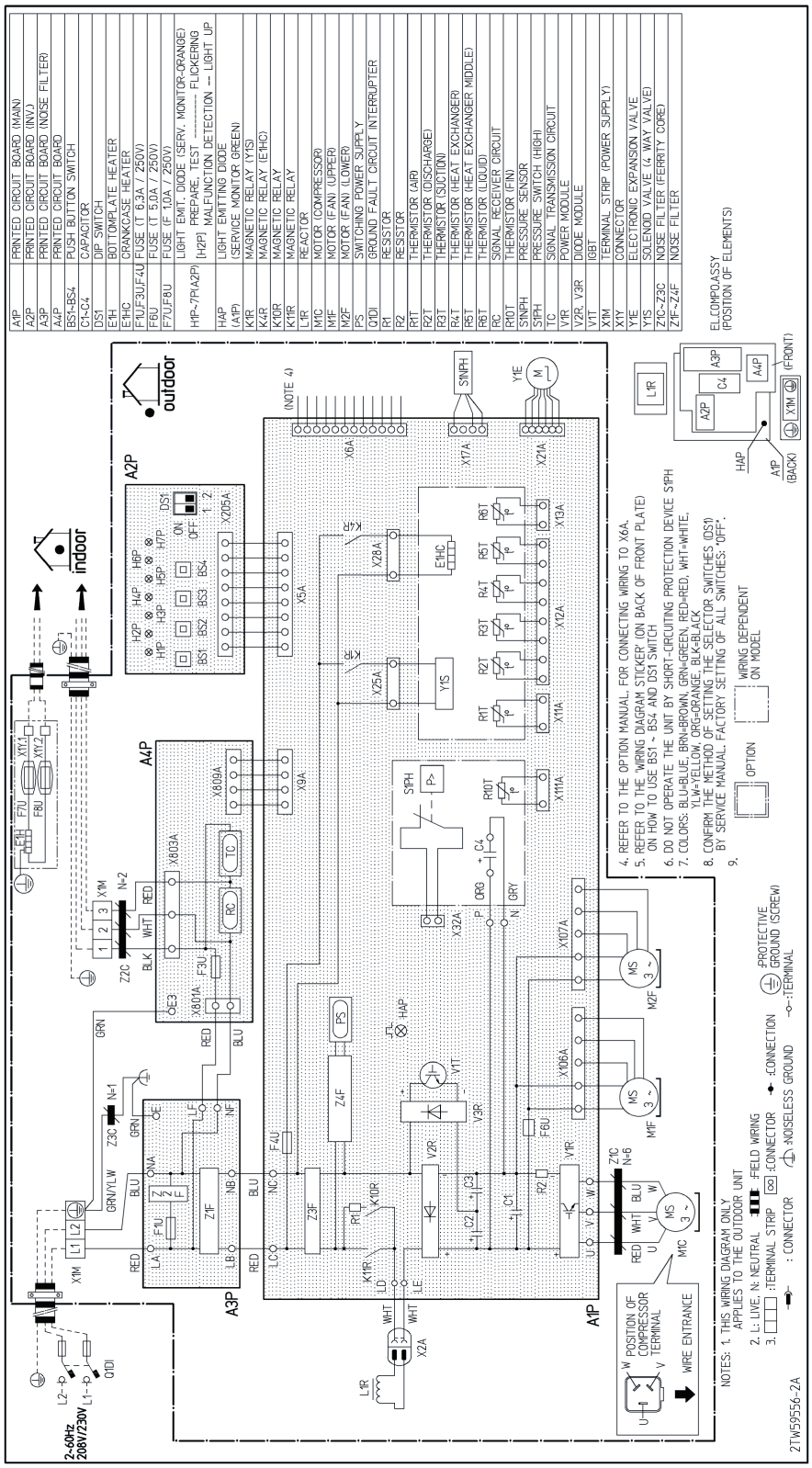
5. Center of Gravity - Split System



6. Piping Diagram - Split System

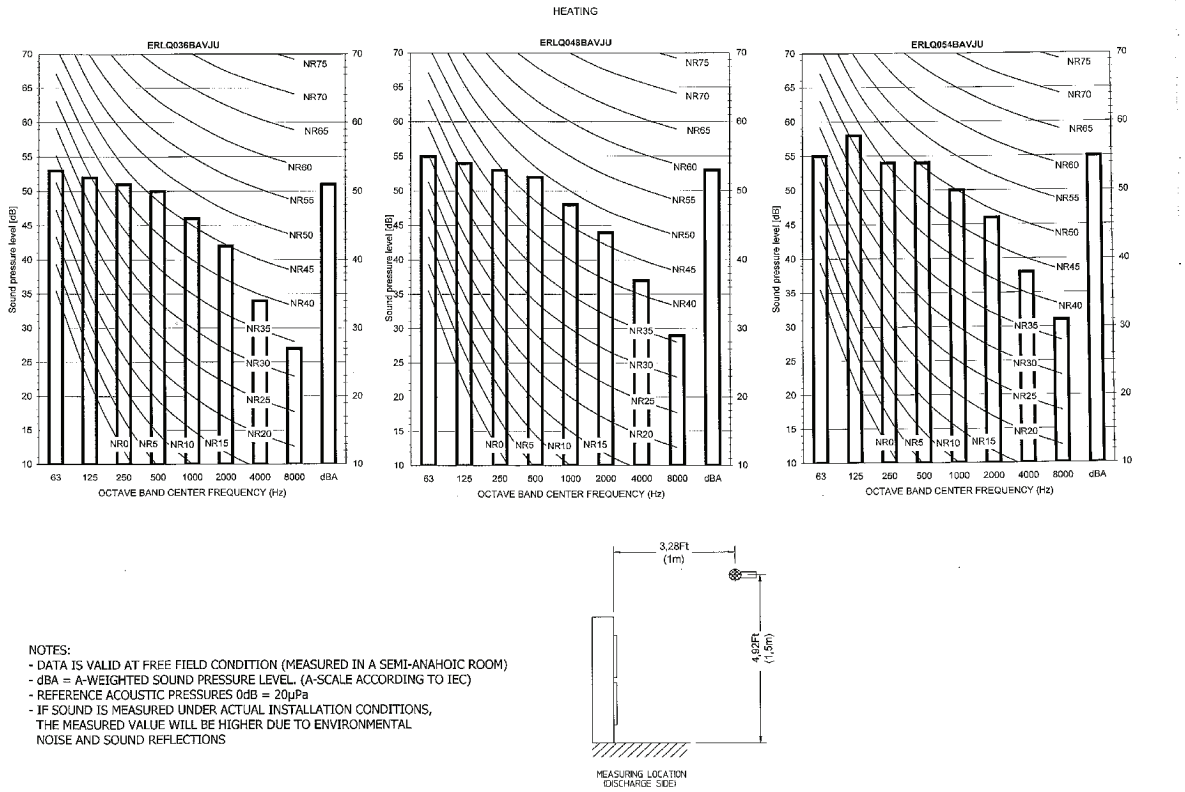


7. Wiring Diagram - Split Sytem



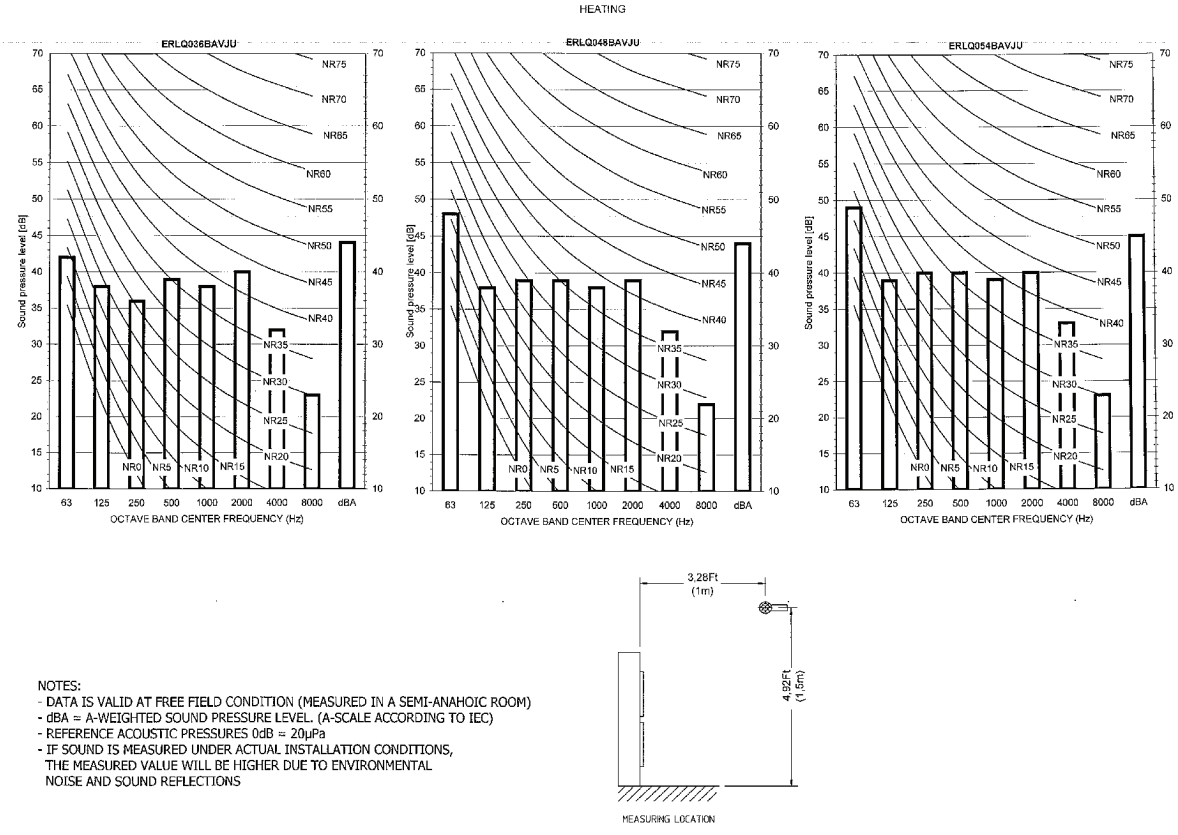
8. Sound Data - Split System

Normal Operation:



NOTES:
- DATA IS VALID AT FREE FIELD CONDITION (MEASURED IN A SEMI-ANAHOIC ROOM)
- dBA = A-WEIGHTED SOUND PRESSURE LEVEL. (A-SCALE ACCORDING TO IEC)
- REFERENCE ACOUSTIC PRESSURES 0dB = 20µPa
- IF SOUND IS MEASURED UNDER ACTUAL INSTALLATION CONDITIONS, THE MEASURED VALUE WILL BE HIGHER DUE TO ENVIRONMENTAL NOISE AND SOUND REFLECTIONS

Night Quiet Operation:



NOTES:
- DATA IS VALID AT FREE FIELD CONDITION (MEASURED IN A SEMI-ANAHOIC ROOM)
- dBA = A-WEIGHTED SOUND PRESSURE LEVEL. (A-SCALE ACCORDING TO IEC)
- REFERENCE ACOUSTIC PRESSURES 0dB = 20µPa
- IF SOUND IS MEASURED UNDER ACTUAL INSTALLATION CONDITIONS, THE MEASURED VALUE WILL BE HIGHER DUE TO ENVIRONMENTAL NOISE AND SOUND REFLECTIONS

9. Installation - Split System

9.1 Installation Location

- The equipment is not is not intended for use in a potentially explosive atmosphere.
- Choose a place solid enough to bear the weight and vibration of the unit, where operation sounds will not be amplified.
- Locate the unit so that operation sounds and discharged hot/cold air will not bother neighbors.
- Avoid places such as bedrooms so that operation sounds are not a problem.
- Allow sufficient space for carrying the unit into and out of the site.
- Ensure there is sufficient space for air passage and a lack of obstructions around the air inlet and the air outlet.
- The site must be free from the possibility of flammable gas leakage in any nearby area.
- Install units, power cable, and inter-unit cables at least 10 feet (3 m) away from televisions and radios to prevent interference.
- Depending on radio wave conditions, electromagnetic interference may still occur even if installed more than 10 ft. (3 m) away.
- In coastal areas or other places with salty atmosphere of sulfate gas, corrosion my shorten the life of the outdoor unit.
- Since condensate flows out of the outdoor unit, do not place anything under the unit that must be kept from moisture.

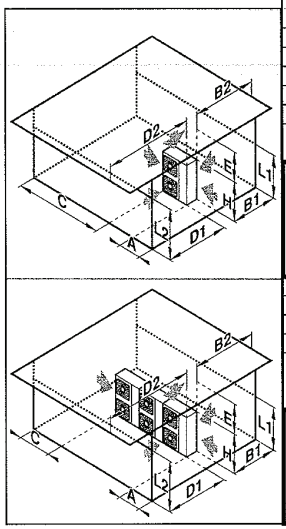
IN COLD CLIMATES:

- To prevent exposure to wind, install the outdoor unit with its suction side facing the wall.
- Never install the outdoor unit at a site where the suction side may be exposed directly to wind.
- To prevent exposure to wind, install a baffle plate on the air discharge side of the outdoor unit.
- Unit should be installed with a minimum of 4” (10 cm) free space below the unit’s bottom plate at all condition, e.g., heavy snowfall (construct a pedestal if necessary).
- In heavy snowfall areas, it is very important to select an installation site where the snow will not affect the unit. If lateral snowfall is possible, make sure the heat exchanger coil is not affected by the snow (construct a lateral canopy if necessary). See Figure 1:

Figure 1: construction of canopy and pedestal

9.2 Installation Space

A. NON STACKED INSTALLATION



↙	↗	↘	↖	↓			A	B1	B2	C	D1	D2	E	L1/L2	
✓								≥4 [100]							
✓		✓	✓				≥4[100]	≥4 [100]		≥4 [100]					
✓				✓				≥4 [100]				≤20 [500]	≥40 [1000]		
✓		✓	✓	✓			≥6[150]	≥6 [150]		≥6 [150]		≤20 [500]	≥40 [1000]		
	✓										≥20 [500]				
	✓			✓					≤20[500]		≥20 [500]		≥40 [1000]		
✓	✓				L1<L2			≥4 [100]			≥20 [500]				
					L2<L1			≥4 [100]			≥20 [500]				
✓	✓			✓	L1<L2	L1≤H		≥10 [250]	≤20 [500]		≥30 [750]		≥40 [1000]	0<L1≤1/2H	
											≥40 [1000]			0<L1≤1/2H	
						H<L1					L1≤H				1
					L2<L1	L2≤H		≥4 [100]			≥40 [1000]	≥20 [500]	≥40 [1000]	0<L2≤1/2H	
								≥8 [200]						1/2H<L2≤H	
						H<L2					L2≤H				
✓		✓	✓				≥8 [200]	≥12 [300]		≥40 [1000]					
✓		✓	✓	✓			≥8 [200]	≥12 [300]		≥40 [1000]		≤20[500]	≥40 [1000]		
	✓										≥40 [1000]				
	✓			✓					≤20[500]		≥40 [1000]		≥40 [1000]		
✓	✓				L1<L2			≥12 [300]			≥40 [1000]				
					L2<L1			≥10 [250]			≥60 [1500]			0<L2≤1/2H	
								≥12 [300]						1/2H<L2≤H	
✓	✓			✓	L1<L2	L1≤H		≥12 [300]	≤20 [500]		≥40 [1000]		≥40 [1000]	0<L1≤1/2H	
											≥50 [1250]			1/2H<L1≤H	1
						H<L1					L1≤H				
					L2<L1	L2≤H		≥10 [250]			≥60 [1500]	≤20 [500]	≥40 [1000]	0<L2≤1/2H	
								≥12 [300]						1/2H<L2≤H	2
						H<L2					L2≤H				

LEGEND (Unit: Inch [mm])

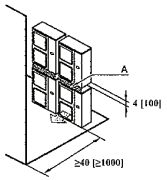
- ↙ Suction side obstacle
- ↗ Discharge side obstacle
- ↘ Left side obstacle
- ↖ Right side obstacle
- ↓ Top side obstacle
- ✓ Obstacle is present
- This situation is not allowed

1 In these cases, close bottom of the installation frame to prevent discharged air from being bypassed

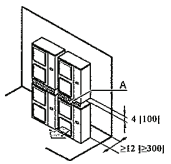
2 In these cases, only 2 units can be installed

B. STACKED INSTALLATION

1. OBSTACLES EXIST IN FRONT OF THE OUTLET SIDE



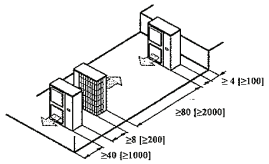
2. OBSTACLES EXIST IN FRONT OF THE AIR INLET



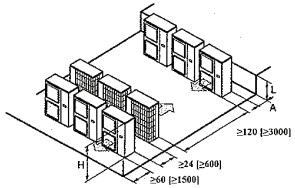
Do not stack more than one unit.
About 4 in. (100mm) is required as the dimension for laying the upper outdoor unit's drain pipe.
Get the portion A sealed so that air from the outlet does not bypass.

C. MULTIPLE-ROW INSTALLATION

1. INSTALLATION OF ONE UNIT PER ROW



2. INSTALLING MULTIPLE UNITS (2 units or more) IN LATERAL CONNECTION PER ROW



Relation of dimensions of H, A and L are shown in the table below.

	L	A
L ≤ H	0<L≤1/2H	10 [250]
	1/2H < L	12 [300]
H < L	Installation not allowed	

Installation - Split System

ITT

Wastewater

Goulds Pumps

SP02/SP03

Submersible Sump Pump

FEATURES

- Corrosion-resistant construction.
- Stainless Steel motor casing and fasteners.
- Glass-filled thermoplastic impeller and casing.
- Bearings: Upper and lower heavy duty ball bearing construction.
- Motor is permanently lubricated for extended service life and is powered for continuous operation. All ratings are within the working limits of the motor.
- Stainless steel shaft.
- Complete unit is light weight, portable and compact.

GOULDS PUMP

Goulds Pumps is a brand of ITT Residential and Commercial Water.

www.goulds.com

Engineered for life

ITT

GOULDS PUMPS
Wastewater

APPLICATIONS

Specially designed for the following uses:
- Basement draining
- Water transfer
- Dewatering

SPECIFICATIONS

Pump:
- Discharge size:
  SP024 – 1¼" NPT,
  SP025 – 1½" NPT,
  SP035 – 1½" NPT.
- Capacities: to 40 GPM
- Maximum head: to 30 feet.
- Temperature: 104ºF (40ºC) maximum, continuous when completely submerged.
- Solids handling: ⅜" maximum spherical.
- Float switch: built-in non-mercury Vertical or Piggyback Wide Angle.
- Manual model also available – SP035M.
- Pumping range: 3.0".
- Maximum pump down - 1¼" from base.

MOTOR

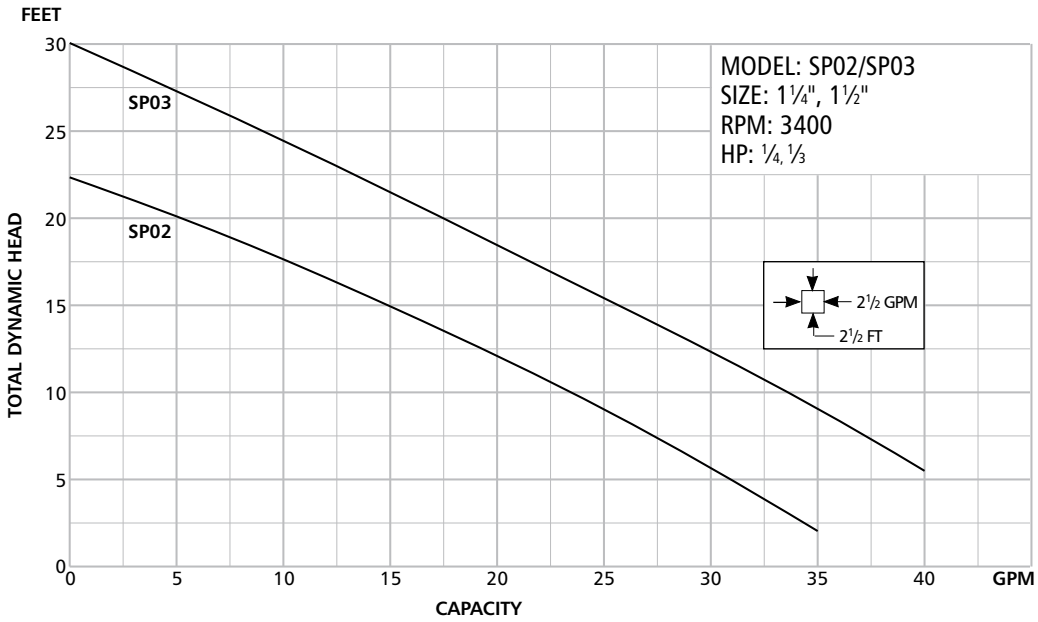
- SP02: ¼ HP, 115 V, 60 Hz, single phase 3400 RPM, 2.4 amps maximum.
- SP03: ⅓ HP, 115 V, 60 Hz, single phase, 3400 RPM, 3.0 amps maximum.
- Built-in thermal overload protection with automatic reset.
- Permanent-split-capacitor type.
- Class B insulation.
- Air filled design.
- Stainless steel shaft.
- Power cord: 10 foot standard length, heavy duty 16/3 SJTW with NEMA 5-15 P three prong grounding plug, 115V.

AGENCY LISTINGS

Tested to CSA 22.2 108 Standards By Canadian Standards Association File #LR38549

Underwriter's Laboratories

Goulds Pumps is ISO 9001 Registered.



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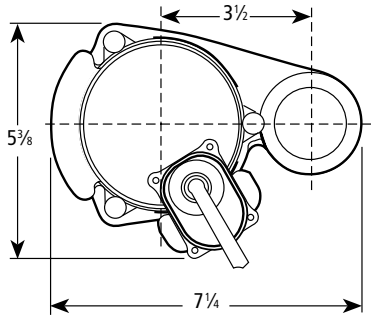
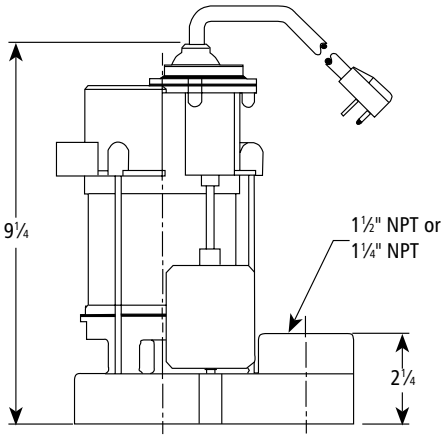
GOULDS PUMPS
Wastewater

DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)





PERFORMANCE RATINGS

SP02

Total Head (feet of water)	GPM	GPH
5	31	1,860
10	23	1,380
15	15	900
20	5	300

SP03

Total Head (feet of water)	GPM	GPH
5	41	2,490
10	34	2,040
15	26	1,560
20	17	1,020
25	8	480

MODEL INFORMATION

Order No.	HP	Volts	Amps	Minimum Circuit Breaker	Phase	Float Switch Style	Cord Length	Discharge Connection	Min. On Level	Min. Off Level	Minimum Basin Diameter	Maximum Solids Size	Shipping Weight lbs/kg
SP024V	¼	115	2.4	10	1	Built-In Vertical	10'	1¼"	6"	3"	9"	⅜"	8 / 3.6
SP024AT				10		Piggyback Wide Angle	10'	1¼"	11"	5"	12"		
SP025V				10		Built-In Vertical	10'	1½"	6"	3"	9"		
SP025AT				10		Piggyback Wide Angle	10'	1½"	11"	5	12"		
SP035V	⅓		3.0	10		Built-In Vertical	10'	1½"	6"	3"	9"		
SP035M				10		Plug / No Switch	10'	1½"	6"	3"	9"		
SP035AT				10		Piggyback Wide Angle	10'	1½"	11"	5"	12"		

ITT

Wastewater

GOULDS PUMP

BSP02/03 August, 2006

Engineered for life

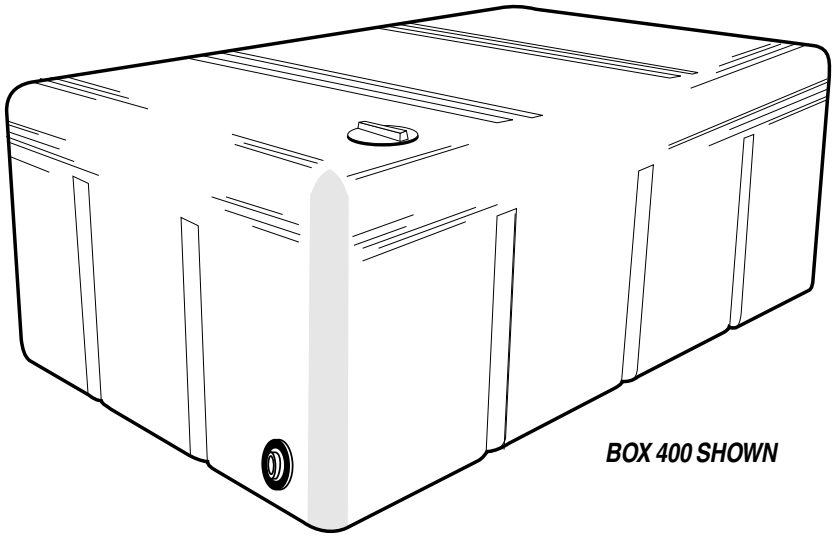
POLYETHYLENE
BOX TANKS

– FOR THOSE LOW DOWN STORAGE JOBS

DRINKING WATER – RAIN WATER – SEWAGE – FERTILIZER – TEMPORARY CONTAINMENT

FEATURES:

- ★ **Only 30" high, or less**
- ★ **Will pass thru 32" wide doorway**
- ★ **Light weight – easily carried**
- ★ **Sturdy construction**
- ★ **Will not leak or corrode**
- ★ **Access/filler cap and fittings ordered separately**
  (can be installed at factory)



BOX 400 SHOWN

APPLICATIONS:

- **Basements/crawlspaces**
- **Portable buildings/mobile homes/ construction trailers**
- **Special events**
- **Truck water delivery**
  (surge baffle slots on 400/800 gal. units)
- **Fertilizer/septic application**
- **Can stand on side or end**
  (with external bracing – consult factory)
- **Can be partially buried**
  (consult factory)

SELECTION GUIDE (Canada/USA)

Model (Can./US)	*Gals (Imp./US)*	*Dimensions*
BOX 25/ BXU 30	25/ 30	12"H x 24"W x 26"L
BOX 50/ BXU 60	50/ 60	24"H x 24"W x 26"L
BOX 100/ BXU 120	100/ 120	23"H x 25"W x 49"L
BOX 200/ BXU 240	200/ 240	25"H x 45"W x 49"L
BOX 250/ BXU 300	250/ 300	30"H x 42"W x 48"L
BOX 400/ BXU 480	400/ 480	30"H x 48"W x 84"L
BOX 800/ BXU 960	800/ 960	30"H x 81"W x 98"L

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Lifting capacities on telescopic boom.
Forces de levage à la flèche télescopique.

LTM 1100/2

38 ft – 171 ft | 360° | 77200 lbs | 85%

ft	38 ft	38 ft *	50 ft	62 ft	74 ft	87 ft	99 ft	1. 1 ft	123 ft	135 ft	148 ft	160 ft	171 ft	ft
9	232													9
10	219	198												10
12	189	187	165	156										12
14	166	166	157	150	143	124								14
16	151	151	143	137	132	121	102							16
18	140	139	133	128	123	115	98.5							18
20	130	127	124	119	114	112	94.5	79	67.5					20
22	119	116	116	111	107	108	91.5	76.5	65.5	54.1				22
24	110	106	107	104	100	103	88.5	74	63.5	53.4				24
26	101	96.5	98	97	94.5	97	85.5	71	61.5	52	45.7			26
28	92.5	89	90.5	89.5	88	89.5	83	69	59.5	50.6	44.6	35.1		28
30			83.5	82.5	84	82.5	80.5	66.5	57.6	49.2	43.4	34.9		30
32			77.5	76.5	79	78	77	64	55.7	47.8	42.3	34.2	27.7	32
34			72.5	71.5	74	73.5	72.5	62	54	46.4	41.3	33.6	27.4	34
36			67.5	66.5	69.5	69	68	59.8	52.4	45.2	40.4	33	26.9	36
38			63	63.5	64.5	64	63	57.6	50.7	44	39.4	32.5	26.3	38
40				60.5	60.5	59.9	58.9	55.3	49.1	42.8	38.5	31.9	25.8	40
45				51.9	51.9	51.5	50.5	49.1	45.2	40	36.5	30.7	24.7	45
50				45.2	45.2	44.7	43.7	43.3	40.9	37.1	34.4	29.6	23.7	50
55					39.5	39.1	38.1	38.5	36.4	34.4	32.2	28.3	22.8	55
60					34.9	34.4	33.9	34.3	33.1	31.7	30	26.8	21.9	60
65					31.1	30.5	31.2	30.4	29.4	28.5	28	25.3	20.9	65
70						27.3	28.2	27.2	26.1	25.8	25.6	23.9	20	70
75						24.7	25.4	24.4	23.7	23.7	23.1	22.6	19.1	75
80							23	22.6	22.3	21.4	21	21.1	18.2	80
85							20.8	20.5	20.1	19.9	19.7	19.1	17.3	85
90							19.1	19.2	18.3	18.3	18.1	17.3	16.4	90
95								17.7	16.8	16.7	16.5	15.3	15	95
100									15.9	15.3	14.9	13.5	13.4	100
105									14.7	13.6	13.2	12.4	12.3	105
110									13.5	12.7	12.3	11.4	11.4	110
115										11.8	11.4	10.5	10.5	115
120										11	10.6	9.7	9.7	120
125											9.8	9	8.9	125
130											9.1	8.3	8.3	130
135											8.5	7.7	7.6	135
140												7.2	7.1	140
145												6.6	6.5	145
150												6.2	6.1	150
155													5.6	155
I	0		0/ 0/ 0	46/ 0/ 0	92/46/ 0	46/46/ 0	46/ 0	92/46/46	92/46/46	92/46/ 0	92/46	92	100	I
II	0		46/ 0/ 0	46/46/ 0	46/46/ 0	92/46/46	46/46	46/92/46	92/92/46	92/92/92	92/92	92	100	II
III	0		0/46/ 0	0/46/ 0	0/46/46	46/46/46	46/46	46/46/46	46/92/46	92/92/92	92/92	92	100	III
IV	0		0/ 0/46	0/ 0/46	0/ 0/46	0/46/46	46/46	46/46/46	46/46/92	46/92/92	92/92	92	100	IV
V %	0		0/ 0/ 0	0/ 0/46	0/ 0/46	0/ 0/46	46/92	46/46/92	46/46/92	46/46/92	46/92	92	100	V %

* over rear / en arrière

TAB 130380 / 130271

120 TON

Remarks referring to load charts

1. The tabulated lifting capacities do not exceed 85% of the tipping load.
2. The crane's structural steelwork is in accordance with DIN 15018, part 3. Design and construction of the crane comply with DIN 15018, part 2, and with F.E.M. regulations.
3. The 85% overturning limit values take into account wind force 5 = wind speed 20 mph.
4. Lifting capacities are given in kips.
5. The weight of the hook blocks and hooks must be deducted from the lifting capacities.
6. Working radii are measured from the slewing centreline.
7. The lifting capacities given for the telescopic boom only apply if the folding jib is taken off.
8. Lifting capacities are subject to modifications.
9. Lifting capacities above 198 kips only with special equipment.

Remarques relatives aux tableaux des charges

1. Les forces de levage indiquées ne dépassent pas 85% de la charge de basculement.
2. La norme DIN 15018, 3ème partie est appliquée pour les charpentes. La construction de la grue est réalisée conformément à la norme DIN 15018, 2ème partie, et aux règles de la F.E.M.
3. A 85% de la charge de basculement, il a été tenu compte d'un vent de force 5 = vitesse de vent 20 mph.
4. Les forces de levage sont données en kips.
5. Le poids des moufles et crochets doit être soustrait des charges indiquées.
6. Les portées sont calculées à partir de l'axe de rotation.
7. Les forces indiquées pour la flèche télescopique s'entendent fléchette dépliable déposée.
8. Les forces de levage sont modifiables sans préavis.
9. Forces de levage plus de 198 kips seulement avec équipement supplémentaire.

Lifting capacities are given in kips (1,000 lbs).

CD-

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- Home
- Work
- Play

Filter by type
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- Deluxe
- Economy
- Industrial
- Inverter
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- Cycloconverter
- HP2S

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EU3000iS

(EU3000iSAN, EU3000iSAC)

- 3000 watts, 120V
- Power for your furnace, fridge, microwave, most 13,500 BTU RV AC units, and more
- Super quiet
- Convenient electric start
- Fuel efficient - up to 20 hrs on 3.4 gals of gas
- Inverter - stable power for computers and more

MSRP $2,329.95*

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*Manufacturer's suggested retail price. Price excludes applicable taxes. Dealer sets actual selling price.

Features Specifications Options

EU3000iS	Specifications
Engine	Honda GX200
Displacement	196cc
AC Output	120V 3000W max.(25A) 2800W rated (23.3A)
Receptacles	20A 125V Duplex, 30A 125V Locking Plug
DC Output	12V, 144W (12A)
Starting System	Recoil, electric
Fuel Tank Capacity	3.4 gals.
Run Time per Tankful	7.2 hrs. @ rated load, 20 hrs. @ 1/4 load
Dimensions (L x W x H)	25.8" x 18.9" x 22.4"
Noise Level	58 dB @ rated load 49 dB @ 1/4 load
Dry Weight	134 lbs.
Residential Warranty	3 Years
Commercial Warranty	3 Years

Tools & Resources

Generator Selection
How much power do I need?
Wattage Calculator
Connecting your generator to your home
Power Management
Generator Operation
Generator sound level comparison
Accessories
Download Brochure

General Information

Dealer Locator
Product Manuals
Brochures
Warranty Information
FAQs
Trade Shows
Special Offers
Product Registration
Owner Link
Product Updates/Recalls
Video Gallery

Appendix F: Construction Specifications

See next page.

Construction Specifications

Division 00 - Procurement and Contracting Requirements

Division 01 – General Requirements

Division 08 – Openings

Division 09 – Finishes

Division 10 – Specialties

Division 11 – Equipment

Division 12 – Furnishings

Not used

Division 13 – Special Construction

Not used

Division 14 – Conveying Equipment

Not used

Division 20 – Mechanical

Division 26 – Electrical continued…

END OF SECTION

COMPETITION DRAWINGS

The following is a list of the competition drawings:

SERIES	NAME/TITLE	DATE	REVISION
General / Compliance			
G-001	Table of Contents	March 22, 2011	100%
G-101	Finished Square Footage Compliance Plan	March 22, 2011	100%
G-102	Egress Plan	March 22, 2011	100%
G-103	ADA Tour Route Compliance Plan	March 22, 2011	100%
G-201	Solar Envelope Compliance Elevations	March 22, 2011	100%
G-202	Solar Envelope Compliance Elevations	March 22, 2011	100%
G-601	Shading Diagrams	March 22, 2011	100%
Architectural			
A-001	Architectural Symbols and Notes	March 22, 2011	100%
A-101	Site Plan	March 22, 2011	100%
A-111	First Floor Plan	March 22, 2011	100%
A-112	First Floor Plan	March 22, 2011	100%
A-121	Reflected Ceiling Plan	March 22, 2011	100%
A-201	Site Elevations	March 22, 2011	100%
A-202	Site Elevations	March 22, 2011	100%
A-211	Elevations	March 22, 2011	100%
A-212	Elevations	March 22, 2011	100%
A-213	Interior Elevations	March 22, 2011	100%
A-214	Interior Elevations	March 22, 2011	100%
A-301	Building Sections	March 22, 2011	100%
A-302	Building Sections	March 22, 2011	100%
A-311	Wall Sections	March 22, 2011	100%
A-312	Wall Sections	March 22, 2011	100%

A-321	Floor Sections	March 22, 2011	100%
A-531	Window Detail	March 22, 2011	100%
A-541	Door Details	March 22, 2011	100%
A-561	Roof Details	March 22, 2011	100%

Interior Design

I-101	Interior Design Plan	Nov.23, 2010	100%
I-102	Interior Furnishing Plan	Nov, 23, 2010	100%
I-103	Interior Design Reflected Ceiling Plan	March 22, 2011	100%
I-201	Interior Design Elevations	March 22, 2011	100%
I-202	Interior Design Elevations	March 22, 2011	100%
I-501	Interior Design Details	March 22, 2011	100%
I-502	Interior Design Details	March 22, 2011	100%

Structural

S-101	Foundation Plan	March 22, 2011	100%
S-102	First Floor Framing Plan	March 22, 2011	100%
S-103	Roof Framing Plan	March 22, 2011	100%
S-201	Framing Elevations	March 22, 2011	100%
S-202	Framing Elevations	March 22, 2011	100%
S-203	Framing Elevations	March 22, 2011	100%
S-204	Framing Elevations	March 22, 2011	100%
S-205	Framing Elevations	March 22, 2011	100%
S-206	Framing Elevations	March 22, 2011	100%
S-501	Plan Details	March 22, 2011	100%
S-511	Section Details	March 22, 2011	100%
S-901	Framing Isometric	March 22, 2011	100%

Mechanical

M-101	HVAC Plan	March 22, 2011	100%
M-101	Mechanical Closet Plan	March 22, 2011	100%
M-201	Mechanical Closet Plan	March 22, 2011	100%

M-603	Solar Water Diagrams	March 22, 2011	100%
M-901	HVAC Isometrics	March 22, 2011	100%
P-101	Plumbing Site Plan	March 22, 2011	100%
P-102	Domestic Supply	March 22, 2011	100%
P-103	Domestic Return	March 22, 2011	100%
P-903	Solar Water Heating Isometric	March 22, 2011	100%

Electrical

E-101	Electrical Plan	March 22, 2011	100%
E-103	Lighting Plan	March 22, 2011	100%
E-601	One-Lien Diagram	March 22, 2011	100%
E-602	Three-Line Diagram	March 22, 2011	100%
C-101	Ground Contact Plan	March 22, 2011	100%

Civil / Landscaping

L-102	Landscape Irrigation and Greywater Plan	March 22, 2011	100%
L-103	Landscape Lighting Plan	March 22, 2011	100%
L-104	Landscape and Planting Site Plan	March 22, 2011	100%
L-201	Landscape Elevations	Nov. 23. 2010	100%
L-202	Landscape Elevations	March 22, 2011	100%
F1.0	Food Services	March 22, 2011	100%
L1.0	Landscape Development		

END OF LIST OF DRAWING SHEETS

PART 1. GENERAL

1.1 SUMMARY

.1 The intent of this bid call is to receive formal offers to construct the following Project:

Name of Project: _____

_____

Location: _____

_____

.2 Bids shall be prepared and submitted and the bidding process shall be in accordance with the bidding requirements as contained herein.

.3 Refer to Section 01 11 00 - Summary of Work for a summary of the Project, including requirements pertaining to Contract Time.

1.2 BID SUBMISSION

.1 The Owner will receive bids before 2:01:00 pm local time on [Tuesday] [Wednesday] [Thursday], [Month Day, Year] (the "bid closing time") at:

[Name of Firm / Company]
[Address]
[City][Province or State][Postal or Zip Code]

Telephone (000) 000-0000
Fax: (000) 000-0000

.2 For bid closing purposes, the official time of receipt of bids shall be as determined by the time recorder clock used to time and date stamp bids upon submission to the above location.

.3 Submit bids on forms provided in the Bid Documents, include and supplementary Bid forms as required and instructed herein

.4 Any Bids received orally, telephoned, telegrammed, faxed, or e-mailed will not be accepted nor acknowledged buy the Owner.

.5 The Owner may extend the bid closing time by addendum.

1.3 INVITATION TO BID

.1 This bid call is by invitation only. Submit bids only in the name indicated in letter of invitation to bid

.2 Bids submitted in a name different to that indicated on the invitation, and from Bidders not invited to bid, may cause the bid to be declared invalid and rejected.

1.4 BASIS OF BID - STIPULATED PRICES

.1 Bids shall be on a Stipulated Price basis

1.5 ADEQUACY OF BID

.1 The submission of a bid shall constitute an incontrovertible representation by the Bidder that:

.1 he Bidder has complied with all bidding requirements,

.2 the Bidder is qualified and experienced to perform the Work in accordance with the Bid Documents,

.3 the bid is based upon performing the Work in accordance with the Bid Documents, without exception, and

.4 the price or prices stated in the bid cover all the Bidder's obligations under the Contract and all matters and things necessary for the performance of the Work in accordance with the Bid Documents.

1.6 BID DOCUMENTS

.1 The Bid Documents are the documents issued or made available to Bidders by the Owner for the purpose of preparing a bid. The Bid Documents consist of the following:

.1 Instructions to Bidders.
.2 Bid Security.
.3 Mandatory Pre-Bid Meeting.
.4 Bid Form and Bid Form Supplements.
.5 Agreement Form.
.6 Definitions.
.7 Payment Conditions.
.8 Statutory Declaration.
.9 Contract Performance Security.
.10 Security for Payment of Claims.
.11 Insurance Conditions.
.12 General Conditions of Contract.

.13 Supplementary Conditions..
.14 Detail Drawings.
.15 Specifications, Divisions 01 to 48inclusive.
.16 Drawings, as listed in the List of Drawings.
.17 Schedules.
.18 Addenda issued during bid period.
.19 Letter of Invitation to Bid.

1.7 BID FORM

.1 Fill-in all blanks in Bid Form and sign as follows:

.1 Limited Company: Print or type in space provided full name of company and name(s) and status of authorized signing officer(s). Authorized signing officer(s) shall sign. Sign Bid Form in the presence of a witness who shall also sign, or in the absence of a witness, affix corporate seal.

.2 Limited Company Joint Venture: Each joint venture company shall sign as for a limited company.

.3 Partnership: Print or type in space provided firm name and name(s) of person(s) signing. One or more of the partners shall sign in the presence of a witness who shall also sign.

.4 Sole Proprietorship: Print or type in space provided business name and name of sole proprietor. Sole proprietor shall sign in the presence of a witness who shall also sign.

.2 Complete Bid Form in its entirety. Any required information that is omitted or illegible, any alterations to the text, or any conditions added on or submitted with the Bid Form, may cause the bid to be declared invalid and rejected.

.3 Enclose Bid Form in an envelope along with the hard copy bid documents.

.4 Clearly indicate the following on the face of the envelope:

.1 Labeled as a “Bid Form”.
.2 Name of the project specified in 1.1.
.3 Address for receipt of bids, as specified in 1.2.
.4 Bidder's name.

.5 Seal envelope and deliver to address specified in 1.2.

1.8 BID FORM SUPPLEMENTS

.1 Prepare and submit each required supplement to the Bid Form as specified below.

.2 Enclose the following Bid Form supplement(s) together with the Bid Form in a single envelope and submit before the bid closing time:

.1 Bid security, as specified in Section 00 43 13.
.2 Contract Performance Security as specified in Section 00 61 10.
.3 Security for payment of Claims as specified in section 00 61 90.
.4 Completed Form 01 26 63A – Schedule of Labour Rates Form.

.3 Bid Form supplements are final and binding on the Bidder upon submission and may not be modified or superseded with another submission, unless the modifying or superseding submission is received before the bid closing time, as specified in the Instructions to Bidders article entitled "Bid Modifications."

.4 Bid Form supplements will be reviewed for compliance with the requirements of the Bid Documents after the private bid opening.

.5 Any of the following irregularities may cause the bid to be declared invalid and rejected:

.1 Any failure to submit a required Bid Form supplement as specified.

.2 Any required information in a Bid Form supplement is omitted, illegible, frivolous, or otherwise improperly submitted.

.3 Any alterations to the text, or any conditions added on or submitted with a Bid Form supplement.

.6 The Owner may, after the bid closing time and before contract award, require any Bidder to submit, in a form prescribed by or acceptable to the Owner, a detailed cost breakdown of the Bid Price(s), or any other additional supplementary information about any aspect of the Bidder's bid which, in the Owner's opinion, is necessary for bid evaluation purposes.

1.9 BID MODIFICATION

.1 A bid, including the Bid Form and Bid Form supplements, submitted in accordance with these bidding requirements may be modified, provided the modification:

.1 is in the form of a fax transmittal received at the fax number specified in 1.2, before the bid closing time, or

.2 is in the form of a letter received at the address specified in 1.2 before the bid closing time, and

.3 states the name of the Bidder, the nature of the modification, and is signed by an authorized person.

.2 For bid closing purposes, the official time of receipt of faxed bid modifications shall be the time of receipt automatically printed on the fax transmission by the receiving fax machine.

.3 When submitting a modification directing a change in a bid amount, do not reveal the original amount nor the revised amount:

.1 State only the amount to be added to or deducted from the original bid amount.

.2 When submitting a second or more modifications related to a single bid amount ensure that there is no ambiguity as to the intended bid price. The written modification shall clearly indicate whether:

.1 the bid amount first submitted is being modified and any previous modifications are to be disregarded, or

.2 a revised bid amount derived from a previous modification is being modified.

.4 State all Addendum Numbers received, if different from what was indicated on originally submitted Bid Form.

.5 The Owner will assume no responsibility or liability for the content of modifications, or for modifications that are, for any reason, delayed, illegible, unclear as to intent, ambiguous, contrary to these instructions, or otherwise improperly received. The Owner may disregard improperly received modifications.

1.10 BID WITHDRAWAL AND ACCEPTANCE

.1 A bid may be withdrawn at any time before the bid closing time provided the request is received in form of:

.1 a fax transmittal received and printed out in its entirety at the fax number specified in 1.2, before the bid closing time, or

.2 a letter received at the address specified in 1.2 before the bid closing time.

.2 Withdrawn bids may be resubmitted in accordance with these bidding requirements providing the resubmitted bid is received at the office specified in 1.2, before the bid closing time.

.3 A bid may not be withdrawn at or after bid closing time and shall be open to acceptance by the Owner until:

.1 some other Bidder has entered into a contract with the Owner for performance of the Work, or

.2 60 working days after the bid closing time,

whichever occurs first.

.4 The 60 working day acceptance period referred to above shall commence at midnight of the date of bid closing and shall terminate at midnight of the 60th working day thereafter.

.5 The 60 working day acceptance period referred to above may be extended at the Owner's request and subject to the Bidder's written agreement to the extension.

.6 The Contract shall be established upon issuance, by the Owner to the successful Bidder, of a letter accepting the bid without qualification or, if the letter accepting the bid contains one or more qualifications, upon written acceptance by the Bidder of all such qualifications.

.7 The lowest or any bid will not necessarily be accepted and the Owner may reject any and all bids.

.8 The Owner may negotiate contract terms with the Bidder submitting the lowest valid bid, provided that the negotiated changes to the Bid Documents result in either no change to the bid price or a reduced bid price. Such changes may be formalized in the form of a Post-Bid Addendum that, upon written acceptance by the Bidder, shall form part of the Contract Documents.

1.11 NOTIFICATION OF INTENT NOT TO SUBMIT A BID

.1 Prospective Bidders who have received Bid Documents from the office specified in 1.2, but do not intend to submit a bid, are requested, to promptly notify the office specified in 1.2 by fax.or e-mail

1.12 BID OPENING

.1 A private bid opening will commence no later than one hour after the bid closing time, at the address specified in 1.2. All bidders are invited to attend.

1.13 IRREGULARITIES

.1 A bid that is informal, incomplete, qualified, non-compliant with the requirements of the Bid Documents, or otherwise irregular in any way, may be declared invalid and rejected.

.2 The Owner may accept or waive a minor and inconsequential irregularity, or where practicable to do so, the Owner may, as a condition of bid acceptance, request a Bidder to correct a minor and inconsequential irregularity with no change in bid price.

.3 The determination of what is, or is not, a minor and inconsequential irregularity, the determination of whether to accept, waive, or require correction of an irregularity, and the final determination of the validity of a bid, shall be at the Owner's sole discretion.

.4 Discrepancies between words and figures will be resolved in favour of words.

1.14 SAFETY PREQUALIFICATION

.1 Prime contract Bidders shall possess, prior to contract award, a valid standard Certificate of Recognition (COR) or a valid Temporary Letter of Certification (TLC) for a standard COR as issued by the Alberta Construction Safety Association (ACSA) or another certifying partner authorized by Alberta Employment, Immigration and Industry to issue CORs or TLCs. Possession of other than a standard COR, such as a Small Employer Certificate of Recognition (SECOR) is not acceptable.

.2 The Owner may, after bid submission and prior to contract award, require proof of possession of a valid standard COR or TLC. A bid from a Bidder who fails to submit the required proof will be declared invalid and will be rejected.

.3 Prospective Bidders who do not possess a standard COR or a TLC for a standard COR, and wish to obtain information about obtaining either one, are advised to contact:

The Alberta Construction Safety Association
#101, 13025 St Albert Trail
Edmonton, Alberta T5L 5G2

Telephone: (780) 453-3311 or 1-800-661-2272
Fax: (780) 455-1120
Internet: www.acsa-safety.org

or another certifying partner authorized by Alberta Employment, Immigration and Industry to issue a standard COR or TLC.

1.15 AVAILABILITY OF BID DOCUMENTS

.1 Bid Documents are available in hard copy, at no charge, to the following bidders only:

.1 Prime contract bidders.
.2 Mechanical subcontract bidders.
.3 Electrical subcontract bidders.

at the following location only:

[Name of Firm / Company]
[Address]
[City][Province or State][Postal or Zip Code]

Telephone (000) 000-0000
Fax: (000) 000-0000

.2 Hard copy Bid Documents are also available, for viewing only, at local Construction Association Plan Rooms.

1.16 RETURN OF BID DOCUMENTS

.1 The successful Bidder shall retain their copy of the Bid Documents. All other unsuccessful Bidders shall return their copies of the Bid Documents to the address specified in 1.2 complete and in good order, not later than 10 working days after notification of contract award.

.2 Prospective Bidders who do not intend to submit a bid are requested to return the Bid Documents promptly, clean, complete and in good order, before the bid closing time.

1.17 EXAMINATION OF BID DOCUMENTS AND SITE

.1 The Bidder shall, before submitting a bid:

.1 examine and read the Bid Documents thoroughly,

.2 visit Place of Work and its immediately adjacent sites and other locations to become familiar with local and other conditions affecting the Work,

.3 Be aware of, understand and consider the effect of regulatory requirements applicable to the Work,

.4 Review, study and correlate Bidder's observations with the Bid Documents,

.5 immediately notify the Owner of all perceived omissions and discovered conflicts, errors and discrepancies that may be apparent to the Bidder subsequent to their review of the Bid Documents and site conditions, and

.6 be completely satisfied that Bidder understands, comprehends and is familiar with the Bid Documents. The Bidder and warrants that they are competent and have sufficient experience and qualifications to undertake and complete the Work as described in the Bid Documents.

.2 Refer to Section 00 31 00 – Available Information Documents which identifies available information pertaining to the Project and specifies the status of and the extent, if any, to which Bidder may rely upon such Information Documents.

.3 Before submitting a bid, each Bidder shall, at the Bidder's expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the conditions at, under or contiguous to the site, which may affect performance of the Work and which the Bidder deems necessary to determine its bid for performing the Work in accordance with the Bid Documents. Bidders shall obtain the Owner's prior approval for access to site for the purpose of carrying out any such activities. Bidders shall restore site to a condition acceptable to the Owner upon completion of such activities.

.4 Lands upon which Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Bid Documents. Additional lands and access thereto required for performance of the Work shall be provided by Contractor.

.5 To arrange for access to and inspection of site, contact:

[Name, address and telephone number]
[ ]
[ ]

1.18 BID SECURITY

.1 Provide and submit the bid security specified in Section 00 43 13 - Bid Security.

1.19 CONTRACT PERFORMANCE SECURITY AND SECURITY FOR PAYMENT OF CLAIMS

.1 Provide and include in bid price for security specified in Section 00 61 13 - Contract Performance Security

.2 Provide and include in bid price for security specified in Section 00 61 90 - Security for Payment of Claims

1.20 APPLICABLE LIEN LEGISLATION

.1 The Builders' Lien Act of Alberta applies to this Project

.2 Any and all claims procedures shall be in accordance with the Builders' Lien Act.

1.21 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Product options: Comply with requirements of Section 01 62 00.

.2 Substitutions:

.1 Comply with requirements of Section 01 62 00.

.2 Where products are specified by a proprietary specification, and substitutions are permitted, Bidders may base their bids on a named product or manufacturer or on unnamed substitutions, subject to the requirements specified for substitutions in Section 01 62 00.

.3 During the bid period, it is the sole responsibility of each Bidder to determine whether a substitution meets the requirements specified in Section 01 62 00.

.4 The Owner will not consider requests for approval of substitutions from Bidders during bid period.

.5 Substitutions will be evaluated and approved or rejected by the Owner after contract award.

.3 Product Acceptability:

.1 The Owner may, after bid submission and before contract award, require any Bidder to submit proof that a product proposed for use complies with requirements of Bid Documents. Such proof shall be in the form of product data as specified in Section 01 62 00.

.2 Should the Owner determine that a proposed product does not meet requirements of Bid Documents, Bidder shall propose a product which, in the Owner's opinion, does meet requirements of Bid Documents, otherwise such Bidder's bid may be declared invalid and rejected.

1.22 AGREEMENT

.1 The successful Bidder will be required to enter into a formal Agreement with the Owner for performance of the Work. Refer to Section 00 72 00 – General Conditions.

1.23 DIVISION OF WORK

.1 Work specified in the Specifications is divided into Divisions and Sections for reference purposes only. Except as may be otherwise specified in the Bid Documents, division of work among Contractor, Subcontractors, Sub-subcontractors and suppliers is Bidders' responsibility.

1.24 INTERPRETATION AND MODIFICATION OF BID DOCUMENTS

.1 Submit questions about the meaning and intent of the Bid Documents to the Owner at the office identified under "Inquiries".

.2 If an inquiry requires an interpretation or modification of the Bid Documents, the response to that inquiry will be issued in the form of a written Addendum only, to ensure that all bidders base their bids on the same information.

.3 Addenda may also be issued by the Owner to modify the Bid Documents as considered necessary by the Owner.

.4 Submit inquiries as early as possible in the bid period. If an inquiry requires an interpretation or modification of the Bid Documents, but is received too close to the bid closing time to permit issuance of an Addendum, the Owner may be unable to respond to that inquiry.

.5 Any replies to inquiries or interpretations or modifications of the Bid Documents made verbally, by e-mail, or by any manner other than in the form of a written Addendum, shall not be binding

1.25 ADDENDA

.1 During the bid period, Addenda will be issued by the Owner via fax, e-mail or courier to all parties recorded by the Owner as having received Bid Documents.

.2 Addenda shall become part of the Bid and Contract Documents.

.3 Each Bidder shall ascertain before bid submission that it has received all Addenda issued by the Owner and shall indicate in the Bid Form the Addendum number(s) of all Addenda received by the Bidder.

1.26 INQUIRIES

.1 Direct all other inquiries during bid period to:

[Name]
[Title]

[Name of Firm / Company]
[Address]
[City][Province or State][Postal or Zip Code]

Telephone (000) 000-0000
Fax: (000) 000-0000

.2 The preferred method for receipt of technical inquiries is by e-mail that includes the telephone number of the inquirer.

END OF SECTION

PART 1. GENERAL

1.1 RELATED REQUIREMENTS

.1 Instructions to Bidders Section 00 21 13.

.2 General Conditions: Section 00 72 00.

1.2 DEFINITIONS

.1 Information Documents means information of any type and in any form, related to the Project and identified in this Section.

.2 Owner: is synonymous with U.S. Department of Energy Event Organizers

1.3 INFORMATION DOCUMENTS

.1 Information Documents, or any part thereof, are not part of the project unless specifically incorporated into Project Documents by means of copying, transcribing or referencing.

1.4 USE OF INFORMATION DOCUMENTS

.1 Information Documents are made available to Project Teams, Contractors, sub contractors, volunteers and support staffing by The Owner for the purpose of providing Teams with information available by The Owner.

.2 Information Documents shall not be considered a representation or warranty that information contained therein is accurate, complete or appropriate.

.3 Project teams are encouraged to obtain specialist advice with respect to any informational documents as provided by the Owner. The Owner assumes no responsibility for such interpretations and conclusions.

.4 Information Documents, or parts thereof, shall not be considered part of the Contract, unless they are specifically incorporated into Project Documents by means of copying, transcribing or referencing, and shall draw his own conclusions from such data and shall not rely on opinions or interpretations contained therein.

1.5 INFORMATION DOCUMENTS INCORPORATED INTO CONTRACT DOCUMENTS

.1 Information Documents incorporated into Contract Documents, in whole or in part, consist of the following:

.2 U.S. Department of Energy Solar Decathlon manual entitled "U.S. Department of Energy Solar Decathlon Rules", dated October 22, 2010, prepared by the U.S. Department of Energy and consisting of seventy two pages. This Information Document is hereby incorporated into the Project Documents in its entirety. This document is available to the Project Team upon request.

.3 U.S. Department of Energy Solar Decathlon Code entitled "Solar Decathlon Building Code, dated march 26, 2010, prepared by the U.S. Department of Energy and consisting of Seventeen pages. This Information Document is hereby incorporated into the Project Documents in its entirety. This document is available to the Project Team upon request.

END OF SECTION

PART 1 GENERAL

1. BID FORM

.1 For the purposes of this bid the bidders shall use the Bid Form 00 41 13A as appended hereto:

.2 Bidders shall comply with all of the requirements as outlined in section 00 21 13 – Instructions to Bidders, if bidders do not comply with the instructions contained therein or any instructions as indicated on the Bid Form – 00 41 13A may cause the bid to been declared informal and is therefore open to acceptance invalid and rejected

END OF SECTION

STIPULATED PRICE BID FORM

Project Number:_____

Project: _____
(Name of the Project)

Located At: _____
(Address of the Project)

Submitted To: _____
(Owner Name)

_____

BIDDER

Legal Name: _____
(Name of the Company)

_____

Address: _____

City: _____ **Province:** _____ **Postal Code:** _____

Bid Price

We, the undersigned, having examined, read and have a full understanding of the Bid Documents as listed in Appendix "A" to this Stipulated Price bid, and having received, examining and understanding Addenda Numbers: _____inclusive, as were issued by _____

_____
(Name of the Consultant)

On behalf of the Owner, And having visited the Place of Work; and reviewing and examining all conditions affecting the work, we are satisfied and we understand the Bid Documents abd declare ourselves competent to undertake the Work. We do hereby irrevocably offer and agree to enter into a Contract to Perform the Work required by the Bid Documents for the Stipulated Price of _____

_____

Dollars ($ _____) in Canadian funds, which price excludes Value Added Taxes.

Interest

Should either party fail to make payments as they become due and payable under the terms and conditions of the Contract or in an award by arbitration in court, an interest rate of _____ percent (_____ %) per annum above the bank rate on such unpaid amounts shall also become due and payable until such time as payment is made. Such interest shall be compounded on a monthly basis. The bank rate shall be the rate established by the bank of Canada as the minimum rate at which the bank of Canada makes short term advances to the chartered banks.

Declarations

We hereby declare that:

(a.) No person, firm or corporation other than the undersigned has any interest in the Bid or in the proposed Contract for which this bid is made;

(b.) It is understood that, with respect to this Bid Form, should any item be omitted or illegible, should any alteration be made to the text, or should any condition be added on or submitted with the Bid Form, the bid may be declared informal and the bid may be rejected.

(c.) This Bid is open to acceptance by the Owner for a period of not more or less then 60 working days from the date of Bid Closing.

Signatures

SIGNED, SUBMITTED AND EXCECUTED this _____ day of _____, 20 _____ .

NAME AND ADDRESS OF BIDDER:
(Print or Type) _____

_____

_____

SIGNATURE OF AUTHORIZED REPRESENTATIVE(S):

NAME AND STATUS OF PERSON(S) SIGNING BESIDE: (Print or Type)

_____ _____
(signature) *(Print name and title of person signing)*

_____ _____
(signature) *(Print name and title of person signing)*

WITNESS'S SIGNATURE OR CORPORATE SEAL:

_____
(signature)

_____
(print name and title of person signing)

PART 1. GENERAL

1.1 TYPE AND AMOUNT OF BID SECURITY

.1 The Bidder shall provide bid security in the form of a bid bond, a certified cheque or bank draft in an amount not less than the lesser of:

.1 10% of the bid price.

.2 Bids not accompanied by bid security will be considered non-compliant and will be rejected and returned to the Bidder.

1.2 BID BONDS

.1 Bid bond shall be in the form of the Canadian Construction Documents Committee (CCDC) standard form of bid bond, CCDC 220, 2002 edition.

.2 Bid bond shall be issued by a duly incorporated surety company authorized to transact business of suretyship in the Province of Alberta.

.3 Consign bid bond to [name of the Owner] Ensure that bid bond is properly executed byboth Bidder and surety.

.4 Bid bond may, upon request and at the Owner’s discretion, be returned to unsuccessful bidders.

1.3 CERTIFIED CHEQUES AND BANK DRAFTS

.1 Bid security provided in the form of a certified cheque or bank draft does not negate the successful bidder's obligation to provide surety bonds as specified in Section 00 61 13 and Section 00 61 90.

.2 Bidders providing bid security in the form of a certified cheque or bank draft shall, as a condition of contract award, submit a Consent of Surety or Agreement to Bond issued by duly incorporated surety company authorized to transact business of suretyship in the Province of Alberta. If a Bidder fails to submit an acceptable Consent of Surety or Agreement to Bond by the earlier of:

.1 a date that the Owner may request in writing, or

.2 seven days before expiry of the bid acceptance period,

.3 The bid will be considered non-compliant and will be rejected.

.3 Make certified cheques and bank drafts payable to the [Name of payee].

.4 The Owner will return certified cheques and bank drafts to unsuccessful bidders promptly upon expiry of the bid acceptance period or, at the Owner's discretion, before expiry of the bid acceptance period.

1.4 DEFAULT BY BIDDER

.1 If a Bidder whose bid is accepted by the Owner in writing, without qualification, and within the acceptance period specified in the Bid Documents, refuses or fails within 15 working days after the date of issuance of the written acceptance of the bid:

.1 to sign a formal Agreement with the Owner for the performance of the Work, and
.2 to provide surety bonds as specified in Section 00 61 13 and Section 00 61 90,

.2 the Bidder shall be liable to the Owner for the difference in money between the amount of its bid and the greater amount for which a contract for the Work is entered into with some other Bidder, up to the maximum amount of the bid security provided.

.3 If a Bidder provides bid security in the form of a certified cheque or bank draft, and fails to submit a Consent of Surety or Agreement to Bond as specified in 3.2, the Bidder shall be liable to the Owner for the difference in money between the amount of the accepted bid and the greater amount for which a contract for the Work is entered into with another Bidder of the Owners choosing.

.4 If a Bidder provides bid security in the form of a certified cheque or bank draft, and fails to submit a Consent of Surety or Agreement to Bond as specified in 3.2, the bidder waives any claims they may have to the bid security as provided under this section and the Owner shall retain the bid security.

END OF SECTION

AGREEMENT BETWEEN TEAM CANADA AND CONTRACTOR

This Agreement made on the _____ day of _____ in the year _____

by and between

The University of Calgary Solar Decathlon Team hereinafter referred to as Team Canada

and

_____

Name of Contractor

_____

Address

hereinafter called the "Contractor".

Team Canada and the Contractor agree as follows:

ARTICLE 1 THE WORK

The Contractor shall perform the Work required by the Contract Documents for:

_____

Title of the Work and the Project

and for which _____

Name of Consultant

is acting as the Consultant, and is hereinafter called the "Consultant", and do and fulfill everything indicated by this Agreement.

ARTICLE 2 - CONTRACT DOCUMENTS

The Contract Documents referred to in Article 1 of this Agreement are further defined in the Definitions portion of the Conditions of Contract but are generally comprised of the following:

- The Letter of Acceptance
- This Agreement Form, once executed by both parties
- Amendments, if any, made prior to execution of the Agreement Form
- Conditions of Contract
- Issued Specifications
  - Portions of Division 0 that have application during the performance of the Contract
  - Divisions 1 to 50
- Issued Drawings
- Schedules
- Subsequent amendments made in accordance with the provisions of the Contract.

ARTICLE 3 - CONTRACT TIME

The Contractor shall attain Interim Acceptance of the Work by the _____ day of _____ in the year _____

ARTICLE 4 - CONTRACT PRICE

The Contract Price is _____ dollars

and _____ cents (_____) in Canadian funds.

ARTICLE 5 - GOODS AND SERVICES TAX

The Minister certifies that the purchaser of the goods and services provided under the Contract is the Government of Alberta or a listed tax-free Government of Alberta agency, and is therefore not subject to the federal Goods and Services Tax.

ARTICLE 6 - PAYMENT

The Minister shall make payments in Canadian funds to the Contractor on account of the Contract Price in accordance with the Payment Conditions and other applicable provisions of the Contract Documents.

ARTICLE 7 - SUCCESSION

The Contract Documents are to be read into and form part of this Agreement and the whole shall constitute the Contract between the parties, and subject to the law and the provisions of the Contract Documents shall enure to the benefit of and be binding upon the parties hereto, their respective heirs, legal representatives, successors and assigns.

In witness whereof the parties hereto have executed this Agreement under their respective seals and by the hands of their duly authorized representatives.

SIGNED, SEALED AND DELIVERED
in the presence of:

CONTRACTOR

Name of Contractor

Signature of Authorized Signing Officer

Name and Title of Officer

Corporate Seal

Signature of Authorized Signing Officer

Signature of Witness

Name and Title of Officer

Name and Title of Witness

TEAM CANADA REPRESENTATIVE OR AUTHORIZED REPRESENTATIVE

Signature

Name and Title

Corporate Seal

Signature of Witness

Name and Title of Witness

END OF SECTION

PART 1. GENERAL

1.1 CONTRACT PERFORMANCE SECURITY

.1 The Contractor shall provide security for payments of claimants for labor and material used or as reasonably required for use in the performance of the Contract. Such Security shall be in the form of a Labour and Materials Payment Bond for an amount not less than fifty percent (50%) of the Contract Price.

.2 The bond shall be in the form of the Canadian Construction Documents Committee (CCDC) standard form of performance Bond, CCDC Document No. 222 – 2002 version.

.3 The performance Bond shall be issued by a duly incorporated Surety company authorized to transact business of a suretyship in the province of Alberta.

.4 Submit the bond to the Owner no later than 15 working days subsequent to the date of issuance of the Letter of Acceptance of Bid.

.5 A copy of the Labour and Material payment Bond shall be posted in a conspicuous location at the Place of Work.

END OF SECTION

PART 1. GENERAL

1.1 CONTRACT DOCUMENTS

.1 The Contract for the performance of this work shall be signed, dated, sealed and executed by the Owner and the Contractor.

.2 The form, Definitions and General Conditions of this Contract shall be those listed the Canadian Construction Documents Committee (CCDC) document No. 2 – Stipulated Price Contract 2008 version.

.3 Any such revisions, modifications, editing, additions or deletions of the Definitions or General Conditions contained in the CCDC 2 – 2008 shall be incorporated in to the Contract by Section 00 73 00 - Supplementary Conditions.

END OF SECTION

PART 1. GENERAL

1.1 DEFINITIONS

.1 Property Line(s): shall mean the designated lot size of 23.8m (78 Feet) east to west, 18.3m (60 Feet) north to south and 5.4m (18 feet) in height as provided to the Contestant for by the National Mall and the U.S. Department of Energy.

1.2 WORK OF THE PROJECT

.1 Work of the Project generally comprises of, but, is not necessarily limited to the following:

.1 The partial pre-fabrication of, site assembly, deconstruction and removal from site a + / - 92.9 square meter (1000 square foot), solar powered modular residence.

.2 Loading, shipping and handling of the pre-fabricated modular section to and from the National Mall in Washington D.C.

1.3 PROJECT MANAGEMENT

.1 The project will be pre-fabricated, shipped, constructed and deconstructed under the supervision of the U.S. Department of Energy and the Team Canada Project Managers and supporting staff.

.2 Team Project Managers will provide full-time site administration to ensure that all hired Contractors, sub contractors, volunteers and sponsors coordinate their work with all other Contractors, sub contractors, volunteers and sponsors and to ensure the established construction schedule is maintained.

.3 Each Contractor, sub contractor, volunteer and sponsor shall cooperate fully with the Team Project Manager and with all other project team members, Contractors, sub contractors, volunteers and sponsors.

.4 Any Contractor who considers that there is a lack of cooperation on the part of any Other Contractor shall promptly so inform the Team Project Manager immediately for resolution to the potential conflict.

.5 The Team Project Manager shall verify and ensure compliance to the Competition and local codes, laws, regulations and guidelines as set forth and enforced by the contest authorities having jurisdiction.

1.4 WORK OF THIS CONTRACT

.1 Work of this Contract shall be completed at the following location:

Project Name: U.S. Department of Energy – 2011 Solar Decathlon

Municipal Address: National Mall,
900 Ohio Drive S.W,
Washington, D.C.
20024-000
United States of America.

.2 Work of the Contract is not necessarily restricted to work within property lines of site, but includes all Work required by Contract Documents, both within and outside property lines.

.3 Third party environmental certification through LEED (Leadership in Energy and Environmental Design) with the Canada Green Building Council:

.1 This Project is intended to be registered LEED [NC] [CI] [ ] Project with the Canada Green Building Council.

.2 Certification level goal is [Silver] [Gold] [Platinum].

.4 Refer to Section 01 35 18-LEED Requirements for procedures, definitions, point categories, prerequisites, and credits.

.4 Refer to Section 01 35 20 - Environmental Procedures for procedures concerning building and site environment.

.3 Refer to Section 01 35 25 - Erosion and Sedimentation Control for control and protection of site environment.

.5 Refer to Section 01 74 19 - Waste Management and Disposal for requirements to reduce, reuse, recycle, and dispose of construction waste.

1.5 CONTRACT TIME

.1 Date of commencement of the assembly and Construction will be on [Monday] [Tuesday] [Wednesday] [Thursday] [Friday] [Saturday] [Sunday], [Month], [Day] 2011.

.2 The date of completion of the project including disassembly and clean up will on [Monday] [Tuesday] [Wednesday] [Thursday] [Friday] [Saturday] [Sunday], [Month], [Day] 2011.

1.6 CONSTUCTION ARRANGEMENT

.1 Work including all pre-planned off site construction activities, transportation to and from the competition site, on site assembly, construction, and disassembly. Clean up will be performed by volunteers, sponsors, locally hired trades and sub trades and all others as designated by the Team Canada Project Managers.

1.7 RELATED WORK BY OTHERS

.1 Coordinate and connect all work of this Project with work of other Contractors, Mall and park staff and regulating authorities as required.

.2 Cut, fit and patch work of this Contract as required to fit, receive or be received by work of others

1.8 MATERIALS AND SERVICES SUPPLIED OR INSTALLED BY OTHERS

.1 Supply following materials will be supplied by the event organizers in accordance with the rules and regulations that govern the competition:

.1 An electrical power grid that provides AC power to and accepts AC power from the houses, including all service conductors and connect the conductors at the utility tie in point.

.2 Team project Managers shall notify the competition organizers if the Project (house) requires an AC service in excess of 60Hz, 120/240V split-phase with neutral.

.3 If requested event organizers shall supply up to 5,678.1 liters (1500 U.S. gallons) of potable water. Water will be delivered to the project house in accordance with article 9-8 of the contest rules and regulations.

.4 Removal of waste water will be supplied by the event organizers. Team Project Managers shall provide assistance to removal service vehicles in accordance with article 9-9 – Water Removal as specified in the Contest rules and Regulations.

1.9 ROADS, CURBS, GUTTERS, AND SIDEWALKS

.1 Contractor shall be responsible for the following in connection with roads, curbs, gutters sidewalks, landscaped (hard or soft) occurring both inside and outside the property lines:

.1 Repair or replacement of damage to existing roads, curbs, gutters and sidewalks caused by Work performed by the transportation, assembly, construction or disassembly of their respective completion entry.

.2 Contestants will make arrangements for paying costs and charges levied by the Contest authorities having jurisdiction.

1.10 CONTESTANTS USE OF PREMISES

.1 Contractor shall have partial use of premises for performance of the Work.

.2 Contractor shall limit his use of premises to allow for:

.1 Public occupancy.
.2 Work of Other Contestants.
.3 Use of Contest Administrators /officiators.
.4 Use as required by Mall and Park:

.1 Staff.
.2 U.S. Department of Energy personnel.
.3 Administration personnel.
.4 Maintenance personnel.
.5 Public use.

.5 All other persons, as required, by the U.S. Department of Energy, Mall and Park authorities having jurisdiction.

1.11 RESPONSIBILITY FOR EXISTING PROPERTY

.1 Contractor shall assume responsibility for the care, custody and control of property which is assigned to him for performance of the Work.

.2 Contractor shall assume responsibility for and shall repair or replace all damage to existing property attributable to performance of Work of their respective contest entry.

.3 Refer to the U.S. Department of Energy – 2011 Solar Decathlon Contest Rules and Regulations.

.4 Refer also to section 01 50 00 – Temporary Facilities.

END OF SECTION

PART 1. GENERAL

1.1 RELATED REQUIREMENTS

.1	Workers' compensation Board Submittals	Section 01 33 00
.2	Contract Price Breakdown	Section 01 33 00
.3	Cash flow Forecast	Section 01 33 00

1.2 CONDITIONS OF PAYMENT

.1 Payments are on a stipulated Price Arrangement, any amounts claimed by the Contractor for progress amounts shall be consistent with the approved contract price breakdown.

1.3 STATUTORY DECLARATION FORMS

.1 Canadian Construction Documents Committee (CCDC) Statutory Declaration form No. 9A shall be used when submitting applications for payment.

1.4 PROGRESS PAYMENT APPLICATION

.1 The Contractor shall submit applications for progress payments on a monthly basis.

.2 Applications for progress payments shall be dated the last day of the monthly payment period or as agreed to by the Owner.

.3 The amount claimed for each billing period shall include:

.1 Amounts for work actually performed, including labour provided and material supplied and installed.

.2 Amounts for any and all materials received that are free from manufacturing defects, shipping damage and remain in good condition are eligible to be submitted for progress payments, provided the materials are on site at the Place of Work and are stored in such a manner as to prevent damage from the elements, construction activities, theft or vandalism.

.3 Sufficient data satisfactory to the Owner and the Consultant to evaluate the amount(s) claimed by the Contractor.

.4 A completed statutory declaration, CCDC form 9A with the second and all subsequent applications for progress payments.

.4 Any and all additional information relating to the application for progress payment as may be requested by the Owner or the Consultant.

.5 The Consultant and the owner will review the application for progress payment and make any adjustments to the amount claimed, including reducing the amount claimed by the amount of deductions as specified in Article 1.9 of this section.

.6 The amount payable by the Owner shall be as referred to in article 1.4, less the holdback amounts specified in article 1.5

1.5 HOLDBACKS

.1 The owner shall holdback an amount of not less than ten percent (10%) from each progress payment as referred to in article 1.4

.2 An amount of up to one hundred percent (100%) of the holdback amounts shall become due and payable to the Contractor provided:

.1 The Consultant, on behalf of the owner has issued a letter of acceptance of the Work.

.2 A period of not less than forty five (45) days has elapsed from the date of acceptance of the Work.

.3 Any and all third party claims received by the owner have been resolved, or addressed and a course of action has been agreed to by both the owner and the Contractor.

.4 Release of hold back amounts are subject to the deductions and withholdings specified in article 5.4.

.3 The Contractor shall submit to the Owner, in writing, an application for payment of holdback amounts, this application shall include:

.1 A letter of Clearance from the Workrers' Compensation board.

.2 A completed Statutory Declaration form CCDC document 9A.

.4 All holdback monies payable subsequent to Article 1.5.2 shall be subject to an deductions under article 1.9 of this section and to any withholdings under Article 10 of this section, and subject to further withholdings as follows:

.1 An amount of not less than twice the Owners estimate of the cost to complete, remedy or correct any defects.

.2 An amount of not less than twice the amount of the Owners estimate of the cost to complete any unfinished or outstanding work.

.5 If any amount of monies is withheld by the Owner as described in Artice 1.5.4, such monies, or portions thereof, shall, at such reasonable times and intervals as the Owner and the Consultant may determine, become due and payable by the Owner when the causes for the withholding of monies are removed.

1.6 PARTIAL RELASE AND PAYMENT OF HOLDBACK AMOUNTS

.1 When a portion or any part of the Work is required for utilization by the Owner and partial release and payment of any holdbacks relating specifically to the area required for utilization, the conditions as stated in Article 1.5 shall apply.

1.7 FINAL PAYMENT

.1 Any unpaid amounts of the Contract price will become due any payable to the Contractor Provided:

.1 The Owner, based on the Consultant's recommendation has issued a Letter of Final Acceptance to the Contractor.

.2 Any and all third party claims received by the owner have been resolved or addressed and a course of action has been agreed to by both the owner and the Contractor.

.3 Any and all Final adjustment of amounts owing has been submitted and agreed to by both the owner and the Contractor

.2 The Contractor shall submit, in writing, application for final payment, the written application shall include the following:

.1 A letter of Clearance from the Workers' Compensation Board.

.2 A completed Statutory Declaration Form – CCDC document 9A

.3 A statement of final adjustments of accounts.

.3 Subsequent and notwithstanding the requirements as outlined in article 1.7 – Final Payment, payment for any and all portions of the Work which cannot be completed due to circumstance beyond the Contractors control may be deferred provided the Owner and the Contractor agree , in writing, to any such amounts.

1.8 GOODS AND SERVICES TAX

.1 Each application shall include any amount for the Federal Goods and Services Tax (GST) and shall be indicated separately on each application for progress payment.

1.9 DEDUCTIONS FROM PAYMENTS

.1 The Owner may deduct from any amount claimed by the Contractor, an amount equal to the value, as determined by the Consultant and/or the Owner, for work that is deemed, in the Owners' or the Consultants' opinion is not in accordance with the Contract Documents.

.2 The owner may deduct from any amount claimed or payable to the Contractor:

.1 The amount of any unresolved third party claims submitted pursuant to the Builders' Lien Act or applicable requirement of the General Condition of the Contract, and

.2 The amount(s)n of any unpaid and overdue statutory account as relating to the Terms and Conditions of the Contract and which is enforceable against the Owner.

1.10 WITHHOLDING OF PAYMENT

.1 The Owner may withhold all or part of any payable amounts, as may be reasonable, to the Contractor to protect the Owner or Third parties from loss due to the Contractors:

.1 Failure to make payments as agreed to under the terms and conditions of the respective sub-contractors contracts, including:

.1 Unpaid amounts for materials, labour or equipment as required by the sub contractor to complete the work, at the Place of Work.

.2 Failure to ensure that Subcontractors make payments to any sub-subcontractors for any labour, materials or equipments used to complete the Work at the Place of Work.

.3 Inability to complete the Work within the specified Contract Time.

.4 Inability to completed the Work for the unpaid balance of the Contract Price.

.5 persistant failure to perform the Work in accordance with the Contact Documents.

1.11 ACCEPTANCE OF THE WORK

.1 The Contractor unconditionally and irrevocably agrees that the title to all work and materials covered by any one and all applications for payment will pass to the Owner, at the time payment is made, and warrants that the all work completed to date is free and clear of all liens, claims, interests or encumbrances.

.2 The Contractor also unconditionally and irrevocably agrees that any and all materials that have been stored at the Place of Work, that have been paid for by the Owner, shall not be removed or damaged or in any way, and shall remain secure and protected.

.3 Payments made to the Contractor shall not in any way be construed as acceptance of the Work, Products or any other part of the Work, completed to date, nor is payment considered to be acceptance that the Work completed at the place of Work in is accordance with the Contract Documents.

END OF SECTION

PART 1. GENERAL

1.1 REFERENCES

.1 U.S. Department of Energy Solar Decathlon Rules – Updated October 22, 2010.

.2 U.S. Department of Energy Solar Decathlon Building Code – Updated October 22, 2010.

1.2 DEFINITIONS

.1 Utility: as used in this Section, "Utility" means utility or service provided by the contest organizers.

1.3 PROJECT TEAM RESPONSIBILITIES

.1 The Project Team shall be responsible for connection of project service lines to Utility's lines and sources, regardless of whether the required work is performed by The Project Team's own forces, Subcontractors, or Sub-Subcontractors, or by a Utility.

.2 Coordinate service connections work. Make all necessary arrangements with, comply with requirements of, and cooperate fully with the requirements of the Codes, laws. Regulations, guidelines and recommendation of the Contest authorities having jurisdiction.

1.4 UTILITY CHARGES

.1 Service charges and penalties, if any, levied by the Contest organizers or suppliers of a Utility shall be levied against the Team in accordance with Rule 9, Article 9.8 – Water Delivery, sentence d. of the Contest rules and regulations.

.2 Service charges and penalties, if any, levied by the Contest organizers or suppliers of a Utility shall be levied against the Team in accordance with Rule 9, Article 9.9 – Water Removal sentence d. of the Contest rules and regulations.

1.5 SERVICE CONNECTIONS, DISTRIBUTION AND REMOVAL

.1 Water / Greywater / Irrigation:

.1 Water:

.1 The Utility shall:

.1 Provide potable water in accordance with Rule 9. Liquids, article 9-8 – Water Delivery, sentences a. and c. of the Contest rules and regulations.

.2 Provide 2 water trucks equipped with pumps to aid in the removal of water from the Project site.

.2 The Project Team shall:

.1 Comply with rule 9. – Liquids of the contest rules and Regulations.

.2 Provide primary supply water a container(s). Container(s) shall be located outside of the finished Project Square footage.

.3 Provide full shading of the primary water supply tanks to sufficiently protect the container from direct solar radiation between 9 a.m. and 5 p.m. EDT or between 8 a.m. and 4 p.m. solar time on October 01.

.4 Provide the Utility with the following:

1. Fill Locations.
2. Quantity of water requested for each fill location.
3. Container dimensions.
4. Diameter or size of fill opening. (Min. of 100mm (4 inches)).
5. Adequate clearance(s) above the container(s) fill location(s), all clearances shall not be less than 304 mm (12 inches) in all directions adjacent to the fill opening(s).
6. Clear and free, unobstructed access to fill opening location(s).

.5 Provide 6 team members, contractors, sub contractors or volunteers, at the request of the Utility provider, to aid in the relocation of the water hose and associated equipment from the previous residence to their Project residence.

.6 Provide suitable distribution within the project residence to operate all fixtures requiring water.

.2 Greywater:

.1 The Project Team shall: Comply with Rule 9. – Liquids, Article 9-7. – Greywater Heat Recovery.

.2 Provide Greywater storage container(s). Container(s) Container(s) shall be located outside of the finished Project Residence Square footage.

.3 Comply with Rile 9. – Liquids, articles 9-1. Container Locations, 9-7. – Greywater Heat Recovery and 9-9. – Water Removal.

.3 Irrigation:

.1 The Utility shall:

.1 Upon request provide a one time delivery of water suitable for irrigation purposes to the project residence. Amount of water that can be requested for irrigation purposes is restricted 189 liter (50 U.S. gallon) per project residence.

.2 Electrical power:

.1 Utility shall: provide a "Village Grid" including all necessary conductors and connectors and shall connect the 60Hz, 120240V Split-phase service as required for each Project Residence.

.2 Provide inspection services as required to ensure that the Project residence is adequately suited to "tie-in" to the Village Grid". Refer to Appendix A –Event Schedules of the Contest Rules and Regulations.

.3 Project Team shall:

.1 Provide terminal connections for the Utility to connect the Project residence to.

.2 Provide panel boards, terminal points, junction boxes, outlet locations and all other required electrical conduit, wiring and accessories as required for the complete and suitable installation of the Project Residence electrically powered equipments.

.3 Restrict the use of modified photovoltaic cells.

.4 Restrict the use of "hard-wired batter banks and large UPS power supplies.

.5 Limit the use of small Photovoltaic (PV) powered devices to a maximum of 100Wh.

.6 Ensure that photovoltaic cells are commercially available to all teams prior to the commencement of the event.

.7 Comply with the U.S. Department of Energy Solar Decathlon Building Code – Updated October 22, 2010.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 Read this Section in conjunction with the conditions governing changes in the Work and valuation of changes in the General Conditions of Contract.

.2 The General Conditions of Contract provide for valuation of changes by three different methods: lump sum, unit price, and cost plus. This Section applies to the lump sum method only.

1.2 DEFINITIONS

.1 "Actual cost of material and labour" as used in the valuation of changes article in the General Conditions of Contract, means the sum of costs directly related to or necessarily and properly incurred by Contractor, Subcontractors and Sub-subcontractors in the performance of a change in the Work. Direct costs shall include:

.1 Materials cost,
.2 total labour cost,
.3 travel and subsistence cost,
.4 temporary work cost,
.5 construction equipment cost,

and shall exclude overhead cost and profit.

.2 "Material cost" means cost of all Materials, including transportation and storage thereof. All rebates, refunds, returns from sale of surplus Materials, and trade discounts other than prompt payment discounts, shall be credited to Minister.

.3 "Total labour cost" means sum of direct labour cost and payroll burden cost.

.4 "Direct labour cost" means base wage costs of employees, excluding payroll burden cost.

.5 "Payroll burden cost" means costs statutory charges and fringe benefit costs additional to direct labour cost and includes unemployment insurance, workers' compensation, vacation pay, statutory holiday pay, health and welfare, pension plan, training fund, and other payroll costs which are hourly wage dependent and are paid by the employer.

.6 "Travel and subsistence cost" means travel and subsistence costs incurred by employees when working beyond a reasonable commuting distance from their normal place of residence.

.7 "Temporary work cost" means cost of temporary structures, facilities, services, controls, and other temporary items used in the performance of a Change in the Work, including maintenance, dismantling and removal, less any residual value after dismantling and removal.

.8 "Construction equipment cost" means the cost of rented or owned equipment, including cost of loading, transportation, unloading, erection, maintenance, dismantling and removal.

.9 "Overhead cost" means Contractor's, Subcontractors' and Sub-subcontractors' costs related to:

.1 operation and maintenance of head offices, branch offices, and site offices,

.2 administration at head offices, branch offices, and site offices,

.3 general management, legal, audit, and accounting services,

.4 buying organization, corporate tax,

.5 financing and other bank charges,

.6 bonding and insurance,

.7 salaries and other compensation of off-site personnel,

.8 salaries and other compensation of on-site superintendents and other supervisory personnel,

.9 planning, estimating, and scheduling of work,

.10 expendable and non-expendable small tools, including maintenance thereof,

.11 recruitment and training of on-site staff, and

.12 all other costs not defined as direct costs.

1.3 SCHEDULE OF LABOUR RATES

.1 Submit to Owner for approval, within 21 days after date of commencement of Contract, a Schedule of Labour Rates in the form of Document 00 62 63A.

.2 Labour rates stated in Schedule shall be the hourly labour rates that will be applied when estimating increases and decreases in cost resulting from changes in the Work. Assume that work will be performed during regular working hours, not premium time.

.3 Approved schedule of Labour Rates will be used by Owner and the Consultant solely for evaluating Contractor Proposals for changes in the Work. Nothing specified herein, nor the submission of a Schedule of Labour Rates by Contractor, shall be construed to mean that the Owner has established, or will establish, minimum wages or benefits applicable to the Work, other than those required by law.

.4 Include all trades that will be employed in the Work, including trades employed by Subcontractors and Sub-subcontractors.

.5 Provide a breakdown indicating hourly labour rates for direct labour cost, payroll burden cost, and the resulting total labour cost for journeymen, apprentices, foremen and other applicable classifications within each trade.

.6 Labour rates stated in Schedule shall be consistent with rates that will actually be paid in the normal performance of the Work, during regular working hours, and shall not exceed the following:

.1 Where collective agreements apply:

.2 rates for direct labour cost shall not exceed rates established by collective agreements, and

.3 rates for payroll burden cost shall not exceed rates established by collective agreements and statutory charges.

.4 Where collective agreements do not apply:

.5 rates for direct labour cost shall not exceed rates prevailing in the locality of the Project, and

.6 rates for payroll burden cost shall not exceed 25% of rates for direct labour cost.

.7 The Owner's approval of rates provided in the Schedule of Labour Rates will be conditional upon compliance with the aforementioned requirements. Approval will be based on most current information available to Owner on Alberta construction industry wages and benefits.

.8 The Contractor may request an amendment to an approved rate stated in the Schedule of Labour Rates, if and when required on account of a change in the rate that will actually be paid in the normal performance of the Work. If Contractor can prove to the Owner's satisfaction that a different rate will actually be paid, the Owner may, at his sole discretion, approve such a change in rate.

1.4 CHANGE ORDER PROCEDURES - LUMP SUM METHOD OF VALUATION

.1 The Consultant of behalf of the Owner will issue a “Proposed Change Notice” (PCN) to the Contractor.

.2 The Contractor shall submit a Contractor Proposal stipulating:

.1 a lump sum increase, decrease, or no change in the Contract Price, and

.2 an increase, decrease, or no change in the Contract Time,

.3 Based on the scope identified in the Proposed Change Notice (PCN) for the proposed change in the Work.

.3 The Contractor shall include in their proposal, a detailed breakdown of lump sum increase or decrease, indicating Contractor's, and where applicable Subcontractors' and Sub-subcontractors':

.1 itemized direct costs applicable to the proposed change in the Work, and

.2 applicable amounts for overhead and profit, in accordance with percentages specified in the General Conditions of Contract.

.4 Do not include costs that would otherwise be incurred in the normal performance of the Work.

.5 Include in detailed breakdown of Contractor Proposal a further breakdown of the total labour cost component indicating, for each applicable trade and trade classification, the labour rate(s) and the number of hours from which the total labour cost is derived.

.6 Include in detailed breakdown of Contractor Proposal only those labour rates included in Schedule of Labour Rates and previously approved by Minister, in writing, unless the extra work cannot be performed during regular working hours and Minister has given approval, in writing, for premium time labour rates.

.7 Upon the Owner's approval and acceptance of Contractor Proposal, a "Change Order" will be issued to Contractor by the Consultant of behalf of the Owner.

END OF SECTION

1. FROM: _____
(Contractor Name)

_____
(Contractor Address)

PROJECT: _____
(Project Name and Location)

_____

2. The Schedule of Labour Rates is submitted in compliance with the requirements of Section 01 23 63 - Change Order Procedures of the Contract Documents.

3. It is fully and irrevocably understood that:

.1 This Schedule of Labour Rates as submitted, is subject to Owner's approval and shall be used solely for the purposes of evaluating the Contractor Proposals for changes in the Work.

.2 The Owner has **not** established, **nor** intends to establish, minimum wages or benefits applicable to the Work, other than those required by law.

4. Schedule of Labour rates for trades employed by Contractor:

Name of Trade	Trade Classification	Direct Labour Cost ($/hour)	Payroll Burden Cost ($/Hour)	Total Labour Cost ($/hour)

We _____ hereby declare that the above stated labour rates are, to the
(name of Bidder / Contractor)

best of our knowledge, the rates that will actually be paid in the normal performance of the Work, during regular working hours, and do not include any overhead cost or profit.

_____ _____ _____

(*name of Contractor)* *(signature)* *(date)*

Name of Trade	Trade Classification	Direct Labour Cost ($/hour)	Payroll Burden Cost ($/Hour)	Total Labour Cost ($/hour)

We _____ hereby declare that the above stated labour rates are, to the
(name of Bidder / Contractor)

best of our knowledge, the rates that will actually be paid in the normal performance of the Work, during regular working hours, and do not include any overhead cost or profit.

_____ _____ _____

(*name of Contractor)* *(signature)* *(date)*

Name of Trade	Trade Classification	Direct Labour Cost ($/hour)	Payroll Burden Cost ($/Hour)	Total Labour Cost ($/hour)

We _____ do hereby declare that the above stated labour rates are, to
(name of Bidder / Contractor)

the best of our knowledge, the rates that will actually be paid in the normal performance of the Work, during regular working hours, and do not include any overhead cost or profit.

_____ _____ _____

(*name of Contractor)* *(signature)* *(date)*

END OF SECTION

PART 1. GENERAL

1.1 GENERAL COORDINATION

.1 Coordinate all construction activities as required to ensure efficient and orderly installation of each part of the Work.

.2 Where the installation of one part of the Work is dependent or codependent on installation of other components, either before or after its own installation, the Project Team shall ensure that the scheduling and coordination of the related construction activities shall be in such a sequence as to achieve and obtain the best results.

.3 Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

.4 Schedule and make adequate and satisfactory provisions to accommodate any and all items scheduled for installation under separate contract or by Owner's own forces at a later date.

1.2 ADMINISTRATIVE PROCEDURES

.1 Coordinate scheduling and timing of required and necessary administrative procedures with construction activities, as required, to avoid conflicts and to ensure orderly and timley progress of the Work. Such administrative activities shall include, but, shall not necessarily be limited to, the following:

.1 Preparation of schedules.
.2 Installation and removal of temporary facilities.
.3 Delivery and processing of submittals.
.4 Progress meetings.
.5 Contract acceptance procedures.
.6 Turnover of demolished materials identified on drawings to owner.

1.3 GENERAL INSTALLATION PROVISIONS

.1 The Contractor shall Require the installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until any and all unsatisfactory conditions have been corrected in an acceptable manner.

.2 Comply with the product manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

.3 Inspect any and all materials immediately upon delivery to site and again prior to installation at the Place of Work. The Contractor shall reject damaged and defective items and notify the Owner and the Consultant immediately, in writing, of any such damaged or defective materials.

.4 Provide attachment and connection devices and methods necessary for securing Work. Secure any and all Work true to line and level. Allow for expansion and building movement.

.5 Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect.

.6 Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as required to prevent deterioration.

.7 Coordinate all temporary enclosures with all required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

.8 The Contractor shall supervise all construction related activities to ensure that no part of the Work, whether completed or in progress, is subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

1.4 CUTTING AND REMEDIAL WORK

.1 Do any required cutting and remedial work required to make all parts of the Work come together properly.

.2 Coordinate the Work to ensure that all cutting and patching is kept to a minimum.

.3 Cutting and remedial work shall be performed by specialists, subcontractors or sub subcontractors, agencies, or other qualified personnel familiar with the materials affected and shall be performed in such a manner as to neither damage nor endanger the Work.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

.1	Construction Schedules:	Section 01 33 16.
.2	Shop Drawings, Product Data, and Samples:	Section 01 33 23.
.3	Project Record Documents:	Section 01 78 39.
.4	Operation and Maintenance Data:	Section 01 78 23.
.5	Spare Parts and Maintenance Materials:	Section 01 78 43.

1.2 WORKERS' COMPENSATION BOARD CERTIFICATE

.1 Before commencement of activities at the Place of the Work, obtain and submit to the Owner a certificate of an account with the Workers' Compensation Board.

1.3 COST BREAKDOWN

.1 Before submission of first application for payment, submit to the Owner a complete, itemized breakdown of the Contract Price, providing as a minimum:

.1 all subcontract amounts,
.2 cost of all own forces work,
.3 cost of all major supply only items,
.4 all specified allowance amounts,
.5 cost of general requirements items, including Contractor's overhead and profit.

.2 The cost breakdown must be equal to the total amount of the Contract Price.

1.4 CASH FLOW FORECAST

.1 Prior to submission of first application for payment, the Contractor shall submit to the Owner for approval, a forecast of approximate monthly progress payments for the duration of the entire Contract.

.2 Submit revised cash flow forecasts as required as the work progresses or within 5 working days subsequent to the request of the Owner or the Consultant.

1.5 PHOTOGRAPHS

.1 Provide progress photographs, photographs shall be taken every two weeks or more often as progress of the work dictates.

.2 The Contractor shall take progress photos from two separate view points; of exterior until building is closed in and interior thereafter. Photographs shall be taken from the same locations and at approximately the same time of day.

.3 In addition, illustrate any special operation, phase of construction or any special detail of unusual interest for Project record purposes.

.4 Forward colour prints of each photograph along with monthly progress estimates. Provide the following information on each photograph:

Date:
Name of Contractor:
Name of Project:
Set Number:

1.6 On completion of building, provide a photograph of the completed project, taken from the best possible view point to show the completed project to its best advantage. Provide colour prints of the photograph.

1.7 All photographs will become the Owner's property, to be used for whatever purposes the owner may desire.

1.8 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES - GENERAL

.1 Submit to Owner, for review, shop drawings, product data and samples called for by the Contract Documents and for such other items as the Owner may reasonably request. Do not proceed with work until related submission has been reviewed and approved .

.2 Coordinate the submission of all Shop Drawings with the approved shop drawing schedule as submitted and outlined in Section 01 33 16 – Construction Schedules.

1.9 SHOP DRAWINGS

.1 Shop Drawings means technical data specially prepared for work of this Contract including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form.

.2 Submit all shop drawings expeditious manner and present drawings in a clear and thorough format as to accurately and appropriately illustrate the work.

.3 Coordinate the submission of all Shop Drawings with the shop drawing schedules as outlined in Section 01 33 16 – Construction Schedules.

1.10 PRODUCT DATA

.1 Product Data means any standard printed information describing materials, products, equipment and systems; not specially prepared for work of this Contract, other than the designation of selections.

.2 Product data consisting of manufacturers' standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and descriptive data will be accepted in lieu of shop drawings provided that:

.1 information not applicable to the work of this Contract is deleted, and

.2 standard information is supplemented with information specifically applicable to the work of this Contract.

.3 The Contractor shall highlight, circle in red pen or use other means to clearly identify the products, colours, sizes, shapes, voltages, motor sizing, finishes, and any and all other pertinent information as it relates to the specified product for which the product data sheet(s) are being submitted for.

1.11 SAMPLES

.1 Samples means cuts, containers of materials or partial sections of manufactured or fabricated components which are physically identical to products proposed for use.

1.12 SUBMISSION OF SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

.1 The Contractor is required to review, stamp, date and sign, all shop drawings, product data and samples, prior to submission to the Owner or the Consultant.

.2 Any Shop drawing, product data sheet, product information or sample that has not been reviewed, stamped, dated and signed will be returned to the Contractor immediately without an Owner review being completed.

.3 The return of any shop drawing, product data sheet, product information or sample, due to the Contractor’s inability to comply with Article 1.10.1 of this Section, shall not in any way adversely affect or impact the Construction Schedule regardless if the item(s) are on the “Critical Path” of Construction.

.4 It remains the Contractor responsibility to ensure that and possible subsequent delay(s) in shipping, delivery, receipt or installation of any products, materials or items due to non-conformance with Article 1.10.1 does not have an adverse effect on the progress of the Work.

.5 The Contractor shall determine and verify:

.1 Field measurements.
.2 Field construction criteria.
.3 Catalogue numbers and similar data.
.4 Conformance with Contract Documents.

.6 Notify the Owner, in writing, on the submission and at the time of submission, of any and all deviations from the requirements of Contract Documents.

.7 Submit 5 hard copies and one electronic copy of each required shop drawings or product data. Acceptable electronic formats are:

.8 .PDF files as produced by Adobe ® or by scanning hard copies to a .pdf format

.9 CAD files as produced by using a current version or a compatible version of Autocadd software.

.10 .jpg, .tiff, bmp or other files not listed will not be accepted.

.11 Make all corrections or changes to rejected submittals and resubmit, as specified for initial submittal.

.12 After final review, the Owner will return reviewed shop drawings and product data. The Contractor shall reproduce, at his expense, the number of prints required for performance of the Work.

.13 The Owner's review of submittals does not relieve nor negate in any manner the Contractor's responsibility to ensure that all products are ordered, manufactured, shipped and received or delivered to site are in strict compliance with the Contract Documents.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 Submit to the Owner, for review, shop drawings, product data and samples called for by the Contract Documents and for such other items as the Owner may reasonably request.

.2 Until submittal is reviewed, and returned with the Consultants' stamp, do not proceed with work involving the relevant product.

1.2 RELATED SECTIONS

.1 Submittals Schedule: Section 01 32 16.

1.3 SHOP DRAWINGS

.1 Shop drawings means technical data specially prepared for work of this Contract; including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form.

.2 Present shop drawings in a clear and thorough manner to appropriately illustrate the work.

.3 Identify field dimensions on drawings.

.4 Identify shop drawings by appropriate references to sheet, detail, schedule or room numbers.

.5 Maximum drawing size: 860 x 1120 mm.

.6 Leave a clear space of 100 mm x 75 mm on each sheet of shop drawings for placement of Consultants' review stamp.

1.4 PRODUCT DATA

.1 Product data means standard printed information describing materials, products, equipment and systems; not specially prepared for work of this Contract, other than the designation of selections.

.2 Clearly mark and identify products intended for use.

.3 Manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and descriptive data will be accepted in lieu of shop drawings provided that:

.1 information not applicable to work of this Contract is deleted, and

.2 standard information is supplemented with information specifically applicable to the work of this Contract.

.4 Submit clear information as follows:

.1 One copy when product data is submitted as:

.1 Data sheets larger than 216 mm x 355 mm.
.2 Unbound data sheets 216 mm x 355 mm or smaller. Submit printed or photocopied sheets.

.2 Ten (10) copies when product data is submitted as follows:

.3 Information which can not be duplicated using a photocopier with an automatic document feeder, such as bound or multi-fold information.

.4 Information containing photographs or other information that does not reproduce well on a commercial photocopier.

1.5 SAMPLES

.1 Samples means cuts or containers of materials or partial sections of manufactured or fabricated components which are physically identical to products proposed for use and which establish minimum standards by which the work will be judged.

.2 Label samples as to origin and intended use in the Work.

1.6 SUBMITTAL PREPARATION

.1 Review, date and sign, shop drawings, product data and samples, prior to submission.

.2 Determine and verify:

.1 Field measurements.
.2 Field construction criteria.
.3 Catalogue numbers and similar data.
.4 Conformance with Contract Documents.

.3 Coordinate each submittal with requirements of work and Contract documents. Individual drawings will not be reviewed until all related shop drawing and product data are available.

.4 Notify the Owner, in writing, on the submittal and at the time of submission, of deviations from requirements of Contract Documents.

1.7 SUBMISSION REQUIREMENTS

.1 Make submittals sufficiently in advance of date that reviewed submittals will be required and in such sequence as to cause no delay in the Work.

.2 Accompany submittals with transmittal letter, containing:

.1 Date.
.2 Project title and number.
.3 Contractor's name and address.
.4 Number of each shop drawing, product data and sample submitted.
.5 Other pertinent data.

.3 Submittals shall include:

.1 Date and revision dates.
.2 Project title and number.
.3 Name of:
  .1 Contractor.
  .2 Subcontractor.
  .3 Supplier.
  .4 Manufacturer.
  .5 Name of detailer when details not prepared by Contractor, sub-contractor, or supplier.

.4 Contractor's stamp, initialed or signed, certifying review of submittal, verification of field measurements, and compliance with Contract Documents.

.5 Make corrections or changes to rejected submittals and resubmit, as specified for initial submission.

1.8 RESPONSIBILITY FOR ERRORS, OMISSIONS AND DEVIATIONS

.1 Owner's review of submittals does not relieve Contractor from responsibility for errors and omissions, nor deviations from requirements of the Contract Documents.

1.9 REPRODUCTION OF SUBMITTALS

.1 After final review, Owner will reproduce at his expense, the number of copies he requires, and return reviewed reproducible documents. Contractor shall reproduce at his expense the number of copies required for performance of the Work

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

.1	Project Coordination	Section 01 31 13.
.2	Submittal Procedures	Section 01 33 00.
.3	LEED Submittal Forms	Section 01 33 27.
.4	Environmental Procedures	Section 01 35 20.
.5	Waste Management and Disposal	Section 01 74 19.

1.2 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning (ASHRAE) Website: www.ashrae.org: ASHRAE 52.2-[99], Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI approved)..

.2 Canada Green Building Council (CaGBC) Website: www.cagbc.org: LEED Green Building Rating System - For New Construction and Major Renovations. LEED Canada-NC – current version with addenda. .

.3 Carpet and Rug Institute (CRI) Website: www.carpet-rug.org: CRI Green Label Indoor Air Quality Test Program - Green Label Testing Program..

.4 Green Seal Environmental Standards, Website: www.greenseal.org:

.1 Standard GC-03-[97], Anti-Corrosive Paints.
.2 Standard GS-11-[93], Architectural Paints.

.3 Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Website: www.smacna.org.

.5 IAQ Guideline for Occupied Buildings Under Construction, Chapter 3, 1995.

.6 South Coast Air Quality Management District (SCAQMD), California State, Website: www.aqmd.gov

.1 SCAQMD Rule 1113-[1996], Architectural Coatings.
.2 SCAQMD Rule 1168-[05], Adhesives and Sealants Applications.

.7 United States Federal Trade Commission (US Federal Trade Commission): 16 CFR 260.7 Trade Commission Guidelines for the Use of Environmental Marketing Claims. Website: www.ftc.gov.

.8 Forest Stewardship Council: Principles and Criteria for Forest Stewardship-[00]. Website: www.fscus.org

1.3 DEFINITIONS

.1 Definitions as written below are supplementary to all laws, statutes, and regulations effective in Alberta. Where definitions conflict, laws, statutes, and regulations take precedent over the definitions below.

.2 CFC: Chlorofluorocarbon. CFC's are halogenated substances that have a significant impact on the Earth's atmosphere as they are ozone depleting and contribute to global warming.

.3 Chain-of-Custody Certification - certificates signed by manufacturers certifying that wood used to make products was obtained from FSC certified forests. Certificates include evidence that mill is certified for chain-of-custody by FSC-accredited certification body.

.4 CO_2 - Carbon Dioxide Monitoring: A method for determining indoor air quality by using the concentration of carbon dioxide as an indicator. Although the level of CO2 is a good general indicator of air quality, it is reliant on the presence of certain conditions and must be applied accordingly.

.5 Commissioning (Building): The process of ensuring installed systems function as specified, performed by a third party Commissioning Authority. Elements to be commissioned are identified, installation is observed, sampling is conducted, test procedures are devised and executed, staff training is verified, and operations and maintenance manuals are reviewed.

.6 Construction and Demolition Waste: Waste building materials, dredging materials, treestumps, and rubble resulting from construction, remodeling, repair, and demolition of homes, commercial buildings and other structures and pavements. May contain lead, asbestos, or other hazardous substances.

.7 Construction Indoor Air Quality Management Plan: A systematic plan for addressing construction practices that can impact air quality during construction and continuing on to occupation.

.8 Construction Site Recycling: See Construction Waste Management

.9 Construction Waste Management: General term for strategies employed during construction and demolition to reduce the amount of waste and maximize reuse and recycling. Construction waste management is a sustainable building strategy in that it reduces the disposal of valuable resources, provides materials for reuse and recycling, and can promote community industries.

.10 Energy Star: Program adProject Teamed by the Environmental Protection Agency that evaluates products based on energy efficiency.

.11 Fluorocarbons (FCs): Any of a number of organic compounds analogous to hydrocarbons in which one or more hydrogen atoms are replaced by fluorine. Once used in the United States as a propellant for domestic aerosols, they are now found mainly in coolants and some industrial processes. FCs containing chlorine are called chlorofluorocarbons (CFCs). They are believed to be modifying the ozone layer in the stratosphere, thereby allowing more harmful solar radiation to reach the Earth's surface. 1

.12 Flush-Out: A period after finish work and prior to occupation that allows the building's materials to cure and release volatile compounds and other toxins. A building flush-out procedure is normally followed, with specified time periods, ventilation rate, and other criteria.

.13 Forest Stewardship Council (FSC): A third-party certification organization, evaluating the sustainability of forest products. FSC-certified wood products have met specific criteria in areas such as forest management, labor conditions, and fair trade.

.14 Global Warming: An increase in the near surface temperature of the earth. Global warming has occurred in the distant past as the result of natural influences, but the term is most often used to refer to the warming predicted to occur as a result of increased emissions of greenhouse gases. Scientists generally agree that the earth's surface has warmed by about 1 degree Fahrenheit in the past 140 years. The Intergovernmental Panel on Climate Change (IPCC) recently concluded that increased concentrations of greenhouse gases are causing an increase in the earth's surface temperature and that increased concentrations of sulfate aerosols have led to relative cooling in some regions, generally over and downwind of heavily industrialized areas.

.15 Green Label: A certification program by the Carpet and Rug Institute for carpet and adhesives meeting specified criteria for release of volatile compounds.

.16 Halon: Bromine-containing compounds with long atmospheric lifetimes whose breakdown in the stratosphere causes depletion of ozone. Halons are used in firefighting.

.17 Heat Island Effect: A "dome" of elevated temperatures over an urban area caused by structural and pavement heat fluxes, and pollutant emissions.

.18 HCFC - Hydrochlorofluorocarbon: HCFCs are generally less environmentally detrimental to depletion of stratospheric ozone than CFCs (chlorofluorocarbons). HCFCs are generally used to replace CFC's where mandates require CFC's to be eliminated. A total ban on all CFC's and HCFCs is scheduled, effective 2030.

.19 HVAC: Heating Ventilation and Air Conditioning to provide thermal comfort and ventilation to building.

.20 Hydrocarbons (HC): Chemical compounds that consist entirely of carbon and hydrogen.

.21 Indoor Air Quality (IAQ): ASHRAE defines acceptable indoor air quality as air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which 80% or more people exposed do not express dissatisfaction.

.22 LEED: Leadership in Energy and Environmental Design. A voluntary, consensus-based, standard, measurement system designed for rating new and existing buildings based on accepted energy and environmental principles, striking a balance between knowledge, established practices, and emerging concepts. A performance-oriented system where points are earned for satisfying criterion in each of five categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality. LEED promotes integrated and sustainable design practices. LEED® is a trademarked name.

.23 LEED Accredited Professional (LEED AP): A professional who has successfully passed the LEED Accreditation exam and is knowledgeable in green building design practices.

.24 Low VOC: Building materials and finishes that exhibit low levels of "offgassing," the process by which VOCs (Volatile Organic Compounds) are released from the material, impacting health and comfort indoors and producing smog outdoors. Low (or zero) VOC is an attribute to look for in an environmentally preferable building material or finish. See "Volatile Organic Compound (VOC)" for more information.

.25 Organic Compound: Vast array of substances typically characterized as principally carbon and hydrogen, but that may also contain oxygen, nitrogen and a variety of other elements as structural building blocks.

.26 Ozone Depletion: Destruction of the earth's ozone layer, which can be caused by the photolytic breakdown of certain chlorine- and/or bromine-containing compounds (e.g., chlorofluorocarbons), which catalytically decompose ozone molecules.

.27 Post-Consumer Recycling: Use of materials generated from residential and consumer waste, raw material or feedstock, for new product or similar purposes; e.g. converting wastepaper from offices into corrugated boxes or newsprint.

.28 Post-Consumer Recycle Content: A product composition that contains some percentage of material that has been reclaimed from the same or another end use at the end of its former, useful life.

.29 Post-Industrial Material: Industrial manufacturing process scrap or waste; also called pre-consumer material.

.30 Post-Industrial Recycle Content: A product composition that contains some percentage of manufacturing waste material that has been reclaimed from a process generating the same or a similar product. Also called pre-consumer recycle content.

.31 Pre-Consumer Materials/Waste: Materials generated in manufacturing and converting processes such as manufacturing scrap and trimmings and cuttings. Includes print overruns, overissue publications, and obsolete inventories.

.32 Rapidly Renewable Materials - materials made from agricultural products that are typically harvested within a ten-year or shorter cycle. Rapidly renewable materials include but are not limited to products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, and wool.

.33 Regionally Materials - materials that are extracted, processed, and manufactured within a radius of 800 km from project site when transported by truck, 2400 km by boat or train. Manufacturing refers to the final assembly of components into the building product that is installed at project site.

.34 Recycled Content - percentage by weight of constituents that have been recovered or otherwise diverted from solid waste stream, either pre-consumer or post-consumer.

.35 Wastes and scraps from manufacturing process that are combined with other materials after minimal amount of reprocessing for use in further production of same product are not recycled materials.

.36 Discarded materials from one manufacturing process that are used as materials in another manufacturing process are pre-consumer recycled materials.

.37 Reuse: Using a product or component of municipal solid waste in its original form more than once. (e.g., refilling a glass bottle that has been returned or using a coffee can to hold nuts and bolts.)

.38 Reuse is a sustainable building strategy in that it:

.1 Reduces the strain on both renewable and nonrenewable resources.

.2 When materials are reused on or near the site of salvage, they reduce transportation-related environmental impacts.

.39 VOC: (Volatile Organic Compound). Organic substances capable of entering the gas phase from either a liquid or solid form. VOCs are volatile enough to evaporate from material surfaces into indoor air at normal room temperatures (referred to as off-gassing). These substances are generally thought of to be harmful to both humans and the environment. They are common in and emitted by many building products over time through out-gassing:

.1 Solvents in paints and other coatings;

.2 Wood preservatives; strippers and household cleaners;

.3 Adhesives in particleboard, fibreboard, and some plywood; and foam insulation.

.4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.

.40 Wastewater: The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

.41 Waste Management Plan: See Construction Waste Management

1.4 PROJECT COORDINATION

.1 Provide coordination associated with LEED Certification.

.2 Refer to section 01 31 13 project coordination.

1.5 PROJECT MEETINGS

.1 Provide LEED program meetings, pre-constructiona and progress meetings, associated with monitoring the progress of LEED requirements.

.2 Refer to Section 01 31 19 Project Meetings.

1.6 CONSTRUCTION SCHEDULES

.1 Provide schedule of LEED submittals as a sub-schedule in the construction schedule.

.2 Refer to section 01 32 16 construction schedules.

1.7 SUBMITTALS

.1 Provide submittals in accordance with Section [01 33 00 - Submittal Procedures] [ ].

.2 Submit shop drawings and product data in accordance with Section [01 33 00 - Submittal Procedures] [ ].

.3 Shop drawings: stamped and signed by professional engineer, licensed in Province of Alberta.

.4 Submit required letters, calculations, spreadsheets and templates for submittal to CaGBC.

.5 Submit additional LEED submittal requirements included in other sections in accordance with Section [01 33 00 - Submittal Procedures] [ ].

.6 Submit in multiple copies when required, as separate submittals for compliance with LEED requirements.

.7 Submit Project Materials and Cost Data: provide statement for total cost for building materials used for Project. Include statement indicating total cost of mechanical and electrical components.

.8 Submit: LEED Action Plan: provide preliminary submittals within 30 days of date for Award of contract indicating how the following requirements will be met.

.1 Materials and Resources:

.1 [MR-2.1 Construction Waste Management: Divert 50% From Landfill]

.2 [MR-2.2 Construction Waste Management: Divert 75% From Landfill]

.3 Prepare Construction Waste Management plan in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 [Credit MR-3.1 Resource Reuse: 5%].

.5 [Credit MR-3.2 Resource Reuse 10 %].

.9 Resources Reuse: prepare list of proposed salvaged and refurbished materials.

.1 Identify materials that will be salvaged or refurbished.

.2 Identify source and cost of materials.

.3 [Credit MR-4.1 Recycled Content 7.5% (post consumer + 1/2 post-industrial)].

.4 [Credit MR-4.2 Recycle Content 15% (post consumer + 1/2 post-industrial)].

.5 Recycled Content. Submit list of proposed materials with recycled content.

.6 Identify cost, post-consumer content and pre-consumer content for products having recycled content.

.7 Regional Materials: Submit list of proposed regionally manufactured materials

.1 Identify regionally manufactured materials.
.2 Identify source and cost.
.3 dentify regionally extracted, harvested or recovered material
.4 Identify source and cost.

.8 Credit MR-7 Certified Wood.

.1 Submit list of proposed certified wood products.
.2 Indicate products containing certified wood.
.3 Indicate source, and cost.
.4 Include statement indicating total cost for wood-based materials used for project, including non-rented temporary construction.

.9 Environment Quality:

.1 Credit EQ-3.1 Construction IAQ Management Plan.
.2 Submit Construction indoor air quality management plan.

PART 2. Products].

2.1 RECYCLED CONTENT OF MATERIALS

.1 Provide building materials with recycled content such that post consumer recycled content constitutes a minimum of 5% of the cost of materials used for the Project or such that post consumer recycled content plus one half of pre consumer recycled content constitutes a minimum of 10% of the cost of materials used for the Project.

.2 The cost of post consumer recycled content of an item shall be determined by dividing the weight of post consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.

.3 The cost of post consumer recycled content plus one half of pre consumer recycled content of an item shall be determined by dividing the weight of post consumer recycled content plus one half of pre consumer recycled content in the item by the total weight of the item and multiplying by the cost of the item.

.4 Do not include mechanical and electrical components in the calculation.

.5 Recycled content of materials shall be as defined above.

2.2 REGIONAL MATERIALS

.1 Provide 20% of building materials, by cost, that are regionally extracted, harvested, and recovered materials.

.2 Of the regionally manufactured materials required by Credit MR 5.1 above, provide at least 50%, by cost, that are regionally extracted, harvested, and recovered materials.

2.3 CERTIFIED WOOD

.1 Provide a minimum of 50%, by cost, of wood based materials that are produced from wood obtained from forests certified by an FSC accredited certification body to comply with FSC 1.2, Principles and Criteria.

.2 Wood based materials include but are not limited to the following materials when made from made wood, engineered wood products, or wood based panel products:

.1 Rough carpentry.
.2 Miscellaneous carpentry.
.3 Finish carpentry.
.4 Architectural woodwork.
.5 Wood paneling.
.6 Wood cabinets.
.7 Non-rented temporary construction, including bracing, concrete formwork, pedestrian barriers, and temporary protection.

2.4 LOW EMITTING MATERIALS

.1 For interior applications use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D, EPA Method 24:

.1 Wood Glues: 30 g/L.
.2 Metal to Metal Adhesives: 30 g/L.
.3 Adhesives for Porous Materials (Except Wood): 50 g/L.
.4 Subfloor Adhesives: 50 g/L.
.5 Plastic Foam Adhesives: 50 g/L.
.6 Cove Base Adhesives: 50 g/L.
.7 Gypsum Board and Panel Adhesives: 50 g/L.
.8 Ceramic Tile Adhesives: 65 g/L.
.9 Multipurpose Construction Adhesives: 70 g/L.
.10 Fibreglass Adhesives: 80 g/L.
.11 Contact Adhesive: 250 g/L.
.12 Plastic Cement Welding Compounds: 350 g/L.

.13 ABS Welding Compounds: 400 g/L.
.14 PVC Welding Compounds: 510 g/L.
.15 Adhesive Primer for Plastic: 650 g/L.
.16 Sealants: 250 g/L.
.17 Sealant Primers for Nonporous Substrates: 250 g/L.
.18 Sealant Primers for Porous Substrates: 775 g/L.

.2 For interior applications use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D, EPA Method 24 and the following chemical restrictions:

.1 Flat Paints and Coatings: VOC not more than 50 g/L.
.2 Non Flat Paints and Coatings: VOC not more than 150 g/L.
.3 Anti Corrosive Coatings: VOC not more than 250 g/L.
.4 Varnishes and Sanding Sealers: VOC not more than 350 g/L.
.5 Stains: VOC not more than 250 g/L.
.6 Aromatic Compounds: Paints and coatings shall not contain more than 1.0% by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
.7 Restricted Components: Paints and coatings shall not contain any of the following:

.1 Acrolein.
.2 Acrylonitrile.
.3 Antimony.
.4 Benzene.
.5 Butyl benzyl phthalate.
.6 Cadmium.
.7 Di (2 ethylhexyl) phthalate.
.8 Di n butyl phthalate.
.9 Di n octyl phthalate.
.10 1,2 dichlorobenzene.
.11 Diethyl phthalate.
.12 Dimethyl phthalate.
.13 Ethylbenzene.
.14 Formaldehyde.
.15 Hexavalent chromium.
.16 Isophorone.
.17 Lead.
.18 Mercury.
.19 Methyl ethyl ketone.
.20 Methyl isobutyl ketone.
.21 Methylene chloride.
.22 Naphthalene.
.23 Toluene (methylbenzene).

.24 1,1,1 trichloroethane.
.25 Vinyl chloride.

.3 Do not use composite wood and agrifiber products that contain urea formaldehyde resin.

PART 3. Execution

3.1 SITE DISTURBANCE

.1 Comply with requirements of Section 01 10 00: Summary of Work.

3.2 REFRIGERANT AND CLEAN AGENT FIRE EXTINGUISHING AGENT REMOVAL

.1 Remove CFC based refrigerants from existing HVAC and refrigeration equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in HVAC Sections.

.2 Credit EA 4.0: Remove HCFC based refrigerants from existing HVAC and refrigeration equipment indicated to remain and replace with refrigerants that are not HCFC based. Replace or adjust equipment to accommodate new refrigerant; [remove clean agent fire extinguishing agents that contain HCFCs or halons, and replace with agent that does not contain HCFCs or halons]:

.3 Refer to HVAC Sections for additional requirements.

3.3 CONSTRUCTION WASTE MANAGEMENT

.1 In accordance with Section 01 74 19: Waste Managing and Disposal.

3.4 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT

.1 Comply with SMACNA IAQ Guideline for Occupied Buildings under Construction, Chapter 3

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

.1	Submittals Procedures	Section 01 33 00.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Contract Acceptance Procedures	Section 01 77 20.

1.2 REFERENCES

.1 LEED™ Canada (Leadership in Energy and Environmental Design - Canada) Reference Guides 1.0. Canada Green Building Council (CaGBC), www.cagbc.org.

1.3 DEFINITIONS

.1 Definitions as written below are supplementary to all laws, statutes, and regulations effective in Alberta. Where definitions conflict any, laws, statutes, and regulations take precedent over the definitions below.

.2 LEED™: Leadership in Energy and Environmental Design. A voluntary, consensus-based, standard, measurement system designed for rating new and existing buildings based on accepted energy and environmental principles, striking a balance between knowledge, established practices, and emerging concepts. It is a performance-oriented system where credits are earned for satisfying criterion in each of five categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality. LEED promotes integrated and sustainable design practices.

.3 Integrated Design: A collaborative process between the client group, operating staff and a multi-disciplinary design team, focusing on the design, construction, operation, and occupancy of a building over its complete life cycle. Functional, environmental and economic goals are defined and realized by proceeding from whole building system strategies, through increasing levels of specificity to achieve more optimally integrated solutions.

.4 Sustainable Design: An integrated approach to building design, construction and operation that focuses on the efficient use and choice of resources and materials in such a way as to be economical while not compromising the health of the environment or the associated health and well being of the building's occupants, builders, the general public, or future generations.

.5 VOC: Volatile Organic Compound. These substances are generally thought of to be harmful to both humans and the environment. They are common in and emitted by many building products over time through out-gassing:

.6 Solvents in paints and other coatings;

.7 Wood preservatives; strippers and household cleaners;

.8 Adhesives in particleboard, fibreboard, and some plywood; and foam insulation.

.9 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.

.10 CFC: Chlorofluorocarbon. CFC's are halogenated substances that have a significant impact on the Earth's atmosphere as they are ozone depleting and contribute to global warming.

.11 HCFC: Hydrochlorofluorocarbon. HCFC's are somewhat more environmentally friendly than CFC's but still contain ozone depleting substances.

.12 HVAC: Heating Ventilation and Air Conditioning to provide thermal comfort and ventilation to building.

.13 Post-Consumer Recycled Content: consumer waste that has become a "raw material" or feedstock for another product.

.14 Post-Industrial Recycled Content: waste from a process that has not been used as a part of a consumer product used as a raw material or feedstock for another product.

.15 Rapidly Renewable Materials: materials and products produced from plants that have a plant to harvest cycle of less than ten years.

1.4 ENVIRONMENTAL CONTROLS

.1 The Contractor shall pay for and obtain and maintain at the Place of Work, current versions of any and all Federal, Provincial and Local Municipality regulations pertaining to waste, air, solid waste, chemical waste, sanitary waste, sediment and noise pollution.

.2 Water resources protection:

.1 Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water in such quantities as to affect normal use, aesthetics, or produce a measurable ecological impact on the area.

.2 Store and service construction equipment at areas designated for collection of oil wastes.

.3 Drainage:

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.3 Work Adjacent to Waterways

.1 Do not operate construction equipment in waterways.
.2 Do not use waterway beds for borrow material
.3 Do not dump excavated fill, waste material or debris in waterways.
.4 Do not skid logs or construction materials across waterways.

.4 Land resources: Prior to construction, identify, with the Owner, all land resources to be preserved within the work area. Do not remove, cut deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without written permission from the Owner.

1.5 QUALITY ASSURANCE

.1 The Contractor shall identify one person on staff to be responsible for sustainable issues compliance and co-ordination and fulfill the requirements of this Section– a "LEED™ Champion".

.1 This Champion shall not be the Site Superintendent nor the Project Manager but a knowledgeable employee who will assemble the required documentation and screen it for adherence to the criteria stated in the Contract Documents prior to submitting it for review to the Consultant.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Take special care to prevent accumulation of moisture on materials and within packaging during delivery, storage and handling to prevent development of mould and mildew on packaging and on products.

.2 Request that suppliers give special attention to minimizing the packaging of materials and equipment:

.1 Deliver materials in recyclable, or in reusable packaging, such as cardboard, wood paper, or reusable blankets which will be reclaimed by supplier or manufacturer for recycling.

.2 Minimize packaging materials to maximum extent possible while still ensuring protection of materials during delivery, storage and handling.

.3 Minimize the use of the following packaging materials: Polyurethane, poly-isocyanurate, polyethylene, and similar plastic materials such as “foam” plastics and “shrink-fit” plastics.

.4 Reusable blankets: Deliver and store materials in reusable blankets and mats reclaimed by manufacturers or suppliers for reuse where program exists or where program can be developed for such reuse.

.5 Pallets: Ensure pallets are removed from site for reuse or for recycling.

.6 Corrugated cardboard and paper: Refer to Section 01 74 19 for recycling.

1.7 PROJECT CONDITIONS

.1 Construction ventilation and preconditioning:

.1 Ventilation:

.1 Temporary Construction Ventilation: Maintain sufficient temporary ventilation in areas where materials that emit VOC’s are used. Maintain ventilation continuously during installation, and until emissions dissipate after installation. If continuous ventilation is not possible with building’s HVAC system(s), then ventilate spaces with open windows and temporary fans, sufficient to provide no less than three air changes per hour.

.2 The period after installation shall be sufficient to dissipate odours from elevated concentrations of VOC’s. Where no specific periods are stated in these Specifications, a time period of 72 hours shall be used.

.3 Ventilate areas directly to outside; ventilation to other enclosed areas is not acceptable.

.4 During dust producing activities (e.g. drywall installation and finishing) turn ventilation system off, and protect openings in supply and return HVAC system from dust infiltration. Provide temporary ventilation as required.

.5 Develop and follow a construction Indoor Air Quality Plan that complies with the SMACNA Guidelines, Chapter 3 - Mechanical.

.2 Preconditioning:

.1 Store products, which have odours and which have significant VOC emissions to off-gas, in dry, well ventilated space for sufficient period to allow for reasonable dissipation of odours and emissions prior to delivery to Project.

.2 Condition products without containers and packaging to maximize off gassing of VOC's.

.3 Condition products in a ventilated warehouse or other building.

1.8 SEQUENCING

.1 Where odorous and/or high VOC emitting products are applied on-site, apply prior to installation of porous and fibrous materials. Where this is not possible, protect porous materials with polyethylene vapour retarders.

.2 Allow for Building Flushout as part of construction schedule. Continuously flush out building at 100% outdoor air for at least fourteen (14) days.

1.9 LEED™ ADMINISTRATION REQUIREMENTS

.1 The Consultant will apply for LEED™ Certification for the building.

.2 The certification process will be conducted through the CaGBC (Canada Green Building Council), based LEED™ submission criteria, and support documentation will be provided by the Consultant and the Contractor and assembled by the Consultant. In order that complete and accurate information is provided, the Contractor and Subcontractors shall assist the Consultant in this process as part of the contract requirements and as their portion of work is undertaken.

.3 The Owner has established, with the design team, the general sustainable goals for design and for construction of the Project. The Contractor, Subcontractors, suppliers, and manufacturers shall assist the Consultant by making the required submissions and performing the required procedures to realize the Owner's sustainable goals.

1.10 SUBMITTALS AND REQUIREMENTS

.1 Procedures:

.1 Indicate materials, equipment or procedures that affect LEED™ requirements by completing the documentation as outlined in Clause 10.2 – LEED Certification Requirements and Submittals.

.1 Materials, equipment, and procedures shall comply with LEED™ requirements.

.2 At shop drawing stage, provide LEED™ Certification Submittals as specified for review. Submit tracking documents attached to each specification section where information is required.

.3 Prior to "Substantial Performance of the Work", provide:

.1 All documents according to Clause 10.2 – LEED Certification Requirements and Submittals.

.2 Certification that LEED™ requirements have been fulfilled, signed by a corporate office holder of contractor, subcontractor, supplier, vendor, installer or manufacturer, provided they are primarily responsible for manufacture of the product and that the product has been installed.

.3 A LEED™ letter template in both electronic and paper copy on letterhead verifying adherence to prerequisite/credit requirements where requested in Clause 10.2 – LEED Certification Requirements and Submittals.

.2 LEED™ Certification Requirements and Submittals

.1 Where shop drawings, plans, product data sheets, or the like are required to be submitted, provide to Consultant for review and comparison to requirements of LEED™.

.2 LEED™ requirements and submittals include the following:

.1 Erosion and Sedimentation Control

.1 Before the Work begins, provide to the Consultant for review, an Erosion and Sedimentation Control plan that shows compliance with the intent of the EPA Document No. EPA-832-R-92-005, Chapter 3 or local erosion control standards, whichever is more stringent. (www.epa.gov/npdes/pubs/chap03_conguide.pdf)

.2 Implement the reviewed and compliant Erosion and Sedimentation Control Plan which may include temporary and/or permanent erosion and sedimentation control devices.

.3 Include provisions for Dust control, air pollution, and odour control. Prevent creation of dust, air pollution and odours by:

1. Water sprinkling, temporary enclosures, and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

2. Storing volatile liquids, including fuels and solvents, in closed containers.

3. Properly maintaining equipment to reduce gaseous pollutant emissions.

4. Disposal operations: Refer to Section 01 74 19.

.4 Provide photos of measures implemented on this project.

.5 Provide a LEED™ letter template stating that the procedures implemented comply with the intent of the EPA Document No. EPA-832-R-92-005, Chapter 3 or local erosion control standards, whichever is more stringent.

.2 Alternative Transportation:

.1 Provide shop drawings for bicycle racks.

.3 Reduced Site Disturbance:

.1 Comply with the limits set out in site drawings and specifications highlighting limits of construction disturbance. Prevent any water-borne soil from escaping from the site.

.4 Light Pollution Reduction:

.1 Provide Product Data sheets for each type of light fixture installed.

.5 Water Efficiency:

.1 Landscaping:

.1 Provide shop drawings and/or Product Data for rainwater collection/storage system.

.2 Water Use Reduction:

.1 Provide Product Data for all water consuming fixtures necessary for the occupancy use of the building, with water conservation specifications highlighted.

.6 CFC Reduction in HVAC Equipment:

.1 Provide equipment schedules and Product Data highlighting refrigerant information for all HVAC system components.

.2 No CFC's or HCFC's are allowed.

.7 Ozone Depletion:

.1 Provide equipment schedules and Product Data highlighting refrigerant information for all HVAC system components.

.2 No CFC's or HCFC's are allowed.

.8 Construction Waste Management:

.1 Provide a copy of the Waste Management Plan for the project indicating how recycling and salvage requirements will be met.

.2 Provide calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that a minimum of 75% of construction wastes were recycled or salvaged

.3 Provide a LEED™ letter template complete with calculations showing the amount of construction waste diverted.

.9 Resource Reuse:

.1 Provide submittals highlighting reused materials used on the project.

.2 Provide documentation for the origin and cost of the reused materials.

.3 Provide a LEED™ letter template complete with calculations showing the amount of reused materials..

.10 Recycled Materials:

.1 Choose products with recycled material in each or as specified.

.2 Provide submittals highlighting recycled materials (specifying amounts of both post-consumer and post-industrial) used on the project.

.3 Provide documentation for the origin and cost of the materials.

.4 Provide a LEED™ letter template complete with calculations showing the amount of recycled materials.

.11 Local Materials

.1 Choose locally manufactured materials where possible.

.2 Provide submittals highlighting cost amount of materials from 800 km radius of project used on the project.

.3 Provide a LEED™ letter template complete with calculations showing the amount of locally harvested and locally manufactured materials.

.12 Rapidly Renewable Materials:

.1 Choose products with rapidly renewable materials in each or as specified.

.2 Provide submittals highlighting cost amount of these materials used on the project.

.3 Provide a LEED™ letter template complete with calculations showing the amount of materials that are rapidly renewable.

.13 Construction IAQ Management Plan:

.1 Prior to construction, develop and have reviewed by Consultant, a plan for indoor air quality during construction (IAQ Plan) that meets or exceeds the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3 AND where absorptive materials stored on-site or installed are protected from moisture damage, AND where air handlers are used during construction, filtration media must be used at each return air grille, as determined by ASHRAE 52.2, AND where all filtration media are replaced immediately prior to occupancy.

.1 Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 8 during construction and 13 prior to occupancy as determined by ASHRAE 52.2-1999.

.2 During construction, implement this plan, documenting implementation through the use of photographs as outlined below.

.3 Provide photographs of construction IAQ management measures such as protection of ducts and on-site stored or installed absorptive materials.

.1 Provide six photographs taken on three different occasions during construction (eighteen total), along with identification of the SMACNA approach featured by each photograph, to show consistent adherence to the IAQ plan.

.4 Provide Product Data of filtration media used during construction and installed immediately prior to occupancy with MERV values highlighted.

.5 Immediately prior to occupancy, conduct a minimum two-week building flush out with new filtration media at 100% outside air, OR conduct a baseline indoor air quality testing procedure consistent with current EPA Protocol for Environmental Requirements.

.1 No construction including correction of deficiencies are allowed during this building flush-out.

.2 Allow time for the building flush-out in construction schedule.

.6 Provide a LEED™ letter template stating that the requirements as outlined above have been fulfilled.

.14 Low-Emitting Materials:

.1 Adhesives must meet or exceed the Volatile Organic Content (VOC) limits of South Coast Air Quality Management District (http://www.aqmd@gov) Rule #1168, AND all sealants used as fillers must meet or exceed Bay Area Air Quality Management District (http://www.baaqmd.gov) Reg. 8, Rule 51.

.2 Fire stopping materials are required to meet these requirements.

.1 Provide Product Data and a Material Safety Data Sheet (MSDS) for each adhesive used in the building highlighting VOC limits.

.2 Provide Product Data and a Material Safety Data Sheet (MSDS) for each sealant used in the building highlighting VOC limits.

.3 Flat and Non-flat paints and coatings must meet or exceed the Volatile Organic Content (VOC) and chemical component limits of Green Seal (http://www.greenseal) requirements.

.1 Provide Product Data and a Material Safety Data Sheet (MSDS) for each paint or coating used in the building highlighting VOC limits and chemical component limits.

.4 All clear coatings and concrete clear coat applied on site must meet the requirements of the South Coast Air Quality Management District (http://www.aqmd.gov) Rule 1113 for Volatile Organic Content (VOC) as follows:

.1 Clear Finishes:

1. Varnish: no more than 350 g VOC/L of Coating

2. Sanding Sealers: no more than 350 g VOC/L

3. Lacquer: no more than 550 g VOC/L

4. Quick Dry Primers, Sealers, and Undercoaters: no more than 200 g. VOC/L

5. Shellac: no more than 550 g VOC/L.

6. Concrete Curing systems: no more than 350 g VOC/L

7. Waterproofing Concrete/Masonry Sealers: no more than 400 g/L

.5 Carpet systems must meet or exceed the Carpet and Rug Institute Green label Indoor Air Quality Test Program.

.1 Provide Product Data for each carpet product used in the building highlighting VOC limits or CRI compliance number.

.6 Composite wood and agrifiber products must contain no added urea-formaldehyde resins.

.1 Provide Product Data for each composite wood or agrifiber product used in the building highlighting resin type.

1.11 PROTECTION

.1 Protect interior materials from water intrusion or penetration.

.2 Where interior products are not intended for wet applications but are exposed to moisture, immediately remove from site and dispose of properly.

.3 Protect installed products using methods that do not support growth of moulds and mildews.

END OF SECTION

PART 1. GENERAL

1.1 WORK SITE SAFETY - THIS THE PROJECT TEAM IS "PRIME THE PROJECT TEAM"

.1 The Project Team shall, for the purposes of the Occupational Safety and Health and Act (United States of America), and for the duration of the Work of this Contract:

.1 be responsible for the Work at the Place of Work , and

.2 do everything that is reasonably practicable to establish and maintain a system or process that will ensure compliance with the Act and its regulations, as required to ensure the health and safety of all persons at the "work site".

.2 The Project Team shall direct all Sub Contractor, Sub-sub Contractors, Volunteers, , employers, workers and any other persons at the "work site" on safety related matters, to the extent required to fulfill its "prime The Project Team" responsibilities pursuant to the Act, regardless of:

.1 whether or not any contractual relationship exists between The Project Team and any of these entities, and

.2 whether or not such entities have been specifically identified in this Contract.

.3 There will be multiple other project teams, volunteers, contractors, sub-contractors, and other trades employed by the event organizers performing the work simultaneously. The Project Team will:

.1 Coordinate their work with the rules and regulation as set forth by the Contest rules, regulations, guidelines and recommendations.

.2 Be aware to their site and the surrounding sites and existing facilities, landscaping (hard and soft) employees of the event, other teams and subsidiary members of each Project Team.

.3 The work of this project shall not contravene the OSHA nor shall the work of this project contravene or inhibit the ability of others working at the event site from complying with the OSH Act.

END OF SECTION

PART 1. GENERAL

1.1 DEFINITIONS

.1 Regulatory requirements means laws, by-laws, ordinances, rules, regulations, codes, orders of authorities having jurisdiction, and other legally enforceable requirements applicable to the Work and which are or become in force during the performance of the Work.

.2 Authority Having Jurisdiction: means any person having the authority within their constituency having the right and power to enforce all codes, laws, by-laws, rules, regulations and guidelines that govern the Project at the time if it's installation and construction.

1.2 GENERAL

.1 Comply with all regulatory requirements including:

.1 Codes
.2 Laws.
.3 By-laws.
.4 Rules.
.5 Regulations.
.6 Guidelines
.7 Recommendation of the Authority Having Jurisdiction.

.2 Where a code, law, by-law, regulation or other regulating ordinance is more stringent than that of another similar code, law, by-law, regulation or guideline, the Project Team and subsidiary members shall comply with the more stringent code, law, by-law, regulation or guideline.

1.3 CONTRACT DOCUMENTS

.1 The Project Team shall be responsible for verifying that Contest Documents comply with regulatory requirements. If Contest Documents are at variance therewith, or changes which require modification to Contest Documents are made to regulatory requirements, by authorities having jurisdiction, subsequent to date of final submission, The Project Team shall notify the event coordinator in writing, requesting direction, immediately when any such variance or change becomes known to him. The event organizer may make changes as required to the Contest Documents, any resulting change in Contest Price or Time will be made in accordance with the rules and regulation the Govern the Contest.

1.4 ALBERTA BUILDING CODE

.1 When the work is being completed in the province of Alberta, Canada the Project Team installers, Contractors, Sub-contractors, Volunteers, and all other people, staff, employees and public members involved in the construction of the Project Shall conform to and perform work in accordance with the current version of the Alberta Building Code.

1.5 SOLAR DECATHLON BUILDING CODE

.1 All work performed at the competition location shall be performed in compliance with the Solar Decathlon Building Code.

1.6 WASHINGTON STATE BUILDING CODE

.1 In addition to compliance with the Solar Decathlon building Code, all work performed at the competition location shall be performed in compliance with the Washington Building Code, by-laws, regulations, guidelines and recommendation of the authorities having jurisdiction.

END OF SECTION

PART 1. GENERAL

1.1 TESTING BY THE PROJECT TEAM

.1 The Project Team shall furnish to competition Authorities, all test results from testing performed by Project Team.

1.2 TESTING BY COMPETITION AUTHORITIES

.1 The Event Organizers may employ services of independent testing agencies to establish if work complies with Competition Documents. Event Organizers will appoint and pay for services of such testing agency.

.2 Where tests or inspections, by Event Organizer appointed testing agency, indicates that the work is not in accordance with the Competition Documents, additional tests or inspections, as may be required, shall be conducted to verify acceptability of corrected work.

1.3 INSPECTION OF LINES AND LEVELS

.1 When connection of the main lines, including: power, water, sewer and sanitary lines, to the building is complete, and floor elevations established. The Project Team shall request the Event Organizer review and inspect this work.

.2 Do not proceed with any further work until this inspection is made and confirmed.

1.4 REFERENCE STANDARDS

.1 Within the text of these specifications, reference may be made, but not necessarily limited to the following standards:

.1 ANSI - American National Standards Institute
.2 ASTM - American Society for Testing and Materials
.3 CGSB - Canadian General Standards Board
.4 CSA - Canadian Standards Association
.5 CAN - National Standard of Canada (published by CGSB)
.6 FM - Factory Mutual Engineering Corporation
.7 ULC - Underwriters Laboratories of Canada

.2 The referenced standard and any amendments in force on the day of receipt of bids shall be applicable to the work during the duration of the Contract.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 To provide temporary facilities and controls specified in this Section and as otherwise required for performance of work of the Project.

1.2 DESIGN OF TEMPORARY FACILITIES

.1 The Project Team shall be responsible for design and safety of temporary, structures, enclosures, barricades and all Temporary Facilities required for the performance of the Work. Temporary facilities of such nature that engineering is required for their design to ensure safety during construction shall be designed by a Professional Engineer in the employ of The Project and registered to practice in the State or Province that the Place of Work is within. Prior to the temporary being structure is used, the person, agency, firm or any authorized agent, firm of person thereof that is responsible for the design, shall review and inspect the structure and issue to the Project Team and the event Organizer a certificate stating that the structure has been constructed according to their design.

.2 Notwithstanding the above article 1.2.1, the review, inspection and certificated does not in any way relieve the Project Team of their responsibilities to ensure that only skilled, qualified, trained or otherwise certified personnel are employed for the purposes of, assembling, erecting or in any way construction the temporary structure in accordance with the engineered design.

1.3 SITE STORAGE

.1 Materials Storage: There will be no on site storage of materials, products or items required for the installation of the Project.

1.4 UTILITIES

.1 Sanitary Facilities: The Project Team will be permitted use of assigned sanitary facilities. The Project Team when using the facilities provided shall be responsible for maintaining assigned facilities in a clean and tidy manner and to repair any such damage as may be attributable to the project Team's usage thereof..

.2 Water Supply: Refer to rule .9 Liquids of the 2011 Solar Decathlon Rules issued October 22, 2010.

.3 Temporary Light and Power: Refer to Rule .4 – Site Operations of the 2011 Solar Decathlon rules issued October 22, 2010.

.4 Telephone: If not used in the operation of the Project the project Team Members are permitted to used devices for mobile communications, such as PDA's, cell phones. Refer to rule 8. Energy of the 2011 Solar Decathlon rules issued October 22, 2010

1.5 CONSTRUCTION AIDS

.1 Refer to rule 4. Site Operations of the 2011 Solar Decathlon Rules issued October 22, 2010.

.2 Appliances and Scaffolding: The Project Team shall furnish all necessary transportation, scaffolding, forms, labour, tools and mechanical appliances, machinery, services and material required for executing the work. Where structural scaffolding is required, the Contractor shall employ and pay for the services of a professional engineer licensed to practice in the Province where the Place of Work is contained, any such engineered design shall be:

.1 Installed using qualified, certified and experienced personnel.

.2 Reviewed and inspected by the design engineer for compliance to the engineered design.

.3 Comply with all safety requirements, and Federal, State, Provincial, Municipal, Local Codes, laws, by-lays, regulations and guidelines

.3 Construction Hoist or Crane: The Project Team shall provide employ and pay for the services of a Crane or hoisting company, firm, agency or sub-trade for the supply, installation and erection of all required materials, or products. Such Crane or hoisting company, agent or firm shall work with the Structural Engineer of record to design and develop a suitable and safe erection design and procedure for the required hoisting requirements.

.4 Hoists and Cranes may in special circumstances and with the approval of the event organizers, be driven on the grassed areas during assembly and disassembly provided:

.1 Extreme caution is taken to ensure that the soft landscaping is not damaged.

.2 Suitable products or materials are installed over the soft landscaping to protect it from damage during the assembly and disassembly procedures

.5 Forklifts and other small vehicles may be driven on the grassed areas during assembly and disassembly provided:

.1 Extreme caution is taken to ensure that the soft landscaping is not damaged.

.2 Suitable products or materials are installed over the soft landscaping to protect it from damage during the assembly and disassembly procedures

1.6 ENCLOSURE OF BUILDING

.1 As soon as construction of building envelope is sufficiently advanced, temporarily enclose and protect openings in envelope by means of temporary doors, barriers and screens.

.2 Cover unglazed window openings with heavy translucent sheeting.

1.7 VEHICULAR ACCESS

.1 The Project Team shall:

.2 Have access to a location as designated by the Event Organizers at or near the competition site for temporary construction parking.

.3 The Event Organizer shall provide and maintain, on site, suitable access for the transportation, movement, delivery, installation or placing of all materials related to the performance or the Work for the entire duration of the Competition period.

.4 The Project Team shall:

.1 Maintain, clean, repair or otherwise be responsible and pay for maintaining, cleaning and repair the street side access “in front” of, and directly affected by their project specific activities during the entire performance of the Work. Including but not limited to: any existing or newly installed driveways, sidewalks, sidewalk crossings, curbs, gutters, paving and concrete directly adjacent to the place of Work

1.8 PROTECTION OF THE PUBLIC AND FIRE SAFETY

.1 Comply with requirements of the Alberta, Washington and Solar Decathlon Building Code, and as required by the Authorities having jurisdiction.

1.9 SECURITY

.1 Equip exterior temporary doors with hardware and locks.

.2 Secure building against illegal entry at end of each work day.

.3 Provide temporary site lighting as required to deter illegal activities during the night hours

1.10 DRAINAGE CONTROLS

.1 Provide temporary drainage and pumping systems as required to keep open basements, excavations and site free from accumulations of water.

.2 Dispose of water containing silt in suspension in accordance with local authority requirements. Do not pump into sewer or drainage system.

1.11 ACTIVITIES GENERATING VIBRATION, NOISE OR SAFETY CONCERNS

.1 Operations considered by the Event Organizer to generate vibration, noise or safety concerns include, but are not limited to, the following:

.1 Jack hammering.
.2 Shotblasting.
.3 Sandblasting.
.4 Cutting and coring of concrete.
.5 Use of powder actuated fasteners.

.2 Do the following when work generating vibration, noise or safety concerns may affect other Project teams, even Organizers and subsidiary staffing and public:

.1 Coordinate with Event Organizers and other representatives as required.

.2 Schedule and coordinate work with Event Organizers and other representatives

.3 Stop operations generating vibration, noise or safety concerns when instructed verbally or in writing by the Authorities having Jurisdiction. Do not resume such operations until authorized by above noted authorities.

1.12 PREVENTING MOULD DURING CONSTRUCTION

.1 Monitor interior relative humidity conditions in relation to surface temperatures to prevent generation of moisture that may contribute to mould growth on the surface of organic construction materials.

.2 Install insulation concurrently with air and vapour retarder.

.3 Protect all organic construction materials from the elements, before, during, and after their installation.

.4 Refer to CCA 82 - 2004 "Mould Guidelines for the Canadian Construction Industry", published by the Canadian Construction Association, for additional information about mould, its implications and recommendations on its prevention.

1.13 CLEANING DURING CONSTRUCTION

.1 Perform ***Daily***, clean-up of the building premises and site and dispose of waste material, rubbish, and debris during the performance of the Work and for the entire Competition Period

.2 Do not allow waste material, rubbish, and debris to accumulate and become an unsightly or a hazardous condition. Maintain site in a clean and orderly condition.

.3 Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

.4 Do not allow waste material, rubbish, and windblown debris to reach and contaminate adjacent properties.

.5 Lower waste material in a controlled manner; do not drop or throw materials from heights.

.6 Clean interior building areas prior to commencement of site painting and finishing operations and continue cleaning on an as-needed basis and to eliminate dust, until building is ready for occupancy.

.7 Ensure that each Subcontractor engaged on the Work bears his full responsibility for cleaning up during and upon completion of his work in accordance with provisions of this article.

1.14 WASTE DISPOSAL REQUIREMENTS

.1 Comply with Federal, State, Provincial and Municipal laws, rules and regulations pertaining to disposal operations.

.2 Provide on-site metal containers with lids, for collection and temporary storage of waste material, rubbish, and debris.

.3 Dispose of waste material, rubbish, and debris at disposal areas away from site.

.4 Do not burn or bury waste material, rubbish and debris on site.

.5 Do not dispose of wastes into brooks, streams, rivers, waterways, lakes or ponds.

.6 Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

1.15 CLEANING OF STREETS AND SIDEWALKS

.1 Take precautions to prevent depositing of mud or debris on roadways, sidewalks, and paved areas. Promptly clean up any mud or debris so deposited.

.2 Neglect of these requirements will cause the event Organizers to have necessary clean-up work carried out and to charge all costs to the Project Team

1.16 REMOVAL AND RESTORATION

.1 Remove temporary facilities specified in this Section.

.2 Clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during the competition to their original condition.

END OF SECTION

PART 1. GENERAL

1.1 RELATED REQUIREMENTS

.1 Substitutions during the Bidding Period Section 00 21 13.

1.2 DEFINITIONS

.1 Proprietary Specification: means a specification which includes one or more proprietary names of products or manufacturers, or both, and may also include descriptive, reference standard, or performance requirements or any combination thereof.

.2 Performance Specification: means a specification which included a descriptive, reference standard or performance requirements, or any combination thereof, but does not include any proprietary names of products or manufacturers.

.3 Substitution means: as product or manufacturer not specified by a proprietary name which may be acceptable in place of a product or manufacturer which is specified by proprietary name

1.3 PRODUCT OPTIONS

.1 For products specified by performance specification:

.1 Select a product or manufacturer, which meets or exceed the requirements of the Contract Documents.

.2 For Products specified by Proprietary specification:

.1 Select a product or manufacturer named, or

.2 Substitute and unnamed product or manufacturer in accordance with Article 4.1 of this section

.3 For Products specified by proprietary specification and accompanied by words indicating that substitutions will not be accepted:

.1 Select products or manufacturers named; substitutions will not be permitted.

1.4 SUBSTITUTIONS

.1 Substitute Products: where substitute products are permitted, unnamed products will be accepted by the Owner, subject to the following:

.1 Substitute products shall be of the same type as, be capable of performing the same functions as, meet or exceed the standards of quality and performance of the named products. Substitutions shall not require revisions to the Contract Documents not to Work of other Contractors.

.2 Substitute Manufacturers: where substitute manufacturers are permitted, unnamed manufacturers will be accepted by the Owner, subject to the following:

.1 Substitute manufacturers shall have the capabilities comparable to those of the name manufacturer(s). Substitutions shall not require revisions to the Contract Documents nor to the Work of Other Contractors or Sub trades.

.3 in making a Substitution the Contractor warrants that:

.1 The have investigated the substitute product or manufacturer, or both, and has determined it meets or exceeds the requirements as specified 1.4.1 or 1.4.2, or both and,

.2 will make any changes to the Work as necessitated by the substitution as required for the Work to be completed in all respects and in accordance with the Contract Documents.

.3 Waives any claims for additional costs as they relate to or caused by the substitution which may subsequently, during the Construction period, become prevalent.

.4 Any substitutions shall not be ordered nor installed without prior consent, in writing, from the Owner.

.5 If in the Owners' opinion the substitution does not meet the requirements of the Contract Documents, the Contractor shall, at no additional cost to the Contract price, provide a product or manufacturer which, in the Owners' opinion, does meet the requirements of the Contract Documents.

1.5 CHANGES TO ACCEPTED PRODUCTS AND MANUFACTURERS

.1 products and manufactures, as accepted by the owner, for use in the performance of the work of the Contract, shall not be changed at any time without the prior written consent of the Owner.

.2 Any requests to change an accepted product or manufacturer must be submitted to the Owner, in writing, and shall include all related product information as described in Article 1.6

1.6 PRODUCT INFORMATION AND DATA

.1 Submit to the Owner, for review, complete information substantiating the compliance of the substitute product or manufacturer with the Contract Documents. The following shall be included in such submission:

.1 Product identification, including manufacturers name address, website, phone and fax number and company brochure.

.2 any manufacturers literature providing the product description, applicable reference standards, and performance testing data.

.3 Samples as applicable.

.4 name and address of projects on which the product has been used and the date of each installation.

.5 maintenance and warranty information related to the product, list any local representation, retailers, companies, firms or agencies authorized to act on behalf of the manufacturer for any warranty or service for the product.

.6 for substitutions and requests for changed to accepted products, the Contractor shall include, in addition to the above, the following:

.1 an itemized comparison of substitution with the named product(s); clearly list any significant variations between the accepted product and the proposed substitution.

.1

END OF SECTION

PART 1. GENERAL

1.1 SUMMARY

.1 This section includes general requirements and procedures for compliance with the Construction Waste Management credit within Canada Green Building Council (CaGBC) LEED Canada-NC 1.0:

.1 Waste Management Goals.
.2 Waste Management Plan.
.3 Implementation of Construction Waste Management.
.4 Documentation.

1.2 RELATED SECTIONS

.1	Summary of Work	Section 01 11 00
.2	Environmental Procedures	Section 01 35 20.

1.3 DEFINITIONS

.1 Definitions as written below are supplementary to all laws, statutes, and regulations effective in Alberta. Where definitions conflict, laws, statutes, and regulations take precedence over the definitions below.

.2 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.

.3 Construction and Demolition Waste: Solid wastes typically including but not limited to, building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

.4 Hazardous: Exhibiting the characteristics of hazardous substances including, but not limited to, flammability, corrosiveness, toxicity or reactivity.

.5 Materials Source Separation Program (MSSP): Consists of a series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.6 Non-hazardous: Exhibiting none of the characteristics of hazardous substances, including, but not limited to, ignitability, corrosiveness, toxicity, or reactivity.

.7 Non-toxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

.8 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and processed into a new product for reuse by others.

.9 Recycle: To provide a use for a thing that would otherwise be disposed of or dealt with as waste, including collecting, transporting, handling, storing, sorting, separating, AND processing, but does not include the application of waste to land or the use of thermal destruction process.To remove a waste material from the Project site to another site for treatment or processing into a new product for reuse by others.

.10 Recycling: The process of sorting, cleansing, treating and reconstituting materials that would otherwise be discarded as trash for the purpose of reusing the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.11 Return: To give back reusable items or unused products to vendors for credit.

.12 Reuse: To use construction material that would otherwise be trash in some manner on the Project site.

.13 Salvage: To reuse a construction material that would otherwise be trash on a construction site other than the Project site. .

.14 Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

.15 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

.16 Toxic: Poisonous to humans either immediately or after a long period of exposure.

.17 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

.18 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes trash, salvageable, returnable, recyclable, and reusable material.

.19 Waste Management Plan (WMP): A Project-related plan for the collection, transportation, and final disposition of the waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material being landfilled. The Plan involves measuring and estimating the quantity and composition of waste, and identifying reasons for waste generation including and any operational factors. Then, based on this information, address opportunities for reduction, reuse, salvaging, or recycling of materials.

1.4 DOCUMENTS

.1 The Project team shall maintain one copy of following documents:

.1 Waste Management Plan.
.2 Material Source Separation Plan.
.3 Schedules completed for project.

1.5 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to site.
.2 Provide temporary security measures.

1.6 SUBMITTALS

.1 Waste Management Plan:

.1 Submit a Waste Management Plan for review. Include the following:

.1 Estimated generation rates specific to the Work and proposed method and facilities for disposal as following:

.2 Landfill options.

.3 Alternatives to Landfill.

.4 Estimated cost/revenue from the sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.

.2 Submit for review a Materials Source Separation Program. Include the following:

.1 List of activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.2 Plan of implementation.

.3 Site/floor plans of areas needed for MSSP showing bins, pallets, or other necessary containment for waste and separated waste materials.

.4 submit weigh-bills, invoices and other documentation confirming that all materials have been hauled to the required locations.

.3 Provide the following submittals:

.1 Submit completed Waste Management Plan.

.2 Submit completed Cost/Revenue Analysis Workplan

1.7 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by the Even Organizers.

.2 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.3 Prevent contamination of materials to be recycled and salvaged and handle materials consistent with requirements for acceptance by designated facilities.

.4 Where materials must be co-mingled, take to a processing facility for separation off site.

.5 Control surface drainage from damaging or effecting mechanical or electrical components.

1.8 SCHEDULING

.1 Coordinate work with other activities at site to ensure timely and orderly progress of the work.

1.9 WASTE MANAGEMENT GOALS

.1 This Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.

.2 Divert Construction Waste from the landfill into recycling and reuse programs so a minimum of 50% of construction wastes were recycled or salvaged.

.3 Minimize waste disposal in landfills.

.4 Develop a Waste Management Plan for this Project and submit as required by the Event Organizers.

1.10 RESOURCES

.1 Information on recyclers specializing in specific categories of materials may be obtained during normal office hours from:

.1 Alberta Environment
.2 Construction, Renovation and Demolition Waste Reduction
.3 Washington State Government authorities.

.2 The Project Team is responsible for obtaining information packets relevant to all of the above listed programs prior to starting work on the Project, and confirming the facilities ability to accept waste from the Project.

.3 Document work methods, recycled materials, alternate disposal methods that qualify for tax credits, rebates, and other savings.

1.11 WASTE MANAGEMENT PLAN

.1 Plan shall contain the following:

.1 Analysis of the proposed jobsite waste expected to be generated, including types and quantities.

.2 Landfill options: The name of the landfill where trash will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfill.

.3 Alternatives to Landfill: A list of each material proposed to be salvaged, reused, or recycled during the course of the Project, the proposed local market for each material, and the estimated net cost savings or additional costs resulting from separating and recycling versus landfill each material; "Net" means that the following have been subtracted from the cost of separating and recycling:

.4 Revenue from the sale of recycled or salvaged materials, and

.5 Landfill tipping fees saved due to diversion of materials from the landfill.

.6 The list of these materials is to include, at minimum, the following materials:

.1 Cardboard.

.2 Clean dimensional wood.

.3 Beverage containers.

.4 Land clearing debris.

.5 Aggregate including: concrete, asphalt, and masonry.

.6 Metals from banding, steel stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.

.7 Gypsum board.

.8 Plastic buckets; waste can be reduced by using plastic lined cardboard dry packed materials instead of premixed moist packed materials where this option is available.

.9 Carpet and carpet pad trim.

.10 Paint.

.11 Plastic sheeting and packaging, where recycling programs are available.

.12 Rigid plastic foam insulation, where recycling programs are available.

.2 Resources for Development of Waste Management Plan: The following sources may be useful in developing the Draft Waste Management Plan:

.1 Transporters and Markets: Investigate local transporters and markets for recyclable materials, and incorporate into Waste Management Plan.

.2 Analysis of the proposed jobsite waste to be generated, including types and quantities.

.3 Landfill options: Name of the landfill where trash will be disposed of, applicable landfill tipping fees, and the projected cost of disposing of all Project waste in landfill.

.4 Alternatives to Landfill: A list of waste materials from the Project that will be separated for reuse, salvage, or recycling.

.5 Materials Handling Procedures: A description of the means by which any waste materials identified in will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.

.6 Transportation: A description of the means of transportation of recyclable materials, whether materials will be site-separated and self-hauled to designated centres, or whether mixed materials will be collected by a waste hauler and removed from the site, and destination of materials.

1.12 MATERIALS SOURCE SEPARATION PROGRAM

.1 Implement a reviewed and compliant MSSP for waste generated.

.2 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.3 Provide containers to collect reusable and recyclable materials.

.4 Locate containers in locations, to facilitate collection of materials without hindering daily operations.

.5 Locate separated materials in areas that will minimize material damage.

1.13 WASTE RESOURCES

.1 Province of Alberta – Ministry of Environment.
.2 State of Washington D.C. – Environmental Services

1.14 DISPOSAL OF WASTES

.1 Burying of trash and waste materials on site is prohibited.

.2 Disposal of any waste, volatile materials, mineral spirits, oil, paint thinner, into the ground, waterways, storm or sanitary sewers is prohibited.

1.15 FIRES

.1 Fires or burning of trash and waste on site is not permitted.

1.16 APPLICATION

.1 Do work in compliance with reviewed WMP.

.2 Handle waste materials whether landfilled, reused, salvaged, recycled, or otherwise disposed of, in accordance with appropriate regulations and codes.

1.17 WASTE MANAGEMENT AND MATERIALS SOURCE SEPARATION PLANS IMPLEMENTATION

.1 Prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.2 Identify opportunities for reduction, reuse, and recycling (3Rs) of materials. Describe management of waste.

.3 Post the work plan or summary where workers at site are able to review its content.

.4 Manager: Designate an on-site individual responsible for instructing workers and overseeing and documenting results of the Waste Management Plan and Source Separation Plan for the Project.

.5 Distribution: Distribute copies of the Waste Management Plan and Source Separation Plan to the Job Site Foreman, each Subcontractor and the Event Organizers

.6 Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

.7 Separation facilities: Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

.8 Hazardous wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

.9 On-site sale of salvaged, recovered, reusable, recyclable materials to the public is not permitted.

.10 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition. Transport to authorized recycling facility or to users of material for recycling.

.11 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition. Ship materials to site operating under Certificate of Approval. Materials must be immediately separated into required categories for reuse of recycling.

1.18 CLEANING

.1 Remove tools and waste materials on completion of work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION

PART 1. GENERAL

1.1 RELATED WORK

.1 Cleaning during construction and waste

.2 Disposal

1.2 CLEANING MATERIALS

.1 Use only cleaning materials recommended by manufacturer of material to be cleaned.

.2 Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

1.3 FINAL CLEANING

.1 Perform final cleaning operations specified herein prior to opening the Project to the Public.

.2 Use experienced workers or professional cleaners for final cleaning.

.3 Remove grease, paint spots, dirt, dust, stains, labels, fingerprints and other foreign matter from interior and exterior surfaces; vacuum and dust behind grilles, louvres and screens; wash floor surfaces not otherwise finished; clean metal doors and frames; clean metal work; clean equipment; clean hardware; clean and polish glass on both sides; clean and polish mirrors.

.4 Repair, patch and touch-up marred surfaces to match adjacent finishes.

.5 Replace cracked and broken glass.

.6 Ensure that cleaning agents and methods do not remove finishes and permanent protective coatings on surfaces being cleaned.

.7 Broom clean or remove snow and ice from all exterior paved areas designed for pedestrian or vehicular traffic, including parking areas. During winter conditions the Contractor shall remove snow from gravel surfaced areas.

.8 Leave all surfaces in perfectly clean and unsoiled condition.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 Perform starting of each system and each item of equipment in accordance with the general requirements specified herein.

1.2 PREPARATION

.1 The Contractor, sub contractors and any related inspection and testing agency, firm or company whether hired by the Event Organizer or the Project Team shall have a copy of the Competition Documents, product data, and operation and maintenance data at hand during starting process.

.2 Coordinate sequence for starting of various equipment and systems.

1.3 MANUFACTURERS' SITE SERVICES

.1 When required or when otherwise requested by the event organizer or the Project Team, require the manufacturer to provide an authorized representative to be present at the Place of Work to perform the following:

.1 Inspect**,** check, verify and approve equipment and systems installation prior to starting**.**

.2 Supervise placing equipment and systems in operation**.**

.3 Provide a detailed written report verifying that the equipment**:**

.1 has been properly installed and lubricated,
.2 is in accurate alignment,
.3 is free from any undue stress imposed by connecting lines or anchor bolts**,** and
.4 has been satisfactorily operated under load conditions.
.5 has been installed, placed and any other construction means methods or sequences used by the Contractor meets or exceeds the manufacturers recommended installation, placement or other instructions an recommendations required to obtain and maintain manufacturer warranties for the system of equipment.

1.4 STARTING

.1 Verify that each item of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, and other conditions affecting starting and operation.

.2 Take any and all corrective action as necessary to achieve proper lubrication, drive rotation, belt tension, control sequence, and other conditions affecting starting and operation.

.3 Execute starting under supervision of The Project Team, Contractor's or sub contract's personnel, the manufacturer's authorized representative.

.4 Ensure Starting of any systems and equipments is completed in the presence of the Event Organizer staff or other authorized representative.

.5 Place equipment and systems in operation in proper sequence and in accordance with the Competition Documents and requirements of the manufactures representative.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 Contractor shall be responsible for testing, adjusting and balancing of all:

.1 piped, ducted, wired and wireless services and systems, including all components and equipment forming part thereof, and all manually and mechanically operated systems including all components and equipment forming part thereof.

.2 The Project Team shall perform testing, adjusting and balancing with qualified personnel, or employ and pay for a qualified organization to perform such services.

.3 Perform testing, adjusting and balancing after starting of equipment and systems.

.4 Provide personnel, operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.5 Report to the Event Organizer any deficiencies or defects noted during testing, adjusting and balancing, which cannot be promptly corrected.

1.2 PREPARATION

.1 Prepare each system and item of equipment for testing, adjusting and balancing.

.2 Verify that each systems and equipment installation is complete and in continuous operation.

.3 Verify ambient conditions.

1.3 TESTING, ADJUSTING AND BALANCING

.1 Testing: Perform tests to confirm compliance with requirements of Competition Documents. Take corrective action as necessary.

.2 Adjusting: Perform adjustments to ensure proper, efficient and safe operation.

.3 Balancing: Perform balancing to ensure that the various parts of system are in a proper state of equilibrium.

END OF SECTION

PART 1. GENERAL

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, plant and equipment to complete the miscellaneous structural steel work indicated on the drawings and specified herein.

1.2 EXTENT OF WORK

.1 The work required under this section consists of all structural steel and erection, which is not a part of a pre-engineered roof or building system, shop painting, and related items necessary to complete the work indicated on the Drawings and specified herein. This includes, but is not limited to, the following:

.1 Structural steel beams, columns, embedments and plates.

1.3 REFERENCE STANDARDS

.1 All codes, standard specifications and by-laws referred to in this Specification shall be current editions including all latest revisions and addenda.

.2 Conform with the Alberta Building Code, any applicable acts of any authority having jurisdiction and the following:

.3 CSA Standard S16-01: Limit States design of Steel Structures

.4 CSA Standard S136: Design of Cold Formed Steel Structural Members

.5 CSA W47.1: Certification of Companies for Fusion Welding of Steel Structures.

.6 CSA W59: Welded Steel Construction (Metal Arc Welding)

.7 CSA G40.21: Structural Quality Steel

.8 ASTM F1554: Standard Anchor Bolts

.9 SSPC: The Society for Protective Coatings

.10 CISC Handbook of Steel Construction, 2007 Ninth Edition, Third Revised Printing.

.11 CISC Code of Standard Practice for Structural Steel, Ninth Edition, 2007, Third Revised Printing.

.12 Where there are differences between the specifications and drawings and the codes, standards or acts, the most stringent shall govern.

.13 Standards referenced within the standards noted above are to apply even if they are not included in the list.

1.4 TOLERENCES

.1 Conform to erection tolerances to CAN/CSA S16.

.2 Fabricating, preparation and coating systems shall be such that they minimize the effects of galvanizing, bending, cambering and the like, on the alignment of the completed members.

.3 The "as fabricated and erected" straightness tolerances of architecturally exposed structural steel members shall not exceed ½ of the standard camber and sweep tolerances specified in G40.20, unless otherwise noted.

1.5 QUALIFICATIONS

.1 Fabricator, erector and all subcontractors performing structural steel work shall be certified under the requirements of the Canadian Welding Bureau CSA Standard W47.1. Fabricator and erector shall have in place, Quality Control Program that is acceptable to the Owner. The Quality Control Program shall satisfy the minimum requirements specified in the contract documents.

.2 Design calculation shall be carried out by or under the direct supervision of a qualified Professional Engineer licensed in the Province of Alberta.

.3 Engineers responsible for welding design, procedures and practice shall be certified in accordance with CSA W47.1.

1.6 DESIGN

.1 All connections shall be designed in accordance with the requirements of CSA Standard-S16-01 to resist forces indicated.

.2 If the fabricator's engineer requires additional information or clarification to aid in the design of his work, he shall request this information in a timely and appropriate manner.

.3 Unless otherwise noted, the fabricator's engineer shall design and be solely responsible for all connections between all steel members including; but not limited to columns, beams, girders, braces, etc. and their supporting members.

.4 Unless otherwise noted, the fabricator's engineer shall also design and be responsible for specifying stiffeners, and the like, required to maintain the local strength and stability of a member and where these stiffeners become an integral part of the connection or where they affect the connection of other steel framing members. Typical examples include, but not limited to cranked sections, moment connections between columns and beams, connections to hollow structural sections and the like. Where connections are exposed to view, the detailing of stiffeners and the like is subject to review by the Architect.

.5 Design connections to safely withstand the combined primary effects of axial forces, shear, moment and torque and any secondary effects due to welding.

.6 For non standard connections, submit sketches and design calculations stamped and signed by qualified Professional Engineer registered in Province of Alberta.

.7 For standard connections, select details from CISC Handbook of Steel Construction to ensure structural adequacy.

.8 Unless noted otherwise, beam connections shall be designed for minimum 50% of shear capacity of beam in accordance with the CISC handbook, 2007 Ninth Edition, Part 3 "Connections" and Part 5 "Flexural Members".

.9 All connections shall have a minimum of two - 20mm diameter bolts per vertical line.

.10 Unless detailed otherwise, all structural steel for roof areas, including joists, shall be designed for wind uplift in accordance with National Building Code of Canada requirements.

1.7 INSPECTION AND TESTING

.1 The Owner will appoint the Independent Inspection and Testing companies to make inspections or perform tests as the Owner or Construction Site Manager directs.

.2 Cooperate with Independent Inspection and Testing companies and assist them, as required, such that the can carry out their work.

.3 When defects are revealed, the Consultant may request, at the Contractor's expense, additional inspection or testing to ascertain the full extent of the defect.

.4 Materials and workmanship will be subject to inspection at any time by the Architect or Engineer or his representative. Access for inspection where work is being done or stockpiled prior to shipment shall be provided.

.5 Copies of mill test reports properly correlated to the materials shall be made available to the Architect upon request.

1.8 SUBMITTALS

.1 Include with the tender documents a copy of fabricators and erectors standard Quality Control Program.

.2 Submit structural steel shop drawings in accordance with Division 1 - Section 01 33 00.

.3 All shop drawings must be signed and sealed by and engineer licensed to practice in Alberta, except for erection diagrams which only contain design information (member sizes, forces, loads and the like) which is shown on the structural drawings. If any field work details, notes to the erector or notifications are made on the erection diagrams, then they must be sealed and signed.

.4 The structural drawings shall not be reproduced in whole or in part, for the use as shop, erection or setting drawings.

.5 Provide shop and erection details including dimensions, finishing, details, anchoring, cuts, copes, connection, holes, bolts and welds and all fabrication. Indicate welds by welding symbols defined in CSA-W59.

.6 Prior to fabrication verify all dimensions and correlate with adjoining construction and materials. Errors in dimensions on shop drawings shall be the responsibility of the Contractor.

.7 Indicate size, type and grade of all members.

.8 Provide copies for review by the Architect and Engineer with sufficient lead time to allow for the review process. Prior to submission to the Architect and Engineer, copies shall be checked in detail by the Contractor and shall bear the checker's initials.

.9 Shop drawings kept at the site shall bear the review stamps and initials of all parties.

.10 Shop drawings and calculations for moment connections shall be submitted for review bearing the seal and signature of the design engineer licensed to practice in Alberta.

.11 Reviewing these drawings is to be regarded as assisting the contractor and the architect or engineer does not hereby assume responsibility for any errors or omissions. Where such errors or omissions are discovered later, they must be made good at not extra cost to the owner irrespective of any review.

.12 When shop drawings are revised and resubmitted, all revisions to the drawings shall be clearly identified by means of "bubbles", "clouds" or other obvious means.

.13 Fabrication and construction may only proceed from reviewed shop drawings which require no resubmission.

1.9 FIELD MEASUREMENTS

.1 The Contractor shall take measurements in the field to verify or supplement dimensions shown on the drawings and shall assume full responsibility for the fit-up of all structural steel.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Conform to the following:

.1 Store all metal above ground on platforms or skids; above snow or mud.

.2 Protect from moisture and corrosion until erected.

.3 Include templates and instructions for proper setting of anchor bolts.

PART 2. PRODUCTS

2.1 MATERIALS

.1 Structural wide flange shapes (W) to conform to CAN/CSA G40.20/G40.21 grade 350W.

.2 Structural welded wide flange shapes (WWF) to conform to CAN/CSA G40.20/G40.21 grade 350W.

.3 Angles and channels (L, C) to conform to CAN/CSA G40.20/G40.21 grade 300W.

.4 Plates to conform to CAN/CSA G40.20/G40.21 grade 300W.

.5 Hollow structural sections (HSS) to conform to CAN/CSA G40.20/G40.21 grade 350W, Class C.

.6 Anchor Rods: Conform to ASTM F1554 or 300W threaded rod conforming to CSA G40.21M, unless otherwise noted or shown.

.7 Bolts, Nuts & Washers: Conform to ASTM A325M.

.8 Concrete Anchors: Shall be Nelson, flux filled deformed bar anchors, type D2L, or approved alternate.

.9 Shop Primer and field touch-up primer: to CISC/CPMA Standard 2-75

.10 Shop Paint: to CISC/CPMA 1-73a

.11 Fastening devices in concrete

.1 Embedded bolts or Hilti bolts as indicated on drawings.

.1 Types and sizes as detailed or required by conditions of installation.

.2 Use no substitutes without prior approval from the Structural Engineer.

PART 3. EXECUTION

3.1 FABRICATION

.1 Prior to fabrication of structural steel, take field measurements where connections are to be made to existing work. Take any and all necessary field measurements.

.2 Modify installation methods and methods for connecting to suite site conditions found and to the approval of the Consultant.

.3 Workmanship and fabrication shall be in accordance with CSA Standard S16 and in accordance with reviewed shop drawings.

.4 Welding shall conform to the requirements of CSA Standard W59 and qualification code CSA Standard W47.1.

.5 The welding of reinforcing bars to plates and other structural steel members where approved by the Architect or shown on the drawings shall be in accordance with CSA Standard W186.

.6 Drawings show major components of the structural framing system. Work of this section also includes leveling plates, column caps, connector clips, separators, ceiling extensions, stiffeners, bridging, truss connections, wall plates, brackets, and other parts required to complete the work although not sized or detailed.

.7 Do shop cutting and reinforcing to accommodate other trades. Punch or drill holes required for bolting wood lagging and fastening work of other trades. Examine Architectural details, Mechanical, Electrical and Structural Drawings to determine locations of such work and show on shop drawings.

.8 Do field cutting and reinforcing at the expense of the sub-trade requiring the work. Drilling and tapping of holes after erection shall be done by the sub-contractor requiring the work. Locations and sizes of the work are subject to the approval of the Consultant.

.9 Finished members shall be true to line and free from twists, bends and open joints.

.10 Provide drain holes in closed sections to prevent water build-up during erection.

.11 Unless noted otherwise on the drawings, provide 6mm cap plate for all hollow structural sections. Cap plate is to be continuously seal welded to HSS member.

.12 Provide the indicated camber to beams and girders in such a manner as to provide a uniform parabolic profile. Ensure that the method used to provide camber does not reduce the safe load carrying capacity or cause distortion to the member.

.13 Camber stated on the drawings is the required camber after fabrication.

.14 Openings shall conform to the requirements shown for location, size, reinforcement and cutting of openings through structural steel.

.15 No openings through structural steel members will be permitted without the Consultant's approval.

.16 All holes shall be drilled or punched at right angles to the surface of the metal, or CNC guided plasma cut in accordance with CISC Specifications.

.17 Drive bolts accurately into the holes without damaging the threads and heads. Bolt heads and nuts shall rest squarely against metal surface.

.18 Provide welded stiffeners in all columns and beams at points of concentrated loads where required by S16, or where specifically shown on the drawings. Fitted stiffeners shall be ground to fit closely against bearing surfaces.

3.2 ERECTION

.1 Erect all structural steel in accordance with CSA Standard S16-01

.2 Equipment: Operate all equipment, apparatus and staging required for the erection of steel work in a safe manner. Install, maintain and remove without injury to the other work, scaffolding, erection bracing and other equipment, etc. as may be necessary or required.

.3 Column base plates shall be supported and aligned on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, the anchor nuts shall be tightened, in preparation for grouting. Wedges and shims shall be cut off flush with the edges of plates and shall be left in place.

.4 Leveling plates shall be set to the established lines and elevations. Provide steel shims as required for proper positioning of column/baseplate.

.5 Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact.

.6 Provide all necessary bracing required for wind and erection loads. Maintain erection bracing as long as required to ensure the overall safety and integrity of the structure. Erection bracing shall only be removed on instruction of the Engineer of Record for the temporary works.

.7 Structural steel members shall not be altered in the field without the Consultants approval.

.8 After erection all field joints and abrasions shall be thoroughly cleaned and painted with primer.

3.3 PROTECTION

.1 Clean structural steel surfaces to SSPC-SP2 & SSPC-SP3 and shop prime structural steel in accordance with CAN/CSA-S16-01 except where members are to be encased in concrete.

.2 Clean surfaces within 50mm (2”) of any field weld location of materials that would prevent proper welding or produce questionable fumes while welding is being done.

.3 Upon completion of erection, clean with mechanical brush and apply primer to welds, bolts and at locations where original primer was damaged.

.4 Provide minimum 2 coats of primer in accordance with CISC/CPMA Standard 2-75 – “A Quick-drying Primer for Use on Structural Steel” to all structural steel at exterior conditions.

.5 Architecturally Exposed Steel: After erection and immediately after grinding welds, etc., touch up and paint with one coat of same paint as shop coat, all damaged and abraded spots, including any unpainted areas.

3.4 QUALITY CONTROL

.1 As a minimum, carry out visual inspection of all shop and field welds in accordance with CSA W59.

.2 Non-destructive testing to be carried out by radiography, magnetic particle or ultra sonic methods, whichever is more appropriate.

.3 Any deficient welds identified by means of Non Destructive Testing (NDT), shall be repaired and the costs shall be addressed in accordance with the terms of the Contract.

.4 Welds found deficient in dimensions, but not in quality may be enlarged by additional welding. Any weld found deficient in quality shall be removed by chipping or gouging and the weld shall be remade.

.5 Implement a system of quality control to ensure that the minimum standards specified herein are attained.

.6 The Consultant's general review during construction and inspection and testing by Independent Inspection and Testing companies are both undertaken to inform the Construction Manager, Consultant and Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

3.5 DEFECTIVE MATERIALS AND WORK

.1 Where reasonable evidence exists that defective work has occurred, the Consultant may have tests, inspections or surveys performed, analytical calculations made and the like in order to help determine whether the work must be replaced. Tests, inspections, surveys or calculations will be paid for in accordance with the terms of the contract.

.2 Materials or work which fails to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

PART 1. GENERAL

~~1.2~~1.1 RELATED WORK

Formatted: Bullets and Numbering

.1 Back priming equipment backboards: Section 09 91 30.

1.2 REFERENCE DOCUMENTS

.1 CSA O80 Series – 97, Wood Preservation.

.2 CSA O121 - M1978 (R1998), Douglas Fir Plywood.

.3 CAN/CSA O141 - 91 (R1999), Softwood Lumber.

.4 CSA O151 - M1978 (R1998), Canadian Softwood Plywood

.5 CSA O153 – M1980 (R1998), Poplar Plywood

.6 CSA O437 Series – 93, Standards on OSB and Waferboard

.7 National Lumber Grading Authority (NGLA), Standard Grading Rules for Canadian Lumber, Latest edition.

1.3 REGULATORY REQUIREMENTS

.1 Comply with applicable requirements of the International Building Code and te Coder requirements of the Competition.

1.4 SOURCE QUALITY CONTROL

.1 Supply lumber graded and stamped by an agency certified by Canadian Lumber Standards Administrative Board.

.2 Supply plywood graded and stamped in accordance with applicable CSA standards.

.3 Supply other panel products marked with a recognized, visible grade stamp.

1.5 PRODUCT DELIVERY AND STORAGE

.1 Protect materials from weather upon delivery to job site.

.2 Store materials on raised supports. Cover materials with waterproof covering. Provide adequate air circulation and ventilation.

.3 Do not store seasoned materials in wet or damp areas.

PART 2. PRODUCTS

2.1 LUMBER

.1 Lumber: to CAN/CSA 0141, softwood, S-P-F, S4S, surface-dry, graded and stamped in accordance with current National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.

.1 Moisture Content: maximum 19% at time of installation.
.2 Finger jointed lumber is not acceptable.

.2 Framing and Board Lumber: in accordance with ABC and as specified in schedules.

.3 Furring, Blocking, Nailing Strips, Grounds, Rough Bucks, Cants, Curbs Fascia Backing and Sleepers: S4S, "Standard" or better grade for board, post and timber sizes, "Standard" light framing or better for dimension sizes.

2.2 PANEL PRODUCTS

.1 Provide panel products manufactured with phenol-formaldehyde or formaldehyde-free adhesives.

.2 Canadian Softwood Plywood: to CSA 0151.

.3 Douglas Fir Plywood: to CSA 0121.

.4 Poplar Plywood: to CSA 0153, standard construction.

.5 Oriented Strand Board: to CSA 0437.0.

.6 Underlayment: Douglas Fir plywood, exterior, sanded grade, G1S, wood inlay patches only, plugged crossbands.

2.3 FASTENING DEVICES AND HARDWARE

.1 Nails and Spikes:

.1 Use common spiral nails and spiral spikes except where indicated otherwise.

.2 Use hot dip galvanized finished steel for exposed exterior work, highly humid interior areas and for pressure - preservative and fire-retardant treated lumber.

.2 Underlayment Fasteners:

.1 Nails: galvanized, annular ringed, length to provide minimum 85% penetration into subfloor, but not enough to anchor underlayment to joists.

.2 Staples: chisel point, non-divergent, double-coated, length ensuring minimum 85% penetration into subfloor but not penetration through.

.3 Bolt, nut, washer, screw and pin type fasteners: hot dip galvanized finish to CSA G164-M92.

.4 Joist hangers: minimum 1.0 mm sheet steel, galvanized.

2.4 ANCILLARY MATERIALS

.1 Subflooring adhesive: to CAN/CGSB 71.26-M88, cartridge loaded.

.2 Surface applied wood preservative: copper napthanate base or pentachlorophene, prepared in accordance with CSA O80.15, coloured green.

.3 Polyethylene Film: to CAN/CGSB-51.34-M86, 100 micrometre thick.

.4 Sealing Tape: minimum 60 mm width, polypropylene sheathing tape with acrylic adhesive, or duct tape of same width.

2.5 PRESSURE PRESERVATIVE TREATED WOOD

.1 Pressure Preservative Treated Wood: in accordance with CSA O80 Series.

.2 Water-borne preservative treated wood shall have maximum moisture content of 19% after treatment.

PART 3. EXECUTION

3.1 APPLICATION OF SURFACE APPLIED WOOD PRESERVATIVE

.1 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of surface applied wood preservative before installation.

3.2 ERECTION OF FRAMING MEMBERS

.1 Install members true to line, levels and elevations. Space uniformly.

.2 Construct continuous members from pieces of longest practicable length.

.3 Install spanning members with "crown-edge" up.

.4 Install blocking to facilitate installation of finishing materials, fixtures, specialty items and trim.

3.3 WOOD FURRING AND BLOCKING

.1 Provide wood furring and blocking at locations indicated on drawings and as specified.

3.4 TELEPHONE AND ELECTRICAL EQUIPMENT BACKBOARDS

.1 Provide backboards for mounting telephone and electrical equipment as indicated. Use 19 mm thick Canadian Softwood Plywood/S1S or Douglas Fir Plywood/G1S on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing.

.2 Prior to installing back boards ensure that backboards are back primed as specified in Section 09 91 05.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

.1 Structural Insulated Magnesium Oxide Insulated Panels (SIPs)

1.2 RELATED SECTIONS

.1	Rough Carpentry	Section 06 10 00.
.2	Spray Applied Polyurethane Foam Air Seal	Section 07 27 28.
.3	Sheet Metal Flashing and Trim	Section 07 62 00.
.4	Joint Sealants	Section 07 92 00.

1.3 SYSTEM DESCRIPTION

.1 Structural Insulated Panels consisting of fiberglass mesh reinforced magnesium oxide board laminated to rigid expanded polystyrene foam board core (EPS).

.2 The system incorporates the use of conventional or manufacturer supplied and recommended splines, adhesives, sealants and fasteners (screws) for installation.

1.4 DESIGN REQUIREMENTS

.1 Provide SIP's which have been manufactured, fabricated and installed to withstand loads as specified by the Structural Engineer registered to practice in the province or state for which the panels are being installed. And to maintain the performance criteria as stated by the SIP manufacturer without defects, damage or failure.

1.5 REFERENCES

.1 American Society For Testing Materials (ASTM):

.1 ASTM E-119-09C Standard Test Method for Fire Tests of Building Construction Materials.

.2 National Fire Protection Association (NFPA):

.1 NFPA 251 (2006) Standard Methods of Tests of Fire resistance of building Construction Materials.

.3 Underwriters Laboratory (UL):

.1 UL 263 (2007) Fire Tests of Building Construction and Materials.

.4 Underwriters Laboratory Canada (ULC):

.1 CAN/ULC-S101-07 Standard Methods of Fire Tests of Building Construction Materials.

.5 Intertek Testing Services NA Ltd.:

.1 Test repot number G100121036COQ-002B-rev 1 Testing on EPS insulated MgO panels.

1.6 SUBMITTALS

.1 Provide submittals in accordance with Division 01

.1 Product Data: Submit manufacturers product literature including:

.1 Manufacturer's installation manual.
.2 MSDS Sheet(s)
.3 SIP code compliance report(s) indicating compliance to the Alberta Building Code.
.4 Manufacturer's Warranty / guarantee information.

.2 Shop Drawings:

.1 Provide 2 hard copies and 1 electronic copy of the following:

.1 Panel layout.
.2 Elevations.
.3 Sections and section details.
.4 Connection details.
.5 Cut out locations for windows, doors, mechanical and electrical penetrations.
.6 Accessories and fasteners.

.3 Calculations: Provide all structural calculation by a structural engineered registered to practice in the province or state in which the panels are being installed and who is qualified to perform such work or calculations.

1.7 SAMPLES

.1 Comply with the requirement of Division 01.

.2 Provide the following samples:

.1 Two 152mm x 152mm panel sample splined together indicating a typical seam installation

1.8 QUALITY ASSURANCE

.1 Installer / Shop Fabrication Qualifications:

.1 The installer shall be certified trained or otherwise approved by the SIP manufacturer.

.2 Shall have a minimum of five (5) years experience in working on projects of similar size and scope and be skilled in custom fabrication installation methods, means, techniques and sequencing.

.3 Shop employees shall be skilled workers who custom fabricate products and materials similar to those specified herein and indicated on the drawings.

.4 Prepare and provide coordination drawings indicating the following:

.1 Related plumbing work

.2 Related electrical Work

.3 Miscellaneous / Custom metal fabrications,

.1 Rough carpentry indicated on plan and elevation where solid backing is required.

.4 Confirm on site by visual inspections and taking field site measurements locations, heights, any and all other such information as may be required for satisfactory installation of the SIPs. Site measurements and verification of locations indicated for installation shall be performed by the Project Team and the installer prior to ordering of any materials required for the work of this section.

.5 The Project Team shall immediately correct, repair or replace any such work, products or materials as well as any deficiencies affecting the installation of the SIPs.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Deliver all products in manufacturers original packaging, upon receipt of materials on site the Project Team shall ensure that no damage to the delivered materials is apparent and all items received are as listed on the packaging slips.

.2 Review and report any such material that is damaged, defective or in any way not acceptable for acceptance of delivery. Replace any such materials that are unsatisfactory.

.3 Handle all materials in such a manner as to prevent physical damage, provide any required protective coverings to prevent damaging the surfaces.

.4 Stack panels on dunnage or pallets SIPs during the storage period to prevent contact with the ground.

.5 Store in a location that is easily accessible for installation purposes.

.6 Protect panels from adjacent construction activities that may cause damage to the SIPs

.7 Protect panels from exposure to the elements.

1.10 WARRANTY

.1 Provide manufactures warranty agreement to repair or replace any such material, panel or other related SIPs products and accessory that fail or are defective due to manufacturing and workmanship deficiencies within the specified and agreed to warranty period.

1.11 MAINTENANCE

.1 Provide all required materials, products, information and documentation required for the proper care and maintaining of the SIP Panels.

.2 Provide the following:

.1 Patching or repair kits or materials as required for the repairing of the SIPS.

.2 Spare fasteners including: Screws, Bolts, nuts, silicone, adhesive and all other materials required for the suitable maintain and repair of the SIPs.

.3 Provide the one copy manufacturers written documentation on maintenance and repairs.

PART 2. PRODUCTS

2.1 MANUFACTURERS

.1 Acceptable Manufacturer:

TitanWall Research & Development Corp.
250007 Mountain View Trail
Calgary, Alberta
T3Z-3S3
Phone: 1-403-247-5100
E-mail: info@titanwall.com
Web: www.titanwall.com

2.2 MATERIALS

.1 Structural Insulated Magnesium Oxide Board Panels consisting of the following:

.1 Panel Sheathing: Fiberglass mesh reinforced magnesium Oxide (MgO) Board.

.2 Core Material:

.1 ULC rated EPS foam with not less than 1lb density.

.3 Adhesives:

.1 One part urethane adhesive designed for application by a bead applicator.

.4 Sealants:

.1 Butyl rubber. Where fire separations are required provide ULC listed sealants.

.2 ULC Listed Low expanding polyurethane foam.

.5 Fasteners:

.1 Panel Joint Fasteners: 44.45mm long (1 ¾" inch) stainless steel self threading screws.

.2 Sheathing Fasteners: 50mm long (2 inch) stainless steel self threading screws

PART 3. EXECUTION

3.1 EXAMINATION

.1 Verify all measurements on site, prior to fabrication.

.2 Verify all substrates and structures that panels will be installed upon. Ensure they are square, level, plum and true.

.3 Ensure all necessary base plates and connecting structures are in place a suitable for the installation of the SIP panels.

.4 Review and inspect all substrates to ensure they are free from defects that may adversely affect the installation of the SIP panels.

3.2 PREPARATION

.1 Ensure that the following are on hand prior to beginning installation of the SIP panels:

.1 A suitable power supply to operate the tools required for installation.

.2 Cordless tool set including:

.1 Drill.
.2 Impact driver.
.3 Circular saw with a min of a 5 ½ inch blade.
.4 Reciprocating saw (sawzall) with a minimum of a 12 inch blade.

.3 Power Actuated Tools:

.1 Angle Grinder.
.2 EPS Hotwire cutting tool.
.3 Air compressor and storage tank.
.4 Pneumatic brad nailer.
.5 Pneumatic nail gun capable of driving a 3 inch 8d galvanized nail.
.6 Pneumatic staple gun capable of driving 16 gauge staples up to 50mm (2 inches)
.7 Electrical Circular saw with a minimum of a 10 1/4 inch blade.
.8 Hammer drill capable of drilling 25mm to 19mm holes. (for concrete installations only).
.9 Table saw with a minimum of a 254mm (10 inch) blade.
.10 Power planer: 76mm (3 inch) hand held electrically operated.

.4 Instrumentation tools:

.1 Laser level.
.2 2, 4 and 6 foot long hand held levels.
.3 50 foot long measuring tapes.

.5 Accessories for tools:

.1 Hole Saw kit.
.2 Various bits suitable for the fastener types used.
.3 Various size drill bits for the various typed of drilling tools.
.4 Spare blades for the various types of saws required.

.6 Laser level.

.1 Utility knifes.
.2 Caulking and adhesive guns.

.3 Foam guns: for installation of expanding foam sealant.

.7 Handheld Tools:

.1 Utility knife.
.2 Hammer.
.3 Chalk lines.
.4 16 or 25 foot long measuring tape.
.5 Cresent wrench.
.6 Socket wrench.
.7 EPS rasps.
.8 Ratchet straps.

.8 Ladders and Scaffolds:

.1 As required for the suitable installation of the SIP panels.

3.3 INSTALLATION

.1 Comply with the manufacturers written installation instructions, manuals, recommendations and guidelines.

.2 Perform all work in accordance with the local codes, laws, by laws, regulations, guidelines and recommendations of the Authorities Having Jurisdiction.

.3 Plan and coordinate for crane or man-lift access to hoist, lift and install SIPs that required to be installed in areas not accessible by ladders or scaffolding.

.4 Install SIPs square, level, plum and true.

.5 Splines shall be fully adhered using the manufacturers recommended adhesive(s).

.6 All connection shall be completed in accordance with the recommendation of the structural engineer of record and in accordance with the manufacturer’s installation instructions.

.7 Ensure panels are installed with the correct heights and lengths in accordance with the structural engineers wind loading calculations. Do not exceed the designed height s and lengths.

.8 Provide adequate bracing during installation.

.9 Ensure all materials, components and products are “on hand” prior to beginning installation.

.10 All fasteners, screws, bolts, connectors, straps and hold downs are to be installed as

specified in the structural engineering drawings. Ensure that the size, number and spacing of all fasteners, connectors, screws, bolts, straps and hold downs is ,completed in strict accordance with the structural engineers design drawings, manufacturers shop drawings and panel manufacturer's installation instructions.

.11 Apply sufficient amounts of adhesives and sealants in accordance with the SIP panel manufacturer and the sealant and adhesive manufacturer's instructions and recommendations.

.12 Securely join adjacent panels. Panels shall be flush and smooth at all joint locations.

.13 Confirm all penetrations with the structural engineer of record.

.14 Subsequent to completion of all mechanical and electrical, conduit, piping, ducts, and other mechanical and electrical equipment or components requiring penetrations through the SIPs, ensure all holes and penetrations are filled using the manufacturer recommended sprayed applied polyurethane foam sealant.

.15 Where conduit, duct or other penetrations pass through a fire separation fill all holes and penetrations with a ULC listed sealant.

.16 Immediately repair or replace damaged materials.

3.4 PROTECTION

.1 Protect finished installation from damage by work of other sections.

3.5 CLEANING

.1 Remove all bracing, clamping and other materials used for the temporary securing of the SIPs after all adhesives and sealants have fully cured.

.2 Remove all excess sealants and adhesives.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

.1	Rough Carpentry:	Section 06 10 00.
.2	Architectural Woodwork:	Section 06 40 00.
.3	Hardware:	Section 08 70 00.

1.2 REFERENCE DOCUMENTS

.1 WM/Series Wood Moulding Patterns published by Wood Moulding and Millwork Producers (WM).

1.3 SAMPLES

.1 Submit 300 mm x 300 mm samples of each type of solid wood or plywood to receive stain or natural finish.

.2 Submit 250 mm long samples of each type of trim and moulding

1.4 DELIVERY AND STORAGE

.1 Make no delivery until site conditions are adequate to receive the work of this Section. Protect materials from weather while in transit to site.

.2 Adequately protect finish surfaces during delivery, handling and storage.

1.5 ENVIRONMENTAL CONDITIONS

.1 Materials for interior installation shall be installed only in areas with a constant and minimum temperature of 15° C, with interior relative humidity conditions within design values.

1.6 COORDINATION

.1 Coordinate provision of concealed blocking or supports.

.2 Ensure that back-priming of finish carpentry surfaces concealed after installation, has been performed as specified in Section 09 91 05, prior to installation.

PART 2. Products

2.1 MATERIALS

.1 Softwood lumber: average moisture content of 6% and maximum of 9% for interior work, an average of 12% and maximum of 15% for exterior work, maple species, to AWMAC custom grade.

.2 Hardwood lumber: average moisture content of 6% and maximum of 9% for interior work, maple species, to AWMAC premium grade.

.3 Hardwood plywood: to CSA O115-M1982, of thickness indicated, 1220mm x 2440mm size sheets, maple species, plain sliced cut face veneer of architectural grade. Use lumber core with Type II bond. Select veneers to provide slip match

.4 Canadian softwood plywood: to CSA O151-M1978, solid two sides medium density overlaid grade.

.5 Douglas fir plywood: to CSA O121-M1978, solid two sides, medium density overlaid grade.

.6 Poplar plywood: to CSA O153-M1980, standard sheathing grade, interior moisture resistant type.

.7 Fasteners: to suit size and nature of components being fastened.

2.2 STANDING AND RUNNING TRIM

.1 Window and Door Casings: Maple species, profile as detailed, grade N for natural or stained finish.

.2 Wall Bases: Maple species, profile as detailed N for natural or stained.

2.3 FABRICATION

.1 Fabricate items rigid, plumb and square, as detailed, with tight, hairline joints. Sand work smooth, set all nails and screws.

.2 Supply and install hanger rods in closets, consisting of 32 mm diameter [hardwood] aluminum rod with matching end brackets.

.3 Fit shelves with hardwood edging.

.4 Provide 10 mm thick solid matching wood strip on plywood edges exposed in final assembly when plywood 12 mm or thicker. Strips same width as plywood.

PART 3. Execution

3.1 INSTALLATION

.1 Scribe and cut as required to fit abutting walls, and surfaces, to fit properly into recesses and to accommodate intersecting or penetrating objects.

.2 Install door and window trim in single lengths without splicing.

.3 Fit backs of baseboards and casing snugly to wall surfaces to eliminate cracks at junction of base and casing with walls.

.4 Set and secure materials and components in place, rigid, plumb and square, with tight, hairline joints.

.5 Form joints to conceal shrinkage.

.6 Set finishing nails to receive filler. Where screws are used to secure components countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.

.7 Butt and cope internal joints of baseboards to make snug, tight joint. Cut right angle joints of mouldings and external corners of base with mitred joints.

.8 Provide heavy duty fixture attachments for wall mounted cabinets, shelving and handrails.

.9 After installation, adjust operating hardware to ensure correct operation.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

.1	Environmental Procedures	Section 01 35 20.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Finish Carpentry:	Section 06 20 00.
.4	Wood Doors:	Section 08 14 16.
.5	Painting and Finishing - General Requirements:	Section 09 91 05.

1.2 REFERENCE DOCUMENTS

.1 ANSI/BMHA A156.9-1994, American National Standard for Cabinet Hardware.

.2 “Architectural Woodwork Quality Standards Illustrated”, Eighth edition, 2003, published by the Architectural Woodwork Institute of the U.S. and jointly copyrighted with the Architectural Woodwork Manufacturer's Association of Canada (AWMAC). This document is herein referred to as the “AWMAC Manual”.

.3 Canadian General Standards Board (CGSB), CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.

.4 Canadian Standards Association (CSA International)

.1 CSA B111-[74(R2003)], Wire Nails, Spikes and Staples.
.2 CSA O112.4 Series-[M1977(R2006)], Standards for Wood Adhesives.
.3 CSA O112.5-Series-M-[1977(R2006)], Urea Resin Adhesives for Wood (Room- and High-Temperature Curing).
.4 CSA O112.7-Series M-[1977(R2006)], Resorcinol and Phenol-Resorcinol Resin Adhesives for Wood (Room- and Intermediate-Temperature Curing).
.5 CSA O121-[M89(R2003)], Douglas Fir Plywood.
.6 CSA O141-[05], Softwood Lumber.
.7 CSA O151-[04], Canadian Softwood Plywood.
.8 CSA O153-[M1980(R2003)], Poplar Plywood.

.5 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-69.25-[M90]/ANSI/BHMA A156.9-[1982], Cabinet Hardware.
.2 CAN/CGSB-69.27-[93]/ANSI/BHMA A156.11-[1991], Cabinet Locks.
.3
.4 CAN/CGSB-69.32-[M90]/ANSI/BHMA A156.16-[1981], Auxiliary Hardware.
.5 CAN/CGSB-69.34-[93]/ANSI/BHMA A156.18-[1987], Materials and Finishes.
.6 CAN/CGSB-69.36-[M90]/ANSI/BHMA A156.20-[1984], Strap and Tee Hinges.

.6 International Organization for Standardization (ISO)

.1 ISO 14040-2006, Environmental Management-Life Cycle Assessment - Principles and Framework.

.2 ISO 14041-98, Environmental Management-Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis.

.7 Forest Stewardship Council (FSC), FSC Accredited Certified Bodies.

.8 National Electrical Manufacturers Association (NEMA), ANSI/NEMA LD-3-[05], High-Pressure Decorative Laminates.

.9 National Hardwood Lumber Association (NHLA), Rules for the Measurement and Inspection of Hardwood and Cypress 1998.

.10 National Lumber Grades Authority (NLGA), Standard Grading Rules for Canadian Lumber 2005.

.11 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)

.1 SCAQMD Rule 1113-04, Architectural Coatings.
.2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.3 SUBMITTALS

.1 Product Data: Submit manufacturer's product literature for items not manufactured by architectural woodwork manufacturer, when requested.

.2 Shop Drawings:

.1 Indicate materials, factory finishes, thicknesses, and hardware. Include plans, elevations, sections and details at the following drawing scales:

.1 Plans and elevations – 1:20
.2 Sections – 1:10
.3 Details – 1:2

.2 Indicate construction details, locations of built-in items, connections, attachments, anchorage and location of exposed fastenings, as applicable.

.3 Samples:

.1 Submit 215 mm x 280 mm samples of panel products for each factory applied finish system.

.2 Submit 32 mm x 350 mm samples of lumber of each species.

.3 Finish one side and edge of samples representing items to receive factory finishes.

.4 Submit samples of veneer flitches when requested.

.5 Submit samples of plastic laminate for selection of colour.

.4 Quality Assurance Submittals: Submit manufacturer’s installation instructions.

.5 Submit MSDS sheets or official manufacturer literature stating no urea-formaldehyde was uses to composite wood.

1.4 PROJECT RECORD DOCUMENTS

.1 Provide project record sheet identifying project title and address, Contractor and architectural woodwork manufacturer.

.2 Provide shop finishes, and type and source of hardware and any specialty items used.

1.5 QUALITY ASSURANCE

.1 Materials and workmanship shall meet or exceed recommendations and requirements of "AWMAC Manual".

.2 Requirements of this Section shall govern in case of conflict between this Section and the AWMAC Manual.

.3 Reference to custom or premium grade in this Section shall be as defined in the AWMAC Manual.

.4 Items without a grade specified shall be custom grade.

.5 Maintain a copy of the specified AWMAC Manual at the factory, readily available for duration of work.

.6 Installer shall be responsible for supplying field dimensions that will affect the work of this Section.

.7 Supply materials certified as Forestry Stewardship Council (FSC).

.8 Provide materials from a manufacturing facility within minimum distance required from Project site and delivered to Project site by acceptable transportation method.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver to site after receiving and storage areas have stable humidity and temperature conditions as recommended in AWMAC Manual.

.2 Protect architectural woodwork items against dampness during and after delivery.

.3 Store architectural woodwork items on level surfaces in ventilated areas, protected from direct sunlight and extreme changes in temperature or humidity.

1.7 COORDINATION

.1 For architectural woodwork items to be site finished, coordinate with work of Section 09 91 05 to ensure that back-priming of surfaces concealed after installation is performed prior to installation.

.2 Coordinate installation of the following items during fabrication of all millwork:

.1 Electrical conduit.
.2 Electrical junction boxes.
.3 Electrical fixtures.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.9 EXTENDED WARRANTY

.1 Provide a two year extended warranty on the work of the architectural woodwork trade, commencing on the date of completion of the Work. The terms of this extended warranty shall be the same as those provided under the terms of the AWMAC Certificate of Guarantee.

.2 The foregoing shall not be construed to mean that the architectural woodwork subcontractor or supplier must be a member of AWMAC or that an AWMAC Certificate of Guarantee must be provided.

1.10 SECURITY FOR EXTENDED WARRANTY

.1 Provide security for the performance of Contractor's obligations under the extended warranty in the form of:

.1 an AWMAC Certificate of Guarantee, or

.2 a maintenance bond in the amount of 100% of the value of the architectural woodwork subcontract and in a form acceptable to the Minister.

.2 Submit AWMAC Certificate of Guarantee or maintenance bond prior to Interim Acceptance of the Work.

1.11 INSPECTION

.1 Arrange and pay for inspection by an AWMAC appointed inspector at the plant and at the site, regardless of whether or not the architectural woodwork subcontractor or supplier is a member of AWMAC.

.2 Submit a copy of the AWMAC inspection report with the AWMAC Certificate of Guarantee or the maintenance bond.

PART 2. Products

2.1 SUSTAINABILITY

.1 Provide Recycle Content of not less than: 7.5% (Post-Consumer + ½ Pre Consumer)

.2 use only Certified Wood.

.3 Use only Low - Emitting Materials: Composite Wood and Laminates Adhesives.

2.2 LUMBER, GENERAL

.1 Materials: to AWMAC Manual, except where otherwise specified.

.1 Framing lumber: specified species, no. 1 grade, S4S.

.1 CSA O141.
.2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Hardwood lumber: meeting AWMAC [custom] [premium] grade, [edge grain] for species specified.

.1 National Hardwood Lumber Association (NHLA).
.2 AWMAC custom and premium grade where specified, moisture content as specified in the AWMAC manual.

2.3 PANEL PRODUCTS, GENERAL

.1 Provide panel products manufactured with phenol-formaldehyde or, if available, formaldehyde-free adhesive.

.2 Materials and Moisture Content: to AWMAC Manual, except where otherwise specified.

.3 Medium Density Fibreboard (MDF): to ANSI A208.2-1994, minimum density 769

.4 Tempered Hardboard: to CAN/CGSB-11.3-M87, Type 2, minimum density of 476 kg/m^3.

.5 Softwood Plywood: to applicable CSA standards referenced in AWMAC Manual, G2S.

.6 Hardwood Plywood: to CSA-O115-M1982 (R2001). Graded in accordance with the Official Grading Rules for Canadian Hardwood Plywood.

.7 Veneers:

.1 Open-grain species: minimum 0.71 mm thick.
.2 Close-grain species: minimum 0.61 mm thick.

.8 High Pressure Decorative Laminate (HPDL): to AWMAC Manual.

2.4 ACCESSORIES

.1 Glass: refer to section 08 81 00 and 08 81 05

.2 Glazing Accessories: refer to sections 08 81 00 and 08 81 05

.3 Silicone Sealant: to CAN/CGSB-19.13-M87, Shore A hardness 15-25, clear colour.

.1 Sealant: to SCAQMD Rule 1168 - Adhesives and Sealants Application.

.1 Laminated plastic adhesive:

.1 Adhesives:

.1 urea resin adhesive to CSA O112.5,
.2 contact adhesive to CAN/CGSB-71.20.
.3 resorcinol resin adhesive to CSA O112.7.
.4 polyvinyl adhesive to CSA O112.4.
.5 two component epoxy thermosetting adhesive.

.2 Maximum VOC limit SCAQMD Rule 1168, Adhesives and Sealants Applications

.3 Adhesives urea-formaldehyde free.

.4 Other Accessories: to AWMAC Manual.

2.5 CASEWORK HARDWARE

.1 Where products are specified by proprietary names, other unnamed products may be substituted in accordance with the requirements of Section 01 62 00 – Product Options and Substitutions.

.2 Hinges: to ANSI-A156.9, B01612 – concealed hinge, self closing, 120 to 125 degree of opening, full overlay type for screw attachment complete with mounting plates. Acceptable products:

.1 Model “71T558” by Blum.
.2 Model “HD1311-552” by Mepla.
.3 Model “A00P94” by Salice.

.4 Model “9956” by Hettich.

.3 Door and Drawer Pulls: back mount, 96 mm wire ‘D’ pulls, brushed finish.

.4 Drawer Slides For Drawers Up To 150 mm Deep: to ANSI-A156.9, B85051, side mount, steel construction, ¾ extension, ball bearing operation, rail disconnect system, bright zinc finish, length as required. Acceptable Products:

.1 Model “2132” by Accuride.
.2 Model “8300” by Knape & Vogt.
.3 Model “4500” by Waterloo.
.4 Model “5632” by Hettich.

.5 Drawer Slides For Drawers Deeper Than 150 mm: to ANSI-A156.9, B85051, side mount, steel construction, full extension, ball bearing operation, bright zinc finish, length as required. Acceptable Products:

.1 Model “3832” by Accuride.
.2 Model “8400” by Knape and Vogt.
.3 Model “3690” by Waterloo.
.4 Model “5632” by Hettich.

.6 Adjustable Shelving Standards: to ANSI-A156.9, B84071, steel construction, adjustable in 13 mm increments, [almond] [white] [brass] [zinc] finish. Acceptable Product:

.1 “KV-255” by Knape & Vogt.

.7 Shelf Rests: to ANSI-A156.9, B84091, steel construction, [almond] [white] [brass] [zinc] finish. Acceptable Product:

.1 “KV-256” by Knape & Vogt.

.8 Locks: Inlay or rim style deadbolt or cam lock system, nickel finished. Confirm keying required (master keyed, keyed alike in groups or keyed differently – supply keying schedule)

2.6 CASEWORK, GENERAL

.1 Fabricate casework to AWMAC grade specified in the individual casework articles in this Section.

.2 Furring, Blocking, Nailing Strips and Grounds: standard grade, to NLGA grading rules, for boards and dimension lumber.

.3 Framing: pine species.

.4 Case Bodies, Ends, Dividers, Bottoms and Doors and Exposed Backs: 19 mm unfinished thickness.

.5 Non-exposed Backs: 6 mm unfinished thickness for all base, tall and wall cabinets with hanging strips and minimum of 12 mm for wall cabinets without hanging strips.

.6 Maximum Unsupported Shelf Length: 1219 mm.

.7 Thickness of Shelves Prior to Finishing:

.1 Unsupported lengths up to 813 mm: 19 mm particle board. or 19 mm veneer core plywood.
.2 Unsupported lengths between 814 mm and 914 mm: 19 mm veneer core plywood.
.3 Unsupported lengths between 915 mm and 1066 mm: 25 mm particle board or 27 mm veneer core plywood.
.4 Unsupported lengths between 1067 mm and 1219 mm: 27 mm veneer core plywood.

.8 Fabricate drawers of box construction as follows:

.1 Perimeters: 12 mm thickness prior to finishing, solid birch or maple for clear and opaque finishes and plywood or particleboard for plastic laminate finish.

.2 Bottoms: 6 mm thickness prior to finishing, MDF or tempered hardboard, dadoed or grooved into perimeter, captured on 3 sides, screwed to back of drawer with a minimum of 4 screws.

.3 Faces: 19 mm thickness prior to finishing.

.9 Edge banding: hardwood, or plastic laminate. PVC edge banding is not acceptable.

.10 Apply panel face HPDL to overlap edges of edge banding HPDL.

.11 Mortise shelf standards fully into casework.

.12 Maximum gap between adjacent doors or drawers shall be 3 mm.

.13 When screw fastening, fasten into MDF or particle board by pre-drilling holes as required and inserting plastic or metal screw dowels to receive screw fasteners.

2.7 CASEWORK, HIGH PRESSURE DECORATIVE LAMINATE (HPDL) FINISH

.1 AWMAC Quality Grade: Custom.

.2 Construction: to AWMAC Manual for flush overlay, except as otherwise detailed on drawings.

.3 Exposed and Semi-exposed Parts:

.1 Panel Products:

.1 Core: hardwood species, shop sanded exterior grade veneer core plywood, G2S.

.2 High Pressure Decorative Laminate (HPDL):

.1 Vertical General Purpose Grade (VGS): thickness of 0.7 mm ±0.10 mm, used on the following:

.1 Vertical surfaces, unless specified otherwise.
.2 Exposed portions of case bodies, including ends, divisions and bottoms.
.3 Exposed shelves.
.4 Casework Doors: exposed and semi-exposed surfaces.
.5 Drawer Faces: exposed and semi-exposed surfaces.

.2 Liner Grade (CLS): thickness of 0.5 mm ±0.10 mm, used on the following:

.1 Semi-exposed shelves.
.2 Interior portions of case bodies.
.3 All surfaces of drawer boxes.

.3 Laminate backer grade (BKL): thickness of 0.5 mm ±0.10 mm, used on the following:

.1 Concealed surface of casework backs.
.2 Concealed surfaces, unless specified otherwise.

.4 Lumber:

.1 Species: Spruce or Pine.
.2 Grade: no. 1 .
.3 Grain: edge.

2.8 FABRICATION

.1 Details for casework shall conform to flush overlay design.

.2 Set nails and countersink screw, apply plain wood filler to indentations, sand smooth and leave ready to receive finish.

.3 Shop install cabinet hardware.

.4 Use draw bolts in countertops and casework joints.

.5 Provide hairline joints in architectural woodwork.

.6 Fabricate work for delivery to site in sizes easily handled and to ensure passage through building openings.

2.9 FACTORY FINISHING MATERIALS

.1 Factory finishing materials: Use only products included in Manufacturers' Product List of the Master Painter Institute Architectural Specification Manual, latest edition.

.2 Backprimers: white alkyd enamel primer or gloss varnish thinned 25%, compatible with exposed finish, as applicable.

.3 Do not use combination filler/stain.

.4 Sustainable Finishes

.1 Comply with SCAQMD Rule 1113- Architectural Coatings.
.2 Maximum allowable VOC limit 350 g/L.

2.10 FACTORY FINISHING

.1 Comply with applicable requirements and recommendations for factory finishing in AWMAC Manual.

.2 Refer to Architectural Woodwork Schedule at end of this Section for factory finishing requirements.

.3 Applied and cured coatings shall be uniform in thickness, sheen, colour and texture, and free of defects detrimental to appearance or performance.

.4 Backprime the following surfaces that will be concealed after installation:

.1 Surfaces in contact with concrete, masonry, floors or floor finishes.
.2 Underside of front edges of countertops and toe-spaces.

.3 Other surfaces that may be subjected to moisture during normal use or cleaning operations.

.5 Use two coats white alkyd wood primer to back prime components receiving opaque finishes.

.6 Use gloss varnish, clear urethane or clear lacquer to back prime components receiving clear finishes.

PART 3. Execution

3.1 VERIFICATION OF CONDITIONS

.1 Verify job site conditions in accordance with AWMAC Manual.

.2 Verify humidity and temperature conditions are stable and as recommended in AWMAC Manual.

.3 Do not deliver to site until job site conditions comply with the requirements outlined in the AWMAC Manual.

3.2 INSTALLATION

.1 Install items in accordance with AWMAC Manual.

.2 Position items accurately, secure and rigid.

.3 Scribe and cut as required to fit neatly to abutting walls and recesses and to projecting, intersecting or penetrating objects.

.4 Apply smallest practicable bead of silicone sealant at junction of splashbacks and adjacent wall finish.

.5 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.

.6 Back prime surfaces of cut-outs for sinks, drains and other mechanical services that will be concealed after installation.

END OF SECTION

PART 1. GENERAL

1.1 SUMMARY

.1 This Section includes the following horizontal and trim solid surface product types:

.1 Countertops with sinks
.2 Vanity tops.
.3 Kitchens.

1.2 DEFINITIONS

.1 Solid Surface: Non-porous, homogenous materials. Maintain the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

1.3 RELATED WORK

.1	Custom Metal Fabrications (counter angle iron supports)	05 50 00.
.2	Rough Carpentry (solid wood backing)	06 10 00.
.3	Architectural Millwork	06 40 00.
.4	Joint Sealants	07 92 00.
.5	Gypsum Wall Board	09 29 00.
.6	Mechanical Plumbing and Fixtures	Division 22.
.7	Electrical	Division 26.

1.4 REFERENCE STANDARDS

.1 American Society for Materials Testing (ASTM)

.1 ASTM C97 – Standard Test Method for Absorption and Bulk Specific gravity of Dimension Stone

.2 ASTM C99 - Standard Test Method for Modulus Rupture of Dimension Stone.

.3 ASTM C170 - Standard Test Method for Compressive Strength ;of Dimension Stone

.4 ASTM C217 - Standard Test Method for Weather Resistance of Slate

.5 ASTM C482 - Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste.

.6 ASTM C484 - Standard Test Method for Thermal Shock Resistance of Glazed Ceramic tile

.7 ASTM C501 - Standard Test Method for Relative resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser

.8 ASTM C880 - Standard Test Method for Flexural Strength of Dimension Stone

.9 ASTM C1028 - Standard Test Method for determining the Static Coefficient of Friction of Ceramic Tile and Other Surfaces by the Horizontal Dyanometer Pull-Meter Method.

.10 ASTM D256 - Standard Test Method for Determining the Izod Pendulum Impact Resistance of Plastics.

.11 ASTM D2047 - Standard Test Method for Static Coefficient of Polish-Coated Flooring Surfaces as Measured by the James Machine.

.12 ASTM E84 - Standard Test Method for Burning Characteristics of Building Materials.

1.5 SUBMITTALS

.1 Comply with the requirements of Section 01 33 00 – Submittal Procedures.

.2 Indicate on the shop drawings the following:

.1 Location of each item.
.2 Dimensioned plans and elevations.
.3 Large scale details.
.4 Fastening devices and types of fasteners.
.5 Other required components required for installation.

.3 Provide full size details, edge details, attachments etc.

.4 Show location and sizing of blocking or backing, including all required concealed backing and reinforcement.

.5 Clearly indicate locations and sizes of “cut outs” and holes for plumbing fixtures, faucets, soap dispensers, waste receptacles and any other items required to be installed in the solid surfacing.

.6 Provide a full product description, fabrication information and clearly indicate compliance with the performance requirements.

.7 Submit complete manufacturer’s fabrication and installation instructions.

.8 Upon completion, furnish the Owner one set of manufacturer’s recommended cleaning procedures.

.9 Provide evidence that materials have been supplied by single source

1.6 SAMPLES

.1 Comply with the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples.

.2 For each type of product indicated provide the following:

.1 A 152mm x 152mm (6" x 6") sample in the specified colour and gloss.

.2 Cut sample and seam together to indicate a typical joint detail.

.3 Approved sample shall be retained by the consultant and used as a standard for work performed on site, samples shall be of the highest quality, finishes shall be blemish free and seam shall be inconspicuous.

1.7 QUALITY ASSURANCE

.1 Installer / Shop Fabrication Qualifications:

.1 The installer shall be certified trained or otherwise approved by the solid surface manufacturer. Sub trade Certification number shall be obtained by the Contractor and provided to the owner and the Consultant prior to beginning the work of this section.

.2 Shall have a minimum of five (5) years experience in working on projects of similar size and scope and be skilled in custom fabrication installation methods, means, techniques and sequencing.

.3 Shop employees shall be skilled workers who custom fabricate products and materials similar to those specified herein and indicated on the drawings.

.4 Prepare and provide coordination drawings indicating the following:

.1 Related plumbing work

.2 Related Electrical Work

.3 Miscellaneous / Custom metal fabrications,

.1 Rough carpentry indicated on plan and elevation where solid backing is required.

.4 Confirm on site by visual inspections and taking field site measurements locations, heights, any and all other such information as may be required for satisfactory installation of the solid surfaces. Site measurements and verification of locations indicated for installation shall be performed by the Contractor and the installer prior to ordering of any materials required for the work of this section.

.5 Immediately inform the Owner and the Consultant of any and all deficiencies or conflicts noted that may adversely affect the installation of the solid surfacing,

.6 The Contractor shall immediately correct, repair or replace any such work, products or materials as well as any deficiencies affecting the installation of the solid surfacing.

.7 Do not begin the work or ordering of materials of this section until such time as the above Contractor and installer site review has been performed and the Owner and the Consultant have reviewed all submittals and have returned them to the Contractor.

1.8 DELIVERY STORAGE AND HANDLING

.1 Deliver all products in manufacturers original packaging, upon receipt of materials on site the Contractor shall ensure that no damage to the delivered materials is apparent and all items received are as listed on the packaging slips.

.2 The Contractor shall immediately report to the manufacturer, Owner and the Consultant any such material that is damaged, defective or in any way not acceptable for acceptance of delivery. Replace any such materials that are unsatisfactory.

.3 Provide a clean, dry weather tight area on site to receipt of materials and store in such a manner as to allow ease of access and logical sequencing for installation. Ambient temperature of Storage location shall be between 4 and 54 °C. Stone shall be stored vertically, in racks, bracing racks and material as required.

.4 DO NOT allow finished surfaces to rub together transport or during storage and handling on site.

.5 Handle all materials in such a manner as to prevent physical damage, provide any required protective coverings to prevent damaging the finished surfaces.

.6 Any holes or slots in the Quartz Surfacing which are capable of collecting water shall be temporarily covered or plugged to prevent freezing of collected water. Such covers or plugs are to be removed immediately prior to installation of the piece.

.7 Upon receipt at the building site, Quartz Surfacing shall remain in the factory-prepared bundles until beginning of the installation. Bundles shall be staged in an area which is least susceptible to damage from ongoing construction activity. If storage is to be prolonged, polyethylene or other suitable, no staining film shall be placed between any wood and finished surfaces of the Quartz Surfacing.

1.9 WARRANTY

.1 Provide manufacturer's warranty against defective materials.

.1 Provide Manufacturers limited Ten (10) Year Warranty guarding against product defects that become apparent subsequent to fabrication or installation.

.2 To obtain manufacturer's warranty the solid surfacing Quartz must manufactured by a certified fabricator and installed by a qualified and recognized installer as approved by the manufacturer.

1.10 MAINTENANCE

.1 Spare Parts and Maintenance Materials

.1 Comply with the requirements of Section 01 78 43 – Spare parts and Maintenance Materials

.2 Provide any and all such materials, products, information and documentation required for the proper care and maintaining of the solid surfacing. All such products and materials shall be turned over to the Owner prior to substantial performance of the work.

.3 Provide materials in sufficient quantities to allow the owners maintenance staff to care for and maintain solid surfacing quartz tops, walls or other vertical or horizontal surface for a minimum of 6 months subsequent to substantial performance of the project. Spare materials shall include:

.1 Repair or patching kits as available from the manufacturer.

.2 Spare fasteners, bolts, lagging bolts, nuts, screws, silicone, adhesives and any other such materials used for the installation of the solid surface.

.3 Cleaning solution, chemical or materials as recommended by the Manufacturer for the routine care of the Solid Surface

PART 2. PRODUCTS

2.1 Product Performance Requirements

.1 Composition: 93% crushed Quartz aggregate combined with resins and pigments. Fabricated into slabs.

.2 Thicknesses: Nominal 20mm (3/4") to 30mm (1 – ¼") as indicated on the drawings.

.3 Size: slabs shall not be less than 1.44 x 3.05m (56.5" x 120")

.4 Identification: Slabs shall clearly be labeled on the unfinished side of the slab with the batch number and manufacturers identifying mark.

.5 Flexural Strength: Shall not be less that 7, 420psi and to ASTM C880

.6 Compressive Strength: To ASTM C-170

.1 Dry: 10, 430 psi (average)
.2 Wet: 11, 265 psi (average)

.7 Izod Impact Strength: 0.361ft lbs/inch of notch average and to ASTM D256

.8 Bond Strength: 205 psi and to ASTM C482 Modified.

.9 Modulus of Rupture: 2,110 average and to ASTM C99.

.10 Mohos Hardness: 6.5 -7.5, scratch test

.11 Absorption: 0.022%v and to ASTM C97

.12 Stain and Acid Resistance: to ASTM D2299

.13 Flame Spread: Shall not be more than 10 and to ASTM E84

.14 Smoke Density: 195 or less and to AST E84

.15 Thermal Shock Resistance: To ASTM C484.16

.16 Coefficient for Thermal Expansion: To ASTM C531.

.17 Weathering Resistance: To ASTM C217, shall have no affect after a seven day period in 1% Sulfuric Acid.

.18 Freeze-Thaw Resistance: No visible damage or discoloration shall be apparent after 25 cycles at -45°C to 23°C; S.L.P with ASTM C62 as a guide.

.19 Wear Resistance: To ASTM C501 36.12g average, tested with 1 kg load , 1000 cycles at 70 r.p.m

.20 Static Coefficient of Friction:

.1 Polished Finish: 0.68 average by ASTM D2047, James Machine; 0.87 average dry and 0.54 average (wet) average by ASTM C1028, Dynamometer Pull Method.

.2 Honed Finish: 0.69 average by ASTM D2047, James machine; 0.73 average (dry) and 0.68 average (wet) by ASTM C1028, Dynamometer Pull Method

2.2 COLOUR AND FINISH

.1 Provide colours and finishes as selected by the Owner from the manufacturer's full colour range. Allow for a minimum of 3 colours.

.1 Colours

.1 Bathroom: CaesarStone, nougat Product number 6600 , Finish: honed.

.2 Kitchen: CaesarStone, white Ash, product Number 9260 Finish: honed shall have a gloss greater than or equal to 35% at 50°C

.2 Exposed Edges: radius profile.

.3 Outside corners: 7.5mm radius (all "hard" edges to be "softened")

.4 Refer to drawings for counter tops, back splashes and other related details

.5 Vanity Bowl: undermount style.

2.3 ACCESSORY MATERIALS

.1 Mounting Adhesives:

.1 Provide structural-grade silicone or epoxy adhesives of types recommended by the manufacturer for the application and conditions of use.

.2 Stone Adhesives:

.1 Provide epoxy or polyester adhesive of type recommended by the manufacturer for application and conditions of use.

.3 Provide grout and any other related fasteners as required for the solid surfacing installation.

.4 Provide clear silicone sealants as recommended by the manufacturer for the application and conditions of use.

.5 Provide anti-bacterial silicone in bathrooms, kitchen and any food preparation areas.

.6 Solvent: Provide product as recommended by the adhesive manufacturer to clean surface of the solid surface quartz

.7 Cleaning Agent: non-abrasive, soft scrub type cleaners

2.4 SHOP FABRICATION

.1 Fabricator shall have not less than five (5) years experience in fabricating architectural stone and shall have water-cooled cutting tools. Fabricator shall be an approved fabricator by the manufacturer.

.2 Observe manufacturers written instructions during shop assembly.

.3 Layout joints as indicated on the reviewed shop drawing, minimize to avoid L-shaped pieces of Quartz

.4 Inspect materials for defects prior to shop fabrication ensure that materials used throughout the project as from the same batch and shall bear labels indicating such.

.5 Cut and polish using only water cooled tools.

.6 Cut outs: shall have a 10mm minimum inside corner radius. Inside corners shall be reinforced in an acceptable manner to prevent cracking, where edges of cut out will be exposed, polish edges.

.7 Laminate layers of quartz surfacing as required to create built up edges, trim and other areas requiring additional thickness.

PART 3. EXECUTION

3.1 SITE VERIFICATION

.1 Verify all measurements, on site, prior to fabrication.

.2 Verify all substrates providing support for the quartz surfacing. Ensure they are level, plumb and square. Surfaces shall be flat to within 1/16” over 10 feet (1.6mm in 3000mm), ensure that all necessary backing and supports are in place.

.3 Review and inspect all finished surfaces and substrates for defects and damage. DO NOT install until damaged or defective work had been repaired or replaced.

3.2 PREPARATION

.1 Protect finished surfaces from scratching. Apply masking where necessary, guard against

3.3 INSTALLATION

.1 Install materials and products in strict accordance with the manufacturers written instructions and recommendation, avoid breakage.

.2 Position materials to verify that all materials and fastening devices are correctly sized, placed and prepared. Make any necessary adjustments.

.1 Use only water cooled tools for any cutting, grinding or polishing that is required for site modification

.2 Allow a 1.5 mm (1/16”) expansion gap per five feet for all counters that installed between two fixed, adjacent vertical surfaces.

.3 Provide shimming for counter tops contain sinks, slope quartz slightly to allow water to drain.

.3 Upon completion of the verification of fit by “dry-fitting’ all products materials and components, remove quartz substrates, clean and ensure supporting substrates are free and clear of all deleterious materials that will affect the satisfactory installation of the solid surface quartz substrate.

.4 Apply sufficient amounts of mounting adhesives in accordance with the adhesive manufacturer’s and the solid surface quartz manufacturer’s written instructions to provide a permanent and secure installation.

.5 ensure that solid surfacing is installed plumb, level and square, flat to within 1.6mm in 3000mm (1/16” in 10 feet)

.6 All joints between adjacent pieces of solid surface quartz shall be flush, tight fitting, level and neat. An epoxy filler or that as recommended by the manufacturers shall be installed in accordance with the manufacturer’s instructions and recommendations the color of the filler shall be matched to the countertop to provide smooth seamless appearance between joints.

.7 Securely join with stone adhesive, fill joints level with quartz surfacing. Provide sufficient and ample clamping or bracing ensuring that solid surface quartz is fixed securely in position while adhesives and fillers cure.

.8 Immediately repair or replace any damaged materials in manner satisfactory to the Owner.

3.4 PROTECTION AND CLEANING

.1 Remove bracing and clamping after adhesives and fillers have fully cured.

.2 Remove all masking and other materials used to protect solid surfacing quartz during storage and installation.

.3 Protect finished installation from damage by work of other sections.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

.1 This Section includes requirements for:

.1 A spray applied rigid cellular polyurethane thermal insulation foam product applied where indicated, so as to provide a continuous air seal.

.2 A spray applied thermal barrier over the polyurethane. Thermal barrier may or may not be required. Refer to Article 1.3.

1.2 ALTERNATIVES

.1 The Project Team shall select one of the following alternatives:

.1 Provide spray applied polyurethane foam containing integral fire inhibitors. An additional, separate thermal barrier is not required.

.2 Provide spray applied polyurethane without integral fire inhibitors. An additional, separate thermal barrier is required.

1.3 APPROVALS

.1 Whichever of the following products is used, The Project Team shall be responsible for obtaining approval for use in intended applications from authority having jurisdiction:

.1 Spray applied polyurethane foam containing integral fire inhibitors.

.2 Thermal barrier required for protection of spray applied polyurethane foam without integral fire inhibitors.

1.4 ENVIRONMENTAL REQUIREMENTS

.1 Maintain minimum ambient temperature of 5°C for minimum 24 hours before, during and 72 hours after completion of application.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, steel strapping, plastic, polystyrene, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.

.4 Ensure emptied containers are sealed and stored safely.

.5 Divert waste materials from landfill to recycling facility.

PART 2. Products

2.1 SPRAY APPLIED POLYURETHANE FOAM

.1 Spray Applied Polyurethane Foam: rigid, cellular thermal insulation with following properties when applied:

Property	Test Method	Requirement
Density	ASTM D1622-08	42 kg/m^3 max. 10 kg/m^3 min.
Compressive strength	ASTM D1621-04a	104 kPa with max. 10% deformation
Tensile Strength	ASTM D1623-03	138 kPa min.
Response to thermal and humid aging	ASTM D2126-04	12% max. volume change
Water absorption	ASTM D2842-06	5% max. by volume
Water vapour permeability	ASTM E96E96M-05	Core: max. 180 ng/(Pa.s.m^2) Skins: max. 60 ng/(Pa.s.m^2)

.2 Spray Applied Polyurethane Foam Containing Integral Fire Inhibitors: same properties as specified in 2.1.1, with following additional fire hazard classification properties when tested to CAN/ULC-S102-07 or ASTM E96E96M-05:

.1 Flame spread: max. 10.
.2 Smoke developed: max. 500.
.3 Fuel contributed: 0.

2.2 THERMAL BARRIER

.1 Thermal Barrier: spray applied fire retardant overcoat meeting applicable requirements of the Alberta Building Code for a thermal barrier over foamed plastic.

PART 3. Execution

3.1 VERIFICATION OF CONDITIONS

.1 Inspect areas to receive work of this Section and ensure conditions are suitable to begin application.

.2 Ensure that all work penetrating through air seal is complete.

.3 Ensure that appropriate back-up material has been installed in all large voids.

3.2 PROTECTION OF EXISTING WORK

.1 Protect from overspray all finish surfaces which will be exposed to view.

3.3 SUBSTRATE PREPARATION

.1 Clean substrates of dirt, dust, grease, oil, loose material and other matter which may affect bond of spray applied materials.

.2 If recommended by manufacturer, prime substrates in accordance with manufacturer's instructions.

.3 Remove oil from galvanized sheet steel substrates and apply prime coating in accordance with manufacturer's instructions.

3.4 SPRAY APPLIED POLYURETHANE FOAM APPLICATION

.1 Spray apply polyurethane foam in accordance with manufacturer's instructions. Use equipment recommended by manufacturer.

.2 Apply material as indicated and in sufficient thickness to achieve a complete air seal.

.3 Wall/decking Junctures: provide continuous gusset profiled seal, extending 150 mm vertically and horizontally from juncture. Ensure application leaves no voids.

.4 Windows & Doors: apply only enough product to form an effective air seal toward warm side of frames, do not fill entire cavity with foam. If application deforms frames, remove foam, restore frame alignment and re-apply foam.

3.5 THERMAL BARRIER APPLICATION

.1 Spray apply fire retardant overcoat to spray applied polyurethane foam surfaces, in sufficient thickness to provide a thermal barrier meeting the Alberta Building Code and requirements of authority having jurisdiction.

3.6 AIR SEAL APPLICATION SCHEDULE

.1 Provide air seal at the following:

.1 Juncture of external walls and roofs.
.2 Perimeter of windows & doors.
.3 SIP panel Joints and Terminations
.4 Other locations indicated on drawings.

END OF SECTION

PART 1. GENERAL

1.1 RELATED WORK

.1 Caulking for waterproofing:
.2 Caulking for SIPs:
.3 Caulking for flashings:
.4 Caulking for aluminum windows:
.5 Caulking for glazing windows:

1.2 SAMPLES

.1 Submit samples of each type of material and colour to be used.

.2 Cure samples under identical conditions to job site, before submission.

1.3 DELIVERY/STORAGE

.1 Receive and store materials as recommended by materials manufacturer.

.2 Maintain containers and labels in undamaged condition.

1.4 EXISTING CONDITIONS

.1 Examine substrate materials, joint voids and note temperature/humidity conditions. Report unacceptable conditions to the Owner.

.2 Commencement of work implies acceptance of conditions.

PART 2. PRODUCTS

2.1 MATERIALS

.1 Joint Cleaner: Non corrosive solvent recommended by sealant manufacturer for applicable substrate material.

.2 Primer: Non-staining type recommended by sealant manufacturer.

.3 Joint Back-Up: Extruded tubing, polyvinylchloride or butyl, 6 mm minimum thick wall, outsized 30-50%.

.4 Joint Back-Up: Round closed cell foam, extruded polyethylene or neoprene, Shore A hardness of 20, tensile strength 140 to 200 kPa, outsized 30-50%, compatible with sealant and primer, non-adhering to sealant.

.5 Joint Back-Up: Round solid rod, neoprene or butyl rubber, Shore A hardness 40.

.6 Bond breaker: Pressure sensitive polyethylene tape, not bondable to sealant.

.7 Sealant: Polysulphide base, one (1) component, to CAN/CGSB-19.13-M87, Shore A hardness 15-25.

.8 Sealant: Polysulphide base, two (2) component, to CAN/CGSB-19.24-M90 Type 2, colour, Shore A hardness 15-25.

.9 Sealant: Acrylic Base, one (1) component to CGSB CAN/CGSB-19.17-M90 emulsion base, Shore A hardness.

.10 Sealant: Silicone base, one (1) component to CAN/CGSB-19.13-M87 curing, Shore A hardness 15-25.

.11 Sealant: Silicone base, two (2) component, to CAN/CGSB-19.24-M90, Shore A hardness 15-25.

.12 Sealant: Polyurethane base, one (1) component, to CAN/CGSB-19.13-M87 type 2, Shore A hardness 20-35.

.13 Sealant: Polyurethane base, multi-component, to CAN/CGSB-19.24-M90 type 2, Shore A hardness 20-35.

.14 Sealant: Butyl-polyisobutylene base, one (1) component, to CGSB 19-GP-14M , Shore A hardness 10-20.

PART 3. EXECUTION

3.1 EXECUTION

.1 Remove dust, paint, loose mortar and all foreign matter; dry joint surfaces.

.2 Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.

.3 Remove oil, grease and other coatings from non-ferrous metals with appropriate solvent.

.4 Prepare concrete, masonry, glazed and vitreous surfaces as recommended by sealant manufacturer.

.5 Examine joint dimensions and size materials to achieve joint depth which is half the width of the joint with minimum width and depth of 5 mm, maximum width 25 mm.

.6 Install joint back-up to achieve correct joint depth.

.7 To prevent staining, mask adjacent surfaces with tape prior to priming.

.8 Apply bond breaker tape in accordance with manufacturer's directions.

.9 Prime sides of joints to manufacturer's directions immediately prior to caulking.

3.2 APPLICATION

.1 Apply sealant in accordance with manufacturer's directions, using a gun with proper size nozzle, to leave a weathertight, air tight installation. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.

.2 Form surface of sealant smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.

.3 In masonry cavity construction, vent caulked joints from cavity to 3 mm beyond external face of wall by inserting 3 mm diameter plastic tubing at bottom of each joint and maximum of 1500 mm O.C. vertically.

.4 Clean adjacent surfaces immediately and leave work neat and clean. Remove excess sealant and droppings, using recommended cleaners as work progresses. Remove masking tape after tooling of joints.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

.1 Passage Doors
.2 Bifold Doors

1.2 RELATED SECTIONS

.1	Rough Carpentry	Section 06 10 00.
.2	Finish Carpentry	Section 06 20 00.
.3	Joint Sealants	Section 07 92 00.
.4	Hardware	Section 08 70 00.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI): ANSI Z97.1: Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.

.2 National Fire Protection Association (NFPA): NFPA 252: Standard Methods of Fire Tests of Door Assemblies.

.3 Underwriters Laboratories, Inc. (UL)

.1 UL10B: Standard for Fire Tests of Door Assemblies (Note: Neutral pressure testing standard.)

.2 UL10C: Standard for Positive Pressure Fire Tests of Door Assemblies.

.4 Underwriters' Laboratories of Canada (ULC): CAN4-S104: Standard Method for Fire Tests of Door Assemblies.

.5 Uniform Building Code Standard 7-2 (UBC)

.1 UBC 7-2 (1994): Fire Tests of Door Assemblies. (Note: Neutral pressure testing standard.)

.2 UBC 7-2 (1997): Fire Tests of Door Assemblies. (Note: Positive pressure testing standard.)

1.4 SUBMITTALS

.1 Submit in accordance with the provisions of section 01 33 00 and 01 33 23.

.2 Provide manufacturer's standard catalog data for specified products.

.3 Indicate on the shop drawings the following:

.1 Location of each item.
.2 dimensioned plans and elevations.
.3 fastening devices and types of fasteners.
.4 other required components required for installation.

.4 Provide full size details, edge details, attachments etc…

.5 Show location and sizing of blocking including all required concealed backing and reinforcement.

.6 Clearly indicate locations and sizes of "cut outs" and holes.

.7 Provide a full product description, fabrication information and clearly indicate compliance with the performance requirements.

.8 Submit complete manufacturer's fabrication and installation instructions.

.9 Upon completion, furnish the Owner one set of manufacturer's recommended cleaning procedures.

.10 Provide evidence that materials have been supplied by single source.

1.5 QUALITY ASSURANCE

.1 Manufacturer shall have a Quality System in place to ensure and be able to substantiate that manufactured units conform to requirements and match the approved design.

.2 Shop employees shall be skilled workers who custom fabricate products and materials similar to those specified herein and indicated on the drawings.

.3 Shall have a minimum of five (5) years experience in working on projects of similar size and scope and be skilled in custom fabrication installation methods, means, techniques and sequencing.

.4 Confirm on site by visual inspections and taking field site measurements locations, heights, any and all other such information as may be required for satisfactory installation of the doors. Site measurements and verification of locations indicated for installation shall be performed by the Contractor and the installer prior to ordering of any materials required for the work of this section.

.5 Immediately inform the Owner and the Consultant of any and all deficiencies or conflicts noted that may adversely affect the installation of the solid surfacing,

.6 The Contractor shall immediately correct, repair or replace any such work, products or materials as well as any deficiencies affecting the installation of the doors.

.7 Do not begin the work or ordering of materials of this section until such time as the above Contractor and installer site review has been performed and the Owner and the Consultant have reviewed all submittals and have returned them to the Contractor

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver all products in manufacturers original packaging, upon receipt of materials on site the Contractor shall ensure that no damage to the delivered materials is apparent and all items received are as listed on the packaging slips.

.2 The Contractor shall immediately report to the manufacturer, Owner and the Consultant any such material that is damaged, defective or in any way not acceptable for acceptance of delivery. Replace any such materials that are unsatisfactory.

.3 Provide a clean, dry weather tight area on site to receipt of materials and store in such a manner as to allow ease of access and logical sequencing for installation.

.4 DO NOT allow finished surfaces to rub together transport or during storage and handling on site.

.5 Handle all materials in such a manner as to prevent physical damage, provide any required protective coverings to prevent damaging the finished surfaces.

1.7 WARRANTY

.1 Provide the manufacturers standard 5 year repair / replacement warranty protecting against defects in materials and workmanship.

.2 The Warranty period shall commence upon substantial Performance of the project.

PART 2. PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 CMI, 500 West Monroe Street, Suite 2010, Chicago, Illinois 60661. Toll Free (866) 382-8701. Fax (312) 382-8703. Website www.craftmasterdoors.com. E-mail info@cmicompany.com.

.2 Doors are based on CraftMaster molded interior doors Carmelle and as follows:

.1 Stiles and Rails: Finger jointed

2.2 PASSAGE DOORS AND BIFOLDING

.1 Door Design:

.1 Surface Finish: Textured

.2 Panels and Profile: Carmelle white shop primed, 6'8" height: Four-panel, eyebrow top with a bead and cove profile.

.2 Core and Frame: Core: Hollow having a thickness of not less than 35mm (1 - 3/8")

.3 Jambs: Pre-finished, three piece adjustable, 117.5mm (4-5/8") wide x 12.5mm (1/2") thick Jambs, complete with door stop trim pieces as provided by the door manufacturer.

.4 Hardware: Refer to Section 08 70 00 – Hardware.

.5 Finish:

.1 Shop Primed using a low VOC primer as recommended by the door manufacturer.

.1 Site paint door prior to installation, but, after hardware preparation is completed. Apply paint coatings in strict accordance with the manufacturers written instructions and recommendations.

.2 Spray or roll apply paints using only paints that are low in VOC's and are eco or environmentally friendly.

2.3 FASTENERS AND SEALANTS

.1 Use only finishing or Brad nails of sufficient diameter and length for the intended application.

.2 Wood filler or paintable caulk as applicable shall be used to fill all nail holes in jambs, stops and casings.

.3 Screws for bifolding doors as supplied by the door manufacturer.

PART 3. EXECUTION

3.1 EXAMINATION

.1 The Project Team, Subcontractor and Manufacturers representative shall verify all measurements, on site, prior to fabrication.

.2 Verify all substrates providing support for doors. Ensure they are level, plumb and square.

.3 Review and inspect all finished surfaces and substrates for defects and damage. DO NOT install until damaged or defective work had been repaired or replaced.

3.2 PREPARATION

.1 Prepare door in strict accordance with the manufacturers written instructions and recommendations.

.2 Drill holes on door panel to accept hardware, use templates as provided by the hardware supplier. Use only wood cutting holes saws with sufficient teeth size and spacing ensuring the door panel does not split, chip, crack or have rough edges around cut outs.

.3 Using a router, prepare door edges to accept hinges and door strikes, use only wood cutting bits, set to a depth as recommended by the door and hardware manufacturers written instructions and recommendations.

.4 Trim bottom of door jambs as required achieving the required distance between the bottom edge of the door and the finished floor, use only wood cutting tools with sufficient number and spacing of teeth to endure a clean, smooth, straight cut.

3.3 BIFOLD DOOR INSTALLATION

.1 Attach manufacturer supplied door hardware to the door.

.2 Install Jamb in the rough opening using the same procedures as those for the passage door jamb ensure that the jambs are square, level, plumb and maintain equal and uniform reveals between the rough opening and the leading edge of the jamb.

.3 Secure jamb in place through shims.

.4 Attach the manufacturer supplied jamb hardware.

.5 Securely fasten door track in the center of the finished opening by inserting screws through the pre-drilled holes.

.6 Affix jamb brackets flush to the finished floor in line with the overhead track.

.7 Install pivot pins in the pre-drilled holes at the top corner bracket and place guide wheel on the track.

.8 Lift door assembly and drop bottom pin into the bottom bracket hole.

.9 Verify door positioning and operation, adjust door and hardware as required to ensure that a smooth, non-binding, satisfactory installation has been achieved.

END OF SECTION

PART 1. GENERAL

1.1 RELATED WORK

.1 Preparation of wood door frames.
.2 Cabinet hardware.
.3 Preparation of wood doors.
.4 Connections for electrical hardware.

1.2 REFERENCE STANDARDS

.1 CAN/CGSB-69.17-M86 / ANSI/BHMA A156.2-1983, Bored and Preassembled Locks and Latches.

.2 CAN/CGSB-69.18-M90 / ANSI/BHMA A156.1-1981, Butts and Hinges.

.3 CAN/CGSB-69.19-93 / ANSI/BHMA A156.3-1989, Exit Devices.

.4 CAN/CGSB-69.20-M90 / ANSI/BHMA A156.4-1986, Door Controls (Closers).

.5 CAN/CGSB-69.21-M90 / ANSI/BHMA A156.5-1984, Auxiliary Locks and Associated products.

.6 CAN/CGSB-69.22-M90 / ANSI/BHMA A156.6-1986, Architectural Door Trim.

.7 CAN/CGSB-69.24-M90 / ANSI/BHMA A156.8-1982, Door Controls – Overhead Holders.

.8 CAN/CGSB-69.28-M90 / ANSI/BHMA A156.12-1986, Interconnected Locks and Latches.

.9 CAN/CGSB-69.29-M90 / ANSI/BHMA A156.13-1980, Mortise Locks and Latches.

.10 CAN/CGSB-69.31-M89 / ANSI/BHMA A156.15-1981, Closer/Holder Release Devices.

.11 CAN/CGSB-69.32-M90 / ANSI/BHMA A156.16-1981, Auxiliary Hardware.

.12 CAN/CGSB-69.33-M90 / ANSI/BHMA A156.17-1987, Self-closing Hinges and Pivots.

.13 CAN/CGSB-69.34-93 / ANSI/BHMA A156.18-1987, Materials and Finishes.

.14 CAN/CGSB-69.37-93 / ANSI/BHMA A156.21-1989, Thresholds.

1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

.1 Supply following products for installation under other Sections:

.1 Cylinders for aluminum doors,

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 The following applies to hardware where reuse of existing doors is specified.

.1 Only lock and latch sets and exit devices that fit existing cut-outs are acceptable for use.

.2 Only closers that cover existing fastener holes or match up to existing thru-bolt penetrations are acceptable for use.

1.5 PRODUCT DATA

.1 Comply with requirements of Division 01.

.2 Hardware Schedule: Submit a detailed hardware schedule indicating the following:

.1 Door and frame types, sizes, door swings.

.2 Type, style, function, size and finish of each hardware item.

.3 Mounting heights, fastenings and other pertinent information.

.4 Name and manufacturer of each item.

.5 Location of all hardware items cross-referenced to door numbers indicated on floor plans and in door and frame schedule.

.6 Explanation of all abbreviations, symbols and codes contained in schedule.

.3 Keying Schedule: Submit a separate detailed schedule clearly indicating how Owner's instructions on keying requirements have been fulfilled.

1.6 OPERATION AND MAINTENANCE DATA

.1 Provide the following:

.1 One copy of manufacturer's key bitting list. Forward by hand, together with keys.
.2 Manufacturer's maintenance instructions.
.3 Complete parts lists.
.4 Manufacturer's installation and operation instructions for all operable hardware.

1.7 SOURCE OF SUPPLY

.1 Use one manufacturer's products only for all similar items

1.8 PACKING AND SHIPPING

.1 Include, with each item of hardware the following:

.1 Screws, bolts and fastenings necessary for installation.
.2 Installation instructions.
.3 Special tools required for installation.

.2 Deliver finish hardware with all items in individual packages, legibly marked and adequately labelled indicating the part of the work for which it is intended.

1.9 STORAGE AND PROTECTION

.1 Provide secure storage on site with adequate shelving and bin space to properly receive and stock hardware prior to installation.

.2 Protect knobs, handles, push plates and pulls with adhesive release paper, of type that is easily removed without marring finish.

1.10 SEQUENCING AND SCHEDULING

.1 Deliver hardware required for shop application in ample time so as not to impede the progress of the Work.

1.11 SPARE PARTS AND MAINTENANCE MATERIALS

.1 Comply with requirements of Division 01.

.2 Provide two sets of wrenches for door closers, lock and latch sets and exit devices.

.3 Spare Hardware: Supply following additional quantities of hardware items:

.1	Hinges:	2 pairs of each different type.
.2	Closers:	2 of each different type.
.3	Lock/Latch Sets:	2 of each different function..
.4	Push/Pull Devices:	2 of each different type or size.

PART 2. PRODUCTS

2.1 LOCKS AND LATCHES

.1 Bored And Preassembled Locks And Latches: to CAN/CGSB-69.17, series 4000 bored lock, grades 1 and 2 as applicable, designed for function, grade and keyed as stated in hardware schedule.

.2 Lever handle: plain design.

.3 Escutcheons: round

.4 Normal strikes: box type, lip projection not beyond jamb.

.5 Cylinders: key into keying system as directed.

.6 Finish: Brushed nickel

.7 Product Manufacturers: one of the following, at The Project Teams' option.

.1 Yale
.2 Corbin Russwin
.3 Sargent

2.2 DOOR HANGING DEVICES:

.1 Butts And Hinges: to CAN/CGSB-69.18, designated by letter A and numeral identifiers listed in standard, followed by size and finish, specified in Hardware Schedule.

.2 Self-Closing Hinges And Pivots: to CAN/CGSB-69.33,

2.3 AUXILIARY LOCKS AND ASSOCIATED PRODUCTS

.1 Products shall be to CAN/CGSB-69.21, Brushe Nickel finish.

.1 Latch bolt and Dead bolt, finished to match door hardware. Key into keying system as directed.

.2 Cylinders: types as required to accommodate lockset, exit device or bolt. Key into keying system as directed.

2.4 ARCHITECTURAL DOOR TRIM

.1 Products shall be to CAN/CGSB-69.22, Brushed Nickel finish, to match door hardware

2.5 AUXILIARY HARDWARE

.1 Products shall be to CAN/CGSB-69.32, brushed nickel finish.

2.6 WEATHERSTRIPPING AND DOOR SEALS

.1 Head and Jamb Seal:

.1 Extruded aluminum frame and nylon brush pile insert, clear anodized finish.
.2 Adhesive backed neoprene material.

.2 Door Bottom Seal:

.1 Extruded aluminum frame and nylon brush sweep, clear anodized finish.

2.7 MISCELLANEOUS HARDWARE

.1 Thresholds: to CAN/CGSB-69.37, to suit the width x full width of door opening, extruded aluminum mill] finish, serrated surface, with thermal break of rigid PVC, with lip and vinyl door seal insert.

2.8 FASTENINGS

.1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.2 Match exposed fastening devices to finish of hardware.

.3 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.4 Use fasteners compatible with material through which they pass.

.5 Use six nuts and bolts for doors without special reinforcing for closers.

2.9 KEYING

.1 Locks shall be keyed alike in groups and construction masterkeyed.

.2 Key two or more doors to the same room alike.

.3 Determine detailed requirements for master keying system upon consultation with the Owner, prior to finalizing keying schedule.

.4 Form keys from nickel silver

.5 Provide two change keys for each lock except where otherwise required. Provide all other keys as required to meet keying system requirements.

PART 3. EXECUTION

3.1 INSTALLATION

.1 Provide door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Install all hardware items to manufacturer's instructions and recommendations.

.3 Where hardware items are required to be installed onto or into surfaces that are to be later painted or finished, install hardware completely to ensure proper fit, remove and store until finishing is complete, and then re-install.

.4 Drill and countersink units which are pre-prepared for anchorage of fasteners. Space fasteners and anchors to manufacturer's recommendations. Use only fasteners supplied by hardware manufacturers

.5 Install hardware to heights and centers as indicated in hardware schedule.

.6 Protect doors and frames from damage due to installation of hardware.

3.2 HARDWARE SCHEDULE

.1 Hardware Group No. 1:

6 Hinges, A5111, NRP, 114 x 101 mm, 630
1 Deadlock, E0151, GMK, 630
2 Flush bolts, L04081, 626
1 Dustproof strike, L07021, 626
2 Pulls with plates, J405, (size)
2 Push plates, J301, (size)
2 Closers, C02011, hinge side mounting
1 Threshold, length to match opening width.
2 Door bottom seals, surface mount.

.2 Hardware Group No. 2:

3 Hinges, A8111, 114 x 101 mm, 646
1 Bored classroom lockset, function F84, MK and KD, 626
1 Wall stop, L0201, 619
1 Kickplates, 203 mm high, door width less 38 mm, 630

.3 Hardware Group No. 3:

3 Hinges, A8111, 114 x 101 mm, 646
1 Preassembled classroom lockset, function F42, MK and KD, 626
1 Floor stop, L02141, 619
1 Kickplates, 203 mm high, door width less 38 mm, 630

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 This Section specifies:

.1 General requirements common to site installed glass and glazing work.
.2 Glass and glazing products.

.2 Read this Section in conjunction with other Sections which specify glass installation in specific components.

.3 This Section is intended to be used as a reference Section; it is not a "section of work". Refer to other Sections for application of requirements specified herein.

1.2 RELATED WORK

.1	Glazing:	Section 08 81 05.
.2	Mirror Glass:	Section 08 83 13.

1.3 SUBMITTALS

.1 Comply with requirements of Division 01.

.2 Samples: Submit 300 mm x 300 mm sized samples of each type of glass, clearly labelled with manufacturer's name and glass type. Reference glass types to those scheduled and specified herein.

.3 Stress Analysis: Prepare a stress analysis on all tinted heat/absorbing glass and light and heat reflecting glass. Submit prior to ordering glass.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Suitably protect glass products to prevent damage from weather and breakage. Individually wrap accessory materials to protect them from damage.

.2 Store glass vertically, off the ground, on "A" frames, braced or blocked to prevent racking, twisting, or sagging.

.3 Take special care to protect edges of insulating glass units from damage but do not apply tape or other materials to edges.

.4 Protect glass products from exposure to moisture or condensation prior to installation.

1.5 CERTIFICATIONS

.1 Insulating glass units shall be certified by the Insulated Glass Manufacturers Alliance (IGMA)

PART 2. PRODUCTS

2.1 CLEAR FLOAT GLASS

.1 Product: to CAN/CGSB-12.3-M91, glazing quality.

2.2 TINTED/HEAT ABSORBING GLASS

.1 Product: to CAN/CGSB-12.4-M91 and as follows:

.1 Glass Quality: Float glass, glazing quality.

.2 Type:

.1 Single Pane Applications: Type 1.

.2 Insulating Glass Applications: Type 2.

.3 Class: B - Heat strengthened.

.4 Tint Colour: as selected by the Project Team

.5 Style: 2 - Medium, 41 to 55%, light transmittance.

.6 Grade: B - Medium, 0.61 to 0.75, shading coefficient.

2.3 LIGHT AND HEAT REFLECTING GLASS

.1 Product: to CAN/CGSB-12.10-M76 and as follows:

.1 Glass Quality: Float glass, glazing quality.

2.4 CLEAR TEMPERED SAFETY GLASS

.1 Product: to CAN/CGSB-12.1-M90 and as follows:

.1 Type: Tempered.

.2 Class: B - Float Glass.

2.5 LOW EMISSIVITY (LOW E) GLASS

.1 Where so indicated in the Insulating Glass Schedule or elsewhere in the Contract Documents, provide primary glass products with a low emissivity coating as follows:

.2 Type of Metallic Coating: Soft, sputtered

2.6 INSULATING GLASS UNITS

.1 Provide sealed insulating glass units in accordance with CAN/CGSB-12.8-M90, in configurations indicated in Insulating Glass Schedule, and as specified herein.

.2 Manufacture sealed insulating glass units without edge channels or tape, that is, with bare glass edges.

.3 Use two stage seal method of manufacture, as follows:

.4 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator, super spacer bar or TDSE Intercept.

.5 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.

.6 Spacer/separator to provide continuous vapour barrier between interior of sealed unit and secondary seal.

.7 Sealants for Insulating Glass Units:

.1 Butyl-polyisobutylene Sealants: one component, polymer base, solvent curing, to CGSB 19-GP-14M, colour to match frame colour.

.2 Polysulphide Base and Polyurethane Base Sealants: to CAN/CGSB-19.24-M90, multi-component, chemical curing, and as follows:

.1 Type: 2 - non-sag.
.2 Class: A - glazing.
.3 Movement Capability: plus and minus 25%.
.4 Colour: Clear.

.3 Silicone Base Sealants: to CAN/CGSB-19.13-M87, one component, elastomeric, chemical curing, and as follows:

.1 Rheological Properties: Class 2 - non-sag.
.2 Substrate Class: G - Glass.
.3 Glazing Suitability: Class A - resists ultraviolet through glass.
.4 Temperature Class: L - low temperature
.5 Movement Class: 40.

.4 Do not use polyurethane sealants for insulating glass units having laminated glass with a polyvinyl butyrate interlayer.

2.7 GLAZING ACCESSORIES

.1 Setting Blocks: neoprene, 80 durometer hardness, 100 mm long x 6 mm thick x width required to support full glass thickness for single glazing and full thickness of thermal units.

.2 Spacer Shims: neoprene, 80 durometer hardness, 75 mm long x minimum 6 mm thick. Do not use metal, plastic, or wood shims.

.3 Glazing Splines and Gaskets: manufacturer's standard dry neoprene glazing splines and gaskets. Provide keyed type for fixed glazing stops and keyed or roll-in type for removable glazing retaining devices. Except where otherwise specified, colour shall match frame colour.

.4 Glazing Tape: preformed butyl tape, 10 - 15 durometer hardness, with integral neoprene shim, 80 durometer hardness, paper release, black colour, width and thickness to suit application

PART 3. EXECUTION

3.1 GLAZING GENERAL REQUIREMENTS

.1 Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying tapes, splines or gaskets. Use solvents and cleaning agents recommended by manufacturer of sealing materials.

.2 Install glazing tapes, splines and gaskets uniformly with accurately formed corners and bevels. Ensure that proper contact is made with glass and rabbet interfaces.

.3 Continuously and uniformly compress length of dry glazing splines and gaskets 38-50 mm per 1200 mm during installation.

.4 Set glass on setting blocks, spaced as recommended by glass manufacturer. Provide at least one setting block at quarter points from each corner.

.5 Centre glass in glazing rabbet to maintain required clearances at perimeter on all four sides.

.6 Use spacers and shims in accordance with glass manufacturer's recommendations.

3.2 CLEANING

.1 Remove dirt, scum, plaster, paint spatter and other harmful or deleterious matter from glass promptly and completely, before they establish tight adhesion.

.2 Use clean water or proprietary glass cleaning solutions that will not damage glass surfaces. Avoid using abrasives, steel wool, razor blades, solvents, alkaline or other harsh cleaning agents.

3.3 PROTECTION

.1 Identify glazed openings immediately following glass installation, using liquid shoe wax in a sponge topped bottle or similar easy-to-remove product.

.2 Protect glass against scratches, pitting and other surface damage.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 Read this Section in conjunction with:

.1 Glass and Glazing General Requirements: Section 08 81 00.

1.2 RELATED SECTIONS

.1 Joint Sealants: Section 07 92 00.
.2 Mirror Glass: Section 08 83 13.

PART 2. PRODUCTS

2.1 GLASS PRODUCTS

.1 Glass, Glazing and Sealing Compounds, and Glazing Accessories: as specified in Section 08 81 00.

PART 3. EXECUTION

3.1 GLAZING

.1 Glaze components required to be glazed under the work of this Section in accordance with general requirements for glazing specified in Section 08 81 00 and detailed requirements specified herein.

.2 Glaze interior and exterior hollow metal doors as follows:

.1 Apply butyl tape to fixed stop, back 2 mm from sight line.

.2 Remove release tape and press glass into place.

.3 Apply butyl tape to removable stop, remove release tape and secure stops in place.

.4 Ensure adequate thicknesses of glazing tape to secure glass in place and prevent glass from rattling.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

.1 This section includes requirements for supply and installation of wall mounted, unframed, fully silvered glass mirror units.

1.2 RELATED SECTIONS

.1 Glass and Glazing General Requirements: Section 08 81 00.
.2 Glazing: Section 08 81 05.

1.3 REFERENCE DOCUMENTS

.1 Canadian General Standards Board (CGSB), CAN/CGSB 12.3 M91, Flat, Clear Float Glass.

.2 Canadian General Standards Board (CGSB), CAN/CGSB 12.1 M90, Tempered or Laminated Safety Glass.

.3 Canadian General Standards Board (CGSB), CAN/CGSB 12.5 M86, Mirrors, Silvered.

.4 Environmental Choice Program (ECP), CCD 045 95, Sealants and Caulking.

1.4 SUBMITTALS

.1 Comply with requirements of Section 08 81 00 – Glass and Glazing General Requirements

1.5 DELIVERY, STORAGE AND HANDLING

.1 Comply with requirements of Section 08 81 00.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Comply with Section 01 74 19 - Waste Management and Disposal.

PART 2. PRODUCTS

2.1 MIRROR GLASS

.1 Mirrors, Silvered: to CAN/CGSB-12.5-M86 and as follows:

.2 Type: 3A - Float glass, tempered

.3 Edges: Beveled edge of 15 mm width. Seal edges to prevent chemical or atmospheric penetration of backing.

2.2 INSTALLATION MATERIALS

.1 Mirror Mastic: Adhesive setting compound produced specifically for setting of mirrors by spot application, compatible with glass coating and as recommended by mirror manufacturer.

PART 3. EXECUTION

3.1 INSTALLATION

.1 Wall Mounted Mirror Installation, Generally:

.1 Install mirrors in accordance with mirror manufacturer's instructions.

.2 Mount mirrors in-place to avoid distorting reflected images.

.2 Mastic Installation:

.1 Inspect surface over which mirror is to be mounted. Comply with mastic manufacturer's installation directions for preparation of mounting surface including coating with mastic manufacturer's special bond coating where applicable.

.2 Apply mastic in spots to comply with mastic manufacturers directions for coverage and to allow air circulation between back of mirror and mounting surface.

.3 Hardware Installation:

.1 Provide permanent means of structural support at bottom edge of mirror.

.2 Attach mirror hardware securely to mounting surface with mechanical fasteners with anchors or inserts.

.3 Place a felt or plastic pad between mirror and metal or plastic clips to prevent spalling of mirror edges.

.4 Mirror Installation:

.1 After mastic is applied, align mirror and press into place while at the same time maintaining a minimum air space of 4 mm for air circulation between back of mirror and mounting surface.

.2 Install clips along top of mirror during mastic curing period.

3.2 CLEANING

.1 Wash mirrors using water or glass cleaners free from substances capable of damaging mirror edges or backing.

3.3 PROTECTION

.1 Protect mirror glass from breakage and contaminating substances resulting from construction operations.

.2 Do not permit edges of mirror to be exposed to standing water.

.3 Maintain environmental conditions which will prevent mirror from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION

PART 1. GENERAL

1.1 RELATED WORK

.1	Rough Carpentry:	Section 06 10 00.
.2	Fibrous batt insulation:	Section 07 21 16.
.3	Firestopping:	Section 07 84 00.
.4	Ceramic Tile	Section 09 30 13.
.5	Air/vapour seals at electrical boxes	Section 26 05 33.

1.2 REFERENCE DOCUMENTS

.1 ASTM C645-00, Standard Specification for Nonstructural Steel Framing Members**.**

.2 ASTM C754-00, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

.3 ASTM C840-01, Standard Specification for Application and Finishing of Gypsum Board. (Provide copy on site.)

.4 ASTM C1047-99, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.5 ASTM C1278/C1278M-01 Standard Specification for Fibre-Reinforced Gypsum Panel

.6 ASTM C1280-99, Standard Specification for Application of Gypsum Sheathing. (Provide copy on site.)

.7 ASTM C1288-99, Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets.

.8 ASTM C1396/C1396M-01, Standard Specification for Gypsum Board.

.9 CAN/CGSB-51.34-M86, Vapor Barrier, Polyethylene Sheet for Use in Building Construction.

.10 CAN/ULC-S101-1989, Fire Endurance Tests of Building Construction and Materials.

1.3 SUBMITTALS

.1 Comply with requirements of Division 01.

.2 Submit duplicate 300 mm x 300 mm samples of vinyl faced gypsum board.

PART 2. PRODUCTS

2.1 GYPSUM BOARD

.1 Gypsum board products shall meet or exceed requirements of ASTM C 1396M unless specified otherwise.

.1 Gypsum board products shall be 1220 mm wide x maximum practical length for application, unless specified otherwise .

.2 Type "X" board and other board specified with Type "X" core shall be labeled in accordance with a certification program accredited by the Standards Council of Canada

.2 Standard Gypsum Board: ends square cut, tapered and beveled edges.

.3 Type "X" Gypsum Board: ends square cut, tapered and beveled edges.

.4 Water Resistant Gypsum Board: standard core or Type X core, ends square tapered and beveled edges.

.5 Gypsum Sheathing: moisture resistant type with[treated, maximum available size in place, ends and edges square cut.

2.2 FRAMING MEMBERS

.1 Studs, Base and Top Plates: Refer to Section 06 10 00 – Rough carpentry

.2 Furring: As required to accommodate plumbing and electrical fixtures, applicance, conduit, piping and duck work.

2.3 ACCESSORIES

.1 Accessories shall meet or exceed requirements of ASTM C1047 unless otherwise required for conformance to fire-rated assemblies.

.2 Screws: to ASTM C1002-00, and modified as required for fastening to 1.22 mm and thicker steel studs.

.3 Nails: to CAN/CSA B111-1974 (R1998), annular ring type, galvanized.

.4 Adhesive for bonding gypsum board or panels to wood framing: to ASTM C557-99, waterproof, organic type, gun applied.

.5 Adhesive for laminating gypsum board or panel to gypsum board or panel: as recommended by gypsum board or panel manufacturer, as applicable.

.6 Corner Beads: galvanized sheet steel to ASTM A653M-96, Z180 zinc coating, beaded angle, knurled and perforated, [32 mm wide flanges, for joint compound filling] [metal and paper flange combination, beaded angle, for installation with joint compound].

.7 Casing Beads: galvanized sheet steel to ASTM A653M-96, Z180 zinc coating, beaded edge, knurled and perforated flange 32 mm wide, for joint compound filling.

.8 Control Joints: pre-formed galvanized metal or plastic "V" type, perforated flanges.

.9 Joint treatment material, joint tape and topping compound: to ASTM C475-94.

.10 Joint tape for cementitious wallboard: coated glass fibre tape, 50 mm wide.

2.4 ACOUSTIC TREATMENT MATERIALS

.1 Acoustic Sealant: non-hardening, non-skinning, permanently flexible, to CAN/CGSB-19.21-M87.

.2 Acoustic Insulation: to ASTM C665-98, Type I, non-combustible, mineral fibre
Or Type II, class C, fibrous glass, unfaced batts, friction fit, thickness as indicated on drawings.

PART 3. EXECUTION

3.1 INSTALLATION, GENERALLY

.1 Meet or exceed the requirements of ASTM C840 for gypsum board and ASTM C1280 for gypsum sheathing.

.2 Materials and installation of fire-rated assemblies shall conform to assemblies that have achieved the specified rating when tested to CAN/ULC-S101.

3.2 INSTALLATION OF METAL FRAMING

.1 Meet or exceed the requirements of ASTM C754.

.2 Provide double studs at partition openings, door and interior window jambs.

.3 Provide concealed bracing as required to construct rigid installation. Provide bracing to building structure for partitions extended above ceilings.

.4 Screw attach studs to top and bottom plates of partitions less than ceiling height.

.5 Install a minimum of 38mm x152mm wood blocking for all, heavy trim, washroom accessories, wall cabinets and similar construction. Position blocking to face gypsum board or panel, screw to studs with two screws per connection.

.6 Frame openings for firestopping and around structural components, cabinets, access panels, and other built-in equipment, on four sides. Extend framing into recesses. Check clearances with respective equipment suppliers.

3.3 FURRING

.1 Furr to form bulkheads between ceilings at different levels. Furr for beams, columns, pipes, and around exposed services, except as otherwise indicated.

.2 Frame perimeter of openings to support access panels, light fixtures, diffusers, grilles and similar components.

3.4 ACOUSTIC TREATMENT

.1 Install acoustic insulation between studs in acoustically rated partitions.

.2 Ensure acoustic insulation fills spaces between studs, full height of walls, and is continuous over door frames and around openings and corners.

.3 Ensure insulation is packed around cut openings in board and panels, behind outlet boxes, around plumbing, heating or structural items passing through the system and at abutting walls.

.4 Unless indicated otherwise on drawings, apply 15 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to acoustically seal gypsum board and panel junction with abutting fixed building components. Seal full perimeter of cutouts around electrical boxes, ducts, piping, etc.

.5 Apply sealant in accordance with manufacturer's directions.

.6 Apply two, 10 mm diameter beads of acoustic sealant 50mm wide x 10mm thick compressible closed cell foam tape between stud framing and fixed building components, around periphery of acoustically rated partitions.

3.5 APPLICATION OF BOARDS AND PANELS

.1 Do not apply gypsum board and panels until framing, blocking, mechanical and electrical work have been inspected and approved by Minister.

.2 Erect gypsum board and panels [and cementitious panels] vertically for walls unless horizontal application results in fewer end joints. Locate end joints over framing members.

.3 Cut holes for penetrating items to minimize gaps between items and board and panels.

.4 Keep end joints away from prominent locations and central portions of ceilings.

.5 Locate vertical joints at least 300 mm from jamb lines of doors, windows and other openings.

.6 Erect ceiling gypsum board and panels with long dimensions perpendicular to framing members.

.7 Install cementitious wallboard in accordance with ASTM C840, similar to water resistant gypsum board, and to manufacturer's recommendations.

3.6 INSTALLATION OF ACCESSORIES

.1 Provide control joints as follows:

.1 where indicated.
.2 at changes in substrate construction.
.3 at wall juncture with suspended ceilings.
.4 over control joints in substrate construction.
.5 at approximate 9 m spacing on long corridor runs.
.6 at maximum 7.5 m spacing in each direction on ceilings.

.2 Install expansion joints at all building expansion joints.

.3 Erect beads and joints straight and rigid. Use full length pieces only. Mitre and fit corners accurately.

.4 Install corner beads at external angles. Secure to substrate.

.5 Install casing beads where gypsum board materials terminate against surface having no trim concealing the junction and where indicated on drawings.

3.7 TAPING AND FINISHING

.1 Meet or exceed requirements of ASTM C 840.

.2 Provide the finish level, specified in ASTM C 840, for the following surfaces:

.1 Level 1: plenum areas above ceilings and other concealed areas.
.2 Level 2: surfaces that are to receive ceramic tile.
.3 Level 3: surfaces that are to receive heavy spray or trowel applied finishes.
.4 Level 4: surfaces to receive wallcoverings, flat paints or light textures.

.3 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and topping compound.

.4 Apply joint system according to manufacturer's directions. Feather out onto board and panel faces.

.5 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of topping compound feathered out 300 mm onto board and panel faces.

.6 Fill each screw and nail head depression individually with joint and topping compounds to bring flush with adjacent surfaces of gypsum board and panels so as to be invisible after painting is completed.

.7 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surfaces of boards and panels.

.8 Use minimum #120 grit sandpaper for first and second sandings. Use minimum #150 grit sandpaper for final sanding.

.9 Completed installation shall be smooth, level or plumb, free from waves and other defects, ready for painting.

3.8 SKIM COATING

.1 Provide finish level 5 as specified in ASTM C 840.

.2 Mix joint compound slightly thinner than for joint taping.

.3 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations and tool marks.

.4 Allow skim coat to dry completely.

.5 Remove ridges by light sanding or wiping with damp cloth.

3.9 CUTTING AND PATCHING

.1 Do all cutting, patching and making good as required to provide a satisfactory finish.

.2 When prime coat has become sufficiently dry, examine surfaces for any final patching that may be required. Use colour tinted patching compound for later visual examination

END OF SECTION

PART 1. GENERAL

1.1 RELATED WORK

.1 Caulking and sealing.
.2 Gypsum board.
.3 Washroom accessories.

1.2 REFERENCE STANDARDS

.1 **American National Standards Institute (ANSI):**

.1 ANSI A 108.1A, 1999 - Specifications for Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar.

.2 ANSI A 108.1B, 1999 - Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.

.3 ANSI A 108.1C, 1999 - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar -or- Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.

.4 ANSI A 108.4, 1999 - Specifications for Ceramic Tile Installed with Organic Adhesives or Water-Cleanable Tile Setting Epoxy Adhesive.

.5 ANSI A 108.5, 1999 - Specifications for Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.

.6 ANSI A 108.6, 1999 - Specifications for Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile-Setting and -Grouting Epoxy.

.7 ANSI A 108.8, 1999 - Specifications for Ceramic Tile Installed with Chemical-Resistant Furan Mortar and Grout.

.8 ANSI A 108.9, 1999 - Specifications for Ceramic Tile Installed with Modified Epoxy Emulsion Mortar/Grout.

.9 ANSI A 108.10, 1999 - Specifications for Installation of Grout in Tilework.

.10 ANSI A 118.1, 1999 - Standard Specification for Dry-Set Portland Cement Mortar.

.11 ANSI A 118.3, 1999 - Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive.

.12 ANSI A 118.4, 1999 - Latex-Portland Cement Mortar.

.13 ANSI A 118.5, 1999 - Chemical-Resistant Furan Mortar and Grout.

.14 ANSI A 118.6, 1999 - Standard Ceramic Tile Grouts.

.15 ANSI A 118.7, 1999 - Polymer Modified Cement Grouts

.16 ANSI A 118.8, 1999 - Modified Epoxy Emulsion Mortar/Grout.

.17 ANSI A 118.9, 1999 - Test Methods and Specifications for Cementitious Backer Units

.18 ANSI A 118.10, 1999 - Load bearing, Bonded, Waterproof Membranes for Thinset Ceramic Tile and Dimensional Stone.

.19 ANSI A 118.11, 1999 - Exterior Grade Plywood (EGP) Latex-Portland Cement Mortar.

.20 ANSI A 136.1, 1999 - Organic Adhesives for Installation of Ceramic Tile.

.21 ANSI A 137.1, 1988 - Specifications for Ceramic Tile.

.2 **American Society For Testing Materials (ASTM):**

.1 ASTM C 50 - Standard Specification for Portland Cement.

.2 ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 1999.

.3 ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

.4 ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.

.5 ASTM C 241 - Test Method For Abrasion Resistance of Stone Subjected to Foot Traffic.

.6 ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 1997.

.7 ASMT C 503 - Specification for Marble Building Stone (Exterior).

.8 ASTM C 615 - Specification for Granite Dimension Stone.

.9 ASTM C 629 - Specification for Slate Dimension Stone.

.10 ASTM D 751 - Standard Test Methods for Coated Fabrics; 1998.

.11 ASTM C 847 - Standard Specification for Metal Lath.

.12 ASTM C 905 - Standard Test Methods for Apparent Density of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing; 1996.

.13 ASTM C 1028 - Test method for Determining the Static Coefficient of Friction or Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull meter Method.

.14 ASTM C 1353 - Standard Test Method Using the Taber Abrader for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic; 1998.

.15 ASTM D 2240 - Standard Test Method for Rubber Property--Durometer Hardness; 1997.

.16 ASTM D 4397 - Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications. ASTM C 627 - Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester; 1993.

.17 ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials; 1995.

.18 ASTM E 413 - Classification for Rating Sound Insulation; 1987 (Reapproved 1999).

.19 ASTM E 492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine; 1990 (Reapproved 1996).

.3 **Canadian General Standards Board (CGSB):**

.1 Tile, Ceramic

.4 **Terrazzo, Tile and Marble Association of Canada (TTMAC)**

.1 Specification Guide 09300 Tile Installation Manual.

.5 **Tile Council of North America (TCNA)**

.1 Handbook for Ceramic Tile Installation.

1.3 PERFORMANCE REQUIREMETNS

.1 Static Coefficient of Friction: Tile on walkway surfaces shall be provided with the following values as determined by testing in conformance with ASTM C 1028.

.1 Level Surfaces: Minimum of 0.6 (Wet).
.2 Step Treads: Minimum of 0.6 (Wet).
.3 Ramp Surfaces: Minimum of 0.8 (Wet).

1.4 QUALITY STANDARD

.1 Do tile work in accordance with Installation Manual 200, "Ceramic Tile", produced by Terrazzo Tile and Marble Association of Canada TTMAC, except where specified otherwise.

1.5 SHOP DRAWINGS

.1 Submit shop drawings of ceramic tile work in accordance with Division 01.

.2 Clearly show layout, pattern and relationship of tile joints to washroom and other fixed accessories and project-formed details.

1.6 DELIVERY, STORAGE AND HANDLING OF MATERIALS

.1 Deliver packaged materials in original unopened containers.

.2 Keep delivered material dry and free from stains. Store cementitious material off damp surfaces.

.3 Deliver and store products in manufacturer's unopened packaging until ready for installation.

.4 Protect adhesives and liquid additives from freezing or overheating in accordance with manufacturer's instructions.

.5 Store tile and setting materials on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Do not install adhesives in an unventilated environment.

.2 Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during tiling and for a minimum of 7 days after completion.

PART 2. PRODUCTS

2.1 MATERIALS

.1 General: Provide tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated. Provide tile in the locations and of the types colors and pattern indicated on the Drawings. Tile shall also be provided in accordance with the following:

.1 Factory Blending: For tile exhibiting color variations within the ranges selected under Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.

.2 Mounting: For factory mounted tile, provide back or edge mounted tile assemblies as standard with the manufacturer, unless otherwise specified.

.3 Factory Applied Temporary Protective Coatings: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.

.4 Glazed Porcelain Floor Tile:

.1 Product: Harmony by Ames tile, Product No. HARM1224
.2 Product Name: Midnight
.3 Moisture Absorption: Less than .5 percent to less than 20 percent.
.4 Frost Resistant: Yes
.5 Size and Shape: 12 inches x 24 inches nominal.
.6 Surface Finish: Honed.
.7 Colour: Charcoal.
.8 Location: Flooring throughout.

.5 Glazed Porcelain Mosaic Wall Tile:

.1 Product: Desert Glow Series by Ames Tile, Product No.DGS16.
.2 Product Name: Smoke.
.3 Moisture Absorption: Less than .5 percent to less than 20 percent.
.4 Frost Resistant: Yes
.5 Size and Shape: 1” x 6” nominal on a 12” x 12” mesh sheet
.6 Surface Finish: Honed.
.7 Colour: Charcoal.
.8 Location: Bathroom walls

.6 Accent Wall Tile:

.1 Product: Pebbles Beach & river Rock Series by Julian Tile
.2 Product Name: Beach Bali Black.
.3 Moisture Absorption: Less than .5 percent to less than 20 percent.
.4 Frost Resistant: No
.5 Size and Shape: Various sizes on a 12” x 12” mesh sheet
.6 Surface Finish: natural, Honed.
.7 Colour: Black
.8 Location: Bathroom & Kitchen walls

.7 Cement: grey to CAN/CSA-A5-93.

.8 Sand: to CSA A82.5-M1978.

.9 Water: potable.

.10 Dry-Set Mortar: to ANSI A118.1-1992.

.11 Adhesive: to CGSB 71-GP-22M Type 2.

.12 Hydrated Lime: to ASTM C207-91 Type S.

.13 Metal Lath: to ASTM C847-95, galvanized finish.

.14 Grout:

.1 Epoxy Grout: High performance grout for use with ceramic, Porcelain, glass and stone tile for residential or commercial applications.

.1 Water cleanability: Up to 80 minutes.
.2 Initial set: 2 hours.
.3 Service strength: 24 hours.
.4 Shrinkage: 0.25 percent.
.5 Quarry/quarry bond strength: 1,000 psi (6.9 MPa) - Failure at tile.
.6 Compressive strength 3,500 psi (24 MPa) - 7 days.
.7 Tensile strength 1,100 psi (7.6 MPa) - 7 days.
.8 Thermal shock 510 psi (3.5 MPa).
.9 Water absorption: Less than 0.50 percent.

.2 Grout Colour: As selected by the Project Team.

.15 Waterproofing and Anti-fracture Membrane:

.1 Crack Suppression and Anti-Fracture Membrane: Thin, fabric reinforced fluid-applied rubber membrane with capability of bridging non-structural cracks.

.1 Service Rating: Passing ASTM C 627 cycles 1-14 (TCA "Extra Heavy").
.2 System Crack Resistance - ANSI A118.12 5.4: Pass at 1/8 inch (3 mm).
.3 Elongation - ASTM D751- 89 17.1: 20- 30%.
.4 Breaking Strength (Cut Strip Method) ASTM D751:1700- 1900 Psi (11.72- 13.10 MPa).
.5 Nominal Dry Thickness LIL 1013- 92 0.020 inch (0.51mm).
.6 28 Day Shear Strength - ANSI A118.12 5.1.5: 125- 175 Psi (0.86- 1.6 MPa).
.7 Point Load - ANSI A118.12 5.2: 3200- 3700 lbf (14- 16 kN).

.16 Tile Edging:

.1 Schluter-JOLLY:

.1 Description: L-shaped profile with 1/8 inch (3.2 mm) wide top section and 3/16 - 1/2 inch (4.5 - 12.5 mm) wide face, that form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.

.2 Anchoring Leg:

1. Provide with straight anchoring leg.

.3 Material and Finish:

1. AT - Satin Nickel Anodized Aluminum.
2. Height as required.

PART 3. EXECUTION

3.1 WORKMANSHIP

.1 Apply tile or backing coats to non-frozen frost free surfaces.

.2 Fit tile units around corners, fitments, fixtures, drains and other built-in objects to maintain uniform joint appearance. Make cut edges smooth, even and free from chipping. Edges resulting from splitting not acceptable.

.3 Make joints between tiles uniform and approximately 1.5 mm, plumb, straight, true, even and with adjacent tile flush. Ensure sheet layout not visible after installation.

.4 Align patterns.

.5 Lay out tiles so that perimeter tiles are minimum 1/2 size.

.6 Sound tiles after setting and replace hollow sounding units to obtain full bond.

.7 Clean installed tile surfaces after installation cured.

.8 Maintain building expansion joints. Keep free of mortar or grout.

.9 Locate ceramic accessories evenly spaced and centered on joint layout. Rigidly install accessories.

.10 Make internal angles square, external angles square. Use Schluter edging at transition points.

.11 Schluter Edge : Jolly – systems, chrome plated brass

.12 Ensure all grouting, setting or other cementitious materials are completely removed immediately after edging installation.

.13 Ensure edging is completely and firmly set in place and all cavities are filled to prevent the collection of alkaline water.

3.2 INSTALLATION - FLOORING

.1 Install tile on floor substrates to TTMAC details No. 313F-2009/2010 Detail C and as required for the applicable substrate and installation conditions.

3.3 INSTALLATION - WALLS

.1 Apply scratch coat and mortar coat. Install cleavage plane and metal lath under all scratch and mortar coats.

.2 Install tile on concrete board walls to TTMAC details No. 305W-2009/2010 and as suitable for the appropriate substrate and installation conditions.

.3 For tub/bathroom walls install tile in accordance with TTMAC 306W-2009/2010 Details A or B as applicable.

.4 Install tile on glass mat backer board in accordance with TTMAC detail 305W-2009/2010 detail B and as suitable for the appropriate substrate and installation conditions.

.5 Install tile on drywall to TTMAC details No. 304W-2009/2010 and as suitable for the appropriate substrate and installation condition

3.4 CLEANING AND PROTECTION

.1 Clean all grout haze, sealant residue and excess thin-set from tile surfaces.

.2 Use only manufacturer recommended cleaners and accessories.

.3 Protect the tile installations from work of other sections.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 This Section specifies general requirements for all painting and finishing work to be performed on site.

.2 Read this Section in conjunction with the following Sections containing more detailed requirements for site painting and finishing:\

.1 Interior Painting and Finishing Schedule: Section 09 91 23.

1.2 RELATED SECTIONS

.1 Waste Management and Disposal Section 01 74 19.

1.3 REFERENCE DOCUMENTS

.1 **CANADIAN GENERAL STANDARDS BOARD (CGSB):**

.1 CGSB 1-GP-71 Set of 3 Standards 2003, Methods of Testing Paints and Pigments - Set includes 1-GP-71 No. 5-96, 1-GP-71 No. 38-96 and 1-GP-71 No. 73-96

.2 Green Seal (GS)

.1 Green Seal Standards GS-11, Paints, First Edition, May 20, 1993

.2 Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.

.3 Master Painters Institute (MPI)

.1 The painting and finishing specifications for new, not previously painted or finished, substrates are based on and make reference to the "Architectural Painting Specification Manual", November 2007 issue, including the latest edition of the "Approved Products Lists", published by the Master Painters Institute (MPI).

.2 The painting and finishing specifications for previously painted or finished substrates are based on and make reference to the "Maintenance Repainting Manual", August 2004 edition, including the latest edition of the "Approved Products Lists", published by the Master Painters Institute (MPI).

.3 The reference documents are available from:

Master Painters Institute (HQ) **or** **Alberta Painting Contractors Association**

4090 Graveley St.
Burnaby, BC V5C 3T6
tel: 888-674-8937 toll free
fax: 888-211-8708 toll free
www.paintinfo.com

2725 - 12th Street N.E.
Calgary, AB T2E 7J2
Tel: 403-250-0903
Fax: 403-291-9562

.4 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1113, January 2004, Architectural Coatings.]

1.4 SUBMITTALS

.1 Product Data

.1 Comply with requirements of Division 01.

.2 Prior to commencement of Work of this Section, submit list of products proposed for use corresponding to the specified finishing systems. Include manufacturer's name, manufacturer's product name, manufacturer's product code and MPI number of each product.

.3 Products identified in submitted products list and approved by The Project Team shall be used in the applications for which they are scheduled and shall not be changed without The Project Team's consent.

.4 Submit product data for the use and application of paint thinner.

.2 Samples:

.1 Comply with requirements of Division 01.

.2 Prepare and submit 300 mm x 300 mm sized samples for the following:

.1 Paint finish on Gypsum Board substrate.

.3 Submittals::

.1 Documentation identifying that VOC content is less than the VOC limits of Green Seal Standards GS-11, Paints, First Edition, May 20, 1993, for architectural paints, coating and primers applied to interior walls and ceilings.

.2 Documentation identifying that VOC content is less than the VOC limits of Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997, for anti-corrosive and anti-rust paints applied to interior ferrous metal substrates.

.3 Documentation identifying that VOC content is less than the VOC limits of State of California's South Coast Air Quality Management District(SCAQMD) Rule #1113, June 2006 for clear wood finishes, floor coatings, stains, and shellacs applied to interior elements.

1.5 FIELD SAMPLES

.1 Finish, with all required coats, a three square meter minimum sized surface of each major substrate and colour scheme, to show selected colours, finish textures, gloss levels, and workmanship. Where surface is less than three square meters, finish the entire surface.

.2 Obtain Project Teams approval before proceeding with remainder of the work. Approved sample area shall serve as the standard to be met or exceeded in the remainder of the work.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials in sealed original labeled containers bearing manufacturer's name, type of material, brand name, colour designation, and where applicable, instructions for mixing and reducing.

.2 Store paint and other materials in a single heated and well ventilated area with a minimum ambient temperature of 7°C.

.3 Take precautionary measures to prevent fire hazards or spontaneous combustion.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.

.4 Ensure emptied containers are sealed and stored safely.

.5 Unused paint materials must be disposed of at official hazardous material collections site as approved by the Authority Having Jurisdiction.

.6 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from State / Provincial Ministries of Environment and Regional levels of Government.

.7 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.8 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.9 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

- .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
- .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
- .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
- .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
- .5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.10 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

1.8 SITE CONDITIONS

.1 Interior:

.1 Temperature: Maintain temperature at minimum 10°C for at least 24 hours before and during application and until coatings have cured.
.2 Ventilation: Adequately ventilate areas where coatings are being applied and maintain a reasonably dust free atmosphere.
.3 Lighting: Maintain bright and uniform levels of lighting in areas where coatings are being applied.

.2 Exterior:

.1 Temperature: Apply coatings only when temperature is above 10°C.
.2 Precipitation: Do not apply coatings during periods of precipitation nor when precipitation is imminent.
.3 Wind: Do not apply coatings under high wind conditions resulting in wind blown dust and debris.

1.9 COORDINATION

.1 Ensure that site applied paints and finishes are compatible with primers or other finishes applied in the shop or factory.

1.10 STANDARD OF ACCEPTANCE

.1 The following requirements establish the standard of acceptance for the Work, when viewed using the final lighting source.

.1 Vertical surfaces: No defects visible from a distance of 1 metre at 90 degrees to surface.
.2 Horizontal surfaces: No defects visible from a distance of 1 metre at 45 degrees to surface.
.3 Ceilings: No defects visible from floor at 45 degrees to surface.
.4 Final coat shall exhibit uniformity of sheen across full surface area.

.2 Defects include brush marks, streaks, runs, laps, drips, heavy stippling, pile up of paints, roller tracking, inadequate hiding of substrate, skipped or missed areas, and foreign materials in paint.

1.11 MAINTENANCE MATERIALS

.1 Leave on premises not less than 4 litres of new material of each colour and finish sheen used.

.2 Provide maintenance materials in new containers, full, tightly sealed and clearly labelled. Remnants of used materials are not acceptable.

PART 2. Products

2.1 MATERIALS

.1 Refer to Schedule Sections for required finishing systems.

.2 Use only MPI approved products from the MPI Approved Product Lists corresponding to the specified finishing systems.

.3 Where the MPI Approved Products List identifies products for a given product type meet GPS-01-08 or GPS-02-08, designated by E1, E2 or E3, select products as follows:

.1 Use a product with either an E2 or E3 designation, where available.

.2 Where a product with an E2 or E3 designation is not available, use a product with a E1 designation.

.3 Products shall meet or exceed the more strict VOC content limit requirements between LEED as described in 2.1.1.2 above and MPI E1, E2, and E3 listings.

.4 Thinners: Odorless paint thinner, pure and clean with no deleterious material.

.5 Patching compounds: Spackling compound or oil base putty for substrates receiving a paint finish. Oil base putty, coloured to match finish, for substrates receiving a transparent finish.

2.2 MIXING

.1 Except as otherwise specified, paint shall be ready mixed. Re-mix prior to application to ensure colour and gloss uniformity. Materials in paste or powder form, or to be field-catalyzed, shall be field mixed in accordance with manufacturer's directions. Perform colour tinting operations prior to delivery to site.

.2 Thinning of materials to extent permitted by paint manufacturer will be permitted only where specified herein or upon The Project Team's approval. Do not use solvent for thinning.

.3 Strain materials thoroughly prior to application.

.4 Accent colours and deep tints shall have factory added colour pigments wherever possible.

2.3 COLOURS

.1 Colour Schedule: As indicated on the Drawings

2.4 GLOSS LEVELS

.1 Specified gloss levels are based on the MPI standard, which is as follows:

.1 Level G1 – Matte or Flat: gloss rating of 0 to 5 units at 60 degrees and sheen rating of a maximum of 10 units at 85 degrees.

.2 Level G2 - Velvet: gloss rating of 0 to 10 units at 60 degrees and a sheen rating of 10 to 35 units at 85 degrees.

.3 Level G3 - Eggshell: gloss rating of 10 to 25 units at 60 degrees and a sheen rating of 10 to 35 units at 85 degrees.

.4 Level G4 - Satin: gloss rating of 20 to 35 units at 60 degrees and a sheen rating of 35 units minimum at 85 degrees.

.5 Level G5 - Semi-gloss: gloss rating of 35 to 70 units at 60 degrees.

.6 Level G6 - Gloss: gloss rating of 70 to 85 units at 60 degrees.

.7 Level G7 – High-gloss: gloss rating of more than 85 units at 60 degrees.

.2 Except as otherwise specified, provide the following gloss levels for specified locations and substrates:

.1 Interior paint finishes:

.4 Satin – G4: Living Area and Kitchen
.5 Semi-gloss – G5: Washrooms and Standing and Running Trim

PART 3. Execution

3.1 VERIFICATION OF CONDITIONS

.1 Ensure all dust generating activities have been terminated and dust removed.

.2 Prior to commencement of painting and finishing work, thoroughly examine substrates scheduled to receive coatings.

.3 Do not apply coatings to substrates whose condition will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work specified herein.

.4 Verify compatibility of any previously applied coatings with specified coatings.

3.2 PROTECTION OF EXISTING SURFACES

.1 Protect adjacent surfaces from spray, splashings, and droppings.

.2 Remove electrical plates, surface hardware, fittings and fastenings prior to painting and finishing operations. Carefully store and replace these items on completion of work in each area.

3.3 CONDITION OF SUBSTRATES

.1 Substrates shall be sound, non-dusting, and free of grease, oil, dirt and other matter detrimental to adhesion and appearance of coatings.

.2 Temperature: minimum 8°C.

.3 Test moisture content using electronic moisture meter. Maximum moisture content as follows:

.1 Plaster and wallboard: 12%
.2 Concrete: 12%
.3 Concrete block and brick: 12%
.4 Wood: 15%

.4 Alkalinity: test cementitious substrates for alkalinity using litmus paper test. If greater than 7, refer to manufacturer's requirements.

3.4 PREPARATION OF NEW/UNFINISHED SUBSTRATES

.1 Prepare substrates in accordance with requirements of the MPI Manual, Chapter 2 and 3, Section 3-Surface Preparation, and as specified herein.

.2 All Substrates: thoroughly broom, vacuum and wipe clean as required to produce acceptable surface. Sand lightly and dust prior to application of each coat. Use recommended type and grade of sandpaper to avoid scratching or gouging of surfaces.

.3 Wood Generally: clean soiled surfaces, sand smooth and dust. Fill nail holes, splits, scratches, small joints and other minor imperfections with patching compound after paint prime coat or first varnish coat has been applied and dried. Apply putty with putty knife, press firmly in place, and finish flush with surface.

.4 Wood for Paint Finish: clean knots, pitch streaks, and sappy sections of residue and seal such areas with shellac or knot sealer before applying prime coat.

.5 Gypsum Board and Plaster: fill minor cracks, holes, and imperfections with tinted patching compound after prime coat has been applied and dried. Allow patching compound to dry, sand smooth and remove dust. Use minimum #150 grit sandpaper.

.6 Alkaline Surfaces: wash and neutralize using recommended type of solution compatible with paint to be used.

3.5 APPLICATION OF COATINGS, GENERALLY

.1 Applied and cured coatings shall be uniform in thickness, sheen, colour, and texture and be free of defects detrimental to appearance and performance. Edges of paint adjoining other materials shall be clean and sharp with no overlapping.

.2 Use rollers that will produce the least possible stipple effect; maximum 10 mm pile for smooth substrates. Heavier pile rollers may be permitted for use on rough substrates, subject to Project Teams' approval.

.3 Back roll airless spray application.

.4 Use a single manufacturer's products for all coats required for each finish system.

.5 Vary slightly the colour of successive coats to visibly differentiate between coats.

.6 Allow each coat to dry hard before succeeding coats are applied with a minimum of 24 hours between coats, except where manufacturer's instructions state otherwise.

3.6 FINISHING OF NEW/UNFINISHED SUBSTRATES

.1 Site paint or finish all work and substrates indicated as requiring site painting or finishing in Schedules, Drawings, or Specifications.

.2 Site apply all prime and finish coats as scheduled, whether or not factory prime coats have been applied.

3.7 BACK-PRIMING INTERIOR WOOD

.1 Except for architectural woodwork having factory applied finishes as specified in Section 06 40 00, back prime following concealed surfaces of interior wood components, prior to their installation:

.1 Surfaces in contact with concrete or masonry.
.2 Surfaces in contact with any floors or floor finishes.

.3 Cut-outs for sinks, drains and other mechanical services.
.4 Underside of front edges of countertops and toe-spaces.
.5 Other surfaces which may be subjected to moisture during normal use or cleaning operations.
.6 Backboards for mechanical and electrical equipment.

.2 Use white alkyd wood primer for components scheduled to receive paint finish.

3.8 FINISHING NEW/UNFINISHED DOORS AND FRAMES

.1 Finish edges of doors in accordance with specified finish system. For top and bottom edges, final coat may be omitted.

.2 Finish wood doors after doors have been hung and adjusted. Refinish tops, bottoms and edges after fitting.

.3 Apply finishes specified for exterior doors to both door faces and edges.

.4 Finish unfinished vertical edges of prefinished wood doors to match door faces.

3.9 FINISHING MISCELLANEOUS SUBSTRATES

.1 Paint substrates behind surface mounted fixtures, wall mounted heating units and unbacked cabinet work with specified finish systems, including specified number of coats.

.2 Finish shelving tops, bottoms and edges with specified finish systems, including specified number of coats.

3.10 PATCHING OF COMPLETED WORK

.1 Repair, touch-up, and refinish damaged finishes and finishes unsatisfactory to The Project Team.

.2 Refinish entire wall or area where deemed necessary by The Project Team.

3.11 CLEANING

.1 Place cotton waste, cloths and other material that may constitute a fire hazard in metal containers and remove from site daily.

END OF SECTION

PART 1. GENERAL

1.1 INTENT

.1 Read this Section in conjunction with Section 09 91 05 - Painting and Finishing General Requirements.

PART 2. PRODUCTS

.1 (Not used).

PART 3. EXECUTION

3.1 INTERIOR PAINTING AND FINISHING SCHEDULE

.1 The following code numbers, finishing system descriptions, gloss levels, coats and product descriptions are derived from the MPI Architectural Painting Specification Manual and the MPI Approved Products List.

INT 9.2 – PLASTER AND GYPSUM BOARD

INT 9.2A	Latex (over latex sealer) Gloss level G3	1st 2nd 3rd	Latex Primer Sealer Latex Latex
INT 9.2B	High Performance Architectural Latex Gloss level G3	1st 2nd 3rd	Latex Primer Sealer HIPAC Latex HIPAC Latex
INT 9.2M	Institutional Low Odor / VOC Gloss level G3	1st 2nd 3rd	Latex Primer Sealer Institutional Low Odor / VOC Institutional Low Odor / VOC

END OF SECTION

PART 1. GENERAL

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	In-Wall Backing & Supports:	Section 06 10 00.
.2	Gypsum Board	Section 09 29 00.
.3	Joint Sealants	Section 07 92 00.

1.2 SUBMITTALS

.1 Shop Drawings: indicate size, description of components, base materials, surface finishes, inside and out, hardware components, attachment and anchorage methods for all components

PART 2. PRODUCTS

2.1 MANUFACTURED PRODUCTS

.1 The following manufacturers' products are acceptable for use for this project:

.1 Bobrick Washroom Equipment of Canada Ltd.
.2 Taymor Industries Ltd.
.3 The Bradley Corporation.
.4 Hubert Industries.
.5 Frost Metal Products Ltd.
.6 Twin-Cee Ltd. Architectural Division of G.H. Wood & Co. Ltd.

.2 The following manufacturer's products are the basis for the attached washroom accessory schedule (with the exception of medicine cabinets):

.1 Taymor Industries Ltd., Sunglow Collection.

2.2 MATERIALS

.1 Sheet Metal: commercial quality, stretcher leveled to ASTM A526-80, zinc coated to ASTM A525-81, G90 coating designation.

.2 Fasteners & Anchors: screws and bolts hot dipped galvanized to CSA G164-M1981, expansion shields fibre, lead or rubber to suit intended installation and as recommended by fixture manufacturer.

2.3 FINISHES

.1 Chrome & Nickel Plating: to ASTM B456-79, satin finish.

.2 Baked Enamel: condition metal by applying one coat metal conditioner to CGSB 31-GP-107a, apply one coat primer to CGSB 1-GP-81M - Type 2, apply two coats Type 2 enamel to CGSB 1-GP-88e and bake to a hard durable finish, colour as selected by the Consultant from manufacturer's standard range.

2.4 FABRICATION

.1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where it is impractical to weld.

.2 Wherever possible form exposed surfaces from one piece or sheet of material, free of joints.

.3 Form surfaces flat without distortion, scratches or dents, radius corners.

.4 Back paint surfaces of components coming in contact with building finishes.

.5 Shop assemble components and package complete with all anchors and fittings.

.6 Deliver templates, inserts and rough-in frames to site at appropriate time for building in.

.7 Provide anchorage devices and concealed plates for installation into building framing**.**

PART 3. EXECUTION

3.1 PREPARATION

.1 Verify with Consultant exact locations of all components before beginning installation.

.2 Examine areas to receive components and notify Consultant of any conflicts detrimental to installation or operation of components.

.3 Ensure all concealed backup and anchorage has been installed in correct locations.

3.2 INSTALLATION

.1 Install all fixtures, accessories and other items in accordance with manufacturer's written instructions.

.2 Install level and plumb, rigidly anchor to substrate.

.3 Use tamperproof fasteners for installation of all components.

.4 Provide necessary supplies for components and install in units when directed by the Consultant.

END OF SECTION

PART 1. GENERAL

1.1 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Standpipe and Hose Systems: Section 21 12 00.

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

PART 2. PRODUCTS

2.1 RATING OF PORTABLE FIRE EXTINGUISHERS

.1 Provide hand portable extinguishers rated in accordance with CAN/ULC S508-1990 and bearing ULC label.

2.2 PORTABLE FIRE EXTINGUISHERS

.1 Multi-Purpose Dry Chemical - Pressure Type:

.2 Description: ammonium phosphate, powder type, heavy duty steel cylinder, baked enamel finish, squeeze grip handle with positive on/off valve, hose and nozzle, mounting brackets.

.3 Capacity: 2.26 kg (5 lbs)

.4 ULC Rating: 3A-40B:C.

.5 Classification: Class A, B, and C fires.

PART 3. EXECUTION

3.1 INSTALLATION

.1 Provide Multi-Purpose Dry Chemical Pressure Type IN THE Kitchen:

.2 Install extinguishers on mounting brackets.

.3 Provide extinguishers where indicated on drawings.

END OF SECTION

PART 1. GENERAL

1.1 SCOPE OF WORK

.1 Provide and install all residential appliances, installation shall include but, may not necessarily be limited to the following:

.1 Electric Counter Top Range:
.2 Fume Hood.
.3 Dishwasher.
.4 Refrigerators.
.5 Clothes Washer.
.6 Clothes Dryer.

1.2 RELATED SECTIONS

.1	Rough Carpentry:	Section 06 10 00.
.2	Finish Carpentry:	Section 06 20 00.
.3	Architectural Millwork:	Section 06 40 00.
.4	Mechanical, Plumbing	Divisions 22 – 23.
.5	Electrical	Divisions 26.

1.3 PRODUCT DATA

.1 Comply with requirements of Division 01.

.2 Submit duplicate copies of manufacturer's product data indicating that insulation materials comply with specified requirements.

1.4 PRODUCT DELIVERY AND STORAGE

.1 Deliver insulation and accessories in original unopened packaging or cartons bearing manufacturer's seals and labels.

.2 Store materials under cover on raised platforms, away from moisture and other elements that may damage or adversely affect the finish or operation of the appliance. Keep dry at all times.

.3 Coordinate delivery times of all equipment and appliance for suitable sequential installations.

.4 Upon delivery review and inspect all equipment and appliances to ensure they remain free and clear form any damage that may have happened during fabrication or transportation.

1.5 QUALITY CONTROL

.1 Strictly adhere to the manufacturers written installation instructions and recommendations.

1.6 COORDINATION

.1 Coordinate installation of any and all appliance with the millwork sub trade, endure that proper spaces remain for installation of all appliances.

PART 2. PRODUCTS

2.1 EQUIPMENT

.1 The contractor shall verify with both the supplier and the millworker for items scheduled to be installed, and shall ensure that all site dimensions are suitable for the installation of the appliances.

.2 Reference Manufacturer: Maytag®

2.2 APPLIANCES

.1 Colour for all appliance shall be White.

.2 All appliances shall bear the Energy Star label.

.3 Microwave: Samsung, Model No.SMH9187

.4 Refrigerator: Samsung French door style Model No. RF263AFRS.

.5 Dishwasher: Samsung DMT300RFS

.6 Clothes Washer: Frigidaire FRFW3700LW 27W x 36H x 3/4D Washer

.7 Clothes Dryer: Samsung, DV520 75. cu ft Front load Dryer

.8 Ensure that all appliances are complete and in suitable contrition for installation including knobs, power cords and supply, finish remain free from damages, scuffs, dents and other deleterious items that adversely affect the installation, appearance or function of the appliance.

PART 3. EXECUTION

3.1 INSPECTION

.1 The Contractor shall verify all site conditions and dimensions prior to installation, immediately notify the owner and the Consultant of any discrepancies.

3.2 INSTALLATION

.1 Comply with and strictly adhere to the manufacturer's written installation instructions and recommendations.

.2 When installations are complete, verify that all appliances are in good working order and are free from any manufacturing defects that may adversely affect the intended operation of the appliance.

.3 Prior to setting appliance in place ensure that all surfaces, interior and exterior, are cleaned and remain free and clear of construction debris, dirt, dust, grease, or other construction related debris or waste.

.4 The Contractor shall ONLY clean appliances with products and equipment as recommended by the manufacturer.

3.3 PROTECTION AND FINAL CLEANING

.1 Protect all appliances from contraction related activities until substantial Performance of the Work has been attained.

.2 Prior to turning the building over to the Owner the contractor shall ensure that all appliances remain operational, finishes are intact and free from damage due to construction related activities.

.3 Provide a final cleaning using only cleaning products and equipment as recommended by the manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 These Specifications are an integral part of the Contract Documents. Tendering and Contract Requirements, General Requirements apply to all Division 20 Specification Sections.

.2 Work in the Specifications is divided into descriptive Sections which are not intended to delegate functions or work to any specific Subcontractor or identify absolute contractual limits between Subcontractor, nor between the Contractor and his Subcontractor. The requirements of any one Section apply to all other Sections, for example: the motor service factor requirement. Refer to other Divisions and Sections to ensure a completed operational product and fully coordinated standard of work.

.3 The direction to 'provide' equipment, materials, products, labour and services shall be interpreted to 'supply, install and test' the Division 20 work indicated on the Drawings and specified in the Specifications.

.4 Provide and include in the Contract Price Division 20 work including mechanical components and normal system accessories not shown on the Drawings or stipulated in the Specifications, and required to ensure completed operational systems and a fully coordinated standard of Work acceptable to the Consultant and all authorities having jurisdiction.

1.2. INTENT /PHASING

.1 Mention in the Specifications or the indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.

.2 Consider the Specifications as an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.

.3 Where there is apparent contradiction or ambiguity in the documents, or where there are apparent discrepancies in or omissions from the documents, or if there is any doubt as to the intent of the documents, the bidder shall request and obtain written clarification(s) from the Consultant prior to submitting a tender. Consideration will not be granted for misunderstanding of the intent of the documents or the extent of the work to be performed.

.4 Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective materials, equipment and parts of equipment and repair related damages.

.5 Phasing shall be scheduled with the Owner.

1.3. METRIC PRACTICE

.1 Conform to Canadian Metric Practice Guide CSA CAN3-Z234.1-89.

.2 Provide adapters between metric and imperial installations.

.3 Metric descriptions in this Division are nominal equivalents of Imperial values.

1.4. COORDINATION

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Coordinate and schedule Division 20 work with all other work in the same area or with work which is dependent upon Division 20 work so as to facilitate mutual progress.

.3 Identify and resolve interference problems prior to prefabrication and installation of equipment. Submit interference drawings for review upon Consultant Request.

.4 Examine the site and all Contract Documents prior to bid submission. No allowance will be made for any difficulties encountered due to any features of the building, methods of construction, site or surrounding public and private property which existed up to the bid close.

1.5. REFERENCE STANDARDS

.1 Provide new materials and equipment of proven design and quality. Provide current models of equipment manufactured in Canada or the United States, unless specified otherwise, with published ratings certified by recognized North American testing and standards agencies.

.2 Select Canadian made materials and equipment and other equipment to maximize the Canadian content of the Work.

.3 Workmanship and installation methods shall conform to the best modern practice. Employ skilled tradesmen to perform work under the direct supervision of fully qualified personnel.

.4 Install equipment in strict accordance with manufacturers written recommendations.

.5 Meet ASHRAE and other industry standards in the selection and provision of equipment, materials, pipe and duct components and systems.

.6 Meet ASHRAE/IES 90.1, 1989 Standards for the supply and installation of all equipment.

.7 Meet MNECB 1997 Standards for the supply and installation of all equipment.

.8 Meet the additional selection, sizing and performance criteria specified in this Specification.

.9 Meet LEED applicable standards for the supply and installation of all equipment as well as all applicable LEED construction practices.

1.6. DRAWINGS AND MEASUREMENTS

.1 Drawings show general design and arrangement of mechanical system installation, and are diagrammatic. Obtain further clarification of Drawings or Specifications from Consultant prior to installation.

.2 Drawings do not indicate exact Architectural, Structural or Electrical features. Examine Drawings prior to laying out.

.3 Do not scale Drawings to order materials. Take field measurements before ordering and fabricating materials.

.4 Clarify 'roughing-in' requirements of equipment which is not part of Division 20 work before proceeding.

.5 Leave areas clear where space is indicated as reserved for future equipment and where space is required to maintain equipment. Maintenance clearances in addition to providing for servicing of equipment, shall allow for removal and reinstallation of replaceable items such as motors, coils and filters.

1.7. REGULATORY REQUIREMENTS

.1 Meet the requirements and recommendations of all Municipal, Provincial and Federal Bylaws and Ordinances.

.2 Do not reduce the quality of work specified and/or shown on the Drawings because of regulatory requirements.

.3 In general, and as applicable, the physical and chemical properties, the characteristics and the performance of Division 20 work shall meet the requirements of recognized agencies including those listed herein:

AMCA	-	Air Moving & Conditioning Association
ADC	-	Air Diffusion Council
ANSI	-	American National Standards Institute
ARI	-	Air Conditioning & Refrigeration Institute
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CGA	-	Canadian Gas Association
CGC	-	Consumers Gas Company
CGSB	-	Canadian General Standards Board
CSA	-	Canadian Standards Association
CTI	-	Cooling Tower Institute
FM	-	Factory Mutual
LEED	-	Leadership In Energy and Environmental Design Canada -NC
MNECB	-	Model National Energy Code for Buildings
MTC	-	Ministry of Transportation and Communication
NBCC	-	National Building Code of Canada
NFPA	-	National Fire Protection Association
ABC	-	Provincial Alberta Building Code
AFM	-	Local Fire Codes or Standards, Alberta Fire Marshall
AML	-	Ministry of Labour and Workmen's Compensation Requirements
NPC	-	National Plumbing Code
PP	-	Local Building Codes : Permit Pro
UL	-	Underwriter's Laboratories Inc.
ULC	-	Underwriter's Laboratories of Canada

.4 Give all necessary notices, obtain all permits and pay for all governmental fees, taxes and other costs in connection with the work. File all necessary Contract Documents, prepare submissions and obtain approvals of regulatory bodies having jurisdiction.

.5 Comply with the requirements of the Model National Energy Code for Buildings in the selection, application and installation of all mechanical equipment and systems.

1.8. CHANGES TO CONTRACT WORK

.1 Do not proceed with any changes to the Work without written authority from the Owner.

.2 Follow procedures outlined in Tendering and Contract Requirements for administration and execution of Contract revisions.

.3 Quotations for changes to Division 20 work shall be based on the actual cost of the work:

.1 For Equipment - The latest edition of the Allpriser, including all applicable discounts or actual invoices where costs are not published.

.2 For Labour Rates –

.1 The Mechanical Contractors of America (MCA) published rates, Latest Edition, and as modified by negotiations.

.2 SMACNA.

.3 National Electrical Contractors Estimating Manual.

.3 Markup for overhead and profit as defined in the Contract General Conditions.

.4 Where changes are extensive, or where requested by the Consultant, material and labour take-off shall be organized on a drawing by drawing basis, or area by area basis to more readily facilitate verification of quantities and labour hours.

1.9. WARRANTY

.1 Meet the requirements of Tendering and Contract Requirements.

.2 Unconditionally warrant all equipment, material and workmanship for not less than one year from date of Substantial Performance of the Work, or for longer periods when stated elsewhere in the Specifications.

.3 If any equipment or material does not match the manufacturer's published data or specially supplied rating schedules during performance tests, replace without delay the defective equipment or material. Bear all associated costs of replacement without charge to the Owner. Adjust all components to achieve the proper ratings.

.4 The Owner will give notice of observed defects promptly in writing.

.5 Promptly correct defects and deficiencies which originate during the warranty period. Pay for resulting damage.

1.10. INSTRUCTIONS TO BIDDERS

.1 Submit Supplementary Mechanical Bid Form. Failure to comply with the stated requirements of the Bid Form may nullify the bid.

.2 The Bidder is invited to submit additional alternative prices not specifically requested with the Bid.

.3 Alternative prices may be used to establish the lowest Contract Price.

.4 The lowest or any Bid will not necessarily be accepted.

PART 2 - SUBMITTALS

2.1. SHOP DRAWINGS

.1 Refer to Division 1. The more stringent of the two shall apply. Submit three (3) copies of shop drawings for Consultant review. One (1) copy will be returned to the General Contractor bearing comments. Include all cost for reproduction of sufficient copies of reviewed shop drawings for manuals, site forces and coordination among other trades. Where submissions are not readily reproducible in photocopy form, provide mylor/vellum copy in addition to two (2) prints.

.2 Identify Shop Drawing by Specification index reference and project name.

.3 Review all Shop Drawings prior to submittal and clearly certify as 'Correct for Review by Consultant'. Show company name, date and sign all Shop Drawings.

.4 Consultant review of Shop Drawings does not relieve the Contractor of full responsibility for errors, necessity to check Shop Drawings, furnish materials and equipment and perform work required by the Contract Documents.

.5 Clearly identify all components, accessories, including options to be supplied with each item.

.6 Submitted product data shall include sufficient detail to allow a reasonable assessment of the equipment being provided. The data shall include, but not be limited to:

.1 dimensions, including service clearance requirements

.2 design and working pressure ratings of pressure vessels and line components

.3 shipping and operating weight including accessories and working fluids, together with point loadings

.4 performance specifications including pump and fan curves/charts

.5 part load operational capabilities and limitations

.6 sound power levels

.7 materials of construction including exterior and internal finishes

.8 factory test standards rating conformance to recognized and applicable industry standards

.9 extended warranty coverage

.10 electrical requirements, including complete wiring diagrams clearly defining field, internal and factory wiring scope

.11 motor, power or control wiring requirements including rated voltage, phase and cycle, rated power draw, full load current, motor size and speed, motor frame size, type of enclosure and maximum rated temperature rise

.12 product installation, startup and operation manuals

.13 statement of compliance with the Model National Energy Code of Canada, as applicable.

.7 Incomplete submissions will be returned as unacceptable.

.8 Bind one set of reviewed Shop Drawings in each Operating and Maintenance Manual.

.9 Where applicable, provide shop drawings for specified items as follows:

Section	Title	Equipment
20 05 00	Basic Mechanical Materials and Methods	Strainers Thermometers & Pressure Gauges Expansion Joints & Guides Anchors Hangers
20 09 00	Motors, Starters, Control Centres & Wiring	Loose Starters VFD Rated Motor Starters Motor Control Centres
20 09 50	Variable Speed Drives	Variable Speed Drives
20 50 00	Site Utilities	Piping and Valves Fire Hydrants Post Indicator Valves Area Drains Catch Basins and Manholes Ground Shutoff Valves
21 40 00	Site Water Storage	Storage Tanks Storage Reservoirs
23 05 48	Sound and Vibration Controls	Silencers Vibration Isolators

Section	Title	Equipment
20 07 00	Insulation	Insulation Materials Spec Sheets Insulation Material - Physical Samples
21 12 26	Wall Service Modules	Wall Service Modules
21 13 00	Sprinkler Systems	Sprinkler Layouts Sprinkler Hydraulic Calculations Sprinkler Heads - Data Sheets and Samples Alarm Check Valves Preaction Valves Dry Valves Air Compressors Deluge Valves Flow Alarms Siamese Connections Excess Pressure Pumps and Starters/Controllers Valves and Supervisory Switches Pipe Couplings
21 34 00	Sprinkler System Pumps	Pumps Excess Pressure Pumps Controllers/Starters Transfer Switches
22 11 00	Plumbing and Drainage Piping Systems	Valves Balancing Valves Pipe Couplings
22 13 29	Bilge and Sewage Pumps	Sewage Pumps Bilge Pumps Submersible Pumps Starters/Controllers Alarms
22 11 23	Domestic Water Booster Systems	Booster Pumps Controllers Assembly Drawings Wiring Diagrams PRVs
22 30 00	Plumbing Specialties	Drainage Products Grease Interceptors complete with Controllers and Wiring Oil Interceptors complete with Controllers and Wiring

Section	Title	Equipment
		Backflow Preventors Water Hammer Arrestors Water Mix Regulating Valves Wall & Post Hydrants Domestic Water Recirculation Pumps Water Meters
22 40 00	Plumbing Fixtures	Plumbing Fixtures Plumbing Trim Flush Valves Drinking Coolers Emergency Equipment Bed Pan Washers
22 33 00	Domestic Water Heaters	Electric Heaters Gas Fired Heaters Hot Water Storage Tanks Instant Hot Water Dispensers
22 31 00	Domestic Water Softening	Water Softeners
23 11 23	Natural Gas Piping Systems	Pressure Reducing Stations Pressure Relief Stations
23 21 13	Hydronic Piping Systems	Gate and Globe Valves Butterfly Valves Piping Joints Circuit Balancing Valves Hydronic Terminal Valves Expansion Tanks
23 21 23	HVAC Pumps	In-line Circulators Pumps Pump Suction and Discharge Fittings
23 25 00	HVAC Water Treatment Systems	Water Treatment Systems Glycol Pumped System Water Softeners
23 52 33	Forced Draft Water Tube Boilers	Boilers Sequencer
23 51 00	Breeching and Stacks	Boiler Stacks Boiler Breechings Assembly Drawings
23 51 23	Class B Gas Vents	Vents and Flues

Section	Title	Equipment
23 75 33	Indirect Fired Makeup Air Units	Makeup Air Units
23 83 00	Snow Melting System	Snow Melting System Piping Layout Expansion Tank Headers Pumps Pipe Fittings Heater Controls
23 81 23	Computer Room Air Conditioning Units	A.C. Units Split Systems Dry Coolers Glycol Pumps Air Cooled Condensers Expansion Tanks
23 57 00	Heat Exchangers	Plate and Frame Exchangers Shell and Tube Exchangers
23 74 00	Packaged Rooftop Heating and Cooling Equipment	Packaged A.C. Units
23 82 16	Air Coils	Water Coils DX Coils Steam Coils
23 82 50	Electric Heating	Convectors Unit Heaters Baseboards Insert Heaters Reheat Coils Infrared Heaters
23 82 00	Hydronic Terminal Units	Linear Radiant Ceiling Panels Wallfin Custom Enclosure Radiators Convector Radiators Cabinet Unit Heaters Forced Convection Radiation Units Unit Heaters
23 82 19	Fan Coil Units	Fan Coil Units
23 75 00	Packaged Air Handling Units	Air Handling Units
23 34 00	Fans	Fans

Section	Title	Equipment
23 41 00	Air Filters	Filters Racks and Frames Manometers
23 31 00	Sheet Metal	Access Doors Fire Dampers Smoke Dampers Backdraft Dampers Exhaust Hoods Fire Rated Enclosures Pilot Test Ports
23 39 00	Louvres	Louvres
23 37 13	Air Terminals	Grilles and Diffusers Light Troffers Air Boots Factory Test Reports
23 33 13	Positive Seal Motorized Dampers	Dampers
25 50 00	Electronic Controls	Control Systems Description Control Systems Diagrams DDC Hardware OWS and Accessories
25 30 00	BMS Instrumentation	Sensors and Thermostats Control Valves and Actuators Control Dampers and Actuators Transmitters Transducers Static Pressure Sensors PE Switches EP Switches Water Flow Measuring Devices Air Flow Measuring Devices BTU Energy Meters
25 06 30	Instrumentation (Point) Schedules	Point Schedules
23 05 93	Balancing	Air Balancing Reports Water Balancing Reports

2.2. ALTERNATIVE MANUFACTURER AND SUPPLIER

.1 Equipment and materials are specifically described for the purpose of indicating standards of quality and workmanship. Base Bid on the items specified and shown on Drawings.

.2 Maximize the Canadian content of all equipment and materials used on this project.

.3 Alternatives for equipment or materials considered equal in quality and performance may be submitted with the Bid Form. Supply with each alternative, following bid submission, upon request by Consultant, the following information:

.1 details of manufacture

.2 dimensions including required clearance

.3 performance data

.4 the cost saving for piping, ductwork and electrical changes imposed by the alternative

.5 the effect upon and estimated cost to other trades

.6 Canadian content percentage

.4 Where alternatives are accepted, there will be no further cost allowances for subsequent changes in Division 20 work or other Contracts to make the alternative complete and equal to the specified equipment and materials.

.5 If alternative equipment, differing from that which is shown on Drawings is accepted, prepare when requested, equipment layouts at no extra cost. Show clearly in plan, elevations and sections, all equipment details including dimensional changes. Show location changes to ducts, pipes and wiring and the effect of these changes on the building. Drawings shall be {1:50} scale.

.6 The right is reserved to accept or reject any alternative.

2.3. SAMPLES

.1 Submit samples or provide site mockup of proposed materials upon request of the Consultant, including:

.1 valve tags and equipment identification plates

.2 insulation and adhesives

.3 hangers, pipe supports, inserts and fastening devices

.4 sprinkler heads and guards

.5 flexible ductwork

.6 lavatory trim

.7 thermostat, cover and guards

.8 radiation covers, supports and hangers

.9 access doors and panels

.10 diffusers, registers and grilles

.11 air terminal control unit

.12 air filters

.13 thermometers

.14 pressure gauges

.15 ECMS instrumentation

.16 supervisory switch

.2 Provide site mockup of proposed materials before proceeding.

2.4. COORDINATION DRAWINGS

.1 Prior to commencement of work, submit for Consultant review, pipe, duct and equipment interference and sleeving drawings for each floor level and for all Division 20 work. Drawings must be coordinated and certified correct for review.

.2 Coordination drawings shall be to a scale sufficient to show the necessary details. Submit for review, using the same procedures as specified for Shop Drawings.

.3 Prepare drawings in conjunction with other Divisions, wherever possible conflict due to the positioning of Division 20 equipment, piping or ductwork exists.

.4 Dimension proposed location of Division 20 work with respect to building elevations and established grid lines.

.5 Prepare fully dimensioned detail drawings of all shafts, duct spaces and pipe spaces. Show sleeving, recessed and formed holes required in concrete for Division 20 work. Include information pertaining to access, clearances, tappings, housekeeping pads, drains and electrical connections.

.6 Base information used to prepare drawings on reviewed Shop Drawings.

.7 Provide field drawings with position of various services when required by Consultant.

.8 Submit a list of access doors and panels showing proposed type, size and location. Coordinate drawings with Architectural detail drawings and reflected ceiling plans prior to submission.

2.5. RECORD DRAWINGS

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Suitably store and protect drawings on site and make available at all times for inspection.

.3 Record inverts of underground piping at building entry/exit and below floor slab at each branch, riser base, change in direction as well as at least three points on straight runs.

.4 Show locations of access doors and panels and identify the equipment and components that they serve.

2.6. OPERATING AND MAINTENANCE MANUALS

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Submit one copy for review at least two weeks before instructions to Owner are commenced.

.3 Submit three copies of final manuals to the consultant.

.4 Ensure that the terminology used in various sections of the manual is consistent.

.5 Each manual shall contain the following information:

.1 description of each system with description of each major component of system

.2 complete sets of page size equipment Shop Drawings

.3 equipment manufacturer’s installation, startup and operation manuals

.4 equipment manufacturer’s recommended spare parts lists

.5 equipment wiring diagrams

.6 lubrication schedule for all equipment

.7 equipment identification list with serial numbers

.8 page size valve tag schedule and flow diagrams

.9 final balancing reports

.10 water treatment procedure and tests

.11 control drawings, sequences of operation

.12 extended warranty documentation if applicable

PART 3 - EXECUTION

3.1. INSPECTION, TESTING AND CERTIFICATES

.1 Periodic inspections of the work in progress will be made to check general conformity of the work to the Contract Documents. Observed deficiencies will be reported. Correct deficiencies immediately.

.2 Meet the requirements of all laws, bylaws, codes, regulations and authorities having jurisdiction.

.3 Where the Contract Documents, instructions or the governing authorities require Division 20 work to be tested, inspected or approved, give sufficient notice of its readiness for inspection and schedule the date and time for such inspection.

.4 Uncover Division 20 work that is covered up without consent, upon Consultant request, for examination and restore at no extra cost to the Owner.

.5 Furnish certificates and evidence that Division 20 work meets the requirements of authorities having jurisdiction.

.6 Correct deficiencies immediately upon notification.

3.2. TEMPORARY SERVICES

.1 Provide temporary mechanical services in accordance with the requirements of Division 1.

.2 Make connections to temporary power source provided and provide extensions for use by Division 20.

.3 Install and maintain temporary fire protection services as required by the authorities having jurisdiction.

.4 When the permanent water service is installed, it shall be used to supply water for the use of Other Contractors.

.5 Perform operations necessary for checking, testing and balancing after written approval is given to start up systems. Ensure that care is taken to protect equipment from damage and to prevent distribution of dust through duct systems.

.6 Do not use permanent plumbing, heating or air conditioning systems for temporary services during construction, except with written permission from Consultant.

3.3. CUTTING AND PATCHING

.1 Meet the requirements of Division 1.

.2 Give notification in time to Other Contractors of openings required for Division 20 Work. Supply accurate details of location and size. When this requirement is not met, bear the cost of cutting and patching.

.3 In existing work, cutting, patching and restoration of finished work to original condition will be carried out by Other Contractors at the expense of Division 20.

.4 Obtain written Consultant approval before cutting openings through structure.

.5 Where new work connects with existing and where existing work is altered, cut, patch and restore to match existing work.

3.4. PROTECTION

.1 Protect all Division 20 work from damage. Keep all equipment dry and clean at all times.

.2 Cover openings in equipment, pipes and ducts, with caps or heavy gauge plastic sheeting until final connections are made.

.3 Repair any damage caused by improper storage, handling or installation of equipment and materials.

.4 Protect equipment, pipes and temporary services installed by Division 15 from weather damage.

3.5. TEMPORARY AND TRIAL USE

.1 Obtain written permission from Consultant to use and test permanent equipment and systems prior to Substantial Performance acceptance by Consultant.

.2 Consultant may use equipment and systems for test purposes prior to acceptance. Provide labour, fuel, material and instruments required for testing. Rectify incomplete work immediately to satisfaction of Consultant.

.3 Protect equipment and system openings from dirt, dust and other foreign materials during temporary usage. Whenever air handling systems are used for temporary services, in addition to other requirements specified, provide minimum {12 mm} [1/2”] thick glass fibre filter media in return air openings, transfer openings and other identified openings.

.4 Clean and renew equipment and systems used prior to acceptance.

.5 Warranty, including duration and commencement date, shall not to be affected by startup date of equipment.

3.6. COMPLETION

.1 Meet the requirements of Division 1.

.2 Remove all debris from inside Division 20 systems and equipment.

.3 Rectify deficiencies and complete work before submitting request for Substantial Performance inspection.

.4 Follow manufacturer's written instructions regarding bearing lubrication. Remove grease from pillowblock type bearings and install new grease before equipment is put into operation.

.5 Check and align all drives to manufacturer's acceptable tolerances.

.6 Adjust belts for proper tension.

.7 Check and align all pumps to manufacturer's acceptable tolerances.

.8 Remove all temporary protection and covers.

.9 Remove oil and grease from equipment and bases.

.10 Clean all fixtures and equipment. Polish all plated surfaces.

.11 Vacuum clean the inside of all air handling systems, including fans, ducts, coils and terminal units to ensure that they are free from debris and dust.

.12 Change air and water filters.

.13 Remove, clean and reinstall pipeline strainer screens.

.14 Leave Division 20 work in as new working order.

3.7. INSTRUCTIONS TO OWNER

.1 Meet the requirements of Division 1.

.2 Submit to Owner, check lists for each system or piece of equipment, indicating that all components have been checked and are complete prior to instruction period.

.3 Thoroughly instruct the Owner in the safe and efficient operation of the systems and equipment.

.4 Arrange and pay for the services of qualified manufacturer's representatives to instruct Owner on specialized portions of the installation, such as refrigeration machines, boilers, automatic controls and water treatment.

.5 Submit a complete record of instructions given to the Owner. For each instruction period, supply the following data:

.1 Date

.2 Duration

.3 system or equipment involved

.4 names of persons giving instructions

.5 names of persons being instructed

.6 other persons present

.6 Submit receipted verification of completed training to Consultant prior to final release of retentions.

.7 Carry out instructional period during a period of 5 days scheduled at Owner's convenience.

3.8. PROTECTION OF OWNER'S PREMISES

.1 Adhere strictly to the Owner's requirements.

.2 Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.

.3 Execute work with least possible interference or disturbance to occupants, public and normal use of premises.

.4 Provide temporary means to maintain security when security has been reduced by Division 20.

.5 Only elevators, dumbwaiters, conveyors or escalators assigned for Contractor's use may be used for moving men and material within building. Protect walls of passenger elevators, to approval of Owner prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.

.6 Provide temporary dust screens, barriers, warning signs in locations where renovations and alteration work is adjacent to areas which will be operative during work.

.7 Drawings indicate approximate locations of known existing underground and above ground facilities. Avoid damage to existing services. Bear cost of repairs and replacements.

.8 Immediately advise Consultant when unknown services are encountered and await instructions.

.9 Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Provide all labour, materials, products, equipment and services to supply and install the basic mechanical materials indicated on the Drawings and specified in Division 20 of these Specifications.

1.2. IDENTIFICATION OF MECHANICAL SERVICES

.1 Identify all mechanical services after finish painting is complete.

.2 Use terminology consistent:

.1 with the Drawings and Specifications

.2 with the Owner's requirements and standards.

.3 Identify lay-in type acoustic ceilings used for access to equipment and components by a method acceptable to Consultant.

.4 Mark valve and equipment identification on Record Drawings.

.5 Provide typewritten master lists for each Equipment Room. Frame under glass. Insert copies in Operating and Maintenance Instruction Manuals.

1.3. PIPE AND DUCTWORK IDENTIFICATION

.1 Provide SMS Wrap-Mark on all pipe coverings, using Wrap-Mark pipe markers with flow arrow and alternating wording. For outside diameters up to {150 mm} [6"], allow marker to completely wrap pipe. For larger outside diameters, secure markers with stainless steel springs. Secure markers on vertical piping and elsewhere where markers could be inadvertently moved.

.2 Use stencils and stencil paint on ductwork or ductwork insulation. Apply solid black capitalized lettering {50 mm} [2"] high and solid black flow arrows {150 mm} [6"] long x {50 mm} [2"] wide.

.3 Locate identification and flow arrows so they can be seen clearly from floor and service platforms

.1 at least once in each room

.2 at each piece of equipment

.3 at each branch close to connection point to main piping and ductwork

.4 at not greater than intervals of {15 metres} [50 ft] on straight runs of exposed piping and ductwork

.5 at entry and leaving point to pipe and duct chases, or other concealed spaces

.6 both sides where piping and ductwork passes through walls, partitions and floors

.7 on vertical pipes and ducts approximately {1800 mm} [6 ft] above floor

.8 behind each access door and panel

.9 at valves, identify piping upstream of valves and identify branch, equipment, building part or building serviced downstream of valve

.4 Colour code pipes to meet code and Owner's requirements. At minimum, colour code pipes with {50 mm} [2"] wide bands in accordance with the detail shown on the drawings.

.5 Identify electrical tracing of pipes on pipe insulation.

1.4. VALVE TAGS

.1 Provide {40 mm} [1-1/2"] dia., {1 mm} [0.040"] thick brass tags with {10mm} [3/8"] high die-stamped black letters.

.2 Attach to valves with {100 mm} [4"] long brass chains.

.3 Tag all valves except for small valves isolating a single piece of equipment such as a unit heater, fan coil unit, terminal reheat coil and radiation section.

1.5. EQUIPMENT NAMEPLATES

.1 Identify equipment, starters, and, remote control devices in a manner consistent with the Drawings.

.2 Use solid black capitalized lettering {100 mm} [4"] high.

.3 Where equipment size does not permit stencil identification, use lamacoid labels, engraved white on black, mechanically fastened to the equipment. Minimum lettering size {10 mm} [3/8"].

1.6. CONTROLS IDENTIFICATION

.1 Meet Section 25 50 00 requirements.

1.7. FLOW DIAGRAMS

.1 Prepare neat diagrams {1200 mm x 900 mm} [48" x 36"] of piping systems to identify equipment and valves.

.2 Insert legible page size copies into each Operating and Maintenance Manual.

.3 Install diagrams, framed under glass, on Equipment Room walls where directed by Owner.

PART 2 - PRODUCTS

2.1. INSERTS

.1 Submit proposed materials and methods for cast-in-place inserts.

.2 Where inserts must be placed after concrete is poured, use Phillips Red Head Multiset II Anchor system or equivalent Hilti System.

2.2. PIPE HANGERS

.1 Provide pipe hangers and supports for all piping. Provide hangers in accordance with the following requirements. Provide steel supports in accordance with the subsequent article in this specification section. Provide galvanized steel hangers and supports with galvanized fittings and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.

.2 Provide manufactured hangers, accessories and supports in accordance with ANSI B31.1 and MSS SP58, SP69, SP89 and SP90 similar to the Grinnell or Myatt figures numbers below.

.3 Select products to ensure adequate safety factors under anticipated loads.

.4 Provide upper attachments as follows:

.1 Standard beam clamp for normal service - Grinnell Fig 133 with Fig 290 or Fig 278 or Myatt Fig 500 with Fig 480 or Fig 440.

.2 Standard side beam clamp for normal service - Grinnell Fig 225 or Myatt Fig 505.

.3 Top beam clamp - Grinnell Fig 92 or Myatt Fig 406.

.4 C clamp - Grinnell Fig 86 or Myatt Fig 586.

.5 Angle clip for light duty side mounting - Grinnell Fig 202 or Myatt Fig 542.

.5 For vertical adjustment of hanger rods, provide forged steel turnbuckle - Grinnell Fig 230 or Myatt Fig 475.

.6 Provide pipe attachments as follows:

.1 Adjustable swivel rings for uninsulated fire service piping - ULC and FM approved - Grinnell Fig 69 or Myatt Fig 41.

.2 Clevis hanger for copper piping up to and including {100 mm} [4"] diameter - Grinnell Fig CT-65 plastic coated or Myatt Fig 56 epoxy coated.

.3 Swivel ring hanger for copper tubing up to and including {25 mm} [1"] diameter - Myatt Fig 43 epoxy coated.

.4 Standard duty clevis hanger for steel piping - Grinnell Fig 260 or Myatt Fig 124.

.5 Standard duty long clevis hanger for steel piping - Grinnell Fig 300 or Myatt Fig 124L.

.7 Provide vertical pipe supports as follows:

.1 Riser clamp for copper pipe - Grinnell Fig CT121C plastic coated or Myatt Fig 186 epoxy coated.

.2 Riser clamp for steel or cast iron pipe - Grinnell Fig 261 or Myatt Fig 182 or Fig 183.

.8 Provide supports for other piping types such as plastic, mechanically fused or packed joint pipe according to the pipe manufacturer's published recommendations. Support piping continuously where required to prevent sagging.

.9 Provide protection saddles where insulated piping is supported from below.

.1 For high temperature insulated pipe - Grinnell Fig 160 or Fig 165 or Myatt Fig 210 or Fig 240.

.2 For insulated pipe with vapour barrier for low temperature service, insulate pipe with calcium silicate at hangers and provide Grinnell Fig 167 or Myatt Fig 251.

.10 Provide roll type supports where shown on the drawings and where longitudinal movement may occur. Provide single pipe rolls - Grinnell Fig 177 or Myatt Fig 262 where supported from below and Grinnell Fig 171 or Myatt Fig 261 where suspended. Provide spring cushions where slight vertical movement is likely and cushioning required - Grinnell Fig 178 or Myatt Fig 880.

.11 Provide Grinnell or Myatt engineered constant support hangers on piping subject to vertical movement exceeding {40 mm} [1 1/2"] due to vertical pipe expansion.

2.3. EQUIPMENT RIGGING SUPPORTS

.1 Provide eyebolts suitable for block and tackle connection, adequately supported by the structure above for:

.1 chiller and condenser shell heads

.2 heat exchanger and shell heads

.3 sewage and bilge pumps

.4 pumps in Mechanical Equipment Rooms

.5 motors

.6 other equipment which will require block and tackle handling

2.4. SLEEVES, WALL AND FLOOR PLATES

.1 For pipe sleeves, use machine cut and reamed standard weight steel piping.

.2 Concealed perimeter risers and runouts may have sleeves of {1.31 mm} [18 gauge] galvanized steel set around section of insulation to provide freedom of movement of piping. Extend {50 mm} [2"] above finished floor level.

.3 For piping through exterior walls, cooperate with the waterproofing trade at all times, and do not break any waterproofing seal without consent of the waterproofing trade. Provide waterproof link seals as detailed on Drawings.

.4 Provide leak plates where pipe sleeves pass through exterior building walls. Each leak plate shall be a {3.42 mm} [10 gauge] steel plate, welded to the sleeve, {100 mm} [4"] diameter greater than sleeve outside diameter.

.5 Provide {1.31 mm} [18 gauge] galvanized steel duct sleeves. Provide adequate bracing for support of sleeves during concrete and masonry work. For fire rated floors and walls, build fire damper assemblies into structure to attain fire rated construction, in a manner acceptable to the governing authorities.

.6 Cover pipe sleeves in walls and ceilings of finished areas, other than Equipment Rooms, with satin finish stainless steel, or satin finish chrome or nickel plated brass escutcheons, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks, however, may be used.

.7 Cover exposed duct sleeves in finished areas with {1.31 mm} [18 gauge] galvanized steel plates in the form of duct collars. Fix in position with non-ferrous metal screws.

2.5. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE

.1 Where space limitations do not permit the use of expansion loops or offsets, provide Flexonics Expansion Joints properly selected for system operating pressures according to the following:

.1 For piping up to and including {65 mm} [2-1/2"], select ends to suit specified pipe fittings. Pressure shall be external to the bellows. Pressure ratings for Model H and HB expansion compensated as {1400 kPa} [200 psi] and {1050 kPa} [150 psi].

.2 Steel Piping - Flexonics Model H expansion compensator with two ply stainless steel bellows.

.3 Copper Piping - Flexonics Model HB expansion compensator with two ply bellow, all bronze construction.

.4 For piping {75 mm} [3"] and above, use flanged ends.

.5 Steel Piping - Flexonics controlled, flexing expansion joint with stainless steel pressure carrier, flanged ends.

.6 Copper Piping - Flexonics controlled, flexing expansion joint with monel pressure carrier, and brass flanged ends.

.7 Submit for Consultant review prior to installation, drawings showing the location of expansion joints, anchors and guides. Show details of proposed connection to structure and loads to be imposed. All Drawings must be signed by a Professional Engineer registered in the Province of Alberta.

2.6. STRAINERS

.1 Provide Spirax Canada Limited pipeline strainers with stainless steel screens according to the following:

Pipe Schedule	Pipe Size	Type	Model	Screen Perforation
Copper	All sizes	Y	BT Bronze	{0.76mm} [.030"] 20 Mesh
Steel	up to {50 mm} [2"]	Y	IT Cast Iron	{0.76mm} [.030"] 20 Mesh
Steel	{65 mm to 150 mm} [2-1/2" - 6"]	Y	IF Standard, for water for steam	 {3 mm} [1/8"] {1.2 mm} [3/64"]
Steel	{200 mm} [8"] and up		Basket 528B Cast Iron	{3 mm} [1/8"]

.2 Supply strainers with extra construction screens and remove after systems have been thoroughly cleaned.

.3 Equip each strainer {40 mm} [1-1/2"] and smaller in size, with plugged blow off tappings.

.4 Equip each strainer {50 mm} [2"] and larger in size, with blow off tapping. Provide blow off piping complete with capped shut off valve. Terminate in downward vertical position. Size blow off piping and valve the same size as the blow off tapping.

.5 Ensure that each strainer can be isolated from piping systems with isolating valves on each side of strainer, and which are not more than {3 metres} [10 ft] away from strainer.

.6 Provide strainers in the following locations:

.1 at the suction side of each pump

.2 immediately upstream of each pressure reducing valve

.3 immediately upstream of each control valve (except control valves, which serve an individual coil, such as a unit heater, fan coil unit, terminal reheat coil, or length of radiation)

.4 immediately upstream of each entering side of a plate and frame heat exchanger

.5 where shown on Detail Drawings

2.7. DRAINS

.1 Provide {40 mm} [1-1/2"] minimum size copper pipe drains from overflows, condensate pans and pump bases to floor drains.

.2 Provide minimum {20 mm} [3/4"] ball valve with hose end adapter, metal cap and chain at all low points of all systems. Locate to allow easy connection of hose.

.3 Provide {40 mm} [1-1/2"] minimum size drains from ductwork connected to intake hoods and wall louvres. Equip drains with deep seal traps. Locate traps in heated areas.

.4 Provide {20 mm} [3/4"] valves with metal caps and chains at the base of all pipe risers. Install hose end ball valve in conjunction with {450 mm} [18"] minimum length full line size dirt leg.

2.8. WELLS

.1 Install wells or sensing elements where required and where directed by the Automatic Controls Trade.

.2 Provide suitable separable chrome plated forged brass thermometer wells, complete with caps and chains in the following locations:

.1 where shown on Detail Drawings and, in addition;

.1 on entering and leaving sides of chillers and condensers

.2 on the entering and leaving sides of liquid-to-liquid heat exchangers, and

.3 on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers

.4 on the entering and leaving sides of water heating and cooling coils

.5 on downstream side of mixing valves

.6 domestic hot water storage tanks

.7 on individual supply and return lines at each boiler

.8 where shown on the Mechanical Drawings

.3 Use extension necks where required to locate sockets outside of insulation.

2.9. THERMOMETERS

.1 For air thermometers, refer to Section 25 50 00 or 25 30 00.

.2 Liquid thermometers shall be Trerice BX9 Series adjustable angle separable well type, calibrated in ^{o}C and ^{o}F

.3 Thermometers shall be complete with fully adjustable angle hinge assembly, {225 mm} [9"] aluminum case, unbreakable window, lens front, red appearing mercury tubing and brass stem. Locate to be easily read from {1500 mm} [5 ft] level.

.4 Select thermometers to suit full temperature range of liquid. Operating temperature shall indicate at approximately mid point of scale.

.5 Thermometers shall have a reservoir top to allow not less than 25% temperature over scale without damage.

.6 Submit schedule in the form of Shop Drawings to show for each thermometer, the duty, location and scale range.

.7 Provide thermometers in the following locations:

.1 where shown on Detail Drawings and, in addition;

.1 on entering and leaving sides of chillers and condensers

.2 on entering and leaving sides of liquid-to-liquid heat exchangers

.3 on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers

.4 on entering and leaving sides of water heating and cooling coils

.5 on downstream side of mixing valves

.6 domestic hot water storage tanks

.7 individual supply line from each boiler

.8 individual return line to each boiler

.9 where shown on the Mechanical Drawings

.8 Supply to the Owner, for his use, two additional thermometers, representative of the above scale ranges.

2.10. PRESSURE GAUGE CONNECTIONS

.1 Provide pressure gauge connections in the following locations:

.1 where shown on Detail Drawings and, in addition;

.1 on entering and leaving sides of chillers, condensers and on cooling tower headers

.2 on the entering and leaving sides of liquid-to-liquid heat exchangers

.3 on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers

.4 on entering and leaving sides of each water heating and cooling coil

.5 on entering domestic cold water services

.6 on suction and discharge sides of pumps and circulators

.7 at the top of fire protection pipe risers

.8 on expansion tanks

.9 on entering and leaving sides of strainers

.10 on entering and leaving sides of pressure reducing valves

.11 at top and bottom of each main supply and return riser (excluding perimeter risers)

.12 where shown on Mechanical Drawings.

.2 Provide Trerice No. 735 {6 mm} [1/4"] brass needle valves at each pressure gauge connection.

.3 Where gauges are not connected, cap gauge connections after balancing of system.

.4 Locate gauge connections to ensure that gauges can be read easily from a level {1500 mm} [5 ft] above the floor.

2.11. PRESSURE GAUGES

.1 Gauges shall be Trerice {113 mm} [4-1/2"] size No. 600B with black finish cast aluminum case, phosphor bronze Bourdon tube, brass rotary type movement, bronze bushed, silver brazed tip and socket joints, adjustable type pointer and calibrated in kPa and psi.

.2 Provide ULC listed and labelled gauges in fire standpipe and sprinkler systems.

.3 Install each gauge with Trerice brass impulse dampener.

.4 Select gauges to suit an overpressure of 25% without damage to movement. Normal operating pressure shall indicate approximately at mid point of dial. Provide compound type gauge and scale for suction connection to pumps connected to open systems or equipment.

.5 Provide gauges with an accuracy of 1% of full scale.

.6 Submit a schedule to show for each gauge, the duty, location and dial range.

.7 Provide gauges in the following locations:

.1 where shown on Detail Drawings and, in addition;

.1 on entering and leaving sides of chillers, condensers and on cooling tower headers

.2 on the entering and leaving sides of liquid heat exchangers

.3 on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers

.4 on entering domestic cold water services

.5 on suction and discharge sides of pumps and circulators

.6 at the top of fire protection pipe risers

.7 on expansion tanks

.8 on entering and leaving sides of pressure reducing valves

.9 where shown on Mechanical Drawings.

.8 Supply two additional gauges to the Owner for his use, representative of the above scale ranges.

2.12. ACCESS DOORS AND PANELS

.1 Provide access to concealed mechanical equipment and components which require inspection, adjustment, repair and preventive maintenance. Install systems and components to result in a minimum number of access doors and panels. Install equipment and components in locations readily accessible through doors and panels.

.2 Supply for installation by Other Contractors, doors, panels and frames. Ensure that access doors and panels are properly located.

.3 Select access doors and panels to suit Architectural finishes and large enough to provide adequate access to equipment and components. Where personnel must pass through, provide {600 mm x 450 mm} [24" x 18"] minimum size doors and panels. Otherwise, provide {300 mm x 300 mm} [12" x 12"] minimum size doors and panels.

.4 Provide access doors and panels with a fire rating required by the code governing the fire rating of the structure.

.5 In tile walls, and washroom walls, supply minimum {2.78 mm} [12 gauge] Type 304 stainless steel with #4 finish, with recessed frame secured with stainless steel countersunk flush head screws.

.6 For all other surfaces, supply minimum {2.66 mm} [12 gauge] welded steel, flush type with concealed hinges, lock and anchor strap, and factory prime coat finish.

2.13. FLASHING

.1 Flashing will be carried out under Division 07 50 00 for roof curbs shown on the Architectural or Structural Drawings.

.2 Provide flashing for pipe openings or premanufactured roof curbs.

.3 Carry out all counterflashing for roof mounted mechanical equipment and for pipes and ducts passing through roof. Fit counterflashing over flashing or curb. Pitch pockets are not acceptable.

2.14. CURBS

.1 Curbs required for Division 20 work and shown on the Structural or Architectural Drawings will be carried out under other Divisions of the Specifications.

.2 Premanufactured curbs for mechanical equipment mounted on roof will be supplied by equipment manufacturer and they are specified under other Sections of this Division.

.3 Curbs are required for roof mounted equipment, around ducts passing through roof and surrounding holes where groups of pipes and/or ducts pass through Equipment Room floors, Kitchens and similar areas where water dams are required.

.4 Provide roof curbs at least {300 mm} [12"] above finished roof, unless exceeded by Architectural considerations.

.5 Provide concrete curbs around holes in Equipment Room floors, extending at least {150 mm} [6"] above finished floor. Make watertight connection between curb and floor.

2.15. CONCRETE

.1 Provide {100 mm} [4"] concrete housekeeping pads under all floor mounted mechanical equipment and supports. Extend pads over the full equipment base and isolator area.

.2 Concrete work, including housekeeping pads, required for Division 20 work and shown on the Structural or Architectural Drawings will be provided by Division 3.

.3 Provide other concrete work required for Division 20 work, including reinforcing steel.

2.16. COVERS

.1 Supply frames for installation by Division 3.

.2 Provide covers for pits and sumps.

.3 Provide gas tight gaskets for sewage pits.

.4 Trench gratings will be provided by Division 5 - Metals.

2.17. STEEL

.1 Provide steel required for Division 20 work including supports, framing of openings and lintels over openings that is not shown on Structural or Architectural Drawings.

.2 Provide steel of adequate strength to support equipment and materials during all operating and test conditions.

.3 Support suspended equipment from the bottom or from manufacturer's designated suspension points. Support tanks and similar equipment with adequate beam strength by saddles with curvature to match the equipment. Continuously support other equipment.

.4 Provide base supports for all pipe risers. Design to distribute operating and static loads.

.5 Fabricate steel supports in contact with water or humidity conditions from materials having approved corrosion resistance or galvanize after fabrication or brush welds clean and apply a prime coat of rust inhibiting paint.

2.18. FIRESTOPPING

.1 Provide ULC classified firestopping products by 3M or Hilti which have been tested in accordance with CAN4-S115.

2.19. WELDING AND BRAZING

.1 All welding and brazing shall conform to all rules and regulations which apply in the latest issues of the following codes and standards:

.1 Building Services Piping Code ANSI/ASME B 31.9 (latest edition)

.2 CSA B51 (latest edition), Boiler, Pressure Vessel and Pressure Piping Code

.3 ASME Boiler Code - Section IX

.4 All requirements of the Technical Standards and Safety Authority (TSSA)

.2 Welding shall conform to a welding procedure which must be in accordance with TSSA requirements and include materials, weld preparation, heat treatment and welding equipment to be used.

.3 Qualify all welders for the project work according to ASME equivalent testing procedures. The contractor shall not use welders, under any circumstances, for on site or off site work which are not qualified for the work performed. Maintain records for all qualification testing, by welder and provide copies to the Consultant on request. Qualification will include welding and examination of test pieces.

.4 Qualified welders shall be issued with an identification number and a stamp for use in identifying welds performed by an individual welder. Welding work shall be identified using the identification number and the contractor shall maintain identification records.

.5 Welds shall be full penetration, continuous and without defects. After deposition, each layer of weld shall be cleaned to remove slag and scale by wire brushing or grinding, then chipped where necessary to prepare for proper deposition of the next layer. The weld reinforcement shall not be less than {1.6 mm} [1/16"] and not more than {3.2 mm} [1/8"] above the normal surface of the joined sections. The reinforcement shall be crowned at the centre and shall merge into the base material without excessive shoulder or undercut.

.6 Welding shall be made by machine or manual shielded metallic arc process. Direct current shall be used exclusively with the base material on the negative side of the line. Electrodes used shall be an approved all position rod type.

.7 Provide a copy of TSSA registration and include with Maintenance Manuals.

PART 3 - EXECUTION

3.1. EXCAVATION AND BACKFILL

.1 Conform to the requirements of Division 2.

.2 Read subsurface information data.

.3 Excavation and backfill required for Division 20 work inside the building and to a point {1.5 m} [5 ft] outside building shall be carried out by the Division listed in the following schedule:

.1 Excavation:

Initial excavation to {150 mm} Division 2 [6"] above pipe inverts

.2 Final excavation to pipe inverts Division 20

.3 Backfill

Initial backfill with sand to Division 20 {300 mm} [12"] above top of pipes

.4 Final backfill Division 2

.4 Ensure that excavation work is executed to attain required inverts and grades.

.5 Remove material excavated by Division 20 and not to be reused, from the site.

.6 Carefully prepare the bottom of pipe trench. Use one of the following bedding methods:

.1 In firm undisturbed soil, lay pipe directly on the soil and shape soil to fit the lower 1/3 segment of pipe and fittings.

.2 In rock, shale and where noted, excavate to {150 mm} [6"] below and minimum {200 mm} [8"] on each side of pipe. Form a {150 mm} [6"] thick bedding using {10 mm} [3/8"] crushed stone. Provide continuous support over at least the lower 1/3 segment of pipe.

.3 In unstable soil, in fill and where soil has been disturbed during previous excavation work, excavate to at least {150 mm} [6"] below bottom of pipe and form a reinforced concrete cradle supporting full length between firm support, or install piers down to undisturbed solid soil. Piers shall be at a maximum spacing of {2400 mm} [8 ft]. Provide at least one pier for each pipe length. Support over at least the lower 1/3 segment of pipe.

.7 Where excavation is necessary close to and below the level of any footing, backfill with {14,000 kPa} [2000 psi] concrete to the level of the highest adjacent footing. Do not proceed with the work prior to receiving written approval from Consultant.

.8 Obtain approval from governing authorities and Consultant before backfilling.

.9 Provide backfilling materials as specified in Division 2. Lay and compact as specified in Division 2.

3.2. PIPE, DUCT AND EQUIPMENT INSTALLATION

.1 Locate distribution systems, equipment and materials for maximum usable space, optimum service clearances and to accommodate current requirements and identified future expansion.

.2 Coordinate Division 20 services installation above typical floor modular ceilings to allow installation and future relocation of lights and air troffers without interfering with or requiring relocation of mechanical, electrical or other services, or removal of ceiling grid.

.3 Include all pipe and duct offsets required to eliminate interference with the work of other Divisions.

.4 Install equipment and materials to present a neat appearance. Run piping, ducts and conduit parallel to or perpendicular to building planes. Conceal piping, ducts and conduit in finished areas. Install so as to require a minimum amount of furring.

.5 Install pipe, duct and conduit straight, parallel and close to walls and slab or deck underside, with specified pitch.

.6 Use standard fittings for all direction changes. Do not use drilled tees and other field fabricated fittings.

.7 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.8 Where pipe sizes differ from connection sizes of equipment, provide reducing fittings between inline components such as valves, strainers and fittings, and equipment. Reducing bushings are not permitted.

.9 Cap open ends of piping during installation.

.10 Lay copper tubing so that it is not in contact with dissimilar metal and will not kink or collapse.

.11 Use non-corrosive lubricant or teflon tape equal to Dow Corning and apply on male thread.

.12 Provide brass adaptors or dielectric couplings wherever dissimilar metals are joined.

.13 No pipe to be laid in water or when, in opinion of Consultant conditions are unsuitable.

.14 Protect buried copper and steel piping with Tapecoat materials using procedures recommended by Tapecoat Company of Canada Limited, or other approved manufacturer.

.15 Ensure that pipe installation does not transmit vibration to the walls and floors through which they pass.

.16 Make provisions for neat insulation finish around equipment and materials. Do not mount equipment within insulation depth.

.17 In electrical rooms and elevator machine rooms, provide drip trays under the entire length of all pipe within the confines of the room. Pipe drip tray to nearest floor drain.

.18 Perform pipe welding to meet ANSI B31.9.

3.3. CONNECTIONS TO EQUIPMENT

.1 Provide unions or flanges at all connections to equipment. Ensure that piping adjacent to equipment is readily removable for servicing and/or removal of equipment without shutting down entire system.

.2 Install unions in piping up to and including {50 mm} [2"] pipe size. Install flanges in piping {65 mm} [2-1/2"] pipe size and larger.

.3 Prevent galvanic corrosion by isolating copper and steel. Use red brass adapters, or completely isolate flanges using full face gaskets with bolts installed through phenolic sleeves with insulating fibre washers. Where the Plumbing Code prohibits the use of red brass adapters, use insulating couplings. Where system valves are required, solid brass isolating valves may be used in lieu of adapters or couplings.

.4 Provide metallic code rated continuity link between flanges or unions, where pipe mains carry flammable fluids or gases.

.5 Make all plumbing and sheet metal connections to equipment provided by the Owner.

3.4. INSERTS

.1 Size and space for the loads to be supported.

.2 Properly locate and firmly secure inserts to forms before concrete is poured.

.3 Place inserts only within main structure and not in any finishing materials.

.4 When inserts are required in precast concrete, supply inserts and location drawings to the precast concrete supplier for casting into material. Otherwise, include the cost of having the precast concrete supplier install inserts at the site.

.5 Do not use powder actuated tools.

3.5. HANGERS

.1 Suspend piping, ductwork and equipment with all necessary hangers and supports required for a safe and neat installation. Ensure that pipes are free to expand and contract and are graded properly. Adjust each hanger to take its full share of the weight.

.2 Suspend hanger rods directly from the structure. Do not suspend pipes, ducts or equipment from other pipes, ducts, equipment, metal work or ceilings.

.3 Provide auxiliary structural steel angles, channels and beams where ductwork, piping and equipment must be suspended between joists or beams.

.4 Use galvanized rods, steel support angles, channels and beams where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.

.5 Space hangers to ensure that structural steel members are not over stressed. In no case shall pipe hangers be further apart than indicated in the tables. When requested, submit detailed drawings showing locations and magnitude of ductwork, piping and equipment loads on the structure. Provide calculations when requested by Consultant.

.6 Do not use trapeze type hangers for support of piping, without prior review by Consultant. Where permitted, fabricate from angle or channel frames, and space hangers to suit the smallest pipe size.

.7 Do not use hooks, chains or straps to support equipment and materials.

.8 For precast concrete work, if inserts cannot be cast into members, pass hanger rods between the members and weld to steel plates resting on the upper surface of the precast

material. To prevent raising of the hanger rod, apply a lock nut and {50 mm} [2"] minimum dia. flat washer tight against the under surface of the precast material.

.9 Ensure that copper materials are completely isolated from ferrous materials. Use plastic or epoxy coated hangers and clamps. Use lead inserts between copper piping and other ferrous materials.

.10 Provide round steel threaded rods meeting ASTM A-36. Provide cadmium plated rod and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.

.11 The following table establishes minimum standards of rod sizes and hanger spacing for steel and copper piping.

Maximum Horizontal Spacing of Supports			
Pipe Size {mm} [in]	**Rod Size {mm} [in]**	**Steel {m} [ft]**	**Copper {m} [ft]**
{12} [1/2]	{10} [3/8]	{1.5} [05]	{1.5} [05]
{20} [3/4]	{10} [3/8]	{1.8} [06]	{1.8} [06]
{25} [1]	{10} [3/8]	{1.8} [06]	{1.8} [06]
{32} [1-1/4]	{10} [3/8]	{2.4} [08]	{2.1} [07]
{40} [1-1/2]	{10} [3/8]	{2.7} [09]	{2.4} [08]
{50} [2]	{10} [3/8]	{2.7} [09]	{2.7} [09]
{65} [2-1/2]	{12} [2]	{3.0} [10]	{3.0} [10]
{75} [3]	{12} [2]	{3.0} [10]	{3.0} [10]
{90} [3-1/2]	{12} [2]	{3.0} [10]	{3.3} [11]
{100} [4]	{16} [5/8]	{3.0} [10]	{3.7} [12]
{125} [5]	{16} [5/8]	{3.7} [12]	{3.7} [12]
{150} [6]	{20} [3/4]	{3.7} [12]	{3.7} [12]
{200} [8]	{22} [7/8]	{3.7} [12]	
{250} [10]	{22} [7/8]	{3.7} [12]	
{300} [12]	{22} [7/8]	{3.7} [12]	
{350} [14]	{25} [1]	{3.7} [12]	
{400} [16]	{25} [1]	{3.7} [12]	
{450} [18]	{29} [1-1/8]	{3.7} [12]	
{500} [20]	{32} [1-1/4]	{3.7} [12]	
{600} [24]	{32} [1-1/4]	{3.7} [12]	

.12 For steel pipe sizes larger than {600 mm} [24"], refer to Drawings.

.13 In addition to these basic requirements, provide hangers in the following location:

.1 to eliminate vibration

.2 at points of vertical and horizontal change of direction of pipe

.3 at inline centrifugal pumps

.4 at valves and strainers

.5 on mains at branch takeoffs

.6 to avoid stress on equipment connections

.14 Install spring hangers or other special supports specified in Section 20 05 48.

.15 Support horizontal cast iron soil pipe at each hub. Where groups of fittings occur, not more than three joints shall be between hangers.

.16 Refer to applicable articles of the Specification regarding thermal insulation requirements. Unless shown specifically on Drawings, provide the following support methods.

.1 For insulated warm and hot water piping, for condensate piping and for steam piping up to {65 mm} [2-1/2"] diameter, support with hangers directly on piping.

.2 For steam piping {75 mm} [3"] diameter and above, support with hangers under specified protection saddles.

.3 For chilled water and domestic cold water piping, hangers shall be large enough to fit over specified pipe covering. At each point of support, install specified protection saddles with sufficient length to prevent crushing of insulation.

.17 Generally, support ducts with {2.7 mm} [12 gauge] by {25 mm} [1"] wide galvanized hangers or with {12 mm} [½"] dia. rods and {40 mm} [1-1/2"] rolled angle saddles to meet SMACNA or ASHRAE Standards.

.18 Support vertical duct risers at each floor with rolled angle collars bearing on building structure.

3.6. SLEEVES, WALL PLATES, FLOOR PLATES

.1 Set sleeves for piping and ductwork in conjunction with erection of floors and walls. Locate sleeves accurately in accordance with submittal drawings, and as follows:

.1 Through interior walls, set sleeves flush with finished surfaces on both sides.

.2 Through exterior walls above grade, set sleeves flush with finished surfaces on inside and to suit flashing on outside.

.3 For floors in Mechanical Equipment Rooms, Janitors Closets, Kitchens and similar areas where a water dam is required, set sleeves flush to underside of structure and extending {50 mm} [2"] above finished floor.

.4 For other floors, set sleeves flush to both finished surfaces. Refer to Room Finish Schedule.

.2 Size sleeves to provide {25 mm} [1"] clearance around insulated piping and ductwork.

.3 Provide continuous insulation runs through fire separations. Ensure that piping and ductwork do not touch sleeves or for warm and hot water piping and ductwork terminate insulation cover on each side of sleeve. For chilled water and domestic cold water piping, provide

same thickness Manville Thermo-12 pipe insulation with all purpose vapour barrier jacket through fire separation to a point {100 mm} [4"] on each side of fire separation.

.4 Install leak tight seals to meet the manufacturer's requirements. Select the inside diameter of each wall sleeve opening to fit the pipe and leak tight seal, all to ensure watertight joint.

.5 Additional sleeving requirements:

.1 Provide sleeves for systems not part of Contract, but identified to be required on Drawings.

.2 Provide sleeves to accommodate compressed air piping and wiring conduits required for Division 20 work.

.3 Provide additional sleeves as required by Drawings to accommodate service requirements. Include for the cost of drilling and setting sleeves.

.4 Fill unused sleeves through fire separations with firestop material (see Firestopping article). Fill other unused sleeves with suitable noncombustible materials.

3.7. FIRESTOPPING

.1 Ensure that fire ratings of floors and walls are maintained.

.2 Pack clearance spaces, fill all spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.

.3 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.8. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE

.1 Make provision for pipe expansion, contraction and building shrinkage with suitable anchors and offsets or expansion loops.

.2 Install piping to allow freedom of movement in all planes without imposing undue stress on any section of main piping, branch piping, equipment and structure.

.3 Use offsets at takeoffs to radiation, unit heaters, fan coil units, risers and other branch lines.

.4 Select expansion joints for the calculated movement according to the following temperature ranges.

.1 For cold pipes, from minimum operating temperature to {38^{o}C} [100^{o}F], plus 25% safety factor.

.2 For warm and hot pipes, from minimum ambient, but not lower than {-5^{o}C} [23^{o}F], to maximum operating temperature plus 25% safety factor.

.5 When ambient temperature during installation is higher than operating temperature, use precompressed expansion joints.

.6 Select expansion joints to withstand system test pressure, as well as operating pressures and temperatures.

.7 Install expansion joints in accordance with manufacturer's published installation instructions.

.8 During the construction and warranty periods, regularly review provisions for building shrinkage and make necessary adjustments to piping to ensure freedom from binding and stress.

3.9. PIPE GUIDES AND ANCHORS

.1 Install pipe guides for expansion joints according to expansion joint manufacturer's published recommendations. Use at least two guides on each side of expansion joint.

.2 Install manufactured or field fabricated alignment guides to allow movement in axial direction only.

.3 Install vertical risers properly anchored and guided to maintain accurate vertical position of piping. At time of startup, clean and lubricate guides, and adjust to allow free sliding at operating conditions.

.4 For piping up to and including {75 mm} [3"], guide pipes at every floor or every {3900 mm} [13 ft]. Guide larger pipes at every second floor or every {7500 mm} [25 ft].

.5 Fabricate anchors from structural steel channels, plates or angles.

.6 Secure anchors to the structure. Avoid introduction of excessive reactive forces and operating weights into the structure and onto equipment and piping.

.7 Where guides are provided on cold piping, provide thermal break to prevent sweating.

3.10. PAINTING

.1 Supply ferrous metal work except piping and galvanized and stainless steel ductwork, with at least one factory prime coat, or paint one prime coat on job.

.2 Clean and steel brush surfaces with welds. Then prime coat all steel supports and brackets.

.3 On uninsulated piping, steel brush and prime coat welds.

.4 Touchup or repaint all surfaces damaged during shipment or installation and leave ready for finish painting.

.5 Prime coat material shall conform to Canadian General Standards Board Standard No. 1-GP-48.

.6 Finish painting will be provided by Division 9.

3.11. ADDITION OF NEW CIRCUITS

.1 Before any system is connected to an existing system, the new system must be separately cleaned by the specified method and treated as required. No system may be connected to an existing system unless certified clean by the Contractor and inspected by the Consultant.

3.12. WELDING AND BRAZING INSPECTION

.1 Make welding and brazing work for HTHW and high pressure steam available at any time for inspection by the Consultant. Welded joints shall be gamma-ray radiographed by an independent reputable firm specialized in this field, whose appointment shall be subject to the Consultant=s approval. Submit the name and qualifications of the proposed firm to the consultant for review. Perform radiography in accordance with CSA Code B51.

1. Seven line joints in piping subject to high working pressure and three in other piping, as selected by the Consultant from the first 50 production welds in each pressure category.

2. Additional joints to a maximum of 1% of all weld joints.

3. Radiograph all above joints over the full circumference.

4. For every failure, two additional joints shall be selected by the Consultant for testing.

.2 Examine weld preparation and welding on site and off site at various stages of fabrication.

.3 Radiographs will be interpreted in accordance with CSA Code B51.

.4 The independent testing firm shall submit written evaluations of all testing.

.5 Make all radiographic film evidence of tested welds available for examination by the Consultant. Turn over original films for Owner's files.

.6 Failure of any retests by one welder shall result in examination of that welder's qualifications and test work. Further testing will be required in that welder's work without additional cost to the Contract.

.7 Any and all welds found to be of poor or doubtful quality shall be cut out and replaced with satisfactory welds at Division 20 expense.

.8 One or more of the following defects shall be cause for rejection of a weld:

.1 failure to meet radiographic requirements or other code tests

.2 welding performed by unqualified personnel

.3 welds not reasonably uniform in appearance

.4 evidence of peeling

.5 cracks

.6 oxidation around welds

.7 lack of fusion

.8 the presence of porosity, slag inclusion or overlaps

.9 undercutting adjacent to completed welds or evidence of undercutting by grinding

.9 Maintain full records of all testing and submit copies to the Consultant showing details of each inspection, with the radiograph recording and the name and identification of the welder. Provide the test results within 24 hours of the test.

.10 Include all costs associated with the specified inspection of welding and brazing.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with the Agreement between the Construction Manager and Trade Contractor and all other documents referred to therein.

.2 Provide all services, materials and labour required to fully commission the mechanical systems in accordance with this Section of the Specification.

.3 Comply with Mechanical Specification 25 50 00 Electronic Controls and Monitoring.

1.2. COORDINATION

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Coordinate the work of this Section with all other Divisions to ensure complete and operational mechanical systems at completion of this work.

.3 Appoint a single person as Commissioning Coordinator who shall be responsible for progressing the commissioning activities of each Division 20 trade. The Commissioning Coordinator shall report to the Commissioning Manager.

.4 Review the design intent of the project and the intended operation of systems with the Consultant before proceeding with commissioning.

1.3. QUALITY ASSURANCE

.1 The commissioning process shall meet the requirements of CAN/CSA Z31 series, the Code of Practice for Commissioning Mechanical Systems in Buildings. Meet ASHRAE Standard 1-1989 Guideline for Commissioning of HVAC Systems and the Commissioning Guideline published by APEGGA.

.2 Division may elect to source startup and handover by a specialist commissioning company. Supply to the Commissioning Manager, the following details regarding the proposed firm:

.1 Principle representative and qualifications

.2 Proposed personnel and relevant project experience

.3 Previous similar assignments and references

.4 Scope of work to be undertaken

.5 Company resources and equipment

.3 Use of a commissioning specialist shall not relieve Division 20 of the obligation to name one of his own employees as the person responsible for progressing commissioning, i.e. the Commissioning Coordinator.

.4 Supply the name, qualifications and experience of the proposed Commissioning Coordinator upon Construction Manager request. Selection shall be subject to review and the approval of the Consultant. Supply alternative person(s) when requested by Consultant.

.5 The Consultant may, at his discretion, attend and advise in the commissioning process. Meet Consultant requirements.

.6 Hold and attend regular meetings during the commissioning process. Prepare detailed progress reports to coincide with regular commissioning meetings. Coordinate with the Commissioning Manager, the preparation and issue of minutes for each meeting to be circulated to each involved trade, the Consultant and the Construction Manager representative(s). Minutes shall highlight action items.

PART 2 - PRODUCTS

2.1. SCHEDULES AND COMPLETION OF INSTALLATION OF SYSTEMS

.1 Submit to the Consultant, 8 weeks prior to the scheduled commissioning, a detailed and comprehensive installation completion/startup/testing schedule, identifying all trades and suppliers to be involved. Update the schedule and resubmit for review, on a bi-weekly basis, during the course of commissioning. If found to be unacceptable, revise the schedule and the construction forces to suit the reviewed schedule. This schedule shall include, but is not limited to the following items:

.1 Installation and testing of pipe systems

.2 Installation, leak testing and cleaning of duct systems

.3 Chemical clean out and treatment of pipe systems, including disinfection of domestic water piping

.4 Control system wiring (by Control Contractor)

.5 Air and water balancing (by Balancing Contractor)

.6 Electrical service connections (by Electrical Contractor)

.7 Equipment suppliers prestart checkout of the equipment installations, including controls and ice rink refrigeration system

.8 Start up of various pieces of equipment and systems

.9 Operational testing of system components

.10 Performance testing of equipment and systems

.11 Acceptance testing of equipment installations and systems including fire and sprinkler systems, by authorities having jurisdiction and Owner's insurance company

.12 Troubleshooting

.13 Calibration of controls and point checkout (by Control Contractor)

.14 Control software setup and checkout including seasonal and response checkout of operating sequences, PID optimization (By Control Subcontractor).

.15 Emergency system checkout

.16 Fire alarm and control system interfacing (by Control Contractor & Division 26)

.17 Submittal of completed equipment and system checkout sheets

.18 Demonstration of systems and equipment

.19 Maintenance manual preparation and submittal

.20 Operator training program

.21 Record documentation submittal

2.2. RECORD DOCUMENTATION

.1 Prepare record documentation for each equipment installation covering:

.1 Equipment identification and supplier

.2 Shop Drawing submittal, review, production release, and delivery dates

.3 Dates for completion of all work required to prepare for equipment installation

.4 Dates for equipment installation, supplier prestart checkout and system availability for startup

.5 Dates for equipment startup, performance testing, proposal for temporary use, acceptance testing, demonstration, turnover and warranty start/finish

.2 Submit proposed record sheets and procedures to Consultant for review, when requested by the Owner.

.3 List all specialist personnel and equipment required for the test and ensure that these are available by the test date.

.4 Provide documentation of the commissioning process for inclusion into the maintenance manuals. These are to include checkout sheets, equipment data sheets, startup certificates from suppliers involved in startup, documentation concerning demonstration to the Owner. Include all records and result sheets from commissioning tests.

.5 Maintain a log of key operating parameters, problems encountered, solutions employed and verification of effectiveness of solutions. Include log in maintenance manuals.

.6 Refer to example documentation available from Construction Manager's representative. Meet or exceed this level of reporting.

2.3. STARTUP

.1 Coordinate and supervise the startup of the various pieces of equipment and systems. Utilize the startup services of the manufacturer's representative. Ensure that the equipment is operating in a satisfactory manner. Check the following items:

.1 Direction of rotation

.2 Grease and lubricants

.3 Noise, if deemed to be a problem

.4 Seals

.5 Alignment of pump and fan drives by a millwright

.6 Piping connections and safeties

.7 Electrical amp draw, starting inrush current and trip/heater settings

.2 Meet Section 20 04 00 requirements for Temporary Services and Temporary and Trial Use.

2.4. TROUBLESHOOTING

.1 Resolve inter-Division coordination problems.

.2 Where problems become apparent during the commissioning process, identify and resolve these problems. The basic functions in troubleshooting are:

.1 What - identification and definition of the problem

.2 Why - determination and evaluation of the causes

.3 When - determine the time available to resolve the problem

.4 Involve the designing authority in the review of the problem and proposed resolution

.5 Coordinate remedial action with the appropriate parties

.6 Evaluate the effectiveness of the remedial action

.7 Record the problem, cause, remedial action and result

2.5. OPERATION AND TESTING

.1 Meet Section 20 04 00 requirements for Inspection, Testing and Certificates.

.2 Test the operation of the individual components and systems. Go through each step of the sequence of operation and verify that each component operates correctly. Direct and ensure that all trades involved make the required changes and adjustments to effect the proper operation of all components and systems. Meet commissioning test requirements.

.3 Document operation and testing.

.4 Carry out operational tests for the current season and simulate operation of summer, winter and intermediate seasons.

2.6. DEMONSTRATION

.1 Demonstrate to the Owner the proper operation of all equipment and systems supplied under this Division. Demonstrations shall occur only after the operation and testing has been successfully completed. Ensure that Trade Contractor and equipment suppliers participate in the demonstration as required.

.2 Meet Section 20 04 00 requirements for Instruction to Owners.

2.7. OPERATING AND MAINTENANCE MANUALS

.1 Meet Section 20 04 00 requirements.

2.8. RECORD DRAWINGS

.1 Meet Section 20 04 00 requirements.

2.9. COMPLETION

.1 Meet Section 20 04 00 requirements.

2.10. SPARE PARTS

.1 Provide a list of spare parts, special tools, lubricants, etc. for each item of equipment which has been purchased as part of the Contract.

.2 Provide a listing of recommended spare parts for all equipment installed under Division 20, to cover a period from Substantial Completion to Warranty end.

.3 Provide at minimum, the following information for recommended spare parts:

.1 Manufacturer's name, address, phone and fax numbers

.2 Manufacturer's part name, part number, unit price, lead time, shelf life

.3 Quantity recommended for 1 year

.4 Alternative suppliers of compatible parts, including local supplier name, address, phone and fax numbers

.4 Submit preliminary list of spare parts and tools to Owner at least 30 days prior to intended system handover to Owner. The Owner reserves the right to add to, reduce or omit entirely, the recommendations contained on these lists.

PART 3 - EXECUTION

3.1. COMMISSIONING TESTS

.1 Verify readings, calibration and setup of sensors and equipment, including:

.1 Temperature sensors

.2 Freeze protection devices

.3 Flow switches

.4 Status switches

.5 Temperature and pressure gauges and gauge connection utilization

.6 Control damper positioning, including tightness when closed and full open/balance position

.7 Alarm contacts

.2 Verify correct sensors are reporting accurately to the distributed field panels and operator workstation.

.3 Operate each air handling unit. Verify and correct the following if required:

.1 Start/stop from the terminal

.2 Correct open/close and modulation procedures with valves and dampers

.3 Stable operation of controls under normal conditions and with changes in air/water/on/off conditions

.4 Trend logs operation indication

.5 Piping, sensor and unit installation

.6 Filters for bypass

.7 Drain pan operation and trap priming

.4 Verify operation of heat pump/condenser water pumps and support systems, including:

.1 Heat exchangers, dampers, heat pump control valves, and makeup water

.2 Condenser water pump and chiller control valves with sequence and flow rates

.3 Condenser water bypass

.5 Verify operation of heated water and chilled water pumps and support systems, including:

.1 Full checkout by manufacturer's startup representative

.2 Heat exchanger operation

.3 Temperature control stability

.4 Strainer and filter performance

.5 Pumping

.6 Verify systems pipe cleaning and chemical treatment condition for all systems.

.7 Verify duct cleaning, air and water balancing and air pattern adjustments.

.8 Verify access to each fire damper.

.9 Verify that all cooling coil drain pans and condensate piping operate.

.10 Verify backflow preventer operation.

.11 Verify operation of fire protection system including flow switches and supervisory switches.

.12 Demonstrate access to all valves, equipment and components for servicing.

.13 Coordinate with Division 26, a power failure test with emergency generator startup.

.1 Miscellaneous equipment on emergency power, with Division 26.

.2 Stability of control equipment with startup power surge

.3 Controls system recovery

.14 Verify the operation of all other equipment provided by Division 20.

.15 Verify that interfacing to the work of other Divisions results in complete and operational systems.

3.2. POST SUBSTANTIAL PERFORMANCE VISITS

.1 Visit the site and the Owner's representative each month after Substantial Performance for a minimum period of two days until the end of the project warranty period.

.2 Review the operation of the system.

.3 Correct any operating problems, if problem is related to warranty issues.

.4 Prepare a report for the Consultant and Construction Manager for inclusion in the Operating Manuals of the problems and issues that have arisen and the corrective action(s) recommended and implemented.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

1. Comply with Division 1, General Requirements and all documents referred to therein.
2. Provide all labour, materials, products, equipment and services to supply and install the motors, starters, control centres and wiring indicated on the Drawings and specified in this Section of the Specification.

1.2. REFERENCE STANDARDS

.1 Provide all labour, materials, products, equipment and services, and perform all work in accordance with the current edition of

.1 The Canadian Electrical Code, (CSA C22),

.2 EEMAC and NEMA Standards

.3 All other standards and regulations referenced by the authorities having jurisdiction.

PART 2 - - PRODUCTS

2.1. MOTORS

.1 Provide, 60 cycle, 1750 rpm motors, except where noted, with the following characteristics:

.1 under {0.75 kW} [1 hp] - single phase, 120 V

.2 {0.75 kW} [1 hp] and over - 3 phase, 460 V

.2 For all motors {.75 kW} [1 hp] up to and including {373 kW} [500 hp], unless specified differently, provide high efficiency T-frame, A.C. three phase motors which meet or exceed the most recent issue of either CSA 390 M 1998, or IEEE 112B, and are approved under the Canadian Electrical Safety Code. Provide 3-phase motors to EEMAC Design B, insulated to Class F with Class B rise, suitable for {40^{o}C} [104°F] ambient.

.3 Select motors for quiet continuous operation to suit loads imposed by equipment. Recognize that motor horsepower specified and scheduled are minimum sizes. Include extra costs for larger motors, starters, power wiring and additional control wiring if larger motors are required for alternative equipment accepted as part of the Contract Price.

.4 Provide motor enclosures as follows:

.1 open drip-proof, 1.15 service factor for motors protected from the weather and moisture entrainment to operate satisfactorily at maximum temperature and moisture levels of surrounding air for motors located in air streams.

.2 totally enclosed fan cooled 1.15 service factor for motors in all other locations.

.3 provide explosion proof motors where scheduled.

.5 Equip motors {18 kW} [25 hp] and larger, as well as those smaller but with longer than 10 second starting time, with inherent overheat protection, consisting of thermistors, one for each phase, embedded in the stator windings. Extend wires out to motor terminal box, ready for field wiring into the starter holding coil circuit. Provide manual reset tripping device compatible with starter.

.6 For variable speed equipment, provide motors which are:

.1 Rated for VFD duty/inverter duty in accordance with NEMA MG1, Part 31.

.2 Operable from a pulse width modulated (PWM) waveform and shall not saturate while operating at up to 110% of the nameplate voltage.

.3 Constructed with least Class F insulation.

.4 Constructed with cast frames.

.5 Capable of running at 10% full rated speed with the VSD output provided by the drives supplied under Section 20 09 50.

.6 Capable of withstanding voltage spikes of 1800 V in a rise time of 0.1 microsecond

.7 Provided with thermal sensors embedded in the windings with connections extended to the motor terminal box. For motor sizes up to and including {18.6 kW} [25 hp], the thermal sensors may be thermistors. For larger sizes, provide RTDs (Resistive Temperature Device). Embed sensors in that part of the windings which is in the iron for response to both copper and iron temperature.

.7 Provide single winding, variable torque (high and low speed) 2-speed motors. Provide starter to suit motor requirements.

.8 Provide motors less than {0.75 kW} [1 hp] with sealed bearings. Provide larger motors with serviceable fill and drain plugs at each bearing. Provide bearings with B_{10} design life of at least 100,000 hours.

2.2. STARTERS, CONTACTORS AND MOTOR CONTROL

.1 Starters and contactors factory built into the control panel of packaged equipment will be considered as an integral part of the package and may be from a different manufacturer.

.2 Refer to Division 26 for all other starters and contactors.

2.3. MOTOR CONTROL CENTRES

.1 Refer to Division 26 for motor control centres.

PART 3 - EXECUTION

3.1. INSTALLATION AND WIRING

.1 Provide control wiring for all equipment provided or supplied under Division 20.

.2 Provide conduit and wiring in strict accordance with the requirements of Division 26.

.3 Provide all interlock connections and relays.

.4 Provide complete wiring diagrams of all control and pilot circuits.

.5 Refer to Division 26 for:

.1 All MCC's, starters, disconnect switches, stop/start stations and lockout stops for mechanical equipment.

.2 All power wiring to mechanical equipment.

.3 Normal and emergency power service locations.

.4 Power wiring for electrical tracing.

.5 Power wiring for controls.

3.2. WARNING NOTICES

.1 Place warning notices at each starter and on or close to each motor under ECMS control.

.2 Provide conspicuous notices with bold lettering and advising that the motor is under ECMS control and may start at any time without warning. Submit notices at the shop drawing stage for Consultant review.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply and install sprinkler systems as indicated on the Drawings and specified in this Section of the Specifications.

.3 Provide all labour, materials, products, equipment and services to supply and install sprinkler systems and to relocate existing sprinkler heads and branches, as indicated on the Drawings and specified in this Section of the Specifications.

.4 Provide all labour, materials, products, equipment and services to supply and install new sprinkler system including new sprinkler heads, branches and mains, as indicated on the Drawings and specified in this Section of the Specifications. Existing branches and mains may be re-used if there is no interference with other trades and such use is acceptable with the Owner.

.5 Provide sprinkler systems including.

.1 hydraulically designed automatic wet pipe system

.2 zoning indicated on Drawings

.3 additional heads as required by Code to achieve a fully sprinklered building.

1.2. SUBMITTALS

.1 Submittals shall include layout drawings, component shop drawings, specifications and hydraulic design calculations.

.2 Submit a sample of each different type of sprinkler head to be employed on this project.

.3 Provide Submittals incorporating requirements of local authorities. Drawings shall be certified correct bearing Contractor's Engineer's stamp prior to submission as follows:

.1 Prepare fabrication and installation drawings. Submit in sequence to:

.1 Local Fire Department and other governing authorities

.2 Consultant for review

.4 At the same time as submission to the Insurance Authority, an initial preliminary single copy of this same submission (together with copy of insurance transmittal form), shall be forwarded to the Consultant for an initial cursory review and file record.

.5 No work on systems installations shall commence until after working plans are reviewed by all the above parties, unless permission in writing is received from both Owner and Consultant. Expedite production of shop drawings as soon as possible and immediately after award of Contract.

.6 After the reviews have been performed, make all required changes to the final fabrication drawings. Forward written confirmation to the Consultant that all review information has been incorporated and forwarded to the site for installations.

.7 Upon completion of the installation, recalculate systems and submit hydraulic design data based on as-built installation.

1.3. REFERENCE STANDARDS

.1 Provide ULC approved, FM approved, sprinkler fire protection systems and equipment.

.2 Supply, install, and test sprinkler fire protection systems and equipment in accordance with the applicable requirements of the current versions of:

.1 Suncor STD 0060: Standard for Fire Protection and Prevention

.2 Alberta Fire Code

.3 National Building Code of Canada.

.4 Alberta Building Code.

.5 Canadian Electrical Code.

.6 National Fire Protection Association Standards, including

.7 NFPA-13R – Standard for the Installation of Sprinkler Systems

.8 Federal Fire Commissioner of Canada

.9 Alberta Fire Marshall

.10 Municipal authorities having jurisdiction, including the Building Department and the Fire Department.

1.4. GOVERNING AUTHORITY APPROVAL

.1 Obtain approval for entire installation, equipment and materials by all governing authorities having jurisdiction.

.2 Perform all tests and provide certification as required by authorities having jurisdiction.

1.5. VERIFICATION OF WATER SUPPLY

.1 Immediately after award of contract, verify with governing authorities that the source of water is adequate for the required pressure and flow.

.2 Perform flow test on nearest fire hydrants to verify water pressure and flow requirements. Submit test data as part of Shop Drawings. Notify Consultant and all authorities 72 hours in advance of all tests. When requested, conduct tests in presence of any authorities and follow requested procedures.

1.6. COORDINATION

.1 Refer to final Architectural Reflected Ceiling Plans and coordinate locations of sprinkler heads with lighting and other ceiling mounted components. Coordinate sprinkler piping to avoid interference with all other services.

PART 2 - PRODUCTS

2.1. GENERAL

.1 Select, install and test all sprinkler system materials and products in compliance with NFPA 13R and the requirements of all authorities having jurisdiction.

.2 All products shall be ULC listed, FM approved., including but not limited to valves, fittings, sprinkler heads, hangers, all components of proprietary piping systems (such as Victaulic Pressfit), couplings, pressure switches, flow switches, alarms, gongs, accelerators, flow alarm valves, preaction valves, deluge valves, preaction and deluge control systems, excess pressure pumps, drum drips, backflow preventers, fire department connections, antifreeze system components, test and drain assemblies.

.3 All materials shall meet current applicable ANSI and ASTM standards.

2.2. PIPE, VALVES, AND FITTINGS

.1 Meet NFPA 13R and requirements specified herein.

.2 Provide pipe hangers and supports to meet NFPA 13R.

2.3. SPRINKLER HEADS

.1 Provide the following head types as shown and specified:

.1 Pendant: chrome plated recessed sprinkler heads with chrome plated escutcheons.

.2 Upright (finished areas): bronze upright sprinkler heads with bright chrome finish.

.3 Upright (unfinished areas): rough bronze upright sprinkler heads.

.4 Concealed: concealed sprinkler heads with cover plate having white paint finish.

.5 Sidewall (finished areas): horizontal chrome plated recessed sidewall sprinkler heads with chrome plated escutcheons. Provide extended coverage heads where required.

.6 Sidewall (unfinished areas): horizontal bronze sidewall sprinkler heads.

.2 Provide high temperature heads where required to suit the governing authority, and where located in elevator machine rooms, in electrical rooms and near heat producing equipment.

.3 Provide quick response heads in all light hazard occupancies, and where required by governing authorities.

PART 3 - EXECUTION

3.1. TESTING

.1 Comply with NFPA-13R requirements.

.2 Carry out any additional tests required by the authorities having jurisdiction.

.3 Perform tests in the presence of each governing authority's authorized inspector.

.4 Submit certification that systems have been designed and installed in accordance with local requirements.

.5 Perform tests before piping is concealed.

.6 Remove all components which will not withstand test pressure, and replace after tests.

.7 Eliminate leaks, or remove and refit defective parts. Caulking of threaded or welded joints will not be permitted.

.8 Repeat tests as often as necessary to obtain certification.

3.2. WATER SUPPLY

.1 Connect to incoming firewater supply as shown on Drawings.

3.3. ALARM VALVE ASSEMBLIES

.1 Install alarm valves and all accessories and connecting piping in accordance with the manufacturers requirements. Ensure that all valves, gauges, switches and other ancillaries are readily accessible for inspection and maintenance.

.2 Install and wire the hand-off-automatic starter for each excess pressure pump, to the high/low pressure switch installed on sprinkler valve discharge line. Provide power loss indicator with additional contacts to alarm loss of excess water pressure. Refer to Division 26 for alarm wiring to annunciator panel.

.3 Rigidly support each excess pressure pump on a steel mounting plate attached to the flange above alarm valve.

3.4. SPRINKLER DRAINS AND TEST CONNECTIONS

.1 Pipe discharge lines to nearest floor drains or service sinks. Do not discharge to the building exterior.

.2 Provide sprinkler drain risers to discharge location.

.3 Pipe backflow preventer relief and drain connections to nearest floor drain.

3.5. SPRINKLER HEAD INSTALLATION

.1 Install sprinkler heads symmetrically in ceiling tiles, unless otherwise directed by the Consultant.

3.6. PROTECTION

.1 Provide guards for sprinkler heads in elevator machine rooms, garbage room, mechanical rooms, storage rooms and where indicated on Drawings.

.2 Assume full responsibility for protecting sprinkler heads during painting. Replace damaged and painted components.

3.7. AS-BUILT REQUIREMENTS

.1 Be responsible for necessary modifications to the installation in the event the as-built hydraulic calculations do not meet the design criteria.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply and install the plumbing and drainage inside the building to point of connection outside the exterior building wall as indicated on the Drawings and specified in this Section of the Specifications.

PART 2 - PRODUCTS

2.1. PIPE AND FITTINGS

.1 Provide chrome plating on all exposed piping within washrooms.

.2 Provide chrome plating on all exposed piping within washrooms.

.3 Drainage and Vent Piping Inside building foundation perimeters:

.1 Underground pipe and fittings within building foundation perimeters shall be type DWV PVC, per CAN/CSA B181.2, with solvent weld joints

.2 Aboveground pipe and fittings shall be type DWV PVC, per CAN/CSA B181.2, with solvent weld joints.

.3 Aboveground drain and vent piping located in ceiling plenum spaces shall have a flame spread rating of 25 or less, and a smoke-developed classification of 50 or less. Cast iron soil pipe may be used as an alternative to plastic.

.4 Domestic Water:

.1 Domestic water piping - all sizes:

.1 Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints **or**

.2 Ipex Plumbbetter Pex hot and cold water system with brass fittings.

.2 Provide Type K soft copper pipe without joints below ground.

2.2. VALVES

.1 Provide ASTM domestic water valves to the following Kitz figure numbers:

.1 Gate Valves:

.1 {50 mm} [2"] and smaller - soldered {1400 kPa} [200 psi] w.o.g. Fig. 44.

.2 Globe Valves:

.1 {50 mm} [2"] and smaller - soldered {2070 kPa} [300 psi] w.o.g. Fig. 10 with suitable composition disc.

.3 Standard Check Valves:

.1 {50 mm} [2"] and smaller - soldered {2070 kPa} [300 psi] w.o.g. Fig. 23.

.2 For {50 mm} [2"] and smaller, ball valves may be provided as substitute for gate and globe valves. Provide ball valves with brass or bronze body, chrome plated solid ball, PTFE seats and seals and full port.

.1 up to {50 mm} [2"] - {4140 kPa} [600 psig] w.o.g. - soldered Fig 59.

.3 Provide Check-Rite or Centre Line non-slam check valves on discharge side of pumps and where shown or specified.

PART 3 - EXECUTION

3.1. VERIFICATION OF INVERTS

.1 Verify all field service conditions immediately after award of Contract to ensure that drainage runs can meet the inverts of the site services.

.2 Give notification immediately of any apparent difficulties or discrepancies.

.3 No extra will be paid at a later date for rerouting of drains because site inverts cannot be met.

3.2. TESTING

.1 Carry out not less than the following tests:

.1 Ball test drains.

.2 Perform water tests on all soil, waste, vent and rainwater systems when rough-in of the system, or section thereof including fittings, branches, cleanouts and traps except fixture traps. When the system or section is filled, shut off the water, and allow to stand for one hour. There shall be no loss by leakage during this time.

.3 Pressure test domestic cold water, domestic hot water, and recirculation lines with water at 150% of maximum operating pressure, for 6 hours without loss of pressure.

.2 Conduct additional tests required by the authorities having jurisdiction.

.3 If tests are required by an authority having jurisdiction, perform tests in the presence of each governing authority's authorized inspector, and obtain certification.

.4 Certify tests not required by the authorities having jurisdiction.

.5 Perform tests before piping, drains or vents are covered or concealed.

.6 Remove all components which will not withstand test pressure, and replace after tests.

.7 Eliminate leaks, or remove and refit defective parts. Caulking of threaded or welded joints will not be permitted.

.8 Repeat tests as often as necessary to obtain certification.

.9 Set all fixtures and fill all traps with water after tests have been completed.

3.3. CLEANING AND FLUSHING SEWERS

.1 On completion of construction of drains, flush all drains until the deposits of earth and other foreign material have been removed.

3.4. CLEANING, FLUSHING AND DISINFECTING WATER PIPING

.1 Be responsible for care and cleaning of the piping system during and after construction. Plug all open ends during construction to prevent the entrance of foreign materials.

.2 Flush all systems with clean, potable water to remove scale and sediment immediately upon filling.

.3 Sterilize all potable water lines to meet local municipal requirements.

.4 After completing satisfactory hydrostatic tests of the complete system, and flushing mains as outlined above, disinfect the mains in accordance with AWWA Standard C651-86. Repeat the flushing and disinfecting operation until the test results are satisfactory.

.5 Ensure by operation of isolating valves or the installation of check valves, that the disinfecting solution does not flow back into street mains or other sections of piping in use.

.6 Arrange and pay for water quality tests to be performed by a recognized independent testing laboratory. Obtain certificates confirming safety of potable water supply.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply and install the domestic water heaters indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

.1 Units shall meet the applicable requirements of Section 20 04 00.

1.3. PACKAGED EQUIPMENT

.1 Packaged equipment shall be factory assembled ready to accept single source power and piping connections.

PART 2 - PRODUCTS

2.1. ELECTRIC HOT WATER HEATERS

.1 Domestic electric hot water heaters shall be John Wood, A.O. Smith or Rheem, and shall be CSA approved.

.2 Tank shall be glass lined steel, factory insulated and covered with an enameled steel jacket. Tank shall be for 860 kPa (125 psi) working pressure.

.3 Heater elements shall be electric immersion type located at the top and bottom of the tank and shall be complete with thermostats. Elements shall be arranged to operate alternatively or simultaneously, as shown. An additional high limit thermostat shall prevent overheating. Access panels in jacket shall provide access to thermostats and elements.

.4 Tanks shall be complete with A.S.M.E. temperature pressure relief valve. Relief valve shall be piped to nearest drain.

.5 Size of tanks and capacity of heaters shall be as scheduled on the drawings.

2.2. POTABLE WATER EXPASION TANKS

.1 Provide Watts series PLT or series DET potable water expansion tanks. Tanks shall be of drawn steel construction and be complete with a Butyl diaphragm.

.2 Contractor to provide expansion tank based on hot water tank volume and manufacturers selection guidelines.

PART 3 - EXECUTION

3.1. INSTALLATION

.1 Provide each hot water heater system with a temperature and pressure relief valve piped to drain.

.2 Pipe storage tanks and heaters as shown on the Drawings.

.3 Comply with manufacturer's instructions for installation and clearances.

.4 Set supply water temperature for {51.7 ^{o}C} [125 ^{o}F] for domestic water service.

.5 Include documentation of extended warranties with operating and maintenance manuals.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply and install the plumbing fixtures and trim indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

.1 Provide fixtures and accessories which are CSA labelled and are new, free from cracks, flaws, and imperfections.

.2 Provide vitreous china or vitreous glazed earthware meeting CSA Standard CAN3-B45 Series.

.3 Provide stainless steel fixtures meeting CSA B45.4.

.4 Provide plumbing trim meeting CSA B125.

1.3. COORDINATION

.1 Make fixture count from Architectural and Mechanical Drawings. Provide the higher fixture quantity including all services.

1.4. MATERIALS

.1 Provide white fixtures, except where noted.

.2 Provide chrome plated piping, valves, fittings and accessories where exposed to view in washrooms.

.3 Equip hot and cold water supplies to each fixture with compression stops.

PART 2 - PRODUCTS

2.1. PLUMBING FIXTURES

.1 Plumbing fixtures shall be as scheduled and specified with all required supports, accessories, drainage, vent and water connections to make the fixtures complete.

.2 Fixtures shall be American Standard, Crane, or Kohler, equal to the fixtures specified. Fixtures shall be white.

.3 Fittings and trim shall be American Standard, Crane, Delta/Cambridge, Kohler, or Moen equivalent to the trim specified. All exposed valves, fittings, escutcheons, trim, etc., at each fixture shall be polished chrome plated brass unless specified otherwise.

.4 All tanks of water closets and urinals shall be internally lined with anti-sweat insulation. Urinal tanks shall be complete with concealed cover.

.5 All flush valves shall have non-syphon by-pass and rate of flow adjustments.

.6 For access to concealed flush valves use Delta Teck 9T400 access panel or approved equal.

.7 Showers shall be Maxx or Hytec, equal to showers scheduled.

2.2. FIXTURE CARRIERS

.1 Fixtures carriers shall be J.R. Smith, Zurn, Mifab, or Watts.

.2 Carriers shall be furnished for all wall hung water closets, urinals, lavatories, service sinks and drinking fountains. Carriers shall be floor mounted and supported independently of the wall. Carriers shall be suitable for each particular fixture. Carrier feet shall not project beyond finished wall.

PART 3 - EXECUTION

3.1. PROTECTION

.1 Protect all fixtures and trim during construction period. Replace any fixtures that contain cracks, flaws or imperfections.

3.2. INSTALLATION

.1 Install all plumbing fixtures, trim, and carriers as per manufacturers recommendations.

.2 Connect fixtures complete with supplies and drains, separately trapped, supported level and square. Hot water faucets shall be on left side. Thermostatic controlled mixing valves shall include check stops on supplies.

.3 Refer to Architectural Drawings for special mounting heights and spacing of fixtures.

.4 Insulate exposed fixture piping in accordance with local plumbing and building codes.

3.3. CLEAN UP

.1 After final installation of plumbing fixtures and trim, clean fixtures and trim, adjust trim and ensure that fixtures and trim are operational. Replace trim that does not perform satisfactorily.

END OF SECTION

PART 1 - GENERAL

1.1. QUALIFICATIONS

.1 The TAB Agency shall be a current member in good standing with either the Associated Air Balance Council or National Environmental Balancing Bureau.

1.2. SUBMITTAL REQUIREMENTS

.1 Submit the following information with the Bid Form:

.1 List of proposed equipment to be used for this project.

.2 Proof of membership in the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB).

.3 The names and qualifications of all personnel who will be assigned to this project. Use of other personnel will be grounds for contract termination.

.4 A listing of references including project names, Consultant, Contractor and Owner references with telephone numbers.

1.3. WORK INCLUDED

.1 Comply with Division 1 - General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to test, adjust and balance all air and hydronic systems to verify conformance to specified quantities and to the design intent of the mechanical system.

.3 Refer to Specification 20 08 00 for commissioning activities to be performed by others. Cooperate with the Commissioning Agent.

.4 The following systems and/or equipment are included in the Scope of Work:

.1 Air Systems:

.1 Air Handling units (Fancoils)

.2 Heat Recovery Ventilators

.3 Exhaust Fans

.4 Zone Branch and Main Ducts

.5 Diffusers, Registers and Grilles

.6 Coils (Air Temperatures and Flow)

.2 Hydronic Systems:

.1 Pumps

.2 System Mains and Branches

.3 Heat Exchangers

.4 Coils (Water Temperature and Flow)

.5 Terminal Units

.3 Domestic Systems:

.1 Domestic Booster Pumps

.2 Domestic Hot Water Recirculation

.3 Domestic Hot Water Storage Tank Heaters

.4 Pressure Reducing Stations

.5 Refer to Specification Section 23 31 00 for test openings in duct system. Provide additional openings to fulfill the work of this section.

1.4. REFERENCE STANDARDS:

.1 All work shall be in accordance with the latest edition of the AABC or NEBB National Standards. If these contract documents set forth more stringent requirements than the Reference Standards, these contract documents shall prevail.

1.5. REFERENCE DOCUMENTS:

.1 Obtain and pay for, a complete set of reviewed Shop Drawings of pumps, fans and control systems.

.2 Obtain and pay for, a complete set of Mechanical Drawings and Specifications.

PART 2 - PRODUCTS

2.1. TEST EQUIPMENT

.1 When requested by the Consultant, provide current calibration certificates for test equipment.

PART 3 - EXECUTION

3.1. GENERAL

.1 The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC or NEBB Standards or "5%, which ever is more stringent.

.2 Any deficiencies in the installation or performance of a system or component shall be reported in writing to the Contractor and Consultant.

.3 Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be physically marked to show final settings.

3.2. JOB SITE INSPECTION

.1 Inspect the installation of the systems to be tested at least twice during the construction period. Ensure specified devices and components required for testing and balancing functions have been installed according to the manufacturer's recommendations.

.2 Ensure all required balancing dampers are installed, functional, and accessible for use in testing and balancing procedures.

.3 Provide a written report of inspection to the Contractor and Consultant identifying specific concerns and deficiencies affecting the testing and balancing procedures.

3.3. FANS AND AIR HANDLING SYSTEMS

.1 Verify that all ductwork, dampers, grilles, registers and diffusers have been installed per design.

.2 Balance air handling systems at minimum outdoor air quantities. On completion of TAB procedures, retest at maximum outdoor air quantities.

.3 Test and adjust fan RPM to achieve design flow.

.4 Test and record motor voltage and amperage. Compare data with nameplate limits.

.5 Perform pitot tube traverse at all main and branch ducts. Compare traverse total with measured outlet total to determine actual duct leakage.

.6 Test and adjust minimum outdoor and relief air volumes.

.7 Test and record system static pressure profile of each air handling system at minimum outdoor air volume. Note coil (ie. wet/dry) and filter condition of time of testing.

.8 Test and record entering and leaving air conditions for each heat transfer coil and device. Simulate conditions to achieve winter or summer design parameters.

.9 Test and record settings of motor thermal overload devices. Adjust settings where required.

3.4. AIR DISTRIBUTION AND TERMINALS

.1 Adjust duct distribution to obtain specified air quantities. At least one zone balancing damper shall be completely open. Multi diffuser/grille branch ducts shall have at least one volume damper completely open.

.2 Test and adjust each air terminal to obtain specified flow. Adjust deflectors and pattern controllers to eliminate drafts.

3.5. HYDRONIC PUMPS

.1 Test and adjust pumps to achieve design flows. Pumps shall be free of cavitation and vibration.

.2 Confirm impeller size by dead head testing.

.3 Plot, on the manufacturer's performance curve, the final operating point. Where pump balancing valves are used to obtain specified water flow, indicate balancing valve final position and recommend impeller size change where applicable.

.4 Test and record motor voltage and amperage. Compare data with nameplate limits.

.5 Test and record system operating pressure at strainer inlet, pump inlet and pump discharge.

.6 Test and record settings of motor thermal overload devices. Adjust settings where required.

3.6. HYDRONIC EQUIPMENT

.1 Test and adjust water flow to devices such as coils, chillers, heat exchangers and cooling towers to obtain the specified flow. Compare actual equipment water side pressure drops with manufacturer's published data.

.2 Where equipment is used in heat transfer (ie. Air/Water Coils), measure entering and leaving liquid/gas conditions and compare to manufacturer's published data.

.3 Where possible, simulate design conditions for testing. If simulation is not practical, perform seasonal testing when design conditions can be achieved.

3.7. HYDRONIC PIPING AND DISTRIBUTION

.1 Adjust water flow in distribution system to obtain specified flows.

.2 Test and record flow and differential pressure systems to establish references for satisfactory operation.

.3 Test and adjust system feeders to ensure adequate system static pressure is available under all operating conditions.

.4 Test and adjust hydronic terminals to obtain specified flow.

3.8. DOMESTIC WATER BOOSTER SYSTEM

.1 Confirm domestic water booster pump impeller size by dead head testing.

.2 Test motor voltage and amperage. Compare readings with nameplate limits.

.3 In multiple pump sets, confirm each individual pump is equally loaded under various pump on/off configurations. Confirm settings of pressure reducing valve assemblies.

3.9. DOMESTIC HOT WATER RECIRCULATION

.1 Test and adjust domestic hot water circulation pump to obtain specified capacity. Confirm impeller size by dead head testing. Test motor voltage and amperage and compare against nameplate limits.

.2 Test and adjust distribution to obtain specified flow through each branch.

3.10. EXHAUST HOODS

.1 Test total air flow by face velocity and pitot tube traverse. Adjust to obtain specified flow and equalize flow across face of hood.

3.11. PRELIMINARY TESTING

.1 In the event preliminary testing reveals a deficiency in the system which cannot be corrected through the balancing process, advise the Contractor and Consultant in writing describing the conditions and suggested corrective action.

3.12. REPORTS

.1 Provide four (4) copies of the TAB report for Consultant review.

.2 Summarize all testing into logical sections, tabulated and summarized.

.3 Identify system terminals and distribution on legible plan or schematic drawings depicting actual system arrangement. Label pitot tube traverse locations, terminal identification and equipment identification in a manner consistent with the contract documents.

3.13. REPORT VERIFICATION

.1 Cooperate with the Consultant in field verification of the final reported valves.

.2 Specific and random verifications will be performed using the same procedures used in preparation of the reports.

.3 Sufficient verifications will be performed to satisfy the Consultant that the reports accurately represent the actual system conditions.

3.14. GUARANTEE

.1 Provide AABC National Project Performance Guaranty or NEBB Performance Bond for the work.

.2 Include a copy of the guarantee in each copy of the Testing and Balancing Report.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply, install and test the heated water, chilled water and condenser water piping systems indicated on the Drawings and specified in this Section of the Specifications.

PART 2 - PRODUCTS

2.1. PIPING, JOINTS AND FITTINGS

.1 Meet the following pipe provision requirements:

.1 Pipe: {12 mm} [½"] to {50 mm} [2"]

.1 Type L copper with soldered joints **or**

.2 Ipex Plumbbetter XPA with brass fittings

.2 Meet Section 20 05 00 requirements for pipe installation and equipment connection including union and flange provision.

2.2. VALVES

.1 Gate and globe valves shall be Crane, Jenkins or Kitz to the following Kitz figure numbers:

To {1400 kPa} [200 psi] working pressure:

	Figure Numbers	
	Gate	**Globe**
{50 mm} [2"] and smaller:		
Soldered	44	10
Screwed	24	09
{65 mm} [2½"] and larger		
Flanged	72	76

.2 For pipe sizes {50 mm} [2"] and smaller, ball valves may be substituted for the above gate and globe valves. Provide ball valves with brass or bronze body, chrome plated solid ball, PTFE seats and seals and full port:

.1 soldered - Kitz Figure 59

.2 screwed - Kitz Figure 58

.3 Check valves shall be non-slam type, Check Rite or Centre Line manufacture, selected for system operating pressures and temperatures.

.4 Butterfly valves shall be DeZurik manufacture, full lug body style, with stainless steel shaft, supported by 3 bearings (top, bottom and actuator), replaceable EPDM seat to the following schedule. All flanges shall be ANSI rated, weld neck. Install spool pieces between valves and adjacent equipment. Equip valves to {100 mm} [4"] with 10 position lever operator. Equip valves {150 mm} [6"] and larger with gear box and handwheel operator. Each valve type shall hold line pressure with downstream flange removed to the full shutoff rating of the valve.

.1 To {1225 kPa} [175 psi] working pressure.

.5 Provide DeZurik plug valves for balancing applications except where circuit balancing valves are specified.

.1 To {1225 kPa} [175 psig] provide Series 425/118 eccentric plug valve. Equip sizes {12 mm to 100 mm} [½" to 4"] with memory stop and drip cap. Equip valves over {100 mm} [4"] with handwheel gear.

.2 To {1575 kPa} [225 psig] provide Series 118SX or 118FX eccentric plug valves. Equip sizes {12 mm to 65 mm} [½" to 2-1/2"] with lever and memory stop. Equip valves over {65 mm} [2-1/2"] with handwheel gear.

.3 To {1995 kPa} [285 psig] provide Series 128 eccentric plug valves. Equip sizes {12 mm to 65 mm} [½" to 2-1/2"] with lever and memory stop. Equip valves over {65 mm} [2-1/2"] with handwheel gear. Meet ANSI B16.5 temperature and pressure requirements.

.4 To {2100 kPa} [300 psig] provide Series Bhp-L2 high performance butterfly valves meeting previous specification.

.5 Provide Toyo 5046A, 3/4 ball drain valves with cap and chain at base of all hydronic risers. Valve rating- {1750 kPa} [250 psi] at {121ºC} [250ºF].

2.3. CIRCUIT BALANCING VALVES

.1 Provide Armstrong Model CBV or approved equal, circuit balancing valves:

.1 on the common return pipe from each coil bank, heat exchanger, boiler and chiller

.2 on each return riser

.3 where shown on the Drawings

.4 for all locations where balancing valves are shown in pipe less than {65 mm} [2-1/2"] in size

.2 For valves to {50 mm} [2"] provide Model CBVI, Y pattern style, all metal, with soldered or screwed connections, builtin drain connection with shut off valve and protective caps, and integral valve insulation.

.3 For valves from {65 mm} [2-1/2"] to {300 mm} [12"] provide Model CBVII, Y pattern style, cast iron body, flat face flanges, or grooved end connections for grooved piping systems.

.4 Provide, for each valve:

.1 vernier type handwheel settings for precision flow balancing

.2 positive shut off valve with no drip seat and plug type stem with teflon disc

.3 tamper proof hidden memory feature

.4 positive shut off metering valves with connections for portable meter

.5 Have the same manufacturer supply two portable differential pressure meters for the project and, following their use by the balancing technician, turn over to Owner in good condition.

.6 Select circuit balancing valve size to give a pressure drop at 100% open between {3.0 kPa} [1 ft] and {21 kPa} [7 ft]. Select valves located remote from the pumps in the circuit near minimum pressure drop and those located near the pumps at higher pressure drops.

2.4. SAFETY AND RELIEF VALVES

.1 Provide safety and relief valves for all closed water systems. Pipe relief to nearest floor drain.

.2 Provide Watts 174A valves rated at {1035 kPa} [150 psig] at {99^{o}C} [210^{o}F] ASTM rated, cast iron body bronze disc and seat, steel spindle assembly, carbon steel spring.

2.5. MIXING VALVES

.1 Mixing valves for glycol/water systems shall be Unimizer series. Valves shall be manufactured by Griswold Controls or approved equal.

.2 ½" TO 3" ACTUATED BALL VALVE

.1 Valve housing shall consist of forged brass CuZn39Pb2 rated at no less than 360 psi at 250°F.

.2 Valve ball shall consist of chemically nickel-plated brass. 2/3-Way Valve: Manufacturer shall be provide 316 SS ball and stem.

.3 Valve shall have a blow-out proof stem with two EPDM O-Rings with minimum 600 psi rating.

.4 Manufacturer shall be able to provide glass-filled polymer ball insert to make flow control equal percentage.

.5 2/3-Way Valve: Valve shall have EPDM O-Rings behind ball seals to allow for a minimum close-off pressure of 100 psi with 35 in-lbs of torque for 1/2" - 2" sizes. 3-Way Valve: 40 psi with 35 in-lbs of torque.

.6 2/3-Way Valve: Valve shall be available with a minimum of 25 unique Cv values.

.7 Valve shall be available with fixed end female, fixed end sweat or union end connections.

.3 VALVE ACTUATOR

.1 Control valve actuator shall be analog modulating (4-20 mA or 2-10 V), floating (tri-state), Pulse Width Modulation, or two position as indicated in the control sequence.

.2 Actuator shall provide minimum torque required for full valve shutoff position.

.3 A 3 foot cable shall be provided for installation to electrical junction box.

.4 A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by Belimo, ELO Drive, Honeywell, Invensys, Johnson Controls, KMC, Neptronics, or Siemens.

.4 ACCESSORIES

.1 Identification tags shall be available for all valves; tags shall be indelibly marked with Cv, model number and location; tags shall be 3" x 3" aluminum.

2.6. HYDRONIC TERMINAL UNIT VALVES

.1 Provide Dahl bronze ball valves at inlet and outlet of each hydronic terminal unit unless combination valve is supplied.as per section 2.5.

2.7. AIR VENTS

.1 Select air vents to suit system operating pressures.

.2 Provide automatic air vents, Spirax Type 13W to {1035 kPa} [150 psi] and 13WH to {2070 kPa} [300 psi] complete with isolating gate valves at all high points where mains are trapped, where shown in the Drawings and where shown on Typical Detail Sheets. Pipe outlet from each vent to a service sink, drip pan or floor drain.

.3 Provide manual air vents, screwdriver or key type at each unit heater, cabinet unit heater,

2.8. DIAPHRAGM TYPE EXPANSION TANKS

.1 Provide a diaphragm type expansion tank, suitable for the system operating pressures, for each closed circulation system. Each tank shall have an EPDM rubber diaphragm suitable for a 50% solution of inhibited ethylene glycol. Refer to Schedules for capacity and size information.

.2 Stamp each expansion tank with ASME pressure rating.

2.9. AIR SEPARATORS

.1 Furnish and install an Armstrong Vortex series VAS air separator complete with strainer and flanged connections as scheduled on the mechanical drawings. Tank shall suitable for {1140 kPa} [165 psi] at {190ºC} [375ºF] operating condtions.

.2 Tank shall be designed and built in accordance with the latest revisions of ASME pressure vessel code.

PART 3 - EXECUTION

3.1. INSTALLATION

.1 Meet Section 20 05 00 requirements.

.2 Use valves and strainers of the same size as pipe in which it is installed, unless otherwise indicated.

.3 Provide globe, ball or plug valves for throttling or controlling flow in accordance with article 2.2.

.4 Provide gate, ball or butterfly valves for shutoff in accordance with article 2.2.

.5 Install reducing fittings so as not to trap air.

.6 Provide flanges or unions at connections to all equipment.

.7 Do not use field fabricated fittings.

.8 Equip low points with {20 mm} [3/4"] drain valve piped to floor drain. Provide, at high points on lines and on equipment connections, collection chambers and high capacity float operated automatic air vents.

3.2. TESTING

.1 Meet testing requirements of all authorities having jurisdiction. Obtain certification and certify tests not required by authorities. Perform not less than the following tests.

.2 Prove hydronic piping tight under a hydrostatic test of 150% of design working pressure but not less than {700 kPa} [100 psi]. Test without pressure drop for a period of not less than 4 hours.

.3 Perform tests before piping is covered or concealed.

.4 Remove all components which will not withstand test pressure and replace after tests.

.5 Eliminate leaks or remove and refit defective parts. Do not caulk threaded or welded joints.

.6 After work is completed, adjust and put all parts of the system into proper working order. Adjust all valves to achieve specified heating capacities. Leave the complete job ready for regular operation, all to the satisfaction of the Consultant.

.7 After the testing period, drain the system, and before water treatment is introduced into the system, clean out all dirt pockets and strainers.

.8 Provide lubricating oils, packing, and other accessories, for proper operation of the system.

.9 The final test and acceptance shall not be made until the work is finally completed.

3.3. INSTALLATION OF CONTROL DEVICES AND INSTRUMENTATION

.1 Install all control devices and instrumentation for the hydronic systems as shown on the drawings, specified in Section 25 30 00 and supplied by the controls supplier.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply and install all pumps for the heating, ventilating and air conditioning systems indicated on the Drawings, and specified in this Section of the Specifications.

1.2. REFERENCE PRODUCTS

.1 For model numbers, sizes, capacities, duties and motor horsepowers, refer to pump schedule.

1.3. SELECTION STANDARDS

.1 Scheduled motor horsepowers and pump efficiencies are minimum acceptable. Select each motor to ensure that motor will not overload when pump is operating on any part of the pump curve.

.2 Select pumps so that installed impeller is no greater than 85% of minimum inside casing diameter.

.3 Select pumps so that design operating exit velocity does not exceed {5.5 m/s} [18 fps].

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

.1 Pumps shall be manufactured by Wilo, Armstrong, or ITT Bell and Gossett equal to product specified herein and on the drawings schedules.

2.2. INLINE CIRCULATORS

.1 Circulators shall be in-line type with flanged inlet and outlet, mechanical seal and suitable for 125 psig working pressure.

.2 For domestic water systems pump shall be all bronze with brass impeller.

.3 For all systems except domestic water pump shall be cast iron, steel impeller and stainless steel shaft.

PART 3 - EXECUTION

3.1. INSTALLATION

.1 Install pumps as per manufacturer’s instructions.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply and install the sheet metal and ductwork systems as indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

.1 Meet Standards described in the latest Edition of HVAC Duct Construction Standards handbook from Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

.2 Duct dimensions shown on Drawings are net, inside insulation and acoustic duct lining.

.3 Combination fire and smoke dampers and fire dampers shall be ULC listed and labelled, and meet requirements of Alberta Fire Marshall and NFPA-90A.

PART 2 - PRODUCTS

2.1. DUCTWORK

.1 Fabricate ductwork from galvanized sheet metal with a minimum coating of {1.83 grams/m5} [0.60 oz/sq.ft.] (G60 coating) unless other materials are specifically named. Duct installation shall conform to the following:

.1 Ductwork shall be smooth on the inside and free of obstructions, vibration and rattle.

.2 Fabricate ductwork, except as described in the next item, according to the following classifications:

.1 Class 1: All ducting subject to positive or negative static pressure of {250 Pa} [1 in wg] or less with maximum velocities of {13 m/s} [2500 fpm] shall be constructed in accordance with SMACNA construction standards for {250 Pa} [1 in wg] duct.

.2 Class 2: All ducting subject to positive or negative static pressure of more than {250 Pa} [1 in wg] up to {500 Pa} [2 in wg] with maximum velocity of {13 m/s} [2500 fpm] shall be constructed in accordance with SMACNA construction standards for {500 Pa} [2 in wg] duct.

.3 Provide duct transformation with expansion fittings having slopes not exceeding 1 to 7 and contraction fittings having slopes not exceeding 1 to 4.

.4 Provide full radius tees, bends, and elbows for changes in direction except where square elbows are required due to space restrictions. Provide DuroDyne double thickness {0.8 mm} [24 gauge] turning vanes assembled in top and bottom rails in square elbows.

.5 Provide balancing dampers free to move in either direction without binding and rattling. Construct dampers in ductwork from {1.2 mm} [18 gauge] galvanized sheet metal. Use manual quadrants on small ducts. On dampers longer than {375 mm} [15"] use push rods with DuroDyne Model SRP ball joints. Use two push rods on ducts wider than {600 mm} [24"]. Provide OBD balancing dampers where shown on the drawings.

.6 Isolate equipment with DuroDyne neoprene {0.8 mm} [0.032"] thick flexible connectors with finished fabric width not less than {150 mm} [6"].

.7 Provide {50 mm} [2"] insulated sheet metal blank off panels behind unused portions of exterior louvers.

.8 Seal all joints in low, medium and high pressure ductwork with Transcontinental MP for low and medium pressure or DuroDyne S2 duct sealer for high pressure. Joints shall be sealed to conform to SMACNA standards as follows:

Seal Class	Sealing Required	Static Pressure Construction Class
A	All transverse joints, longitudinal seams and duct wall penetrations.	{1000 Pa} [4" w.g. and up]
B	All transverse joints and longitudinal seams.	{500-750 Pa} [2" - 3" w.g.]
C	Transverse joints	Up to {500 Pa} [2" w.g.]

.9 Seal joints in exhaust ducting where fan intake is further than {25 m} [82 ft] from furthest intake in accordance with seal Class A. Similarly seal all exhaust ducting for ETO exhaust, swimming pool and change room systems.

.2 Construct round ductwork to meet high pressure duct standards and as follows:

.1 Provide welded slip joint construction round duct fittings. Wipe pipe and fittings with Durodyne S-2 duct sealer before assembly. Secure joints with self-tapping screws, then brush again with thick coat of duct sealer.

.2 Provide dieformed round elbows through {200 mm} [8"] dia. constructed from {1.1 mm} [20 gauge] galvanized steel. Provide 5 section construction for larger elbows.

.3 Provide conical round tees.

.3 Flexible Ductwork:

.1 Provide Flexmaster Triple Lock Aluminum, flexible ductwork as indicated on the Drawings.

.2 Construct ductwork from a tape of soft annealed aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and flexibility. Provide a triple

mechanical lock to form a continuous secure air joint without the use of adhesives for pressures up to {3000 Pa} [12"].

.3 Conform to the requirements of NFPA 90 and Underwriters Laboratories classification for round duct to specification UL 181.

.4 Provide flexible ductwork in maximum lengths of {1500 mm} [5'-0"].

2.2. ACCESS DOORS

.1 Provide access doors for galvanized ductwork using {0.7 mm} [24 gauge] galvanized material with galvanized mounting frame and {25 mm} [1"] rigid insulation between panels. Provide fastening devices to give tight closure.

.2 Provide access doors for stainless steel ductwork using {0.61 mm} [24 gauge] stainless steel with stainless steel mounting frame and {25 mm} [1"] rigid insulation between panels. Provide fastening devices to give tight closure.

.3 Provide access doors for aluminum ductwork of {0.61 mm} [24 gauge] aluminum with aluminum mounting frame, and {25 mm} [1"] rigid insulation between panels. Provide fastening devices to give tight closure.

.4 Provide access doors and removable panels in plenums and casings of {1.31 mm} [18 gauge] galvanized material with {50 mm} [2"] thickness fiberglass insulation. Equip doors with handles and hinges to open from either side (without risk of injury) as follows:

.1 for mandoors:

.1 handles - Durodyne SP-20

.2 hinges - Durodyne HB-3

.3 gaskets - Durodyne GN-22

.2 for removable panels:

.1 sash locks - Durodyne SL-1

.2 gaskets - Durodyne GN-22

.5 Construct all access doors with double panels.

.6 Provide neoprene gaskets securely formed into door frames around the periphery of all duct

.7 Provide access doors at all fire dampers.

2.3. ACOUSTIC DUCT LINING

.1 Provide {25 mm} [1"] thick acoustic duct liner where shown on drawings and as follows:

.1 Rectangular Duct Liner: Permacote Linacoustic meeting ASTM C 1071 with air surface coated with acrylic coating treated with EPA registered anti-microbial agent proven to resist microbial growth as determined by ASTM G 21 and G 22.

.1 Noise Reduction Coefficient: .70 or higher based on “Type A mounting” and tested in accordance to ASTM C 423.

.2 Adhesive: meeting ASTM C 916.

.3 Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.

.2 Round Duct Liner: Permacote Spiracoustic, rigid preformed round liner, or Spiracoustic Plus with air surface coated with acrylic coating treated with EPA register anti-microbial agent proven to resist microbial growth as determined by ASTM G 21 and G 22.

.1 Noise Reduction Coefficient of .70 as per ASTM C 423. (Type A mounting)

2.4. FIRE DAMPERS

.1 Provide Ruskin curtain or parallel blade type dampers to maintain fire rating integrity of membrane being pierced. Minimum rating to be 1-1/2 hours with {100^{o}C} [212^{o}F] fusible link. Provide multiple dampers where sizes exceed code limitation.

.2 Provide models as follows, to suit application:

Model No.	Application
IBD-2, Style B or C	Normal duct application (2 hrs.)
IBD-20 Style G	Behind grilles (2 hrs.)
IBDT	In doors or thin separations (2 hrs.)
IBD-23	In fire walls (4 hrs.)
FSF	Behind outlets in fire rated floor (roof) and ceiling assemblies
FD-35	Combination fire and balancing damper (2 hrs.)

.3 Select dampers with air flow resistance not exceeding {13 Pa} [0.05 in. w.g.] at design flow rates.

2.5. INSULATED CONTROL DAMPERS

.1 Provide Ruskin CDTI 50 insulated dampers suitable for use in temperatures from {-40^{o}C to 93^{o}C} [-40^{o}F to 200^{o}F].

.2 Frames shall be 6063T5 extruded aluminum {3.2 mm} [.125"] wall thickness. Blades shall be heavy gage 6063T5 extruded aluminum, airfoil shape injected with two part high density (CFC free) polyurethane foam; each blade provided with a thermal isolation gap. Bearings shall be molded synthetic and linkage {12 mm} [1/2"] tie bars. Blade edge seals shall be low temperature extruded vinyl.

.3 Refer to Drawings for locations, mounting direction and air flow direction.

2.6. BACKDRAFT DAMPERS

.1 Provide Ruskin Model CBD2 counter-balanced backdraft dampers suitable for use in temperatures from {-40°C to 93°C} [-40°F to 200°F].

.2 Frames shall be 6063T5 extruded aluminum {2.3 mm} [.090"] wall thickness. Blades shall be formed aluminum, {.63 mm} [.025"] wall thickness. Bearings shall be molded synthetic and linkage {12 mm} [1/2"] tie bars. Blade edge seals shall be extruded vinyl. Dampers shall be equipped with adjustable counter-balance weights attached to rear of blades.

.3 Refer to Drawings for locations, mounting direction and air flow direction.

PART 3 - EXECUTION

3.1. SHEET METAL INSTALLATION

.1 Frame and install motorized dampers. Unless shown otherwise, attach each motorized damper module to the channel framing.

.2 Provide DuroDyne IP-1 or IP-2 test openings in all ducts entering and leaving air handling equipment. Install test openings at {150 mm} [6"] intervals across the long dimension of rectangular ducts, and at 90 degree intervals around circular ducts. In insulated surfaces, provide extension to suit insulation thickness. Provide additional Model IP-4 test ports in ductwork where required for air balancing. Submit drawings to indicate proposed locations.

.3 Make provisions in ductwork and plenums for installation of duct type smoke detectors and

.4 Provide neoprene isolation gaskets and nylon bolts at connections required for dissimilar metals.

.5 Seal water tight bottom and sides of intake and exhaust ducts connected to exterior louvers as follows:

.1 Intake - from Louvre to air handling unit.

.2 Exhaust - from Louvre to {2 metres} [6'-6"] upstream of Louvre.

3.2. ACOUSTIC DUCT LINING INSTALLATION

.1 Seal all leading and trailing edges and repair all rips or tears of acoustic duct liner with a suitable sealing compound similar to Johns-Manville Superseal.

.2 Provide a tapered sheet metal nose piece to hold the leading edge of acoustic duct liner and direct the air over the edge.

3.3. TESTING

.1 Pressure test all ductwork in accordance with the outlines and classification described in the SMACNA, HVAC Duct Leakage Test manual.

.2 The leakage amount shall not exceed the allotted amount for the pressure class. The test pressures shall be based on the static pressure for each fan.

Duct Construction Class	Leakage Class
{2500 Pa} [10" w.g.]	3
{1500 Pa} [6" w.g.]	6
{1000 Pa} [4" w.g.]	6
{750 Pa} [3" w.g.]	12
up to {500 Pa} [2" w.g.]	12

.3 Repair duct and retest where air leakage exceeds the specified limits.

.4 Make good all audible leakage, whether test is within limit specified or not.

.5 Provide calibrated tester, connection hoses, temporary plugs, etc., as required.

3.4. INSTALLATION OF FIRE DAMPERS

.1 Install dampers in approved manner suitably anchored to building structure in locations indicated on the Drawings.

.2 Install fire dampers complete with sleeve and full perimeter steel angle on both sides of barrier being pierced. Provide manufacturers recommended minimum clearance between masonry or non-combustible frame and sleeve. Sleeve shall accept actual size of damper with blades pocketed outside of air stream.

.3 Divide openings into smaller openings using fire resistant structures where openings to be protected require dampers larger than maximum UL listed sizes.

3.5. CLEAN UP

.1 Vacuum clean the inside of all air handling systems, including fans, plenums, ducts, coils and terminal units to ensure that they are free from debris and dust.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to provide air terminals as indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

.1 Provide equipment performance rated in accordance with ADC (Air Diffusion Council) Equipment Test Code 1062GRD 84, 1S0 Standard 5135 and 1S0 Standard 5219.

1.3. SAMPLES

.1 Submit air terminal samples when requested by Consultant.

PART 2 - PRODUCTS

2.1. GRILLES, REGISTERS & DIFFUSERS

.1 Provide grilles, registers and diffusers from one manufacturer.

.2 Provide E.H. Price, Nailor, or Titus grilles, registers and diffusers for air quantities and locations shown on Drawings.

.3 Refer to Schedule for description of types.

.4 Equip each exhaust air terminal with a volume control damper and an equalizing grid.

.5 Provide mitred corners and end borders for linear diffuser.

.6 Provide end cap for continuous linear diffuser terminating at walls and partitions.

PART 3 - EXECUTION

3.1. INSTALLATION

.1 Provide air terminals in strict accordance with manufacturer's recommendations and final reflected ceiling plans.

.2 Provide plaster frames for units installed in plaster finishes. Fit frames tightly to prevent leakage and smudging.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

.1 Comply with Division 1, General Requirements and all documents referred to therein.

.2 Provide all labour, materials, products, equipment and services to supply and install the unitary heat pumps indicated on the Drawings and specified in this Section of the Specifications.

PART 2 - PRODUCTS

2.1. HEAT PUMP EQUIPMENT - GENERAL

.1 Provide Daikin water source heat pump unit(s) as scheduled, consisting of cabinet, fan and motor assembly, compressor, air to refrigerant heat exchanger, water to refrigerant heat exchanger, four way reversing valve, controls and safety devices.

.2 Factory assemble, wire, charge and test each package unit.

.3 Provide factory installed protective caps on water connection pipe ends.

2.2. UNIT CONSTRUCTION - VERTICAL TYPE

.1 Construct cabinet of galvanized steel, painted externally and fully insulated.

.2 Provide removable service panels.

.3 Provide insulated galvanized steel condensate pan with drain connection.

.4 Provide return air filter tracks for standard size disposable filters. Include two sets of filters.

2.3. UNIT CONSTRUCTION - CONSOLE TYPE

.1 Provide formed steel cabinet, finished for exposed space installation with a baked enamel finish. Provide similarly finished top access door for user access to controls. Provide finished discharge grille with 15 degree deflection. Construct cabinets to allow either left or right hand piping and electrical connections and arranged for field reversal.

.2 Provide heat pump chassis to rest directly on the floor and supporting the entire refrigerant system with associated valves and internal piping. Construct chassis and refrigerant system to allow either left or right hand piping and electrical connections.

.3 Provide air filter assembly with {12 mm} [2"] permanent filter, arranged to allow removal without disturbing the cabinet.

.4 Provide control panel, factory mounted within the chassis.

2.4. FAN AND MOTOR ASSEMBLY

.1 Provide direct drive DWDI centrifugal fan.

.2 Statically and dynamically balance the fan wheel.

.3 Provide multi speed fan motor, permanent split capacitor type with permanently lubricated sleeve bearings, isolated mounting brackets and internal thermal overload protection.

.4 Provide fan motor speed adjustment.

2.5. COMPRESSORS AND REFRIGERANT COMPONENTS

.1 Provide fully hermetic type compressors with internal isolation and external rubber grommet isolation.

.2 Provide four way reversing valve which is energized in the cooling mode to fail safe in the heating mode.

.3 Provide strainer in the liquid refrigerant line.

2.6. HEAT EXCHANGERS

.1 Provide air to refrigerant coil heat exchanger constructed of copper tubes with aluminum fins.

.2 Provide water to refrigerant coaxial tube heat exchanger constructed of copper and suitable for water pressure of {1380 kPa} [200 PSI].

2.7. CONTROLS

.1 Provide, for each vertical unit, internal, factory installed and wired controls located in a dedicated control box and arranged to operate the compressor, reversing valve and fan when connected to a suitable low voltage space thermostat.

.2 Include safety devices for low and high discharge pressure, low suction temperature, compressor short cycling, high motor current/temperature. These devices will provide lockout protection such that manual reset is required.

.3 Provide, for each console unit, internal, factory installed and wired controls complete with thermostat to operate the compressor, reversing valve and fan to maintain space temperature as determined by the internal thermostat. Provide controls which require a manual changeover from heating to cooling and include a system switch for Off/Hi/Low/Heat/Cool.

.4 Include safety devices for high refrigerant discharge pressure and low water temperature and these devices will provide lockout protection such that manual reset is required.

.5 Provide for each unit, a resettable circuit breaker for low voltage side of controls transformer.

.6 Provide a terminal board in each unit for field connection of thermostat.

.7 Provide 24V space thermostats for each unit for wall mounting. These thermostats will allow manual or automatic heating/cooling changeover and include indicators for filter plugged and other fault conditions.

.8 Provide a condensate overflow switch on each unit which interrupts unit operation when the pan level is high.

.9 Provide a filter indicator switch on each unit which provides a signal to detect plugged air filter.

.10 Provide low and high water temperature switch (es) on each unit which stops and locks out the unit if the loop water temperature reaches {4.4ºC} [40ºF] on the low side or {46.1ºC} [115ºF] on the high side.

.11 Provide a self diagnostic control board with LED lights to indicate the fault source. Lights will remain on after fault detection until board is reset.

.12 Provide alarm signal activated by a lockout fault detection and suitable for activation of a remote alarm device.

.13 Provide a relay in the controls of each unit which, when actuated by a remote signal, will shut down the unit.

.14 Provide unit mounted automatic changeover thermostat with a system switch in the accessible control panel for Off/Hi/Low.

.15 Provide for each unit, a low voltage, remote thermostat suitable for wall mounting with manual/automatic changeover between heating and cooling. Provide system selector switches on the thermostat for On/Auto fan operation and Off/Heat/Cool/Auto system mode selection.

.16 Provide a night setback relay as part of the control circuitry such that energizing the 24V coil circuit from an independent source will switch control to a second remote night setback thermostat.

2.8. ACCESSORIES

.1 Provide a factory supplied hose kit for supply and return water consisting of {900 mm} [36"] {450 mm} [18"] long EPDM tubes with diameters as indicated in the schedule.

.2 Provide a factory supplied hose kit for condensate consisting of a clear PVC tube with connector clamps or adapters.

.3 Provide, for each unit, factory supplied brass body ball valves with teflon seats and seals for supply and return water. Sizes will match scheduled units inlet and outlet sizes.

.4 Provide {50 mm} [2"] thick return air filters and unit tracks in lieu of standard {25 mm} [1"] thick.

PART 3 - EXECUTION

3.1. INSTALLATION

.1 Maintain factory installed pipe caps until water connections are made.

.2 Provide flexible connections between the units and ductwork.

.3 Install units in accordance with manufacturers instructions and install all accessories specified herein.

.4 Provide condensate drain piping from each unit to floor drain in accordance with Section 22 11 00.

.5 Locate units according to the drawings and ensure that mounting position allows full access to the service panels, filters, etc.

.6 Provide five year compressor warranty in addition to one year warranty on entire unit and installation.

END OF SECTION

PART 1. GENERAL

1.1 SUMMARY

.1 Section includes: solar-electric photovoltaic systems;
.2 roof mounted, poly-crystalline photovoltaic (PV) solar roof tile modules;
.3 trellis-mounted, cylindrical copper indium gallium selenide (cigs) thin-film photovoltaic modules;
.4 related electrical work (balance of system):

.1 Solar array combiner boxes.
.2 Solar array DC disconnect switches.
.3 DC to AC inverters.
.4 AC disconnect switches.
.5 Energy management system interconnection.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

.1 Wiring and conduits from solar modules to the balance of system equipment.

.2 Utility interface and utility-required equipment.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 This section covers the furnishing and installation of solar photovoltaic modules that are mounted to the building structure and connected electrically to the building electrical power system. it requires close coordination with specifications for the roofing system, structural system, and related electrical work.

1.4 SUBMITTALS

.1 Product data: submit for photovoltaic modules, inverters, combiner boxes, and switches describing physical characteristics, sizes, patterns, and method of installation.

.2 Shop drawings: submit complete shop drawings showing plans, sections, elevations and details.

.1 System plans with photovoltaic module layout.

.2 Include locations and types of inverters, combiners, equipment, attAChments, penetrations, drains, ands vents.

.3 Show roof structures and screens, dimensioned for size and location.

.4 Provide site plans and elevations showing adjoining shading structures, including trees, adjacent buildings and structures. indicate location, height, and type of structure.

.5 Electrical single line diagram for both AC and DC systems.

.6 Electrical equipment room layout drawing to scale.

.7 Structural attachment details for positive attachments of PV modules to structure.

.8 Insulation calculations verifying annual energy production performance of eACh system.

.3 Installation instructions: submit manufacturer's detailed installation manual.

.4 Certificates: submit certified evidence of installer's qualifications and experience record in installation of photovoltaic systems, or submit certification from manufacturer of photovoltaic modules that proposed installer has been trained by manufacturer's representatives and is considered by manufacturer to be fully qualified to install the system.

.5 code approvals: submit evidence indicating compliance with state and local building codes.

1.5 CLOSEOUT SUBMITTALS:

.1 Maintenance data: submit manufacturer's recommended cleaning and maintenance data. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

.2 record drawings: provide complete drawings showing dimensioned locations of modules, junction boxes, combiner boxes, disconnect switches and isolation transformer. provide complete wiring and circuit diagrams.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company with a minimum of 3 years documented experience in the installation of solar power systems and single ply roof systems, approved by manufacturers of both.

.2 Submit a list of at least five 5 installations that have been in use for a minimum of two years using solar power systems similar to the systems specified.

.3 Include contact name and phone numbers**.**

.4 Installer shall be certified by the manufacturer.

.2 Compliance with regulatory requirements: the installation of solar modules and electrical components shall be performed in compliance with ieee 928, ieee 929, ieee 1374, iec 1277, nfpa 70 article 690 and 705, the national electrical safety code, occupational safety and health administration (osha) regulations, international building code (ibc), state and local codes.

.3 Pre-installation meeting: after approval of submittals but prior to beginning installation of work of this section, conduct a meeting at the site attended by architect, contrACtor, installers of roof panel system and related electrical work to be installed with the system, to describe in detail the installation process and to establish agreement, coordination, safety and responsibilities. prepare a detailed report of this meeting and furnish copies to the architect and attendees.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Solar modules shall be stored in an ambient temperature of 40 f to 80 f. modules shall be delivered to the site in the original unopened containers or wrappings.

.2 Handle materials carefully to prevent damage.

.3 place materials on pallets and fully protect from moisture. Leave protective packaging in place until modules are installed.

1.8 PROJECT SITE CONDITIONS

.1 Coordination: installation of solar PV system requires close coordination between work of installation of basic roofing system, electrical conduits connecting the various components, installation of the modules and their connections, and wiring and connections to the combiner boxes, DC disconnect, inverters, AC disconnect, and isolation transformer.

1.9 WARRANTY

.1 provide certified copies of the following manufacturer’s product warranties:

.1 Solar module manufacturer’s 20-year warranty covering power output of modules, and 5-year warranty of rebated material and workmanship.

.2 DC to AC inverter manufacturer’s 10-year warranty

PART 2. PRODUCTS

2.1 Basis of Design

.1 Provide products indicated in this section and on the drawings, or ACcepted substitute products subject to the compliance requirements of this section.

.2 Wherever applicable, photovoltaic system components must be listed as *eligible equipment* by the state of California, California solar initiative program.

2.2 MANUFACTURERS

.1 Roof-mounted system design is based on solar modules manufactured by Sunpower corporation, or equal.

.1 Model: Sunpower t5 solar roof tile.
.2 Nominal peak power: 315 watts per panel.
.3 cec ptc rating: 291.6 watts.
.4 Type: single pre-engineered unit combining photovoltaic panel, interlocking frame, and non-penetrating mounting system.

.2 Trellis –mounted system design is based on solar modules manufACtured by: Solyndra, inc.

.3 Model: Solyndra sl-001-191 module.

.4 Nominal peak power: 191 watts per module.

.5 Type: non-penetrating, powder-coated aluminum mounts included with each module.

.6 AC to DC inverter(s) are based on products manufactured by xantrex, or equal.

.1 Xantrex grid tie gt100 series.
.2 60 hz, 3-phase.

.7 Outdoor rated and corrosion resistant cabinet.

.8 Roof-mounted PV system description

.1 The roof-mounted PV system shall be designed for installation over a single ply roof membrane, as specified in division 07.

.2 A positive roof attachment system shall be coordinated with the roofing work as specified in division 07. This mounting system shall be approved by the architect, the PV module manufacturer, and the authorities having jurisdiction. the attachment system shall resist uplift winds up to 100 mph.

.3 The photovoltaic roof module shall combine solar panel, frame, and mounting system into a single pre-engineered unit.

.4 The roof-mounted non-penetrating tiles shall be positioned at a 5-degree tilt, facing south.

.5 The weight of the rooftop PV system shall be no more than 4 lbs/sf.

.6 Each solar module shall be capable of generating DC power.

.7 The system shall be formulated for stability in low light and continuous exposure to ambient weather conditions.

.8 The wiring interconnecting the PV modules shall be provided by the PV module manufacturer.

.9 The roof-mounted system shall be nominally rated 70kw and shall produce approximately 100,000kwh of electrical energy per year.

2.3 TRELLIS-MOUNTED PV SYSTEM DESCRIPTION

.1 Trellis-mounted PV system shall be designed for installation over a tube-steel trellis structure, as indicated on the drawings.

.2 Positive structural attachment system shall be coordinated with trellis structural design. Mounting system shall be approved by architect, the PV module manufacturer, and the authorities having jurisdiction. Attachment system shall resist uplift winds up to 100 mph.

.3 Photovoltaic module shall employ cylindrical collectors which capture sunlight ACross a 360-degree photovoltaic surface capable of converting direct, diffuse, and reflected sunlight into electricity.

.4 Trellis-mounted PV modules shall be positioned horizontally.

.5 Weight of the trellis-mounted PV system shall be no more than 4 lbs/sf.

.6 Each solar panel shall be capable of generating DC power.

.7 System shall be formulated for stability in low light and continuous exposure to ambient weather conditions.

.8 Wiring interconnecting the PV modules shall be provided by the PV module manufacturer.

.9 Trellis-mounted system shall be nominally rated 50kw and shall produce approximately 70,000kwh of electrical energy per year.

2.4 BALANCE OF SYSTEM COMPONENTS

.1 Solar array combiner boxes: ul listed, series fusing or circuit breakers for solar roof panel source circuits in nema3r enclosure as required.

.2 Solar array DC disconnect switches: UL: listed, heavy duty fused safety switches on the output of the solar array in nema3r enclosures as required.

.3 DC-to-AC inverter: high efficiency, UL listed, utility interactive, phase, voltage and current matched to line and load, with maximum power point tracking (mppt) electronics, over- and under-voltage and frequency protection in accordance with requirements of ul 1741, harmonic control in accordance with ieee 519, and anti-islanding protection as required by ieee 929. Inverter shall have automatic start-up, shut-down, self-diagnosis, and fault detection. Units shall comply to fcc electromagnetic interference (emi) part 15, subparts a, b and j, and iec 1727.

.4 AC disconnect switch: UL listed heavy duty fused safety switch on the output of the inverter in nema3r enclosure as required.

.5 KWH meter socket and meter main, as required by the local electrical utility company, shall be phase, voltage, and current matched to load, 22k rms amperes short circuit current rated or higher with utility approval, UL listed, nema3r enclosure as required, including required openings and lugs.

.6 Electric service panel interconnection: ul listed circuit breaker, in accordance with national electrical code, local codes and local electric utility company requirements. Circuit breaker shall be located in new electric service panel enclosure as required.

.7 Wiring shall be copper conductors in metallic conduit. Metal clad cable and exposed conductors are not allowed.

.8 Provide permanently adhered, riveted, bakelite-type labels indicating the identification of eACh device in the system (combiner box, inverter, disconnect, etc.) visible from the equipment enclosure exterior.

2.5 energy data monitoring system

.1 Photovoltaic systems shall include an energy data monitoring system to support monitoring of system output and operating conditions.

.2 Energy data monitoring system shall include utility grade electrical meters for the monitoring and recordation of DC/AC energy and power data from the inverters, at least one pyranometer, temperature thermocouples, and sub systems for the measurement of ambient and PV surface temperature for each photovoltaic system.

.3 Photovoltaic system energy data monitoring system shall be compatible with and output recorded data to the campus energy management and controls (emcs) system. the following data shall be available to the campus emcs:

.1 Horizontal surfACe solar irradiation.
.2 DC system voltage.
.3 DC system current.
.4 AC system power output.
.5 Horizontal surface solar irradiation.
.6 Ambient temperature.
.7 PV cell temperature.
.8 Roof surface temperature.

.4 Configured campus emcs to calculate and trend the following data points for the photovoltaic systems:

.1 Instantaneous system output in kw.
.2 Instantaneous and year to date irradiation on watts/square meter.
.3 Instantaneous and year to date irradiation on watts/square meter.
.4 Instantaneous ambient, cell, surfACe, and sub-surfACe temperature in degrees Fahrenheit.
.5 Daily system output in kwh: any day, and day to hour.
.6 Monthly system output kwh: any month, and month to date.

PART 3. EXECUTION

3.1 EXAMINATION

.1 Verify that the DC to AC inverters have ground fault protection and that the DC circuits of the PV system are not earth-grounded.

3.2 SEQUENCE

.1 Sequence of installation:

.1 Make a solar panel roof layout drawing to include conduit runs, junction boxes, combiner boxes and electrical homerun to the DC disconnect switch and inverter.

.2 Clean the roof deck surface of dirt, debris and foreign materials.

.3 Locate the modules as indicated and in accordance with ansi/asce c2-1990 and ansi/asce 7-88. do not install wiring in conduit at this time.

.4 Locate the modules as indicated. do not install wiring in conduit until after solar panel are installed.

.5 Install conduit, junction boxes and combiner boxes on the roof deck per standard commercial practices and codes.

.6 Install insulation board and gypsum board in accordance with manufacturers' recommendations and mark conduit runts to prevent penetrating conduit with roofing nails or screws.

.7 Before installing solar modules, feed a mandrel through conduit to ensure that conduit is clear of roofing nails or screws. Install solar modules in accordance with manufacture's recommendations and approved submittals.

.8 Feed the solar panel wiring into the junction box and conduit.

.9 Attach the solar panel perimeter to the roof membrane in accordance with the recommendations of panel manufacturer, roofing manufacturer and the approved submittals.

.10 Complete the panel wiring in the combiner box and array homerun.

.11 Install and connect the balance of system (bos) equipment (consisting of combiner box, DC disconnect switch inverter, isolation transformer, AC disconnect switch and utility interconnection equipment) in accordance with ieee 929 and iec 1173.

.12 Inspect, test, and startup the solar power system in accordance with the panel solar panel manufacturer’s installation manual and in accordance with ieee 1373.

3.3 SPECIAL CAUTIONS

.1 Do not cut or drive screws into any part of the system solar modules or wiring are present which includes, but is not limited to, solar modules, inter-panel wiring assembly, and solar array wiring. (PV systems contain live electrical components enclosed and protected within.)

.2 Avoid electrical hazards when installing, wiring, operating, and maintaining the solar roof panel and other electrical equipment.

.3 Modules generate DC electricity when exposed to sunlight or other light sources.

.4 Do not touch the exposed copper wire leads while the panel is exposed to light or during installation. use properly insulated tools only.

.5 Work only under dry conditions with a dry panel and tools.

.6 Use extreme caution and proper roof safety practices when working on or near the modules. solar roof modules are slippery when wet.

.7 Do not stand or step on the modules.

.8 Do not drop modules or allow objects to fall on the modules. do not place equipment on the modules.

.9 Cover solar modules with an opaque material before making wiring connections to reduce the risk of electric shock or sparks.

.10 Do not leave PV modules unsecured.

.11 Keep the PV module front and back surfaces free from foreign objects.

.12 Do not install modules where flammable gases or vapors are present since sparks may be produced.

.13 Do not drill or cut holes in the panel solar modules or wiring. Avoid sharp edges.

.14 Artificially concentrated sunlight shall not be directed on the panel.

.15 Use the panel for its intended use only. do not disassemble the panel or remove any part or label installed by the manufacturer.

3.4 INSTALLATION

.1 Wire solar PV membrane roofing system as specified in division 26.

.2 Install solar array combiner box, array DC disconnect switch, inverter, isolation transformers, and other equipment in accordance with requirements of division 26.

3.5 FIELD QUALITY CONTROL

.1 An authorized representative of the manufacturer shall inspect the installation periodically during construction and at completion to ensure that the system is installed in compliance with these specifications.

.2 Upon completion, in addition to code required testing of electrical components and system, megger test each circuit, and furnish a report of the tests to the owner.

3.6 SYSTEM STARTUP

.1 Furnish the services of a trained representative of the solar panel manufacturer to instruct the owner's personnel in operation and routine maintenance of the solar panel system for a period of not less than one day at a time as directed by owner.

3.7 ADJUSTING

.1 Adjust electrical components for proper operation.

.2 Adjust energy management system components for proper operation.

3.8 CLEANING

.1 Immediately prior to final acceptance, clean the modules, energy management system components and electrical components.

3.9 CLOSEOUT ACTIVITIES

.1 Furnish a complete operation and maintenance manual to the owner at time of system startup.

END OF SECTION