TEAM SOLAR NEST

PROJECT MANUAL

U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2015

SACRAMENTO STATE
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AS-BUILT PHASE
AUGUST 17, 2015

reflect home

TEAM SOLAR NEST

U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

A project by:

U.S. DEPARTMENT OF ENERGY

Organized by:

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Hosted By:

ORANGE COUNTY GREAT PARK

Team Solar NEST is:

CALIFORNIA STATE UNIVERSITY, SACRAMENTO

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Contents

Mission Statement

Sacramento State's Team Solar NEST Sacramento State's Team Solar NEST strives to discover the future of sustainable, energy-efficient housing and deliver these innovations to home buyers at an affordable price. To make strategic improvements to conventional building methods with regard to aesthetics, performance, and affordability. Through our efforts, we aspire to redefine the possible by building tomorrow one home at a time.

Our Reflect Home is the embodiment of those ideas and the essence of what we hope to accomplish.

Article 01. Summary of Changes

Revision March 26, 2015

- Updated quantity takeoff
- Revised specifications
- Revised Interconnection Application Form
  - Changed inverter model
  - Changed number of panels
- Updated formatting, styling & general housekeeping

Revision February 12, 2015

- Updated quantity takeoff
- Revised the rules compliance checklist
- Miscellaneous formatting

Revision November 18, 2014

- Updated rules compliance checklist
- Updated Construction Specifications
- Updated Interconnection Application form
- Revised water budget
- Revised structural calculations
- Miscellaneous housekeeping and formatting

Article 02. Rules Compliance Checklist

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	O-101
Rule 4-2	Construction Equipment	Specifications for heavy machinery	01 50 00
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	N/A
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	S-101 S-104
Rule 4-5	Generators	Specifications for generators (including sound rating)	N/A
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	A-103, F-102 H-501, P-101 P-104
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	22 11 16 22 11 19 22 33 00 41 62 23
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists	Article 03
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot	S-101
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	C-102, G-201
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	N/A
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that 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	Article 03, All "S" drawing Sheets

Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101, A-101
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	N/A
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-103
Rule 7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	L-101
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	N/A
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	26 31 00
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	A-104, G-102, F-101
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	28 31 00
Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	N/A
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	N/A
Rule 8-5	Village Grid	Completed interconnection application form	Article 07
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	A-103, E-101, M-201,
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	26 31 00
Rule 8-5	Village Grid	One-line electrical diagram	E-601
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-001
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	E-101
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-201

Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	H-101
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. PDT or between 8 a.m. and 4 p.m. solar time on October 1	P-102
Rule 9-2	Team-Provided Liquids	Quantity, specifications, and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	22 35 00
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	N/A
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	A-561, L-104
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	N/A
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	N/A
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	N/A
Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	TBD
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	22 11 19
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	TBD
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	22 13 19
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-103

6000 J Street

Sacramento, CA 95819-6126

(916) 217-0023

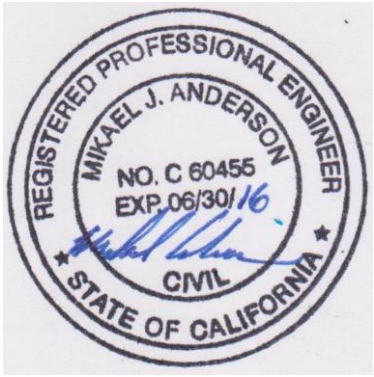
STRUCTURAL DESIGN CALCULATIONS

100% COMPLETE SET

Prepared for:

California State University, Sacramento

Department of Construction Management



February 12, 2015

Engineer-of-Record:

Mikael J. Anderson, PE

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STRUCTURAL DESIGN CRITERIA – Live Loads

2013 California Building Code (CBC)

1. Type of Construction:
   a) Wood-Framed Residential Structure, on mobile trailers (flooring)

2. Design Live Loads:

a)	Roof	P_{LL} =	20	psf	CBC Table 1607.1
	(non-reducible, < 4:12 roof slope)				
b)	Floor	P_{LL} =	50	psf	CBC Table 1607.1
	(increase from 40 psf per DOE)				
c)	Canopy	P_{LL} =	5	psf	CBC Table 1607.1
d)	Decks	P_{LL} =	100	psf	CBC Table 1607.1
e)	Ramps/Egress	P_{LL} =	100	psf	CBC Table 1607.1
f)	Paved Surface	P_{LL} =	6000	psf	CBC Table 1607.1

3. Foundation Design:

Soil Report: **Minimum allowable per CBC - non paved areas**
Dated: **N/A**

Allowable Bearing Pressure:		
Typical Footing =	1000	psf

DOE: **Solar Decathlon, Paved Surfaces**
Dated: **September 24, 2014**

Allowable Bearing Pressure:		
Typical Footing =	6000	psf

STRUCTURAL DESIGN CRITERIA – Lateral Design (SEISMIC)

2013 California Building Code (CBC)

4. Lateral Design: **Primary Structure**

a) Seismic (Static Force Procedure) CBC 1630.2.1

Seismic Design Category, SDC =	D	Provided by DOE
Building Occupancy Category =	II	CBC Table 1604.5
0.2 Sec Response, S_S =	2.75	CBC Seismic Maps, Figure 22-3
1.0 Sec Response, S_1 =	1.00	CBC Seismic Maps, Figure 22-4
Soil Classification, S =	D	CBC Table 1613.5.2
Site Coefficient, F_a =	1.0	CBC Table 11.4-1
Site Coefficient, F_v =	1.5	CBC Table 11.4-2
Maximum Seismic Spectral Response, S_{MS} =	2.75	(S_S * F_a)
Maximum Seismic Spectral Response, S_{M1} =	1.50	(S_1 * F_v)
DESIGN Seismic Spectral Response, S_{DS} =	1.83	(2/3 * S_{MS})
DESIGN Seismic Spectral Response, S_{D1} =	1.00	(2/3 * S_{M1})
Importance, I =	1.0	CBC Table 11.5-1
Response Modification Factor, R =	5.0	CBC Table 12.2-1 (Wood-framed Bearing Wall System)

Building Structure Period, T_a:

Structure Coefficient, C_t =	0.035	(wood framed, all other structures)
Structure Factor, x =	0.75	(wood framed, all other structures)
Mean Roof Height, h_n =	16.0	Feet
Structure Period, T_a =	0.28	Seconds

Seismic Response Coefficient, Cs

C_s =	0.367	[S_{DS} / (R/I)]
$(C_s)_{max}$ =	0.714	[S_{D1} / (T_a*R/I)]
$(C_s)_{min}$ =	0.010	for S_1 > 0.6 g
Seismic Response Coefficient, C_s =	0.367	

Redundancy Factor, □ = 1.0

Earthquake Load, E = □ * E_h + E_v

E_h =	0.367	(C_s * W)
E_v =	0	(ASD)

∴E = 0.37 W

STRUCTURAL DESIGN CRITERIA – Lateral Design (SEISMIC)

2013 California Building Code (CBC)

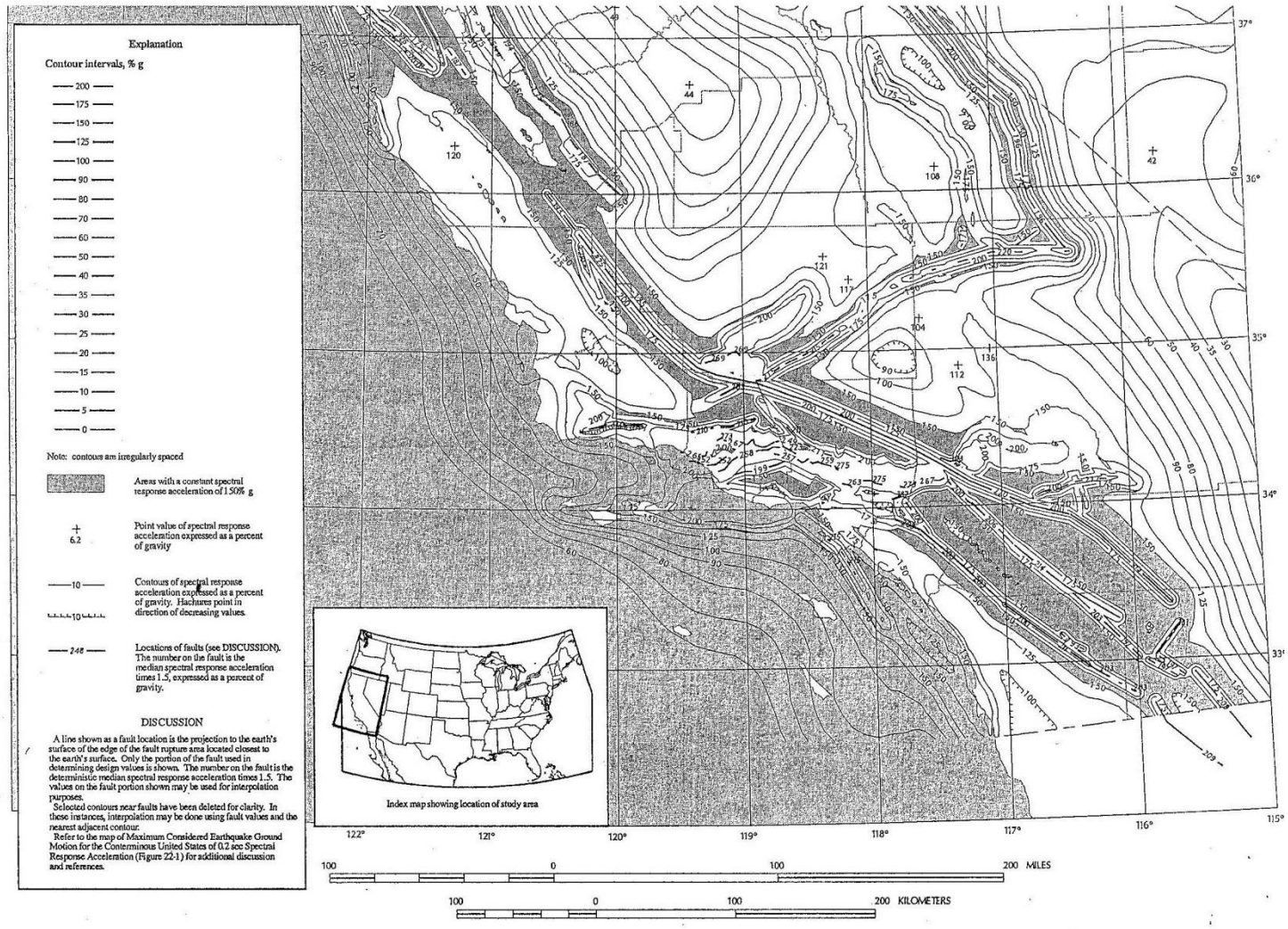


FIGURE 22-3 MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR REGION 1 OF 0.2 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

STRUCTURAL DESIGN CRITERIA – Lateral Design (SEISMIC)

2013 California Building Code (CBC)

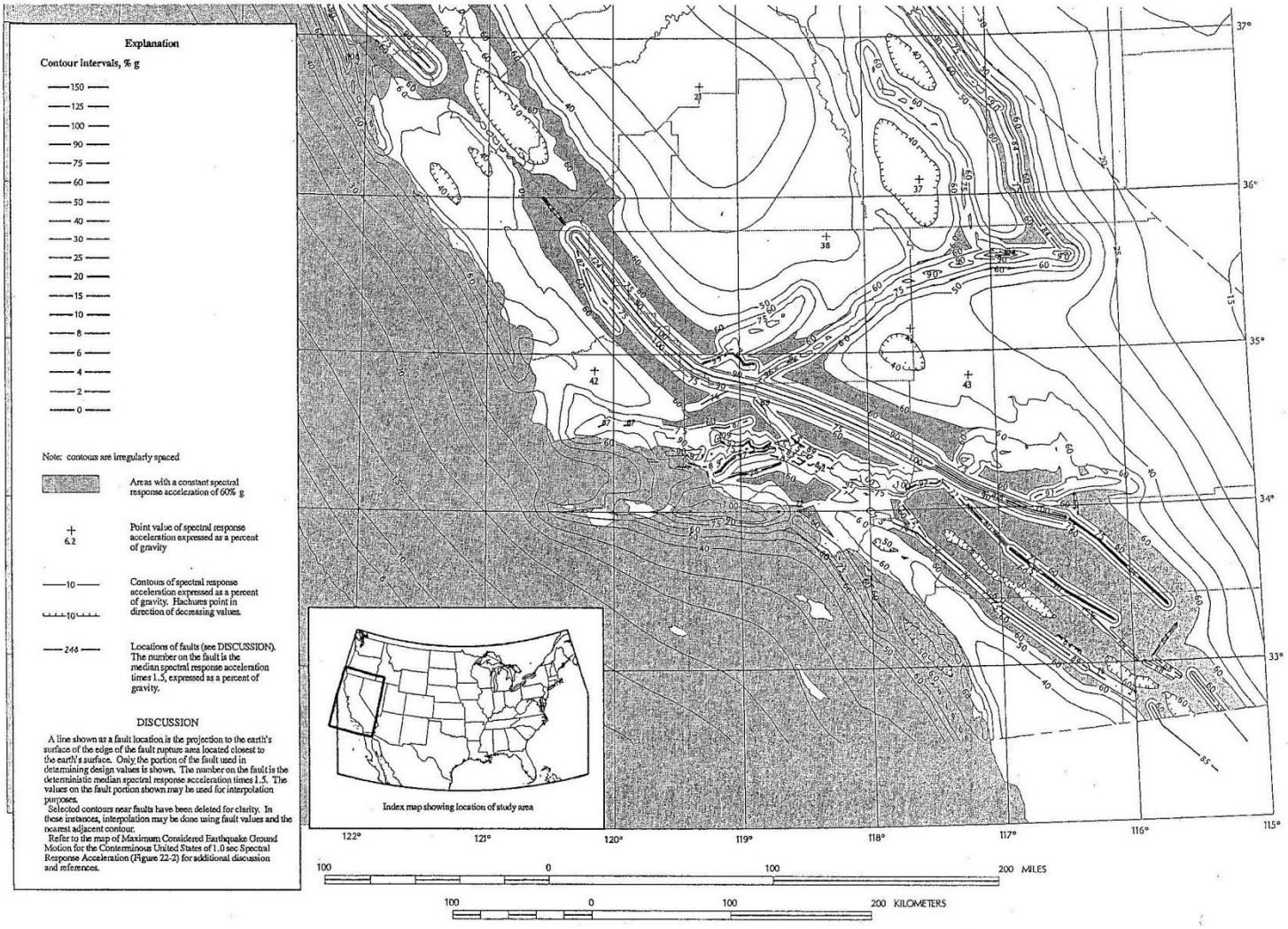


FIGURE 22-4 MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR REGION 1 OF 1.0 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

STRUCTURAL DESIGN CRITERIA – Lateral Design (SEISMIC)

2013 California Building Code (CBC)

TABLE 11.4-1 SITE COEFFICIENT, F_a

Site Class	Mapped Maximum Considered Earthquake Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.5$	$S_S = 0.75$	$S_S = 1.0$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7				

NOTE: Use straight-line interpolation for intermediate values of S_S.

Minimum Design Loads for Buildings and Other Structures

TABLE 11.4-2 SITE COEFFICIENT, F_v

Site Class	Mapped Maximum Considered Earthquake Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \leq 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \geq 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7				

NOTE: Use straight-line interpolation for intermediate values of S_1.

STRUCTURAL DESIGN CRITERIA – Lateral Design (SEISMIC)

2013 California Building Code (CBC)

TABLE 11.5-1 IMPORTANCE FACTORS

Occupancy Category	I
I or II	1.0
III	1.25
IV	1.5

TABLE 12.2-1 DESIGN COEFFICIENTS AND FACTORS FOR SEISMIC FORCE–RESISTING SYSTEMS

Seismic Force–Resisting System	ASCE 7 Section where Detailing Requirements are Specified	Response Modification Coefficient, R^a	System Overstrength Factor, $\Omega_0{}^g$	Deflection Amplification Factor, $C_d{}^b$	Structural System Limitations and Building Height (ft) Limit^c				
					Seismic Design Category				
					B	C	D^d	E^d	F^e
A. BEARING WALL SYSTEMS									
1. Special reinforced concrete shear walls	14.2 and 14.2.3.6	5	2½	5	NL	NL	160	160	100
2. Ordinary reinforced concrete shear walls	14.2 and 14.2.3.4	4	2½	4	NL	NL	NP	NP	NP
3. Detailed plain concrete shear walls	14.2 and 14.2.3.2	2	2½	2	NL	NP	NP	NP	NP
4. Ordinary plain concrete shear walls	14.2 and 14.2.3.1	1½	2½	1½	NL	NP	NP	NP	NP
5. Intermediate precast shear walls	14.2 and 14.2.3.5	4	2½	4	NL	NL	40^k	40^k	40^k
6. Ordinary precast shear walls	14.2 and 14.2.3.3	3	2½	3	NL	NP	NP	NP	NP
7. Special reinforced masonry shear walls	14.4 and 14.4.3	5	2½	3½	NL	NL	160	160	100
8. Intermediate reinforced masonry shear walls	14.4 and 14.4.3	3½	2½	2¼	NL	NL	NP	NP	NP
9. Ordinary reinforced masonry shear walls	14.4	2	2½	1¾	NL	160	NP	NP	NP
10. Detailed plain masonry shear walls	14.4	2	2½	1¾	NL	NP	NP	NP	NP
11. Ordinary plain masonry shear walls	14.4	1½	2½	1¼	NL	NP	NP	NP	NP
12. Prestressed masonry shear walls	14.4	1½	2½	1¾	NL	NP	NP	NP	NP
13. Light-framed walls sheathed with wood structural panels rated for shear resistance or steel sheets	14.1, 14.1.4.2, and 14.5	6½	3	4	NL	NL	65	65	65
14. Light-framed walls with shear panels of all other materials	14.1, 14.1.4.2, and 14.5	2	2½	2	NL	NL	35	NP	NP
15. Light-framed wall systems using flat strap bracing	14.1, 14.1.4.2, and 14.5	4	2	3½	NL	NL	65	65	65

STRUCTURAL DESIGN CRITERIA – Lateral Design (WIND)

2013 California Building Code (CBC)

4. Lateral Design: **Primary Structure – cont'd**

b) Wind (Method 1 - simplified approach) CBC 1620

Exposure =	C	Provided by DOE
Basic Wind Speed, V_w =	85	Mph
Importance, I_w =	1.0	ASCE 7-05, figure 6-1
topo factor, K_{zt} =	1	ASCE 7-05, figure 6-4 (no slopes)
Exposure & Height Factor, λ_1 =	1.21	ASCE 7-05, figure 6-2 (for h = 0-15 ft)
Exposure & Height Factor, λ_2 =	1.29	ASCE 7-05, figure 6-2 (for h = 15 - 20 ft)

Wind Pressure, ps30 (psf), slope = 9.46° - ASCE 7-05, figure 6-2

Wind Pressure, $(p_{30})_A$ =	11.5	psf (Area A)
Wind Pressure, $(p_{30})_B$ =	-5.9	psf, uplift (Area B)
Wind Pressure, $(p_{30})_C$ =	7.6	psf (Area C)
Wind Pressure, $(p_{30})_D$ =	-3.5	psf, uplift (Area D)
Wind Pressure, $(p_{30})_E$ =	-13.8	psf, uplift (Area E)
Wind Pressure, $(p_{30})_F$ =	-7.8	psf, uplift (Area F)
Wind Pressure, $(p_{30})_G$ =	-9.6	psf, uplift (Area G)
Wind Pressure, $(p_{30})_H$ =	-6.1	psf, uplift (Area H)

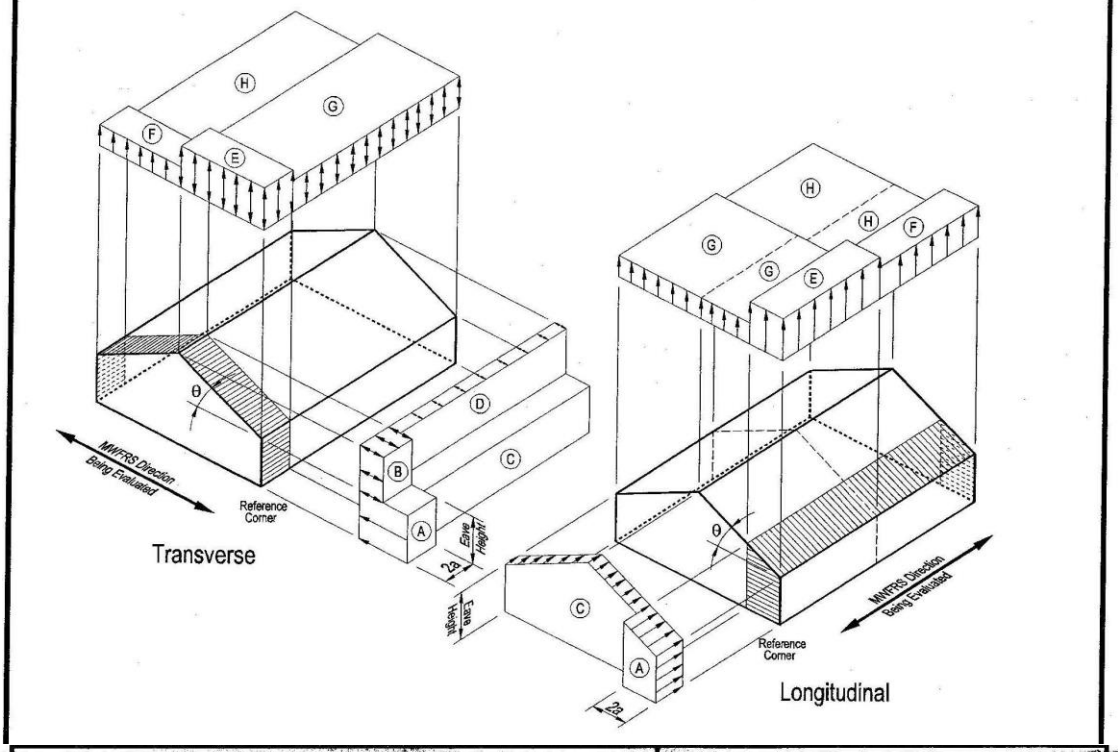
$$\text{Wind Pressure, } p_i = (\lambda * K_{zt} * I_w) * p_{s30i}$$

Area	h	λ	K_{zt}	I_w	p_{s30} (psf)	p_i (psf)
A	0-14ft	1.21	1.0	1.0	11.5	**13.92**
B	14-18ft	1.29	1.0	1.0	-5.9	**-7.61**
C	0-14 ft	1.21	1.0	1.0	7.6	**9.20**
D	14-18ft	1.29	1.0	1.0	-3.5	**-4.52**
E	16ft	1.29	1.0	1.0	-13.8	**-17.80**
F	16ft	1.29	1.0	1.0	-7.8	**-10.06**
G	16ft	1.29	1.0	1.0	-9.6	**-12.38**
H	16ft	1.29	1.0	1.0	-6.1	**-7.87**

STRUCTURAL DESIGN CRITERIA – Lateral Design (WIND)

2013 California Building Code (CBC)

Main Wind Force Resisting System – Method 1		h ≤ 60 ft.
Figure 6-2	Design Wind Pressures	Walls & Roofs
Enclosed Buildings		



Main Wind Force Resisting System – Method 1		h ≤ 60 ft.
Figure 6-2 (cont'd)	Design Wind Pressures	Walls & Roofs
Enclosed Buildings		

Simplified Design Wind Pressure, p_{s30} (psf) *(Exposure B at h = 30 ft., K_{zt} = 1.0, with I = 1.0)*

Basic Wind Speed (mph)	Roof Angle (degrees)	Load Case	Zones									
			Horizontal Pressures				Vertical Pressures				Overhangs	
			A	B	C	D	E	F	G	H	EOH	GOH
85	0 to 5°	1	11.5	-5.9	7.6	-3.5	-13.8	-7.8	-9.6	-6.1	-19.3	-15.1
	10°	1	12.9	-5.4	8.6	-3.1	-13.8	-8.4	-9.6	-6.5	-19.3	-15.1
	15°	1	14.4	-4.8	9.6	-2.7	-13.8	-9.0	-9.6	-6.9	-19.3	-15.1
	20°	1	15.9	-4.2	10.6	-2.3	-13.8	-9.6	-9.6	-7.3	-19.3	-15.1
	25°	1	14.4	2.3	10.4	2.4	-6.4	-8.7	-4.6	-7.0	-11.9	-10.1
		2	------	------	------	------	-2.4	-4.7	-0.7	-3.0	------	------
	30 to 45	1	12.9	8.8	10.2	7.0	1.0	-7.8	0.3	-6.7	-4.5	-5.2
		2	12.9	8.8	10.2	7.0	5.0	-3.9	4.3	-2.8	-4.5	-5.2

STRUCTURAL DESIGN CRITERIA – Lateral Design (WIND)

2013 California Building Code (CBC)

Importance Factor, I (Wind Loads)

Table 6-1

Category	Non-Hurricane Prone Regions and Hurricane Prone Regions with V = 85-100 mph and Alaska	Hurricane Prone Regions with V > 100 mph
I	0.87	0.77
II	1.00	1.00
III	1.15	1.15
IV	1.15	1.15

Note:

1. The building and structure classification categories are listed in Table 1-1.

Main Wind Force Resisting System – Method 1 | **h ≤ 60 ft.**

Figure 6-2 (cont'd) | **Design Wind Pressures**

Enclosed Buildings | **Walls & Roofs**

Adjustment Factor for Building Height and Exposure, λ

Mean roof height (ft)	Exposure B	Exposure C	Exposure D
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

DEAD LOAD TABLES

ROOF LOADS (psf):

1/6 in 12 SLOPED WOOD ROOF: (psf)

Load Type	Decking	Rafter	Lateral
Roofing, metal decking, 26 ga	1.0	1.0	1.0
2" Polyiso Rigid Insulation Panels	0.5	0.5	0.5
5/8" Sheathing	1.8	1.8	1.8
Rafters - 2x8 @ 1'-0"oc		3.0	3.0
R-19 Insulation (5.5", loose)		0.5	0.5
1x Ship Lap Ceiling		1.8	1.8
Sprinklers, Fire Protection (wet system)		1.0	1.0
Miscellaneous	3.7	3.4	3.4
Dead Load	7.0	13.0	13.0
Live Load (non-reduced for 0.167:12 slope)	20.0	20.0	0.0
Total Load	**27.0**	**33.0**	**13.0**

FLOOR LOADS (psf):

Load Type	Decking	Joists	Lateral
Flooring, wood laminate	1.5	1.5	1.5
1-1/8" T&G Sheathing	3.4	3.4	3.4
9-1/2" TJI Joists @ 16" oc		1.7	1.7
R-30 Insulation (7.5", loose)		0.8	0.8
Mobile Trailer, Steel Framing			5.0
Miscellaneous	3.1	3.6	3.6
Dead Load	8.0	11.0	16.0
Live Load (non-reduced)	60.0	60.0	0.0
Total Load	**68.0**	**71.0**	**16.0**

DEAD LOAD TABLES

EXTERIOR DECK LOADS (psf):

Load Type	Decking	Joists	Lateral
Composite Decking, 1x6 planks	6.0	6.0	6.0
2x8 PT Joists @ 16" oc		2.3	2.3
Miscellaneous	3.0	3.7	3.7
Dead Load	9.0	12.0	12.0
Live Load (non-reduced)	100.0	100.0	0.0
Total Load	**109.0**	**112.0**	**12.0**

WALL LOADS (psf):

Load Type	Studs	Lateral
2x6 Studs @ 16" oc	1.7	1.7
5/8" Drywall	2.8	2.8
2" Polyiso Rigid Insulation Panels	0.5	0.5
1/2" Sheathing	1.5	1.5
Exterior Cladding, horizontal siding	2.3	2.3
Miscellaneous	2.2	2.2
Dead Load	11.0	11.0
Live Load	0.0	0.0
Total Load	**11.0**	**11.0**

VERTICAL DESIGN

VERTICAL LOAD DESIGN - Framing

Live Loads:

Floor:	L_f = 50psf	(per calc page 3)
Roof:	L_r = 20psf	(per calc page 3)
Canopy:	L_c = 5psf	(per calc page 3)
Decks/Ramps:	L_d = 100psf	(per calc page 3)

Dead Loads:

Floor:	D_f = 11psf	(per calc page 12)
Roof:	D_r = 13psf	(per calc page 12)
Decks/Ramps:	D_d = 12psf	(per calc page 13)
Walls:	D_w = 11psf	(per calc page 13)

Units:

$psf := \frac{lbf}{ft^2}$

$pcf := \frac{lbf}{ft^3}$

$plf := \frac{lbf}{ft}$

ROOF STRUCTURE DESIGN

I) Roof Rafters, R1 @ Great Room

Span: L = 14.67ft (horiz)

Trib Width: b = 16in

$slope_{adj} := \frac{\sqrt{(3.5)^2 + (21)^2}}{21}$ $slope_{adj} = 1.01$

$w_{tot} := \left[slope_{adj} \cdot (D_r) + L_r\right] \cdot b$ W_{tot} = 44.24 • plf

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 324.49 \cdot lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 1190.1 \cdot ft \cdot lbf$

DF #1 F_b = 1000psi F_v = 180psi E = 1.7 * 10^6 psi

C_D = 1.25 (dead + roof live…roof live governs)

C_m = 1.0 & C_t = 1.0 (assume dry & normal temp, unless given)

C_L = 1.0 (fully-braced with roof ply on compression side of beam)

C_r = 1.15 (3 or more members, continuous ply, and spacing <24"oc…All 3, YES)

C_F = 1.2 (initially assumed 2x8, verify later)

$F'_b = F_b \cdot C_D \cdot C_m \cdot C_t \cdot C_L \cdot C_r \cdot C_F$ F'_b = 1725 • psi

$F'_v = F_v * C_D * C_m \cdot C_t$ F'_v = 225 • psi

$E' = E \cdot C_m \cdot C_t$ E' = 1.7 x 10^6 • psi

VERTICAL DESIGN

Bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 8.28 \cdot in^3$ **2x8 DF#1 Joists @ 24"oc**

$S_x = 13.14\ in^3$ **OK**

Shear: $A_{reqd} := \frac{1.5V_{max}}{F'_v}$ $A_{reqd} = 2.16 \cdot in^2$

$A = 10.88\ in^2$ **OK**

Deflection: = L/240) $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 36.97 \cdot in^4$

$I_x = 47.63\ in^4$ **OK**

Check actual deflection: $I_x = 47.63 in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0.57 \cdot in$ $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.73 \cdot in$

II) Header @ Upper Celestial Windows:

Span: L = 40ft

Point loads at 16"oc from roof rafter reactions: $P = V_{max}$ $P = 324.49 lbf$

Two point loads at 1/3 points: $a = 16in$

Shear: $V_{max} = F$ $V_{max} = 324.49 \bullet lbf$

Moment $M_{max} = P \bullet a$ $M_{max} = 432.7 \bullet ft \bullet lbf$

DF #2 $F_b = 900psi$ $F_v = 180psi$ $E = 1.6 \times 10^6 psi$

$C_D = 1.25$ (dead + roof live…roof live governs)

$C_m = 1.0$ & $C_t = 1.0$ (assume dry & normal temp, unless given)

$C_L = 1.0$ (fully-braced with roof ply on compression side of beam)

$C_r = 1.0$ (3 or more members, continuous ply, and spacing <24"oc…All 3, NO)

$C_F = 1.5$ (initially assumed 4x4, verify later)

$F'_b = F_b \bullet C_D \bullet C_m \bullet C_t \bullet C_L \bullet C_r \bullet C_F$ $F'_b = 1687.5 \bullet psi$

$F'_v = F_v * C_D * C_m \bullet C_t$ $F'_v = 225 \bullet psi$

$E' = E \bullet C_m \bullet C_t$ $E' = 1.7 \times 10^6 \bullet psi$

VERTICAL DESIGN

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 3.08 \cdot in^3$

shear: $A_{reqd} := \frac{1.5 V_{max}}{F'_v}$ $A_{reqd} = 2.16 \cdot in^2$

4x4 DF#2 Header

$S_X = 7.15\ in^3$ **OK**

$A = 12.25\ in^2$ **OK**

$I_X = 12.51\ in^4$ **OK**

deflection: $I_{reqd} := \frac{P \cdot a}{24 \cdot E' \cdot \left(\frac{L}{240}\right)} \cdot \left(3 \cdot L^2 - 4 \cdot a^2\right)$ $I_{reqd} = 3.98 \cdot in^4$

(= L/240)

Check actual deflection: $I_x := 47.63 in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0 \cdot in$ > $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.20 \cdot in$

III.) Roof Rafters, R2 @ Garage

span, $L := 18ft$ (horiz) $slope_{adj} := \frac{\sqrt{(3.5)^2 + (21)^2}}{21}$ $slope_{adj} = 1.01$

trib width, $b := 12in$

$w_{tot} := \left[slope_{adj} \cdot (D_r) + L_r\right] \cdot b$ $w_{tot} = 33.18 \cdot plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 298.61 \cdot lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 1343.8 \cdot ft \cdot lbf$

DF #1 $F_b = 1000psi$ $F_v = 180psi$ $E = 1.7 \times 10^6 psi$

$C_D = 1.25$ (dead + roof live…roof live governs)

$C_m = 1.0$ & $C_t = 1.0$ (assume dry & normal temp, unless given)

$C_L = 1.0$ (fully-braced with roof ply on compression side of beam)

$C_r = 1.15$ (3 or more members, continuous ply, and spacing <24"oc…All 3, YES)

$C_F = 1.2$ (initially assumed 2x8, verify later)

$F'_b = F_b \bullet C_D \bullet C_m \bullet C_t \bullet C_L \bullet C_r \bullet C_F$ $F'_b = 1725 \bullet psi$

$F'_v = F_v * C_D * C_m \bullet C_t$ $F'_v = 225 \bullet psi$

$E' = E \bullet C_m \bullet C_t$ $E' = 1.7 \times 10^6 \bullet psi$

VERTICAL DESIGN

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 9.35 \cdot in^3$

shear: $A_{reqd} := \frac{1.5 V_{max}}{F'_v}$ $A_{reqd} = 1.99 \cdot in^2$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 51.22 \cdot in^4$

= L/240)

2x8 DF#1 Joists @ 12"oc

S_X = 13.14 in^3 **OK**

A = 10.88 in^2 **OK**

I_X = 47.63 in^4 **OK**

Check actual deflection: $I_x := 47.63 in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0.97 \cdot in$ > $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.90 \cdot in$

IV.) Roof Rafters, R3 @ Upper Roof

span, $L := 15ft$ (horiz) $slope_{adj} := \frac{\sqrt{(3.5)^2 + (21)^2}}{21}$ $slope_{adj} = 1.01$

trib width, $b := 24in$

$w_{tot} := \left[slope_{adj} \cdot (D_r) + L_r\right] \cdot b$ $w_{tot} = 66.36 \cdot plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 497.69 \cdot lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 1866.3 \cdot ft \cdot lbf$

DF #1 F_b = 1000psi F_v = 180psi E = 1.7 x 10^6psi

C_D = 1.25 (dead + roof live…roof live governs)

C_m = 1.0 & C_t = 1.0 (assume dry & normal temp, unless given)

C_L = 1.0 (fully-braced with roof ply on compression side of beam)

C_r = 1.15 (3 or more members, continuous ply, and spacing <24"oc…All 3, YES)

C_F = 1.2 (initially assumed 2x8, verify later)

$F'_b = F_b \bullet C_D \bullet C_m \bullet C_t \bullet C_L \bullet C_r \bullet C_F$ $F'_b = 1725 \bullet psi$

$F'_v = F_v * C_D * C_m \bullet C_t$ $F'_v = 225 \bullet psi$

$E' = E \bullet C_m \bullet C_t$ $E' = 1.7 \times 10^6 \bullet psi$

VERTICAL DESIGN

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 12.98 \cdot in^3$

shear: $A_{reqd} := \frac{1.5 V_{max}}{F'_v}$ $A_{reqd} = 3.32 \cdot in^2$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 59.28 \cdot in^4$

= L/240)

2x8 DF#1 Joists @ 24"oc

S_X = 13.14 in^3 **OK**

A = 10.88 in^2 **OK**

I_X = 47.63 in^4 **OK**

Check actual deflection: $I_x := 47.63 in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0.93 \cdot in$ > $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.75 \cdot in$

V.) Roof Beam, B1 @ Patio:

span, $L := 15.0 ft$

trib width, $b := \frac{14.67 ft}{2} + 24 in$

$A_{trib} := L \cdot b$ $A_{trib} = 140.03 ft^2$ < 200 ft^2, NO Live Load reduction

$w_{tot} := (D_r + L_r) \cdot b$ $w_{tot} = 308.06 \cdot plf$ $E' := 2.0 \cdot 10^6 psi$

shear: $V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 2310.41 \cdot lbf$

moment: $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 8664 \cdot ft \cdot lbf$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 233.93 \cdot in^4$

= L/240)

OPTION #1

5-1/4" x 11-1/4" Parallam PSL 2.0E

M_{all} = 26,955 ft-lb

V_{all} = 11,420 lbs

I_{all} = 623 in^4

VERTICAL DESIGN

Alternately - Glulam Beam

Glulam 24F-V4: $F_b := 2400psi$ $F_v := 265psi$ $E := 1.8 \cdot 10^6 psi$

$C_D := 1.25$ (dead + roof live...roof live governs)

$C_m := 1.0$ & $C_t := 1.0$ (assume dry & normal temp, unless given)

$C_L := 1.0$ (fully-braced with roof ply on compression side of beam)

$C_r := 1.0$ (3 or more members, continuous ply, and spacing < 24" oc...ALL 3, **NO**)

$C_V := 1.0$ (initially assumed, verify later with exact beam size chosen)

$F'_b := F_b \cdot C_D \cdot C_m \cdot C_t \cdot C_L \cdot C_r \cdot C_V$ $F'_b = 3000 \cdot psi$

$F'_v := F_v \cdot C_D \cdot C_m \cdot C_t$ $F'_v = 331.25 \cdot psi$

$E' := E \cdot C_m \cdot C_t$ $E' = 1.8 \times 10^6 \cdot psi$

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 34.66 \cdot in^3$

shear: $A_{reqd} := \frac{1.5 V_{max}}{F'_v}$ $A_{reqd} = 10.46 \cdot in^2$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 259.92 \cdot in^4$

= L/240)

try 3-1/8"x10.5" Glulam Beam

$S_x := 57.42in^3$

$A := 32.81in^2$

$I_x := 301.5in^4$

VERTICAL DESIGN

Re-check Fb with actual Glulam size:

$b := 3.125in$ $d := 10.5in$ $k := 1.0$ (simply supported)

$$C_V := k \cdot \left(\frac{21ft}{L}\right)^{0.10} \cdot \left(\frac{12in}{d}\right)^{0.10} \cdot \left(\frac{5.125in}{b}\right)^{0.10}$$

$C_V = 1.1$ > 1.0 ☐ **use Cv = 1.0**

all other adjustment factors = **SAME**
i.e. NO CHANGE to bending stress

Check actual deflection:

$$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$$

$\Delta_{max} = 0.65 \cdot in$ > $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.75 \cdot in$

OPTION #2

3-1/8"x10.5" Glulam 24F-V4

$S_X = 57.42\ in^3$ **OK**

$A = 32.81\ in^2$ **OK**

$I_X = 301.50\ in^4$ **OK**

VI.) Column, C1:

column height, $H := 10ft$

column load, $$P_{C1} := 2\left(\frac{w_{tot} \cdot L}{2}\right) + 4lbf$$ $P_{C1} = 4624.82 \cdot lbf$

DF#2 Posts: $F_c := 1350psi$ $E := 1.3 \cdot 10^6 psi$ $E_{min} := 580000psi$

try 4x4 Member: $A := 12.25in^2$

$C_D := 1.25$ (dead + roof live...roof live governs)

$C_m := 1.0$ & $C_t := 1.0$ (assume dry & normal temp, unless given)

$C_F := 1.0$ (6x6 post, d < 12" use C_F = 1.0)

$F'_c := F_c \cdot C_D \cdot C_m \cdot C_t \cdot C_F$ $F'_c = 1687.5 \cdot psi$

$E' := E \cdot C_m \cdot C_t$ $E' = 1.3 \times 10^6 \cdot psi$

VERTICAL DESIGN

Column Stability, C_p:

$d_x := 5.5in$ $l_{ux} := H$ $l_{ux} = 10\,ft$

$d_y := 5.5in$ $l_{uy} := H$ $l_{uy} = 10\,ft$

$K_e := 1.0$ (pin-pin ends)

$$le\_d := \max\left(\frac{K_e \cdot l_{ux}}{d_x}, \frac{K_e \cdot l_{uy}}{d_y}\right) \qquad le\_d = 21.82$$ < 50 slenderness ratio **OK**

$c := 0.80$ (sawn lumber)

$F''_c := F_c \cdot C_D \cdot C_F$ $F''_c = 1687.5 \cdot psi$

$$F_{cE} := \frac{0.822 \cdot E_{min}}{le\_d^2} \qquad F_{cE} = 1001.53 \cdot psi$$

$$Cp := \frac{1 + \left(\frac{F_{cE}}{F''_c}\right)}{2 \cdot c} - \sqrt{\left[\frac{1 + \left(\frac{F_{cE}}{F''_c}\right)}{2 \cdot c}\right]^2 - \frac{\frac{F_{cE}}{F''_c}}{c}}$$

$C_p := \min(Cp, 1.0)$ $C_p = 0.5$

$F'_c := F''_c \cdot C_p$ $F'_c = 836.86 \cdot psi$ > $f_c := \frac{P_{C1}}{A}$ $f_c = 377.54 \cdot psi$ **OK**

DF#2, 4x4 Posts

VERTICAL DESIGN

WALL STUD DESIGN

I.) Stud Wall: **2x4 @ 24"oc**

column height, $H := 10ft$

column load, $P_C := \left(D_r + L_r\right) \cdot \frac{15ft}{2} \cdot (24in)$ $P_C = 495 \cdot lbf$

DF#2 Posts: $F_c := 1350psi$ $E := 1.6 \cdot 10^6 psi$ $E_{min} := 580000psi$

2 x 4 studs, $A := 5.25in^2$

$C_D := 1.25$ (dead + roof live...roof live governs)

$C_m := 1.0$ & $C_t := 1.0$ (assume dry & normal temp, unless given)

$C_F := 1.0$ (6x6 post, d < 12" use C_F = 1.0)

$F''_c := F_c \cdot C_D \cdot C_m \cdot C_t \cdot C_F$ $F''_c = 1687.5 \cdot psi$

$E' := E \cdot C_m \cdot C_t$ $E' = 1.6 \times 10^6 \cdot psi$

$E'_{min} := E_{min} \cdot C_m \cdot C_t$ $E'_{min} = 5.8 \times 10^5 \cdot psi$

Column Stability, C_P:

$d_x := 3.5in$ $l_{ux} := H$ $l_{ux} = 10ft$

$d_y := 1.5in$ $l_{uy} := 12in$ $l_{uy} = 1ft$

$K_e := 1.0$ (pin-pin ends)

$le\_d := \max\left(\frac{K_e \cdot l_{ux}}{d_x}, \frac{K_e \cdot l_{uy}}{d_y}\right)$ $le\_d = 34.29$ < 50 slenderness ratio **OK**

$c := 0.80$ (sawn lumber)

$F''_c := F_c \cdot C_D \cdot C_F$ $F''_c = 1687.5 \cdot psi$

$F_{cE} := \frac{0.822 \cdot E_{min}}{le\_d^2}$ $F_{cE} = 405.58 \cdot psi$

VERTICAL DESIGN

$$Cp := \frac{1 + \left(\frac{F_{cE}}{F''_c}\right)}{2 \cdot c} - \sqrt{\left[\frac{1 + \left(\frac{F_{cE}}{F''_c}\right)}{2 \cdot c}\right]^2 - \frac{\frac{F_{cE}}{F''_c}}{c}}$$

$$C_p := \min(Cp, 1.0) \qquad C_p = 0.23$$

$$F'_c := F''_c \cdot C_p \qquad F'_c = 383.08 \cdot psi \quad > \quad f_c := \frac{P_C}{A} \qquad f_c = 94.29 \cdot psi \quad \underline{\text{OK}}$$

DF#2, 2x4 studs @ 24"oc

BEDROOM STORAGE AREA FLOOR STRUCTURE DESIGN

I.) Floor Joists @ 16" oc, J1

span, $L := 8.0ft$ trib width, $b := 16in$

$w_{tot} := (D_f + L_f) \cdot b$ $w_{tot} = 81.33\,plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 325.33\,lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 650.7\,ft \cdot lbf$

TJI Type 110, 9.5" Joist

$EI_{tji} := 157 \cdot 10^6 \cdot in^2 \cdot lbf$ $d_{tji} := 9.5in$

$$\Delta_{max} := \frac{22.5 \cdot w_{tot} \cdot (L^4)}{1728 \cdot EI_{tji}} + \frac{2.67 \cdot w_{tot} \cdot (L^2) \cdot \left(\frac{ft}{lbf}\right)}{144\left(d_{tji} \cdot 10^5\right)}$$

$\Delta_{max} = 0.062\,in > \Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.40\,in$

TJI Type 110 Joist, 9.5"
V_{all} = 1,220 lbf **OK**
M_{all} = 2,500 ft-lbf **OK**

VERTICAL DESIGN

II.) Floor Header over Restroom:

span, $L := 12.833ft$ trib width, $b := 4ft$

$A_{trib} := L \cdot b$ $A_{trib} = 51.33\,ft^2$ < 200 ft2, NO Live Load reduction

$w_{tot} := (D_f + L_f) \cdot b$ $w_{tot} = 244\,plf$ $E' := 2.0 \cdot 10^6 psi$

shear: $V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 1565.63\,lbf$

moment: $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 5022.9\,ft \cdot lbf$

Glulam 24F-V4: $F_b := 2400psi$ $F_v := 265psi$ $E := 1.8 \cdot 10^6 psi$

$C_D := 1.25$ (dead + roof live...roof live governs)

$C_m := 1.0$ & $C_t := 1.0$ (assume dry & normal temp, unless given)

$C_L := 1.0$ (fully-braced with roof ply on compression side of beam)

$C_r := 1.0$ (3 or more members, continuous ply, and spacing < 24" oc...ALL 3, **NO**)

$C_V := 1.0$ (initially assumed, verify later with exact beam size chosen)

$F'_b := F_b \cdot C_D \cdot C_m \cdot C_t \cdot C_L \cdot C_r \cdot C_V$ $F'_b = 3000\,psi$

$F'_v := F_v \cdot C_D \cdot C_m \cdot C_t$ $F'_v = 331.25\,psi$

$E' := E \cdot C_m \cdot C_t$ $E' = 1.8 \times 10^6 psi$

VERTICAL DESIGN

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 20.09\,in^3$

shear: $A_{reqd} := \frac{1.5V_{max}}{F'_v}$ $A_{reqd} = 7.09\,in^2$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 128.92\,in^4$

= L/240)

try 3-1/8"x10.5" Glulam Beam

$S_x := 57.42in^3$

$A := 32.81in^2$

$I_x := 301.5in^4$

Re-check Fb with actual Glulam size:

$b := 3.125in$ $d := 10.5in$ $k := 1.0$ (simply supported)

$C_V := k \cdot \left(\frac{21ft}{L}\right)^{0.10} \cdot \left(\frac{12in}{d}\right)^{0.10} \cdot \left(\frac{5.125in}{b}\right)^{0.10}$ $C_V = 1.12$ > 1.0 **use Cv = 1.0**

all other adjustment factors = **SAME**
i.e. NO CHANGE to bending stress

Check actual deflection:

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0.27\,in$ > $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.64\,in$

3-1/8"x10.5" Glulam 24F-V4

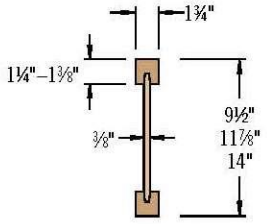
S_X = 57.42 in^3 **OK**

A = 32.81 in^2 **OK**

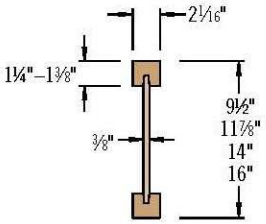
I_X = 301.50 in^4 **OK**

VERTICAL DESIGN

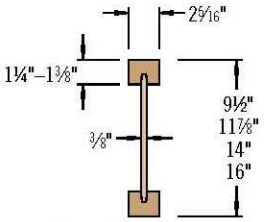
DESIGN PROPERTIES



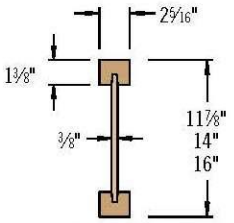
TJI® 110 Joists



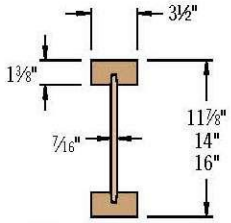
TJI® 210 Joists



TJI® 230 Joists



TJI® 360 Joists



TJI® 560 Joists

Design Properties (100% Load Duration)

Depth	TJI®	Basic Properties				Reaction Properties					
		Joist Weight (lbs/ft)	Maximum Resistive Moment(1) (ft-lbs)	Joist Only EI x 10⁶ (in.²-lbs)	Maximum Vertical Shear (lbs)	1¾" End Reaction (lbs)	3½" End Reaction (lbs)	3½" Intermediate Reaction (lbs)		5¼" Intermediate Reaction (lbs)	
								No Web Stiffeners	With Web Stiffeners(2)	No Web Stiffeners	With Web Stiffeners(2)
9½"	110	2.3	2,500	157	1,220	910	1,220	1,935	N.A.	2,350	N.A.
	210	2.6	3,000	186	1,330	1,005	1,330	2,145	N.A.	2,565	N.A.
	230	2.7	3,330	206	1,330	1,060	1,330	2,410	N.A.	2,790	N.A.
11⅞"	110	2.5	3,160	267	1,560	910	1,375	1,935	2,295	2,350	2,705
	210	2.8	3,795	315	1,655	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.0	4,215	347	1,655	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.0	6,180	419	1,705	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.0	9,500	636	2,050	1,265	1,725	3,000	3,475	3,455	3,930
14"	110	2.8	3,740	392	1,860	910	1,375	1,935	2,295	2,350	2,705
	210	3.1	4,490	462	1,945	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.3	4,990	509	1,945	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.3	7,335	612	1,955	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.2	11,275	926	2,390	1,265	1,725	3,000	3,475	3,455	3,930
16"	210	3.3	5,140	629	2,190	1,005	1,460	2,145	2,505	2,565	2,925
	230	3.5	5,710	691	2,190	1,060	1,485	2,410	2,765	2,790	3,150
	360	3.5	8,405	830	2,190	1,080	1,505	2,460	2,815	3,000	3,360
	560	4.5	12,925	1,252	2,710	1,265	1,725	3,000	3,475	3,455	3,930

(1) **Caution: Do not** increase joist moment design properties by a repetitive member use factor.

(2) See detail W on page 6 for web stiffener requirements and nailing information.

VERTICAL DESIGN

MAIN FLOOR STRUCTURE DESIGN

I.) Floor Joists @ 16" oc, J2

span, $L := 10.0ft$ trib width, $b := 16in$

$w_{tot} := (D_f + L_f) \cdot b$ $w_{tot} = 81.33\,plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 406.67\,lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 1016.7\,ft \cdot lbf$

TJI Type 110, 9.5" Joist

$EI_{tji} := 157 \cdot 10^6 \cdot in^2 \cdot lbf$ $d_{tji} := 9.5in$

$$\Delta_{max} := \frac{22.5 \cdot w_{tot} \cdot \left(L^4\right)}{1728 \cdot EI_{tji}} + \frac{2.67 \cdot w_{tot} \cdot \left(L^2\right) \cdot \left(\frac{ft}{lbf}\right)}{144\left(d_{tji} \cdot 10^5\right)}$$

$\Delta_{max} = 0.139\,in > \Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.50\,in$

TJI Type 110 Joist, 9.5"
V_{all} = 1,220 lbf **OK**
M_{all} = 2,500 ft-lbf **OK**

VERTICAL DESIGN

II.) Trailer Edge Girders

span, $L := 5.5ft$ (max, between piers)

trib width, $b := 6ft$ (10-ft wide and 12-ft wide modules)

$w_{tot} := \left[\left(D_r + D_f\right) + \left(L_r + L_f\right)\right] \cdot b$ $w_{tot} = 564 \cdot plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 1551 \cdot lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 2132.6 \cdot ft \cdot lbf$

DF #1: $F_b := 1000psi$ $F_v := 180psi$ $E := 1.7 \cdot 10^6 psi$

$C_D := 1.25$ (dead + roof live...roof live governs)

$C_m := 1.0$ & $C_t := 1.0$ (assume dry & normal temp, unless given)

$C_L := 1.0$ (fully-braced with roof ply on compression side of beam)

$C_r := 1.0$ (3 or more members, continuous ply, and spacing < 24" oc...ALL 3, **NO**)

$C_F := 1.3$ (initially assumed 4x8, verify later)

$F'_b := F_b \cdot C_D \cdot C_m \cdot C_t \cdot C_L \cdot C_r \cdot C_F$ $F'_b = 1625 \cdot psi$

$F'_v := F_v \cdot C_D \cdot C_m \cdot C_t$ $F'_v = 225 \cdot psi$

$E' := E \cdot C_m \cdot C_t$ $E' = 1.7 \times 10^6 \cdot psi$

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 15.75 \cdot in^3$

shear: $A_{reqd} := \frac{1.5 V_{max}}{F'_v}$ $A_{reqd} = 10.34 \cdot in^2$

deflection: (= L/240) $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 24.84 \cdot in^4$

4x8 DF#1 Girders

$S_X = 30.66\ in^3$ **OK**

$A = 25.38\ in^2$ **OK**

$I_X = 111.1\ in^4$ **OK**

Check actual deflection:

$I_x := 111.1in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0.06 \cdot in > \Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.28 \cdot in$

VERTICAL DESIGN

ALTERNATE DESIGN - **STEEL Main Girders**

span, $L := 11ft$ (max, between piers)

trib width, $b := 6ft$ (10-ft wide and 12-ft wide modules)

Permanent Design Loads:

$w_{tot} := \left[\left(D_r + D_f\right) + \left(L_r + L_f\right)\right] \cdot b$ $w_{tot} = 564 \cdot plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 3102 \cdot lbf$

$M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 8530.5 \cdot ft \cdot lbf$

LIFTING Design Loads:

$w_{tot2} := \left[\left(D_r + D_f\right) \cdot b + D_w \cdot 11ft\right]$ $w_{tot} = 564 \cdot plf$

Two pick points: Pick #1 at 1/4 point front (forklift)
Pick #2 at 1/4 point rear (dolly)

$P_1 := w_{tot2} \cdot \frac{(33ft)}{2} \cdot 2$ $P_1 = 8745 \cdot lbf$ forklift

$P_2 := w_{tot2} \cdot \frac{(33ft)}{2} \cdot 2$ $P_2 = 8745 \cdot lbf$ dolly

$V_{max} := \frac{P_1}{2}$ $V_{max} = 4372.5 \cdot lbf$ **Governs Design**

$M_{max} := \frac{P_1 \cdot \frac{33ft}{2}}{2}$ $M_{max} = 72146.3 \cdot ft \cdot lbf$ **Governs Design**

VERTICAL DESIGN

Grade 50 Steel Channel $F_y := 50000psi$

$F_b := 0.66 \cdot F_y$ $F_b = 33000 \cdot psi$

$F_v := 0.40 \cdot F_y$ $F_v = 20000 \cdot psi$

$E_s := 29000000psi$

$L := \frac{33ft}{2}$

bending: $Sx_{reqd} := \frac{M_{max}}{F_b}$ $Sx_{reqd} = 26.24 \cdot in^3$

shear: $A_{reqd} := \frac{V_{max}}{F_v}$ $A_{reqd} = 0.22 \cdot in^2$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot2} \cdot L^4}{384 \cdot E_s \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 18.47 \cdot in^4$

= L/240)

C10x30 Girders

$S_X = 20.7\ in^3$ **OK**

$A = 8.82\ in^2$ **OK**

$I_X = 103\ in^4$ **OK**

Check actual deflection: $I_x := 103in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot2} \cdot L^4}{384 \cdot E_s \cdot I_x}$ $\Delta_{max} = 0.15 \cdot in$ > $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.83 \cdot in$

VERTICAL DESIGN – DECK & RAMP FRAMING

I.) Joists @12"oc

span, $L := 6.5ft$ (max)

trib width, $b := 1ft$

$w_{tot} := \left[\left(D_d\right) + \left(L_d\right)\right] \cdot b$ $w_{tot} = 112 \cdot plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 364 \cdot lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 591.5 \cdot ft \cdot lbf$

DF #2: $F_b := 900psi$ $F_v := 180psi$ $E := 1.6 \cdot 10^6 psi$

$C_D := 1.25$ (dead + roof live...roof live governs)

$C_m := 1.0$ & $C_t := 1.0$ (assume dry & normal temp, unless given)

$C_L := 1.0$ (fully-braced with roof ply on compression side of beam)

$C_r := 1.0$ (3 or more members, continuous ply, and spacing < 24" oc...ALL 3, **NO**)

$C_F := 1.3$ 2x6

$F'_b := F_b \cdot C_D \cdot C_m \cdot C_t \cdot C_L \cdot C_r \cdot C_F$ $F'_b = 1462.5 \cdot psi$

$F'_v := F_v \cdot C_D \cdot C_m \cdot C_t$ $F'_v = 225 \cdot psi$

$E' := E \cdot C_m \cdot C_t$ $E' = 1.6 \times 10^6 \cdot psi$

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 4.85 \cdot in^3$

shear: $A_{reqd} := \frac{1.5 V_{max}}{F'_v}$ $A_{reqd} = 2.43 \cdot in^2$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 8.65 \cdot in^4$

(= L/240)

2x6 DF#2 Joists @ 12"oc

$S_X = 7.56\ in^3$ **OK**

$A = 8.25\ in^2$ **OK**

$I_X = 20.80\ in^4$ **OK**

Check actual deflection:

$I_x := 20.80in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0.14 \cdot in >$ $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.33 \cdot in$

VERTICAL DESIGN – DECK & RAMP FRAMING

II.) Beams at deck perimeter

span, $L := 6ft$ (max)

trib width, $b := \frac{6.5ft}{2}$

$w_{tot} := [(D_d) + (L_d)] \cdot b$ $w_{tot} = 364 \cdot plf$

$V_{max} := \frac{w_{tot} \cdot L}{2}$ $V_{max} = 1092 \cdot lbf$ $M_{max} := \frac{w_{tot} \cdot L^2}{8}$ $M_{max} = 1638 \cdot ft \cdot lbf$

DF #2: $F_b := 900psi$ $F_v := 180psi$ $E := 1.6 \cdot 10^6 psi$

$C_D := 1.25$ (dead + roof live...roof live governs)

$C_m := 1.0$ & $C_t := 1.0$ (assume dry & normal temp, unless given)

$C_L := 1.0$ (fully-braced with roof ply on compression side of beam)

$C_r := 1.0$ (3 or more members, continuous ply, and spacing < 24" oc...ALL 3, **NO**)

$C_F := 1.3$ 4x6

$F'_b := F_b \cdot C_D \cdot C_m \cdot C_t \cdot C_L \cdot C_r \cdot C_F$ $F'_b = 1462.5 \cdot psi$

$F'_v := F_v \cdot C_D \cdot C_m \cdot C_t$ $F'_v = 225 \cdot psi$

$E' := E \cdot C_m \cdot C_t$ $E' = 1.6 \times 10^6 \cdot psi$

bending: $Sx_{reqd} := \frac{M_{max}}{F'_b}$ $Sx_{reqd} = 13.44 \cdot in^3$

shear: $A_{reqd} := \frac{1.5 V_{max}}{F'_v}$ $A_{reqd} = 7.28 \cdot in^2$

deflection: $I_{reqd} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot \left(\frac{L}{240}\right)}$ $I_{reqd} = 22.11 \cdot in^4$

= L/240)

4x6 DF#2 Joists @ 12"oc

$S_X = 17.65\ in^3$ **OK**

$A = 19.25\ in^2$ **OK**

$I_X = 48.53\ in^4$ **OK**

Check actual deflection:

$I_x := 20.80in^4$

$\Delta_{max} := \frac{5 \cdot w_{tot} \cdot L^4}{384 \cdot E' \cdot I_x}$ $\Delta_{max} = 0.32 \cdot in$ > $\Delta_{allow} := \frac{L}{240}$ $\Delta_{allow} = 0.30 \cdot in$

VERTICAL DESIGN

FOUNDATION DESIGN

I.) Piers/Jacks

Reaction from main floor beams is the load on these piers/jacks, x2

$$P_{pier} := 2 \cdot \left(w_{tot} \cdot \frac{11ft}{2} \right) \qquad P_{pier} = 6204 \cdot lbf$$

Precast footing pads, 12" x 12" pier. 2000 psi concrete

$$A_{pier} := 12in \cdot 12in \qquad A_{pier} = 1ft^2$$

$$P_{allow} := 2000psi \cdot A_{pier} \qquad P_{allow} = 288000 \cdot lbf \quad > \quad P_{pier} = 6204 \cdot lbf \qquad \textbf{OK}$$

$$p_{asphalt} := 6000psi \qquad \text{(per project specs)}$$

$$p_{max} := \frac{P_{pier}}{A_{pier}} \qquad p_{max} = 43.08\,psi \qquad \textbf{OK}$$

II.) Sliding Friction

The precast concrete pads provide a static fricition against sliding due to lateral loads.

There are 24 seismic piers on this project, each with 12"x12" concrete pads.

Coefficient for sliding, concrete on asphalt is 0.40-0.70, use $\mu_{conc} := 0.40$

Structure weight (per lateral calcs below), $W_{total} := 58752lbf$

Friction force, $F_f := W_{total} \cdot \mu_{conc} \qquad F_f = 23500.8lbf$

Max shear due to lateral load calcs below, $V_{lateral} := 8535lbf$

since $V_{lateral} = 8535lbf$ < $F_f = 23500.8lbf$ NO SLIDING

LATERAL DESIGN

SEISMIC vs. WIND

1.) Determine the governing Lateral Load

a. Seismic Loads:

Building Weight, W_S:

$A_{roof} := 68ft \cdot (36ft)$ $\quad A_{roof} = 2448\,ft^2$

$A_{floor} := 68ft \cdot (36ft)$ $\quad A_{floor} = 2448\,ft^2$

$W_s := A_{roof} \cdot (D_r) + A_{floor} \cdot (D_f)$ $\quad W_s = 58752 \cdot lbf$

$E := 0.7 \dfrac{(0.36 \cdot W_s)}{2}$ (per Calc Page 4, ASD Load Combo 0.7*E, 1/2 of load to roof diaphragm, 1/2 to floor)

$E = 7402.75 \cdot lbf$ seismic base shear to roof diaphragm

b. Wind Loads:

*Analyze the transverse direction as worst case scenario to compare to Seismic

No ridge on roof, single slope => pressure areas F & H not relevant (see Page 10)

Wall height, $h_w := 13ft$

Roof height, $h_r := 5ft$ (from 13ft to 18ft max, 2:12 slope)

Building Corners, $a := \min(0.10 \cdot 33ft, 0.4 \cdot h_w)$ $\quad a = 3.3ft$

LATERAL DESIGN

Area A (wall corner): $p_A := 13.92psf$ (per Calc page 9)

$w_A := p_A \cdot (h_w)$ $w_A = 180.96 \cdot plf$

$L_A := 2 \cdot a$ $L_A = 6.6\,ft$

Area C (walls): $p_C := 7.6psf$ (per Calc page 9)

$w_C := p_C \cdot (h_w)$ $w_C = 98.8 \cdot plf$

$L_C := (65ft) - 2 \cdot a$ $L_C = 58.4\,ft$

Area B (roof corner) (horizontal): $p_B := 7.61 \cdot psf$ (per Calc page 9)

$w_B := p_B \cdot (h_r)$ $w_B = 38.05 \cdot plf$

$L_B := 2 \cdot a$ $L_B = 6.6\,ft$

Area D (roofs) (horizontal): $p_D := 4.52psf$ (per Calc page 9)

$w_D := p_D \cdot (h_r)$ $w_D = 22.6 \cdot plf$

$L_D := (65ft) - 2 \cdot a$ $L_D = 58.4\,ft$

Area E, roof corners (vertical, uplift): $p_E := -17.80 \cdot psf$ (per Calc page 9)

$w_E := p_B \cdot (33ft)$ $w_E = 251.13 \cdot plf$

$L_E := 2 \cdot a$

LATERAL DESIGN

Area G (roofs): $p_G := 12.38psf$ (per Calc page 9)

$w_G := p_G \cdot (33ft)$ $w_G = 408.54 \cdot plf$

$L_G := (65ft) - 2 \cdot a$ $L_G = 58.4\,ft$

Wind Shear to Roof Diaphragm:

Longitudinal length of building, $L_L := 65ft$

$V_w := w_A \cdot L_A + w_B \cdot L_B + w_C \cdot L_C + w_D \cdot L_D$

$V_w = 8535.23 \cdot lbf$ > $E = 7402.751lbf$

Therefore WIND Governs Lateral Systems Design

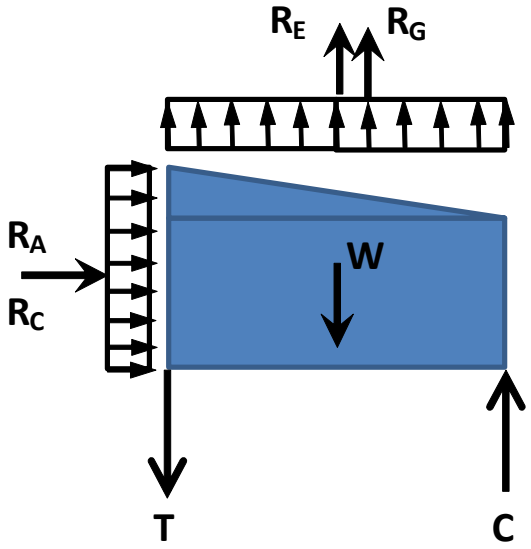
LATERAL DESIGN

Overturning Check:

Building length, $L := 65ft$ Building width, $w := 33ft$

Transverse loading governs design:

Resisting Moment, $RM := W_s \cdot \frac{w}{2}$ $RM = 969408 \cdot ft \cdot lbf$



$R_A := w_A \cdot L_A$ $R_A = 1194.34\,lbf$

$R_C := w_C \cdot L_C$ $R_C = 5769.92\,lbf$

$R_B := w_B \cdot L_B$ $R_B = 251.13\,lbf$

$R_D := w_D \cdot L_D$ $R_D = 1319.84\,lbf$

$R_E := w_E \cdot L_E$ $R_E = 1657.46\,lbf$

$R_G := w_G \cdot L_G$ $R_G = 23858.74\,lbf$

$arm_{AC} := \frac{h_w}{2}$ $arm_{AC} = 6.5\,ft$

$arm_{BD} := h_w + \frac{h_r}{2}$ $arm_{BD} = 15.5\,ft$

$arm_{EG} := \frac{33ft}{2}$ $arm_{EG} = 16.5\,ft$

$OTM := (R_A + R_C) \cdot arm_{AC} + (R_B + R_D) \cdot arm_{BD} + (R_E + R_G) \cdot arm_{EG}$

$OTM = 490635\,ft \cdot lbf$ < $RM = 969408\,ft \cdot lbf$ **NO UPLIFT**

LATERAL DESIGN

Roof & Floor Diaphragms: - N/S Direction 1

Transverse loading (North-South):

Diaphragm length, $L_1 := 54.5ft$

Diaphragm depth, $d_1 := 33ft$

$$M_1 := \frac{\left(\frac{w_C}{2} + \frac{w_D}{2}\right) \cdot (L_1)^2}{8} \qquad M_1 = 22536.77\,ft \cdot lbf$$

max chord force, $T_1 := \frac{M_1}{d_1}$ $T_1 = 682.93\,lbf$ top plate, chord force

diaphragm reaction, $R_1 := \left(\frac{w_C}{2} + \frac{w_D}{2}\right) \cdot \frac{L_1}{2}$ $R_1 = 1654.08\,lbf$

diaphragm unit shear, $v_1 := \frac{R_1}{d_1}$ $v_1 = 50.12\,plf$ diapragm shear

ICC Report ESR-1539
Case 1 loading, unblocked, 15/32" ply
8d Common @ 6" edge & 12" field
allowable unit shear, v = 235 plf (table 10)

LATERAL DESIGN

Roof & Floor Diaphragms: - E/W Direction 2

Longitudinal loading (East-West):

Diaphragm length, $L_2 := 33ft$

Diaphragm depth, $d_2 := 54.5ft$

$$M_2 := \frac{\left(\frac{w_C}{2} + \frac{w_D}{2}\right) \cdot (L_2)^2}{8} \qquad M_2 = 8262.79\,ft \cdot lbf$$

max chord force, $T_2 := \frac{M_2}{d_2}$ $T_2 = 151.61\,lbf$ top plate, chord force

diaphragm reaction, $R_2 := \left(\frac{w_C}{2} + \frac{w_D}{2}\right) \cdot \frac{L_2}{2}$ $R_2 = 1001.55\,lbf$

diaphragm unit shear, $v_2 := \frac{R_2}{d_2}$ $v_2 = 18.38\,plf$ diapragm shear

ICC Report ESR-1539
Case 2 loading, unblocked, 15/32" ply
8d Common @ 6" edge & 12" field
allowable unit shear, v = 180 plf (table 10)

LATERAL DESIGN

Shearwall Design - N/S Direction 1

Transverse direction #1 (North-South):

NOTE: We have identified 4 walls in N/S direction that are 11-ft or longer as shearwall type A. The WEST wall next to garage has the most tributary wind load, so the design is based off of this wall for type A shearwall.

shearwall length, $L_1 := 11ft$

trib wind to wall $b_1 := \frac{20ft}{2}$ $b_1 = 10\,ft$

reaction to wall from wind trib, $R_1 := \left(\frac{w_C}{2} + \frac{w_D}{2}\right) \cdot b_1$ $R_1 = 607\,lbf$

wall unit shear, $v_{s1} := \frac{R_1}{L_1}$ $v_{s1} = 55.18\,plf$

ICC Report ESR-1539
Table 19, 15/32" ply, direct to framing
8d Common @ 6" edge & 12" field
allowable unit shear, v = 255 plf

LATERAL DESIGN

Shearwall Design - E/W Direction 2

Longitudinal direction #2 (East-West):

North walls, 4 at 2'8" each, govern the design in direction 2:

shearwall length, $L_2 := 2.666\,ft$

trib wind to wall $b_2 := \frac{33ft}{2}$ $b_2 = 16.5\,ft$

reaction to wall from wind trib, $R_2 := \left(\frac{w_C}{2} + \frac{w_D}{2}\right) \cdot b_2$ $R_2 = 1001.55\,lbf$

wall unit shear, $v_{s2} := \frac{R_2}{4L_2}$ $v_{s2} = 93.92\,plf$

ICC Report ESR-1539
Table 19, 15/32" ply, direct to framing
8d Common @ 6" edge & 12" field
allowable unit shear, v = 255 plf

Article 04. Detailed Water Budget

Description	Events	Use Per Event (Gal)	Total Use (Gal)	Notes
Sunday (Day 7)				
Initial Systems Fill	1	0	0	
Hot and Cold Piping	1	60	60	Includes water heater fill
HVAC System	1	10	10	
Fire Water Tank	1	400	400	
Irrigation	1	30	30	
Total Sunday			*500*	*Gallons*
Friday (Day 12)				
Clothes Washer	1	23	23	C7-3
Dishwasher	1	5	5	C7-5
Hot Water	1	20	20	C8-2
Irrigation	1	30	30	
Total Friday			*78*	*Gallons*
Saturday (Day 13)				
Clothes Washer	1	23	23	C7-3
Hot Water	2	20	40	C8-2
Total Saturday			*63*	*Gallons*
Sunday (Day 14)				
Clothes Washer	1	23	23	C7-3
Dishwasher	1	5	5	C7-5
Hot Water	1	20	20	C8-2
Cooking	1	1	1	C7-6
Total Sunday			*49*	*Gallons*
Monday (Day 15)				
Clothes Washer	2	23	46	C7-3
Hot Water	3	20	60	C8-2
Irrigation	1	30	30	
Total Monday			*136*	*Gallons*
Tuesday (Day 16)				

Cooking	1	1	1	C7-6
Dishwasher	1	5	5	C7-5
Hot Water	3	20	60	C8-2
Total Tuesday			*66*	*Gallons*
Wednesday (Day 17)				
Clothes Washer	2	23	46	C7-3
Cooking	2	1	2	C7-6
Hot Water	3	20	60	C8-2
Total Wednesday			*108*	*Gallons*
Thursday (Day 18)				
Dishwasher	1	5	5	C7-5
Hot Water	2	20	40	C8-2
Irrigation	1	30	30	
Total Thursday			*75*	*Gallons*
Friday (Day 19)				
Clothes Washer	1	23	23	C7-3
Dishwasher	1	5	5	C7-5
Hot Water	1	20	20	C8-2
Cooking	1	1	1	C7-6
Total Friday			*49*	*Gallons*
Subtotals				
Systems Fill			500	
Clothes Washer	8	23	184	
Hot Water	16	20	320	
Dishwasher	5	5	25	
Irrigation	4	30	120	
Cooking	5	1	5	
Contingency	1	150	150	
Competition Total			**1304**	**Gallons**

Article 05. Summary of Unlisted Electrical Components

No unlisted electrical components will exist within the competition structure. All electrical components to be used will be approved by an approved testing agency as per Section 6-7 of the SD2015 Building Code.

Article 06. Summary of Reconfigurable Features

No reconfigurable features will exist within the competition structure.

Article 07. Interconnection Application Form

Sacramento State Solar N.E.S.T. – Lot 102

PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
Bosch	Roof-mounted solar array: 27 x Bosch c-Si M 60 panels arranged in series (240w EA)	6,480 W
SOLARIA	"Solar Skylight" Array: 24 x SOLARIA SIBV4 panels arranged in series (120w EA)	2,880 W
SOLARIA	"Solar Railing" Array: 2 x SOLARIA SIBV4 panels arranged in series (120w EA)	240 W

Total DC power of all arrays is **9.6 kW** (in tenths)

Inverters

Inverter Manufacturer	Model Number	Voltage	Rating (KW)	Quantity
Enecsys Micro Inv.	SMI-D480W-60-UL	240v	0.46	14
Solaredge	SE3000A	240v	3	1

Total AC power of all inverters is **9** kW (in whole numbers)

Required Information

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)

Item	Location
One-Line Electrical Schematic	E-601
Calculations of service/feeder net computed load and neutral load (NEC 220)	E-501
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	E-101, A-103

The team's "electrical engineer" contact information has been provided in the "Team Officer Contact Info" database on the Yahoo Group.

Article 09. Quantity Takeoff of Prototype House

Section	Brief Description	Detailed Description	Qty	Unit
Division 01 - General Requirements				
01 54 00	**Construction Aids**			
01 54 16.50	Rent Forklift	Rough terrain forklift with 9000 lb capacity, 42' lift, 35' reach	5	Day
01 54 23	Temporary Scaffolding	Rolling, Portable Scaffolding	5	Day
Division 06 - Wood, Plastics and Composites				
06 05 00	**Common Work Results for Wood, Plastics, and Composites**			
06 05 23	Framing Nails	16d coated framing nails, collated, 5000/box	Several	Box
06 05 23	Framing Nails	8d coated framing nails, collated, 5000/box	Several	Box
06 05 23	Sub-floor Nails	3" ring shank brite coated nails, collated, 5000/box	Several	Box
06 05 23	Finish Nails	2", 16-gauge finish nail, collated, 2500/box	Several	Box
06 05 23	Drywall Screws	2 1/2" #8 Phillips bugle-head coarse thread, collated 1000/box	Several	Box
06 05 23	Deck Screws	3 1/2", #10 Square flat-head, coarse thread, polymer coated exterior, 15lb/box	Several	Box
06 10 00	**Rough Carpentry**			
06 10 63	Exterior Deck	Wood framed exterior deck with 2" X 10" Treated Doug Fir No. 2 or better Joists, 16" O.C. with Simpson Strong Tie LUS hangars with Zmax coating, Wood railing with 4" X 4" posts and 2" X 6 " top rail around entire perimeter	1300	SF
06 11 00	**Wood Framing**			
06 11 12	2 X 6 Stud Exterior Walls	Wood framing, 10' high, Douglas Fir No. 2 or better, 2" X 6 " studs 16" O.C, single bottom plate and double top plate	75	LF
06 11 12	2 X 6 Stud Exterior Walls	Wood framing, 10' high, Douglas Fir No. 2 or better, 2" X 6 " studs 16" O.C, single bottom plate and double top plate	67	LF
06 11 12	2 X 6 Stud Exterior Walls	Wood framing, 4' high, Douglas Fir No. 2 or better, 2" X 6 " studs 16" O.C, single bottom plate and double top plate	13	LF

06 11 12	2 X 6 Stud Exterior Walls	Wood framing, 2.75' high, Douglas Fir No. 2 or better, 2" X 6 " studs 16" O.C, single bottom plate and double top plate	39	LF
06 11 12	2 X 6 Stud Exterior Walls	Wood framing, 10' High, wall with large openings, Engineered beam (to be designed) with central column.	30	LF
06 11 12	2 X 4 Stud Interior Walls	Wood framing, 8.5" High, 2"x4" Doug Fir No. 2 or better 16" O.C., incl, single bottom plate, double top plate	10	LF
06 11 12	Floor Structure	Wood framing, 2" X 6 " Doug Fir No. 2 or better, 16" O.C.	1096	SF
06 11 12	Roof Structure	Wood framed roof, with 2"x8" joists doug fir no 2 or better 24" O.C.	1824	SF
06 11 12	Decking Material	Trex Composite Decking Material	1300	SF
06 16 00	**Sheathing**			
06 16 36	Wall Sheathing	4' X 8' X 1/2" thick OSB Sheets	641	SF
06 16 36	Roof Sheathing	4' X 8' X 1/2" thick OSB Sheets, with radiant barrier	1824	SF
06 46 00	**Wood Trim**			
06 46 13	Door Casing	3 1/2" wide door molding kit, Incl. 1 head & 2 sides with pre-mitered ends	3	Kits
Division 07 - Thermal and Moisture Protection				
07 21 00	**Thermal Insulation**			
07 21 13	Foam Board Insulation	Polystyrene foam board insulation, 2" thick, R8	641	SF
07 21 16	Blanket Insulation	Fiberglass Batt 6" insulation	641	SF
07 25 00	**Weather Barriers**			
07 25 10	Building Paper	Building Paper, asphalt felt paper, 15#	1824	SF
07 25 10	Housewrap	Spun bonded polypropylene exterior house wrap	641	SF
07 41 00	**Roof Panels**			
07 41 13	Roof Panels	Aluminum roof panels, ribbed, painted, 0.0155" thick	1824	SF
07 42 00	**Wall Panels**			
07 42 63	Klip-Tech Wall Panels	Bio-Fiber Composite Phenolic core wall panel, Klip-tech Eco-Clad	254	SF

07 46 00	**Siding**			
07 46 23	6" Cedar Siding	Cedar siding, 1/2" X 6" boards, beveled, B or better, tongue & groove	2116	SF
07 46 23	8" Cedar Siding	Cedar siding, 1/2" X 8" boards, beveled, B or better, tongue & groove	1326	SF
07 46 46	Fiber Cement Siding	Hardie Panel fiber cement siding, 4' X 8' Sheets, stucco texture	568	SF
07 65 00	**Flexible Flashing**			
07 65 10	Sheet Metal Flashing	Aluminum sheet metal flashing for deck ledgers, mill finish, .019" thick	60	SF
07 71 00	**Roof Specialties**			
07 71 23	Downspouts	Aluminum downspouts, embossed, 2" x 3", 0.020" thick	54	LF
07 71 23	Gutters	Aluminum gutters, stock units, 5" box, 0.027" thick	30	LF
Division 08 - Openings				
08 14 00	**Wood Doors**			
08 14 33	Bi-fold Closet Doors (Linen Closet)	Interior bi-fold closet door, flush, primed, 2'-0" x 6'-8"	1	EA
08 14 33	Bi-fold Closet Doors (Laundry)	Wood bi-fold, interior, louvered, 2'-7 1/2" x 6'-8"	2	EA
08 14 33	Closet Door (Master Bed)	Full lite, 5'0" x 6'-8"	1	EA
08 17 00	**Integrated Door Opening Assemblies**			
08 17 23	Exterior Front Door	36" X 80" Entry door with dual 8" sidelites	1	EA
08 17 23	Interior Doors	Doors, prehung, interior, passage, luan, flush, 3'-0" x 6'-8"	2	EA
08 17 23	Bedroom Door	Raydoor 3 Panel Sliding Wall, Low profile track, black frame, oyster linen core, push pull hardware RP-60	1	EA
08 35 00	**Folding Doors and Grilles**			
08 35 13.33	Panel Folding Door	Marvin Windows & Doors, folding glass door, 14' X 8'	2	EA
08 35 13.33	Panel Folding Door	Marvin Windows & Doors, folding glass door, 8' X 8'	1	EA
08 36 00	**Panel Doors**			
08 36 13	Garage Door	8' X 7' Sectional overhead garage door, incl. tracks, motor, & sensors	1	EA

08 52 00	**Wood Windows**			
08 52 13	Upper Windows	Marvin Windows & Doors 3624 AWNG, 3'-0" X 2'-0 1/16"	16	EA
08 52 13	Small Upper Windows	Marvin Windows & Doors 3614 AWNG, 3'-0" X 1'-2 1/16"	3	EA
08 52 13	Ground Level Windows	Marvin Windows & Doors CUDH 3626E, 3'-0" x 5'-1"	6	EA
08 52 13	Kitchen Window	Milgard Manufacturing, Inc., 7'-0" X 3'-6"	1	EA
08 62 00	**Unit Skylights**			
08 62 13	Solar Tube Skylight	VELUX TGF Solartube Skylight	1	EA
08 71 00	**Door Hardware**			
08 71 00	Front Door Hardware	Baldwin Lakeshore Hardware in Satin Nickel	1	Set
08 71 00	Interior Privacy Door Hardware	Kwikset Halifax Satin Nickel Privacy Handle Set, 155HFL SGT 15 6AL RCS	2	Sets
08 71 00	Door Stops	Conventional post door stops	3	EA
08 81 00	**Glass Glazing**			
08 81 00	Loft Interior Window	Trapezoidal Plate glass window, 8'-7" X 3'-4" X 8'-8" X 1'-10"	1	EA
Division 09 - Finishes				
09 29 00	**Gypsum Board**			
09 29 10	Gypsum Wallboard	Standard gypsum wallboard, 1/2" thick, taped & finished	1766	SF
09 29 10	Gypsum Wallboard - Mold Resistant	Mold resistant gypsum wallboard, 1/2" thick, taped & finished	226	SF
09 29 10	Corner Bead	Accessories, gypsum board, corner bead, galvanized steel, 1-1/4" x 1-1/4"x 10'	10	EA
09 30 00	**Tiling**			
09 30 10	Main Flooring	Cali Bamboo Vintage Pearl Fossilized, wide, click flooring	957	SF
09 30 10	Bathroom Flooring	Daltile Colour Scheme glazed porcelain tile, suede gray, 12" x 12"	40	SF
09 30 23	Wall Tile (Bathroom)	Daltile, rittenhouse, square, ceramic wall tile, matte, desert gray 3" x 6"	80	SF
09 30 23	Wall Tile (Kitchen)	Fireclay CRT gloss tile, 8" x 2"	50	SF
09 34 00	**Waterproofing Membrane Tiling**			
09 34 13	Ceramic Tile Floor Underlayment	Waterproofing membrane ceramic tiling, fleece laminated polyethylene grid, 1/8" thick, on floors, including thinset	957	SF

09 91 00	**Painting**			
09 91 13	Exterior Paint	Benjamin Moore, Latex, Exterior, Flat Spray, 2 Coats	4	Gal
09 91 13	Wood Sealer	Thompson Water Seal	10	Gal
09 91 23	Interior Paint	Benjamin Moore, Latex, Interior, eggshell, Spray, 2 Coats	10	Gal
Division 10 - Specialties				
10 28 00	**Toilet, Bath, and Laundry Accessories**			
10 28 13	Residential Bath Accessories	Towel Rack	1	EA
10 28 13	Residential Bath Accessories	Robe Hook	1	EA
10 28 13	Residential Bath Accessories	Toilet Tissue Dispenser	1	EA
10 28 16	Medicine Cabinet	In-wall medicine cabinet with mirror	1	EA
10 44 00	**Fire Protection Specialties**			
10 44 16.53	Fire Extinguishers	Portable fire extinguishers	3	EA
10 57 00	**Wardrobe and Closet Specialties**			
10 57 23	Closet Rod & Shelving	Wood shelving, adjustable closet rod and shelf, 12" wide, 8' long	2	EA
Division 11 - Equipment				
11 31 00	**Residential Appliances**			
11 31 13	Electric Cooktop	Samsung flex duo induction range	1	EA
11 31 13	Refrigerator/Freezer	Samsung 22.5 CF French door refrigerator, stainless, counter depth	1	EA
11 31 13	Garbage Disposal	InSinkErator Badger 500-1/2 HP continuous feed garbage disposal	1	EA
11 31 13	Range Hood	Fututo Futuro, 14" Juniper Light Island range hood with integrated lighting	1	EA
11 31 13	Dish Washer	Samsung 24 in. dishwasher, top control, stainless, stainless tub	1	EA
11 31 23	Clothes Washer	LG 2.3 CF large 24" compact front load washer	1	EA
11 31 23	Clothes Dryer	LG 24 in. compact ventless front load dryer, electric	1	EA
Division 12 - Furnishings				
12 32 00	**Manufactured Wood Casework**			
12 32 16	Kitchen Cabinets	IKEA Abstrakt door style High gloss white	1	LS
12 32 23	Bathroom Vanity Base	Signature Hardware Bamboo vanity	1	EA

12 32 23	Cabinet Hardware	IKEA Orrnas, stainless, various sizes	20	EA
12 36 00	**Countertops**			
12 36 61	Kitchen Countertops	Caesarstone, Quartz Reflections 7141	30	SF
Division 21 - Fire Suppression				
21 10 00	**Water Based Fire Suppression Systems**			
21 10 00	Typical Wet Fire Sprinkler System	Sprinkler System Components, 6" fire cycle system, controls, includes panel, batteries, solenoid valves & pressure switches	922	SF/living
Division 22 - Plumbing				
22 11 00	**Plumbing Piping**			
22 11 16	Domestic Water Piping	3/4" PEX Piping	150	LF
22 12 00	**Facility Potable-Water Storage Tanks**			
22 12 19	Ground Mounted Water Tank	300 gallon rectangular water storage tank	4	EA
22 13 00	**Facility Sanitary Sewer**			
22 13 16	Vent Flashing	Vent Flashing, neoprene, one piece, 2"	2	EA
22 13 16	Sanitary Waste and Vent Piping	ABS waste piping	1	LS
22 33 00	**Electric Domestic Water Heaters**			
22 33 30	Water Heater	Electric, residential, 30 gallon	1	EA
22 41 00	**Residential Plumbing Fixtures**			
22 41 13	Water Closet	Kohler Santa Rosa comfort 1 Piece, 1.28 GPF toilet with Aqua Piston Flush Technology	1	EA
22 41 16.13	Lavatory Sink	Semi-recessed sink, included with bathroom vanity	1	EA
22 41 16.16	Kitchen Sink	VIGO VG3020C 30-inch Farmhouse Stainless Steel 16 Gauge Single Bowl Kitchen Sink	1	EA
22 41 19	Bathtub	Kohler Archer right drain soaking tub, white	1	EA
22 41 39	Kitchen Faucet	Moen Align Spot Resist Stainless Pull-Down Kitchen Faucet	1	EA
22 41 39	Lavatory Faucet	Danze Como Brushed Nickel 1-Handle Single Hole WaterSense Bathroom Sink Faucet	1	EA
22 41 39	Shower Faucet	Danze Amalfi Brushed Nickel 1-Handle Bathtub and Shower Faucet	1	EA

Division 23 - Heating, Ventilating, and Air-Conditioning				
23 09 00	**Instrumentation and Control for HVAC**			
23 09 53	Thermostat	Honeywell touch screen thermostat, Wi-Fi enabled	1	EA
23 34 00	**HVAC Fans**			
22 34 23	Ceiling Fan (Great Room)	Minka Aire Slipstream, 65" energy efficient ceiling fan with light kit	1	EA
22 34 23	Ceiling Fan (Master Bed)	Modern Fan Company, Cloud Ceiling Fan, 42" blades with light kit	1	EA
23 34 23	Ceiling Fan (Second Bed)	Fanimation Fans, Embrace, FPS7967 44" Brushed Nickel	1	EA
23 34 23	Bathroom Exhaust fan	Bathroom exhaust fan kit with ceiling cover, tubing, and roof vent	1	EA
23 81 00	**Decentralized Unitary HVAC Equipment**			
23 81 26	Split Ductless HVAC System	Daiken mini-split HVAC system with 4 vent heads	1	LS
23 81 26	Split Ductless Accessories	Misc. accessories	1	LS
Division 26 - Electrical				
25 05 00	**Common Work Results for Electrical**			
26 05 19	Wiring	Non-metallic sheathed cable, copper with ground wire, 600 V, 2 conductor, with ground, #12 (Romex)	300	LF
26 24 00	**Switchboards and Panelboards**			
26 24 16	Load Center	200 amp interior wall mount distribution panel	1	EA
26 27 00	**Low-Voltage Distribution Equipment**			
26 27 26	Switch Plates	Single switch plates, decora white	11	
26 27 26	Receptacle Plates	Decora plastic receptacle plates, white	24	EA
26 27 26	Duplex Receptacle	White, standard receptacle, grounded, tamper resistant, 120 volt, 15 amp	20	EA
26 27 26	Dryer Receptacle	50 amp in wall dryer receptacle	1	EA
26 27 26	GFCI Receptacle	Tamper Resistant GFCI receptacle, 120 V 15A	4	EA
26 27 73	Doorbell System	Low voltage doorbell set with chime, transformer, button, and wiring	1	EA
26 31 00	**Photovoltaic Collectors**			
26 31 13	Roof PV Modules	Bosch c-Si M 60	27	EA

27 31 13	Skylight PV Modules	Solaria SBIPV2, semitransparent solar panel	24	EA
28 31 13	Railing PV Modules	Solaria SBIPV2, semitransparent solar panel	2	EA
26 31 13	Roof Array Inverter	Enecsys SMI-D480W-60-UL dual micro inverter	14	EA
27 31 13	Skylight Array Inverter	Solaredge SE3000A	1	EA
26 31 13	DC Circuit Breaker	Circuit breaker for PV arrays	3	EA
26 31 13	PV Rack System	Roof rack system for mounting on standing seam metal roof	1	LS
26 33 00	**Battery Equipment**			
26 33 43	Vehicle Charging System	Clipper Creek charging station	1	EA
26 51 00	**Interior Lighting**			
26 51 13	Suspended Cable Lighting System	Suspended Cable Lighting. Tech Tiella Lighting with 5, MR-16 Heads	4	EA
26 51 13	Light Fixture	WAC Lighting Geos dwelLED Flush mount/Wall Sconce	2	EA
26 51 13	Light Fixture	Lights Up Weegee Large Pendant with white linen shade	1	EA
26 51 13	Light Fixture	Quorum International, Mini Pendant No. 882, Frosted white and clear glass monopoint pendant	3	EA
26 51 13	Light Fixture	Pixi FLT11R27MD0811 Recessed Edge-lit dimmable LED fixture	2	EA
26 51 13	Light Fixture	WAC Lighting dwelLED Wall Sconce	2	EA
26 51 13	Light Fixture	Modern Forms Ledge LED Indoor/Outdoor wall sconce, black, medium	2	EA
26 51 13	Light Fixture	Cree 40" LED linear light fixture	3	EA
36 53 00	**Exit Signs**			
26 53 13	Exit Lighting	Illuminated exit signs.	3	EA
Division 28 - Electronic Safety and Security				
28 31 00	**Fire Detection and Alarm**			
28 31 46	Smoke Detection Sensors	Hardwired, interconnected smoke alarms with battery backup	3	EA
Division 31 - Earthwork				
31 66 00	**Special Foundations**			
31 66 00	Standard Foundation Pier	Central Piers basic foundation pier	20	EA
31 66 00	Seismic Foundation Pier	Central Piers, CP Anchor pier on concrete pads	40	EA

Article 10- Construction Specifications

00 01 01
PROJECT TITLE PAGE

1.1 PROJECT MANUAL VOLUME 1

A. The Reflect House

B. Team Solar Nest, Sacramento State

C. Sacramento, CA

D. Collaborating Departments:

1. Department of Construction Management
2. Department of Interior Architecture
3. Department of Communications
4. Department of Mechanical Engineering
5. Department of Electrical Engineering
6. Department of Business

E. California State University, Sacramento

F. 6000 J Street

G. Sacramento, CA 95826

H. Phone: 916-278-6616

I. Web Site: solarnest.org

END OF SECTION 00 01 01

00 01 15
LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

G-001	COVER
G-002	GENERAL NOTES AND SYMBOLS, SHEET LIST
G-101	FINISHED SQUARE FOOTAGE COMPLIANCE PLAN
G-102	EGRESS PLAN
G-103	ADA TOUR ROUTE COMPLIANCE PLAN
G-201	SOLAR ENVELOPE COMPLIANCE ELEVATIONS
G-202	SOLAR ENVELOPE COPMLIANCE ELEVATIONS
G-601	SHADING DIAGRAMS
G-901	GENERAL PROJECT RENDERINGS
G-902	GENERAL PROJECT RENDERINGS
H-001	HAZARDOUS MATERIALS NOTES AND SYMBOLS
H-501	SPILL CONTAINMENT DETAILS
H-601	SCHEDULE OF LIQUID CONTAINMENT DEVICES
C-102	GROUND CONTACT PLAN
C-001	CIVIL NOTES AND SYMBOLS
C-103	SITE PLAN
C-104	SITE ELEVATIONS
C-101	SITE LOCATION
C-601	SCHEDULES
L-001	LANDSCAPE NOTES AND SYMBOLS
L-101	LANDSCAPE AND PLANTING SITE PLAN
L-102	ARBOR AND VERTICAL GARDEN DETAILS
L-103	SANDBOX AND PLANTER DETAILS
L-501	LANDSCAPE DETAILS
L-601	LANDSCAPE PLANTING SCHEDULE
L-602	PLANTING SCHEDULES
L-901	LANDSCAPE RENDERINGS
L-104	RAINWATER COLLECTION PLAN
S-101	FOUNDATION PLAN
S-102	FIRST FLOOR FRAMING PLAN
S-103	ROOF FRAMING PLAN
S-104	DECK FRAMING PLAN
S-001	STRUCTURAL NOTES AND SYMBOLS
S-201	FRAMING ELEVATIONS
S-301	FRAMING SECTIONS
S-302	FRAMING SECTIONS
S-501	PLAN DETAILS
S-511	SECTION DETAILS
S-521	DECK DETAILS

S-531	ROOF DETAILS
S-601	REINFORCING AND FRAMING SCHEDULES
S-602	COLUMNN AND BEAM SCHEDULES
S-611	LOAD DIAGRAMS
S-701	TYPICAL DETAILS
S-901	FRAMING ISOMETRICS
A-104	REFLECTED CEILING PLANS
A-103	ROOF PLAN
A-212	BUILDING ELEVATIONS
A-211	BUILDING ELEVATIONS
A-302	BUILDING SECTIONS
A-301	BUILDING SECTIONS
A-311	WALL SECTIONS
A-501	PLAN DETAILS
A-203	INTERIOR ELEVATIONS - GREAT ROOM
A-511	SECTION DETAILS
A-601	SCHEDULES
A-001	ARCHITECTURAL SYMBOLS AND NOTES
A-201	SITE ELEVATIONS
A-202	SITE ELEVATIONS
A-205	INTERIOR ELEVATIONS - KITCHEN
A-321	FLOOR SECTIONS
A-322	ROOF SECTIONS
A-401	LARGE SCALE PLANS
A-521	ELEVATION DETAILS
A-531	WINDOW DETAILS
A-541	DOOR DETAILS
A-551	PV MOUNTING DETAILS
A-561	ROOF DETAILS
A-571	SIDING DETAILS
A-581	CASEWORK DETAILS
A-602	SCHEDULES
A-603	MOVEABLE COMPONENT DIAGRAM
A-701	TYPICAL DETAILS
A-901	ARCHITECTURAL RENDERINGS
A-902	ARCHITECTURAL RENDERINGS
A-403	LARGE SCALE PLANS
A-101	FIRST FLOOR PLAN
A-102	LOFT STORAGE FLOOR PLAN
A-204	INTERIOR ELEVATIONS - GREAT ROOM
A-206	INTERIOR ELEVATIONS - BEDROOM 2
A-207	INTERIOR ELEVATIONS - BEDROOM 1
A-208	INTERIOR ELEVATIONS - HALLWAY
A-209	INTERIOR ELEVATIONS - BATHROOM

A-210	INTERIOR ELEVATIONS - MECH. ROOM
A-402	LARGE SCALE PLANS
I-001	INTERIOR SYMBOLS AND NOTES
I-101	INTERIOR DESIGN PLAN
I-102	INTERIOR FURNISHING PLAN
I-103	INTERIOR DESIGN REFLECTED CEILING PLAN
I-201	INTERIOR DESIGN ELEVATIONS
I-202	INTERIOR DESIGN ELEVATIONS
I-401	LARGE-SCALE INTERIOR DESIGN PLANS
I-501	INTERIOR DESIGN DETAILS
I-601	INTERIOR DESIGN SCHEDULES
F-001	FIRE PROTECTION INDEX, SYMBOLS AND NOTES
F-101	FIRE DETECTION AND ALARM FLOOR PLAN
F-102	FIRE PROTECTION FLOOR PLAN
F-501	FIRE SUPPRESSION CALCULATIONS, DETAILS, AND SCHEDULES
F-602	FIRE PROTECTION DIAGRAM
F-103	FIRE PROTECTION PIPING PLAN
P-001	PLUMBING SYMBOLS AND NOTES
P-102	FIRST FLOOR PLUMBING PLAN
P-101	PLUMBING SITE PLAN
P-103	DOMESTIC RETURN
P-104	SOLAR WATER SYSTEM
P-501	PLUMBING DETAILS
P-601	SCHEDULES
P-901	SUPPLY ISOMETRICS
P-902	RETURN ISOMETRICS
P-903	SOLAR WATER HEATING ISOMETRICS
M-001	MECHANICAL SYMBOLS AND NOTES
M-101	HVAC EQUIPMENT AND DISTRIBUTION PLAN
M-201	MECHANICAL ELEVATIONS
M-401	LARGE SCALE VIEWS
M-501	MECHANICAL DETAILS
M-601	SCHEDULES
M-602	HVAC DIAGRAMS
M-603	SOLAR WATER DIAGRAMS
M-701	TYPICAL DETAILS
M-901	HVAC ISOMETRICS
M-102	MECHANICAL CEILING PLAN
E-101	ELECTRICAL POWER PLAN
E-102	ELECTRICAL PV WIRING PLAN
E-001	ELECTRICAL INDEX, SYMBOLS, AND NOTES
E-103	ELECTRICAL LIGHTING PLAN
E-201	ELECTRICAL ELEVATIONS
E-401	ELECTRICAL ENLARGED PLANS

E-501	ELECTRICAL CALCULATIONS, DETAILS, AND SCHEDULES
E-601	ELECTRICAL ONE-LINE DIAGRAM
E-602	ELECTRICAL THREE-LINE DIAGRAM
E-603	SCHEDULES
E-502	SOLAR SKYLIGHT
O-001	OPERATIONS SYMBOLS AND NOTES
O-102	ARRIVAL/DEPARTURE SEQUENCE PLANS
O-601	CONSTRUCTION EQUIPMENT SCHEDULE
O-602	TRUCK LOADING DIAGRAM

END OF SECTION 00 01 15

01 50 00
TEMPORARY FACILITIES AND CONTROLS

1.1 SECTION REQUIREMENTS

A. Water: Available from Organizer's existing system. Distribution and use to be in accordance with Solar Decathlon Rules and Solar Decathlon Building Code.

B. Electric Service: Available from Organizer's existing system to provide tie in to Village Grid. All use to be in accordance with Solar Decathlon Rules and Solar Decathlon Building Code.

C. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA and the Solar Decathlon Building Code.

PART 1 - PRODUCTS

0.1 TEMPORARY FACILITIES

A. Provide storage sheds/boxes and other support facilities as necessary for construction operations. Store combustible materials apart from building in accordance with Solar Decathlon Rules, Solar Decathlon Building Code, and with team Health and Safety Plan.

0.2 CONSTRUCTION EQUIPMENT

A. Forklift: Team to provide forklift for purpose of maneuvering house modules and supplies and materials. Forklift will be capable of maneuvering house components and of appropriate size for the intended terrain.

PART 2 - EXECUTION

2.1 TEMPORARY UTILITY INSTALLATION

A. Sanitary Facilities: Toilets: Use of Owner's existing toilet facilities will be permitted.

B. Heating: Provide temporary heating required for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

C. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, and inspections.

2.2 SUPPORT FACILITIES INSTALLATION

A. Waste Disposal Facilities: Use waste containers provided by Organizer. Comply with requirements of Organizer and authorities having jurisdiction in regards to sorting and recycling.

2.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

2.4 OPERATION, TERMINATION, AND REMOVAL

A. Remove each temporary facility when need for its service has ended or when it has been replaced by authorized use of a permanent facility.

END OF SECTION 01 50 00

05 50 00
METAL FABRICATIONS

2.5 SECTION REQUIREMENTS

A. Submittals: Shop Drawings.

PART 1 - PRODUCTS

0.1 METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Rolled Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

C. Steel Tubing: ASTM A 500/A 500M.

D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40).

E. ASTM A 666, Type 304.

F. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

G. Zinc-Coated Steel Wire Rope: ASTM A 741.

1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

H. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

I. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

J. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

K. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

0.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.

2. Provide stainless-steel fasteners for fastening stainless steel.

0.3 FABRICATION

A. General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges. Form bent-metal corners to smallest radius possible without impairing work.

B. Welding: Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. At exposed connections, finish welds and surfaces smooth, with contour of welded surface matching those adjacent.

C. Comply with AWS for recommended practices in shop brazing. Braze behind finished surfaces without distorting or discoloring exposed side. Clean exposed brazed joints of flux, and dress exposed and contact surfaces.

0.4 STEEL AND IRON FINISHES

A. Prepare uncoated ferrous metal surfaces to be weather and rustproof.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Provide anchorage devices and fasteners where needed to secure items to in-place construction.

B. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack.

C. Fit exposed connections accurately together to form hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers.

END OF SECTION 05 50 00

06 10 00
ROUGH CARPENTRY

2.2 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Engineered wood products shall have allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

2.3 TREATED MATERIALS

A. Preservative-Treated Materials: AWPA U1; Use Category UC2[for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground].

1. Use treatment containing no arsenic or chromium.

2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

B. Provide preservative-treated materials for all rough carpentry exposed to weather or the ground.

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, blocking, and similar concealed members in contact with masonry or concrete.

3. Wood framing members that are less than 18 inches above the ground.

4. Wood floor plates that are installed over concrete slabs-on-grade.

2.4 FRAMING

A. Dimension Lumber:

1. Maximum Moisture Content: 19 percent

2. Non-Load-Bearing Interior Partitions: Doug fir no. 2 or better

3. Framing Other Than Non-Load-Bearing Interior Partitions: Doug fir no. 2 or better.

4. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

a. Species: Douglas Fir

b. Grade: No. 2 or better.

B. Timbers 5-Inch Nominal Size and Thicker: No. 1 Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south: NLGA, WCLIB, or WWPA.

1. Maximum Moisture Content: 23 percent.

C. Laminated-Veneer Lumber: Manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Georgia-Pacific Building Products.

b. Pacific Woodtech Corporation.

c. Roseburg Forest Products.

d. Standard Structures Inc.

2. Refer to article 03 “STRUCTURAL CALCULATIONS” for appropriate member characteristics

D. Wood I-Joists: Prefabricated units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Georgia-Pacific Building Products.

b. Pacific Woodtech Corporation.

2. Web Material: Either oriented strand board or plywood, Exposure 1

3. Structural Properties: Provide units with depths and design values not less than those indicated.

2.5 SHEAR WALL PANELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Shear Transfer Systems.
2. Simpson Strong-Tie Co., Inc.
3. Weyerhaeuser Company.

B. Allowable Design Loads: Shear wall panels shall have allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

2.6 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

1. Power-Driven Fasteners: CABO NER-272.
2. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

B. Metal Framing Anchors: Structural capacity, type, and size indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Simpson Strong-Tie Co., Inc.
   b. USP Structural Connectors.
2. Use anchors made from hot-dip galvanized steel complying with ASTM A 653/A 653M, G60 coating designation for interior locations where stainless steel is not indicated.
3. Use anchors made from stainless steel complying with ASTM A 666, Type 304 for exterior locations and where indicated.

C. Flexible Flashing: Self-adhesive product consisting of a butyl rubber or rubberized-asphalt compound, bonded to a backing sheet to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Do not splice structural members between supports unless otherwise indicated.

D. Securely attach rough carpentry to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.

2. Published requirements of metal framing anchor manufacturer.

END OF SECTION 06 10 00

06 10 53
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - PRODUCTS

0.1 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

0.2 TREATED MATERIALS

A. Preservative-Treated Materials: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Use treatment containing no arsenic or chromium.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

B. Provide preservative-treated materials for all miscellaneous rough carpentry to be exposed to weather or in contact with the ground unless otherwise indicated.

0.3 LUMBER

A. Interior Partition Framing: Standard, Stud, or No. 3: Western woods: WCLIB or WWPA with 19 percent maximum moisture content.

B. Miscellaneous Dimension Lumber: Standard, Stud, or No. 3 grade with 19 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

0.4 FASTENERS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

1. Power-Driven Fasteners: CABO NER-272.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Set miscellaneous rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Securely attach miscellaneous rough carpentry to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

END OF SECTION 06 10 53

06 15 33

WOOD PATIO DECKING

PART 1 - PRODUCTS

0.1 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

B. Maximum Moisture Content:

1. Boards: 19 percent.
2. Dimension Lumber: 19 percent.
3. Timber: 19 percent.

0.2 WOOD MATERIALS

A. Wood Decking and ramps

1. Decking and Ramps: See section 1.4 PLASTIC DECKING.

B. Railings: Provide material hand selected for freedom from characteristics that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

1. Dimension Lumber Railing Members: No. 2 grade and any of the following species:

a. Hem-fir or hem-fir (north); NLGA, WCLIB, or WWPA.

b. Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; NLGA, WCLIB, or WWPA.

c. Mixed southern pine; SPIB.

d. Redwood

e. Cedar

f. Wood-plastic composite.

C. Dimension Lumber Framing

1. Deck and Ramp Framing: Construction or No. 2 grade and any of the following species:

a. Hem-fir (north); NLGA.

b. Southern pine; SPIB.

c. Douglas fir-larch; WCLIB or WWPA.

d. Spruce-pine-fir; NLGA.

e. Douglas fir-south; WWPA.

f. Hem-fir; WCLIB or WWPA.

g. Douglas fir-larch (north); NLGA.

h. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2. Dimension Lumber Posts: No. 2 grade and any of the following species:

a. Hem-fir or hem-fir (north); NLGA, WCLIB, or WWPA.

b. Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; NLGA, WCLIB, or WWPA.

c. Mixed southern pine; SPIB.

d. Redwood

e. Cedar

f. Wood-plastic composite.

0.3 TREATED MATERIALS

A. Preservative-Treated Boards and Dimension Lumber: AWPA U1; Use Category UC3b.

B. Preservative-Treated Timber and Poles: AWPA U1; Use Category UC4a, waterborne preservative.

1. Use treatment containing no arsenic or chromium.

C. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.

D. Provide preservative-treated materials for all exterior rough carpentry unless otherwise indicated.

1. Framing members less than 18 inches above grade.

2. Sills and ledgers.

3. Members in contact with masonry or concrete.

4. Posts.

5. Round wood poles.

6. Decking.

7. Stair treads.

0.4 PLASTIC DECKING

A. Plastic Lumber, General: Products acceptable to authorities having jurisdiction and for which current model code evaluation reports exist that show compliance with building code in effect for Project for indicated occupancy and type of construction.

1. Allowable loads and spans, as documented in evaluation reports or in information referenced in evaluation reports, shall not be less than design loads and spans indicated.

B. Composite Plastic Lumber: solid or hollow shapes made from a mixture of cellulose fiber and polyethylene or polypropylene.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. GAF Decking Systems, LLC.

b. Thermal Industries, Inc.

c. TimberTech.

d. Trex Company, Inc.

e. Universal Forest Products, Inc.

f. Weyerhaeuser Company.

C. Decking Size: 1-1/4 by 6 nominal, 1 by 5-1/2 inches actual, 1-1/2 by 6 nominal, 1-1/4 by 5-1/2 inches actual, or 2 by 6 nominal, 1-1/2 by 5-1/2 inches actual.

D. Configuration: Provide product with grooved edges designed for fastening with concealed splines or tongue-and-groove edges designed for concealed fastening.

E. Surface Texture: Wood grain. Refer to plans for finish.

0.5 MISCELLANEOUS PRODUCTS

A. Fasteners: Use stainless steel or fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or ASTM F 2329 unless otherwise indicated.

1. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

2. Power-Driven Fasteners: ICC-ES AC70.

B. Post installed Anchors: Stainless-steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed as determined by testing according to ASTM E 488.

C. Metal Framing Anchors: Structural capacity, type, and size indicated, made from hot-dip galvanized steel complying with ASTM A 653/A 653M, **G60** coating.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Simpson Strong-Tie Co., Inc.

D. Deck Splines: Corrosion-resistant metal or UV-resistant plastic splines designed to fit in grooves routed into the sides of decking material and to be fastened to deck framing with screws.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Blue Heron Enterprises, LLC.

b. Ipe Clip Fastener Company Inc. (The).

c. Titan Metal Werks, Inc.

E. Deck Clips: Black-oxide-coated stainless-steel clips designed to be fastened to deck framing with screws, and to secure decking material with teeth.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. a

F. Deck Tracks: Formed metal strips designed to be fastened to deck framing and to secure decking material from underside with screws. Made from epoxy-powder-coated, hot-dip galvanized steel or stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Grabber Construction Products.

b. Ty-Lan Enterprises Inc.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Securely attach work to substrates, complying with the following:

1. ICC-ES AC70 for power-driven fasteners.

2. "Fastening Schedule" in ICC's International Building Code.

3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.

D. Secure decking to framing with deck splines, deck clips, deck tracks, or screws.

E. Railing Installation: Countersink fastener heads.

1. Fit balusters to railings, glue, and screw in place.

2. Secure newel posts to stringers and risers with through bolts, lag screws, or countersunk-head wood screws and glue.

3. Secure wall rails with metal brackets. Fasten freestanding railings to newel posts and to trim at walls with countersunk-head wood screws or rail bolts and glue.

END OF SECTION 06 15 33

06 16 00
SHEATHING

PART 1 - PRODUCTS

0.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1.

B. Oriented Strand Board: DOC PS 2.

0.2 TREATED PLYWOOD

A. Preservative-Treated Plywood: AWPA U1; Use Category UC2.

1. Use treatment containing no arsenic or chromium.

2. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

B. Provide preservative-treated plywood for items indicated on Drawings.

C. Fire-Retardant-Treated Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use Exterior type for exterior locations and where indicated.

2. Use Interior Type A unless otherwise indicated.

3. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.

4. Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.

D. Provide fire-retardant-treated plywood for items indicated on Drawings.

0.3 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I, Exterior, Exposure 1, Structural I, or Exposure 1 sheathing.

B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

C. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. Georgia-Pacific Building Products.

b. National Gypsum Company.

D. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. Georgia-Pacific Building Products; Dens-Glass Gold.

b. National Gypsum Company; Gold-Bond e(2)XP.

E. Cementitious Backer Units: ASTM C 1325, Type A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. Custom Building Products; Wonderboard.

b. United States Gypsum Company; DUROCK Cement Board.

F. Fiberboard Wall Sheathing: AHA A194.1, Type IV, Grade 1 (Regular).

G. Insulating Foam Wall Sheathing: One of the following:

1. Extruded-Polystyrene-Foam Wall Sheathing: ASTM C 578, Type IV.

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. DiversiFoam Products.

b. Owens Corning.

3. Foil-Faced, Polyisocyanurate-Foam Wall Sheathing: ASTM C 1289, Type I or Type II, Class 2. Foam-plastic core and facings shall have flame spread of 25 or less, when tested individually.

4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dow Chemical Company (The).

0.4 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I, Exterior, Exposure 1, Structural I, or Exposure 1 sheathing.

B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I or Exposure 1 sheathing.

C. Composite Nail Base Insulated Roof Sheathing: Polyisocyanurate foam with oriented strand board laminated to one face complying with ASTM C 1289, Type V.

0.5 SUBFLOORING AND UNDERLAYMENT

A. Combination Subfloor-Underlayment:

1. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exposure 1, Underlayment single-floor panels.

2. Oriented-Stand-Board Combination Subfloor-Underlayment: Exposure 1 single-floor panels.

B. Subflooring:

1. Plywood Subflooring: Exposure 1 single-floor panels or sheathing.

2. Oriented-Strand-Board Subflooring: Single-floor panels or sheathing.

0.6 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2. Power-Driven Fasteners: CABO NER-272.

B. Sheathing Joint-and-Penetration Treatment Materials:

1. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant, recommended by tape and sheathing manufacturers for application indicated.

2. Sheathing Tape for Glass-Mat Gypsum Sheathing: Self-adhering, glass-fiber tape recommended by sheathing and tape manufacturers for application indicated.

3. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

C. Adhesives for Field Gluing Panels to Framing: APA AFG-01.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Securely attach to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

B. Fastening Methods:

1. Combination Subfloor-Underlayment:

a. Glue and nail to wood framing.

b. Screw to cold-formed metal framing.

2. Subflooring:

a. Glue and nail to wood framing.

b. Screw to cold-formed metal framing.

3. Wall and Roof Sheathing:

a. Nail to wood framing.

b. Screw to cold-formed metal framing.

END OF SECTION 06 16 00

06 18 00
GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

0.1 SECTION REQUIREMENTS

A. Delegated-Design Submittal: Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design structural glued-laminated timber and connectors.

B. Structural Performance: Provide structural glulam timber capable of withstanding design loads indicated according to AITC 117 or as determined according to ASTM D 3737.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

A. Standards: Comply with AITC A 190.1.[Factory mark with AITC Quality Mark or APA-EWS trademark on surfaces that will not be exposed in the completed Work.]

B. Adhesive: Wet-use adhesive complying with AITC A190.1.

C. Species: Any species.

D. Species and Beam Stress Classification for Beams and Purlins: Any species, 20F-1.5E

1. Lay-Up: Either balanced or unbalanced.

E. Appearance: Framing grade.

F. Finish: Leave as factory finish.

2.3 CONNECTORS

A. General: Use manufactured steel connectors of appropriate size and capacity.

B. Beam Seats: 3/8-inch bearing plates, 3/4-inch- diameter-by-12-inch- long deformed bar anchors, and 0.239-inch side plates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install structural glued-laminated timber for a close fit and neat appearance of joints. Carefully trim ends to fit connectors, mark and drill for bolts, and seal cuts with end sealer.

B. Handle and temporarily support members to prevent visible surface damage. When hoisting members into place, use padded slings, and protect corners with wood blocking.

C. Brace members as they are placed to maintain safe condition until full stability is provided.

D. Repair damaged surfaces after completing erection.

END OF SECTION 06 18 00

06 20 00

FINISH CARPENTRY

PART 1 - PRODUCTS

0.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

B. Softwood Plywood: DOC PS 1.

C. MDF: ANSI A208.2, Grade 130[, made with binder containing no urea-formaldehyde resin].

D. Particleboard: ANSI A208.1, [Grade M-2] [Grade M-2, made with binder containing no urea-formaldehyde resin].

E. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper.

0.2 EXTERIOR FINISH CARPENTRY

A. Exterior Lumber Trim: Smooth-textured, Grade B, western red cedar or better. Prime or D finish hem-fir

1. Maximum Moisture Content: 19 percent.

B. Wood Moldings: WMMPA WM 4, N-grade if left natural or P-grade it painted wood moldings. Made from kiln-dried stock to patterns included in WMMPA WM 12.

1. Species: Any Species

C. Cellular PVC Exterior Trim: Extruded, expanded PVC with a small-cell microstructure, made from UV- and heat-stabilized, rigid material.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. Royal Mouldings Limited; Pro Series Exterior Moldings.

D. Lumber Siding: Kiln-dried, Grade B or better, western red cedar.

0.3 INTERIOR STANDING AND RUNNING TRIM

A. Wood Moldings: WMMPA WM 4 made to patterns in WMMPA WM 12 from kiln-dried stock.

1. Softwood Moldings for Transparent Finish: Western red cedar

2. Moldings for Painted Finish: P-Grade primed medium-density fiberboard.
3. Base: WM [623, ogee] [713, ranch] [753, beaded-edge] base.
4. Shoe Mold: WM 126, 1/2-by-3/4-inch quarter-round shoe.
5. Casing: WM [327, clamshell] [366, featheredge] [376, beaded-edge] casing.
6. Stop: WM [856, ranch] [946, ogee] [866, bullnose] stop.
7. Density: Not less than 20 lb/cu. ft..
8. Flame-Spread Index: Not more than 75 when tested according to ASTM E 84.
9. Thickness: Not more than 1/2 inch.
10. Width: Not more than 8 inches.

0.4 SHELVING AND CLOTHES RODS

A. Shelving: **3/4-inch** finish boards as specified for interior softwood lumber trim.

B. Clothes Rods: 1-1/2-inch- diameter, clear, kiln-dried Douglas fir or southern pine.

C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.

0.5 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Stainless steel, hot-dip galvanized steel, or aluminum.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer.

1. Wood glue shall have a VOC content of 30 g/L or less.
2. Use waterproof resorcinol glue for exterior applications.

C. Adhesive for Cellular PVC Trim: Product recommended by trim manufacturer.

1. Adhesive shall have a VOC content of 50 g/L or less.

D. Insect Screening for Soffit Vents: Aluminum or Steel.

E. Continuous Soffit Vents: Aluminum hat channel shape with stamped louvers or perforations.

F. Round Soffit Vents: Stamped aluminum or Molded plastic louvered vents, Dimension as shown on plans.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Prime and back prime lumber for painted finish exposed on the exterior. Cut to length and prime ends.

B. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.

1. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/8-inch maximum offset for flush installation and 1/8-inch maximum offset for reveal installation.

C. Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary. Stagger joints in adjacent and related trim. Cope at returns and inside corners and miter at outside corners.

D. Nail siding at each stud. Do not allow nails to penetrate more than one thickness of siding, unless otherwise recommended by siding manufacturer. Seal joints at inside and outside corners and at trim locations.

E. Select and arrange paneling for best match of adjacent units. Install with uniform tight joints.

END OF SECTION 06 20 00

06 46 00
WOOD TRIM

PART 3 - GENERAL

3.1 SECTION REQUIREMENTS

A. Environmental Limitations for Interior Wood Trim: Do not deliver or install interior wood trim until building is enclosed and wet work is complete.

PART 4 - PRODUCTS

4.1 WOOD TRIM

A. Quality Standard: AWI, AWMAC, and WI's "Architectural Woodwork Standards."

B. Exterior Trim: Variable grade, made from any closed-grain hardwood.

C. Interior Trim for Transparent Finish: Variable grade, made from western red cedar, plain sliced/plain sawn, rift cut/rift sawn, or quarter cut/quarter sawn.

D. Interior Trim for Opaque Finish: Economy grade, made from any closed-grain hardwood.

4.2 MATERIALS

A. Wood Moisture Content for Exterior Woodwork: 9 to 15 percent.

B. Wood Moisture Content for Interior Woodwork: 5 to 10 percent.

C. Medium-Density Fiberboard: ANSI A208.2, Grade 130

D. Particleboard: ANSI A208.1, Grade M-2

E. Blocking and Shims: Softwood or hardwood lumber, kiln dried.

F. Water-Repellent Preservative-Treated Materials: Comply with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment) for woodwork items indicated to receive water-repellent preservative treatment.

G. Fasteners for Exterior Wood Trim:

1. Nails: Aluminum hot-dip galvanized or stainless steel.

2. Screws: Aluminum hot-dip galvanized or stainless steel.

H. FABRICATION

I. Complete fabrication to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

J. Back out or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

4.3 SHOP PRIMING

A. Shop prime wood trim for opaque finish with one coat of specified wood primer.

B. Back prime with one coat of sealer or primer, compatible with finish coats.

4.4 SHOP FINISHING OF INTERIOR WOOD TRIM

A. Finishes: Same grades as items to be finished.

B. Shop finish transparent-finished interior wood trim at fabrication shop.

1. Apply one coat of sealer or primer to concealed surfaces of wood trim.

2. Apply a wash coat sealer to wood trim made from closed-grain wood before staining and finishing.

C. Transparent Finish:

1. System - 5: Conversion varnish, or

2. System - 6: Synthetic penetrating oil.

3. Sheen: Satin unless otherwise indicated

PART 5 - EXECUTION

5.1 INSTALLATION

A. Before installation, condition wood trim to average prevailing humidity conditions in installation areas.

B. Install wood trim to comply with referenced quality standard for grade specified.

C. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut wood trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor wood trim to anchors or blocking built into or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork.

F. Exterior Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

G. Interior Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than **96 inches** long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

END OF SECTION 06 46 00

07 21 00
THERMAL INSULATION

PART 6 - GENERAL

6.1 SECTION REQUIREMENTS

A. Surface-Burning Characteristics: According to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

PART 7 - PRODUCTS

7.1 INSULATION PRODUCTS

A. Extruded-Polystyrene Board Insulation: ASTM C 578, [**Type IV**] [**Type V**] [**Type VI**] [**Type VII**] [**Type X**], with flame-spread and smoke-developed indexes of 75 and 450, respectively.

B. Mineral-Wool Board Insulation: ASTM C 612, foil faced on one side; flame-spread and smoke-developed indexes of 25 and 450, respectively.

C. Glass-Fiber-Blanket Insulation: ASTM C 665, Type III, Class A, foil faced on one side with flame-spread and smoke-developed indexes of 25 and 450, respectively.

D. Mineral-Fiber-Blanket Insulation: ASTM C 665, Type III, Class A, foil faced on one side with flame-spread index of 25 or less.

7.2 ACCESSORIES

A. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed to fit between roof framing members and to provide cross-ventilation between insulated attic spaces and vented eaves.

PART 8 - EXECUTION

8.1 INSTALLATION

A. Install insulation in areas and in thicknesses indicated or required to produce R-values indicated. Cut and fit tightly around obstructions and fill voids with insulation.

B. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

C. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

D. Except for loose-fill insulation and insulation that is friction fitted in stud cavities, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

E. Place loose-fill insulation to comply with ASTM C 1015.

1. Comply with the CIMA's Special Report #3, "Standard Practice for Installing Cellulose Insulation."

F. Spray-Applied Insulation: Apply insulation according to manufacturers written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs.

G. Install sheet radiant barriers according to ASTM C 1158.

H. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage. Locate seams at framing members, overlap, and seal with tape. Seal joints caused by pipes, conduits, electrical boxes, and similar items with tape.

END OF SECTION 07 21 00

07 25 00
WEATHER BARRIERS

PART 9 - PRODUCTS

9.1 WATER-RESISTIVE BARRIERS

A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

B. Building Paper: Kraft building paper with not less than 50 lbf/in. tensile strength, 1-hour water resistance, and 75 g/sq. m x 24 h water-vapor transmission.

C. Building Wrap: ASTM E 1677, Type I air barrier; with water-vapor permeance not less than 5 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A); flame-spread and smoke-developed indexes not greater than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. DuPont Building Innovations: E. I. du Pont de Nemours and Company; Tyvek Home Wrap

9.2 ACCESSORIES

A. Flexible Flashing: Adhesive butyl rubber or rubberized-asphalt compound, bonded to plastic film or spunbonded polyolefin, with an overall thickness of 0.030 inch.

1. Butyl Rubber:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

DuPont Building Innovations: E. I. du Pont de Nemours and Company; DuPont Flashing Tape.

2. Rubberized Asphalt:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

Advanced Building Products Inc; Wind-o-wrap.

B. Building Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

PART 10 - EXECUTION

10.1 INSTALLATION

A. Building Paper Installation:

1. Apply building paper immediately after sheathing is installed.
2. Apply horizontally with a 2-inch overlap and a 6-inch end lap.
3. Seal seams, edges, fasteners, and penetrations with tape.
4. Extend into jambs of openings and seal corners with tape.

B. Building Wrap Installation:

1. Apply building wrap immediately after sheathing is installed.
2. Seal seams, edges, fasteners, and penetrations with building wrap tape.
3. Extend into jambs of openings and seal corners with building wrap tape.

C. Flexible Flashing Installation:

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 3 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller.

END OF SECTION 07 25 00

07 46 46
FIBER-CEMENT SIDING

PART 11 - PRODUCTS

11.1 MATERIALS

A. Fiber-Cement Siding: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84. **Factory primed.**

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. James Hardie Building Products, Inc;

2. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186.

3. Vertical Pattern: 48-inch- wide sheets with wood-grain texture and grooves 8 **inches** o.c.

4. Panel Pattern: 48-inch- wide sheets with smooth texture.

B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:

1. Corner posts.

2. Door and window casings.

3. Fasciae.

4. Moldings and trim.

PART 12 - EXECUTION

12.1 INSTALLATION

A. Install fiber-cement siding and related accessories.

1. Install fasteners no more than **24 inches** o.c.

END OF SECTION 07 46 46

07 71 00
ROOF SPECIALTIES

PART 13 - PRODUCTS

13.1 PERFORMANCE REQUIREMENTS

A. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested according to SPRI ES-1 and capable of resisting design pressures indicated on Drawings and structural calculations

13.2 ROOF SPECIALTIES

A. Gutters and Downspouts:

1. Gutters: Manufactured in uniform section lengths, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish expansion joints and expansion-joint covers.

a. Gutter Style: TBD out of one of the following: Rectangular

b. Aluminum: TBD thick.

c. Prepainted, Zinc-Coated Steel: TBD thick.

d. Gutter Supports: TBD out of one of the following: Manufacturer's standard supports as selected by Architect with finish matching the gutters.

2. Downspouts: TBD out of one of the following: Open-face rectangular with mitered elbows. Furnish wall brackets of same material and finish as downspouts, with anchors.

a. Formed Aluminum: TBD thick.

b. Extruded Aluminum: TBD thick.

c. Prepainted, Zinc-Coated Steel: TBD

13.3 MATERIALS

A. Felt Underlayment: ASTM D 226/D 226M, Type II (No. 30) or Type I (No. 15), asphalt-saturated organic felts.

B. Self-Adhering Sheet Underlayment, High Temperature: Butyl or SBS-modified asphalt; slip resisting polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F and passes after testing at minus 20 deg F; ASTM D 1970.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

   a. Henry Company; Blueskin PE200 HT.

C. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements.

1. Exposed Penetrating Fasteners: Gasketed screws with heads matching color of metal.

2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant.

E. Butyl Sealant: ASTM C 1311, solvent-release butyl rubber sealant.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

PART 14 - EXECUTION

14.1 INSTALLATION

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement.

B. Separate dissimilar metals with a bituminous coating or polymer-modified, bituminous sheet underlayment.

C. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

D. Space movement joints at a maximum **of 12 feet with no joints within 18 inches** of corners or intersections unless indicated.

E. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches, except where pretinned surface would show in finished Work.

G. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 30 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

H. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

END OF SECTION 07 71 00

07 92 00
JOINT SEALANTS

PART 15 - GENERAL

15.1 SECTION REQUIREMENTS

A. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

PART 16 - PRODUCTS

16.1 JOINT SEALANTS

A. Low-Emitting Materials: Sealants shall comply with limits for VOC content as required by California law.

B. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.

C. Sealant for General Exterior Use Where Another Type Is Not Specified: **One of the Following**:

1. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; for Use NT.

a. Products: Subject to compliance with requirements, provide one of the following:

Dow Corning Corporation; 758.

GE Construction Sealants; Momentive Performance Materials Inc; SCS2350.

Polymeric Systems, Inc; [**PSI-631**] [**PSI-641**].

2. Single-component, nonsag urethane sealant, ASTM C 920, Type S; Grade NS; Class 25; and for Use NT.

a. Products: Subject to compliance with requirements, provide one of the following:

Sherwin-Williams Company (The); **Stampede-1**, **Stampede-TX**.

Sika Corporation; Sikaflex Textured Sealant.

D. Sealant for Use in Interior Joints in Ceramic Tile and Other Hard Surfaces in Kitchens and Toilet Rooms and around Plumbing Fixtures:

1. Single-component, mildew-resistant silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; for Use NT; formulated with fungicide.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex Sil 100 WF.

E. Sealant for Interior Use at Perimeters of Door and Window Frames:

1. Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

a. Products: Subject to compliance with requirements, provide the following:

May National Associates, Inc.; a subsidiary of Sika Corporation; Bondaflex 600

16.2 MISCELLANEOUS MATERIALS

A. Provide sealant backings of materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

D. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 17 - EXECUTION

17.1 INSTALLATION

A. Comply with ASTM C 1193.

B. Install sealant backings to support sealants during application and to produce cross-sectional shapes and depths of installed sealants that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

END OF SECTION 07 92 00

0871 00
DOOR HARDWARE

PART 18 - PRODUCTS

18.1 HARDWARE

A. Fire-Resistance-Rated Assemblies: Provide products that comply with NFPA 80 and are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for applications indicated. On exit devices provide label indicating "Fire Exit Hardware."

B. Hinges:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. Baldwin Hardware Corporation

b. Lawrence Hardware Inc.

2. Stainless steel or Brass/bronze hinges with stainless-steel pins for exterior.

3. Nonremovable hinge pins for exterior exposure.

4. Ball bearing hinges for doors with closers and entry doors.

5. Two hinges for 1-3/8-inch- thick wood doors.

6. Three hinges for 1-3/4-inch- thick doors 90 inches or less in height; four hinges for doors more than 90 inches in height.

C. Locksets and Latch sets:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Schlage; an Allegion brand.

2. Provide trim on exit devices matching locksets.

D. Key locks to Owner's new master-key system.

E. Provide wall stops or floor stops for doors without closers.

F. Hardware Finishes:

1. Hinges: Matching finish of lockset/latch set.

2. Locksets, Latchets, and Exit Devices: Satin chrome plated.

3. Other Hardware: Matching finish of lockset/latch set.

PART 19 - EXECUTION

19.1 INSTALLATION

A. Mount hardware in locations required to comply with governing regulations and according to SDI A250.8 and DHI WDHS.3.

B. Furnish organizers with copies of keys.

END OF SECTION 08 71 00

08 80 00
GLAZING

PART 20 - PRODUCTS

20.1 GLASS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

20.2 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I, Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT; Type I; Quality-Q3.

C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS; Type I; Quality-Q3.

D. Reflective-Coated Glass: ASTM C 1376, coated by pyro lytic or vacuum deposition (sputter-coating) process.

E. Patterned Glass: ASTM C 1036, Type II, Form 3; Quality-Q6.

F. Tempered Patterned Glass: ASTM C 1048, Kind FT, Type II, Form 3; Quality-Q6.

G. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials.

H. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

I. BIPV Solar Panel Units: Units in use as a Skylight in an overhead glazing condition shall conform to IRC section R308.6.3.

PART 21 - EXECUTION

21.1 INSTALLATION

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are contained in GANA's "Glazing Manual."

B. For fire-protection-rated glazing, use methods approved by testing agencies that listed and labeled products.

C. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

D. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION 08 80 00

09 29 00
GYPSUM BOARD

PART 22 - PRODUCTS

22.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

22.2 PANEL PRODUCTS

A. Provide in maximum lengths available to minimize end-to-end butt joints.

B. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Regular type unless otherwise indicated.

1. Products: Subject to compliance with requirements, provide the following:

   a. National Gypsum Company; Gold Bond Brand Gypsum Wallboard

C. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, in thickness indicated. Regular type unless otherwise indicated

1. Products: Subject to compliance with requirements, provide one of the following:

   a. American Gypsum; M-Bloc® with Mold & Moisture Resistance

   b. Lafarge North America Inc; Mold Defense

D. Glass-Mat, Water-Resistant Gypsum Backing Board: ASTM C 1178/C 1178M, of thickness indicated. Regular type unless otherwise indicated

1. Products: Subject to compliance with requirements, provide the following:

   a. Georgia-Pacific Building Products; DensShield Tile Backer.

E. Cementitious Backer Units: ANSI A118.9, ASTM C 1288, or ASTM C 1325.

1. Products: Subject to compliance with requirements, provide the following:

a. James Hardie Building Products, Inc; Hardiebacker

22.3 ACCESSORIES

A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. For exterior trim, use accessories formed from hot-dip galvanized-steel sheet, plastic, or rolled zinc.

1. Provide cornerbead at outside corners unless otherwise indicated.

2. Provide LC-bead (J-bead) at exposed panel edges.

3. Provide control joints where indicated.

B. Aluminum Accessories: Extruded-aluminum accessories indicated with manufacturer's standard corrosion-resistant primer.

C. Joint-Treatment Materials: ASTM C 475/C 475M.

1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.

2. Joint Compounds: Setting-type compounds or Drying-type, ready-mixed, all-purpose compounds.

3. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

4. Cementitious Backer Unit Joint-Treatment Materials: Products recommended by cementitious backer unit manufacturer.

D. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

PART 23 - EXECUTION

23.1 INSTALLATION

A. Install gypsum board to comply with ASTM C 840.

1. Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws.

2. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws

B. Install cementitious backer units to comply with ANSI A108.11.

C. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.

D. Finishing Gypsum Board: ASTM C 840.

1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.

2. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.

3. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.

4. Where indicated, provide Level 5 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges. Apply skim coat to entire surface.

E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

G. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.

END OF SECTION 09 29 00

09 30 23
GLASS TILING

PART 24 - PRODUCTS

24.1 GLASS TILE

A. Glass tile that complies with ANSI A137.2, "Specifications for Glass Tile."

B. Glass Tile Type: Factory-mounted miniature mosaic glass tile, [**cast**] [**fused**] [**low temperature**].

1. Specifics to be determined

24.2 INSTALLATION MATERIALS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, 1/2 inch thick.

1. Products: Subject to compliance with requirements, provide the following:

a. United States Gypsum Company; DUROCK Cement Board.

B. Waterproofing Membranes for Thinset Installations: ANSI A118.10, fabric-faced chlorinated polyethylene, PVC, or polyethylene sheet product.

C. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.

1. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02; use white cement unless otherwise indicated.

2. Thinset Mortar Type: Dry-set Portland cement; white, unless otherwise indicated.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

Custom Building Products.

3. Grout Type: Standard cement grout, ANSI A118.6, unless otherwise indicated.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

Custom Building Products.

PART 25 - EXECUTION

25.1 INSTALLATION

A. Comply with manufacturer's instructions for installation.

B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight, aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.

D. Install cementitious backer units and fiber-cement underlayment**,** and treat joints according to ANSI A108.11.

E. Install waterproofing to comply with ANSI A108.13.

F. Do not install tile over waterproofing until waterproofing has cured.

G. Interior Wall Tile Installation Method(s):

1. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring: **TCNA B412;** thinset mortar on cementitious backer units or fiber-cement underlayment

END OF SECTION 09 30 23

09 91 13
EXTERIOR PAINTING

PART 1 - PRODUCTS

1.1 PAINT

A. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."

1. Block Filler, Latex: MPI #4.
2. Primer, Alkali Resistant, Water Based: MPI #3.
3. Primer, Bonding, Water Based: MPI #17.
4. Primer, Bonding, Solvent Based: MPI #69.
5. Primer, Alkyd, Anticorrosive: MPI #79.
6. Primer, Galvanized, Water Based: MPI #134.
7. Primer, Quick Dry, for Aluminum: MPI #95.
8. Primer, Latex: MPI #6.
9. Primer, Alkyd: MPI #5.
10. Latex, Exterior Flat (Gloss Level 1): MPI #10.
11. Latex, Exterior Low Sheen (Gloss Level 3-4): MPI #15.
12. Latex, Exterior Semigloss (Gloss Level 5): MPI #11.
13. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.
14. Light Industrial Coating, Exterior, Water Based (Gloss Level 3): MPI #161.
15. Light Industrial Coating, Exterior, Water Based, Semigloss (Gloss Level 5): MPI #163.
16. Light Industrial Coating, Exterior, Water Based, Gloss (Gloss Level 6): MPI #164.
17. Alkyd, Exterior Flat (Gloss Level 1): MPI #8.
18. Alkyd, Exterior, Semigloss (Gloss Level 5): MPI #94.
19. Alkyd, Exterior Gloss (Gloss Level 6): MPI #9.

20. Alkyd, Quick Dry, Semigloss (Gloss Level 5): MPI #81.

21. Alkyd, Quick Dry, Gloss (Gloss Level 7): MPI #96.

22. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3): MPI #60.

23. Floor Enamel, Alkyd, Gloss (Gloss Level 6): MPI #27.

B. Material Compatibility: Provide materials that are compatible with one another and with substrates.

1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Colors: As scheduled.

PART 2 - EXECUTION

2.1 PREPARATION

A. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.

B. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

2.2 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Paint exposed surfaces, new and existing, unless otherwise indicated.

1. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.

C. Apply paints according to manufacturer's written instructions.

1. Use brushes only where the use of other applicators is not practical.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

2.3 EXTERIOR PAINT APPLICATION SCHEDULE

1. Paint as scheduled on plans.

END OF SECTION 09 91 13

09 91 23

INTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data:[Include printout of MPI's "MPI Approved Products List" with product highlighted.]

2. Samples.

B. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.

C. Extra Materials: Deliver to Owner [1 gal.] [1 quart] <Insert quantity> of each color and type of finish-coat paint used on Project, in containers, properly labeled and sealed.

PART 2 - PRODUCTS

2.1 PAINT

A. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."

1. Block Filler, Latex: MPI #4.

2. Primer Sealer, Latex: MPI #50.

3. Primer, Alkali Resistant, Water Based: MPI #3.

4. Primer Sealer, Institutional Low Odor/VOC: MPI #149.

5. Primer, Latex, for Interior Wood: MPI #39.

6. Primer Sealer, Alkyd, Interior: MPI #45.

7. Primer, Bonding, Water Based: MPI #17.

8. Primer, Bonding, Solvent Based: MPI #69.

9. Primer, Alkyd, Anticorrosive: MPI #79.

10. Primer, Galvanized, Water Based: MPI #134.

11. Primer, Quick Dry, for Aluminum: MPI #95.

12. Latex, Interior, Flat, (Gloss Level 1): MPI #53.

13. Latex, Interior, (Gloss Level 2): MPI #44.

14. Latex, Interior, (Gloss Level 4): MPI #43.

15. Latex, Interior, Semigloss, (Gloss Level 5): MPI #54.

16. Latex, Interior, Gloss, (Gloss Level 6, except Minimum Gloss of 65 Units at 60 Degrees): MPI #114.

17. Latex, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.

18. Latex, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.

19. Latex, Institutional Low Odor/VOC, Semigloss (Gloss Level 5): MPI #147.

20. Latex, High-Performance Architectural, (Gloss Level 2): MPI #138.

21. Latex, High-Performance Architectural, Semigloss (Gloss Level 5): MPI #141.

22. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.

23. Alkyd, Interior, Semigloss (Gloss Level 5): MPI #47.

24. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.

25. Alkyd, Quick Dry, Semigloss (Gloss Level 5): MPI #81.

26. Alkyd, Quick Dry, Gloss (Gloss Level 7): MPI #96.

27. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3): MPI #60.

28. Floor Enamel, Alkyd, Gloss (Gloss Level 6): MPI #27.

B. Material Compatibility: Provide materials that are compatible with one another and with substrates.

1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Paints and coatings shall comply with the following limits for VOC content:

1. Flat Paints and Coatings: [50] <Insert value> g/L.

2. Nonflat Paints, Coatings: [150] <Insert value> g/L.

3. Primers, Sealers, and Undercoaters: [200] <Insert value> g/L.

4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: [250] <Insert value> g/L.

5. Floor Coatings: [100] <Insert value> g/L.

D. Colors: As selected.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.

C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.2 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Paint exposed surfaces unless otherwise indicated.

1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.

2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint the backside of access panels.

4. Color-code mechanical piping in accessible ceiling spaces.

5. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.

C. Apply paints according to manufacturer's written instructions.

1. Use brushes only where the use of other applicators is not practical.

2. Use rollers for finish coat on interior walls and ceilings.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

3.3 INTERIOR PAINT APPLICATION SCHEDULE

Paint as scheduled per plans.

END OF SECTION 09 91 23

09 93 00
STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data

PART 2 - PRODUCTS

2.1 STAINING AND TRANSPARENT FINISHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Benjamin Moore & Co.

B. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."

1. Wood Filler Paste: MPI #91.
2. Primer, Latex for Exterior Wood: MPI #6.
3. Primer, Alkyd for Exterior Wood: MPI #5.
4. Preservative, for Exterior Wood: MPI #37.
5. Alkyd, Sanding Sealer, Clear: MPI #102.
6. Shellac: MPI #88.
7. Stain, Exterior, Water Based, Solid Hide: MPI #16.
8. Stain, Exterior, Solvent Based, Solid Hide: MPI #14.
9. Stain, Exterior, Solvent Based, Semitransparent: MPI #13.
10. Stain, for Exterior Wood Decks: MPI #33.
11. Stain, Semitransparent, for Interior Wood: MPI #90.
12. Varnish, Water Based, Clear, Satin (Gloss Level 4): MPI #128.

13. Varnish, Water Based, Clear, Semigloss (Gloss Level 5): MPI #129.
14. Varnish, Water Based, Clear, Gloss (Gloss Level 6): MPI #130.
15. Varnish, with UV Inhibitor, Exterior, Semigloss (Gloss Level 5): MPI #30.
16. Varnish, with UV Inhibitor, Exterior, Gloss (Gloss Level 6): MPI #29.
17. Varnish, Marine Spar, Exterior, Gloss (Gloss Level 7): MPI #28.
18. Varnish, Interior, Flat (Gloss Level 1): MPI #73.
19. Varnish, Interior, Semigloss (Gloss Level 5): MPI #74.
20. Varnish, Interior, Gloss (Gloss Level 6): MPI #75.
21. Varnish, Interior, Polyurethane, Oil Modified, Satin (Gloss Level 4): MPI #57.
22. Varnish, Interior, Polyurethane, Oil Modified, Gloss (Gloss Level 6): MPI #56.
23. Varnish, Polyurethane, Moisture Cured, Gloss (Gloss Level 6): MPI #31.
24. Varnish, Aliphatic Polyurethane, Two Component (Gloss Level 6 or 7): MPI #78.
25. Danish Oil: MPI #92.

C. Colors: As scheduled.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Clean and prepare surfaces in an area before beginning finishing in that area. Schedule finishing so cleaning operations will not damage newly finished surfaces.

3.2 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Finish exposed surfaces unless otherwise indicated.

C. Apply stains and transparent finishes according to manufacturer's written instructions.

D. Apply stains and transparent finishes to produce surface films without color irregularity, cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other imperfections. Use multiple coats to produce a smooth surface film of even luster.

3.3 EXTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

A. Wood, nontraffic surfaces, including wood trim, architectural woodwork, doors, windows, wood siding.

1. Sealer: Transparent exterior wood stain and sealer..

3.4 INTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

A. Wood substrates, nontraffic surfaces, including wood trim, architectural woodwork, doors, windows, wood siding Sealer; Transparent interior wood and sealer.

END OF SECTION 09 93 00

10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

A. Toilet Tissue Dispenser:

1. Type: Single-roll dispenser.
2. Mounting: Recessed or surface.
3. Material: Satin-finish aluminum.
4. Capacity: Designed for 5-inch- diameter-core tissue rolls .

B. Shower Curtain Rod:

1. Outside Diameter: **1 inch**
2. Mounting: Flanges with exposed concealed fasteners.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Medicine Cabinet:

1. Mounting: Recessed, for nominal 4-inch wall depth
2. Size: Per plans
3. Door: Framed mirror door concealing storage cabinet equipped with continuous hinge and spring-buffered, rod-type stop and magnetic door catch
4. Shelves: Minimum Three, adjustable

D. Towel Bar:

1. Description: **3**/4-inch- round tube with circular end brackets.
2. Mounting: Flanges with concealed fasteners.
3. Length: Per plans.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.

C. Mirrors: ASTM C 1503, mirror-glazing quality, clear-glass mirrors, nominal 6.0 mm thick.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Adjust accessories for unencumbered, smooth operation, and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10 28 00

10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINETS

A. Fire-Protection Cabinets: Enameled-steel, surface mounted for fire extinguisher

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Steel sheet.

1. Trim Style: Trimless

D. Door Material: Aluminum.

1. Door Style: Full acrylic bubble with frame.

2. Door Glazing: Acrylic

E. Finishes: Fabricate to match surrounding wall finish.

1. Manufacturer's standard baked-enamel paint for the following:

a. Exterior of cabinet except for those surfaces indicated to receive another finish.

b. Interior of cabinet.

2. Aluminum: Clear anodic.

2.2 FIRE EXTINGUISHERS

A. Portable Fire Extinguishers: NFPA 10, listed and labeled for the type, rating, and classification of extinguisher.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Amerex Corporation.

b. Ansul Incorporated; Tyco International.

2. Multipurpose Dry-Chemical Type: UL-rated Minimum 2-A:10-B:C, 5-lb nominal capacity, in enameled-steel container.

B. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for fire extinguishers indicated, with plated or baked-enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cabinets at heights acceptable to authorities having jurisdiction.

END OF SECTION 10 44 00

11 31 00
RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 RESIDENTIAL APPLIANCES

A. Regulatory Requirements: Comply with the following:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Electric Range: **30-inch-** wide, freestanding range with 4 burners and self-cleaning oven with broiler unit.

1. Products: Subject to compliance with requirements, provide the following:

a. Samsung; 5.9 cu. Ft. Induction Range with Self-Cleaning True Convection Oven.

2. Color: stainless steel

3. Model: NE595NoPBSR

C. Microwave Oven: Built-in microwave oven, **1.2-cu. ft.**

1. Products: Subject to compliance with requirements, provide the following:

a. BOSCH Home Appliances; HMD8451UC

2. Color: Stainless Steel

D. Exhaust Hood: suspended-island-canopy exhaust hood with four-speed automatic fan.

1. Products: Subject to compliance with requirements, provide the following:

a. Futuro Fururo; Juniper Series IS14JUNIPER

2. Color: stainless steel

E. Refrigerator/Freezer: Freestanding, frost-free, two-door French door refrigerator with bottom top-mounted freezer drawer.

1. Products: Subject to compliance with requirements, provide the following:

a. Samsung; RF23HCEDBSR.

2. Color: Stainless Steel.

3. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

F. Dishwasher: Built-in, under counter, automatic dishwasher, sized to replace 24-inch- base cabinet.

1. Products: Subject to compliance with requirements, provide the following:

a. Samsung; DW80F600UTS

2. Color: Stainless Steel

3. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

G. Combination Clothes Washer and Electric Clothes Dryer: Freestanding, top-loading, automatic clothes washer and dryer with **2.3-cu. ft.** capacity stainless-steel tub and

1. Products: Subject to compliance with requirements, provide the following:

a. LG Electronics; WM3477HW

2. Color: Stainless Steel

3. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

B. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

D. Verify that accessories required have been furnished and installed.

END OF SECTION 11 31 00

21 10 00
WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data for valves, sprinklers, specialties, and alarms.

2. Submit sprinkler system drawings identified as "working plans" and calculations according to NFPA 13. Submit required number of sets to authorities having jurisdiction for review, comment, and approval. Include system hydraulic calculations.

3. Submit test reports and certificates as described in NFPA 13.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design and Installation Approval: Acceptable to authorities having jurisdiction.

B. Hydraulically design sprinkler systems according to NFPA 13.

C. Comply with NFPA 13R and NFPA 70.

D. UL-listed and -labeled and FM-approved pipe and fittings.

2.2 PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 442/F 442M, UL 1821, 175-psig rating, made in NPS for sprinkler service. Include "Listed" and "CPVC Sprinkler Pipe" marks on pipe.

B. CPVC Plastic Pipe Fittings: ASTM F 438 for NPS 3/4 to NPS 1-1/2 and ASTM F 439 for NPS 2, UL listed, 175-psig rating, for sprinkler service. Include "Listed" and "CPVC Sprinkler Fitting" marks on fittings.

C. Provide hangers, supports, and seismic restraints with UL listing and FM approval for fire-protection systems.

2.3 VALVES

A. Two-Piece Ball Valves with Indicators:

1. Description: UL 1091, and FM Global Class Number 1112, Forged brass or bronze, 175 psig working pressure.

2. End Connections for Valves NPS 1 through NPS 2: Threaded ends.

3. End Connections for Valves NPS 2-1/2: Grooved ends.

B. Bronze Butterfly Valves with Indicators:

1. Description: UL 1091 and FM Global Class Number 1112, Bronze, 175 psig working pressure.

2. End Connections for Valves NPS 1 through NPS 2: Threaded ends.

3. End Connections for Valves NPS 2-1/2: Grooved ends.

C. Bronze OS&Y Gate Valves:

1. Description: UL 262, cast bronze, solid wedge, outside screw and yoke, rising stem, 175 psig working pressure.

D. Check Valves:

1. Description: UL 312 and FM Global standard for swing check valves, Class Number 1210, 175 psig working pressure, cast iron, or bronze with bronze clapper.

E. Alarm Check Valves:

1. Description: UL 193, 175-psig working pressure, designed for horizontal or vertical installation, with cast-iron, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, retarding chamber, fill-line attachment with strainer, and drip cup assembly.

F. Automatic (Ball Drip) Drain Valves:

1. Description: UL 1726, 175-psig working pressure NPS 3/4, ball check device with threaded end connections.

2.4 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Globe Fire Sprinkler Corporation.

2. Tyco Fire & Building Products LP.

3. Victaulic Company.

B. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide" listing published by FM Global.

1. Pressure Rating for Residential Sprinklers: 175 psig maximum.

2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Residential Applications: **UL 1626**

2. Early-Suppression, Fast-Response Applications: **UL 1767**

3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes: as specified by architect.

E. Sprinkler Escutcheons (for Ceiling and Sidewall Mounted): as specified by architect, one piece, flat.

F. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and one wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on Project.

2.5 PIPING SPECIALTIES AND ALARM DEVICES

A. Water-Flow Indicators:

1. Description: UL 346, electrically supervised, paddle-type, with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two SPDT circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

B. Pressure Switches:

1. Description: UL 346, electrical-supervision-type, water-flow switch with retard feature. Include SPDT, normally closed contacts and design that operates on rising pressure and signals water flow.

C. Valve Supervisory Switches:

1. Description: UL 346, electrically supervised; SPDT, with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

D. Pressure Gages:

1. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 250 psig.

E. Home Hydrant System:

1. Talco Fire Systems HH3-150C shall be used in lieu of stand alone tank, pump, switch, gauge, and valves.

2.6 SLEEVES

A. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.7 GENERAL PIPING INSTALLATIONS

A. Install piping free of sags and bends.

B. Install fittings for changes in direction and branch connections.

C. Sleeves:

1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

2. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide **1-inch** annular clear space between piping and concrete slabs and walls.

D. Escutcheons and Floor Plates:

1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

E. Install unions at final connection to each piece of equipment.

2.8 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated and drain at connection to water-service piping.

2.9 SPRINKLER PIPING INSTALLATION

A. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve.

B. Protect piping from earthquake damage as required by NFPA 13.

C. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Install gages to permit removal, and install where they will not be subject to freezing.

D. Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.

E. Install check valve in each water supply connection. Install backflow preventers in potable-water supply sources.

2.10 SPRINKLER SCHEDULE

A. Special Applications: Extended coverage or quick-response sprinklers as indicated.

B. Sprinkler Finishes: as indicated, in finished spaces, rough bronze in unfinished spaces, and as indicated, in residential spaces. Provide escutcheons in finished and residential spaces.

2.11 PIPING SCHEDULE

A. Use CPVC plastic pipe and fittings and metal-to-plastic transition fittings with solvent-cemented joints.

B. Install shutoff valve, check valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water service piping.

2.12 TESTING

A. Flush, test, and inspect sprinkler piping systems according to NFPA 13 and Solar Decathlon Building Code

END OF SECTION 21 10 00

22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 2 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder-joint connections.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

2.2 GENERAL-DUTY VALVES

A. Valve Sizes: Same as upstream piping unless otherwise indicated.

B. One-Piece, Brass Ball Valves:

1. Description:

a. Standard: MSS SP-110.

b. CWP Rating: 400 psig.

c. Body Design: One piece.

d. Body Material: Forged brass or bronze.

e. Ends: Threaded and soldered.

f. Seats: PTFE.

g. Stem: Brass or stainless steel.

h. Ball: Chrome-plated brass or stainless steel.

i. Port: Reduced.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use gate and ball valves for shutoff duty; globe and ball for throttling duty.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves as specified in plans.

D. Install valves in a position to allow full stem movement.

END OF SECTION 22 05 23

22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - PRODUCTS

1.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, and system contents.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.2 HANGERS AND SUPPORTS FOR PLUMBING PIPING EQUPMENT

A. Galvanized Steel or Plastic Pipe Support Strap

1. Attach to building structure below floors.

B. Pipe Support Staples

1. Staple pipe to building structure where appropriate.

PART 2 - EXECUTION

2.1 GENERAL PIPING INSTALLATIONS

A. Install piping free of sags and bends.

B. Install fittings for changes in direction and branch connections.

2.2 HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.

END OF SECTION 22 05 29

22 07 00
PLUMBING INSULATION

PART 1 - PRODUCTS

1.1 PERFORMANCE REQUIREMENTS

A. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less according to ASTM E 84.

B. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less according to ASTM E 84.

1.2 INSULATION MATERIALS

A. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

PART 2 - EXECUTION

2.1 PIPE INSULATION INSTALLATION

A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Flexible Elastomeric Insulation Installation:

1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.

2. Sanitary drainage and vent piping.

3. Drainage piping located in crawlspaces unless otherwise indicated.

4. Chrome-plated pipes and fittings, except for plumbing fixtures for people with disabilities.

5. Piping specialties, including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

2.2 INDOOR PIPING INSULATION SCHEDULE

A. Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawlspaces.

2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Domestic Cold Water:

1. **NPS 1** and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: **1/2 inch**, **3/4 inch**, **1 inch**

C. Domestic Hot and Recirculated Hot Water:

1. **NPS 1-1/4**and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: **3/4 inch**, **1 inch** thick.

END OF SECTION 22 07 00

22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For transition fittings and dielectric fittings.

PART 2 - PRODUCTS

2.1 PREFORMANCE REQUIREMENTS

A. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 PIPE AND FITTINGS

A. Sharkbite Plumbing Solutions

B. PEX Tube and Fittings: ASTM F 877, SDR 9 PEX tubing and ASTM F 1807, metal insert-type fittings with copper or stainless-steel crimp rings, or push-lock type quick connect fittings.

1. Manifold: ASTM F 877 plastic or corrosion-resistant-metal assembly, with a plastic or corrosion-resistant-metal valve for each outlet.

2. CPVC and PVC Union Ball Valves: MSS SP-122, with full-port ball, socket detachable end connectors, and pressure rating not less than **150 psig** at **73 deg F**

C. Transition Fittings: Manufactured piping coupling or specified piping system fitting. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.

1. Plastic-to-Metal Transition Unions:

a. Description:

CPVC or PVC four-part union.
Brass threaded end.
Solvent-cement-joint plastic end.
Rubber O-ring.
Union nut.

D. Flexible Connectors: Stainless steel, corrugated-metal tubing with wire-braid covering. Working-pressure rating a minimum of **200 psig**

2.3 PRESSURE GAGES AND TEST PLUGS

A. Direct-Mounted, Metal-Case or Plastic-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Movement: Mechanical, with link to pressure element and connection to pointer.
3. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
4. Pointer: Dark-colored metal.
5. Window: Plastic.
6. Ring: Metal.

B. Test Plug: Corrosion-resistant brass or stainless steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating 500 psig at 200 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping free of sags and bends.

B. Install fittings for changes in direction and branch connections.

C. Install unions at final connection to each piece of equipment.

D. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.

E. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.

F. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.

G. Install domestic water piping without pitch for horizontal piping and plumb for vertical piping.

H. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

   a. NPS 1 and Smaller: 32 inches with 3/8-inch rod.

   b. Install hangers for vertical PEX piping every 48 inches.

I. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

3.2 INSPECTING AND CLEANING

A. Inspect and test piping systems as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

END OF SECTION 22 11 16

22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: **125 psig** unless otherwise indicated.

2.3 MANUFACTURED UNITS

A. Clothes Washer Outlet Boxes

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Watts; a Watts Water Technologies company.

2. Mounting: Recessed.

3. Material and Finish: Plastic box and faceplate.

4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.

5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.

6. Drain: **NPS 2** standpipe and P-trap for direct waste connection to drainage piping.

B. Icemaker Outlet Boxes

1. Mounting: Recessed.

2. Material and Finish: Plastic box and faceplate.

3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.

4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

C. Hose Bibbs

1. Standard: ASME A112.18.1 for sediment faucets.

2. Body: Bronze.

3. Seat: Bronze, replaceable.

4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.

5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 125 psig.

7. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

8. Finish for Service Areas: Rough bronze.

D. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.

2. Type: Copper tube with piston.

3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

E. Potable Water Storage Tanks

Potable water will be stored in on site tanks for the purpose of competition tasks, irrigation, and fire protection.
Tank Characteristics:
a. 300 Gallon Portable Utility tank
b. Ace Roto-Mold A-LP0300-RT or similar
c. Equipped with 8" lid, and 2" fittings on ends
d. Multiple tanks will be connected to provide sufficient combined water capacity.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water-hammer arresters in water piping according to PDI-WH 201.

END OF SECTION 22 11 19

22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data. For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIRMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 778 for motor-operated water pumps.

2.2 DOMESTIC WATER PUMPS

A. In-Line, Sealless Centrifugal Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Walrus Pumps; WA-TQ800, 1 HP Electronic Pump

2. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps. Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontally mounted; rated for 125-psig minimum working pressure and minimum continuous water temperature of 225 deg F.

3. Casing: Bronze, with threaded or companion-flange connections.

4. Impeller: Plastic.

2.3 MOTORS

A. Comply with NEMA MG 1 unless otherwise indicated.

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

C. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 26 29 13 "Enclosed Controllers."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

C. Support pumps and piping so weight of piping is not supported by pump volute.

D. Install electrical connections for power, controls, and devices.

E. Suspend in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers. Fabricate brackets or supports as required for pumps.

F. Install vertical in-line pumps on concrete bases.

G. Connect piping with valves that are at least the same size as piping connecting to pumps.

H. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

I. Install shutoff valve and strainer on suction side of pumps.

J. Install nonslam check valve and throttling valve on discharge side of pumps.

K. Install pressure gages on suction and discharge of each pump. Install at integral pressure gage tappings where provided.

END OF SECTION 22 11 23

22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 - PRODUCTS

1.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: **10-foot head of water**.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7.**

C. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components.

1.2 PIPES AND FITTINGS

A. PVC Plastic, DWV Pipe and Fittings: ASTM D 2665, Schedule 40, plain ends with PVC socket-type, DWV pipe fittings.

1. Adhesive Primer: ASTM F 656.

a. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent Cement: ASTM D 2564.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 2 - EXECUTION

2.1 PIPING INSTALLATION

A. Comply with requirements in Section 22 11 13 "Facility Water Distribution Piping" for basic piping installation requirements.

B. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines.

Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

C. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

D. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

E. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

F. Comply with requirements in Section 22 11 13 "Facility Water Distribution Piping" for basic piping joint construction.

G. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure unless otherwise indicated.

2.2 PIPE SCHEDULE

A. Aboveground Applications: PVC plastic, DWV pipe and fittings with solvent-cemented joints.

END OF SECTION 22 13 16

22 13 19
SANITARY WASTE PIPING SPECIALTIES

PART 1 - PRODUCTS

1.1 PERFORMANCE REQUIREMENTS

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.

b. Closure: Countersunk plug.

c. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

1.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured flashing collar and skirt extending at least **6 inches** from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

a. Open-Top Vent Cap: Without cap.

b. Low-Silhouette Vent Cap: With vandal-proof vent cap.

c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

1.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings: ASME A112.1.2, chrome-plated brass cover.

1.5 Waste Water Storage Tanks

Waste water will be stored in on site tanks Tank Characteristics:
a. 300 Gallon Portable Utility tank
b. Manufactured by Ace Roto-Mold A-LP0300-RT

c. Equipped with 8" lid, and 2" fittings on ends
d. Multiple tanks will be connected to provide sufficient combined water capacity.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

B. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

C. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

END OF SECTION 22 13 19

22 33 00
ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type and size of domestic-water heater.

2. Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

a. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

3. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to local jurisdiction

B. Comply with performance efficiencies prescribed in ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings."

2.2 WATER HEATERS, GENERAL

A. Insulation: Suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.

B. Anode Rods: Factory installed, magnesium.

C. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

D. Drain Valve: Factory or field installed.

2.3 ELECTRIC WATER HEATERS

A. Residential, Small-Capacity, Electric, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Daiken, altherma.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temperature and pressure relief valves and extend to closest floor drain.

B. Install vacuum relief valves in cold-water-inlet piping.

C. Install shutoff valves and unions at hot- and cold-water piping connections.

D. Make piping connections with dielectric fittings where dissimilar piping materials are joined.

E. Electrically ground units according to authorities having jurisdiction.

END OF SECTION 22 33 00

23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: **Insert psig** at **200 deg F**
2. Chilled-Water Piping: **Insert psig** at **200 deg F**.
3. Condenser-Water Piping: **Insert psig** at **150 deg F**
4. Condensate-Drain Piping: **150 deg F**
5. Blowdown-Drain Piping: **200 deg F**
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 PIPES, TUBES, AND FITTINGS

A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40, plain ends with ASTM F 438, socket-type solvent welding fittings.

1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. PVC Pipe: ASTM D 1785, Schedule 40, plain ends with ASTM F 438, socket-type solvent welding fittings.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Unions: ASME B16.39, malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

D. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure, 250 deg F maximum operating temperature.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded ends.

2.3 HYDRONIC SPECIALTIES

A. Manual Air Vents:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Bronze body and nonferrous internal parts; 150-psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.

C. SLEEVES AND SLEEVE SEALS

D. Galvanized-Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

E. PVC Pipe: ASTM D 1785, Schedule 40.

F. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.4 ESCUTCHEONS AND FLOOR PLATES

A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

C. One-Piece Floor Plates: Cast-iron flange.

2.5 PRESSURE GAGES AND TEST PLUGS

A. Direct-Mounted, [**Metal-Case**] [**Plastic-Case**], Dial-Type Pressure Gages:

1. Standard: ASME B40.100.

2. Case: Sealed, [open-front, pressure-relief] [solid-front, pressure-relief] <Insert type> type(s); [cast aluminum or drawn steel] [plastic]; [**4-1/2-inch**] [**6-inch**] nominal diameter.

3. Movement: Mechanical, with link to pressure element and connection to pointer.

4. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.

5. Pointer: Dark-colored metal.

6. Window: Plastic <**Insert material**>.

7. Ring: Metal.

8. Accuracy: [Grade A, plus or minus 1 percent of middle half of] [Grade B, plus or minus 2 percent of middle half of] [Grade C, plus or minus 3 percent of middle half of] [Grade D, plus or minus 5 percent of whole] scale range.

B. Test Plug: Corrosion-resistant brass or stainless-steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating of 500 psig at 200 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping free of sags and bends and install fittings for changes in direction and branch connections.

E. Use the fewest number of joints belowground and within floor slabs.

F. Install piping at a uniform slope of 0.2 percent upward in the direction of flow.

G. Make reductions in pipe sizes using eccentric reducer fitting installed with level side up.

H. Install branch connections to mains using T-fittings in main with takeoff out the bottom of the main, except for up-feed risers, which shall have swing joint and takeoff out the top of the main line.

I. Install unions in pipes adjacent to each valve, at final connections with each piece of equipment, and elsewhere as indicated.

J. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.

K. Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before soldering or brazing.

L. Sleeve-Seal-System Installation:

1. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand, and make a watertight seal.

M. Escutcheons and Floor Plates:

1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3. Install floor plates for piping penetrations of equipment-room floors.

4. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.2 VALVE INSTALLATIONS

A. Shutoff Duty: Use gate or ball valves.

B. Throttling Duty: Use globe or ball valves.

C. Install shutoff-duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.

D. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

E. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.

F. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage, consisting of a T-fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple and cap.

G. Install check valves on each pump discharge and elsewhere as required to control flow direction.

H. Install safety relief valves on hot-water generators and elsewhere as required by authorities having jurisdiction. Pipe discharge to floor drain without valves.

I. Install manual air vents at high points in the system, at heat-transfer coils, and elsewhere as required for system air venting.

J. Run piping from boiler air vent connection or air separator to compression tank with 1/4 inch per foot upward slope towards tank. Connect boiler outlet piping.

K. Install valves with stem up. Allow clearance above stem for check mechanism removal.

3.3 SPECIALTIES INSTALLATIONS

A. Install chemical feeders in each hydronic system in upright position with top of funnel not more than 48 inches above floor. Install feeder across pump or in bypass line, off main using ball valves on each side of feeder, and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.

B. Install diaphragm-type compression tanks on floor. Vent and purge air from hydronic system; charge tank with proper air charge to suit system design requirements.

C. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated.

3.4 TESTING, ADJUSTING, AND BALANCING

A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens.

B. Hydrostatically test completed piping at a pressure one and one-half times operating pressure. Isolate equipment before testing piping. Repair leaks and retest piping until there are no leaks.

C. Balance water flow [within distribution system, including submains, branches, and terminals, to indicated quantities.] [as required by Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."]

3.5 PIPING SCHEDULE

A. Hot and Chilled Water, NPS 2 and Smaller:

1. Aboveground: Drawn-temper copper tubing with soldered joints, or steel pipe with threaded joints.

2. Aboveground: Steel pipe with threaded joints.

3. Aboveground: CPVC pipe and fittings with solvent-welded joints.

4. Belowground or within Slabs: Annealed-temper copper tubing with soldered joints.

B. Condensate Drain Lines: Drawn-temper copper tubing with soldered joints or PVC pipe with solvent-welded joints.

END OF SECTION 23 21 13

22 35 00
DOMESTIC WATER HEAT EXCHANGERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. A custom built solar thermal collector for the purpose of heating water for the domestic water supply using solar thermal energy.

B. Working fluid in the system will consist of 2.5 gallons of Dynalene PG, and 1 gallon of distilled water.

C. Fluids will be delivered with solar thermal collector assembly during initial phase of construction.

2.2 INSTALLATION

A. Install units level and plumb. Maintain recommended clearances.

B. Install unit on roof in best location for heat collection

END OF SECTION 22 35 00

23 62 00
PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 2 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 AIR-COOLED CONDENSING UNITS

A. Description: Factory assembled and tested, air cooled; consisting of compressors, condenser coils, fans, motors, refrigerant reservoirs, and operating controls.

B. Compressors: Hermetic or semihermetic and isolated for vibration. Include thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

C. Refrigerant Charge: R-410A.

D. Condenser Fans: Direct or belt-drive propeller fans with separate motor for each fan.

E. Operating and safety controls.

2.3 CAPACITIES AND CHARACTERISTICS

1. Refer to Product Specification Sheet for manufacturer listed capacities.

a. Daiken

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb. Maintain recommended clearances.

B. Install ground-mounted units on 4-inch- thick, reinforced-concrete base. Anchor unit to base using inserts or anchor bolts.

C. Install electrical devices according to NFPA 70.

END OF SECTION 23 62 00

26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

2.2 CONDUCTORS AND CABLES

A. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for nonmetallic-sheathed cable, Type NM with ground wire.

B. Cable Type NM-B Cable: Comply with UL 719, with Type THHN/THWN conductors complying with UL 83.

C. Cable Type SEU: Comply with UL 854, with Type THHN/THWN conductors complying with UL 83 or Type XHHW2 conductors complying with UL 44.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Feeders and Branch Circuits: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Service Entrance: [Type THHN/THWN, single conductors in raceway] [Type XHHW, single conductors in raceway] [Type SE or USE multiconductor cable].

C. Exposed Feeders, Branch Circuits, and Class 1 Control Circuits, Including in Crawlspaces: Nonmetallic-sheathed cable, Type NM or NMC.

D. Feeders and Branch Circuits Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Nonmetallic-sheathed cable, Type NM or NMC.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain-relief device at terminations to suit application.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway. Use manufacturer-approved pulling compound or lubricant where necessary.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Make splices, terminations, and taps that are compatible with conductor material. Install conductor at each outlet, with at least **12 inches** of slack.

3.3 FIELD QUALITY CONTROL

A. Contractor will perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding all critical equipment and services for compliance with requirements.

END OF SECTION 26 05 19

26 27 13
ELECTRICITY METERING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data

B. Coordinate with utility companies for services and components they furnish.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Utility company will furnish meters.

B. Meter Sockets: Comply with requirements of electrical power utility company.

C. Modular Meter Center: Factory-coordinated assembly of a main service disconnect device, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. General Electric Company; GE Energy Management - Electrical Distribution.

   b. Siemens Energy.

   c. Square D; by Schneider Electric.

2. Comply with requirements of utility company for meter center.

3. Housing: NEMA 250, Type 1, Type 3R, or better enclosure.

4. Main Disconnect Device: [Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers] [Fusible switch, series-combination rated by breaker manufacturer to protect downstream feeder and branch circuit breakers].

5. Surge Protective Device: Integrally mounted, complying with UL 1449 Type 1.

6. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house load centers and panel boards that have 10,000-A interrupting capacity.

a. Identification: Provide legend identifying tenant's address.

b. Physical Protection: Tamper resistant, with hasp for padlock.

7. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads, and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

END OF SECTION 26 27 13

26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.2 DECORATOR-STYLE DEVICES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

B. GFCI, Feed Through-Type Convenience Receptacles: Square face, 125 V, 15 A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Leviton Manufacturing Co., Inc.

C. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Leviton Manufacturing Co., Inc.

2.3 RESIDENTIAL DEVICES

A. Device Color: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

B. Residential-Grade, Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498. Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Leviton Manufacturing Co., Inc.

C. Weather-Resistant and Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498. Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Leviton Manufacturing Co., Inc.

D. Fan Speed Controls: 120-V, full-wave, solid-state units with integral, quiet on-off switches, audible frequency, and EMI/RFI filters. Comply with UL 1917.

1. Continuously adjustable electronic control

E. Telephone Outlet: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair unshielded twisted pair (UTP); TIA/EIA-568-B.1; complying with Category 5e Comply with UL 1863.

F. Combination TV and Telephone Outlet: Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e Comply with UL 1863.

2.4 WALL-BOX DIMMERS

A. Control: Continuously adjustable electronic dimmer; with single-pole or three-way switching. Comply with UL 1472.

1. 600 W; dimmers shall require no derating when ganged with other devices.[

2.5 WALL PLATES

A. Wall Plates, Finished Areas: as selected by architect unless otherwise noted fastened with metal screws having heads matching plate color.

B. Wall Plates, Unfinished Areas: Galvanized steel with metal screws.

C. Wall Plates, Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

C. Select device colors and wall plates as follows:

1. For plastic covers, match device color unless otherwise specified.

D. Install unshared neutral conductors on line and load side of dimmers.

E. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multigang wall plates.

END OF SECTION 26 27 26

26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMNTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 MOLDED-CASE CIRCUIT BREAKERS

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. General Electric Company; GE Energy Management - Electrical Distribution.

   b. Square D; by Schneider Electric.

B. Description: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with field-adjustable instantaneous trip settings.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

5. GFEP Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

2.3 ENCLOSURES

A. NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.4 SUPPORT AND ANCHORAGE COMPONENTS

A. Raceway and Cable Supports: As described in NECA 1.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Install electrical equipment to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

C. Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.

D. Install electrical equipment to allow right of way for piping and conduit installed at required slope.

E. Install electrical equipment to ensure that connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.

F. Install required supporting devices in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

G. Install fuses in fusible devices.

H. Comply with NECA 1.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections, and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification.

END OF SECTION 26 28 16

26 31 00
PHOTOVOLTAIC COLLECTORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Nationally Recognized Testing Laboratory Listing: Entire assembly shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for electrical and fire safety, [**Class A**] [**Class C**], according to UL 1703.

B. FM approved for NFPA 70, Class 1, Division 2, Group C and Group D hazardous locations.

2.2 PHOTOVOLTAIC COLLECTORS

A. Products: Subject to compliance with requirements, provide each of the following:

1. Bosch; c-Si M 60 designation M225 3BB.

2. SOLARIA; SIBV4.

2.3 SYSTEM DESCRIPTION

A. Grid-Tied PV System:

1. An array of 10 modules to generate a total nominal 5,000 rated W

2. An array of 8 modules to generate a total nominal 900 rated W

3. An array of 15 modules to generate a total nominal 350 rated W

4. Modules will be connected via a utility meter to the electrical utility.

B. Bypass Diode Protection: Internal.

C. Output Cabling:

1. Quick, multiconnect, polarized connectors.

2. Two-Conductor Harness: No traditional return wire is needed from the end of a row back to the source combiner.

2.4 CAPACITIES AND CHARACTERISTICS

1. See attached product documentation sheets for manufacturer specified capacities

a. Bosch c-Si M 60, designation M225 3BB

b. SOLARIA SIBV4

2.5 MODULE FRAMING

1. Bosch c-Si M 60, designation M225 3BB:

a. PV laminates mounted in anodized extruded-aluminum frames.

b. Entire assembly UL listed for electrical and fire safety, Class II, according to UL 1703, complying with IEC 61730.

c. Finish: Anodized aluminum

2. SOLARIA SIBV4

a. PV laminates custom built into window frames

2.6 ARRAY CONSTRUCTION

A. Framing:

1. Material: Extruded aluminum, Galvanized steel, or Coated steel.

B. Roof Mounting:

1. Service Life: 25 years.

2. System anchored to roof seams.

2.7 INVERTER

A. See attached product documentation sheets for manufacturer specified capacities

1. Enecsys Microinverter SMI-D480W-60-UL

2. Solaredge SE3000A-US

2.8 MOUNTING STRUCTURES

A. Roof Mount: Extruded aluminum, two rails, tilt legs, and roof standoffs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed. Do not begin installation until mounting surfaces have been properly prepared.

B. Install arrays per manufacturer's written instructions.

C. Test arrays to ensure proper function.

END OF SECTION 26 31 00

26 50 00

LIGHTING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data for each luminaire, including lamps.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fixtures, Emergency Lighting Units, Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where luminaire efficacy rating (LER) is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. Exterior Luminaires: Comply with UL 1598, and listed and labeled for installation in wet locations by a Nationally Recognized Testing Laboratory acceptable to authorities having jurisdiction.

E. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Fixture: as scheduled.

1. Voltage: 120 V ac.
2. Mounting: Per manufacturer's specifications for each fixture
3. Lamps: Energy efficient Light Emitting Diode or Fluorescent.
4. Ballast for Fluorescent Lamps: Supplied by manufacturer for specific fixture.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate ceiling-mounted luminaires with ceiling construction, mechanical work, and security and fire-prevention features mounted in ceiling space and on ceiling.

B. Lighting Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

C. Comply with NFPA 70 for minimum fixture supports.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

END OF SECTION 26 50 00

26 53 00

Exit Signs

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Individual illuminated EXIT signs hardwired into 120V electrical system for use in identifying building exits in event of emergency.

B. Signs will have an integral battery backup as directed by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install detectors as specified in plans and per manufacturer instructions.

END OF SECTION 26 53 00

28 31 00

FIRE DETECTION AND ALARM

PART 2 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Individual smoke/fire and carbon monoxide alarms hardwired to 120v, and interconnected, with additional battery backup

B. Battery backup shall be either conventional 9v battery or sealed internal battery

C. Kidde KN-COSM-IBA or similar.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install detectors as specified in plans and per manufacturer instructions.

END OF SECTION 28 31 00

41 62 23

FORKLIFT TRUCKS

3.2 SECTION REQUIREMENTS

A. Comply with all competition rules and OSHA requirements regarding the safe operation of forklift trucks.

PART 3 - PRODUCTS

1.1 TELEHANDLER TYPE FORKLIFT

A. A Caterpillar TL1055C or similar shall be used.

B. Equipment shall have four wheel steering capability.

C. The equipment must be in good working order with no leaking fluids.

D. A fire extinguisher shall be placed within or near the operator's cab.

PART 2 - EXECUTION

2.1 OPERATION

A. No person shall operate a forklift without proper training.

B. At the beginning of the shift, the operator shall perform a safety inspection of the forklift and shall not use it should any deficiencies be noted.

C. If fueling operations are to take place, a spill kit must be readily available.

END OF SECTION 41 62 23

APPENDICES

Appendix A – Water Service Calculations

WATER AND WASTE SERVICE CALCULATIONS

JOB NAME: Solar NEST DATE: 10/01/14
JOB NUMBER: 2014-1 USER: KTP

FIXTURE TYPE	NO.	WASTE		COLD WATER		HOT WATER		TOTAL WATER
		FU	TOTAL	FU	TOTAL	FU	TOTAL	FU
BAR SINK	0	2	0	1.5	0	1.5	0	0
BATH TUB/SHOWER	1	3	3	3	3	3	3	4
CLOTHES WASHER	1	3	3	3	3	3	3	4
DRINKING FOUNTAIN	0	0.5	0	0.5	0	0	0	0
HOSE BIBB	2	0	0	2.5	5	0	0	5
KITCHEN SINK (DOMESTIC)	1	3	3	1.125	1.125	1.125	1.125	1.5
LAUNDRY SINK	0	2	0	1.125	0	1.125	0	0
LAVATORY (SINGLE)	1	1	1	0.75	0.75	0.75	0.75	1
LAVATORY (MULTIPLE)	0	2	0	0.75	0	0.75	0	0
SERVICE SINK	0	3	0	2.25	0	2.25	0	0
FLOOR DRAIN	0	2	0	0	0	0	0	0
FLOOR SINK RECEPTOR	0	3	0	0	0	0	0	0
SHOWER	0	2	0	1.5	0	1.5	0	0
SINK, 1-1/2" TRAP	0	2	0	1.5	0	1.5	0	0
SINK, 2" TRAP	0	3	0	1.5	0	1.5	0	0
URINAL, 1.0 GPF	0	2	0	4	0	0	0	0
WASHFOUNTAIN, 1-1/2"	0	2	0	1.5	0	1.5	0	0
WATER CLOSET, 1.6 TANK	1	4	4	2.5	2.5	0	0	2.5
WATER CLOSET, 1.6 FV	0	4	0	5	0	0	0	0
MISCELLANEOUS FIXTURE	0	0	0	0	0	0	0	0
MISCELLANEOUS FIXTURE	0	0	0	0	0	0	0	0
MISCELLANEOUS FIXTURE	0	0	0	0	0	0	0	0
TOTAL FU			14.0		15.4		7.9	18.0

EQUIVALENT COLD WATER FLOW RATE (GPM):	13
ADDITIONAL DEMAND LOAD (GPM)	5
PRESSURE AVAILABLE AT MAIN (PSI):	70
PRESSURE BOOSTER PUMP	0
MINIMUM REQUIRED FIXTURE PRESSURE (PSI):	12
ELEVATION RISE (FT):	8
METER LOSS (PSI):	6
BACKFLOW PREVENTER LOSS (PSI):	10
ADDITIONAL LOSSES (PSI):	0
EQUIVALENT PIPE LENGTH FROM METER TO MOST REMOTE FIXTURE (FT	50
FRICTION LOSS PRESSURE AVAILABLE (PSI):	38.53
MAXIMUM ALLOWABLE FRICTION LOSS (PSI/100 FT):	77.06
WATER FLOW VELOCITY (FPS):	7.00
CALCULATED FRICTION HEAD LOSS (PSI/100 FT):	10.34
MINIMUM REQUIRED 'WATER' PIPE SIZE (INCHES):	1.0
MINIMUM REQUIRED 'WASTE' PIPE SIZE (INCHES):	3
(CALCULATIONS PER THE PLUMBING CODE)	

WATER HEATING SIZING CALCULATIONS

JOB NAME: Solar NEST
JOB NUMBER: 2014-1

DATE: 10/01/14
USER: KTP

Occupancy Type. (Select From Drop Down Menu): RESIDENCE

QTY.	FIXTURE TYPE	G.P.H. PER OCCUPANCY TYPE									G.P.H.
		APART	CLUB	GYM	HOSP	HOTEL	INDUST	OFFICE	RESID	SCHOOL	
1	Lavatory/Bidet/Bar Sink	2	2	2	2	2	2	2	2	2	2
0	Basins, public lavatory	4	6	8	6	8	12	6	0	15	0
1	Bathtubs	20	20	30	20	20	0	0	20	0	20
0	Dishwashers	15	100	0	100	150	100	0	15	75	0
0	Foot basins	3	3	12	3	3	12	0	3	3	0
1	Kitchen sink	10	20	0	20	30	20	20	10	20	10
1	Laundry, stationary tubs	20	28	0	28	28	0	0	20	0	20
0	Laundry Tray/Sink	5	10	0	10	10	0	10	5	10	0
0	Showers	30	150	225	75	75	225	30	30	225	0
0	Slop sink	20	20	0	20	30	20	20	15	20	0
0	Hydrotherapeutic showers	0	0	0	400	0	0	0	0	0	0
0	Hubbard baths	0	0	0	600	0	0	0	0	0	0
0	Leg baths	0	0	0	100	0	0	0	0	0	0
0	Arm baths	0	0	0	35	0	0	0	0	0	0
0	Sitz baths	0	0	0	30	0	0	0	0	0	0
0	Continuous-flow baths	0	0	0	165	0	0	0	0	0	0
0	Circular wash sinks	0	0	0	20	20	30	20	0	30	0
0	Semicircular wash sinks	0	0	0	10	10	15	10	0	15	0
4	TOTAL DEMAND	0	0	0	0	0	0	0	0	0	52
	Demand Factor	0.30	0.30	0.40	0.25	0.25	0.40	0.30	0.30	0.40	0.30
	Storage Capacity	1.25	0.90	1.00	0.60	0.80	1.00	2.00	0.70	1.00	0.70

Base Required: Heating Capacity	16	GPH
Base Required: Storage Capacity	11	GAL.

Electric Heat Required.	2.3	KW
Gas Heat Required.	10	MBH

What size Water Heater tank would you like to use?	40	GAL
Adjusted Gallons Per Hour Recovery	5	GPH

Adjusted Electric Heat Required.	0.8	KW
Adjusted Gas Heat Required.	3	MBH

Water Tempature		
C.W.	60	Deg.
H.W.	120	Deg.

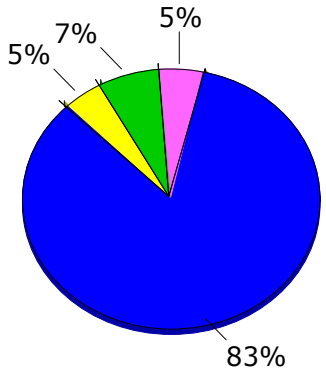
Duration of Peak load	
2	HR's

W.H. Efficiencies	
80	%

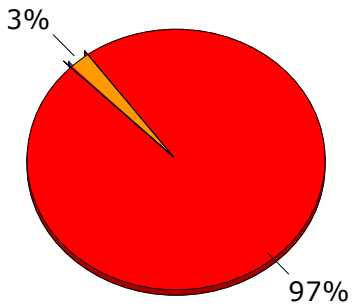
(Note: Natural gas calculations shown for information purposes only. Competition house will use electric energy only.)

Annual Peak Demand by Enduse

	Electricity	Natural Gas	Steam	Chilled Water
	kW	Btu/h	Btu/h	Btu/h
Space Cool	3.98	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	60,492	-	-
HP Supp.	-	-	-	-
Hot Water	-	1,552	-	-
Vent. Fans	0.24	-	-	-
Pumps & Aux.	-	0	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	0.32	-	-	-
Task Lights	-	-	-	-
Area Lights	0.23	-	-	-
Total	4.77	62,045	-	-

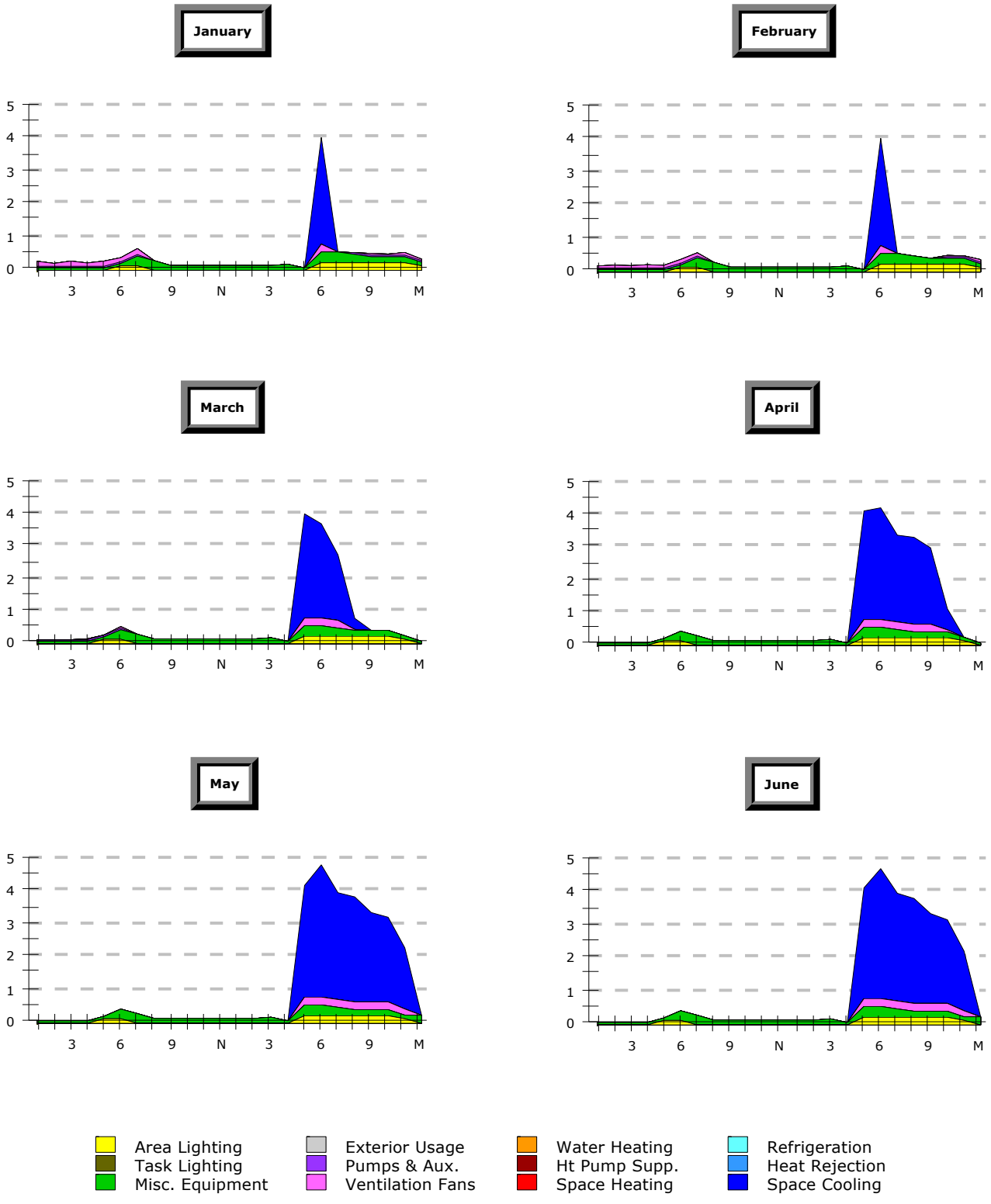


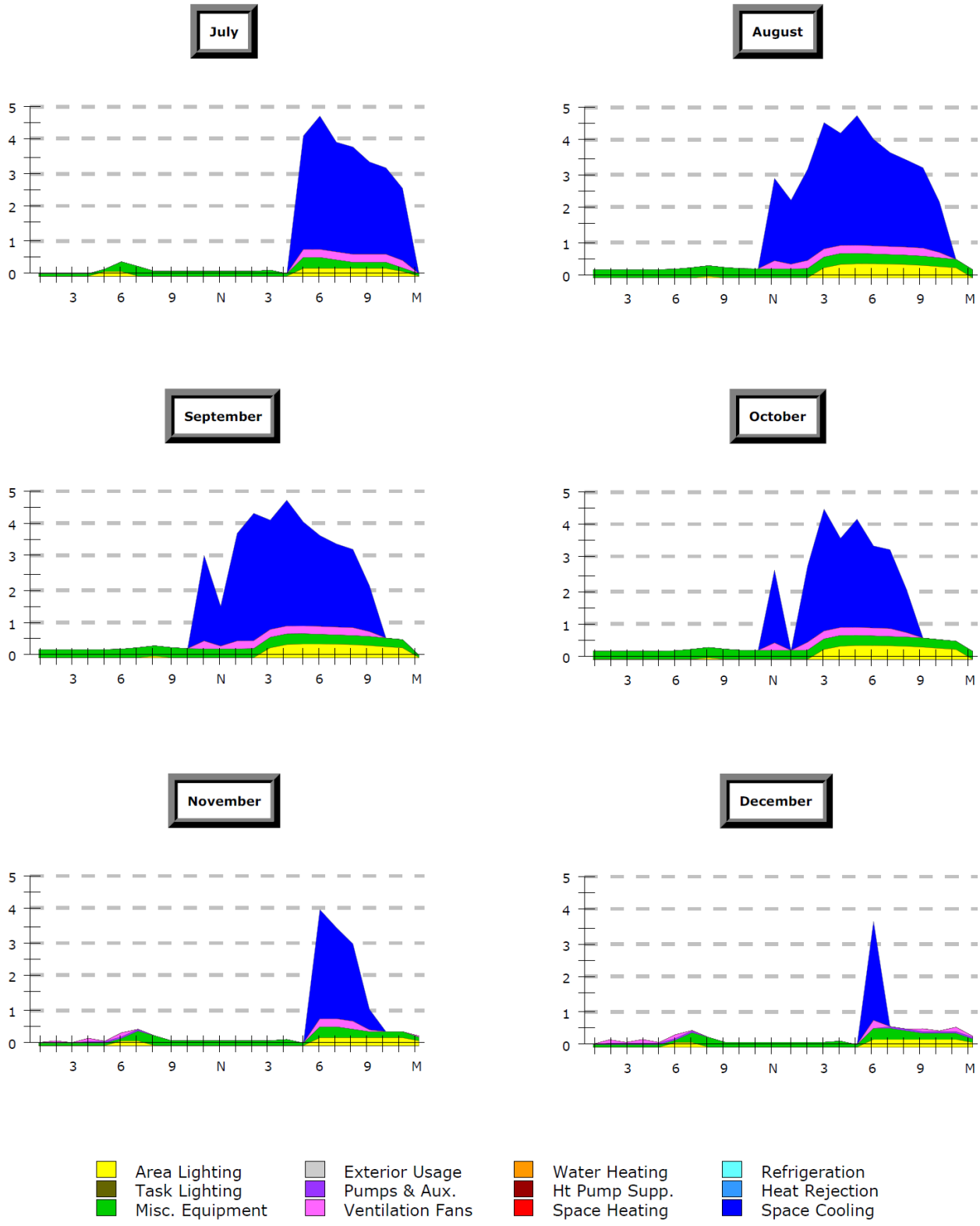
Electricity



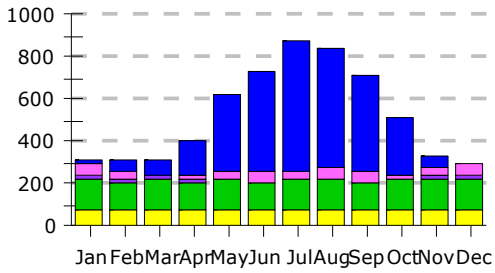
Natural Gas

Appendix D - Monthly Electric Peak Loads

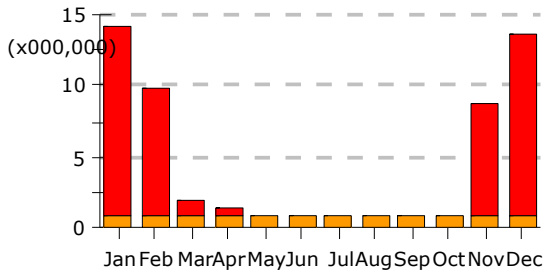



July
August
September
October
November
December
0
1
2
3
4
5
3
6
9
N
M
Area Lighting
Task Lighting
Misc. Equipment
Exterior Usage
Pumps & Aux.
Ventilation Fans
Water Heating
Ht Pump Supp.
Space Heating
Refrigeration
Heat Rejection
Space Cooling

Electric Consumption (kWh)



Gas Consumption (Btu)



Electric Consumption (kWh)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	12.3	53.2	69.9	174.1	361.1	481.2	608.0	574.9	465.3	270.5	62.0	5.3	3,137.8
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	49.0	36.7	9.6	17.0	30.9	40.3	50.2	47.5	39.1	24.2	33.7	47.1	425.3
Pumps & Aux.	23.1	15.3	12.3	9.2	3.1	0.7	0.1	0.1	0.8	4.4	13.3	22.5	104.7
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	145.8	131.6	145.6	136.6	146.0	139.1	143.1	146.0	139.1	143.3	147.4	143.1	1,706.7
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	70.8	63.9	70.8	65.9	70.8	67.4	69.2	70.8	67.4	69.2	72.1	69.2	827.3
Total	301.0	300.7	308.1	402.8	611.9	728.7	870.5	839.2	711.7	511.6	328.5	287.2	6,201.9

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	13.29	9.06	1.12	0.62	0.09	0.00	0.01	-	0.04	0.21	8.02	12.93	45.39
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.80	0.75	0.85	0.79	0.79	0.71	0.69	0.67	0.64	0.69	0.71	0.76	8.85
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	0.04	0.04	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.04	0.65
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	14.14	9.85	2.02	1.47	0.94	0.77	0.75	0.73	0.74	0.95	8.79	13.73	54.88

Sac State Solar NEST

Location	Irvine, CA
Building owner	California State University Sacramento
Program user	
Company	
Comments	

Floor - U-FACTOR = 0.053
Roof - " = 0.036
Wall - " = 0.047
Window " = 0.22
SHADE COEFFICIENT = 0.23
Skylight U-FACTOR = 0.87
SC = 0.89

By	Glumac
Dataset name	C:\Users\DavidH\Documents\TRACE 700 Projects\Solar NEST - Sac State.trc
Calculation time	07:10 PM on 10/01/2014
TRACE® 700 version	6.3
Location	Irvine, California
Latitude	33.0 deg
Longitude	117.0 deg
Time Zone	8
Elevation	54 ft
Barometric pressure	29.9 in. Hg
Air density	0.0759 lb/cu ft
Air specific heat	0.2444 Btu/lb·°F
Density-specific heat product	1.1132 Btu/h·cfm·°F
Latent heat factor	4,900.3 Btu·min/h·cu ft
Enthalpy factor	4.5542 lb·min/hr·cu ft
Summer design dry bulb	85 °F
Summer design wet bulb	70 °F
Winter design dry bulb	39 °F
Summer clearness number	1.05
Winter clearness number	0.95
Summer ground reflectance	0.20
Winter ground reflectance	0.20
Carbon Dioxide Level	400 ppm
Design simulation period	January - December
Cooling load methodology	TETD-TA1
Heating load methodology	UATD

TRANE

TRACE 700 comprehensive building analysis software from Trane

Design Cooling Load Summary

By Glumac
Sac State Solar NEST
Irvine, CA

System - System - 003
Zone - Bedroom 2
Room - Bedroom 2

Coil Location - Room

Coil Peak Calculation Time: November, hour 14
Ambient DB/WB/HR: 72 / 58 / 48

COOLING COIL LOAD INFORMATION

Load Component	Sensible Btu/h	Latent Btu/h	Total Btu/h	Percent of Total
Solar Gain	2,663		2,663	63.8%
Glass Transmission	-80		-80	-1.9%
Wall Transmission	165		165	4.0%
Roof Transmission	0		0	0.0%
Floor Transmission	0		0	0.0%
Adj Floor Transmission	0		0.00	0.0%
Partition Transmission	0		0	0.0%
Net Ceiling Load	0		0	0.0%
Lighting	83		83	2.0%
People	500	500	1,000	23.9%
Misc. Equipment Loads	146	0	146	3.5%
Cooling Infiltration	0	0	0	0.0%
Sub-Total ==>	3,478	500	3,978	95.3%
Ventilation Load	0	0	0	0.0%
Exhaust Heat	0	0	0	0.0%
Supply Fan Load	0		0	0.0%
Return Fan Load	0		0	0.0%
Net Duct Heat Pickup	54		54	1.3%
Wall Load to Plenum	123		123	2.9%
Roof Load to Plenum	0		0	0.0%
Adj Floor to Plenum	21		21	0.5%
Lighting Load to Plenum	0	0	0	0.0%
Misc. Equip. Load to Plenum	0		0	0.0%
Glass Transmission to Plenu	0		0	0.0%
Glass Solar to Plenum	0		0	0.0%
Over/Under Sizing	0		0	0.0%
Reheat at Design	0	0	0	0.0%
Underfloor Sup Heat Pickup	0		0	0.0%
Supply Air Leakage	0	0	0	0.0%
Total Cooling Loads	3,676	500	4,176	100.0 %

COOLING COIL SELECTION

Coil Selection Parameters		
Coil Entering Air (DB / WB)	75.8 / 62.8	°F
Coil Entering Humidity Ratio	65.04	gr/lb
Coil Leaving Air (DB / WB)	58.2 / 55.4	°F
Coil Leaving Humidity Ratio	61.22	gr/lb
Coil Sensible Load	3.68	MBh
Coil Total Load	4.18	MBh
Cooling Supply Air Temperature	58.15	°F
Total Cooling Airflow	187.11	cfm
Resulting Room Relative Humidity	50.00	%

General Engineering Checks		
Total Cooling Load	0.4	ton
Area / Load	350.61	ft²/ton
Total Floor Area	122	ft²
Cooling Airflow	1.53	cfm/ft²
Airflow / Load	537.71	cfm/ton
Percent Outdoor Air	0.0	%
Cooling Load Methodology	TETD-TA1	

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

TRACE® 700 v6.3 calculated at 07:10 PM on 10/01/2014
Alternative - 1 Design Cooling Load Report Page 5 of 5

System - 001

System Checksums

By Glumac

Variable Refrigerant Volume

COOLING COIL PEAK

Peaked at Time: 11 / 14
Outside Air: OADB/WB/HR: 72 / 58 / 48

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	130	0	130	1
Skylite Cond	0	-4	-4	0
Roof Cond	0	708	708	3
Glass Solar	10,151	0	10,151	49
Glass/Door Cond	-267	0	-267	-1
Wall Cond	152	60	211	1
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	10,166	764	10,930	53
Internal Loads				
Lights	486	122	608	3
People	8,000	0	8,000	39
Misc	1,237	0	1,237	6
Sub Total ==>	9,723	122	9,845	47
Ceiling Load	256	-256	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	20,145	630	20,775	100.00

CLG SPACE PEAK

Mo/Hr: 11 / 14
OADB: 72

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	248	1
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	10,301	62
Glass/Door Cond	-146	-1
Wall Cond	270	2
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	10,671	64
Internal Loads		
Lights	486	3
People	4,000	24
Misc	1,237	7
Sub Total ==>	5,723	34
Ceiling Load	249	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing		
Exhaust Heat	0	0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	16,643	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	-28	0.26
Roof Cond	0	-659	5.96
Glass Solar	0	0	0.00
Glass/Door Cond	-2,067	-2,067	18.67
Wall Cond	-527	-760	6.86
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-2,594	-3,514	31.75
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-170	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-7,554	-7,554	68.25
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-10,318	-11,068	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.6	82.0
Ra Plenum	76.3	69.1
Return	76.3	69.1
Ret/OA	0.0	0.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	

AIRFLOWS

	Cooling	Heating
Diffuser	772	772
Terminal	772	772
Main Fan	772	772
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	77	77
Return	772	772
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.26	1.26
cfm/ton	446.14	
ft²/ton	354.66	
Btu/hr ft²	33.84	-18.03
No. People	16	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	1.7	20.8	16.8	772	76.3	63.1	65.5	55.6	54.1	60.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.7	20.8								

AREAS

	Gross Total ft²	Glass ft²	(%)
Floor	614		
Part	0		
Int Door	0		
ExFlr			
Roof	614	1	0
Wall	826	298	36
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-11.1	772	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif		0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-11.1			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

TRACE® 700 v6.3 calculated at 07:10 PM on 10/01/2014
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System Checksums

By Glumac

System - 002 — Variable Refrigerant Volume

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 16
Outside Air: OADB/WB/HR: 84 / 71 / 91

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	353	353	17
Glass Solar	184	0	184	9
Glass/Door Cond	47	0	47	2
Wall Cond	169	37	206	10
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	400	390	790	39
Internal Loads				
Lights	79	20	99	5
People	1,000	0	1,000	49
Misc	139	0	139	7
Sub Total ==>	1,218	20	1,238	61
Ceiling Load	163	-163	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup			0	0
Underflr Sup Ht Pkup		0	0	0
Supply Air Leakage			0	0
Grand Total ==>	1,780	247	2,027	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 16
OADB: 84

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	184	14
Glass/Door Cond	47	4
Wall Cond	169	13
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	400	31
Internal Loads		
Lights	79	6
People	500	39
Misc	139	11
Sub Total ==>	718	56
Ceiling Load	163	13
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing		0
Exhaust Heat	0	0
RA Preheat Diff.		0
OA Preheat Diff.		0
Additional Reheat		0
Underflr Sup Ht Pkup		0
Supply Air Leakage		0
Grand Total ==>	1,280	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Percent Tot Sens Of Total Btu/h	(%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-120	15.38
Glass Solar	0	0	0.00
Glass/Door Cond	-156	-156	20.03
Wall Cond	-252	-318	40.76
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-408	-594	76.17
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-74	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-186	-186	23.83
Exhaust Heat		0	0.00
RA Preheat Diff.		0	0.00
OA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-668	-780	100.00

TEMPERATURES

	Cooling	Heating
SADB	52.0	82.0
Ra Plenum	79.4	68.0
Return	79.4	68.0
Ret/OA	79.4	68.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	50	50
Terminal	50	50
Main Fan	50	50
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	5	5
Return	50	50
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.43	0.43
cfm/ton	296.00	
ft²/ton	686.67	
Btu/hr-ft²	17.48	-6.73
No. People	2	

COOLING COIL SELECTION

	Total Capacity ton	Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.2	2.0	1.5	50	79.4	64.5	66.9	52.0	50.6	52.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	2.0								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	116		
Part	0		
Int Door	0		
ExFlr	0		
Roof	116	0	0
Wall	245	23	9
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-0.8	50	68.0	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-0.8			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

TRACE® 700 v6.3 calculated at 07:10 PM on 10/01/2014
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System Checksums

By Glumac

System - 003

Variable Refrigerant Volume

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 11 / 14
Outside Air: OADB/WB/HR: 72 / 58 / 48

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	123	123	3
Glass Solar	2,663	0	2,663	64
Glass/Door Cond	-80	0	-80	-2
Wall Cond	165	54	219	5
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	2,749	177	2,926	70
Internal Loads				
Lights	83	21	104	2
People	1,000	0	1,000	24
Misc	146	0	146	3
Sub Total ==>	1,229	21	1,250	30
Ceiling Load	31	-31	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid.Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage			0	0
Grand Total ==>	4,009	166	4,176	100.00

CLG SPACE PEAK

Mo/Hr: 11 / 14
OADB: 72

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	2,663	76
Glass/Door Cond	-80	-2
Wall Cond	165	5
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	2,749	78
Internal Loads		
Lights	83	2
People	500	14
Misc	146	4
Sub Total ==>	729	21
Ceiling Load	31	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Exhaust Heat	0	0
OA Preheat Diff.		0
RA Preheat Diff.		0
Additional Reheat		0
Underflr Sup Ht Pkup		0
Supply Air Leakage		0
Grand Total ==>	3,509	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-131	4.87
Glass Solar	0	0	0.00
Glass/Door Cond	-497	-497	18.46
Wall Cond	-291	-386	14.36
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-788	-1,014	37.69
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-35	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-1,677	-1,677	62.31
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat			
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-2,500	-2,691	100.00

TEMPERATURES

	Cooling	Heating
SADB	58.2	82.0
Ra Plenum	75.8	69.1
Return	75.8	69.1
Ret/OA	75.8	69.1
Fn MnTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	187	187
Terminal	187	187
Main Fan	187	187
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	19	19
Return	187	187
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.53	1.53
cfm/ton	537.71	
ft²/ton	350.61	
Btu/hr-ft²	34.23	-22.05
No. People	2	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB/HR °F	Enter WB/HR gr/lb	Leave DB °F	Leave WB/HR °F	Leave WB/HR gr/lb
Main Clg	0.4	4.2	3.7	187	75.8	62.8	65.0	58.2	55.4	61.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.4	4.2								

AREAS

	Gross Total ft²	Glass ft²	(%)
Floor	122		
Part	0		
Int Door	0		
ExFlr	0	0	0
Roof	122	72	21
Wall	340	0	0
Ext Door	0		

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-2.7	187	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-2.7			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Bedroom 1

Zone Checksums

By Glumac

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 16
Outside Air: OADB/WB/HR: 84 / 71 / 91

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	353	353	17
Glass Solar	184	0	184	9
Glass/Door Cond	47	0	47	2
Wall Cond	169	37	206	10
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	400	390	790	39
Internal Loads				
Lights	79	20	99	5
People	1,000	0	1,000	49
Misc	139	0	139	7
Sub Total ==>	1,218	20	1,238	61
Ceiling Load	163	-163	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup		0	0	0
Supply Air Leakage			0	0
Grand Total ==>	1,780	247	2,027	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 16
OADB: 84

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	184	14
Glass/Door Cond	47	4
Wall Cond	169	13
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	400	31
Internal Loads		
Lights	79	6
People	500	39
Misc	139	11
Sub Total ==>	718	56
Ceiling Load	163	13
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	
Exhaust Heat		0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	1,280	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-120	15.38
Glass Solar	0	0	0.00
Glass/Door Cond	-156	-156	20.03
Wall Cond	-252	-318	40.76
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-408	-594	76.17
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-74	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-186	-186	23.83
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-668	-780	100.00

TEMPERATURES

	Cooling	Heating
SADB	52.0	82.0
Ra Plenum	79.4	68.0
Return	79.4	68.0
Ret/OA	79.4	68.0
Fn MnTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	50	50
Terminal	50	50
Main Fan	50	50
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	5	5
Return	50	50
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.43	0.43
cfm/ton	296.00	
ft²/ton	686.67	
Btu/hr-ft²	17.48	-6.73
No. People	2	

COOLING COIL SELECTION

	Total Capacity ton	MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	WB °F	HR gr/lb	Leave DB °F	WB °F	HR gr/lb
Main Clg	0.2	2.0	1.5	50	79.4	64.5	66.9	52.0	50.6	52.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	2.0								

AREAS

	Gross Total ft²	Glass (%)
Floor	116	
Part	0	
Int Door	0	
ExFlr	0	
Roof	116	0
Wall	245	23 9
Ext Door	0	0 0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-0.8	50	68.0	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-0.8			

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Dataset Name: Solar NEST - Sac State.trc

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Zone Checksums

By Glumac

Bedroom 2

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 11 / 14
Outside Air: OADB/WB/HR: 72 / 58 / 48

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	123	123	3
Glass Solar	2,663	0	2,663	64
Glass/Door Cond	-80	0	-80	-2
Wall Cond	165	54	219	5
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	2,749	177	2,926	70
Internal Loads				
Lights	83	21	104	2
People	1,000	0	1,000	24
Misc	146	0	146	3
Sub Total ==>	1,229	21	1,250	30
Ceiling Load	31	-31	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat			0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup		0	0	0
Supply Air Leakage			0	0
Grand Total ==>	4,009	166	4,176	100.00

CLG SPACE PEAK

Mo/Hr: 11 / 14
OADB: 72

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	2,663	76
Glass/Door Cond	-80	-2
Wall Cond	165	5
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	2,749	78
Internal Loads		
Lights	83	2
People	500	14
Misc	146	4
Sub Total ==>	729	21
Ceiling Load	31	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing		0
Exhaust Heat	0	0
OA Preheat Diff.		0
RA Preheat Diff.		0
Additional Reheat		0
System Plenum Heat		0
Underflr Sup Ht Pkup		0
Supply Air Leakage		0
Grand Total ==>	3,509	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-131	4.87
Glass Solar	0	0	0.00
Glass/Door Cond	-497	-497	18.46
Wall Cond	-291	-386	14.36
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-788	-1,014	37.69
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-35	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-1,677	-1,677	62.31
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-2,500	-2,691	100.00

TEMPERATURES

	Cooling	Heating
SADB	58.2	82.0
Ra Plenum	75.8	69.1
Return	75.8	69.1
Ret/OA	75.8	69.1
Fn Mtr/TD	0.0	0.0
Fn Bld/TD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	187	187
Terminal	187	187
Main Fan	187	187
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	19	19
Return	187	187
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.53	1.53
cfm/ton	537.71	
ft²/ton	350.61	
Btu/hr-ft²	34.23	-22.05
No. People	2	

COOLING COIL SELECTION

	Total Capacity ton	Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.4	4.2	3.7	187	75.8	62.8	65.0	58.2	55.4	61.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.4	4.2								

AREAS

	Gross Total	Glass ft² (%)
Floor	122	
Part	0	
Int Door		
ExFlr	0	0
Roof	122	0
Wall	340	72 21
Ext Door	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-2.7	187	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-2.7			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Great Room

Zone Checksums

By Glumac

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 11 / 14
Outside Air: OADB/WB/HR: 72 / 58 / 48

	Space Sens. +Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	450	450	3
Glass Solar	9,945	0	9,945	57
Glass/Door Cond	-231	0	-231	-1
Wall Cond	161	76	238	1
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	9,876	526	10,402	60
Internal Loads				
Lights	267	67	334	2
People	6,000	0	6,000	34
Misc	668	0	668	4
Sub Total ==>	6,936	67	7,003	40
Ceiling Load	107	-107	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	16,918	486	17,404	100.00

CLG SPACE PEAK

Mo/Hr: 11 / 14
OADB: 72

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	9,945	71
Glass/Door Cond	-231	-2
Wall Cond	161	1
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	9,876	71
Internal Loads		
Lights	267	2
People	3,000	22
Misc	668	5
Sub Total ==>	3,936	28
Ceiling Load	107	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	
Exhaust Heat		0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	13,918	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-421	4.45
Glass Solar	0	0	0.00
Glass/Door Cond	-1,785	-1,785	18.87
Wall Cond	-365	-544	5.75
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-2,150	-2,751	29.08
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-108	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-6,560	-6,560	69.34
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		-149	1.58
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage			
Grand Total ==>	-8,819	-9,460	100.00

TEMPERATURES

	Cooling	Heating
SADB	56.1	82.0
Ra Plenum	75.9	69.1
Return	75.9	69.1
Ret/OA	75.9	69.1
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	660	660
Terminal	660	660
Main Fan	660	660
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	66	66
Return	660	660
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.69	1.69
cfm/ton	455.16	
ft²/ton	270.07	
Btu/hr-ft²	44.43	-24.15
No. People	12	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	1.5	17.4	14.4	660	75.9	62.8	64.9	56.1	53.9	58.8
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.5	17.4								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	392		
Part	0		
Int Door			
ExFlr	0		
Roof	392	0	0
Wall	636	257	40
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-9.5	660	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif		0	0.0	0.0
Opt Vent		0	0.0	0.0
Total	-9.5			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Zone Checksums

By Glumac

Hallway

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 15
Outside Air: OADB/WB/HR: 85 / 70 / 86

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	222	0	222	14
Skylite Cond	0	7	7	0
Roof Cond	0	391	391	25
Glass Solar	0	0	0	0
Glass/Door Cond	0	0	0	0
Wall Cond	50	12	62	4
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	273	410	683	43
Internal Loads				
Lights	85	21	106	7
People	500	0	500	32
Misc	284	0	284	18
Sub Total ==>	868	21	889	57
Ceiling Load	82	-82	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat			0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup			0	0
Underflr Sup Ht Pkup		0	0	0
Supply Air Leakage			0	0
Grand Total ==>	1,224	349	1,572	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 14
OADB: 84

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	248	25
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	0	0
Glass/Door Cond	0	0
Wall Cond	41	4
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	288	29
Internal Loads		
Lights	85	9
People	250	25
Misc	284	29
Sub Total ==>	618	63
Ceiling Load	76	8
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Exhaust Heat		0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	983	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	-28	4.46
Roof Cond	0	-132	20.90
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	-50	-63	9.91
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-50	-223	35.27
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-34	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-505	-505	79.83
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		96	-15.10
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage			
Grand Total ==>	-590	-633	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.0	82.0
Ra Plenum	77.1	69.1
Return	77.1	69.1
Ret/OA	77.1	69.1
Fn MtrTD	0.0	0.0
Fn BltTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	44	44
Terminal	44	44
Main Fan	44	44
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	4	4
MinStop/Rh	44	44
Return	0	0
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.36	0.36
cfm/ton	337.11	
ft²/ton	946.43	
Btu/hr-ft²	12.68	-5.10
No. People	1	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.1	1.6	1.3	44	77.1	63.3	65.1	55.0	51.0	49.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.1	1.6								

AREAS

	Gross Total ft²	Glass (%)
Floor	124	
Part	0	
Int Door	0	
ExFlr	0	
Roof	124	1
Wall	44	0
Ext Door	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-0.6	44	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-0.6			

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Kitchen

Zone Checksums

By Glumac

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 15
Outside Air: OADB/WB/HR: 85 / 70 / 86

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	306	306	11
Glass Solar	356	0	356	13
Glass/Door Cond	84	0	84	3
Wall Cond	67	23	90	3
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	508	329	836	30
Internal Loads				
Lights	134	34	168	6
People	1,500	0	1,500	54
Misc	285	0	285	10
Sub Total ==>	1,919	34	1,953	70
Ceiling Load	65	-65	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid.Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup		0	0	0
Supply Air Leakage			0	0
Grand Total ==>	2,492	297	2,789	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 15
OADB: 85

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	356	20
Glass/Door Cond	84	5
Wall Cond	67	4
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	508	29
Internal Loads		
Lights	134	8
People	750	43
Misc	285	16
Sub Total ==>	1,169	67
Ceiling Load	65	4
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	
Exhaust Heat		0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	1,742	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-106	10.84
Glass Solar	0	0	0.00
Glass/Door Cond	-281	-281	28.85
Wall Cond	-111	-153	15.67
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-393	-540	55.36
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-27	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-489	-489	50.15
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
System Plenum Heat		54	-5.51
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-909	-975	100.00

TEMPERATURES

	Cooling	Heating
SADB	52.0	82.0
Ra Plenum	77.1	69.1
Return	77.1	69.1
Ret/OA	77.1	69.1
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	68	68
Terminal	68	68
Main Fan	68	68
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStopRh	7	7
Return	68	68
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.69	0.69
cfm/ton	292.79	
ft²/ton	422.94	
Btu/hr-ft²	28.37	-9.92
No. People	3	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB/WB/HR °F	°F	gr/lb	Leave DB/WB/HR °F	°F	gr/lb
Main Clg	0.2	2.8	2.0	68	77.1	64.0	68.5	52.0	49.9	50.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	2.8								

AREAS

	Gross Total ft²	Glass (%)
Floor	98	
Part	0	
Int Door	0	
ExFlr	0	
Roof	98	0
Wall	147	41 28
Ext Door	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-1.0	68	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-1.0			

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Room Checksums

By Glumac

Bedroom 1

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 16
Outside Air: OADB/WB/HR: 84 / 71 / 91

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	353	353	17
Glass Solar	184	0	184	9
Glass/Door Cond	47	0	47	2
Wall Cond	169	37	206	10
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	400	390	790	39
Internal Loads				
Lights	79	20	99	5
People	1,000	0	1,000	49
Misc	139	0	139	7
Sub Total ==>	1,218	20	1,238	61
Ceiling Load	163	-163	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	1,780	247	2,027	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 16
OADB: 84

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	184	14
Glass/Door Cond	47	4
Wall Cond	169	13
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	400	31
Internal Loads		
Lights	79	6
People	500	39
Misc	139	11
Sub Total ==>	718	56
Ceiling Load	163	13
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing		
Exhaust Heat	0	0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	1,280	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Percent Tot Sens Of Total (%)
Envelope Loads		
Skylite Solar	0	0.00
Skylite Cond	0	0.00
Roof Cond	-120	15.38
Glass Solar	0	0.00
Glass/Door Cond	-156	20.03
Wall Cond	-252	40.76
Partition/Door	0	0.00
Floor	0	0.00
Adjacent Floor	0	0.00
Infiltration	-408	76.17
Sub Total ==>		
Internal Loads		
Lights	0	0.00
People	0	0.00
Misc	0	0.00
Sub Total ==>	0	0.00
Ceiling Load	-74	0.00
Ventilation Load	0	0.00
Adj Air Trans Heat	0	0
Ov/Undr Sizing	-186	23.83
Exhaust Heat		0.00
OA Preheat Diff.		0.00
RA Preheat Diff.		0.00
Additional Reheat		0.00
System Plenum Heat		0.00
Underflr Sup Ht Pkup		0.00
Supply Air Leakage		0.00
Grand Total ==>	-668	-780 100.00

TEMPERATURES

	Cooling	Heating
SADB	52.0	82.0
Ra Plenum	79.4	68.0
Return	79.4	68.0
Ret/OA	0.0	0.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Fric	0.0	

AIRFLOWS

	Cooling	Heating
Diffuser	50	50
Terminal	50	50
Main Fan	50	50
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	5	5
Return	50	50
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.43	0.43
cfm/ton	296.00	
ft²/ton	686.67	
Btu/hr-ft²	17.48	-6.73
No. People	2	

COOLING COIL SELECTION

	Total Capacity ton	MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	WB °F	HR gr/lb	Leave DB °F	WB °F	HR gr/lb
Main Clg	0.2	2.0	1.5	50	79.4	64.5	66.9	52.0	50.6	52.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	2.0								

AREAS

	Gross Total ft²	Glass ft²	(%)
Floor	116		
Part	0		
Int Door			
ExFlr	0		
Roof	116	0	
Wall	245	23	9
Ext Door	0	0	

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-0.8	50	68.0	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif		0	0.0	0.0
Opt Vent		0	0.0	0.0
Total	-0.8			

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Dataset Name: Solar NEST - Sac State.trc

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Room Checksums

By Glumac

Bedroom 2

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 11 / 14
Outside Air: OADB/WB/HR: 72 / 58 / 48

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	123	123	3
Glass Solar	2,663	0	2,663	64
Glass/Door Cond	-80	0	-80	-2
Wall Cond	165	54	219	5
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	2,749	177	2,926	70
Internal Loads				
Lights	83	21	104	2
People	1,000	0	1,000	24
Misc	146	0	146	3
Sub Total ==>	1,229	21	1,250	30
Ceiling Load	31	-31	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	4,009	166	4,176	100.00

CLG SPACE PEAK

Mo/Hr: 11 / 14
OADB: 72

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	2,663	76
Glass/Door Cond	-80	-2
Wall Cond	165	5
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	2,749	78
Internal Loads		
Lights	83	2
People	500	14
Misc	146	4
Sub Total ==>	729	21
Ceiling Load	31	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Exhaust Heat		0
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	3,509	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Percent Tot Sens Of Total (%)
Envelope Loads		
Skylite Solar	0	0.00
Skylite Cond	0	0.00
Roof Cond	-131	4.87
Glass Solar	0	0.00
Glass/Door Cond	-497	18.46
Wall Cond	-291	14.36
Partition/Door	0	0.00
Floor	0	0.00
Adjacent Floor	0	0.00
Infiltration	0	0.00
Sub Total ==>	-788	37.69
Internal Loads		
Lights	0	0.00
People	0	0.00
Misc	0	0.00
Sub Total ==>	0	0.00
Ceiling Load	-35	0.00
Ventilation Load	0	0.00
Adj Air Trans Heat	0	0
Ov/Undr Sizing	-1,677	62.31
Exhaust Heat		0.00
OA Preheat Diff.		0.00
RA Preheat Diff.		0.00
Additional Reheat		0.00
System Plenum Heat		0.00
Underflr Sup Ht Pkup		0.00
Supply Air Leakage		0.00
Grand Total ==>	-2,500	-2,691 100.00

TEMPERATURES

	Cooling	Heating
SADB	58.2	82.0
Ra Plenum	75.8	69.1
Return	75.8	69.1
Rel/OA	75.8	69.1
Fn Mtr/TD	0.0	0.0
Fn Bld/TD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	187	187
Terminal	187	187
Main Fan	187	187
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	19	19
Return	187	187
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.53	1.53
cfm/ton	537.71	
ft²/ton	350.61	
Btu/hr-ft²	34.23	-22.05
No. People	2	

COOLING COIL SELECTION

	Total Capacity ton	MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.4	4.2	3.7	187	75.8	62.8	65.0	58.2	55.4	61.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.4	4.2								

AREAS

	Gross Total ft²	Glass ft²	(%)
Floor	122		
Part	0		
Int Door	0		
ExFlr	0	0	0
Roof	122	72	21
Wall	340	0	0
Ext Door	0		

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-2.7	187	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-2.7			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Room Checksums

By Glumac

Great Room

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 11 / 14
Outside Air: OADB/WB/HR: 72 / 58 / 48

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	450	450	3
Glass Solar	9,945	0	9,945	57
Glass/Door Cond	-231	0	-231	-1
Wall Cond	161	76	238	1
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	9,876	526	10,402	60
Internal Loads				
Lights	267	67	334	2
People	6,000	0	6,000	34
Misc	668	0	668	4
Sub Total ==>	6,936	67	7,003	40
Ceiling Load	107	-107	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup			0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	16,918	486	17,404	100.00

CLG SPACE PEAK

Mo/Hr: 11 / 14
OADB: 72

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	9,945	71
Glass/Door Cond	-231	-2
Wall Cond	161	1
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	9,876	71
Internal Loads		
Lights	267	2
People	3,000	22
Misc	668	5
Sub Total ==>	3,936	28
Ceiling Load	107	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing		0
Exhaust Heat	0	0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	13,918	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-421	4.45
Glass Solar	0	0	0.00
Glass/Door Cond	-1,785	-1,785	18.87
Wall Cond	-365	-544	5.75
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-2,150	-2,751	29.08
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-108	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-6,560	-6,560	69.34
Exhaust Heat	0	0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
System Plenum Heat		-149	1.58
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-8,819	-9,460	100.00

TEMPERATURES

	Cooling	Heating
SADB	56.1	82.0
Ra Plenum	75.9	69.1
Return	75.9	69.1
Ret/OA	75.9	69.1
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	

AIRFLOWS

	Cooling	Heating
Diffuser	660	660
Terminal	660	660
Main Fan	660	660
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStopRh	66	66
Return	660	660
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.69	1.69
cfm/ton	455.16	
ft²/ton	270.07	
Btu/hr-ft²	44.43	-24.15
No. People	12	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	1.5	17.4	14.4	660	75.9	62.8	64.9	56.1	53.9	58.8
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.5	17.4								

AREAS

	Gross Total ft²	Glass ft² (%)
Floor	392	
Part	0	
Int Door	0	
ExFlr		0
Roof	392	0
Wall	636	257 40
Ext Door	0	0 0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-9.5	660	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-9.5			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Room Checksums

By Glumac

Hallway

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 15
Outside Air: OADB/WB/HR: 85 / 70 / 86

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	222	0	222	14
Skylite Cond	0	7	7	0
Roof Cond	0	391	391	25
Glass Solar	0	0	0	0
Glass/Door Cond	0	0	0	0
Wall Cond	50	12	62	4
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	273	410	683	43
Internal Loads				
Lights	85	21	106	7
People	500	0	500	32
Misc	284	0	284	18
Sub Total ==>	868	21	889	57
Ceiling Load	82	-82	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat			0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup			0	0
Underflr Sup Ht Pkup		0	0	0
Supply Air Leakage			0	0
Grand Total ==>	1,224	349	1,572	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 14
OADB: 84

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	248	25
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	0	0
Glass/Door Cond	0	0
Wall Cond	41	4
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	288	29
Internal Loads		
Lights	85	9
People	250	25
Misc	284	29
Sub Total ==>	618	63
Ceiling Load	76	8
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Exhaust Heat	0	0
OA Preheat Diff.		0
RA Preheat Diff.		0
Additional Reheat		0
System Plenum Heat		0
Underflr Sup Ht Pkup		0
Supply Air Leakage		0
Grand Total ==>	983	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	-28	4.46
Roof Cond	0	-132	20.90
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	-50	-63	9.91
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-50	-223	35.27
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-34	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-505	-505	79.83
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
System Plenum Heat		96	-15.10
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-590	-633	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.0	82.0
Ra Plenum	77.1	69.1
Return	77.1	69.1
Ret/OA	77.1	69.1
Fn Mtr/TD	0.0	0.0
Fn Bld/TD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	44	44
Terminal		
Main Fan	44	44
Sec Fan	44	44
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	4	4
Return	44	44
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.36	0.36
cfm/ton	337.11	
ft²/ton	946.43	
Btu/hr-ft²	12.68	-5.10
No. People	1	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.1	1.6	1.3	44	77.1	63.3	65.1	55.0	51.0	49.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.1	1.6								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	124		
Part	0		
Int Door	0		
ExFlr	0		
Roof	124	1	1
Wall	44	0	0
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-0.6	44	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif		0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-0.6			

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Dataset Name: Solar NEST - Sac State.trc

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Room Checksums

By Glumac

Kitchen

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 15
Outside Air: OADB/WB/HR: 85 / 70 / 86

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	306	306	11
Glass Solar	356	0	356	13
Glass/Door Cond	84	0	84	3
Wall Cond	67	23	90	3
Partition/Door	0		0	0
Floor	0	0	0	0
Adjacent Floor	0		0	0
Infiltration	0		0	0
Sub Total ==>	508	329	836	30
Internal Loads				
Lights	134	34	168	6
People	1,500	0	1,500	54
Misc	285	0	285	10
Sub Total ==>	1,919	34	1,953	70
Ceiling Load	65	-65	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat		0	0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup			0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	2,492	297	2,789	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 15
OADB: 85

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	356	20
Glass/Door Cond	84	5
Wall Cond	67	4
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	508	29
Internal Loads		
Lights	134	8
People	750	43
Misc	285	16
Sub Total ==>	1,169	67
Ceiling Load	65	4
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing		
Exhaust Heat	0	0
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	1,742	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 39

	Space Peak Space Sens Btu/h	Coil Peak Percent Tot Sens Of Total Btu/h	(%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-106	10.84
Glass Solar	0	0	0.00
Glass/Door Cond	-281	-281	28.85
Wall Cond	-111	-153	15.67
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-393	-540	55.36
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-27	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	
Ov/Undr Sizing	-489	-489	50.15
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
System Plenum Heat		54	-5.51
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-909	-975	100.00

TEMPERATURES

	Cooling	Heating
SADB	52.0	82.0
Ra Plenum	77.1	69.1
Return	77.1	69.1
Ret/OA	77.1	69.1
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	68	68
Terminal	68	68
Main Fan	68	68
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStopRh	7	7
Return	68	68
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.69	0.69
cfm/ton	292.79	
ft²/ton	422.94	
Btu/hr-ft²	28.37	-9.92
No. People	3	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB/WB/HR °F	°F	gr/lb	Leave DB/WB/HR °F	°F	gr/lb
Main Clg	0.2	2.8	2.0	68	77.1	64.0	68.5	52.0	49.9	50.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	2.8								

AREAS

	Gross Total ft²	Glass ft²	(%)
Floor	98		
Part	0		
Int Door	0		
ExFlr	0		
Roof	98	0	0
Wall	147	41	28
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-1.0	68	69.1	82.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-1.0			

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Design Cooling Load Summary

By Glumac
Sac State Solar NEST
Irvine, CA

System - System - 001
Zone - Great Room
Room - Great Room

Coil Location - Room

Coil Peak Calculation Time: November, hour 14
Ambient DB/WB/HR: 72 / 58 / 48

COOLING COIL LOAD INFORMATION

Load Component	Sensible Btu/h	Latent Btu/h	Total Btu/h	Percent of Total
Solar Gain	9,945		9,945	57.1%
Glass Transmission	-231		-231	-1.3%
Wall Transmission	161		161	0.9%
Roof Transmission	0		0	0.0%
Floor Transmission	0		0	0.0%
Adj Floor Transmission	0		0.00	0.0%
Partition Transmission	0		0	0.0%
Net Ceiling Load	0		0	0.0%
Lighting	267		267	1.5%
People	3,000	3,000	6,000	34.5%
Misc. Equipment Loads	668	0	668	3.8%
Cooling Infiltration	0	0	0	0.0%
Sub-Total ==>	13,811	3,000	16,811	96.6%
Ventilation Load	0	0	0	0.0%
Exhaust Heat	0	0	0	0.0%
Supply Fan Load	0		0	0.0%
Return Fan Load	0		0	0.0%
Net Duct Heat Pickup	0		0	0.0%
Wall Load to Plenum	76		76	0.4%
Roof Load to Plenum	450		450	2.6%
Adj Floor to Plenum	0		0	0.0%
Lighting Load to Plenum	67		67	0.4%
Misc. Equip. Load to Plenum	0	0	0	0.0%
Glass Transmission to Plenu	0		0	0.0%
Glass Solar to Plenum	0		0	0.0%
Over/Under Sizing	0		0	0.0%
Reheat at Design	0	0	0	0.0%
Underfloor Sup Heat Pickup	0		0	0.0%
Supply Air Leakage	0	0	0	0.0%
Total Cooling Loads	14,404	3,000	17,404	100.0 %

COOLING COIL SELECTION

Coil Selection Parameters		
Coil Entering Air (DB / WB)	75.9 / 62.8	°F
Coil Entering Humidity Ratio	64.94	gr/lb
Coil Leaving Air (DB / WB)	56.1 / 53.9	°F
Coil Leaving Humidity Ratio	58.77	gr/lb
Coil Sensible Load	14.40	MBh
Coil Total Load	17.40	MBh
Cooling Supply Air Temperature	56.06	°F
Total Cooling Airflow	660.15	cfm
Resulting Room Relative Humidity	49.92	%

General Engineering Checks		
Total Cooling Load	1.5	ton
Area / Load	270.07	ft²/ton
Total Floor Area	392	ft²
Cooling Airflow	1.69	cfm/ft²
Airflow / Load	455.16	cfm/ton
Percent Outdoor Air	0.0	%
Cooling Load Methodology	TETD-TA1	

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Design Cooling Load Summary

By Glumac
Sac State Solar NEST
Irvine, CA

System - System - 001
Zone - Hallway
Room - Hallway

Coil Location - Room

Coil Peak Calculation Time: July, hour 15
Ambient DB/WB/HR: 85 / 70 / 86

COOLING COIL LOAD INFORMATION

Load Component	Sensible Btu/h	Latent Btu/h	Total Btu/h	Percent of Total
Solar Gain	222		222	14.2%
Glass Transmission	0		0	0.0%
Wall Transmission	50		50	3.2%
Roof Transmission	0		0	0.0%
Floor Transmission	0		0	0.0%
Adj Floor Transmission	0		0.00	0.0%
Partition Transmission	0		0	0.0%
Net Ceiling Load	85		85	5.4%
Lighting	250	250	500	31.8%
People	284	0	284	18.0%
Misc. Equipment Loads	0	0	0	0.0%
Cooling Infiltration	891	250	1,141	72.6%
Sub-Total ==>				
Ventilation Load	0	0	0	0.0%
Exhaust Heat	0	0	0	0.0%
Supply Fan Load	0		0	0.0%
Return Fan Load	0		0	0.0%
Net Duct Heat Pickup	0		0	0.0%
Wall Load to Plenum	12		12	0.7%
Roof Load to Plenum	391		391	24.9%
Adj Floor to Plenum	0		0	0.0%
Lighting Load to Plenum	21		21	1.3%
Misc. Equip. Load to Plenum	0	0	0	0.0%
Glass Transmission to Plenu	7		7	0.4%
Glass Solar to Plenum	0		0	0.0%
Over/Under Sizing	0		0	0.0%
Reheat at Design	0	0	0	0.0%
Underfloor Sup Heat Pickup	0		0	0.0%
Supply Air Leakage	0	0	0	0.0%
Total Cooling Loads	1,322	250	1,572	100.0 %

COOLING COIL SELECTION

Coil Selection Parameters		
Coil Entering Air (DB / WB)	77.1 / 63.3	°F
Coil Entering Humidity Ratio	65.08	gr/lb
Coil Leaving Air (DB / WB)	55.0 / 51.0	°F
Coil Leaving Humidity Ratio	49.45	gr/lb
Coil Sensible Load	1.32	MBh
Coil Total Load	1.57	MBh
Cooling Supply Air Temperature	55.01	°F
Total Cooling Airflow	44.17	cfm
Resulting Room Relative Humidity	50.03	%

General Engineering Checks		
Total Cooling Load	0.1	ton
Area / Load	946.43	ft²/ton
Total Floor Area	124	ft²
Cooling Airflow	0.36	cfm/ft²
Airflow / Load	337.11	cfm/ton
Percent Outdoor Air	0.0	%
Cooling Load Methodology	TETD-TA1	

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Design Cooling Load Summary

By Glumac
Sac State Solar NEST
Irvine, CA

System - System - 001
Zone - Kitchen
Room - Kitchen

Coil Location - Room

Coil Peak Calculation Time: July, hour 15
Ambient DB/WB/HR: 85 / 70 / 86

COOLING COIL LOAD INFORMATION

Load Component	Sensible Btu/h	Latent Btu/h	Total Btu/h	Percent of Total
Solar Gain	356		356	12.8%
Glass Transmission	84		84	3.0%
Wall Transmission	67		67	2.4%
Roof Transmission	0		0	0.0%
Floor Transmission	0		0	0.0%
Adj Floor Transmission	0		0.00	0.0%
Partition Transmission	0		0	0.0%
Net Ceiling Load	0		0	0.0%
Lighting	134		134	4.8%
People	750	750	1,500	53.8%
Misc. Equipment Loads	285	0	285	10.2%
Cooling Infiltration	0	0	0	0.0%
Sub-Total ==>	1,677	750	2,427	87.0%
Ventilation Load	0	0	0	0.0%
Exhaust Heat	0	0	0	0.0%
Supply Fan Load	0		0	0.0%
Return Fan Load	0		0	0.0%
Net Duct Heat Pickup	23		23	0.8%
Wall Load to Plenum	306		306	11.0%
Roof Load to Plenum	0		0	0.0%
Adj Floor to Plenum	34		34	1.2%
Lighting Load to Plenum	0	0	0	0.0%
Misc. Equip. Load to Plenum	0		0	0.0%
Glass Transmission to Plenu	0		0	0.0%
Glass Solar to Plenum	0		0	0.0%
Over/Under Sizing	0		0	0.0%
Reheat at Design	0	0	0	0.0%
Underfloor Sup Heat Pickup	0		0	0.0%
Supply Air Leakage	0	0	0	0.0%
Total Cooling Loads	2,039	750	2,789	100.0 %

COOLING COIL SELECTION

Coil Selection Parameters		
Coil Entering Air (DB / WB)	77.1 / 64.0	°F
Coil Entering Humidity Ratio	68.54	gr/lb
Coil Leaving Air (DB / WB)	52.0 / 49.9	°F
Coil Leaving Humidity Ratio	50.04	gr/lb
Coil Sensible Load	2.04	MBh
Coil Total Load	2.79	MBh
Cooling Supply Air Temperature	52.00	°F
Total Cooling Airflow	68.05	cfm
Resulting Room Relative Humidity	52.65	%

General Engineering Checks

Total Cooling Load	0.2	ton
Area / Load	422.94	ft²/ton
Total Floor Area	98	ft²
Cooling Airflow	0.69	cfm/ft²
Airflow / Load	292.79	cfm/ton
Percent Outdoor Air	0.0	%
Cooling Load Methodology	TETD-TA1	

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

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Design Cooling Load Summary

By Glumac
Sac State Solar NEST
Irvine, CA

System - System - 002
Zone - Bedroom 1
Room - Bedroom 1

Coil Location - Room

Coil Peak Calculation Time: July, hour 16
Ambient DB/WB/HR: 84 / 71 / 91

COOLING COIL LOAD INFORMATION

Load Component	Sensible Btu/h	Latent Btu/h	Total Btu/h	Percent of Total
Solar Gain	184		184	9.1%
Glass Transmission	47		47	2.3%
Wall Transmission	169		169	8.3%
Roof Transmission	0		0	0.0%
Floor Transmission	0		0	0.0%
Adj Floor Transmission	0		0.00	0.0%
Partition Transmission	0		0	0.0%
Net Ceiling Load	79		79	3.9%
Lighting	500	500	1,000	49.3%
People	139	0	139	6.8%
Misc. Equipment Loads	0	0	0	0.0%
Cooling Infiltration	1,117	500	1,617	79.8%
Sub-Total ==>				
Ventilation Load	0	0	0	0.0%
Exhaust Heat	0	0	0	0.0%
Supply Fan Load	0		0	0.0%
Return Fan Load	0		0	0.0%
Net Duct Heat Pickup	37		37	1.8%
Wall Load to Plenum	353		353	17.4%
Roof Load to Plenum	0		0	0.0%
Adj Floor to Plenum	20		20	1.0%
Lighting Load to Plenum	0	0	0	0.0%
Misc. Equip. Load to Plenum	0		0	0.0%
Glass Transmission to Plenu	0		0	0.0%
Glass Solar to Plenum	0		0	0.0%
Over/Under Sizing	0		0	0.0%
Reheat at Design	0	0	0	0.0%
Underfloor Sup Heat Pickup	0		0	0.0%
Supply Air Leakage	0	0	0	0.0%
Total Cooling Loads	1,527	500	2,027	100.0 %

COOLING COIL SELECTION

Coil Selection Parameters		
Coil Entering Air (DB / WB)	79.4 / 64.5	°F
Coil Entering Humidity Ratio	66.90	gr/lb
Coil Leaving Air (DB / WB)	52.0 / 50.6	°F
Coil Leaving Humidity Ratio	52.69	gr/lb
Coil Sensible Load	1.53	MBh
Coil Total Load	2.03	MBh
Cooling Supply Air Temperature	52.00	°F
Total Cooling Airflow	50.00	cfm
Resulting Room Relative Humidity	51.41	%

General Engineering Checks		
Total Cooling Load	0.2	ton
Area / Load	686.67	ft²/ton
Total Floor Area	116	ft²
Cooling Airflow	0.43	cfm/ft²
Airflow / Load	296.00	cfm/ton
Percent Outdoor Air	0.0	%
Cooling Load Methodology	TETD-TA1	

Project Name: Sac State Solar NEST
Dataset Name: Solar NEST - Sac State.trc

TRACE® 700 v6.3 calculated at 07:10 PM on 10/01/2014
Alternative - 1 Design Cooling Load Report Page 4 of 5

Appendix E – Product Information Sheets

Powerful performance – high stability.
Bosch Solar Module c-Si M 60 NA30119

High-quality – high-performance – reliable.
Solar modules from Bosch Solar Energy.

BOSCH

Our crystalline solar modules offer impressive features including:

- Excellent quality assured through fully-automated production and testing processes as well as world-class quality assurance programs
- Excellent processing and long-term stability right along the value-added chain
- A reliable and durable design through the use of proven US and German components, tempered front glass and a robust anodized frame
- Latest generation monocrystalline cells with energy efficiency exceeding 18%
- Higher specific yields due to positive power sorting

Warranty conditions:

- 10 years product warranty
- 25-year performance guarantee (90% up to 10 years, 80% up to 25 years)
- Product certification to UL 1703
- CEC registered

c UL US

Bosch Solar Module c-Si M 60 | NA30119

Manu-facturer	Length [x]	Width [y]	Height [z]	Weight	Junction box	Plug connector	Cable [l]	Front glass surface
19	64.96 in 1650.0	38.98 in 990.0	1.65 in 42.0	41.89 lb 19.0	Yukita	Yukita, MC4 compatible	39.37 in 1000	Struc-tured
If not stated differently, x, y, z, l in mm, ±2 mm; weight in kg ±0.5								

Notes on assembly:

- See installation and operating manual at: www.bosch-solarenergy.com/products/
- Horizontal and vertical assembly possible
- System voltage max. 600 V

Crystalline solar module	
Performance classes	**240 Wp, 245 Wp**
Performance sorting	–0/+4.99 Wp
Structure	**Glass-foil laminate** ▶ Anodized aluminum frame with additional coating ▶ Junction box (IP 65) with 3 bypass diodes ▶ Weather-resistant back sheet (white) ▶ Cable 12 AWG (4 mm²)
Cells	**60x monocrystalline solar cells** in 156 mm x 156 mm format
Mechanical load	**2400 Pa superimposed load, 2400 Pa suction load,** in accordance with UL 1703

Weak light performance:

Intensity [W/m²]	Vmpp [%]	Impp [%]
800	0.0	–20
600	0.0	–40
400	–0.4	–60
200	–3.2	–80
100	–6.0	–90
The electrical data applies for 25 °C and AM 1.5.		

Electrical characteristics for STC*:

Designation	Pmpp [Wp]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	Reverse-current load capacity [A]
245 Wp	245	29.80	8.25	36.80	8.60	17
240 Wp	240	29.70	8.15	36.70	8.50	17
Reduction in module efficiency with decrease in irradiation level from 1000 W/m² to 200 W/m² (at 25 °C): –0.33% (absolute); measuring tolerance P ±3%						

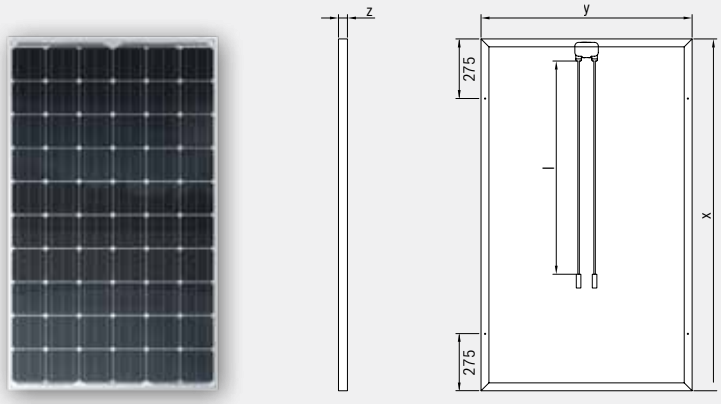
Thermal characteristics:

Operating temperature range	–40 to 85 °C
Temperature coefficient Pmpp	–0.46%/K
Temperature coefficient Voc	–0.32%/K
Temperature coefficient Isc	0.032%/K

Electrical characteristics for NOCT*:

Designation	Pmpp [W]	Vmpp [V]	Voc [V]	Isc [A]
245 Wp	177	27.07	34.09	6.92
240 Wp	173	26.98	34.00	6.84
NOCT: Normal Operation Cell Temperature 45.3 °C: Irradiation level 800 W/m², AM 1.5, temperature 20 °C, wind speed 1 m/s, electrical open circuit operation				

Dimensions**:



Specifications in mm

* Electrical parameters are typical mean values from historical production data. Bosch Solar Energy assumes no liability for the accuracy of this data for future production batches.

** Drawings are not to scale. For detailed dimensions and tolerances, see above.

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San Mateo, CA 94403
USA
Phone: +1 650 356 3100
Fax: +1 650 525 0830
sales.se@us.bosch.com
www.bosch-solarenergy.com

Version: 08/2011

Cat®
TL1055C

Telehandler

Specifications

Engine

Model	Cat® C4.4 ACERT™ Tier 4 Interim	
Gross Power (Basic)	106 kW	142.1 hp

Weight

Operating Weight	15 495 kg	34,160 lb

Operating Specifications

Rated Load Capacity	4536 kg	10,000 lb
Maximum Lift Height	16.8 m	55.1 ft
Maximum Forward Reach	13 m	42.7 ft
Frame Leveling	10°	
Top Travel Speed	32.8 kph	20.4 mph
Capacity at Max Height (o/r Up)	—	—
Capacity at Max Height (o/r Down)	2268 kg	5,000 lb
Capacity at Max Reach (o/r Up)	—	—
Capacity at Max Reach (o/r Down)	1134 kg	2,500 lb
Turning Radius over Tires	4.3 m	14.1 ft
Drawbar Pull (Loaded)	106.8 KN	24,000 lb

Hydraulic System

Variable displacement load sensing axial piston pump

System Operating Pressure	252 bar	3,650 psi
Auxiliary Hydraulic Pressure	207 bar	3,000 psi
Auxiliary Hydraulic Flow at Boom Head	57 L/min	15 gal/min

- Auxiliary Hydraulic Circuit used for all attachments equipped with cylinders or other hydraulic components. Consists of valves, controls, and hydraulic lines.

Service Refill Capacities

Fuel Tank	144 L	38 gal
Hydraulic System	238 L	63 gal

Tires

Standard	400/75-28 Duraforce MT
Optional	14.00 x 24 Foam Filled 400/75-28 Foam Filled 14.00 x 24 12 PR

Transmission Speeds

Forward	4 speed
Reverse	3 speed

Boom Performance

Boom Up	13.8 Seconds
Boom Down	13.7 Seconds
Tele In	14.8 Seconds
Tele Out	17.4 Seconds

Axles

- Trunnion mounted planetary 55 degree steer axles.
- Integral steer cylinder.
- High bias limited slip differential on front axle.

Brakes

- Service Brakes are inboard wet disc brakes on front and rear axles.
- Parking Brakes are mechanical on front axle. Light on dash indicates when brake is on.

Work Tools

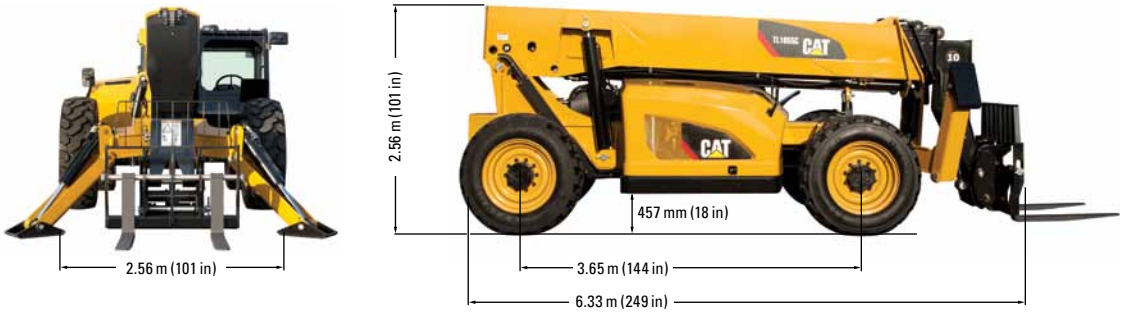
Hydraulic IT Coupler	Includes Auxiliary Electrics	Includes Auxiliary Electrics
Pallet Forks	(2) 1525 mm, 60 mm x 150 mm	(2) 60 in, 2. 36 in x 6 in
	(2) 1220 mm, 60 mm x 100 mm	(2) 48 in, 2.36 in x 4 in
Lumber Forks	(2) 1525 mm, 45 mm x 180 mm	(2) 60 in, 1.75 in x 7 in
	(2) 1829 mm, 50 mm x 150 mm	(2) 72 in, 2 in x 6 in
Cubing Forks	(2) 1220 mm, 50 mm x 50 mm	(2) 48 in, 2 in x 2 in
Carriages:		
Standard Tilt	1270 mm	50 in
Wide Tilt	1829 mm	72 in
Side Shift	1220 mm	48 in
Standard Rotate	1270 mm	50 in
Wide Rotate	1829 mm	72 in
Swing	100°, 1829 mm, 4536 kg Capacity, 2268 kg Swung	100°, 72 in, 10,000 lb Capacity, 5,000 lb Swung
Dual Fork Positioning	1270 mm	50 in

CAT®

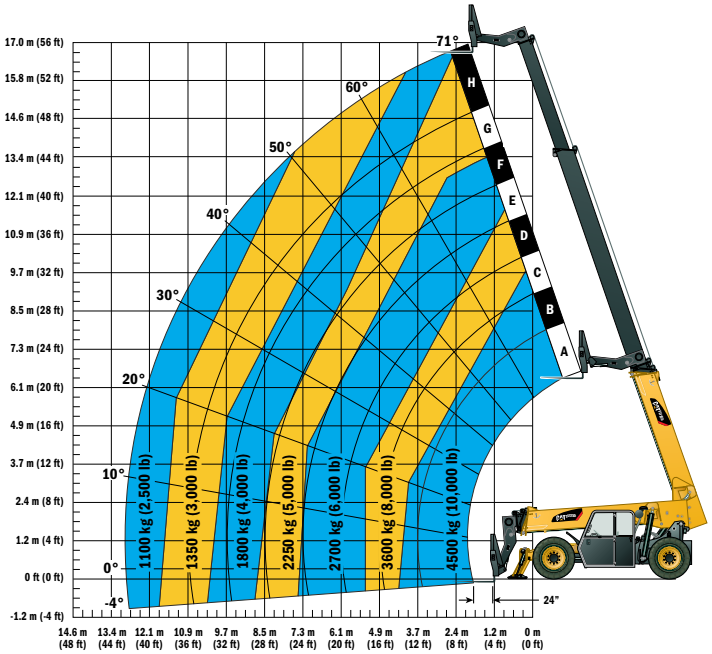
TL1055C Telehandler

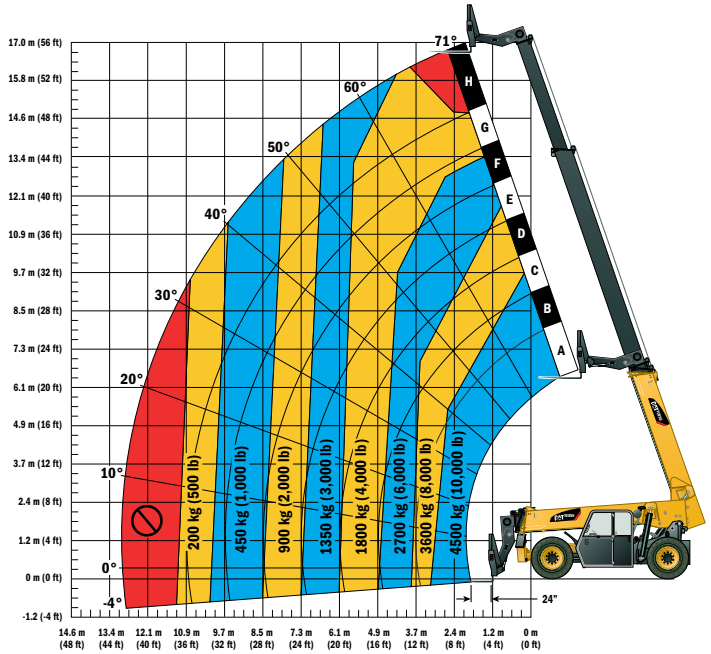
Dimensions

All dimensions are approximate.



Load Chart and Dimensions





IMPORTANT

Rated lift capacities shown are with machine equipped with carriage and pallet forks. The machine must be level on a firm surface with undamaged, properly inflated tires. Machine specifications and stability are based on rated lift capacities at specific boom angles and boom lengths. (If specifications are critical, the proposed application should be discussed with your dealer.)

DO NOT exceed rated lift capacity loads, as unstable and dangerous machine conditions will result.

DO NOT tip the machine forward to determine the allowable load.

Use only approved attachments with proper material handler model/attachment load capacity charts displayed in the operator's cab. OSHA requires all rough terrain forklift operators be trained according to OSHA 29 CFR 1910.178 (1).

Due to continuous product improvements, machine specifications and/or equipment changes may be made without prior notification. This machine meets or exceeds ANSI/ITSDF B56.6-2005 as originally manufactured for intended applications.

For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at www.cat.com

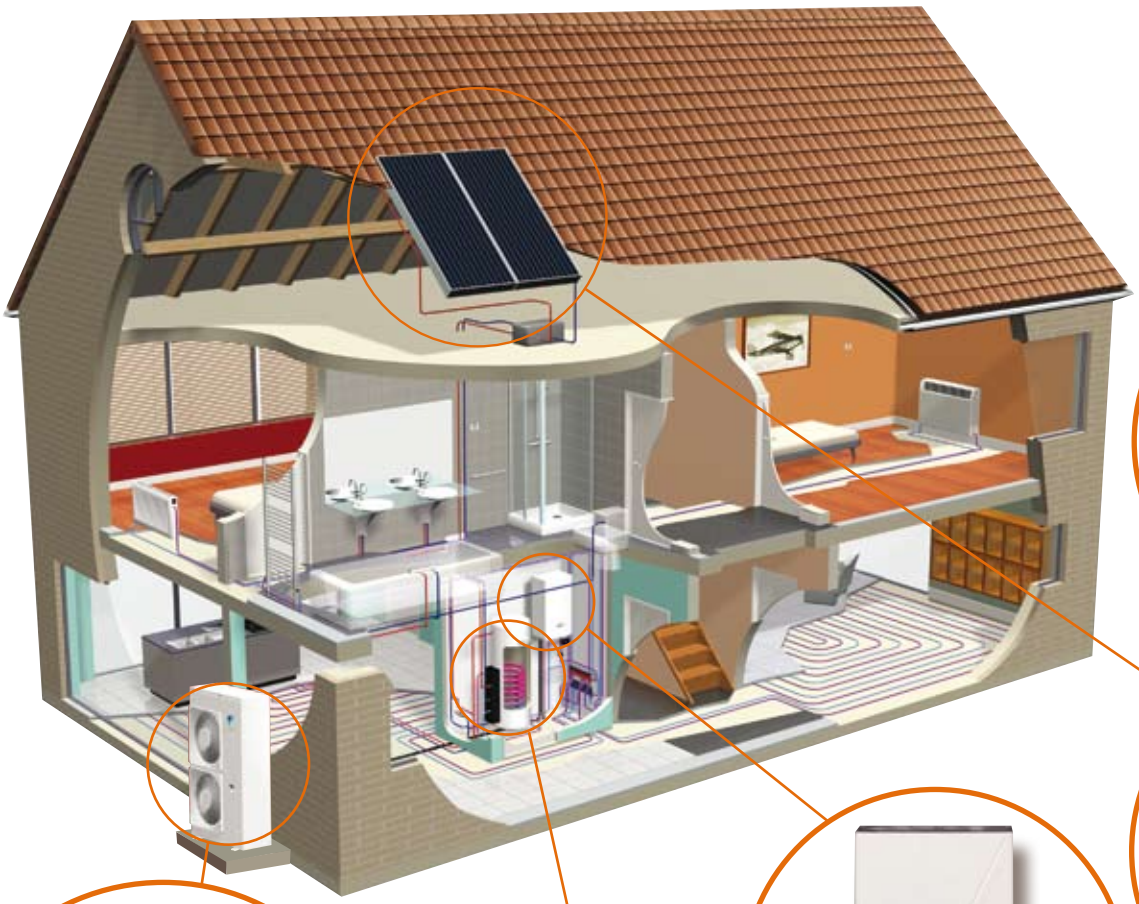
AEHQ6648-00 (01-2012)

DAIKIN

altherma™

All-in-one, all year round heating, cooling and domestic hot water supply solution

HEAT PUMP
INVERTER
R-410A



DAIKIN AC®
absolute comfort

HEAT PUMP SOLUTION TO FIT BOTH NEW BUILD HOMES AND THE HARDER TO HEAT OLDER PROPERTIES

High Quality, Innovative Products

Innovation and quality are constantly at the forefront of Daikin's philosophy. Daikin's systems provide highly efficient solutions, which minimize the impact on the environment and running costs.

Daikin Altherma™ Advantages over Traditional Boiler Systems

- ✓ 30 – 50% reduction in CO_2 emissions
- ✓ Low running and maintenance costs
- ✓ Low noise – unobtrusive and quiet
- ✓ Easy to install, no groundwork i.e. trenches or boreholes
- ✓ Ideal for off gas grid properties
- ✓ Single phase power supply with low starting current
- ✓ Flexible, can be connected to underfloor heating, low temperature radiators or fan coils
- ✓ Advanced Energy Saving Features
  - Outdoor reset built in as standard
  - Inverter Technology
- ✓ Excellent option for net zero home- with thermal solar domestic hot water production and inverter driven compressor compatability with photovoltaic solar.

DID YOU KNOW...

Renewable heating and hot water solutions help save money and also help the environment

3 IN 1 SYSTEM

FOR NEW CONSTRUCTION

& RENOVATION

- MORE COMFORT
- LOW ENERGY CONSUMPTION
- FEWER CO_2 EMISSIONS

DOMESTIC HOT WATER PRODUCTION

1.THE 3 IN 1 GUARANTEE FOR ABSOLUTE COMFORT

Daikin Altherma™ is an innovative system that **heats**, produces **domestic hot water** and can even **cool** spaces. Daikin Altherma offers your customer maximum comfort the whole year through.

These heat pumps are also an interesting alternative for classic gas or fuel oil heating as they offer your customers unique benefits:

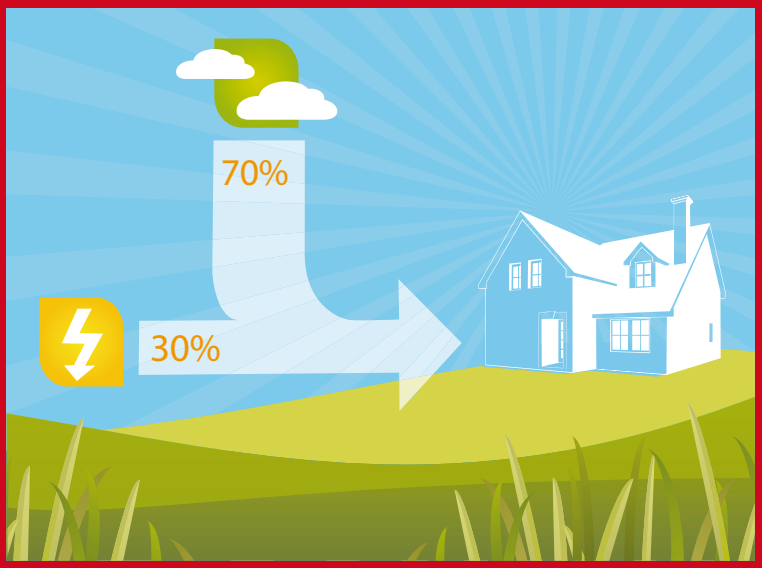
- They use renewable energy sources (such as outside air)
- They deliver considerable savings in energy
- They deliver a significant contribution in the fight against CO_2 emissions
- They can provide heating, cooling and domestic hot water

ENERGY EFFICIENT OPERATION

The air-to-water heat pump from Daikin uses a sustainable energy source. In fact, it extracts heat from the outside air. The system consists of a closed circuit containing R-410A refrigerant. A thermodynamic cycle is created through evaporation, condensation, compression and expansion. A heat pump "pumps" heat from a low to a high temperature level. The heat raised is transferred to the water distribution system (under floor heating, low temperature radiators and/or fan coil units) in the home via a heat exchanger.

Depending on the model and the conditions, a Daikin Altherma air-to-water heat pump delivers between 3 and 5 kWh of usable heat for every 1 kWh of electricity it uses. That's a great ratio from 3:1 - 5:1!

Renovating your heating system and wanting to reduce your energy costs? Interested in a heating solution with lower energy costs? The heat pump is currently the most efficient indoor comfort system on the market: a cutting-edge technology with clear benefits for you and the environment.



DAIKIN HEAT PUMP EXPERIENCE

Daikin has more than 50 years of experience with heat pumps, and supplies more than one million of them to homes, shops and offices each year. This success is not just a quirk of fate: Daikin has always been at the cutting edge of technology and its goal is to provide you with turn-key comfort. Only a market leader can guarantee you this level of service and quality control!

HIGH EFFICIENCY MEANS LOW ENERGY COSTS

Heating system efficiency is measured using the Coefficient of Performance (COP), which is the ratio of heat produced to energy consumed.

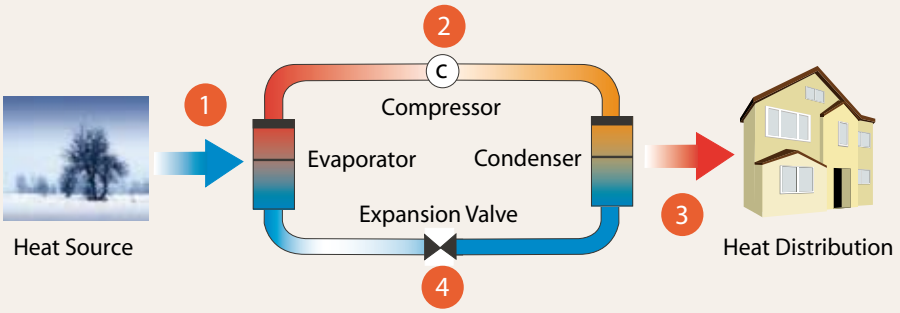
DAIKIN OFFERS THE COMPLETE RENEWABLE SOLUTION FOR HOME HEATING AND HOT WATER

Daikin Altherma™ Benefits for New Construction and Retrofit Installations

- ✓ Cost effective installations
- ✓ Inverter technology and weather compensation as standard
- ✓ Low energy consumption
- ✓ Reduced CO_2 emissions
- ✓ Safe, easy to maintain and comfortable all year round
- ✓ No extensive ground works
- ✓ No Flues, fuel lines or fuel tanks
- ✓ Providing all your heating and hot water needs throughout the year
- ✓ A fully packaged heat pump system – no hidden 'extras'
- ✓ Superior technology ensuring performance is unaffected in a cool climate, infact even as low as -4°F (-20°C)

How Heat Pumps Work

A "Heat Pump" is a mover of heat, utilizing the available renewable heat from the outside air. It works on the same principle as a refrigerator, but in reverse!



1 STAGE ONE

The heat transfer medium (the refrigerant) is colder than the heat source (the outside air). As the outside air passes across the first heat exchanger (the evaporator) the liquid refrigerant absorbs the heat and evaporates.

2 STAGE TWO

The vapor then passes to the compressor and is compressed. When compressed the pressure is increased and the temperature of the vapour rises, effectively concentrating the heat.

3 STAGE THREE

The hot vapor passes to the second heat exchanger (the condenser) where the heat is rejected and the vapor condenses back into a liquid. In the case of Altherma the rejected heat is passed into the water of the central heating and hot water system ready for use in the home.

4 STAGE FOUR

The liquid refrigerant than passes through an expansion valve, reducing its pressure and temperature, ready to start the whole cycle once again.

DID YOU KNOW THAT…

Air source heat pumps provide 3-5kW of energy for every 1kW of electricity used

2.THE BASICS

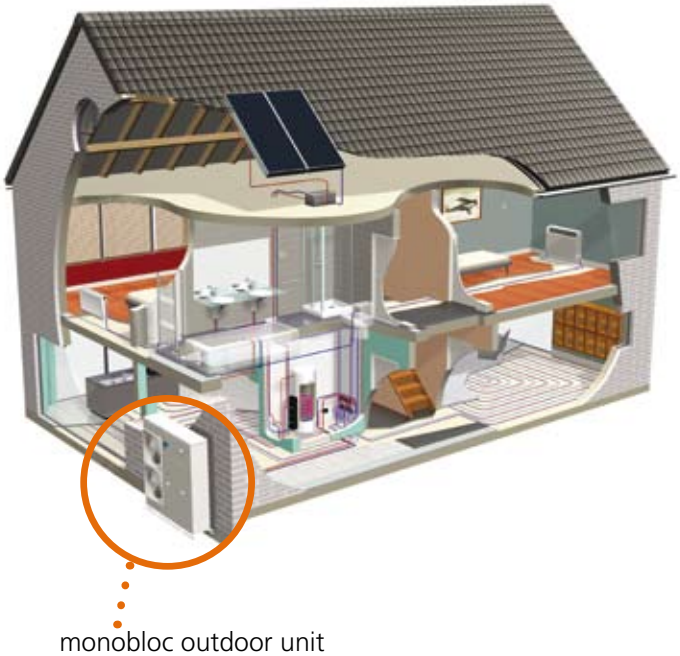
Daikin offers you the choice between a Daikin Altherma™ system with an outdoor unit and indoor unit, or a Daikin Altherma™ Monobloc System, in which the hydrobox components are located within the outdoor unit. The Daikin Altherma™ is a low temperature heating system optimized to work with radiant floor heating.

	DAIKIN ALTHERMA™ SPLIT TYPE
Application	Heating and (optional) cooling (+ domestic hot water)  outdoor and indoor unit
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.

	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.

THE BASICS

AIR-TO-WATER HEAT PUMP

The system consists of 5 components which work 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.

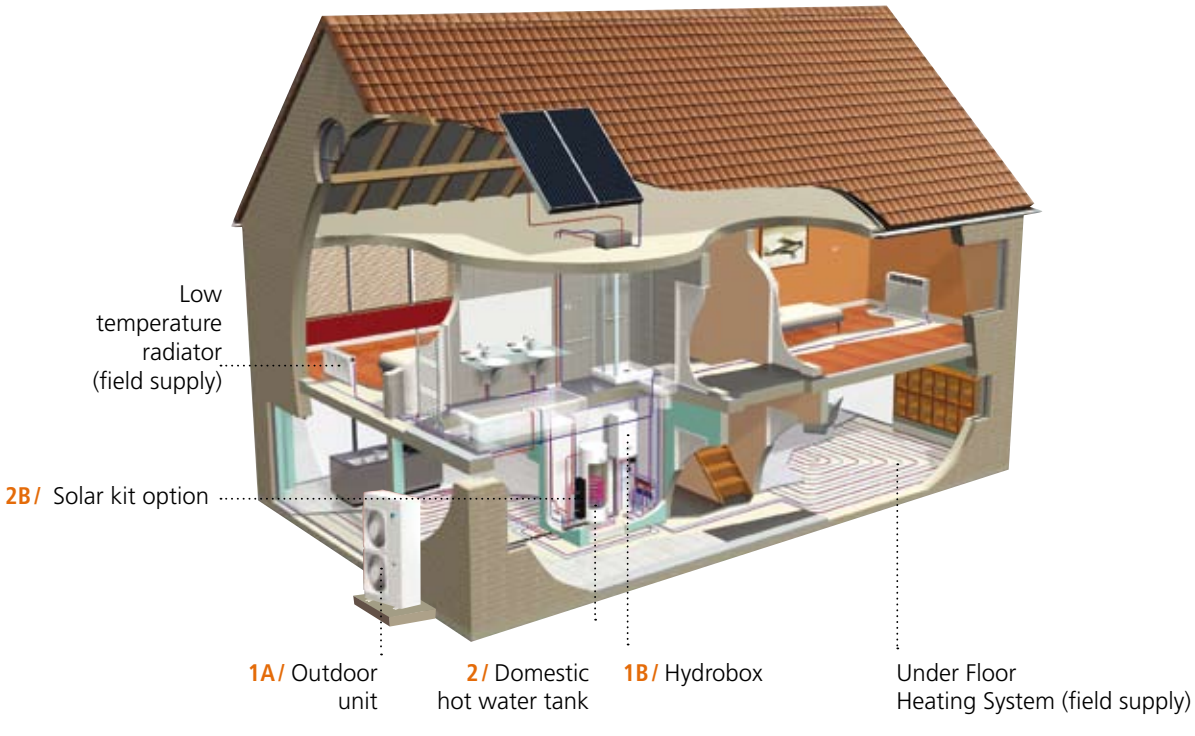
1B / HYDROBOX : THE HEART OF THE DAIKIN ALTHERMA™ SYSTEM

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.

1A / USING HEAT PUMP TECHNOLOGY
2B / WITH SOLAR KIT OPTION



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 CONNECTION KIT

Averaged over an entire year, the sun delivers half of the energy we need to bring our domestic water up to the desired temperature for free. Your customer can use this free solar energy by connecting a solar boiler to his Daikin Altherma system. A solar boiler is a thermal solar-energy system whereby solar rays are transformed into heat. The heat is then stored in a water supply tank.

4A / SOLAR COLLECTOR PANEL (FIELD SUPPLY)

The high-efficiency collectors transfer all the short-wave solar radiation into heat as a result of their highly selective coating. The collectors can be mounted on the roof tiles.

4B / SOLAR PUMP STATION (FIELD SUPPLY)

Typical pump stations are equipped with safety valve, pressure gauge and connection for expansion vessel, and flow and return temperature indication. A digital temperature difference controller with plain text is also included. The Solar yield (kWh) is measured by a sensor. Pump speed is controlled by the solar intensity to ensure maximum efficiency. The heat pump is disabled during solar heating as solar energy gets the first priority, which ensures system protection and maximum efficiency.

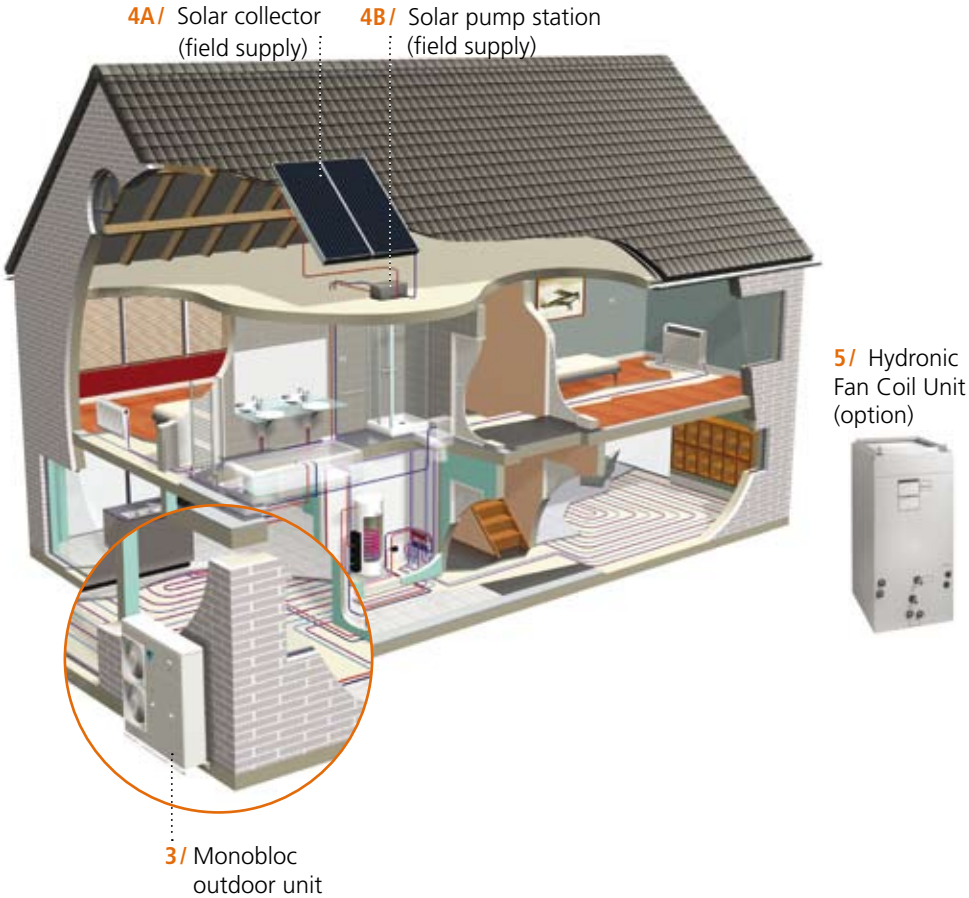
5 / HYDRONIC FAN COIL UNIT (OPTION)

For Hydro-Air or traditional forced air applications, the high efficiency hydronic fan coil unit can be used to meet your comfort needs.

6 / ROOM THERMOSTAT

With the wired room thermostat, the ideal temperature can be easily, quickly and conveniently regulated.

6



1 - DAIKIN ALTHERMA™ SPLIT TYPE AIR-TO-WATER HEAT PUMP

THE OUTDOOR UNIT

- Compact, weather-resistant and easy to install
- Contains an inverter controlled compressor for energy efficiency and precise temperature regulation
- Heat pump operation range: heating and domestic hot water to -4°F (-20°C) outside temperature

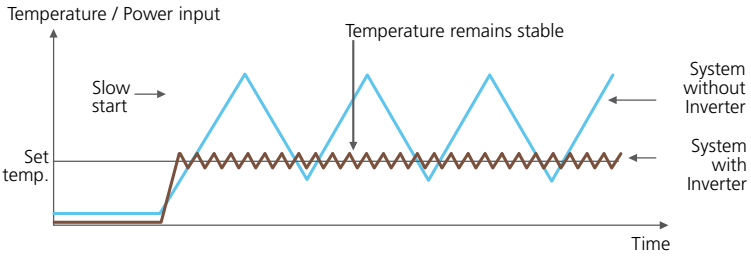
HEAT EXCHANGER ANTI-CORROSION TREATMENT

As standard, the heat exchanger in the outdoor unit is provided with an anti-corrosion treatment. This treatment guarantees and noticeably increases the resistance against acid rain and salt corrosion.

SUPER PERFORMANCE THANKS TO THE INVERTER PRINCIPLE

The coefficient of performance (COP) of the Daikin Altherma heat pump is also largely attributable to the Daikin inverter principle. An integrated frequency-converter adjusts the rotational speed of the compressor to suit the heating demand. Therefore, the system seldom operates at full capacity and your customer only pays for the energy which they actually need.

Heating operation:



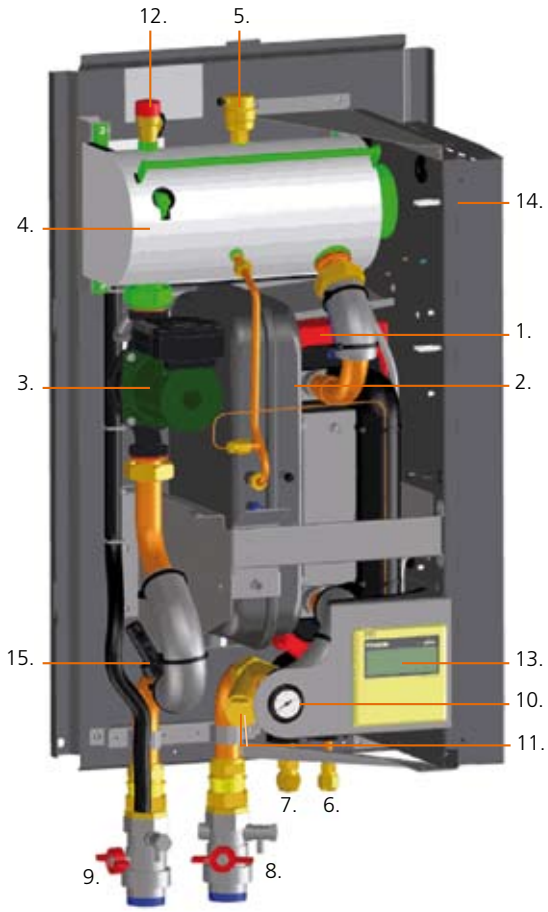
HIGH EFFICIENCY COMPRESSORS:

The **scroll-compressors** are designed as a compact, robust, low-noise device to guarantee optimal operational reliability (no valves and built-in swing-link coupling) and efficiency (through a low initial flow and a constant compression ratio). It uses Pulse Width Modulation (PWM) Technology.

The **swing-compressors** have been setting trends in the area of energy efficient performance for the past 10 years (leaks and friction are basically non-existent). The design of the swing compressor reduces friction during operation for smoother and quieter rotation with less vibration resulting in a more durable compressor. It also minimizes the leakage of refrigerant gas during compression. The result is a system that operates quietly and efficiently. It uses Pulse Amplitude Modulation (PAM) Technology. The PAM Control reduces energy loss by controlling how often the converter switches on and off.

HYDROBOX

- Available in two versions: EKHBH for heating only, EKHBX for heating and cooling
- Built-in electric back-up heater for additional heating during extremely cold outdoor temperatures or as back-up in case of problems with the outdoor unit
- 2 shut-off valves to assemble the water outlet and inlet
- Compact and easy to install: all components are pre-assembled, all parts are easy to reach for maintenance. Wall-mounting is comparable to a traditional gas heater.



1. Heat exchanger
2. Expansion tank (2.64 gal.)
3. Circulator
4. Tank with back-up heating
5. Air purge valve
6. Refrigerant liquid connection
7. Refrigerant gas connection
8. Water inlet connection
9. Water outlet connection
10. Pressure gauge (water circuit)
11. Water filter
12. Pressure relief valve
13. User interface
14. Switch box
15. Flow switch

EXTRA POSSIBILITIES THANKS TO THE INDOOR UNIT…

Heating and Cooling

If you choose Daikin Altherma with an indoor unit EKHBX, it can not only heat the house, but also cool it. The heat pump is then equipped with a reversible 4-way valve, whereby the refrigeration cycle is reversed and heat is removed from the rooms. The indoor unit can cool rooms via under floor cooling or fan coil units.

Set temperature limits

To prevent incorrect manual adjustments, temperature limits can be implemented for both cooling and heating. With under floor heating, for example, it is important that the temperature of the water is controlled to the type of floor element. To prevent condensation problems, the temperature for floor cooling can never be lower than 64.4°F (18°C). For fan coil units, the water temperature can be allowed to decrease to 41°F (5°C).

THE USER INTERFACE

With the easy to reach digital user interface in the indoor unit, controlling the Daikin Altherma system is also simple for your customer. The display offers a great deal of useful information:

- Day of the week
- Time
- Operating mode
  (heating or cooling, heating domestic hot water, low-noise operating outdoor unit)
- Compressor operation
- Pump operation
- Back-up operation
- Booster heating operation
  (in the hot water tank)
- Error codes for alarm
- Temperature
  (outdoor temperature, temperature in hot water tank, leaving water temperature at indoor unit exit)

DID YOU KNOW...

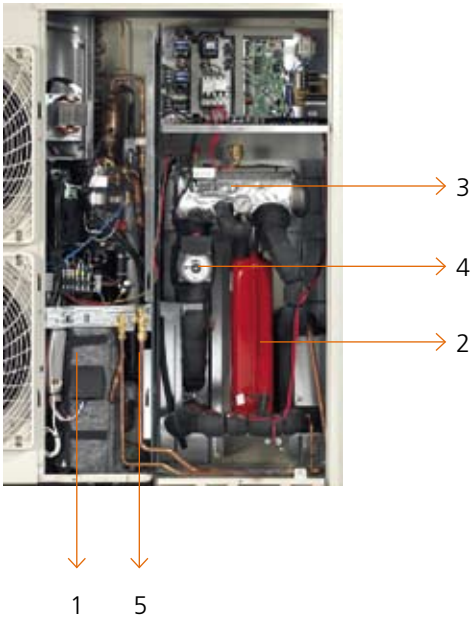
Your customer can select a maximum of five time periods each day during which the following functions will or will not be activated:

- Low-noise operation of the outdoor unit
- Electric booster heater in the hot water tank
- Heating of the domestic water
- Reduction of the water temperature

The five time periods per function are repeated daily. Your customer can still manually adjust the system when he stays home unexpectedly or stays up later. These settings are automatically switched off at the next programmed event.

2 - DAIKIN ALTHERMA™ MONOBLOC AIR-TO-WATER HEAT PUMP

- All hydronic parts are located within the outdoor unit
- H_2O piping between outdoor unit and indoor heating apparatus



1. High efficiency compressor
2. Expansion tank
3. Tank with back up heating
4. Pressure gauge (water circuit)
5. Refrigerant connection

DID YOU KNOW…

In order to protect the water pipes from freezing up during winter, insulation is provided for all hydronic components and special software has been applied to activate the pump and back-up heater if necessary. This prevents the water temperature from dropping below freezing point and can minimize the need for the addition of glycol to the water pipes.

- **The Daikin Altherma™ monobloc is available in different versions**
  - heating only or heating and cooling
  - with bottom plate heater
  - single phase
  - 35MBH, 48MBH, or 54MBH

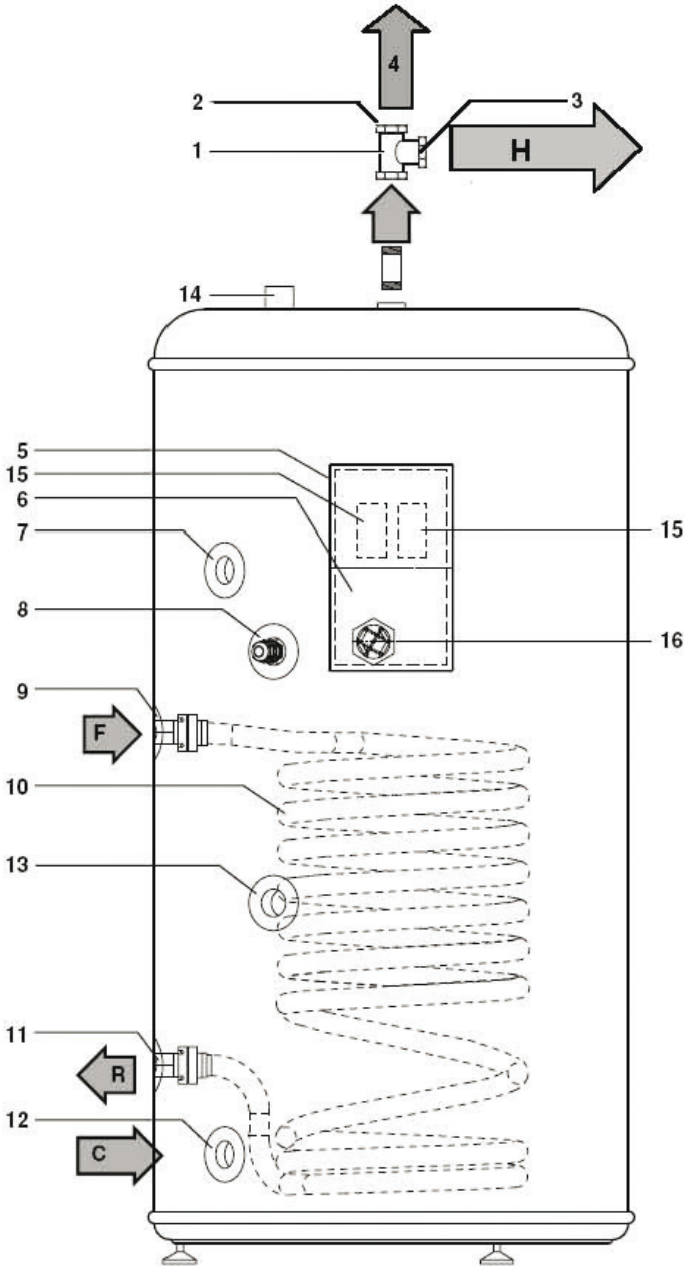
- **Built-in electric back-up heater** for additional heating during extremely cold outdoor temperatures. The Daikin Altherma Monobloc is standard equipped with a 6 kW back-up heater, which can be adjusted to 3 kW.

  If necessary, an "in line" back-up heater of 6 kW can be mounted indoors (also adjustable to 3 kW or 3.5 kW)

- The **scroll-compressors** provided are designed as a compact, robust, low-noise device to guarantee optimal operational reliability (no valves and built-in swing-link coupling) and efficiency (through a low initial flow and a constant compression ratio).

3 - THE DOMESTIC HOT WATER TANK

- Available in 2 capacities: 50 and 80 gallons for floor mounted installation.
- Stainless steel design.
- 1 37/64" cfc-free insulation material (polyurethane).
- Contains 2 heating elements: a heat exchanger at the bottom where the hot water from the hydrobox circulates and an extra 3 kW electric heater at the top.
- A thermistor in the hot water tank controls a 3-way valve and/or booster heater via the hydrobox.



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 main unit)
10. Heat exchanger coil
11. Return outlet connection (R) (to main unit)
12. Cold water connection (C)
13. Threaded thermistor hole for use with solar kit option. (Refer to the Installation manual EKSOLHWBAVJU).
14. Temperature and pressure relief valve connection
15. Thermal protectors (Q2L, Q3L)
16. Booster heater

Flow direction

MULTIFUNCTIONAL HOT WATER TANK …

- **Stainless steel**

  Daikin offers a tank made of stainless steel equipped with a sacrificial rod to protect the tank against corrosion.

- **Anti-bacteria function**

  To prevent the development of bacteria, the hot water tank is equipped with an anti-bacteria function. You can set up the program so the water is heated to a specific temperature (standard setting = 158°F (70°C) at a set time on one or more days of the week.

- **Flexible control**

  It is possible to set "priority setting" for the production of domestic hot water. In this way the customer has domestic hot water available at any time of the day.

  The heating of the domestic hot water can also be set up according to the night tarif. Another opportunity for rational energy consumption.

- **Regulating switch-on and shut-off temperatures**

  You personally set the minimum and maximum temperature when the water in the tank must be heated by the heat pump for the customer.

- **Delaying booster heater switch-off**

  To prevent the booster heater from switching on and off too often, you can allow the system to switch off as soon as the temperature reaches a maximum of 39°F (22°C) higher than the set temperature.

- **Allowing back-up heater and booster heater to work separately**

  Programming the system to prevent the simultaneous operation of the back-up heater and the booster heater is also possible. An interesting possibility for homes with a limited current amp load!

- No natural gas or fuel oil connection or exhaust fume channel required.

DID YOU KNOW…

Your customers with a solar boiler can enjoy wonderful hot water at any time, even when the sun is not shining? An integrated re-heater is included in the system to help the sun on cloudy days.

4 - SOLAR CONNECTION

SOLAR THERMAL BOILER

Averaged over an entire year, the sun delivers half of the energy we need to bring our domestic water up to the desired temperature for free. Your customer can use this solar energy by connecting a solar boiler to the Daikin Altherma system. A solar boiler is a thermal solar-energy system, whereby solar rays are transformed into heat. The heat is then stored in a water supply tank.

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.

SOLAR THERMAL SYSTEM

High-efficiency collectors transfer all the short-wave solar radiation into heat as a result of their highly selective coating. The collectors can be mounted on the roof tiles. The solar kit controller and 3rd party pump station provide the transfer of solar heat to the Daikin Altherma domestic 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.

Daikin Altherma™ when used with a solar thermal package

- Solar collector (field supply)
- Plumbing network and solar pump station (field supply)
- Supply tank: standard Daikin Altherma™ domestic hot water tank
- Solar kit
- Auxiliary (Daikin Altherma™ heat pump unit, which also provides the home with heating)

1. Solar collector (Flat plate collector) (field supply)

2. Hydrobox

3. Domestic Hot Water Tank

4. Solar kit

5. Solar pump station (field supply)

5 - HYDRONIC FAN COIL UNIT

The Hydronic Fan Coil Unit has been engineered to provide an effective solution in combination with the "Low Temperature" Daikin Altherma system. High efficiency and comfort are delivered and allow your application to blend into the environment using the traditional ductwork for Heating and Cooling air distribution.

- Single A-Coil configured for Hydronic Heating and Cooling Operation
- ECM fan motor for improved sound levels and energy savings
- Flexible installation with Upflow, Horizontal L and Horizontal R configuration possible
- Factory installed MERV 8 Filter for cleaner indoor air (throwaway type)
- Minimal cabinet dimensions with 1/2" TUF-SKIN Cabinet Insulation
- Option electric heat integrated fan coil units also available

6 - THE ROOM THERMOSTAT

The large LCD screen on the room thermostat indicates all the necessary information regarding the setting of the Daikin Altherma system in a blink of an eye. The user can also easily navigate between the different menus whose most common functions and modes include:

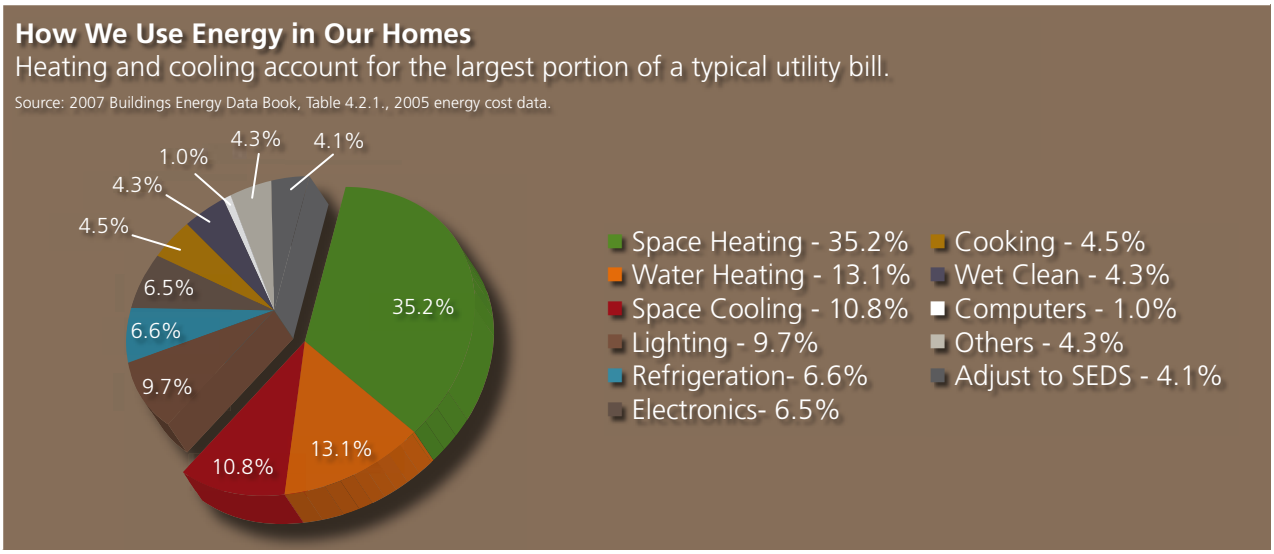
- Setting the temperature of the room based on measurements from the built-in sensor
- Cooling and heating mode
- Off function (with integrated frost-protection function)
- Vacation function mode
- Comfort and reduced function modes
- Time (day and month)
- Programmable weekly timer with 2 standard and 5 pre-set programs
- Keylock function
- Setting limits. The installer can change the upper and lower limits

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	✓

DID YOU KNOW THAT…

Daikin has set up a number of monitoring sites (in Europe, Oregon, New Hampshire, Alaska, ...), where Daikin Altherma has been tested under totally different climate conditions. High satisfaction has been achieved with increased comfort, stable indoor temperature, low energy consumption and hot water always available... whatever the weather conditions at the monitoring site.

4.ECONOMICALLY



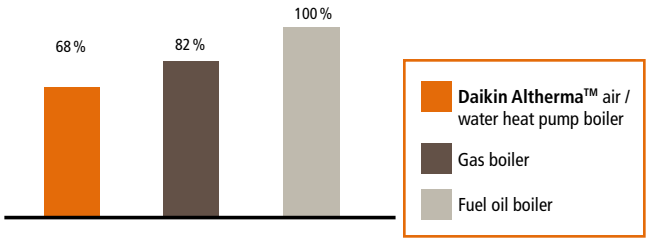
- Customers today are, more than ever, conscious of the cost of heating.
- There is not only the increasing cost of fuel oil and natural gas, but also the limited supply of fossil fuels and the problem of CO_2 emissions.
- Energy efficient heating solutions are gaining in popularity.
- Daikin Altherma™ debuted in Europe in 2006 and since then has demonstrated significant economical advantages over traditional systems as highlighted on the following graphics:

1. 66 To 80% Additional Heat

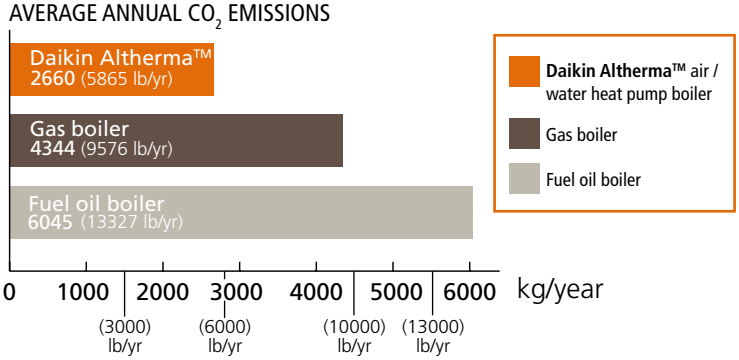
A heat pump boiler works more efficiently and saves more energy than a traditional heating system using fossil fuel. Daikin Altherma™ generates at least 3 to 5 kW of additional heat per 1kW of electricity used. Talk about a good investment.

OPERATING COSTS:

Conditions: Required annual heating energy: 20,000 kWh. Source: Energy prices based on EUROSTAT statistics [first semester 2007].



AVERAGE ANNUAL CO_2 EMISSIONS



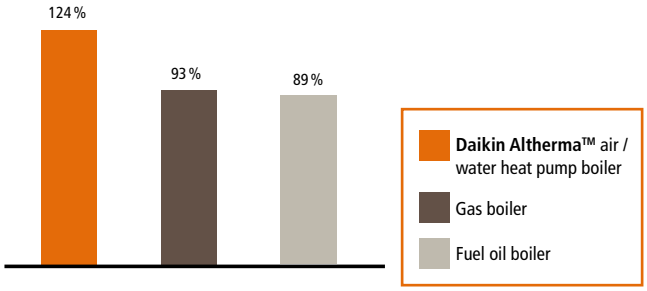
Calculation based on data from Eurelectric (organization of European electricity producers), "Eurelec Progam - 2001" for EU27

2. PER (primary energy ratio)

This is the relationship between the useable energy generated and the primary energy consumed, with consideration for the electricity production efficiency and the electricity distribution.

LOW PRIMARY ENERGY CONSUMPTION

Conditions : For combustion systems, the PER indicates the overall efficiency of the system, while for heat pumps it is equal to the seasonal performance factor multiplied by the electricity production efficiency which on average is 0.4 in the European Union.



LOWER CO_2 EMISSIONS

Daikin Altherma produces no direct CO_2 emissions, so you personally contribute to a better environment. The system does use electricity, but even without renewable electricity the CO_2 emissions are still much lower than boilers that use fossil fuels.

5.APPLICATIONS

DESIGN STEP 1 — Define the leaving water temperature range of the necessary heat emitters and the heat load.

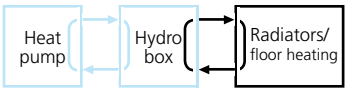
DESIGN STEP 2 — Calculation of heat losses (Transmission and ventilation losses)

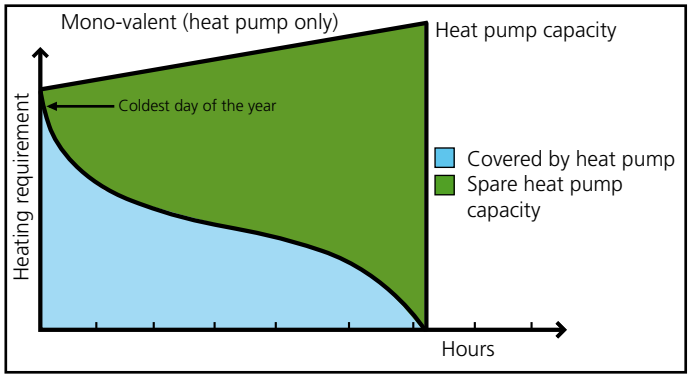
DESIGN STEP 3 — Selection of the Daikin Altherma™ system based on heat loss calculation.
Tip: Use the available Daikin Altherma™ selection and software tools.

DAIKIN ALTHERMA™ SYSTEM CONFIGURATIONS

MONO-VALENT

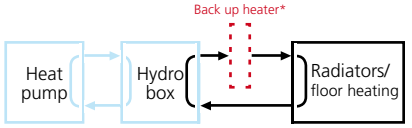
- Uses heat pump energy only
- Ideal for new construction
- 100% heat pump coverage: selection of bigger capacity and higher investment cost heat pump

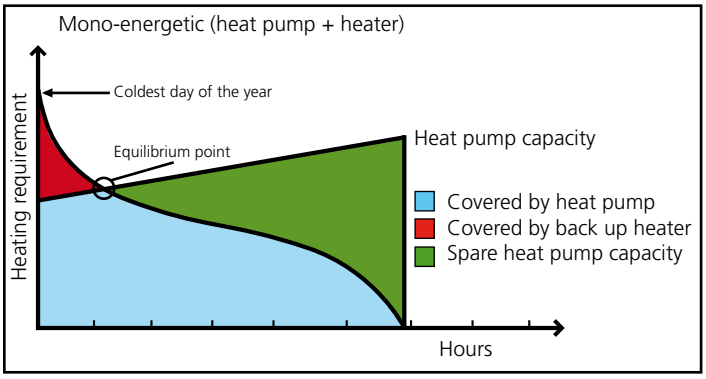




MONO-ENERGETIC

- Uses heat pump energy with backup electric heater
- Ideal for new construction
- Best balance between investment cost and running cost, results in lowest lifecycle cost

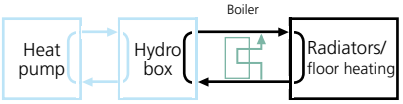


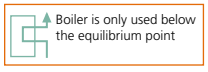


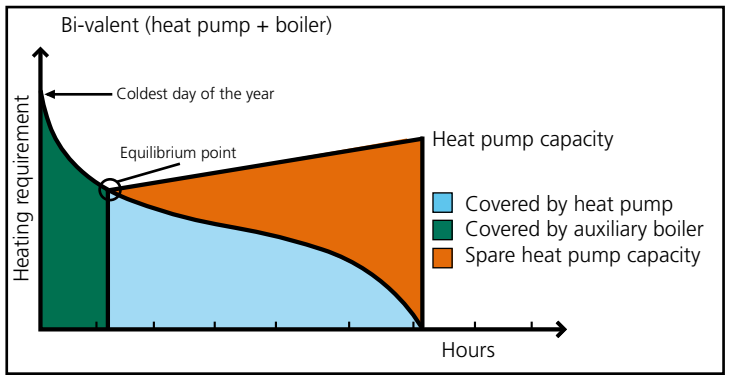
*Back up heater is mounted inside the hydrobox

BI-VALENT

- Uses heat pump energy with auxiliary boiler
- Ideal for refurbishment/upgrade





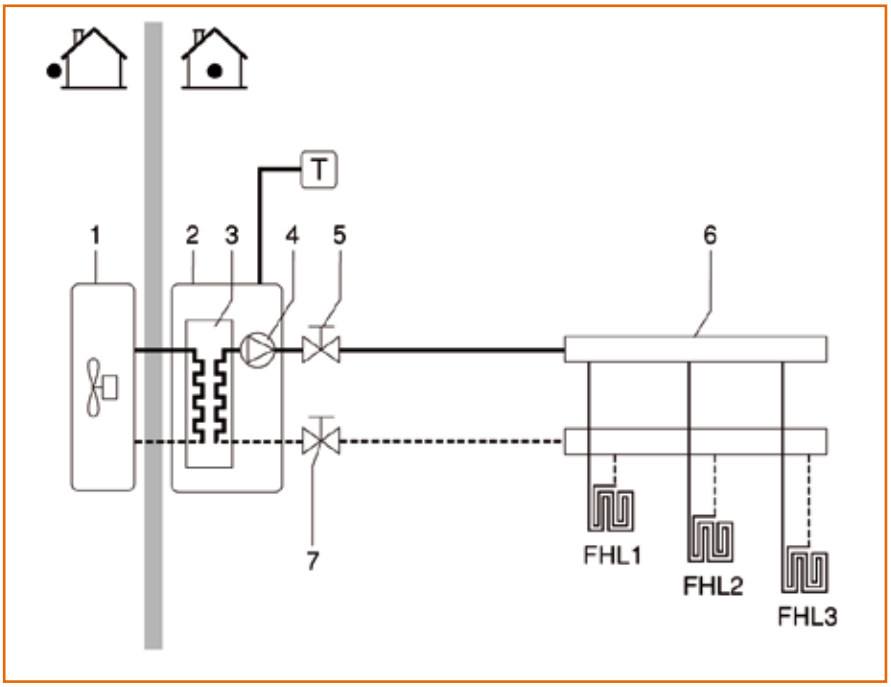


SPACE HEATING WITH AN AUXILIARY BOILER

1. Space heating application by either the Daikin Altherma™ Hydrobox or by an auxiliary boiler connected in the system.
2. An auxiliary contact decides whether the Hydrobox or the boiler will operate.
3. The auxiliary contact can be an outdoor temperature thermostat, an electricity tariff contact, a manually operated contact, etc...
4. Domestic hot water in such an application is always produced by the system tank connected to the Hydrobox, including when the boiler is in operation for space heating.

DAIKIN ALTHERMA™ SPLIT TYPE APPLICATIONS

1. Application “heating only” with a room thermostat connected to the indoor unit

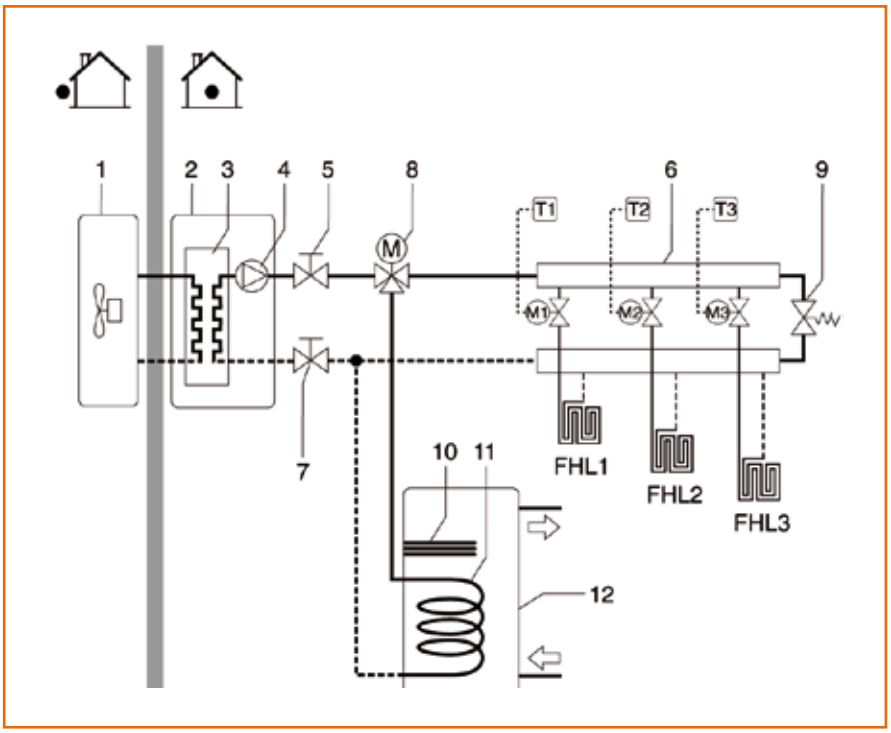


1. Outdoor unit
2. Hydrobox
3. Heat exchanger
4. Pump
5. Valve
6. Manifold (field supply)
7. Valve

FHL1…3 (Under) floor heating loop (field supply)
T Room thermostat

2. Application “heating” and “production of domestic hot water”

The temperature in each room is regulated by a valve on every water circuit. Hot water for domestic use is delivered by the domestic hot water tank connected to the indoor unit.

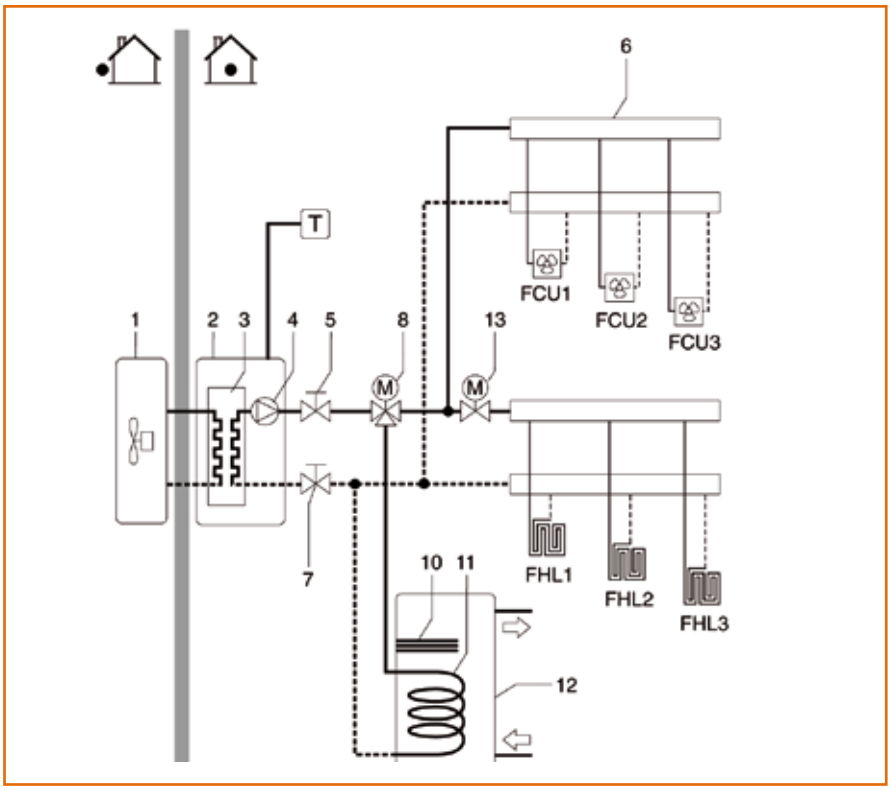


1. Outdoor unit
2. Hydrobox
3. Heat exchanger
4. Pump
5. Valve
6. Manifold (field supply)
7. Valve
8. Motorized 3-way valve
9. Pressure relief valve
10. Booster heater
11. Heat exchanger spiral
12. Tank for domestic hot water

FHL1…3 (Under) floor heating loop (field supply)
T 1…3 Individual room thermostat

3. Application “heating/cooling” via room thermostat and “production of domestic hot water”

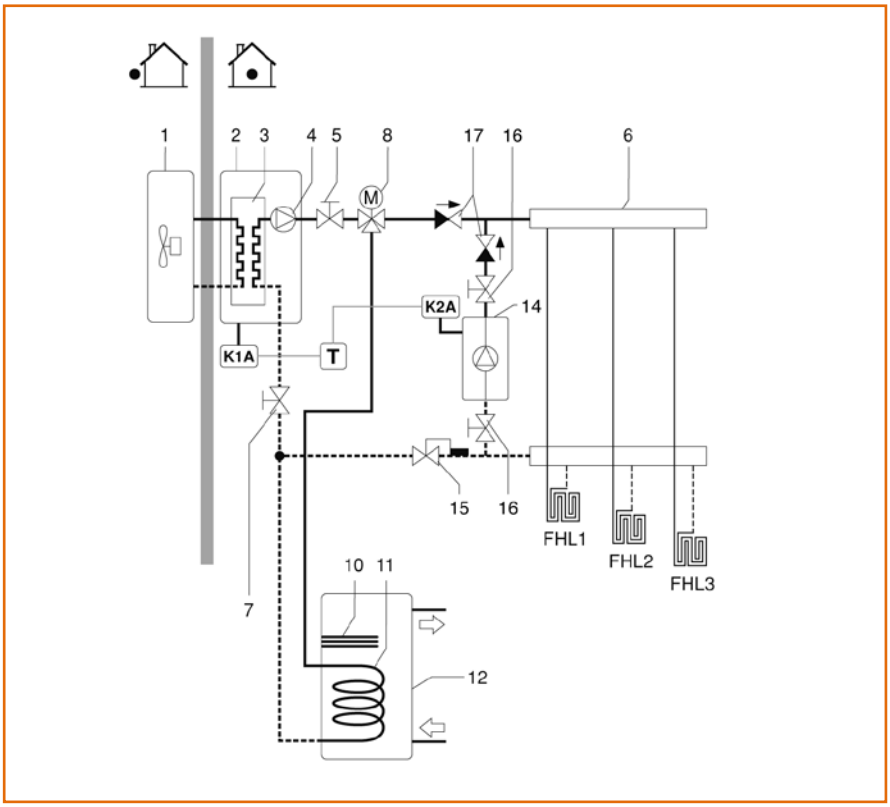
Heating using under floor heating loops and fan coil units. Cooling using only the fan coil units.
Hot water for domestic use is delivered by the domestic hot water tank connected to the indoor unit.



1. Outdoor unit
2. Hydrobox
3. Heat exchanger
4. Pump
5. Valve
6. Manifold (field supply)
7. Valve
8. Motorized 3-way valve
10. Booster heater
11. Heat exchanger spiral
12. Tank for domestic hot water
13. Motorized 2-way valve (field supply)

FCU1…3 Fan coil unit (field supply)
FHL1…3 (Under) floor heating loop (field supply)
T Room thermostat with cooling / heating switch

4. Bi-valent application

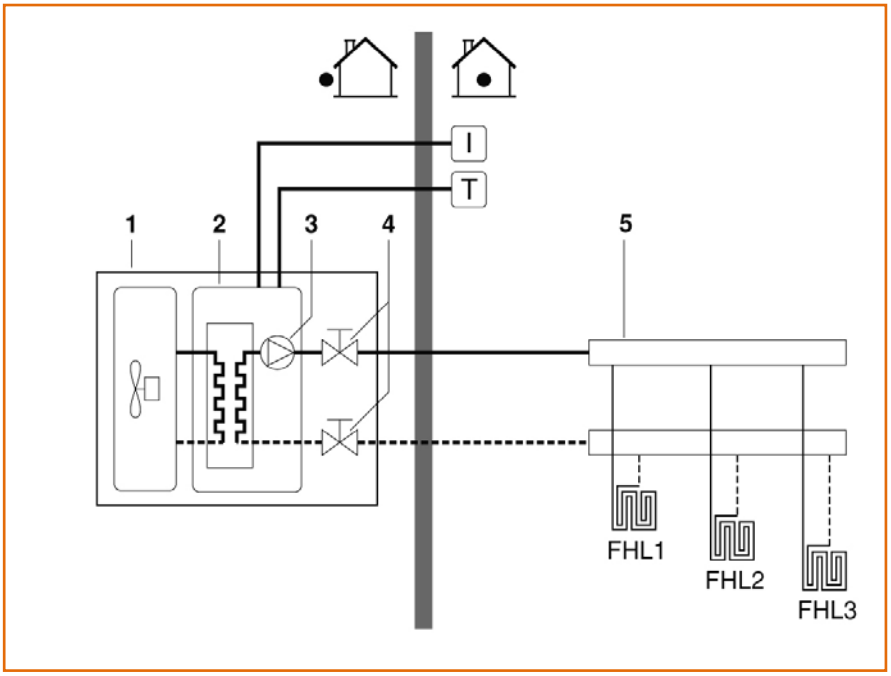


1. Outdoor unit
2. Hydrobox
3. Heat exchanger
4. Pump
5. Valve
6. Manifold (field supply)
7. Valve
8. Motorized 3-way valve
10. Booster heater
11. Heat exchanger spiral
12. Tank for domestic hot water
14. Alternate heating device (field supply)
15. Aquastat (field supply)
16. Valve (field supply)
17. One-way valve (field supply)

FHL1…3 (Under) floor heating loop (field supply)
K1A Relay for activating EKHB*unit (field supply)
K2A Relay for activating hot water tank (field supply)
T Room thermostat

DAIKIN ALTHERMA™ MONOBLOC APPLICATIONS

1. Application “heating only” with a room thermostat connected to the indoor unit

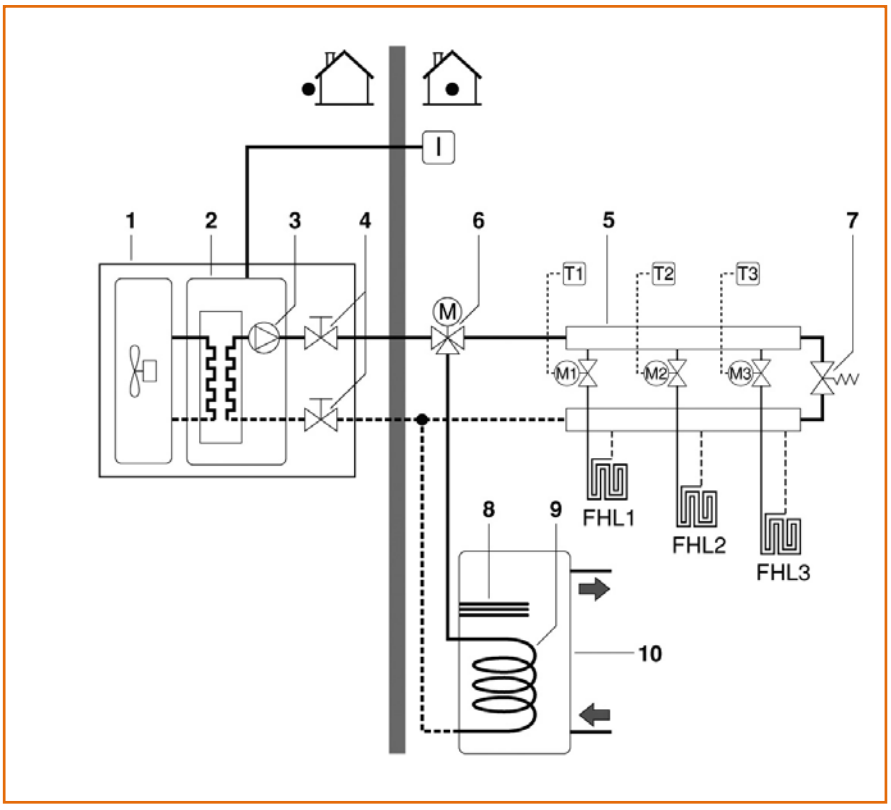


1. Unit
2. Heat exchanger
3. Pump
4. Shut-off valve
5. Collector (field supply)

FHL1…3 Floor heating loop (field supply)
T Room thermostat (field supply)
I User interface

2. Application “heating” and “production of domestic hot water”

The temperature in each room is regulated by a valve on every water circuit. Hot water for domestic use is delivered by the domestic hot water tank connected to the unit.

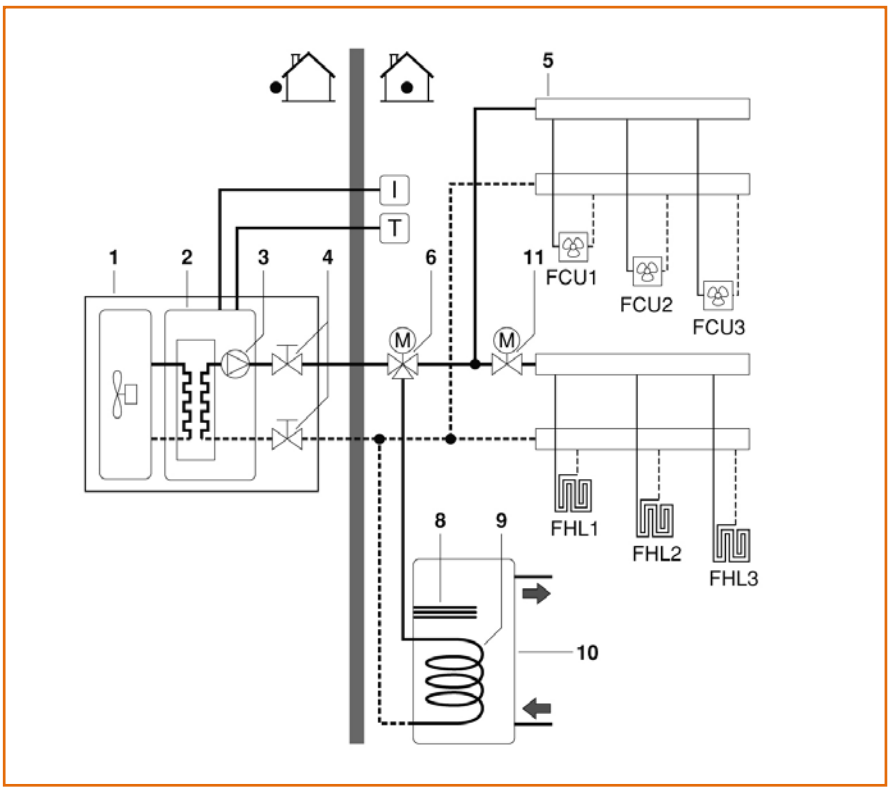


1. Unit
2. Heat exchanger
3. Pump
4. Shut-off valve
5. Collector (field supply)
6. Motorized 3-way valve
7. By-pass valve (field supply)
8. Booster heater
9. Heat exchanger coil
10. Domestic hot water tank

FHL1…3 Floor heating loop (field supply)
T 1…3 Individual room thermostat (field supply)
M 1…3 Individual motorized valve to control loop FHL1 (field supply)
I User interface

3. Application “heating/cooling” via room thermostat and “production of domestic hot water”

Heating using under floor heating loops and fan coil units. Cooling using only the fan coil units.
Hot water for domestic use is delivered by the domestic hot water tank connected to the unit.

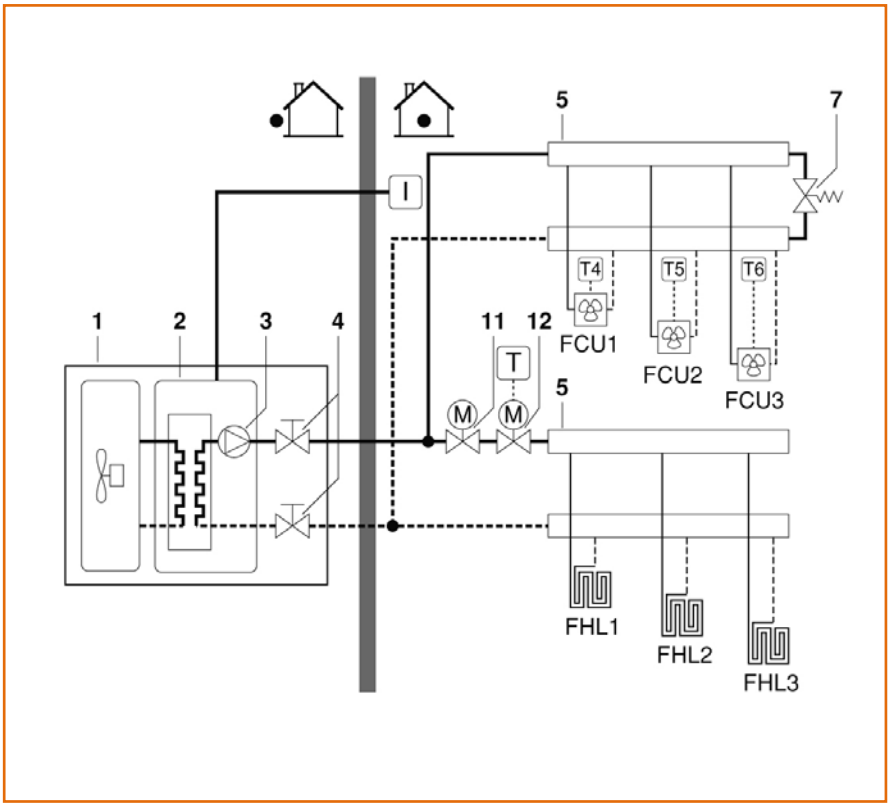


1. Unit
2. Heat exchanger
3. Pump
4. Shut-off valve
5. Collector (field supply)
6. Motorized 3-way valve
8. Booster heater
9. Heat exchanger coil
10. Domestic hot water tank
11. Motorized 2-way valve (field supply)

FCU1…3	Fan coil unit (field supply)
FHL1…3	Floor heating loop (field supply)
T	Room thermostat with cooling/heating switch (field supply)
I	User interface

4. Application “heating/cooling” without a room thermostat

but with a heating only room thermostat controlling the underfloor heating and a cooling/heating thermostat controlling the fan coil units.



1. Unit
2. Heat exchanger
3. Pump
4. Shut-off valve
5. Collector (field supply)
6. By-pass valve (field supply)
11. Motorized 2-way valve to shut off the floor heating loops during cooling operation (field supply)
12. Motorized 2-way valve for activation of the room thermostat (field supply)

FCU1…3	Fan coil unit with thermostat (field supply)
FHL1…3	Floor heating loop (field supply)
T	Heating only room thermostat (field supply)
T4..6	Individual room thermostat for fan coil heated/cooled room (field supply)
I	User interface

6.TECHNICAL SPECIFICATIONS

OUTDOOR SPLIT TYPE

ERLQ018/024/030BAVJU

ERLQ036/048/054BAVJU

OUTDOOR UNIT

				ERLQ018BAVJU	ERLQ024BAVJU	ERLQ030BAVJU	ERLQ036BAVJU	ERLQ048BAVJU	ERLQ054BAVJU
Nominal capacity (1)		Heating	Btu/hr	19,620	23,340	28,760	38,200	47,800	54,600
		Cooling	Btu/hr	24,570	27,840	28,560	47,600	59,100	60,600
Nominal input (1)		Heating	kW	1.35	1.66	2.21	2.58	3.30	3.97
		Cooling	kW	2.36	2.87	3.06	3.91	5.94	6.94
COP				4.25	4.12	3.81	4.34	4.24	4.03
EER				10.41	9.7	9.33	12.17	9.95	8.73
Fan	Motor	Model		Brushless DC motor			Brushless DC motor		
		Output	W	53			70		
Operation range		Heating	°F (°C)	-4 - 77 (-20 - 25)			-4 - 95 (-20 - 35)		
		Cooling	°F (°C)	50 - 110 (10 - 43)			50 - 114.8 (10 - 46)		
		Domestic water	°F (°C)	-4 - 110 (-20 - 43)*			-4 - 109.4* (-20 - 43)		
Sound power level		Heating	dBA	61	61	62	64	64	66
		Cooling	dBA	63	63	63	64	66	69
Sound pressure level		Heating	dBA	48	48	49	49	51	53
		Cooling	dBA	48	48	50	50	52	54
Air Flow Rate (nominal at 230V) (cfm)		Heating	m³/min	N/A	N/A	N/A	3178	3178	3178
		Cooling	m³/min	N/A	N/A	N/A	3390	3531	3425
Piping connections	Liquid (OD)	Type		Flare connection			Flare connection		
		Diameter (OD)	in.	ø 1/4	ø 1/4	ø 1/4	ø 3/8	ø 3/8	ø 3/8
	Gas	Type	in.	Flare connection			Flare connection		
		Diameter (OD)	in.	ø 5/8	ø 5/8	ø 5/8	ø 5/8	ø 5/8	ø 5/8
	Drain	Type	in.	Socket			Hole		
		Diameter (OD)	in.	ø 7/10	ø 7/10	ø 7/10	ø 1-1/32	ø 1-1/32	ø 1-1/32
	Piping Length	Minimum	ft.	10	10	10	16.4	16.4	16.4
		Maximum	ft.	98	98	98	246	246	246
		Equivalent	ft.	-	-	-	312	312	312
		Chargeless	ft.	33	33	33	98.4	98.4	98.4
	Installation Height Difference	Maximum	ft.	66	66	66	98.4	98.4	98.4
Refrigerant charge	Charge	R-410A	lbs.	3.75			8.15		
	Additional		oz./ft.	0.21			Refer to chart in installation instructions		
Power supply				208-230V/1Ph/60Hz			208-230V/1Ph/60Hz		
Minimum Circuit Amps (MCA)			A	18	18	18	26.5	26.5	26.5
Maximum Overcurrent Protection (MOP)			A	20	20	20	30	30	30
Dimensions (Net)		HxWxD	in.	28 9/10 x 32 1/2 x 11 8/10			46 1/16 x 35 7/16 x 12 5/8		
Weight		Net	lbs.	123	123	123	227	227	227
		Gross	lbs.	134	134	134	251.3	251.3	251.3

Measuring conditions: Heating Ta DB/WB 44.6°F/42.8°F (7/6°C) - LWC 95°F (35°C) (DT=9°F (5°C)
- Cooling Ta 95°F (35°C) - LWE 64.4°F (18°C) (DT=9°F (5°C)
* Booster heater operation from 95°F (35°C) onwards
(1) These conditions are based on under floor heating/cooling application

OUTDOOR MONOBLOC TYPE

OUTDOOR UNIT

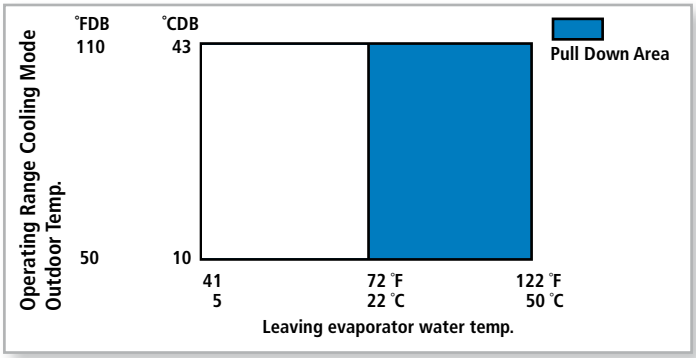
				HEATING ONLY			REVERSIBLE		
SINGLE PHASE	With bottom plate heater			**EDLQ036BA6VJU**	**EDLQ048BA6VJU**	**EDLQ054BA6VJU**	**EBLQ036BA6VJU**	**EBLQ048BA6VJU**	**EBLQ054BA6VJU**
Nominal capacity (3)		Heating	Btu/hr	38,200	47,700	54,600	38,200	47,700	54,600
		Cooling	Btu/hr	-	-	-	43,800	54,500	57,000
Nominal input (3)		Heating	kW	2.47	3.33	3.93	2.53	3.33	3.93
		Cooling	kW	-	-	-	3.91	5.79	6.43
COP				4.32	4.2	4.07	4.32	4.2	4.07
EER				-	-	-	11.21	9.42	8.88
Operation range		Heating	°F (°C)	5 - 95 (1) (-15 - 35)			5 - 95 (1) (-15 - 35)		
		Cooling	°F (°C)	-			50 - 114.8 (10 - 46)		
		Domestic water	°F (°C)	5 - 95 (1) (2) (-15 - 35)			5 - 95 (1) (2) (-15 - 35)		
Sound power level		Heating	dBA	64	64	66	64	64	66
		Cooling	dBA	-	-	-	65	66	69
Sound pressure level		Heating	dBA	51	51	52	51	51	52
		Cooling	dBA	-	-	-	50	52	54
Refrigerant charge		R-410A	lbs.	6.5			6.5		
Power supply				208-230V/1Ph/60Hz			208-230V/1Ph/60Hz		
Minimum Circuit Amps (MCA)			A	26.5			26.5		
Maximum Overcurrent Protection (MOP)			A	30			30		
Dimensions (Net)		HxWxD	in.	55 27/32 x 56 1/2 x 15 1/32			55 27/32 x 56 1/2 x 15 1/32		
Weight		Net	lbs.	397			397		
		Gross	lbs.	441			441		
Leaving water temperature range		Heating	°F (°C)	59 - 131 (15 - 55)			59 - 131 (15 - 55)		
		Cooling	°F (°C)	N/A			41 - 71.6 (5 - 22)		
Expansion vessel		Volume	gal.	2.64			2.64		
		Max. water pressure	PSI	43.5			43.5		
		Pre Pressure	PSI	14.5			14.5		
Water Piping connections diameter			in.	1 1/4 Female BSP			1 1/4 Female BSP		
Safety valve			PSI	< 43.5			< 43.5		
Total water volume			gal.	1.45			1.45		
Pump (Nominal ESP)		Heating	PSI	7.61	6.31	5.00	7.61	6.31	5.00
		Cooling	PSI	N/A	N/A	N/A	8.11	7.12	6.79
Water side Heat exchanger		Water volume	gal.	0.27			0.27		
		Water flow rate Min./Max	GPM	4.23 / 15.32			4.23 / 15.32		
		Water flow rate Nom.	Heating GPM	8.48	10.59	12.13	8.48	10.59	12.13
			Cooling GPM	N/A	N/A	N/A	9.72	12.13	12.68
Factory mounted Back Up Heater		Capacity	kW	6			6		
		Capacity Steps		2			2		
		Max Overcurrent Protection (MOP)		28.6			28.6		
		Minimum Circuit Amps (MCA)		30			30		
		Power supply		208-230V/1Ph/60Hz			208-230V/1Ph/60Hz		

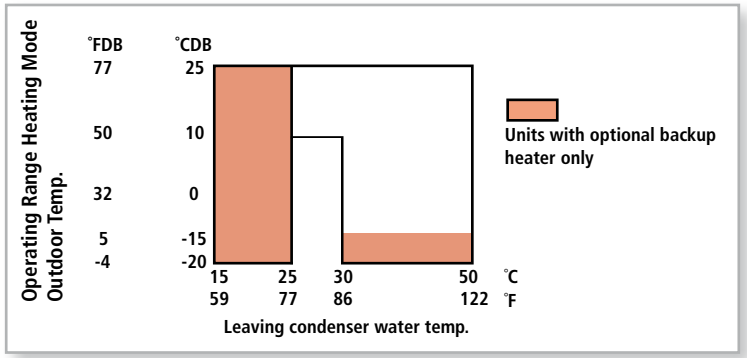
Measuring conditions: Heating Ta DB/WB 44.6°F/42.8°F (7/6°C) - LWC 95°F (35°C) - Cooling Ta 95°F (35°C) - LWE 64.4°F (18°C)
(1) E(D/B)L* models can reach -4°F (-20°C) but without capacity guarantee
(2) Booster heater operation from 95°F (35°C) onwards
(3) These conditions are based on under floor heating/cooling application
(4) For further information pertaining to the hydronic specs of the MonoBloc system, refer to the engineering databook

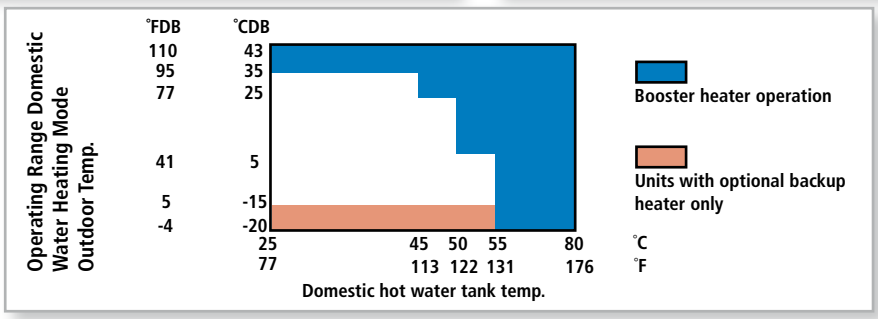
HYDROBOX (FOR USE WITH ERLQ018/024/030BAVJU)

HYDROBOX						EKHBH030BA3VJU	EKHBX030BA3VJU	EKHBH030B6VJU	EKHBX030B6VJU
Function						Heating only	Reversible	Heating only	Reversible
Leaving water temperature range			Heating	°F (°C)		(59) 77 - 131* ((15) 25 - 55)		(59) 77 - 131* ((15) 25 - 55)	
			Cooling	°F (°C)		-	41 - 71.6 (122) (5 - 22 (50))	-	41 - 71.6 (122) (5 - 22 (50))
Drain valve						Yes			
Material						Epoxy polyester painted galvanized steel			
Color						Neutral white (RAL 9010)			
Dimensions (Net)			HxWxD	in.		36 5/16 x 19 3/4 x 14 7/32	36 5/16 x 19 3/4 x 14 7/32	36 5/16 x 19 3/4 x 14 7/32	36 5/16 x 19 3/4 x 14 7/32
Weight			Net	lbs.		101		101	
			Gross	lbs.		130		130	
Factory mounted heater			Capacity	kW		3	3	6	6
			Capacity Steps			1	1	2	2
			Max Overcurrent Protection (MOP)			20 A	20 A	30 A	30 A
			Minimum Circuit Amps (MCA)			14.3 A	14.3 A	28.6 A	28.6 A
			Power supply			208-230V/1Ph/60Hz	208-230V/1Ph/60Hz	208-230V/1Ph/60Hz	208-230V/1Ph/60Hz
When connected to all outdoor units	Main components	Expansion vessel	Volume		gal.	2.64		2.64	
			Max. water pressure		PSI	43.5		43.5	
			Pre Pressure		PSI	14.5		14.5	
	Water circuit	Piping connections diameter			in.	1" Male BSP		1" Male BSP	
		Piping			in.	1		1	
		Safety valve			PSI	43.5		43.5	
		Total water volume			gal.	5.5		5.5	
	Refrigerant circuit	Gas side diameter			in.	ø 5/8		ø 5/8	
		Liquid side diameter			in.	ø 1/4		ø 1/4	
	Operation range	Waterside	Heating		°F (°C)	(59) 77 - 131* ((15) 25 - 55)		(59) 77 - 131* ((15) 25 - 55)	
			Cooling		°F (°C)	-	41 - 71.6 (122) (5 - 22 (50))	-	41 - 71.6 (122) (5 - 22 (50))
When connected to **ERLQ018**	Main components	Pump	Nominal ESP unit	Heating	PSI	7.1		7.1	
				Cooling	PSI	-	7.4	-	7.4
		Water side Heat exchanger	Water volume		gal.	0.18		0.18	
			Water flow rate Min./Max		GPM	3.17/11.09		3.17/11.09	
			Water flow rate Nom.	Heating	GPM	4.35		4.35	
				Cooling	GPM	-	3.88	-	3.88
When connected to **ERLQ024**	Main components	Pump	Nominal ESP unit	Heating	PSI	6.5		6.5	
				Cooling	PSI	-	8.5	-	8.5
		Water side Heat exchanger	Water volume		gal.	0.18		0.18	
			Water flow rate Min./Max		GPM	3.17/11.09		3.17/11.09	
			Water flow rate Nom.	Heating	GPM	5.18		5.18	
				Cooling	GPM	-	4.44	-	4.44
When connected to **ERLQ030**	Main components	Pump	Nominal ESP unit	Heating	PSI	5.5		5.5	
				Cooling	PSI	-	7.00	-	7.00
		Water side Heat exchanger	Water volume		gal.	0.18		0.18	
			Water flow rate Min./Max		GPM	3.17/11.09		3.17/11.09	
			Water flow rate Nom.	Heating	GPM	6.37		6.37	
				Cooling	GPM	-	4.60	-	4.60

*Back up heater operation between 59°F (15°C) and 77°F (25°C)



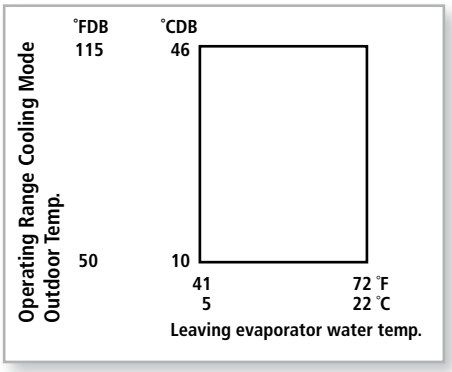


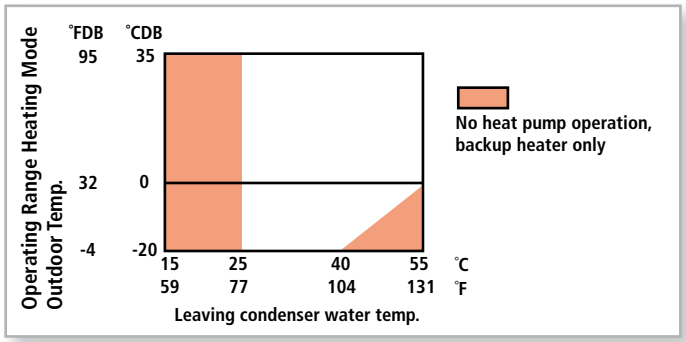


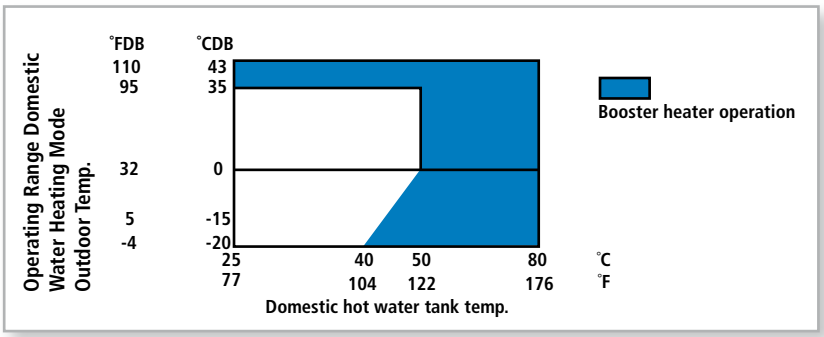
HYDROBOX (FOR USE WITH ERLQ036/048/054BAVJU)

HYDROBOX						EKHBH054BA3VJU	EKHBX054BA3VJU	EKHBH054B6VJU	EKHBX054B6VJU
		Function				Heating only	Reversible	Heating only	Reversible
		Leaving water temperature range	Heating	°F (°C)		(59) 77 - 131* ((15) 25 - 55)		(59) 77 - 131* ((15) 25 - 55)	
			Cooling	°F (°C)		-	41 - 71.6 (5 - 22)	-	41 - 71.6 (5 - 22)
		Drain valve				yes			
		Material				Epoxy polyester painted galvanized steel			
		Color				Neutral white (RAL 9010)			
		Dimensions (Net)	HxWxD		in.	36 5/16 x 19 3/4 x 14 7/32	36 5/16 x 19 3/4 x 14 7/32	36 5/16 x 19 3/4 x 14 7/32	36 5/16 x 19 3/4 x 14 7/32
		Weight	Net		lbs.	123		123	
			Gross		lbs.	152		152	
		Factory mounted heater	Capacity		kW	3	3	6	6
			Capacity Steps			1	1	2	2
			Max Overcurrent Protection (MOP)			20 A	20 A	30 A	30 A
			Minimum Circuit Amps (MCA)			14.3 A	14.3 A	28.6 A	28.6 A
			Power supply			208-230V/1Ph/60Hz	208-230V/1Ph/60Hz	208-230V/1Ph/60Hz	208-230V/1Ph/60Hz
When connected to all outdoor units	Main components	Expansion vessel	Volume		gal.	2.64		2.64	
			Max. water pressure		PSI	43.5		43.5	
			Pre Pressure		PSI	14.5		14.5	
	Water circuit	Piping connections diameter			in.	1 1/4 Male BSP		1 1/4 Male BSP	
		Piping			in.	1 1/4		1 1/4	
		Safety valve			PSI	43.5		43.5	
		Total water volume			gal.	1.45		1.45	
	Refrigerant circuit	Gas side diameter			in.	ø 5/8		ø 5/8	
		Liquid side diameter			in.	ø 3/8		ø 3/8	
	Operation range	Waterside	Heating		°F (°C)	59 - 131 (15 - 55)		59 - 131 (15 - 55)	
			Cooling		°F (°C)	-	41 - 71.6 (5 - 22)	-	41 - 71.6 (5 - 22)
When connected to **ERLQ036**	Main components	Pump	Nominal	Heating	PSI	7.6		7.6	
			ESP unit	Cooling	PSI	-	8.1	-	8.1
		Water side Heat exchanger	Water volume		gal.	0.26		0.26	
			Water flow rate Min./Max		GPM	4.23/15.32		4.23/15.32	
			Water flow rate Nom.	Heating	GPM	8.48		8.48	
				Cooling	GPM	-	7.58	-	7.58
When connected to **ERLQ048**	Main components	Pump	Nominal	Heating	PSI	6.3		6.3	
			ESP unit	Cooling	PSI	-	7.1	-	7.1
		Water side Heat exchanger	Water volume		gal.	0.26		0.26	
			Water flow rate Min./Max		GPM	4.23/15.32		4.23/15.32	
			Water flow rate Nom.	Heating	GPM	10.59		10.59	
				Cooling	GPM	-	9.46	-	9.46
When connected to **ERLQ054**	Main components	Pump	Nominal	Heating	PSI	5.08		5.08	
			ESP unit	Cooling	PSI	-	6.79	-	6.79
		Water side Heat exchanger	Water volume		gal.	0.26		0.26	
			Water flow rate Min./Max		GPM	4.23/15.32		4.23/15.32	
			Water flow rate Nom.	Heating	GPM	12.13		12.13	
				Cooling	GPM	-	9.93	-	9.93

*Back up heater operation between 59°F (15°C) and 77°F (25°C)







DOMESTIC HOT WATER TANK

			EKHWS050BA3VJU	EKHWS080BA3VJU
Water volume		gal.	52.8	79.2
Max.water temperature		°F (°C)	185 (85)	
Max.water pressure		PSI	145	
Insulation (Polyurethane foam) Min. thickness		in.	1 5/8	
Height		in.	45 3/8	63
Diameter		in.	22 7/8	
Booster heater		kW	3	
Piping connections	Water inlet H/E Diameter	in.	ø 3/4 FBSP	
	Water outlet H/E Diameter	in.	ø 3/4 FBSP	
	Cold water in Diameter	in.	ø 3/4 FBSP	
	Hot water out Diameter	in.	ø 3/4 FBSP	
Minimum Circuit Amps (MCA)		A	14.3	
Maximum Overcurrent Protection (MOP)		A	20	
Power supply			208-230V/1Ph/60Hz	
Material inside tank			Stainless steel (DIN 1.4521) - 316L	
Material outside casing			Epoxy-coated mild steel	
Color			Neutral white	
Dimensions (Net)	HxWxD	in.	45 9/32 x 22 27/32 x 22 27/32	63 x 22 27/32 x 22 27/32
Empty weight		lbs.	99	129.8

Note: 3-Way Valve is factory included with the Domestic Hot Water Tank for field installation

SOLAR KIT

			EKSOLHWBAVJU
Heat exchanger	pressure drop	psi	3.12
	max.inlet temp	°F (°C)	230 (110)
	heat exchange capacity	W/K	1,400
	Logarithmic mean temperature difference (LMTD)	K	5
Pump	Number of speeds		3
	Power input	W	46
Water circuit	Piping connections diameter	in.	3/4 FBSP
Ambient temperature	max.	°F	95 (35)
	min.	°F	33.8 (1)
Power supply			208-230V/1Ph/60Hz
Power supply intake			from indoor unit
Dimensions (Net)	HxWxD	in.	30 1/32 x 12 x 10 1/32

ROOM THERMOSTAT

thermostat

			EKRTWA
Ambient temperature	Storage	°F (°C)	-4 - 140 (-20 - 60)
	Operation	°F (°C)	32 - 122 (0 - 50)
Temperature setpoint range	Heating	°F (°C)	39.2 - 98.6 (4 - 37)
	Cooling	°F (°C)	39.2 - 98.6 (4 - 37)
Clock			yes
Regulation function			proportional band
Dimensions (Net)	HxWxD	in.	3 27/64 x 4 59/64 x 1 11/32
Weight (Net)		lbs.	0.47

FAN COIL UNIT

Capacity		018	024	030	036	048	054
Model Number (No Electric Heat Options)		EFWT024AEVLU**	EFWT024AEVLU	EFWT036AEVLU**	EFWT036AEVLU	EFWT048AEVLU	EFWT060AEVLU
Model Number (With Electric Heat Options)		EFWT024AEVJU**	EFWT024AEVJU	EFWT036AEVJU**	EFWT036AEVJU	EFWT048AEVJU	EFWT060AEVJU
Cooling Performance (chilled water cooling):							
Nominal Capacity	Btu/hr	19,100	22,600	28,600	32,000	42,700	52,400
Nominal Sensible Capacity	Btu/hr	14,200	17,700	22,400	25,800	34,700	42,400
EWT Range	°F	40 - 50°F					
Nominal Flow Rate	GPM	4.5	5.0	6.0	6.0	8.0	10.0
Nominal Pressure drop	Ft Hd	5.5	7.7	4.8	5.5	5.4	7.9
Heating Performance (hot water heating):							
Nominal Capacity	Btu/hr	19,300	25,000	31,900	34,800	50,200	60,900
EWT Range	°F	100 - 125°F					
Nominal Flow Rate	GPM	3.0	4.5	4.5	4.5	8.0	10.0
Nominal Pressure drop	Ft Hd	2.5	5.5	3.0	3.0	5.4	7.9
Airflow Rate:							
Nominal	CFM	600	800	1050	1200	1600	2000
Total External Static Pressure	WG"	0.3" WG Std, 0.5" WG Max					
Blower Speed setting		"C" FACTORY SETTING	"A" FACTORY SETTING	"B" FACTORY SETTING	"A" FACTORY SETTING	"A" FACTORY SETTING	"A" FACTORY SETTING
Motor rating	HP	1/3 HP		1/2 HP		3/4 HP	1 HP
Airflow arrangement		Upflow, Horizontal L, Horizontal R (Possible)					
Electrical Data (No Electric Heat Options):							
Power supply		120V / 1 / 60Hz					
Minimum Circuit Amps (MCA)		6.0	6.0	10.0	10.0	14.0	15.0
Maximum overcurent protection (MOP)	A	15	15	15	15	15	15
Electrical Data (With Electric Heat Options):							
Power supply		208-230V/1Ph/60Hz					
Minimum Circuit Amps (MCA)		3.0	3.0	4.0	4.0	6.0	9.0
Maximum overcurent protection (MOP)	A	15	15	15	15	15	15
Electrical Heater Options 10 to 25kW		5kW, 10kW	5kW, 10kW	5kW, 10kW, 15kW	10kW, 15kW, 20kW	15kW, 20kW, 25kW	15kW, 20kW, 25kW
Electrical Heat Integral Disconnect		FACTORY INSTALLED SERVICE SWITCH OVER 10KW (NO DISCONNECT)					
Physical Data:							
Dimension	HXWXD	40 x 20 x 20		40 x 23 x 20		48 x 21-1/4 x 28	
Weight	lbs.	115		170		230	290
insulation type / R-Rating		1/2" JM TUF-SKIN					
Installation Clearances		U.L. LISTED FOR INSTALLATION WITH ZERO INCHES CLEARANCE TO COMBUSTABLE MATERIALS					
Connection type:							
Inlet / Outlet Connections	in.	7/8	7/8	7/8	7/8	1-1/8	1-1/8
Connection Type		Sweat	Sweat	Sweat	Sweat	Sweat	Sweat
Feature:							
Thermostat Connection		24V	24V	24V	24V	24V	24V
Air Filter (MERV 8 Throwaway)		18 x 20 x 1		20 x 22 x 1		20 x 25 x 1	

Notes:
1. Cooling Capacity is based on 50°F Entering Water Temp and 80°F DB/67°F WB Entering Air Conditions.
2. Heating Capacity is based on 110°F Entering Water Temp and 70°F DB Entering Air Conditions.
3. Refer to detailed capacity tables for further information pertaining to the entire entering water temperature range and for flow rates and pressure drop.
4. Refer to engineering data book for further information on electric heat options.
5. Std efficiency models with PSC motor are available on request.

OPTION LIST

	MODEL NUMBER	NOTES
Condensate Kit	EKHBDP	For Cooling Mode Applications
Digital I/O PCB	EKRP1HBAAU	Unit On/Off Alarm On/Off Solar Input
BSP to NPT Connection Adaptors	DACA-DHWRA-1	DHW Recirculation Loop 1/2"
	DACA-DHWTA-1	DHW Tank Inlet/Outlet 3/4"
	DACA-THXA-1	DHW He-Ex 1"
	DACA-3WVTA-1	3-Way Valve 1 1/4"
	DACA-3WVTH-1	3-Way Valve 1"
	DACA-HBA-1	EKHB_054 Hydrobox Inlet/Outlet 1 1/4"
	DACA-HBA-2	EKHB_030 Hydrobox Inlet/Outlet 1"
	DACA-HBA-3	EDLQ/EBLQ Inlet/Outlet 1 1/4"
	DACA-MP-1	DHW Tank Plug 3/4"
Pre-Insulated Line Sets (Applicable to ERLQ018/024/030BA Units Only)	DACA-RA3-10-1	1/4" x 5/8" (10 ft. Length)
	DACA-RA3-15-1	1/4" x 5/8" (15 ft. Length)
	DACA-RA3-30-1	1/4" x 5/8" (30 ft. Length)
	DACA-RA3-50-1	1/4" x 5/8" (50 ft. Length)
	DACA-RA3-65-1	1/4" x 5/8" (65 ft. Length)
	DACA-RA3-100-1	1/4" x 5/8" (100 ft. Length)
Wall Mounting Bracket for Consensing Unit	DACA-WB-3	Unit Weight - Up to 500 lbs.
3rd Party DHW Tank Connection Kit	DACA-DHW-KIT-1	For Tanks up to 119G

UNIQUE BENEFITS

altherma™

DID YOU KNOW...

with a Daikin Altherma™ heat pump, the temperature of the domestic water can go up to 185°F (85°C), the temperature of the hot water for heating ranges between 59°F (15°C) and 131°F (55°C) and the temperature of the cold water for cooling between 41°F (5°C) and 72°F (22.2°C).

Control customized to your customer

The water temperature changes in function with the outside temperature so that your customer can enjoy a stable level of heating at any time. As the installer, you set up the system according to the desires of your customer. You input four temperatures to determine the "heating curve" and in doing so, you perfectly tune the Daikin Altherma system to the type of home.

Automatic re-start after power interruption

In the event of a power interruption of up to two hours, the system automatically resumes with the previously set parameters.

Quiet operation

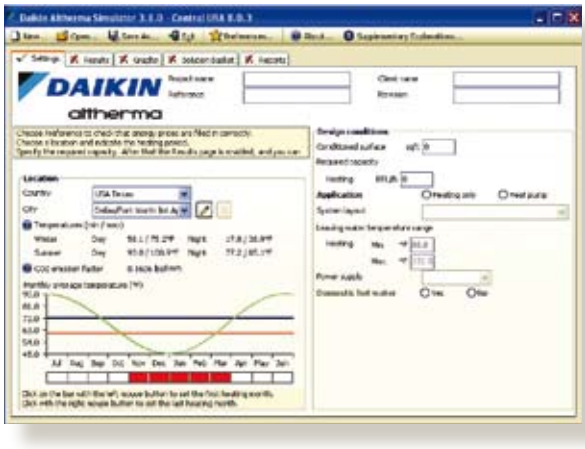
The outdoor unit makes hardly any noise thereby leaving your customer's (and the neighbor's) peace and quiet undisturbed. You can even set the outdoor unit to produce 10dB(A) less noise during the night.

Electric back-up heating

Every Daikin Altherma system is equipped with a back-up heater (heating capacity of 3 or 6 kW). This unit can be used for supplemental heating during extremely cold outdoor temperatures or as a back-up in case of any problems with the outdoor unit. Your customer can then enjoy comfortable heating at any moment.

The operation of the back-up heater can be coupled to the outside temperature. The back-up heater will then only operate when outside temperatures are extremely low.

7.THE SOFTWARE



Daikin Altherma's "simulator" software program allows quick and easy indication of the benefits of a Daikin Altherma system.

By specifying a number of parameters such as the location, the surface area to be heated, the required heating and cooling capacity, the entry and exit water temperatures of the distribution network and the local energy prices, the program displays the following simulation details.

1. Material list with technical specification

2. Simulation graphics:

   a) Required and available heating and cooling capacity with indication of the SPF (or Seasonal COP) and Annual EER based on the defined climate conditions.

   b) Duration of the heating and cooling operation periods as a function of the outside temperature

   c) The annual energy cost compared with a heating system using gas or fuel oil

   d) The annual amount CO2 emitted in tonnes compared with a heating system using gas or fuel oil

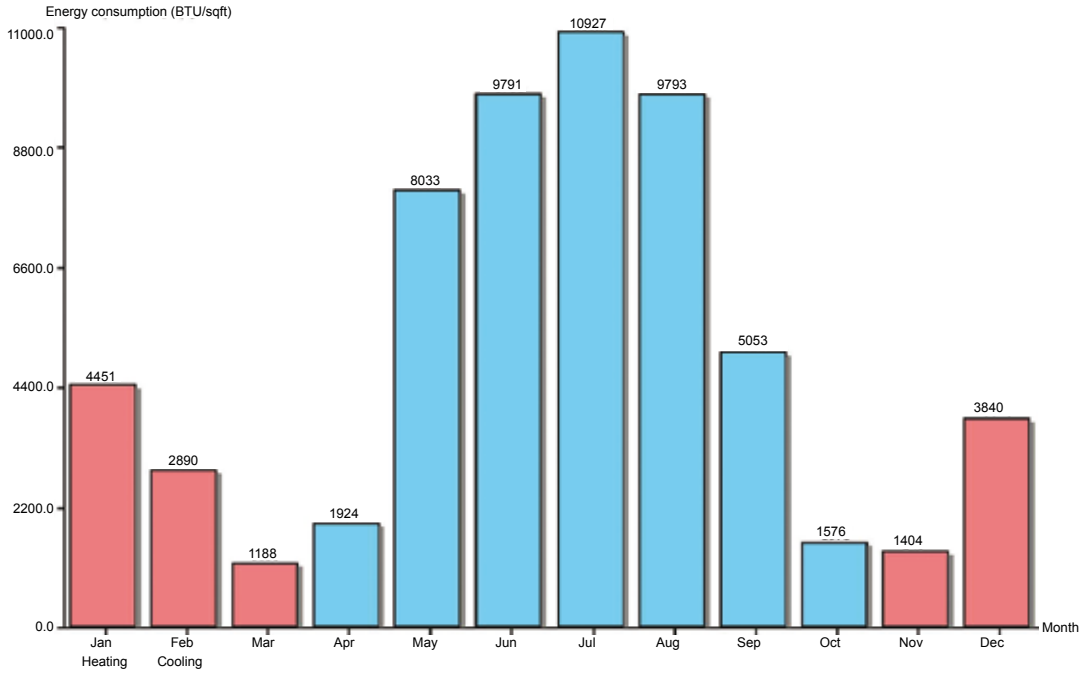
   e) The monthly energy consumption in kWh

   f) The monthly energy cost in dollars

   g) The total amount of thermal energy in kWh as a function of the outside temperature

   h) The radiated heat per ft2 (in Btu/ft2) per month

   All data is collected in a separate report. If you are interested in this software, contact your local Daikin Altherma distributor



OTHER RESIDENTIAL SOLUTIONS AVAILABLE

SINGLE ZONE

Single Split Systems

R-410A INVERTER

SEER

18 — Heat Pump FTXS/RXS, Cool Only FTKS/RKS — ENERGY STAR — TAX CREDIT QUALIFIED Heat Pump Only

15+ — Heat Pump FTXS/RXS — ENERGY STAR 15MBH Only

14 — Heat Pump FTXN/RXN, Cool Only FTKN/RKN

13 — Concealed FDXS/RXS

Capacity	9kBtu/h	12kBtu/h	15kBtu/h	18kBtu/h	24kBtu/h
Recommended Maximum Room size	450 sq. ft.	625 sq. ft.	813 sq. ft.	1,050 sq. ft.	1,460 sq. ft.

For reference use only.
Equipment selection should always be based on detailed load calculations.

Quaternity™ System

SEER

Up to 26.1 — Heat Pump FTXG/RXG

TAX CREDIT QUALIFIED — ENERGY STAR — HEAT PUMP INVERTER R-410A

Capacity	9kBtu/h	12kBtu/h	15kBtu/h
Recommended Maximum Room size	450 sq. ft.	625 sq. ft.	813 sq. ft.

For reference use only.
Equipment selection should always be based on detailed load calculations.

MULTI ZONE / WHOLE HOUSE

Multi-Split Systems

SEER

Up to 19.5 — Heat Pump 2MXS (Wall Mounted/Concealed) — ENERGY STAR — TAX CREDIT QUALIFIED Duct-free Only

Up to 17.2 — Heat Pump 4MXS (Wall Mounted/Concealed)

Up to 16.6 — Heat Pump 3MXS (Wall Mounted/Concealed) — ENERGY STAR — TAX CREDIT QUALIFIED Duct-free Only

HEAT PUMP INVERTER R-410A

Capacity	7k/9kBtu/h	12kBtu/h	15kBtu/h	18kBtu/h	24kBtu/h	32kBtu/h
Recommended Maximum Room size	450 sq. ft.	625 sq. ft.	813 sq. ft.	1,050 sq. ft.	1,460 sq. ft.	2,080 sq. ft.

For reference use only.
Equipment selection should always be based on detailed load calculations.

Daikin Inverter Ducted System

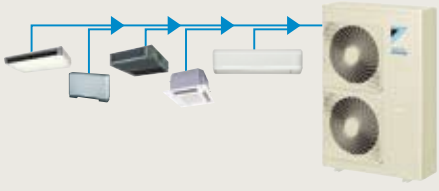
- Energy efficient for residential ducted applications (SEER up to 18.15, HSPF up to 8.92)
- Quiet operation
- Electric heater options
- Auto fan logic allows unit to cycle on and off with the load
- ECM Fan Motor

HEAT PUMP INVERTER R-410A — TAX CREDIT QUALIFIED — ENERGY STAR

VRVIII-S System

- Air cooled heat pump system
- New G-type variable speed compressor to match heating/cooling mode
- Choice of models (36 MBH to 48 Mbh)
- Up to 6 or 8 fan coil units for one outdoor unit
- Piping allowance accommodates maximum 165 ft. height difference, longest single piping run of 492 ft.
- Easy-fit Refnet piping connectors
- Advanced diagnostics
- High energy efficiency

HEAT PUMP INVERTER R-410A — ENERGY STAR



WARNINGS

- Always use a licensed installer or contractor to install this product. Improper installation can result in water or refrigerant leakage, electrical shock, fire or explosion.
- Use only those parts and accessories supplied or specified by Daikin. Ask a licensed contractor to install those parts and accessories. Use of unauthorized parts and accessories or improper installation of parts and accessories can result in water or refrigerant leakage, electrical shock, fire or explosion.
- Read the User's Manual carefully before using this product. The User's Manual provides important safety instructions and warnings. Be sure to follow these instructions and warnings.

For any inquiries, contact your local Daikin sales office.

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, manufacturing as well as to services related to the product.

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.

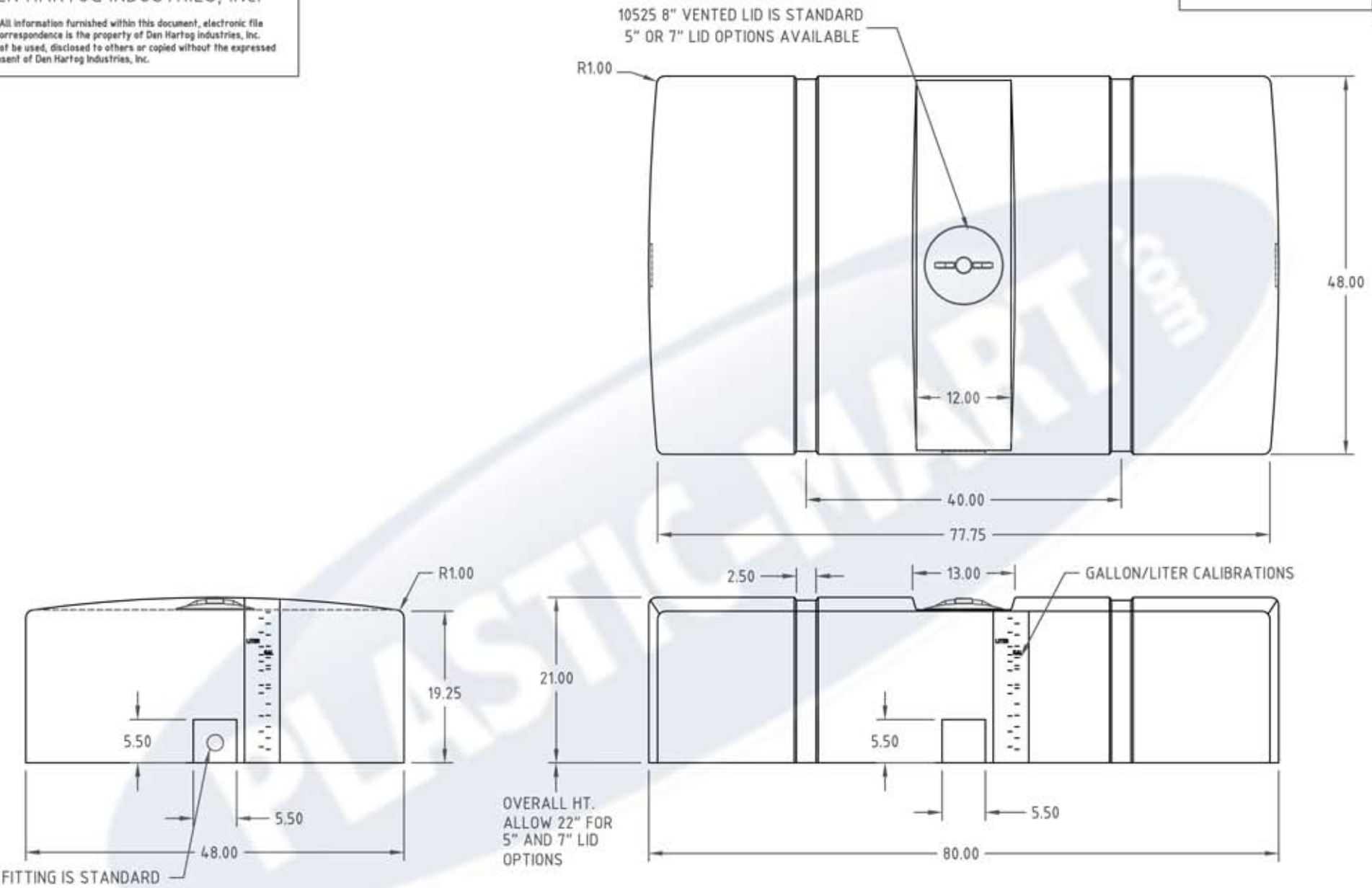
absolute comfort

Daikin AC (Americas), Inc.
1645 Wallace Drive, Suite 110
Carrollton, TX 75006 USA
www.daikinac.com/altherma
866-4DAIKIN
972-245-1510

Dealer Information

PCAWUSE11-06B

LP0300-RT



REV	DESCRIPTION	BY / DATE	CCN

ALL DIMENSIONS ARE IN DECIMAL INCHES
TOLERANCES UNLESS OTHERWISE SPECIFIED

POLYETHYLENE	METAL
±1% @ 68° F	DECIMAL ± .125" FRACTION ± 1/4" ANGLE ± 1°

THIRD ANGLE PROJECTION
ANSI 14.5M

DRAWN / DATE
DHJ 6/12/06

APPRD. / DATE
REH 10/11/10

SHOT WEIGHT: 133 LB.

SHIPPING WEIGHT: 135 LB.

FINISH:

MATERIAL
HDPE OR EQUIVALENT
REFERENCE MATERIAL DATA SHEET
FOR SPECIFIC PROPERTIES.

NOTES:
1. NOM. WALL @ .310
2. NATURAL OR YELLOW COLOR

PLASTIC-MART.com

866-310-2556

DESCRIPTION: 300 GAL. LOW PROFILE RECTANGULAR TANK

SCALE: N.S.

PART NO.: LP0300-RT

Enecsys Enables
OPTIMAL
SOLAR
SOLUTIONS

Enecsys Micro Inverters

SMI-D480W-60-UL

Maximized Energy Harvest

Improved Safety

Increased Lifetime & Reliability

Enhanced Monitoring Capability

Simplified PV Array Design & Installation

Enecsys develops, manufactures and markets world leading, highly reliable grid-connected solar micro inverters and monitoring systems that offer an outstanding value proposition for solar PV systems.

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Fax.+44 1223 792103
uk-sales@enecsys.com

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taiwan-sales@enecsys.com

info@enecsys.com | www.enecsys.com

enecsys
MICRO INVERTERS

Enecsys
Micro Inverters

SMI-D480W-60-UL

Technical Specification	SMI-D480W-60-UL
Input Data (DC)	
Nominal PV Power	480W
Recommended Maximum PV Power (STC)	500W
Maximum PV Voltage	44V
Operating PV Voltage Range	20V - 44V
MPPT Voltage Range	23V - 35V
Min/Max Start-up Voltage	22V / 42.5V
Maximum PV Current	24A
Max PV Source Short-circuit Current	32A
Output Data (AC)	
Maximum Power	460W
Nominal Voltage/Range	240V / 211V - 264V
Nominal Current	1.92A
Nominal Frequency/Range	60Hz / 59.3Hz - 60.5Hz
Power Factor	> 0.95
Total Harmonic Distortion	< 5%
Maximum Units Per 16A Branch System	6 (single phase)
Maximum Fault Current	10.8A AC 3ms
Efficiency	
CEC Efficiency	95.0%*1
Peak Efficiency	96.0%1
Maximum Night Power Consumption	< 30mW
Mechanical Data	
Ambient Temperature Range	-40ºC to +85ºC
Operating Temperature Range	-40ºC to +100ºC
Enclosure Rating	UL 50 Type 4x
Dimensions (LxHxW)	262mm x 160mm x 40mm*2
Weight	2.1kg
Cooling	Natural Convection
Features & Compliance	
Safety Class Compliance	UL1741, CSA-C22.2.107.1-01
EMC (Emission & Immunity) Compliance	FCC Part 15 Class B
Grid Connection Compliance	IEEE 1547.1*3
Communication	Zigbee IEEE 802.15.4
Connector	MC4 or MC4 Compatible
PV Compatiblity	Compatible with most 60 cell modules
Warranty	20 Years (at full ambient temperature range)
Technology	Thin film capacitors
Isolation	Galvanic
Application	Duo inverter / residential and commercial

*1 - Efficiency maintained over full ambient temperature range from -40ºC to +85ºC and at nominal output power

*2 - Without the mounting bracket

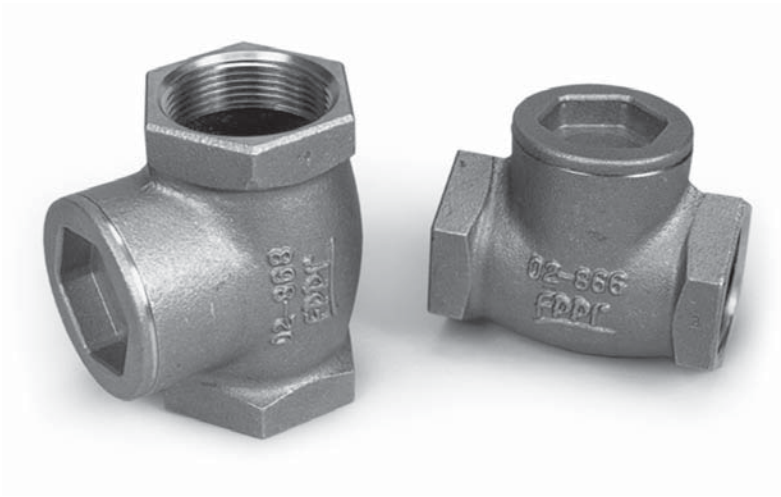
*3 - In accordance with the Enecsys installation guidelines (please refer to the Enecsys Installation Manual)

All technical specifications contained within this document are subject to change without prior notice

enecsys MICRO INVERTERS

Swing Check Valve

Full Floating Clapper Assembly



Description

The bronze* swing check valve features a full floating clapper assembly that provides for a positive seal each time the valve is cycled. This feature improves the swing check valves ability to "clear" any debris that may be present in the water supply. The seat material is NBR which provides for a positive seal even under light residual pressures.

Specifications

Valve Body:
Cast Bronze*
(85-5-5-5)

Clapper Assembly:
Forged Brass

Seat:
NBR (Chloramine Resistant)

Sizes:
1/2" IPS- 2" IPS
Female by female

Rated Pressure:
250 psi

*Contains lead. Not for use in water systems intended for human consumption.

Installation

The female by female swing check valve should be installed in accordance with commonly used installation practices for the fire sprinkler industry. Proper seal of the threads can be accomplished by applying a liberal amount of PTFE based thread sealant such as PipeFit® Thread Sealant Paste or PTFE Tape. Never use tape and paste together. This will cause excessive stress on the threaded connection leading to failure of the valve. Do not exceed one full turn past hand tight when installing male threads into the check valve.

Warning

DO NOT OVER TIGHTEN. Over tightening during installation will crack the valve body. Evidence of overtightening may not be readily visible or apparent upon pressurization.

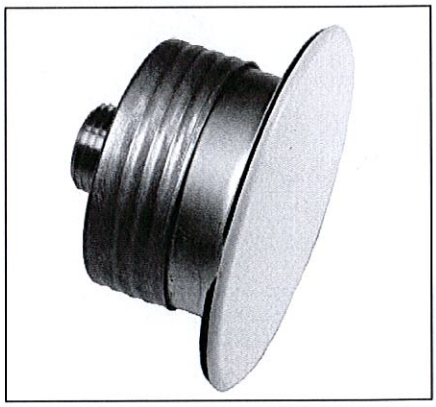
Fire Protection Products, Inc
6241 Yarrow Drive, Suite A, Carlsbad, CA 92011-1541
For questions: 1 800 344-1822 • 1 800 344-3775 fax • www.fppi.com

Reliable®

Model RFC30 (SIN RA0611)
Model RFC43 (SIN RA0612)
Model RFC49 (SIN RA0616)
Residential Flat Concealed Sprinklers

Bulletin 006 Rev. F

A Residential Flat Concealed Sprinkler engineered for a minimum design density of 0.05 gpm/ft² with low GPM requirements.



Features

1. Very low water flow requirements.
2. ½" (13mm) Total adjustment.
3. Thread-On/Thread-Off or Push-On/Thread Off cover attachment option.
4. Smooth aesthetic ceiling profile.
5. Available in brass, chrome and black plated or painted finishes.

Listings & Approval

1. Listed by Underwriters Laboratories, and certified by UL for Canada (cULus)
2. NYC MEA 258-93-E

UL Listing Categories

Residential Automatic Sprinklers

UL Guide Number

VKKW

Product Description

Model RFC30, RFC43 and RFC49 Concealed Residential Sprinklers are fast response residential fusible solder link automatic sprinklers. Residential sprinklers differ from standard sprinklers primarily in their response time and water distribution patterns.

Model RFC30, RFC43 and RFC49 sprinklers discharge water in a hemispherical pattern below the sprinkler deflector. Residential distribution patterns are higher and generally contain a finer droplet size than standard sprinkler patterns.

The combination of speed of operation and high discharge pattern required for residential sprinklers has demonstrated, in fire testing, an ability for controlling residential fires, and thereby providing significant evacuation time for occupants.

The RFC30, RFC43 and RFC49 Sprinklers provide the best form of fire protection by combining an attractive appearance and ½" (13mm) of cover adjustment for ease of installation. The small diameter cover plate is easily and positively attached and blends into the ceiling, concealing the most dependable fire protection available, an automatic sprinkler system.

The RFC30, RFC43 and RFC49 are UL Listed Residential Sprinklers to be installed in the residential portions of any occupancy in accordance with NFPA 13, 13R, & 13D.

The RFC30, RFC43 and RFC49 can reduce the need for precise cutting of drop nipples. The threaded cover plate assembly can be adjusted without tools to fit accurately against the ceiling. The fire protection system need not be shut down to adjust or remove the cover plate assembly.

Application and Installation

The RFC30, RFC43 and RFC49, for residential installations, use a 165°F (74°C) fusible solder link in a tuning fork style sprinkler frame with a drop-down deflector. This assembly is recessed into the ceiling and concealed by a flat cover plate. The cover plate is attached to the skirt, using 135°F (57°C) ordinary temperature classification solder. When the ceiling temperature rises, the solder holding the cover plate releases the cover allowing the deflector to drop into position and exposing the sprinkler inside to

ceiling temperature. The subsequent operation of the solder link opens the waterway and causes the deflector to drop into position to distribute the discharging water in a hemispherical pattern below the sprinkler deflector. Any adjustment of thread engagement between the cover plate and cup will assure that the drop-down deflector is properly located below the ceiling. The residential distribution pattern contains a finer droplet size than a standard sprinkler, and the pattern produces significantly higher wall wetting.

After a 2⁵/₈ inch diameter hole is cut in the ceiling, the sprinkler is to be installed with the Model FC Wrench. When installing a sprinkler, the wrench is first positioned into the sprinkler/cup assembly and around the hexagonal body of the sprinkler frame. The Wrench must bottom out against the cup in order to ensure proper, safe installation. The sprinkler is then tightened into the pipe fitting. When inserting or removing the wrench from the sprinkler/cup assembly, care should be taken to prevent damage to the sprinkler. DO NOT WRENCH ON ANY OTHER PART OF THE SPRINKLER/CUP ASSEMBLY. MODEL RFC30, RFC43 AND RFC49 CONCEALED SPRINKLERS MUST BE INSTALLED ONLY WITH 135°F RATED COVERS.

Note: A leak tight ½" NPT (R1/2) sprinkler joint can be obtained with a torque of 8-18 ft-lbs (10,8 - 24,4 N-m). Do not tighten sprinklers over maximum recommended torque. It may cause leakage or impairment of the sprinklers.

Cover assemblies provide up to ½" (13mm) of adjustment. Turn the cover clockwise until the flange is in contact with the ceiling. For the push-on/thread-off option, the cover assembly is pushed onto the cup and final adjustment is made by turning the cover clockwise until the skirt flange makes full contact with the ceiling. Cover removal requires turning in the counter-clockwise direction.

In ceilings that have a plenum space above the sprinkler, the plenum space may have neutral or negative pressurization but must not be positively pressurized. Inspect all sprinklers after installation to ensure that the gap between the cover plate and ceiling and the 4 slots in the cup are all open and free from any air flow impediment.

Temperature Rating

Sprinkler	Cover Plate	Max. Ambient Temp.
165°F/74°C	135°F/57°C	100°F/38°C

Installation Data: RFC30 (SIN RA0611)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½" (15mm)	3.0	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	9 (34.1)	9.0 (0.62)
½" (15mm)	3.0	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	10 (37.8)	11 (0.76)

Note: 1 bar = 100 Kpa

Installation Data: RFC43 (SIN RA0612)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½" (15mm)	4.3	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	12 (45)	7.8 (0.54)
½" (15mm)	4.3	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	13 (49)	9.1 (0.63)
½" (15mm)	4.3	16 x 16 (4.9x4.9)	8 (2.43)	8 (2.43)	13 (49)	9.1 (0.63)
½" (15mm)	4.3	18 x 18 (5.5x5.5)	9 (2.74)	8 (2.43)	18 (68)	17.5 (1.21)
½" (15mm)	4.3	20 x 20 (6.0x6.0)	10 (3.05)	8 (2.43)	21 (79)	23.8 (1.64)

Note: 1 bar = 100 Kpa

Installation Data: RFC49 (RA0616)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½" (15mm)	4.9	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	13 (49)	7.0 (0.48)
½" (15mm)	4.9	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	13 (49)	7.0 (0.48)
½" (15mm)	4.9	16 x 16 (4.9x4.9)	8 (2.43)	8 (2.43)	13 (49)	7.0 (0.48)
½" (15mm)	4.9	18 x 18 (5.5x5.5)	9 (2.74)	8 (2.43)	17 (64.3)	12.0 (0.83)
½" (15mm)	4.9	20 x 20 (6.0x6.0)	10 (3.05)	8 (2.43)	20 (75.7)	16.7 (1.14)

Note: 1 bar = 100 Kpa

FOR SLOPED CEILING APPLICATIONS SEE RASCO BULLETIN 035.

Maintenance

Model RFC30, RFC43 and RFC49 Concealed Sprinklers should be inspected quarterly and the sprinkler system maintained in accordance with NFPA 25. Do not clean sprinklers with soap and water, ammonia or any other cleaning fluids. Remove dust by using a soft brush or gentle vacuuming. Remove any sprinkler cover plate assembly which has been painted (other than factory applied) or damaged in any way. A stock of spare sprinklers should be maintained to allow quick replacement of damaged or operated sprinklers. Prior to installation, sprinklers should be maintained in the original cartons and packaging until used to minimize the potential for damage to sprinklers that would cause improper operation or non-operation.

Model RFC30, RFC43 and RFC49 Residential Concealed Sprinkler Specification

Sprinklers shall be cULus Listed low flow residential concealed sprinklers with drop-down deflector and adjustable flat cover plate engineered for a minimum design density of 0.05 gpm/ft^2. Sprinkler frame and deflector shall be of bronze frame construction having a ½" NPT thread. Thermal element shall consist of an approved black-painted beryllium-nickel fusible solder link with symmetric lever mechanism, maintaining a Teflon-coated Belleville spring washer and machined brass cap water seal assembly containing no plastic parts. Sprinkler K-factor shall be nominal 3.0 (44), 4.3 (62.4), and 4.91 (70) having a 5/16", 3/8" and 7/16" orifice. Temperature rating shall be Ordinary 165°F (74°C); cover plate temperature rating to be 135°F (57°C). Cover plate assembly shall consist of a brass cover plate and copper alloy retainer flange allowing a ½" cover plate adjustment. Any secure engagement between the cover plate and the cup will assure that the drop-down deflector is properly located below the ceiling. A plastic protective cap shall be provided and factory installed inside the sprinkler cup to protect the drop-down sprinkler deflector from damage, which could occur during construction before the cover plate is installed. Standard cover finish: [Chrome] [White] [Specialty – specify]. Residential concealed sprinklers shall be Reliable Model RFC30, SIN RA0611 (Bulletin 006), Model RFC43, SIN RA0612 (Bulletin 006) or Model RFC49, SIN RA0616 (Bulletin 006).

Ordering Information

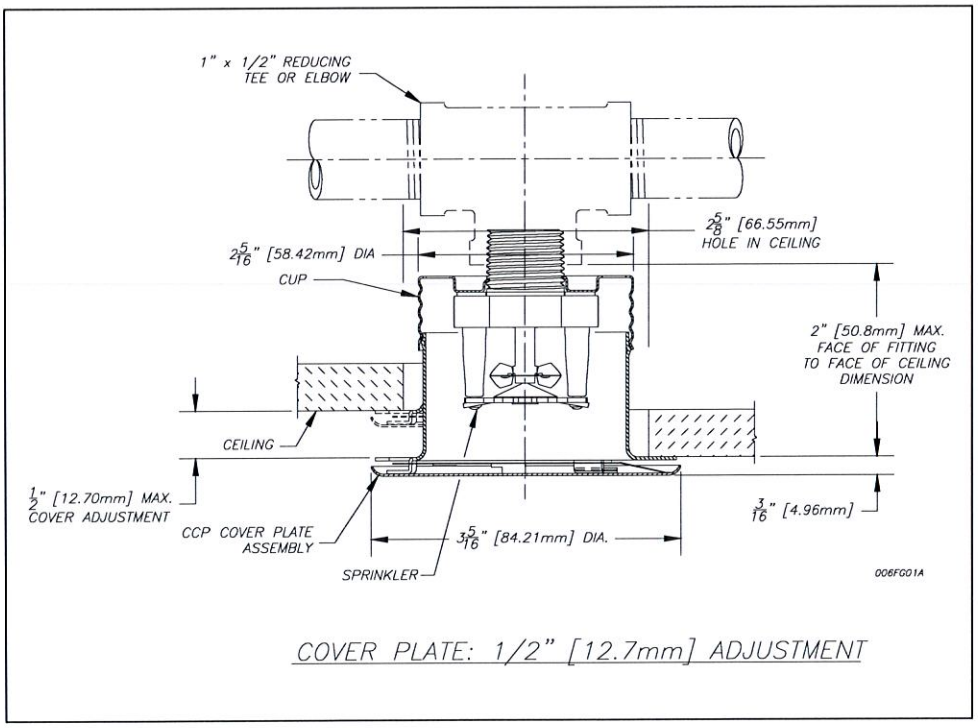
Specify:

1. Sprinkler Model
2. Cover Plate Finish
3. Thread-On or Push-On Feature

Cover Plate Finishes [1]

Standard Finishes
Chrome White
Special Application Finishes
Bright Brass Black Plating Black Paint Off White Satin Chrome

[1] Other colors and finishes available. Consult factory for details.
Note: Paint or any other coatings applied over the factory finish will void all approvals and warranties.



COVER PLATE: 1/2" [12.7mm] ADJUSTMENT

Bulletin 033

Model F1 RES LL Residential Sprinklers for Design Density of .05 gpm/ft²

Specifically Listed for use in Multipurpose Systems that serve both domestic water and fire protection.

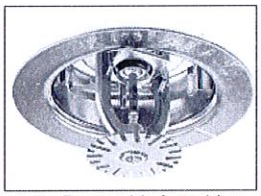
Model F1 Res LL Sprinklers Listed for the lowest flows to meet the minimum design density of .05 gpm/ft² with potable water

F1 Res 30 LL, 49 LL & 58 LL Pendent

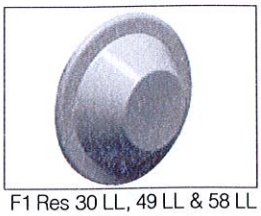
Types:

1. F1 Res 30 LL Pendent
2. F1 Res 30 LL Recessed Pendent/F2
3. F1 Res 30 LL Recessed Pendent/FP
4. F1 Res 49 LL Pendent
5. F1 Res 49 LL Recessed Pendent/F1
6. F1 Res 49 LL Recessed Pendent/FP
7. F1 Res 58 LL Pendent
8. F1 Res 58 LL Recessed Pendent/F1
9. F1 Res 58 LL Recessed Pendent/FP
10. F1 Res 30 LL CCP Pendent
11. F1 Res 49 LL CCP Pendent
12. F1 Res 58 LL CCP Pendent
13. F1 Res 44 LL HSW
14. F1 Res 44 LL Recessed HSW/F2
15. F1 Res 58 LL HSW
16. F1 Res 58 LL HSW Recessed HSW/F2
17. F1 Res 44 LL SWC

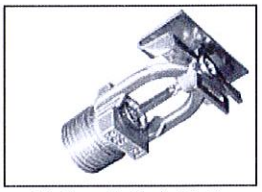
F1 Res 49 LL & 58 LL Recessed Pendent/F1
F1 Res 30 LL Recessed Pendent/F2



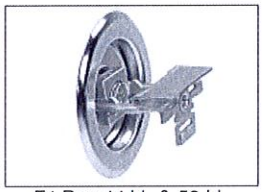
F1 Res 49 LL & 58 LL Recessed Pendent/F1



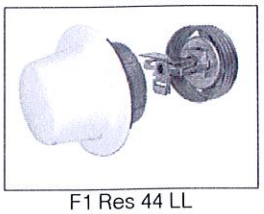
F1 Res 30 LL, 49 LL & 58 LL CCP Pendent



F1 Res 44 LL & 58 LL HSW



F1 Res 44 LL & 58 LL Recessed HSW/F2



F1 Res 44 LL SWC

Listings & Approvals

1. Listed by Underwriters Laboratories Inc. and UL Certified for Canada (cULus)
2. NSF Certified to NSF/ANSI Standard 61 Annex G (Less than 0.25% Lead Content.)

Additional Bulletins applicable to all F1RES LL Sprinklers

- Wall Wetting - Bulletin 007
- Slope Ceiling - Bulletin 035
- Design and Installation - Bulletin 140

UL Listing Category

Residential Automatic Sprinkler

UL Guide Number

VKKW

Patents

US Patent No. 6,516,893 applies to the Model F1 Res 49 LL & 58 LL Pendent Sprinklers
Other patents pending.

Product Description

Model F1 Res LL Pendent sprinklers (Figs. 1, 2, 3, & 4) are fast response sprinklers combining excellent durability, high sensitivity glass-bulb and low profile decorative design. The F1 Res LL Horizontal Sidewall sprinklers (Figs. 5, & 6) are equally attractive when above ceiling piping cannot be used.

The 3mm glass-bulb pendent sprinklers permit the efficient use of residential water supplies for sprinkler coverage in residential fire protection design.

The low flow F1 Res LL sprinklers are specially engineered for fast thermal response to meet the sensitive fire protection application needs of the latest residential market standards (UL 1626 Standard). Upon fire conditions, rising heat causes a sprinkler's heat-sensitive glass-bulb to shatter, releasing the waterway for water flow onto the deflector, evenly distributing the discharged water to control a fire.

Technical Data:

- Thermal Sensor: Nominal 3mm glass-bulb
- Sprinkler Frame : Brass
- Sprinklers' Pressure Rating : 175 psi
  Factory Hydrostatically Tested to 500 psi
- Thread Size: ½" NPT (R½)
- K-Factor: 3.0 (Actual) - F1 Res 30 LL Pendent Sprinkler
  4.9 (Actual) - F1 Res 49 LL Pendent Sprinkler
  5.8 (Actual) - F1 Res 58 LL Pendent & HSW Sprinkler
  4.4 (Actual) - F1 Res 44 LL HSW Sprinkler
- Density: Minimum 0.05 gpm/ft²

The Reliable Automatic Sprinkler Co., Inc., 103 Fairview Park Drive, Elmsford, New York 10523

Application

Model F1 Res LL Sprinklers are used for Residential Fire Protection according to UL 1626 Standard*. Be sure that orifice size, temperature rating, deflector style and sprinkler type are in accordance with the latest published standards of The National Fire Protection Association or the approving authority having jurisdiction.

- **Model F1 Res 30 LL, 49 LL & 58 LL Pendent**

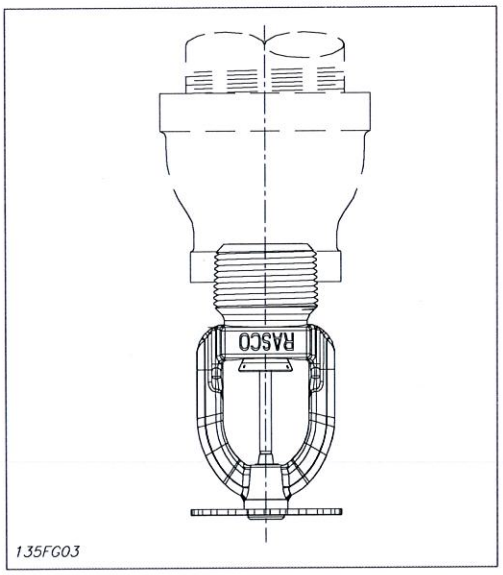


Fig. 1

Installation

Models F1 Res LL sprinklers are to be installed as shown. Model F1, F2 and FP Escutcheons, illustrated herewith, are the only recessed escutcheons to be used with Model F1 Res LL sprinklers. Use of any other recessed escutcheon will void all approvals and warranties. For installing Model F1 Res LL Pendent sprinklers use only the Model D sprinkler Wrench; for installing Models F1 Res LL Recessed Pendent, CCP & SWC sprinklers use only the Model GFR2 sprinkler wrench; for installing Model F1 LL Res Recessed HSW sprinklers use only the Model GFR2 Sprinkler Wrench. Use of wrenches other than those specified may damage these sprinklers. Install F1 Res 44 LL with a ceiling to deflector distance of 4" - 12". Flow arrow on deflector must point away from near wall and "Top" marking must face ceiling.

- **Model F1 Res 30 LL Recessed Pendent / F2**
- **Model F1 Res 49 LL & 58 LL Recessed Pendent / F1**

F1 escutcheon, 3/4" (19mm) adjustment

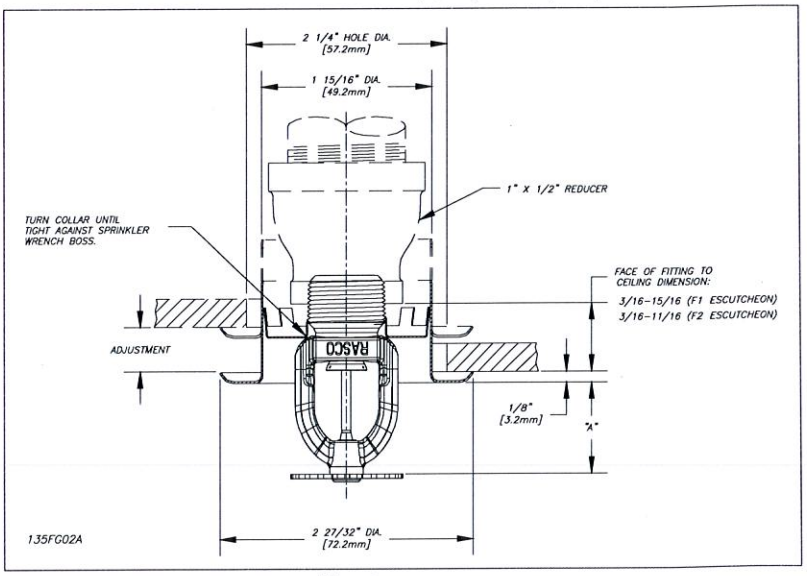


Fig. 2

Escutcheon*, F1 or F2, Data:

Type	Adjustment Inch (mm)	"A" Inch (mm)	Face of fitting to ceiling Inch (mm)
F1	3/4 (19.0)	Min.=3/4" (19.1) Max.=1 1/2" (38.1)	3/16 - 15/16 (4.7 - 24.0)
F2	1/2 (12.7)	Min.=15/16" (23.8) Max.=1 1/2" (38.1)	3/16 - 11/16 (4.7 - 17.4)

* **Note:** Escutcheons F1 or F2 may be used with Model F1 Res 49 LL & 58 LL Recessed Pendent Sprinkler

Bulletin 135 Rev. H

Model F1 Residential Sprinklers for Design Density of .05 gpm/ft²

Model F1 Res Sprinklers engineered for the lowest flows to meet the minimum design density of .05 gpm/ft²

Types:

1. F1 Res 30 Pendent
2. F1 Res 30 Recessed Pendent/F2
3. F1 Res 30 Recessed Pendent/FP
4. F1 Res 49 Pendent
5. F1 Res 49 Recessed Pendent/F1
6. F1 Res 49 Recessed Pendent/FP
7. F1 Res 58 Pendent
8. F1 Res 58 Recessed Pendent/F1
9. F1 Res 58 Recessed Pendent/FP
10. F1 Res 76 Pendent
11. F1 Res 76 Recessed Pendent/F1
12. F1 Res 76 Recessed Pendent/FP
13. F1 Res 30 CCP Pendent
14. F1 Res 49 CCP Pendent
15. F1 Res 58 CCP Pendent
16. F1 Res 76 CCP Pendent
17. F1 Res 44 HSW
18. F1 Res 44 Recessed HSW/F2
19. F1 Res 58 HSW
20. F1 Res 58 HSW Recessed HSW/F2
21. F1 Res 44 SWC

Listings & Approvals

1. Listed by Underwriters Laboratories Inc. and UL Certified for Canada (cULus)
2. NYC MEA 258-93-E

Slope Ceiling Approvals: Refer to Bulletin 035

Sprinklers for .10 Density: Refer to Bulletin 176

UL Listing Category

Residential Automatic Sprinkler

UL Guide Number

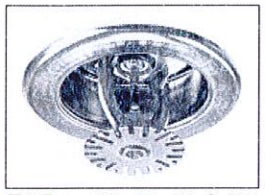
VKKW

Patents

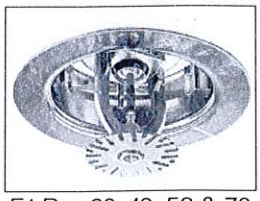
US Patent No. 6,516,893 applies to the Model F1 Res 49 & 58 Pendent Sprinklers

Product Description

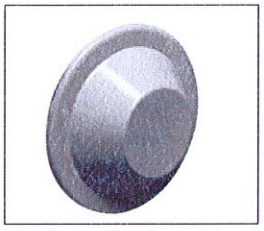
Model F1 Res Pendent sprinklers (Figs. 1, 2, 3, & 4) are fast response sprinklers combining excellent durability, high sensitivity glass-bulb and low profile decorative design. The F1 Res Horizontal Sidewall sprinklers (Figs. 5, 6 & 7) are equally attractive when above ceiling piping cannot be used.



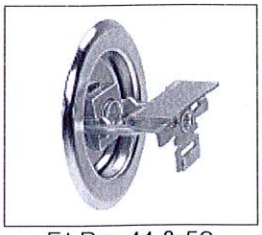
F1 Res 30, 49, 58 & 76 Recessed Pendent / F1



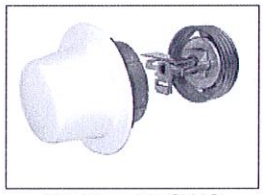
F1 Res 30, 49, 58 & 76 Recessed Pendent / FP



F1 Res 30, 49, 58 & 76 CCP Pendent



F1 Res 44 & 58 Recessed HSW/F2



F1 Res 44 SWC

The 3mm glass-bulb pendent sprinklers permit the efficient use of residential water supplies for sprinkler coverage in residential fire protection design.

The low flow F1 Res sprinklers are specially engineered for fast thermal response to meet the sensitive fire protection application needs of the latest residential market standards (UL 1626 Standard). Upon fire conditions, rising heat causes a sprinkler's heat-sensitive glass-bulb to shatter, releasing the waterway for water flow onto the deflector, evenly distributing the discharged water to control a fire.

Technical Data:

- Thermal Sensor: Nominal 3mm glass-bulb
- Sprinkler Frame : Brass Casting
- Sprinklers' Pressure Rating : 175 psi
  Factory Hydrostatically Tested to 500 psi
- Thread Size: ½" NPT (R½)
- K-Factor: 3.0 (Actual) - F1 Res 30 Pendent Sprinkler
  4.9 (Actual) - F1 Res 49 Pendent Sprinkler
  5.8 (Actual) - F1 Res 58 Pendent & HSW Sprinkler
  7.6 (Actual) - F1 Res 76 Pendent Sprinkler
  4.4 (Actual) - F1 Res 44 HSW Sprinkler
- Density: Minimum 0.05 gpm/ft²

The Reliable Automatic Sprinkler Co., Inc., 103 Fairview Park Drive, Elmsford, New York 10523

Application

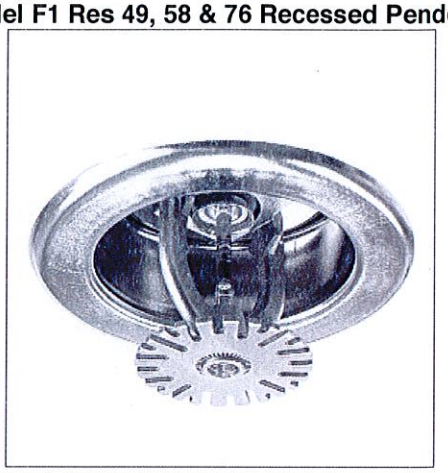
Model F1 Res Sprinklers are used for Residential Fire Protection according to UL 1626 Standard*. Be sure that orifice size, temperature rating, deflector style and sprinkler type are in accordance with the latest published standards of The National Fire Protection Association or the approving authority having jurisdiction.

Installation

Models F1 Res sprinklers are to be installed as shown. Model F1, F2 and FP Escutcheons, illustrated herewith, are the only recessed escutcheons to be used with Model F1 Res sprinklers. Use of any other recessed escutcheon will void all approvals and warranties. For installing Model F1 Res Pendent sprinklers use only the Model D sprinkler

- **Model F1 Res 30, 49, 58 & 76 Pendent**

- **Model F1 Res 30 Recessed Pendent / F2**
- **Model F1 Res 49, 58 & 76 Recessed Pendent / F1**



F1 escutcheon, 3/4" (19mm) adjustment

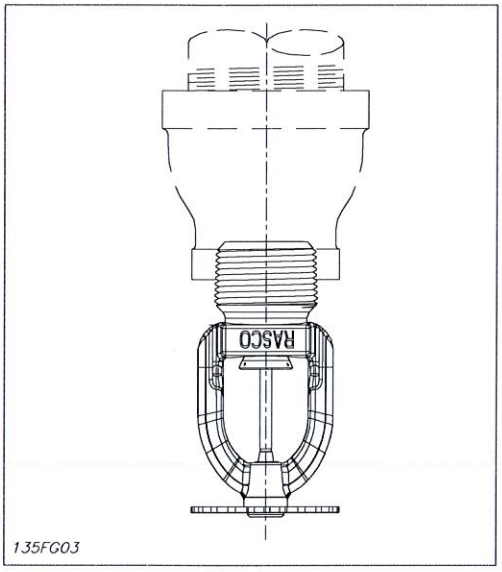


Fig. 1

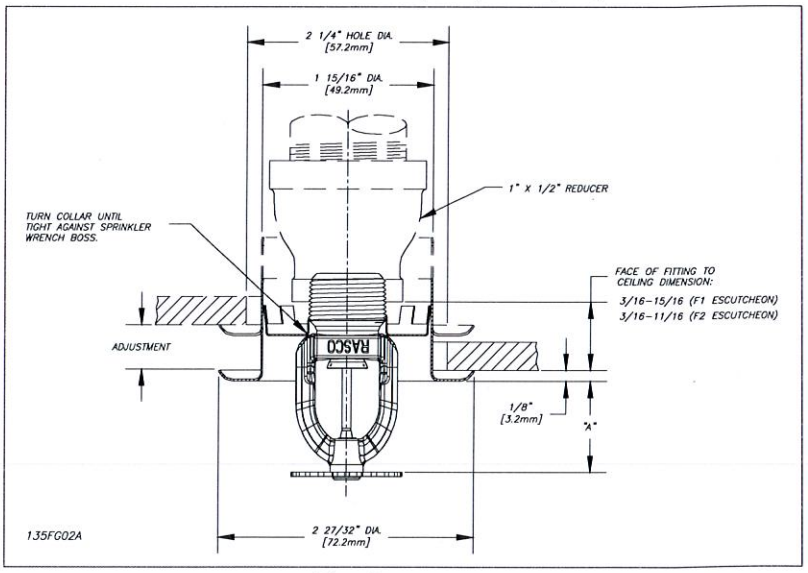


Fig. 2

Wrench; for installing Models F1 Res Recessed Pendent, CCP & SWC sprinklers use only the Model GFR2 sprinkler wrench; for installing Model F1 Res Recessed HSW sprinklers use only the Model GFR2 Sprinkler Wrench. Use of wrenches other than those specified may damage these sprinklers. Install F1 Res 44 with a ceiling to deflector distance of 4" - 12". Flow arrow on deflector must point away from near wall and "Top" marking must face ceiling.

Escutcheon*, F1 or F2, Data:

Type	Adjustment Inch (mm)	"A" Inch (mm)	Face of fitting to ceiling Inch (mm)
F1	3/4 (19.0)	Min.=3/4" (19.1) Max.=1 1/2" (38.1)	3/16 - 15/16 (4.7 - 24.0)
F2	1/2 (12.7)	Min.=15/16" (23.8) Max.=1 1/2" (38.1)	3/16 - 11/16 (4.7 - 17.4)

* **Note:** Escutcheons F1 or F2 may be used with Model F1 Res 49, 58 & 76 Recessed Pendent Sprinkler

Technical Data: F1Res 30 Pendent and Recessed Pendent

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		Actual K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	21/64" (8.2)	155 175	68 79	175 (12)	100	38	3.0	2.25 (57)

Deflector - to - ceiling
Maximum 1" (25mm) to 4" (100mm)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	8 (30.3)	7.0 (0,48)	R3511
14 x 14 (4,3 x 4,3)	10 (37.8)	11 (0,76)	

Technical Data: F1Res 49 Pendent and Recessed Pendent.

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		Actual K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	7/16" (11)	155 175	68 79	175 (12)	100 150	38 66	4.9	2.25 (57)

Deflector - to - ceiling
Maximum 1" (25mm) to 4" (100mm)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	13 (49)	7.0 (0,48)	R3516
14 x 14 (4,3 x 4,3)	13 (49)	7.0 (0,48)	
16 x 16 (4,9 x 4,9)	13 (49)	7.0 (0,48)	
18 x 18 (5,5 x 5,5)	17 (64.3)	12.0 (0,83)	
20 x 20 (6,1 x 6,1)	20 (75.7)	16.7 (1,14)	

Deflector - to - ceiling
Maximum 4" (100mm) to 8" (203mm)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	15 (57)	9.4 (0,65)	R3516
14 x 14 (4,3 x 4,3)	16 (60.5)	10.6 (0,73)	
16 x 16 (4,9 x 4,9)	17 (64.3)	12.0 (0,83)	
18 x 18 (5,5 x 5,5)	19 (72)	15.0 (1,0)	
20 x 20 (6,1 x 6,1)	22 (83.2)	20.2 (1,4)	

***Note:** The F1 Res 49 pendent and recessed pendent residential sprinklers can be installed per NFPA 13 in beamed ceilings meeting the following criteria:

1. Maximum beam depth = 7" (178mm)
2. Beam spacing at or greater than 7.5 ft. (2.3m) on center.

Technical Data: F1Res 58 Pendent and Recessed Pendent.

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		Actual K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	½" (13)	155 175	68 79	175 (12)	100 150	38 66	5.8	2.25 (57)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Ceiling -to- Deflector Inch (mm)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	16 (61)	7.6 (0,53)	1- 4 (25 - 100)	R3513
14 x 14 (4,3 x 4,3)	16 (61)	7.6 (0,53)		
16 x 16 (4,9 x 4,9)	16 (61)	7.6 (0,53)		
18 x 18 (5,5 x 5,5)	19 (72)	10.8 (0,75)		
20 x 20 (6,1 x 6,1)	22 (83.3)	14.4 (1,0)		

Reliable®

Model F1 Residential Sprinklers for Design Density of .10 gpm/ft²

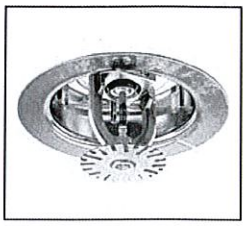
Bulletin 176 Rev. A

Model F1 Res Sprinklers engineered for the lowest flows to meet the minimum design density of .05 gpm/ft²

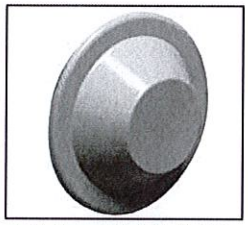
Types:

1. F1 Res 49 Pendent
2. F1 Res 49 Recessed Pendent/F1
3. F1 Res 49 Recessed Pendent/FP
4. F1 Res 49 CCP Pendent
5. F1 Res 58 Pendent
6. F1 Res 58 Recessed Pendent/F1
7. F1 Res 58 Recessed Pendent/FP
8. F1 Res 58 CCP Pendent
9. F1 Res 44 & 58 HSW
10. F1 Res 44 & 58 HSW Recessed HSW/F2
11. F1 Res 44 SWC
12. F1 Res 76 Pendent
13. F1 Res 76 Recessed Pendent/F1
14. F1 Res 76 Recessed Pendent/FP
15. F1 Res 76 CCP Pendent

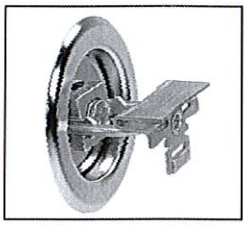
F1 Res 49, 58 & 76 Recessed Pendent / F1



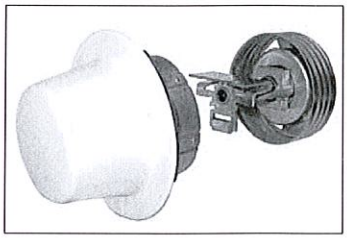
F1 Res 49, 58 & 76 Recessed Pendent / FP



F1 Res 49, 58 & 76 CCP Pendent



F1 Res 44 & 58 Recessed HSW/F2



F1 Res 44 SWC

Listings & Approvals

1. Listed by Underwriters Laboratories Inc. and UL Certified for Canada (cULus)
2. NYC MEA 258-93-E

UL Listing Category

Residential Automatic Sprinkler

UL Guide Number

VKKW

Patents

US Patent No. 6,516,893 applies to the Model F1 Res 49 & 58 Pendent Sprinklers

Product Description

Model F1Res Pendent sprinklers (Figs. 1, 2, 3 & 4) combine excellent durability, high sensitivity glass-bulb and low profile decorative design.

The 3mm glass-bulb pendent sprinklers permit the efficient use of residential water supplies for sprinkler coverage in residential fire protection design.

The low flow F1 Res sprinklers are specially engineered for fast thermal response to meet the sensitive fire protection application needs of the latest residential market standards (UL 1626 Standard *).

Upon fire conditions, rising heat causes a sprinkler's heat-sensitive glass-bulb to shatter, releasing the waterway for water flow onto the deflector, evenly distributing the discharged water to control a fire.

Technical Data:

- Thermal Sensor: Nominal 3mm glass-bulb
- Sprinkler Frame : Brass Casting
- Sprinklers' Pressure Rating : 175 psi
  Factory Hydrostatically Tested to 500 psi
- Thread Size: ½" NPT (R1/2)
- K-Factor: 4.9 (Actual) - F1 Res 49 Pendent Sprinkler
  5.8 (Actual) - F1 Res 58 Pendent & HSW Sprinkler
  7.6 (Actual) - F1 Res 76 Pendent Sprinkler
  4.4 (Actual) - F1 Res 44 HSW Sprinkler
- Density: Minimum 0.10 gpm/ft²

* Effective date 7/12/02

The Reliable Automatic Sprinkler Co., Inc., 103 Fairview Park Drive, Elmsford, New York 10523

Application

Model F1 Res Sprinklers are used for Residential Fire Protection according to UL 1626 Standard*. Be sure that orifice size, temperature rating, deflector style and sprinkler type are in accordance with the latest published standards of The National Fire Protection Association or the approving authority having jurisdiction.

When using F1 Residential Sprinklers for systems design to NFPA 13D or NFPA 13R, use listed area of coverage and minimum flow and pressure requirements shown in Bulletin 135.

For systems designed to NFPA 13, use information in this bulletin. The number of design sprinklers shall be the most hydraulically demanding sprinklers as required by NFPA 13. Flows and pressures can not be below the baseline flows and pressurers.

NFPA 13

For residential sprinkler systems designed to NFPA 13, a minimum density of 0.1 gpm/ft^2 must be provided over the "design area" that includes the four (4) hydraulically most demanding sprinklers for the actual coverage areas being protected by the 4 sprinklers. The minimum required discharge from each of the four most hydraulically demanding sprinklers shall be the greater of the following:

1. The flow rates given in the Reliable Residential Sprinkler Technical Bulletins referenced in Table A for NFPA 13D and 13R as a function of temperature rating and maximum allowable coverage area (for actual coverage areas less than or between those indicated in the respective technical bulletin, it is required to use the minimum required flow for the next largest coverage area); or
2. A minimum discharge density of 0.1 gpm/ft^2 applied over the "design area" consisting of the four most hydraulically demanding sprinklers for the actual coverage areas being protected by the four sprinklers. The maximum dimension of the actual coverage area cannot be any greater than the maximum coverage area indicated in the technical bulletins referenced in Table A.

   Design Note: Using the A_S = S x L method to determine the sprinkler protection area of coverage in accordance with NFPA 13, apply the 0.1 gpm/ft^2 density to this area to determine the minimum required flow. Compare this flow to the minimum 0.05 gpm/ft^2 cULus Listed flow for the appropriate coverage area in the technical bulletin for the specific residential sprinkler. If the flow stated in the technical bulletin is less than the calculated 0.1 gpm/ft^2 density flow required, the .1 density flow must then be used in the equation $Q=K\sqrt{P}$, solving for P, to establish the minimum required pressure using the sprinkler K-factor. **Note:** In many cases the listed flow of individual residential sprinklers may exceed the required minimum 0.05 gpm/ft^2 density. Reliable has available residential sprinklers with larger K-factors (K=5.8 and K=7.6) that will provide lower pressure demands for 0.1 gpm/ft^2 densities in NFPA 13 residential applications.

Example No. 1
Room Size= 12 ft x 20 ft (3.6 m x 6.1 m)
Coverage Area= 12 x 20 = 240 ft^2 (22.3 m^2)
Flow @ 0.10 gpm/ft^2 density= 240 x 0.10 = 24 gpm
Using an F1 Res 49 Pendent Sprinkler, K=4.9
Pressure= $(24/4.9)^2$ = 24 psi (1.65 bar)
The baseline flow for a 20 ft x 20 ft (6.1 m x 6.1 m) coverage area using the baseline density of 0.05 gpm/ft^2 will be 20 gpm @ 16.7 psi (75.7 L/min @ 1.14 bar). Therefore, the minimum flow required is 24 gpm @ 24 psi (90.8 L/min @ 1.65 bar).

Example No. 2
Room Size= 8 ft x 20 ft (2.4 m x 6.1 m)
Coverage Area= 8 x 20 = 160 ft^2 (14.9 m^2)
Flow @ 0.10 gpm/ft^2 density= 160 x 0.10 = 16 gpm
Using an F1 Res 49 Pendent Sprinkler, K=4.9
Pressure= $(16/4.9)^2$ = 10.7 psi (0.74 bar)
The baseline flow for a 20 ft x 20 ft (6.1 m x 6.1 m) coverage area using the baseline density of 0.05 gpm/ft^2 will be 20 gpm @ 16.7 psi (75.7 L/min @ 1.14 bar). Therefore, the minimum flow required is 20 gpm @ 16.7 psi (75.7 L/min @ 1.14 bar).

Example No. 3
Room Size= 10 ft x 16 ft (3.0 m x 4.91 m)
Coverage Area= 10 x 16 = 160 ft^2 (14.9 m^2)
Flow @ 0.10 gpm/ft^2 density= 160 x 0.10 = 16 gpm
Using an F1 Res 76 Pendent Sprinkler, K=7.6
The baseline flow for a 16 ft x 16 ft coverage area is 21 gpm @ 7.6 psi (79.5 L/min @ 0.52 bar). Therefore, the minimum flow and pressure is 21 gpm @ 7.6 psi (79.5 L/min @ 0.52 bar).

Example No. 4
Room Size= 14 ft x 18 ft (4.3 m x 5.5 m)
Coverage Area= 14 x 18 = 252 ft^2 (23.6 m^2)
Flow @ 0.10 gpm/ft^2 density= 252 x 0.10 = 25.2 gpm (94.6 L/min)
Using an F1 Res 76 Pendent Sprinkler, K=7.6
Pressure= $(252/7.6)^2$ = 11 psi (0.76 bar)
The baseline flow and pressure of an 18 ft x 18 ft coverage area is 21 gpm @ 7.6 psi (79.5 L/min @ 0.52 bar). Therefore, the minimum flow and pressure is 25.2 gpm @ 11 psi (94.6 L/min @ 0.76 bar).

In general residential sprinklers require flows and pressures as listed for 0.05 densities to achieve the proper spray pattern so the flows and pressures at 0.05 density are the baseline flows and pressures. Flows and pressures below the listed 0.05 density shall not be used.

Installation

Models F1 Res sprinklers are to be installed as shown. Model F1, F2 and FP Escutcheons, illustrated herewith, are the only recessed escutcheons to be used with Model F1 Res sprinklers. Use of any other recessed escutcheon will void all approvals and warranties. For installing Model F1 Res Pendent sprinklers use only the Model D sprinkler Wrench; for installing Models F1 Res Recessed Pendent, CCP sprinklers use only the Model GFR2 sprinkler wrench; for installing Model F1 Res recessed HSW sprinklers use only the Model GFR2 Sprinkler wrench. Use of wrenches other than those specified may damage these sprinklers.

Note: A 'leak tight" sprinkler joint can be obtained with the following torque:

- ¾" NPT (R3/4) – 14-20 ft-lbs (19 - 27.1 N-m)
- ½" NPT (R1/2) – 8-18 ft-lbs (10.8 – 24.4 N-m)

Do not tighten sprinklers over maximum recommended torque. It may cause leakage or impairment of the sprinklers.

- **Model F1 Res 49, 58 & 76 Pendent**

- **Model F1 Res 49, 58 & 76 Recessed Pendent / F1/F2**

F1 escutcheon, ¾" (19mm) adjustment

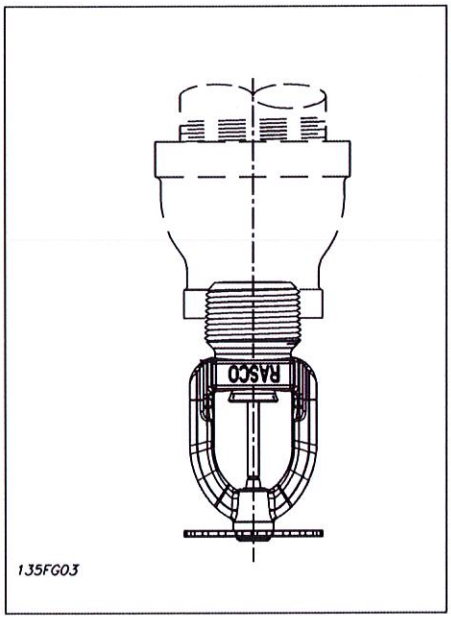


Fig. 1

Note: See escutcheon table for dimensions.

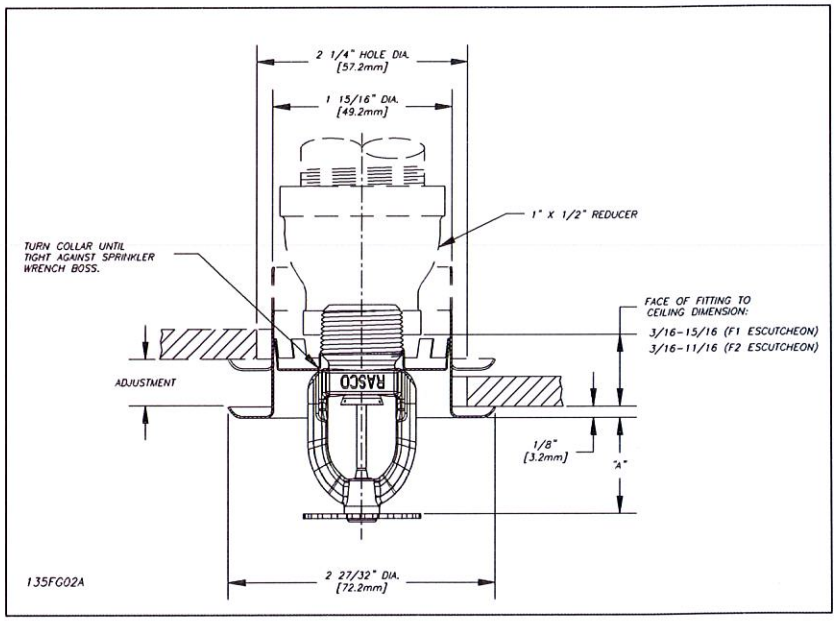
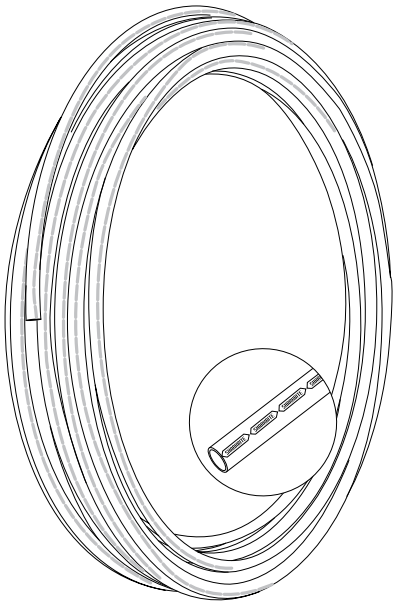


Fig. 2

SharkBite® PEX Tubing Without Oxygen Barrier

DESCRIPTION

SharkBite® tubing is a cross-linked polyethylene tubing used for potable water application. The tubing is printed with a SharkBite® imprint pattern that provides a visual aid to determine if the tube has been inserted all the way into the SharkBite® push-fit fitting. This feature only works if the tubing is cut between the SharkBite® imprint pattern.



FEATURES AND BENEFITS

Tubing printed with SharkBite® imprint pattern:
Allows for easy assembly with SharkBite® push-fit fittings without use of elaborate and costly tools.

SharkBite® tubing:
Strong, flexible, resilient tubing that provides superior temperature performance.

Complete connection system:
System provides a wide selection of fittings and tubing to ensure a trouble-free rough-in.

Listed to NSF 14 and CSA B137.5 for use in potable water systems:
Inspector friendly, peace of mind!

Manufactured and tested to meet or exceed the requirements of the ASTM F-876, ASTM F-877, ASTM F-2023 and CSA B137.5:
Specify and install with confidence!

Variety of connections options, SharkBite® PEX can be connected with SharkBite® push-fit fittings, or Cash Acme barbed fittings:
Flexible installation options.

SPECIFICATION

System shall be plumbed using SharkBite® Tubing cross-linked polyethylene pipe and all joints shall be made using SharkBite® push-fit fittings or brass Cash Acme barbed fittings with clamps. Tubing and fittings shall be installed as outlined in the SharkBite® PEX installation manual.

SPECIFICATION DATA

Performance:
Maximum Working Pressure:
160 psi @ 73.4°F (23°C)
100 psi @ 180°F (82°C)
80 psi @ 200° F (93°C)

Materials:
Tubing . . . . . PEX-B cross-linked polyethylene

CERTIFICATIONS

The **SharkBite® tubing** is approved for use in all model codes in the US and Canada for use in hydronic and potable water systems and is certified to the following standards: **NSF 14/61, NSF P171, ASTM F-876, ASTM F-877, CSA B137.5 and AWWA C904.**

CASH ACME®

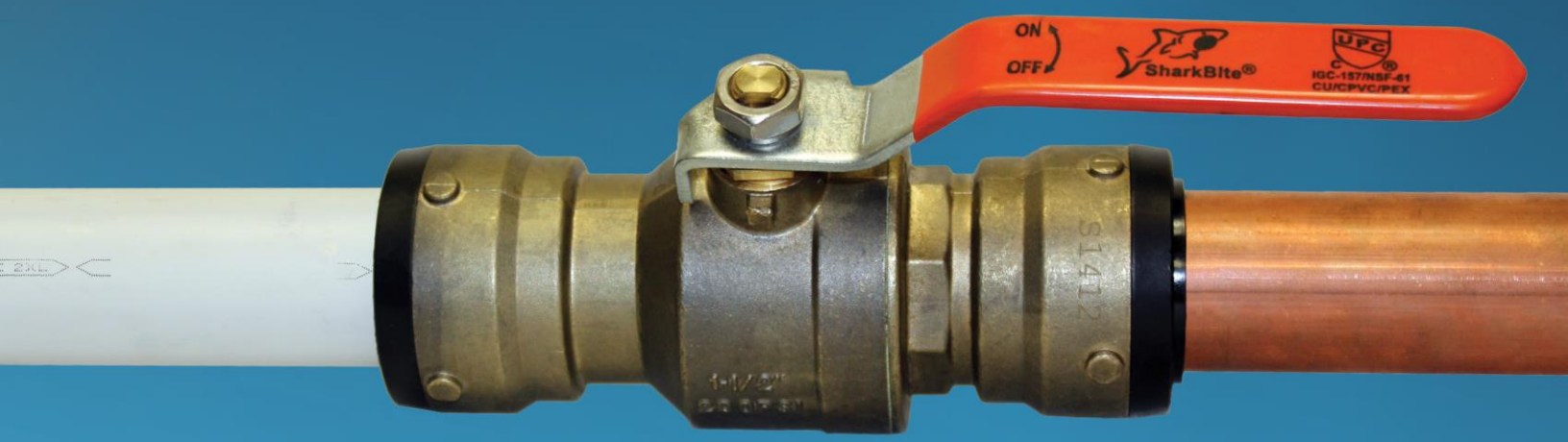
SharkBite® PEX Tubing Without Oxygen Barrier

SPECIFICATION DATA

Model	Nominal Tubing Size				Length		Bend Radius		Fluid Capacity Per 100'		Package Weight	
	ID		OD		ft	M	in	mm	gal	ltrs	lbs	kgs
	in	mm	in	mm								
Natural PEX w/Black Text (Coil)												
U855N100	3/8"	10	1/2"	15	100	30.48	4	102	0.53	2.01	4.5	2.0
U855N300	3/8"	10	1/2"	15	300	91.44	4	102	0.53	2.01	13.5	6
U855N500	3/8"	10	1/2"	15	500	152.40	4	102	0.53	2.01	23	10.4
Natural PEX w/Red Text (Coil)												
U855NR100	3/8"	10	1/2"	15	100	30.48	4	102	0.53	2.01	4.5	2.0
U855NR300	3/8"	10	1/2"	15	300	91.44	4	102	0.53	2.01	13.5	6
U855NR500	3/8"	10	1/2"	15	500	152.40	4	102	0.53	2.01	23	10.4
Blue PEX (Coil)												
U860B100	1/2"	13	5/8"	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860B300	1/2"	13	5/8"	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860B500	1/2"	13	5/8"	16	500	152.40	5	127	0.96	3.63	24	10.9
U870B100	3/4"	19	7/8"	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870B300	3/4"	19	7/8"	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870B500	3/4"	19	7/8"	22	500	152.40	7	178	1.9	7.19	45	20.4
U880B100	1"	25	1-1/8"	29	100	30.48	10	254	3.1	11.73	18	8.2
U880B300	1"	25	1-1/8"	29	300	91.44	10	254	3.1	11.73	54	24.6
U880B500	1"	25	1-1/8"	29	500	152.40	10	254	3.1	11.73	90	40.8
Red PEX (Coil)												
U860R100	1/2"	13	5/8"	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860R300	1/2"	13	5/8"	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860R500	1/2"	13	5/8"	16	500	152.40	5	127	0.96	3.63	24	10.9
U870R100	3/4"	19	7/8"	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870R300	3/4"	19	7/8"	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870R500	3/4"	19	7/8"	22	500	152.40	7	178	1.9	7.19	45	20.4
U880R100	1"	25	1-1/8"	29	100	30.48	10	254	3.1	11.73	18	8.2
U880R300	1"	25	1-1/8"	29	300	91.44	10	254	3.1	11.73	54	24.6
U880R500	1"	25	1-1/8"	29	500	152.40	10	254	3.1	11.73	90	40.8
White PEX (Coil)												
U860W100	1/2"	13	5/8"	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860W300	1/2"	13	5/8"	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860W500	1/2"	13	5/8"	16	500	152.40	5	127	0.96	3.63	24	10.9
U870W100	3/4"	19	7/8"	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870W300	3/4"	19	7/8"	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870W500	3/4"	19	7/8"	22	500	152.40	7	178	1.9	7.19	45	20.4
U880W100	1"	25	1-1/8"	29	100	30.48	10	254	3.1	11.73	18	8.2
U880W300	1"	25	1-1/8"	29	300	91.44	10	254	3.1	11.73	54	24.6
U880W500	1"	25	1-1/8"	29	500	152.40	10	254	3.1	11.73	90	40.8
Blue PEX (Straight Lengths)												
U860B5	1/2"	13	5/8"	16	5'	1.52	5	127	0.96	3.63	3.00	1.4
U860B10	1/2"	13	5/8"	16	10'	3.04	5	127	0.96	3.63	6.00	2.7
U860B20	1/2"	13	5/8"	16	20'	6.09	5	127	0.96	3.63	12.0	5.5
U870B5	3/4"	19	7/8"	22	5'	1.52	7	178	1.9	7.19	5.25	2.5
U870B10	3/4"	19	7/8"	22	10'	3.04	7	178	1.9	7.19	10.5	4.8
U870B20	3/4"	19	7/8"	22	20'	6.09	7	178	1.9	7.19	21	9.5
U880B5	1"	25	1-1/8"	29	5'	1.52	10	254	3.1	11.73	TBD	TBD
U880B10	1"	25	1-1/8"	29	10'	3.04	10	254	3.1	11.73	TBD	TBD
U880B20	1"	25	1-1/8"	29	20'	6.09	10	254	3.1	11.73	TBD	TBD
Red PEX (Straight Lengths)												
U860R5	1/2"	13	5/8"	16	5'	1.52	5	127	0.96	3.63	3.00	1.4
U860B10	1/2"	13	5/8"	16	10'	3.04	5	127	0.96	3.63	6.00	2.7
U860B20	1/2"	13	5/8"	16	20'	6.09	5	127	0.96	3.63	12.0	5.5
U870B5	3/4"	19	7/8"	22	5'	1.52	7	178	1.9	7.19	5.25	2.5
U870B10	3/4"	19	7/8"	22	10'	3.04	7	178	1.9	7.19	10.5	4.8
U870B20	3/4"	19	7/8"	22	20'	6.09	7	178	1.9	7.19	21	9.5
U880B5	1"	25	1-1/8"	29	5'	1.52	10	254	3.1	11.73	TBD	TBD
U880B10	1"	25	1-1/8"	29	10'	3.04	10	254	3.1	11.73	TBD	TBD
U880B20	1"	25	1-1/8"	29	20'	6.09	10	254	3.1	11.73	TBD	TBD
White PEX (Straight Lengths)												
U860R5	1/2"	13	5/8"	16	5'	1.52	5	127	0.96	3.63	3.00	1.4
U860W10	1/2"	13	5/8"	16	10'	3.04	5	127	0.96	3.63	6.00	2.7
U860W20	1/2"	13	5/8"	16	20'	6.09	5	127	0.96	3.63	12.0	5.5
U870W5	3/4"	19	7/8"	22	5'	1.52	7	178	1.9	7.19	5.25	2.5
U870W10	3/4"	19	7/8"	22	10'	3.04	7	178	1.9	7.19	10.5	4.8
U870W20	3/4"	19	7/8"	22	20'	6.09	7	178	1.9	7.19	21	9.5
U880W5	1"	25	1-1/8"	29	5'	1.52	10	254	3.1	11.73	TBD	TBD
U880W10	1"	25	1-1/8"	29	10'	3.04	10	254	3.1	11.73	TBD	TBD
U880W20	1"	25	1-1/8"	29	20'	6.09	10	254	3.1	11.73	TBD	TBD

SharkBite®
Plumbing Solutions

SHARKBITE® PUSH-FIT CONNECTION SYSTEM



Push To Connect Fittings for Copper, PEX and CPVC

Specification Submittal Package for Potable Water and Hydronic Heating

www.sharkbite.com

Table of Contents

SYSTEM DATA SHEET

System Description
The SharkBite Push-Fit quick-connect plumbing system is the easiest and most dependable way to join copper, CPVC or PEX pipe in any combination—with no soldering, clamps, unions or glue. Available in an assortment of over 200 fittings and sizes ranging from ¼" to 2" copper tube size (CTS).

Applications
Tubing: Hard drawn copper pipe Type K, L and M and annealed Type M not to exceed 3/8 nominal complying with ASTM B 88, PEX tubing complying with ASTM F 876 or CSA B137.5, or CVPC tubing complying with ASTM D 2846 or CSA B137.6. SharkBite fittings are approved for installations above and below ground applications. Please consult with local code for final approval. Failure to comply with the above types of pipe or application could result in connection failures.

Operating Parameters
Operating Pressure: 200 PSI Max
Operating Temperature: 200°F Max

Approved Applications
- Potable Water
- Hydronic Heating (w/ Glycol concentration up to 100%)

System Benefits
- Instant push-fit connection for increased ease of use
- No soldering, clamps, unions or glue needed
- Reduces installation time with no tightening of nuts, clamps and unions.
- Connects three types of pipe in any combination
- No mapping of system
- Can be installed wet or dry
- Rotatable after installation
- Approved for behind the wall and underground applications.
- Removable after installation
- Clean, professional installation

Fittings
SharkBite push-fit fittings are available in 200+ configurations including: Couplings, Elbows, Tees, Reducers, Threaded Adapters, Caps, Stops, Stub Outs, Ball Valves, Slips, Water Heater Hoses and Valves with SharkBite Connections. Made from Lead Free Dezincification Resistant (DZR) brass and available in sizes ¼" – 2" CTS.

Push-Fit Technology
The SharkBite fitting works via a two stage process that ensures a quick, easy connection.
- The tubing passes through the release collar and then through the stainless steel grab ring.
- The tube is pushed through an o-ring protector that aligns the tube. It then passes through a specially formulated o-ring that compresses between the pipe and the wall of the fitting before it reaches the tube stop.

How to Make a Connection
1. Cut the pipe. Make sure the cut is square and even.
2. Deburr the end of the pipe to remove any sharp edges. Sharp edges can cut the o-ring and lead to leaks.
3. Mark the pipe with the proper insertion depth (see below for reference).
4. Push the pipe into the fitting. The mark made on the pipe should rest against the collar of the fitting, ensuring a proper seal.

FITTING SIZE	INSERTION DEPTH
1/4"	0.813"
3/8"	0.875"
1/2"	0.938"
5/8"	1.125"
3/4"	1.125"
1"	1.313"
1-1/4"	2.000"
1-1/2"	2.250"
2"	2.500"

Tube Liner
SharkBite fittings ranging in sizes 3/8" to 1" come with an integral tube liner preinstalled for use with PEX pipe. SharkBite sizes 1-1/4" to 2" do not come with tube liners preinstalled and are sold separately. The tube liner must be used when PEX piping is utilized.

Tools
Tools are available to make the installation process easier.
- SharkBite depth & deburring tool for 1/4" to 1" CTS
- SharkBite depth & deburring tool for 1-1/4" to 2" CTS
- SharkBite disconnect clip (1 size per tubing)
- SharkBite disconnect tongs (1 size per tubing)

History
SharkBite was launched in the Australian market in 1999 and in the North America market in 2004, ushering in a new way to do plumbing. Reliance Worldwide, an ISO 9001 organization, is one of the world's largest manufacturers of thermostatic water control valves and has been a major world supplier of hot water safety valves for over 50 years.

Warranty
SharkBite fittings carry a 25 year warranty against any manufacturer's defect as long as the item has been installed per installation instructions and comply with local code. Please contact Customer Service for more information.

IAPMO
http://pld.iapmo.org/default.asp
(Select Listee Name and enter "Reliance Worldwide")

For more information on SharkBite products, contact:
Reliance Worldwide Corporation
2727 Paces Ferry Road
Building 2, Suite 1800
Atlanta, GA 30339
United States: 1-877-700-4242
Canada: 1-888-820-0120
Web: www.sharkbite.com

ENGINEERING SPECIFICATIONS

The push-fit fitting shall be installed on hard drawn copper type K, L and M complying with ASTM B88, cross-linked polyethylene pipe (PEX) complying with ASTM F 876 or CSA B137.5 or CPVC piping complying with ASTM D 2846 or CSA B137.6. The fitting shall be made of lead free dezincification brass and compliant with ASSE 1061, NSF/ANSI 61 and NSF/ANSI 372. The fitting shall consist of an EPDM O-ring, a grade 316 stainless steel grab ring, and contain a polysulfone tube liner for PEX applications. The fitting shall be used in a potable water system or a hydronic heating water distribution up to 200 psi and 200°F. The fitting shall be a SharkBite fitting.

PART 1: GENERAL

1.1 SUMMARY

A. Push-Fit Connection System for Potable Water Distribution and Hydronic Heating Water Distribution

1.2 DEFINITIONS

A. ASME: American Society of Mechanical Engineers
B. ASSE: American Society of Safety Engineers
C. ASTM: American Society for Testing and Materials
D. CSA: Canadian Standards Association
E. EPDM: Ethylene Propylene Diene Monomer
F. IAPMO: International Association of Plumbing and Mechanical Officials
G. NSF: National Sanitation Foundation

1.3 REFERENCES

A. ASSE 1061: Performance Requirements for Push-Fit Fittings
B. NSF/ANSI Standard 61: Certification for Drinking Water System Components – Health Effects
C. NSF/ANSI Standard 14: Plastics Piping System Components and Related Materials
D. NSF/ANSI Standard 372: Lead Content Certification
E. ASTM B 88: Standard Specifications for Seamless Copper Water Tube
F. ASTM F 876: Standard Specification for Cross-linked Polyethylene (PEX) Tubing
G. CSA B137.5: Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications
H. CSA B137.6
I. ASTM D 2846: Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot-and Cold-Water Distribution Systems.
J. IAPMO: Uniform Plumbing Code
K. IAPMO: National Plumbing Code of Canada
L. IAPMO: International Plumbing Code
M. AWWA C904: Cross-Linked Polyethylene (PEX) Pressure Pipe, ½ In. (12mm) Through 3 In. (.76 mm) for Water Service.

1.4 QUALITY ASSURANCE

A. Installer shall be well informed on installation instructions prior to installing.
B. The installation of tubing and fittings for hot and cold water distribution systems shall conform to the requirements of the ICC International Plumbing Code or IAPMO Uniform Plumbing Code.
C. The piping shall be cut square, even and have no rough edges.

1.5 WARRANTY

A. SharkBite Push-Fit Fittings have a 25 year limited warranty from point of sale.
B. All products must be installed in accordance with all applicable codes and in accordance with any local, state, provincial or federal requirements.
C. The installing contractor must use construction techniques compliant with applicable codes to install the range of products and use the product(s) within the design parameters specified in any installation guidelines and technical notes for the applicable system. This shall include field pressure testing prior to concealing with concrete or by other means.
D. Products must not be installed in a system that may operate at temperatures or at pressures that exceed the printed rating on the product, packaging or installation instructions.
E. Evidence of tampering, mishandling, neglect, accidental damage, freeze damage or unauthorized modifications or repairs that cause damage to RWC warranted products void any warranty coverage of those particular products. It is expressly understood that failure as a result of any freezing fluids within the pipes does not constitute a defect in material or workmanship and shall not be covered by this warranty.
F. Although RWC provides a plumbing system to facilitate a complete installation, other manufacturers tubing and/or fittings may be installed in any given installation provided manufacturing of the tubing and/or fittings demonstrates compliance with the applicable ASTM standards, and the product has been certified by a recognized third-party testing agency. The RWC product in the given installation will continue to be covered under this warranty. **NOTE**: RWC will be responsible only for proven defects in material or workmanship in RWC products. Problems in products manufactured by another company should be reported to that manufacturer.
G. For full warranty information, please see page 30.

PART 2: PRODUCTS

2.1 MANUFACTURERS

A. RWC, 2727 Paces Ferry Road, Building 2, Suite 1800, Atlanta, GA 30339
Telephone: 1-877-700-4242, Website: www.sharkbite.com

2.2 MATERIAL

A. Tubing Standard: Copper tubing shall be hard drawn Type K, L, or M and annealed Type M copper complying with ASTM B 88.
B. Tubing Standard: Cross-linked polyethylene pipe (PEX) shall conform to ASTM F 876 or CSA B137.5.
C. Tubing Standard: CPVC tubing shall conform to ASTM D 2846 or CSA B137.6.
D. O-ring shall be made from EPDM.
E. Grab ring shall be made from Grade 316 Stainless Steel.
F. Push-fitting: Brass fitting shall comply with ASSE 1061 and NSF/ANSI 61.

2.3 SOURCE QUALITY

A. All fittings in contact with drinking water shall be listed by a third party agency to NSF 61.

PART 3: EXECUTION

3.1 EXAMINATION

A. If installing PEX pipe, ensure that the tube liner has been installed.
B. Ensure the fitting is free from any damage, including but not limited to damaged or missing O-ring, cracked brass forging or deformed grab ring.

3.2 PREPARATION

A. The tubing shall be cut square to ensure a proper connection.
B. The tubing shall be free of dirt, debris or scale buildup. Any burrs shall be removed using a deburring tool.
C. Mark the piping to use as verification of proper insertion into the fitting.

3.3 INSTALLATION

A. Push-fit fitting shall be installed in accordance with the manufacturer's installation instructions.
B. Pressure Rating: Install components having a pressure rating equal to or less than the system operating pressure.
C. Threaded Joints: Threaded joints shall have thread seal tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
D. Pipe Protection: Provide protection against abrasion where tubing/fitting is in contact with other building materials (including burial) by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
E. Hydronic Heating: Glycol mixture for hydronic heating application is acceptable up to and including 100%.
F. Behind the wall installation: Pressure test system for no less than 24 hours to ensure no leakage.
G. Removal and reuse of push-fit fitting is allowed when executed in accordance with manufacturer's installation instructions.

3.4 FIELD QUALITY CONTROL

A. Water Testing: The copper tubing system shall be water tested for joint tightness. The piping system shall be filled with water. The system shall be pressurized to the maximum pressure and length of time required by the code or standard. The system shall have no leaks at the rated pressure.

THE SHARKBITE DESIGN (1/4” – 1”)

The SharkBite Fitting incorporates a number of unique and patented features.

WHY SHARKBITE?

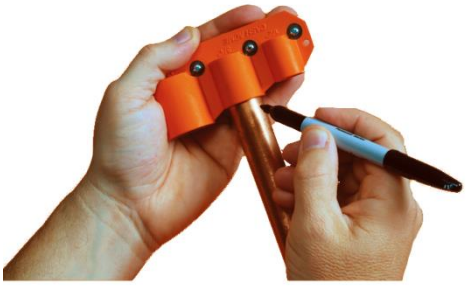
- **Instant push-fit connection for increased ease-of-use:**
  - No soldering, clamps, unions, or glue required.
- **Fittings certified to 200 PSI and 200°F (93°C):**
  - Proven durability and quality.
- **Fits copper tubing, and CTS CPVC and PEX:**
  - Connects all three types in any combination.
- **Integral tube liner for PEX installations:**
  - Integrated design means no loose components, ensures secure, reliable connection.
- **Design certified and agency listed:**
  - Inspector friendly, peace of mind!
- **Compact, robust DZR brass body:**
  - Foundation of a strong, corrosion resistant, durable fitting.
- **Design certified to ANSI/NSF-61 and ASSE 1061 product standard for use in potable water and hydronic heating water distribution:**
  - Quality engineered and manufactured.
- **Approved to be used underground and behind walls without access panels.**
  - Designed for hydronic heating as well as potable water distribution.

CONNECTING A SHARKBITE FITTING

1. Cut the desired length of pipe.
    - Make sure cuts are square and even.

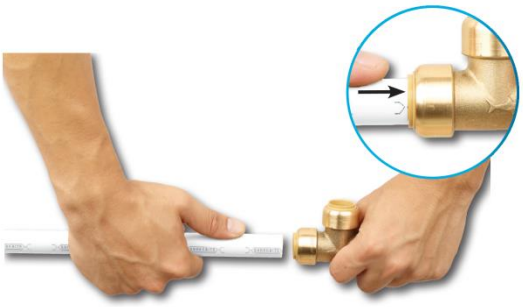
2. Deburr the end of the pipe to remove any sharp edges.
    - This will ensure that the o-ring will not be damaged upon insertion of the pipe.

3. Using a depth gauge, mark the pipe.
    - A 1” mark on the pipe can be used as a guideline. Proper insertion depths are listed below.
    - This will let you know if your connection is successful.



Pipe Size	Insertion Depth
1/4”	0.813”
3/8”	0.875”
1/2”	0.938”
5/8”	1.125”
3/4”	1.125”
1”	1.313”

4. Push the pipe into the fitting.
    - The mark you made on the pipe should rest against the edge of the fitting.



DISCONNECTING A FITTING

With the Disconnect Clip

1. Place the SharkBite disconnect clip around the tube with the non-branded side against the release collar.

2. Push the clip against the release collar and pull the tube with a twisting action to release the tube.

With Disconnect Tongs

1. Place the teeth around the fitting assembly. The fork end with the SharkBite brand logo should be positioned around the tube and the other end around the neck of the fitting.

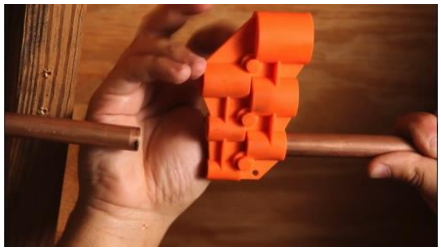
2. Squeeze the tool with one hand and pull the tube with a twisting action with the other hand to release the tube.

Check the fitting and tube end for damage. The fitting and tubing should be free of damage, foreign objects and marks on the outside diameter. If the tubing is damaged or marked, then cut and use a new section of tubing.

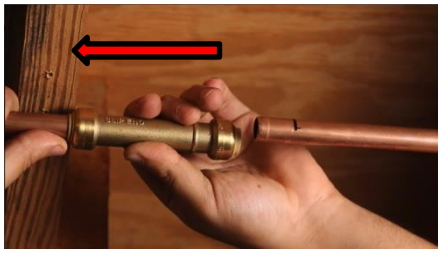
SHARKBITE SLIP PRODUCTS

Slip fittings simplify repair by doing the job that two couplings and extra pipe would do. Only one end of the coupling has a stop, allowing the other end to slide freely over the end of a pipe. The fitting can be released with a disconnect tool and slid back onto the other end of the pipe for successful leak repair.

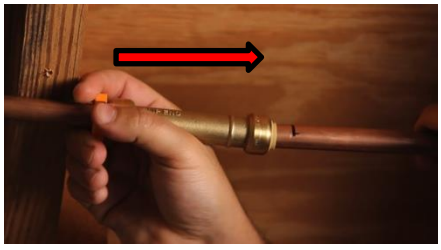
Cut out the section of the pipe needing repair (no more than 2” in length).



Using the SharkBite Deburring & Depth Gauge, clean the edges of the copper pipe. Use the gauge to mark the proper insertion depth on the pipe.



On the side of the fitting marked “SLIP END,” slide the copper pipe into the fitting until it bottoms out.



Place the SharkBite Disconnect Clip on the copper pipe, on the same side as the “SLIP END.” As you are pressing the clip to release the fitting, slide the SharkBite fitting to meet the other copper pipe.

Continue to slide the fitting until the non-slip end bottoms out. Ensure the fitting lines up with the mark you made. Also ensure the Slip End of the fitting has not proceeded past the depth mark you originally made.

SHARKBITE SLIP PRODUCTS

In addition to slip coupling and tees, we also have slip ball valves and slip pressure regulators available to ease installation woes.

To see an installation video on installing a slip fitting, please visit:

http://www.youtube.com/watch?v=lgdBv5BK5dQ&list=PL0ABAD0AF076CFA60&feature=c4-overview-vl

SHARKBITE FOR CONCEALED AREAS

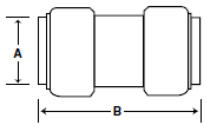
SharkBite fittings can be utilized in underground applications and as manufactured joints without access panels, per IAPMO Certificate of Listing File No. 4630.

If burying SharkBite, it is recommended:

Fitting should be wrapped with an impervious material, chloride-free tape or tightly wrapped and sealed insulation works well to prevent direct contact with the backfill. Backfill should be free of rocks, debris or any sharp objects that may cause damage through impact or abrasion.

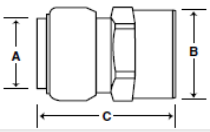
It is also recommended to pressure test the system for 24 hours before closing up any inaccessible location.

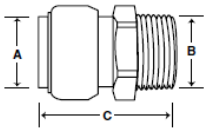
DIMENSIONS



Straight Coupling Dimensions

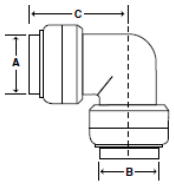
P/N	A	B
U004	1/4"	1.59"
U006	3/8"	1.84"
U008	1/2"	2"
U016	3/4"	2.36"
U020	1"	2.72"





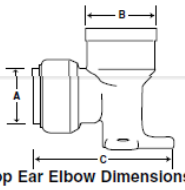
Connector Dimensions

P/N	A	B	C
U066	1/4"	1/2" FNPT	1.61"
U068	1/2"	3/4" FNPT	1.75"
U070	3/8"	1/2" FNPT	1.73"
U072	1/2"	1/2" FNPT	1.64"
U092	3/4"	1/2" FNPT	1.83"
U088	3/4"	3/4" FNPT	1.88"
U094	1"	1" FNPT	2.17"
U110	1/4"	1/2" MNPT	1.64"
U118	3/8"	1/2" MNPT	1.77"
U120	1/2"	1/2" MNPT	1.64"
U116	1/2"	3/4" MNPT	1.75"
U134	3/4"	3/4" MNPT	1.89"
U138	3/4"	1/2" MNPT	1.90"
U140	1"	1" MNPT	2.48"
U142	1"	3/4" MNPT	2.11"



Elbow Dimensions

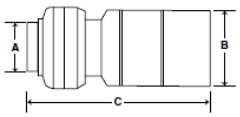
P/N	A	B	C
U244	1/4"	1/4"	1.16"
U276	1/4"	3/8" MIP	1.16"
U246	3/8"	3/8"	1.28"
U272	1/2"	3/8"	1.43"
U248	1/2"	1/2"	1.36"
U256	3/4"	3/4"	1.64"
U260	1"	1"	1.933"
U274	3/4"	1/2"	1.373"
U280	1/2"	1/2" MNPT	1.21"
U308	1/2"	1/2" FNPT	1.21"



Drop Ear Elbow Dimensions

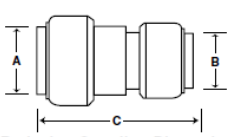
P/N	A	B	C
U249	1/2"	1/2"	2.20"
U332	3/8"	1/2" FNPT	1.83"
U334	1/2"	1/2" FNPT	1.77"
U335*	1/2"	1/2" FNPT	2.0"
U340	3/4"	3/4" FNPT	2.5"

*Hy-Ear Elbow



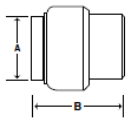
Fitting Reducer Dimensions

P/N	A	B	C
U719	3/8"	1/2"	2.08"
U721	3/8"	3/4"	2.27"
U722	1/2"	1"	3"
U724	3/4"	1"	2.5"



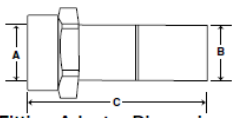
Reducing Coupling Dimensions

P/N	A	B	C
U009	3/8"	1/2"	2.0"
U058	3/4"	1/2"	2.2"
U060	1"	3/4"	2.51"



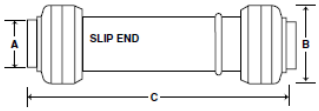
End Stop Dimensions

P/N	A	B
U512	3/8"	1.11"
U514	1/2"	1.08"
U518	3/4"	1.32"
U520	1"	1.52"



Fitting Adapter Dimensions

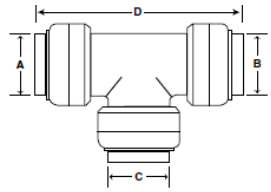
P/N	A	B	C
U766	3/4" FNPT	3/4"	2.83"
U772	1" FNPT	1"	2.83"



Slip Coupling* Dimensions

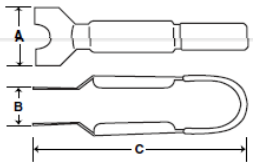
P/N	A	B	C
U3008	1/2"	1.075"	4.46"
U3016	3/4"	1.355"	4.42"
U3020	1"	1.64"	4.5"

*For use with copper only.



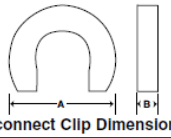
Tee Dimensions

P/N	A	B	C	D
U358	1/4"	1/4"	1/4"	2.30"
U360	3/8"	3/8"	3/8"	2.77"
U362	1/2"	1/2"	1/2"	2.72"
U363	1/2"	1/2"	3/8"	2.85"
U364	3/8"	3/8"	1/2"	2.77"
U370	3/4"	3/4"	3/4"	3.24"
U374	1"	1"	1"	3.84"
U412	3/4"	3/4"	1/2"	3.04"
U416	1"	1"	3/4"	3.63"
U444	3/4"	1/2"	3/4"	3.08"
U454	3/4"	1/2"	1/2"	2.92"



Disconnect Tong Dimensions

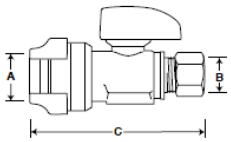
P/N	Fits SharkBite	A	B	C
U711	1/2"	1.7"	2"	6.5"
U713	3/4"	1.7"	2"	6.5"
U715	1"	1.7"	2"	6.5"



Disconnect Clip Dimensions

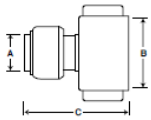
P/N	Size	A	B
U706	1/4"	1.19"	0.3"
U708	3/8"	1.22"	0.3"
U710	1/2"	1.22"	0.3"
U712	3/4"	1.72"	0.4"
U714	1"	2"	0.4"

Note: Disconnect Clips sold separately



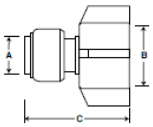
Straight Stop (*Chrome Plated*) Dimensions

P/N	A	B	C
23037-0000	1/2"	3/8" compression	2.68"



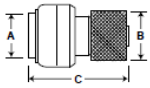
Ballcock Connector Dimensions (*Chrome Plated*)

P/N	A	B	C
U3531	1/4"	7/8" ballcock	1.58"



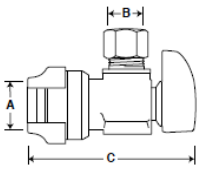
Faucet Connector Dimensions (*Chrome Plated*)

P/N	A	B	C
U3525	1/4"	1/2" NPS	1.58"



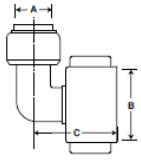
Stop Connector Dimensions (*Chrome Plated*)

P/N	A	B	C
U3523	1/4"	9/16" X 24 UNEF	1.61"



Angle Stop (*Chrome Plated*) Dimensions

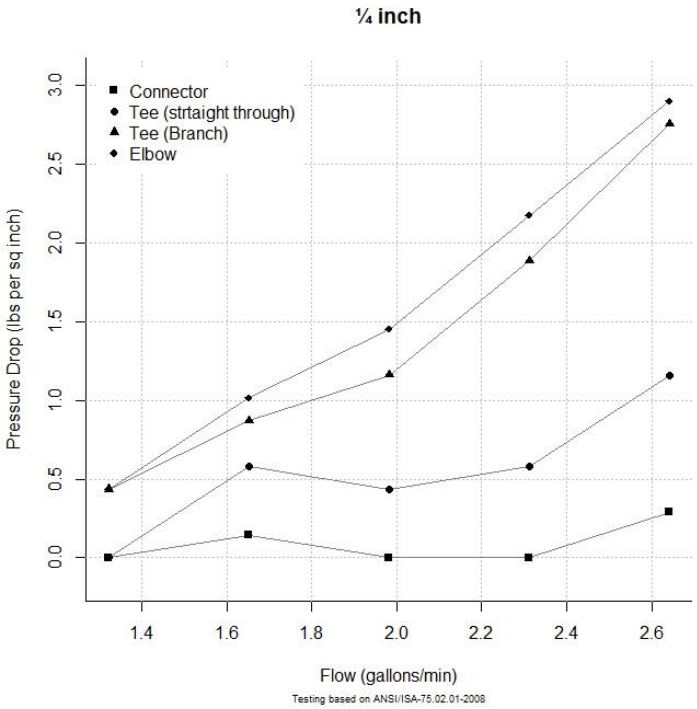
P/N	A	B	C
23036-0000	1/2"	3/8" compression	2.58"

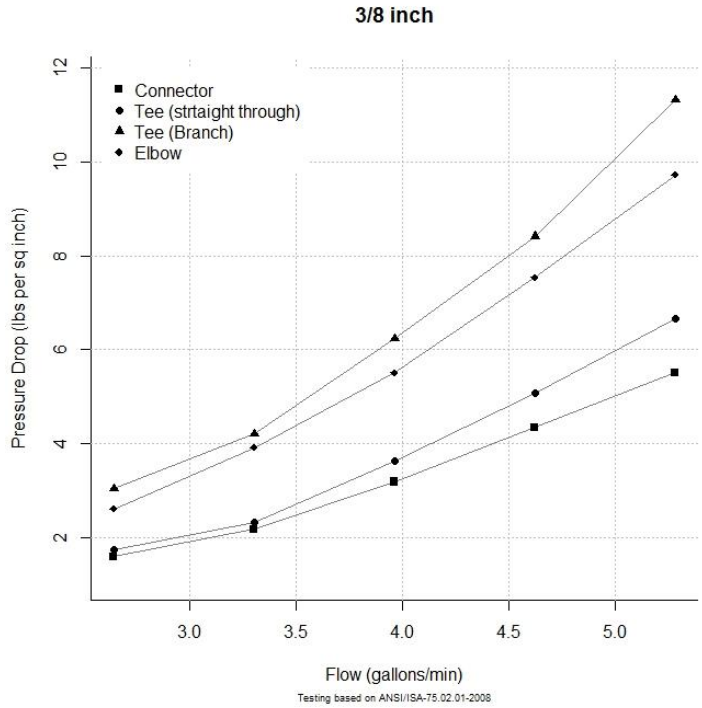


Ballcock Elbow Dimensions (*Chrome Plated*)

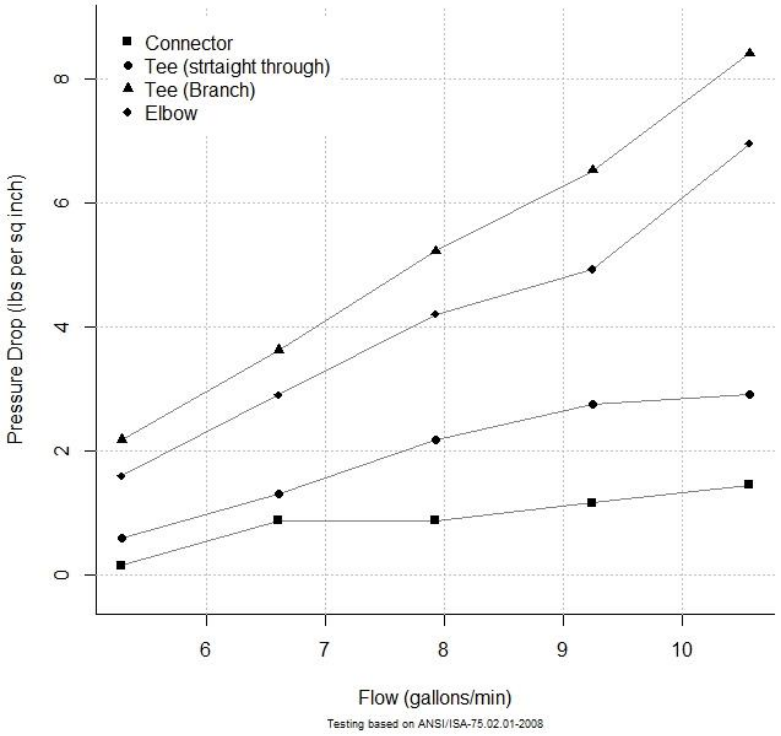
P/N	A	B	C
U3537	1/4"	7/8" ballcock	1.05"

PRESSURE LOSS AND FLOW RATES

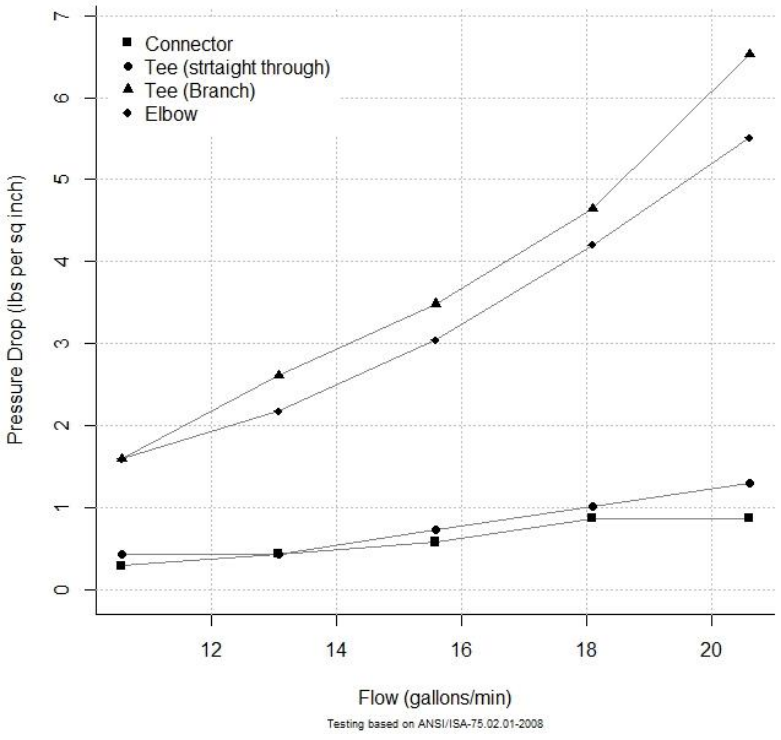


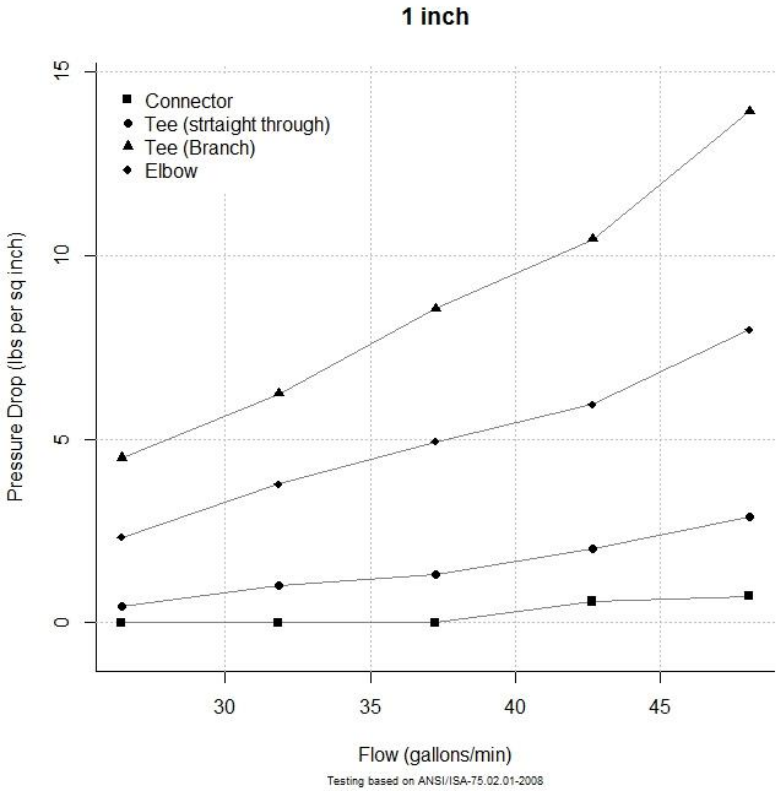


½ inch

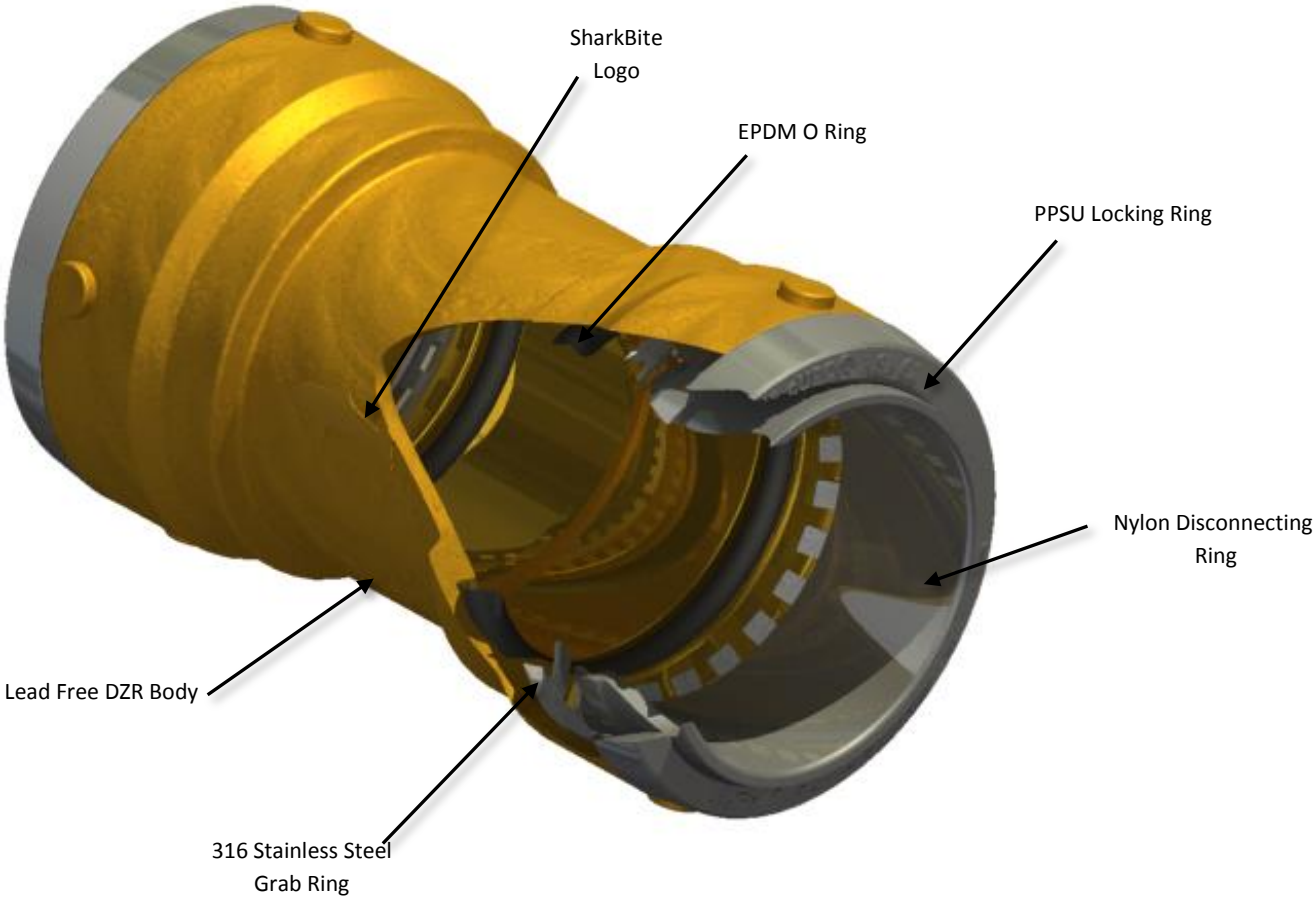

Connector
Tee (strtaight through)
Tee (Branch)
Elbow
Pressure Drop (lbs per sq inch)
0
2
4
6
8
6
7
8
9
10
Flow (gallons/min)
Testing based on ANSI/ISA-75.02.01-2008

¾ inch


Connector
Tee (strtaight through)
Tee (Branch)
Elbow
Pressure Drop (lbs per sq inch)
0
1
2
3
4
5
6
7
12
14
16
18
20
Flow (gallons/min)
Testing based on ANSI/ISA-75.02.01-2008


1 inch
Connector
Tee (strtaight through)
Tee (Branch)
Elbow
Pressure Drop (lbs per sq inch)
0
5
10
15
30
35
40
45
Flow (gallons/min)
Testing based on ANSI/ISA-75.02.01-2008

THE SHARKBITE 2XL DESIGN (1-1/4” – 2”)



WHY SHARKBITE 2XL?

- **Quick Connect:**
  - No tools, soldering, clamps, unions or glue required. Cut pipe square, de-burr to remove rough edges/debris, mark the pipe for correct depth and push to get a pressure ready connection every time.
- **Quick Disconnect:**
  - Disconnect in seconds by sliding the De-Mount Tool down the pipe to engage the demount lugs and rotate clockwise to lock the open position leaving both hands free, you can now remove the pipe.
- **SAFE-Recessed Release Collar:**
  - Commercial SharkBite require a special Demount Tool and cannot be accidentally disconnected/released.
- **Extensive Range Including Slip Feature on Couplings and Tee's:**
  - When repairing or tapping into existing pipe with "Push-Fittings" you must be able to either move the fitting or the pipe to ensure the pipe is engaged fully into the fitting. With rigid pipe like copper the only way with "Push-Fittings" is to have a SLIP feature to allow easy installation when tapping into existing pipe.
- **Easy Installation:**
  - Unlike the tool intensive connection methods there is NO need to send multiple fitters to a job, SharkBite 2XL has been designed to be installed or removed by one person. All fittings are lubricated for easy connection and by fitting the De-Mount Tool before engaging the pipe the force required can be reduced further. With the De-Mount Tool locked on you also have hands free disconnection. WET OR DRY: No waiting for copper tube to dry before soldering or glue to cure, SharkBite makes an instant connection in seconds.
- **No Tools:**
  - Unlike alterative tool intensive connections systems, SharkBite has no special tooling required for installation.
- **No Time:**
  - Fastest connection - CUT-PUSH-DONE.
  - Easy access to small or tight places.
  - No Flame - Does not require fire permit or fire marshal.
- **No Waste:**
  - Should you make an error or simply want to change your installation, no problem for SharkBite. Simply remove and re-use. (Fittings used for repeated testing must not be used in any permanent application).
- **Fittings Cannot be Disassembled:**
  - SharkBite 2XL Fittings are factory assembled and components cannot be removed.
- **Long Pipe Engagement:**
  - Provides pipe support against lateral pipe forces.
- **Lead Free (LF) Dezincifcation Resistance (DZR) Brass:**
  - Exceeds current no lead legislation - AB1953 or NSF372. Suitable for underground installation subject to local code authorites/inspectors. Dezincification properties (DZR) exceed ISO6509 and NSF-14.
- **Environmentally Friendly:**
  - Remove and re-use fittings, no need to be scrapped. No heat is required for installation.

HOW TO MAKE A SHARKBITE 2XL CONNECTION

1. Cut copper, CPVC or PEX using a quality tuber or pipe cutter with a sharp blade.

2. Remove burrs and ensure pipe surface is free of scratches and any debris. It is critical that pipe be marked with the correct insertion depth as listed below:

   1-1/4" Pipe Insertion Depth = 2"

   1-1/2" Pipe Insertion Depth = 2-1/4"

   2" Pipe Insertion Depth = 2-1/2"

3. Align pipe with the fitting, insert pipe while rotating either pipe or fitting.

4. SharkBite 2XL PEX Stiffener must be inserted into PEX pipe prior to fitting.

   Connection is complete when pipe is fully inserted with depth insertion marked on pipe is still visible at the head of the fitting

DISCONNECTING A SHARKBITE 2XL CONNECTION

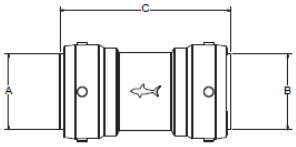
1. Place the Shark Shifter De-Mount Tool on the pipe just above the connection. Then slide the tool down to engage lugs on the head of the fitting.

2. Rotate the Shark Shifter De-Mount Tool clockwise to lock onto the lugs. This will lock the Shark Shifter De-Mount Tool in place.

3. Rotate the Shark Shifter De-Mount Tool clockwise to lock onto the lugs. This will lock the Shark Shifter De-Mount Tool in place.

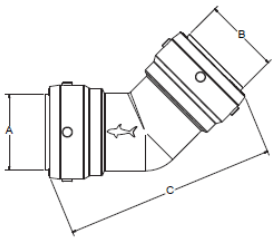
With the Shark Shifter De-Mount Tool Withdraw locked in place, pull the pipe from the fitting. Rotate the Shark Shifter De-Mount Tool counter-clockwise to remove the fitting.

SHARKBITE 2XL DIMENSIONS



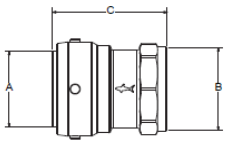
Coupling

P/N	A	B	C	Weight
SB0135	1¼″	1¼″	3.26″	0.84
SB0141	1½″	1½″	4.37″	1.15
SB0154	2″	2″	4.80″	1.56
SB013528	1¼″	1″	3.26″	0.69
SB014135	1½″	1¼″	4.37″	1.02
SB015441	2″	1½″	4.80″	1.42



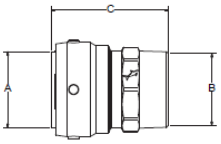
45° Elbow

P/N	A	B	C	Weight
SB0535	1¼″	1¼″	5.15″	0.97
SB0541	1½″	1½″	5.77″	1.35
SB0554	2″	2″	6.50″	1.91



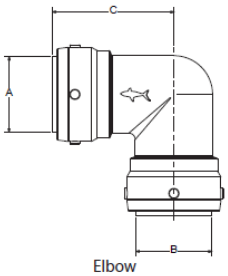
Female Connector

P/N	A	B	C	Weight
SB113532F	1¼″	1¼″FNPT	2.98″	0.72
SB114140F	1½″	1½″FNPT	3.21″	0.92
SB115450F	2″	2″FNPT	3.42″	1.23



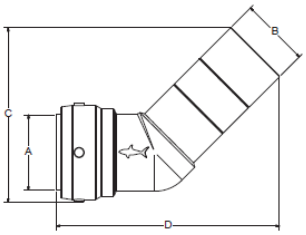
Male Connector

P/N	A	B	C	Weight
SB113532M	1¼″	1¼″MNPT	3.03″	0.71
SB114140M	1½″	1½″MNPT	3.20″	0.89
SB115450M	2″	2″MNPT	3.43″	1.20



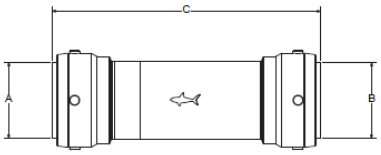
Elbow

P/N	A	B	C	Weight
SB0235	1¼″	1¼″	2.80″	1.07
SB0241	1½″	1½″	3.16″	1.52
SB0254	2″	2″	3.60″	2.18



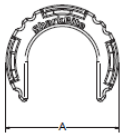
Street 45° Elbow

P/N	A	B	C	D	Weight
SB0735	1¼″	1¼″	4.24″	5.45″	0.97
SB0741	1½″	1½″	4.70″	6.05″	1.35
SB0754	2″	2″	5.30″	6.74″	1.91



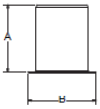
Slip Coupling

P/N	A	B	C	Weight
SB0635	1¼″	1¼″	6.69″	1.20
SB0641	1½″	1½″	7.40″	1.71
SB0654	2″	2″	7.98″	2.33



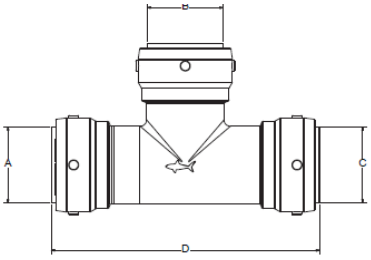
Demount Clip

P/N	Size	A	Weight
SBDC35	1¼″	2.70″	0.07
SBDC41	1½″	2.94″	0.08
SBDC54	2″	2.45″	0.09



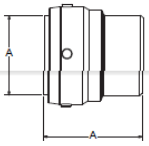
Pex Stiffener

P/N	Size	A	B	Weight
SBLT35	1¼″	1.65″	1.34″	0.08
SBLT41	1½″	1.89″	1.59″	0.10
SBLT54	2″	2.09″	2.09″	0.15



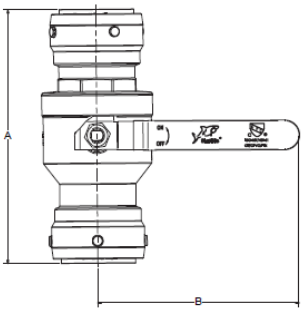
Tee

P/N	A	B	C	D	Weight
SB0335	1¼″	1¼″	1¼″	6.50″	1.61
SB0341	1½″	1½″	1½″	6.70″	2.26
SB0354	2″	2″	2″	7.99″	3.07
SB03353516	1¼″	½″	1¼″	6.70″	1.25
SB03353522	1¼″	¾″	1¼″	6.70″	1.28
SB03353528	1¼″	1″	1¼″	6.70″	1.42
SB03414122	1½″	¾″	1½″	7.39″	1.78
SB03414128	1½″	1″	1½″	7.39″	1.92
SB03414135	1½″	1¼″	1½″	7.39″	2.08
SB03545428	2″	1″	2″	7.99″	2.55
SB03545435	2″	1¼″	2″	7.99″	2.72
SB03545441	2″	1½″	2″	7.99″	2.86



End Stop

P/N	Size	A	Weight
SB0435	1¼″	2.35″	0.57
SB0441	1½″	2.62″	0.82
SB0554	2″	2.89″	1.25

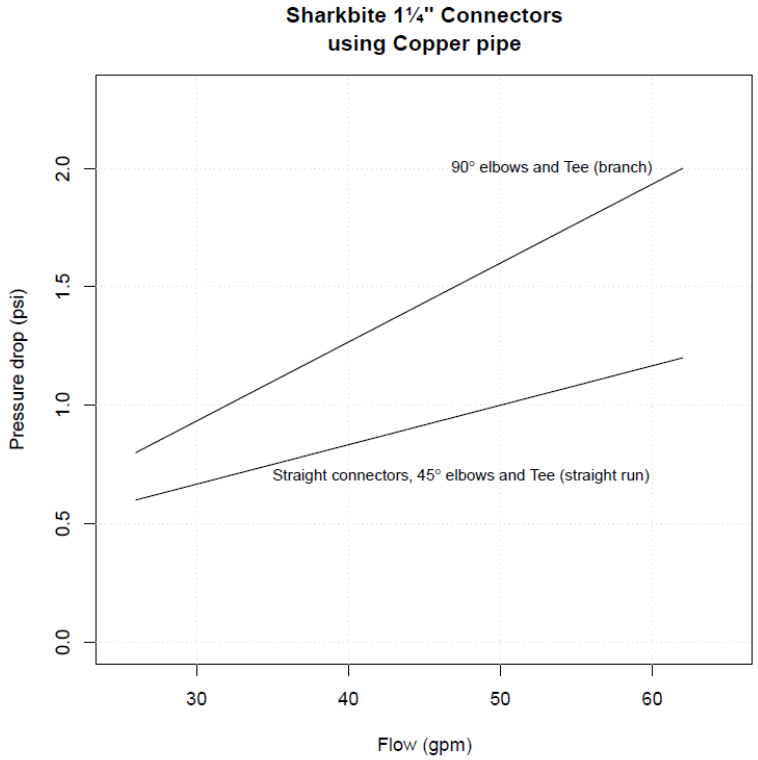


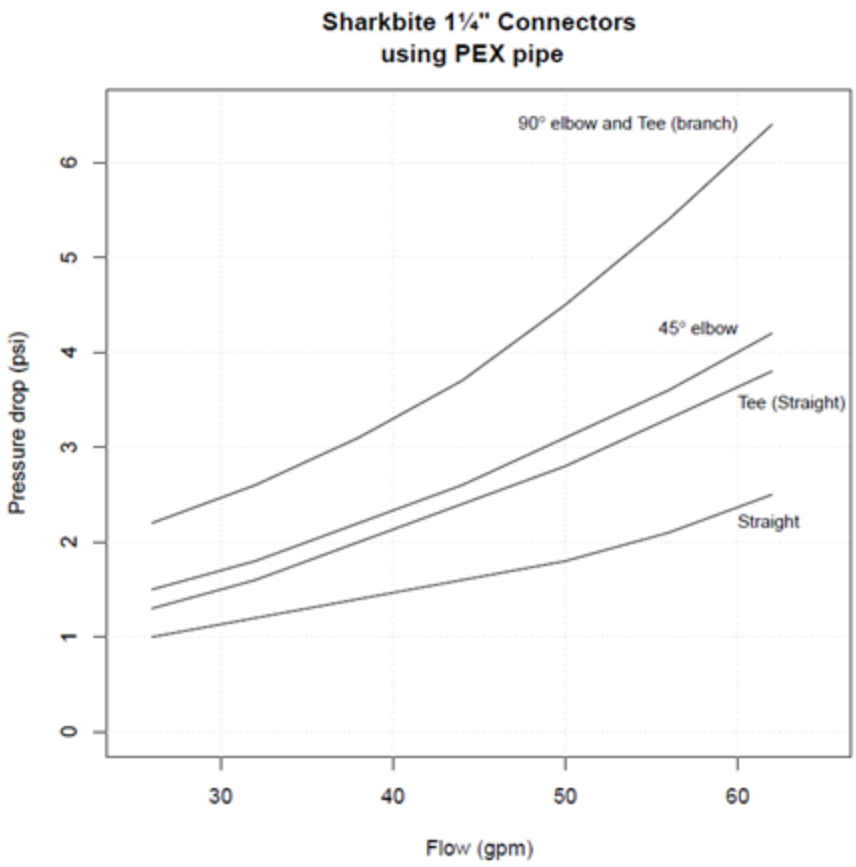
Ball Valve

P/N	Size	A	B	Weight
SBBV435	1¼″	6.08″	5.10″	2.06
SBBV441	1½″	6.79″	6.10″	2.99
SBBV454	2″	7.58″	6.16″	4.45

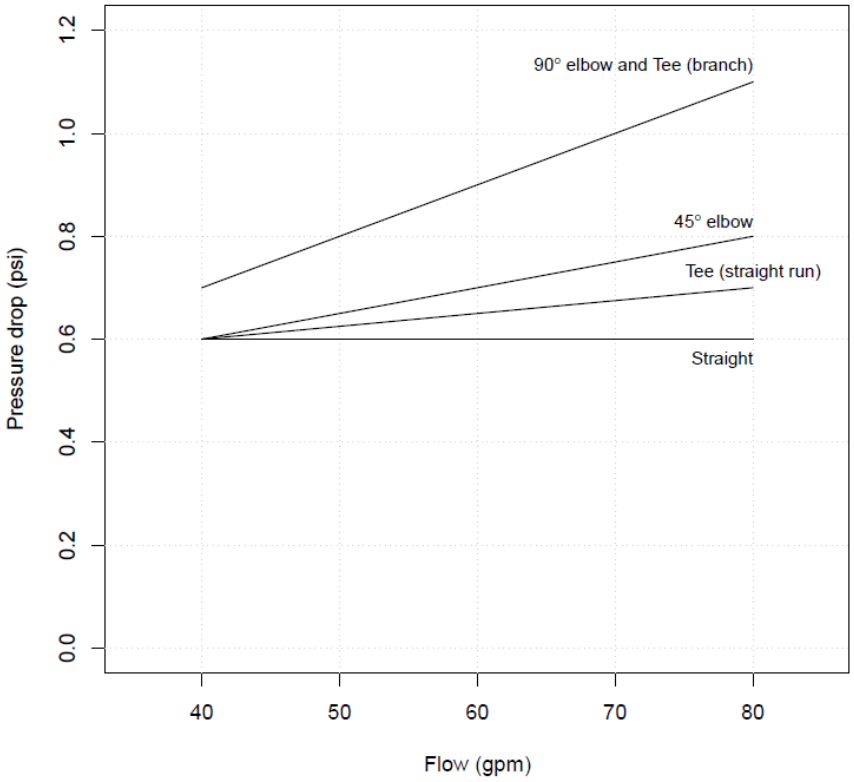
* All weights are in pounds

SHARKBITE 2XL PRESSURE LOSS AND FLOW RATES

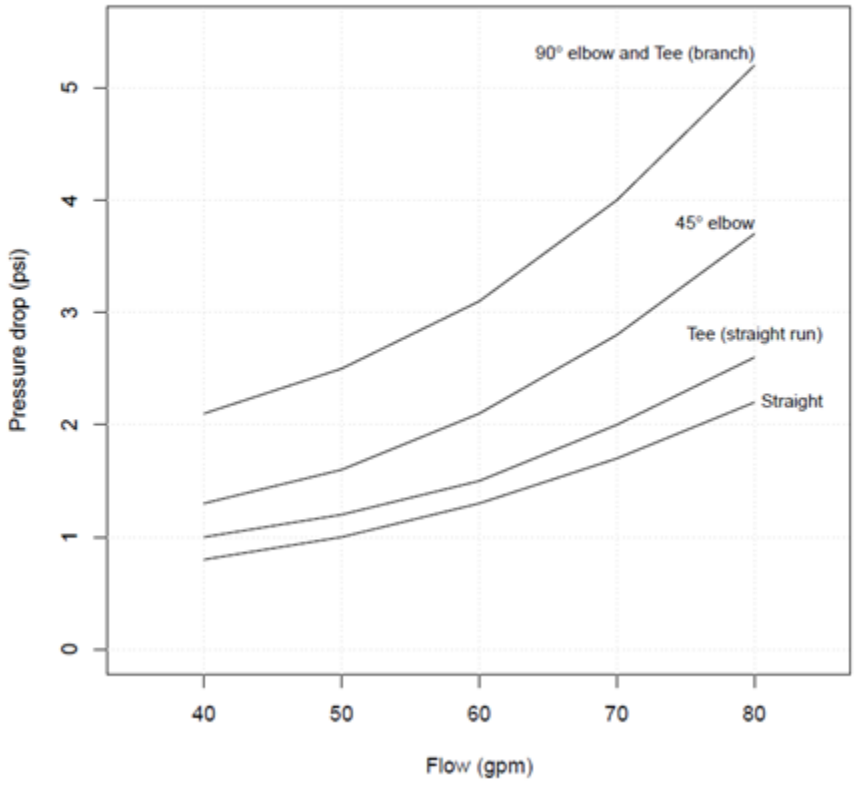


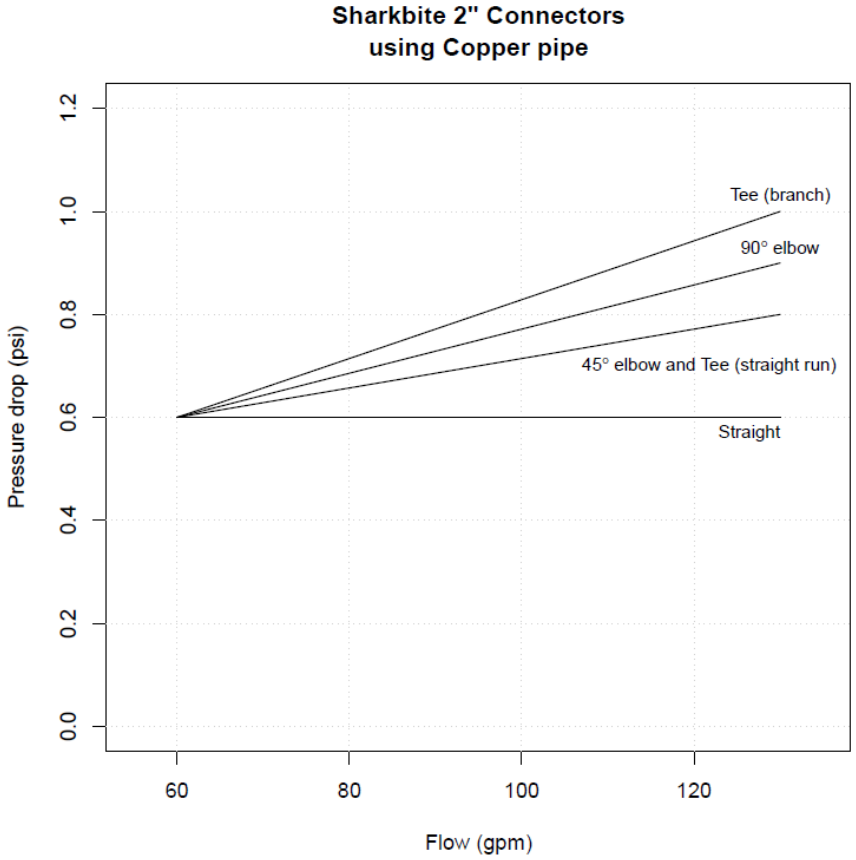


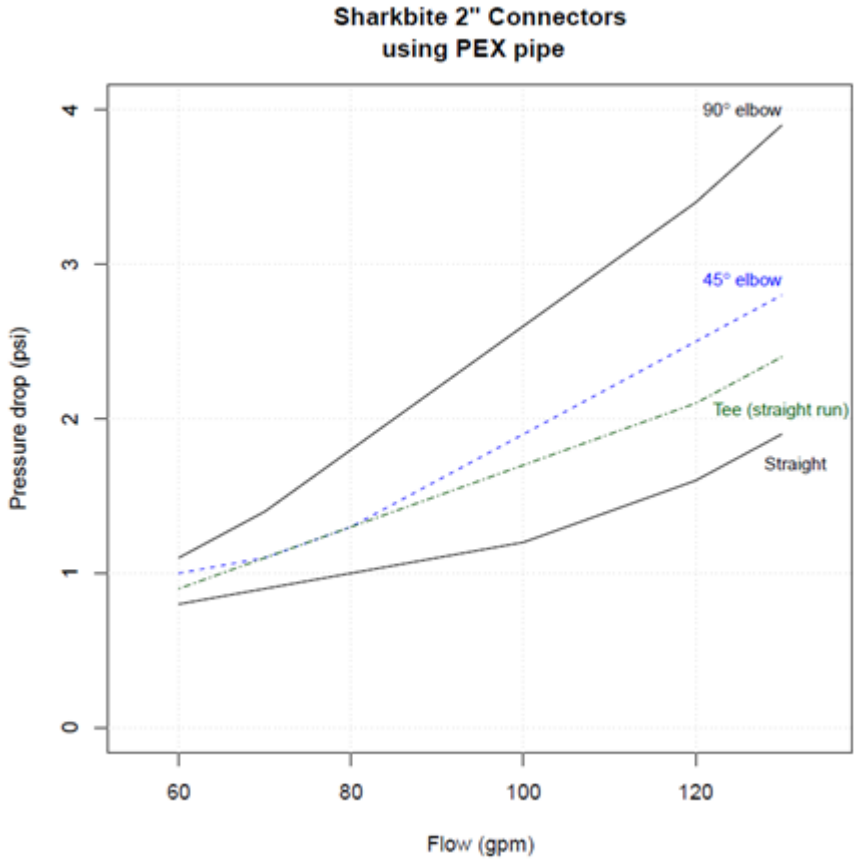
Sharkbite 1½" Connectors using Copper pipe



Sharkbite 1½" Connectors using PEX pipe




Sharkbite 2" Connectors
using Copper pipe
Pressure drop (psi)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Tee (branch)
90° elbow
45° elbow and Tee (straight run)
Straight
60
80
100
120
Flow (gpm)


Sharkbite 2" Connectors
using PEX pipe
Pressure drop (psi)
0
1
2
3
4
90° elbow
45° elbow
Tee (straight run)
Straight
60
80
100
120
Flow (gpm)

SHARKBITE PEX TUBING

SharkBite PEX tubing is a cross-linked polyethylene tubing for a wide range of residential and commercial plumbing applications. Manufactured without an oxygen barrier for potable water systems (available in white, blue, and red) and with an oxygen barrier for radiant floor and hydronic heating applications (available in orange). The oxygen diffusion barrier applied to the exterior limits oxygen permeation through the tubing wall in hydronic heating applications which prevents corrosion of ferrous metal parts in the heating system.

FEATURES AND BENEFITS

- Flexible: Easy to install and service.
- Quieter: Minimizes noise caused by water hammer.
- Resists corrosion and scale buildup: Improves the performance of the plumbing system.
- Fewer fittings required: Reduces total installation cost.
- Fewer joints: Reduces the chances of call backs.
- Pressure test immediately: No waiting for glue to dry or joints to cool

A repeating SharkBite imprint pattern provides a visual aid to determine if the tube has been inserted all the way into the SharkBite Push-Fit Fitting. This feature only works if the tubing is cut between the SharkBite imprint pattern.

CERTIFICATIONS

The SharkBite tubing with and without oxygen barrier is approved for use in all model codes in the US and Canada for use in hydronic and potable water systems and is certified to the following standards:

- NSF 14/61,
- NSF P171,
- ASTM F 876,
- ASTM F 877,
- CSA B137.5
- AWWA C904.

PEX PIPE SPECS AND DIMENSIONS

Model	Nominal Tubing Size				Length		Bend Radius		Fluid Capacity Per 100'		Package Weight	
	ID		OD		FT	M	in	mm	gal	ltrs	lbs	kgs
	in	mm	in	mm								
Blue PEX (Coil)												
U860B100	1/2	13	5/8	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860B300	1/2	13	5/8	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860B500	1/2	13	5/8	16	500	152.4	5	127	0.96	3.63	24	10.9
U870B100	3/4	19	7/8	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870B300	3/4	19	7/8	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870B500	3/4	19	7/8	22	500	152.4	7	178	1.9	7.19	45	20.4
U880B100	1	25	1-1/8	29	100	30.48	10	254	3.1	11.73	18	8.2
U880B300	1	25	1-1/8	29	300	91.44	10	254	3.1	11.73	54	24.6
U880B500	1	25	1-1/8	29	500	152.4	10	254	3.1	11.73	90	40.8
Red PEX (Coil)												
U860R100	1/2	13	5/8	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860R300	1/2	13	5/8	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860R500	1/2	13	5/8	16	500	152.4	5	127	0.96	3.63	24	10.9
U870R100	3/4	19	7/8	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870R300	3/4	19	7/8	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870R500	3/4	19	7/8	22	500	152.4	7	178	1.9	7.19	45	20.4
U880R100	1	25	1-1/8	29	100	30.48	10	254	3.1	11.73	18	8.2
U880R300	1	25	1-1/8	29	300	91.44	10	254	3.1	11.73	54	24.6
U880R500	1	25	1-1/8	29	500	152.4	10	254	3.1	11.73	90	40.8
White PEX (Coil)												
U860W100	1/2	13	5/8	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860W300	1/2	13	5/8	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860W500	1/2	13	5/8	16	500	152.4	5	127	0.96	3.63	24	10.9
U870W100	3/4	19	7/8	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870W300	3/4	19	7/8	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870W500	3/4	19	7/8	22	500	152.4	7	178	1.9	7.19	45	20.4
U880W100	1	25	1-1/8	29	100	30.48	10	254	3.1	11.73	18	8.2

Model	Nominal Tubing Size				Length		Bend Radius		Fluid Capacity Per 100’		Package Weight	
	ID		OD		FT	M	in	mm	gal	ltrs	lbs	kgs
	in	mm	in	mm								
White PEX (Coil)												
U880W300	1	25	1-1/8	29	300	91.44	10	254	3.1	11.73	54	24.6
U880W500	1	25	1-1/8	29	500	152.4	10	254	3.1	11.73	90	40.8
U885W100	1-1/4	31.75	1-3/8	35	100	30.48	7	175	4.67	17.68	25	11.34
U890W100	1-1/2	38.1	1-5/8	41	100	30.48	8	206	6.5	24.61	35	15.88
U895W100	2	50.8	2-1/4	54	100	30.48	11	270	11.4	43.15	60	27.22
Blue PEX (Straight Lengths)												
U860B5	1/2	13	5/8	16	5	1.52	5	127	0.96	3.63	3	1.4
U860B10	1/2	13	5/8	16	10	3.04	5	127	0.96	3.63	6	2.7
U860B20	1/2	13	5/8	16	20	6.09	5	127	0.96	3.63	12	5.5
U870B5	3/4	19	7/8	22	5	1.52	7	178	1.9	7.19	5.25	2.5
U870B10	3/4	19	7/8	22	10	3.04	7	178	1.9	7.19	10.5	4.8
U870B20	3/4	19	7/8	22	20	6.09	7	178	1.9	7.19	21	9.5
U880B5	1	25	1-1/8	29	5	1.52	10	254	3.1	11.73	4.5	2
U880B10	1	25	1-1/8	29	10	3.04	10	254	3.1	11.73	8.8	4
U880B20	1	25	1-1/8	29	20	6.09	10	254	3.1	11.73	17.4	7.9
Red PEX (Straight Lengths)												
U860R5	1/2	13	5/8	16	5	1.52	5	127	0.96	3.63	3	1.4
U860R10	1/2	13	5/8	16	10	3.04	5	127	0.96	3.63	6	2.7
U860R20	1/2	13	5/8	16	20	6.09	5	127	0.96	3.63	12	5.5
U870R5	3/4	19	7/8	22	5	1.52	7	178	1.9	7.19	5.25	2.5
U870R10	3/4	19	7/8	22	10	3.04	7	178	1.9	7.19	10.5	4.8
U870R20	3/4	19	7/8	22	20	6.09	7	178	1.9	7.19	21	9.5
U880R5	1	25	1-1/8	29	5	1.52	10	254	3.1	11.73	4.5	2
U880R10	1	25	1-1/8	29	10	3.04	10	254	3.1	11.73	8.8	4
U880R20	1"	25	1-1/8	29	20	6.09	10	254	3.1	11.73	17.4	7.9
White PEX (Straight Lengths)												
U860W10	1/2	13	5/8	16	10	3.04	5	127	0.96	3.63	6	2.7
U860W20	1/2	13	5/8	16	20	6.09	5	127	0.96	3.63	12	5.5
U870W5	3/4	19	7/8	22	5	1.52	7	178	1.9	7.19	5.25	2.5
U870W10	3/4	19	7/8	22	10	3.04	7	178	1.9	7.19	10.5	4.8
U870W20	3/4	19	7/8	22	20	6.09	7	178	1.9	7.19	21	9.5
U880W5	1	25	1-1/8	29	5	1.52	10	254	3.1	11.73	4.5	2
U880W10	1	25	1-1/8	29	10	3.04	10	254	3.1	11.73	8.8	4
U880W20	1	25	1-1/8	29	20	6.09	10	254	3.1	11.73	17.4	7.9
U885W20	1-1/4	31.75	1-3/8	35	20	6.10	7	175	4.76	7.68	25	11.34
U890W20	1-1/2	38.1	1-5/8	41	20	6.10	8	206	6.5	24.61	35	15.88
U895W20	2	50.8	2-1/4	54	20	6.10	11	270	11.4	43.15	36	16.33

IAPMO RESEARCH AND TESTING, INC.

5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 •
www.iapmort.org

CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date: July 2013 -Rev. 1/8/2014- Void After: July 2014

Product: Push Fit Fittings File No. 4630

Issued To: Cash Acme/Reliance Worldwide
2400 7TH AVE SW
CULLMAN, AL 35055

Identification: Each fitting shall have the following information marked on it where it will be visible after it has been installed:
Name of manufacturer or trademark.
When a fitting is not suitable for all four (4) materials, it shall be marked as follows for the materials for which they are suitable:
Copper or Cu
CPVC
PEX
PE-RT
When push-fit connectors are used on plumbing devices, the markings are permitted to be on the plumbing device.

Fittings CTS or smaller are permitted to use a permanent label complying with the requirements of UL 969 or CSA C22.2 N. 0.15 to display the required markings.

The markings shall be permanent.

The product shall also bear the cUPC mark.

Characteristics: Push fit fittings that have a quick assembly push fit mechanism that can be used with Copper, PEX and CPVC tubing and pipes. Fittings for use in domestic and commercial application for both potable water distribution systems and hydronic heating systems. Push fit fittings can be utilized in underground applications and as manufactured joints without access panels. To be installed in accordance with the manufacturer's instructions and the latest edition of the Uniform Plumbing Code and the National Plumbing Code of Canada.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following code(s):

Uniform Plumbing Code (UPC)
National Plumbing Code of Canada
International Plumbing Code (IPC)

Products are in compliance with the following standard(s):

ASSE 1061-2011

MODELS:

Note: The requirements of Section 609.3.2 in the Uniform Plumbing Code are satisfied for push fit fittings by section 301.4.1 of the same Uniform Plumbing Code when installed in accordance with the manufacturer's installation guides.

Note: All 1/2" through 1" models comply with ANSI/NSF 14.

For a complete list of compliant models and the most up to date listing, please visit
http://pld.iapmo.org/file_info.asp?file_no=0004630

5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 •
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Effective Date: October 2013 -Rev. 12/4/2013- Void After: October 2014

Product: Lead Free Plumbing Products File No. 6544

Issued To: CASH ACME/RELIANCE WORLDWIDE
2400 7TH AVE SW
CULLMAN, AL 35055

Identification: Each product shall bear permanent and legible markings to identify the manufacturer. This marking shall be the trade name, trademark, or other mark known to identify the manufacturer. The product and/or product packaging may also bear the term "Lead Plumbing Law", "Complies with Lead Plumbing Law", or either "Lead Free" or "Low Lead" above or in close proximity to the appropriate IAPMO R&T certification mark, or the term "Certified by IAPMO R&T". The product packaging may also bear a grey dot, a check mark with circle, or any other home centers marking requirements.

Characteristics: Products may include any pipe, pipe fitting, solder, flux, or other plumbing products providing water for human consumption. Products listed below are to be installed in accordance with the manufacturer's instruction. These products have been verified with weighted average lead content <=0.25%; Solder and flux lead content <=0.2%.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following standard(s):

Section 1417(d) of the Safe Drinking Water ActThe lead content requirements of Section 116875 of the California Health & Safety Code
NSF/ANSI 372-2010

For a complete list of compliant models and the most up to date listing, please visit
http://pld.iapmo.org/file_info.asp?file_no=0006544

IAPMO RESEARCH AND TESTING, INC.

5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 • www.iapmort.org

NSF/ANSI 61

CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date: December 2013 -Rev. 2/20/2014- Void After: December 2014

Product: Drinking Water System Components – Health Effects File No. N-4630

Issued To: Cash Acme/Reliance Worldwide
2400 7TH AVE SW
CULLMAN, AL 35055

Identification: Each product shall be permanently and legibly marked with the manufacturer’s name or trademark. The product may also be marked with the standard designation "NSF/ANSI 61".

Characteristics: Materials or products that come into contact with drinking water and/or drinking water treatment chemicals. Products and materials may include process media, protective materials, joining and sealing materials, pipes and related products, mechanical devices used with treatment/transmission/distribution systems, and mechanical plumbing devices. To be installed in accordance with the manufacturer's instruction.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following standard(s):

NSF/ANSI 61-2011

For a complete list of compliant models and the most up to date listing, please visit
http://pld.iapmo.org/file_info.asp?file_no=N4630

5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 • www.iapmort.org

CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date: October 2013 -Rev. 11/6/2013- Void After: October 2014

Product: Crosslinked Polyethylene Water Distribution System (PEX) File No. 7143

Issued To:
CASH ACME/RELIANCE WORLDWIDE
2400 7TH AVE SW
CULLMAN, AL 35055

Identification: The tubing shall be marked with the manufacturer's name or trademark, ASTM F876 and ASTM F877 PEX, pressure rating at 180° F, nominal size, standard dimension ratio and a code number identifying the compound and the date of manufacture. The fittings shall be marked with the manufacturer's name or trademark, and ASTM F877. Both tubing and fittings shall be marked with the cUPC® certification mark.

Characteristics: Crosslinked polyethylene plastic hot and cold water distribution systems made in one standard dimension ratio and intended for a maximum of 100 psi water service up to and including a maximum working temperature of 180° F. Components are comprised of tubing and/or fittings. To be installed in accordance with the manufacturer's instructions and the requirements of the latest edition of the Uniform Plumbing Code.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following code(s):

Uniform Plumbing Code (UPC®)
National Plumbing Code of Canada
International Plumbing Code (IPC®)

Products are in compliance with the following standard(s):
ASTM F877-2011a and CSA B137.5-2009

For a complete list of compliant models and the most up to date listing, please visit

http://pld.iapmo.org/file_info.asp?file_no=0007143

WARRANTY

Limited Warranty – SharkBite® and Cash Acme® Products

What Does This Warranty Cover?

Subject to conditions outlined in this statement, RWC (in the USA, Reliance Worldwide Corporation and in Canada, Reliance Worldwide Canada Inc.) warrants SharkBite® and Cash Acme® products, when used and installed in accordance with the requirements set forth below, to be free from defects in material and workmanship for the applicable warranty period.

How Long Does The Warranty Coverage Last?

Product(s)	Warranty Period (from the date of sale)
SharkBite® PEX Tubing	Twenty-Five (25) years
SharkBite® Push-Fit Fittings	Twenty-Five (25) years
SharkBite® Brass PEX Barbed-Fittings	Five (5) years
SharkBite® Copper PEX Manifolds	Five (5) years
All other SharkBite® products	Two (2) years
All Cash Acme® products	One (1) year

Proof of purchase is required to validate the warranty period. If proof of purchase is not available, the warranty period shall default to the date of manufacture for each product. **NOTE:** Warranty is applicable to product installed in the country it was purchased.

What Are The Conditions Of This Warranty?

1. All products must be installed in accordance with all applicable codes and in accordance with any local, state, provincial or federal requirements.
2. The installing contractor must use construction techniques compliant with applicable codes to install the range of products and use the product(s) within the design parameters specified in any installation guidelines and technical notes for the applicable system. This shall include field pressure testing prior to concealing with concrete or by other means.
3. Products must not be installed in a system that may operate at temperatures or at pressures that exceed the printed rating on the product, packaging or installation instructions.
4. Evidence of tampering, mishandling, neglect, accidental damage, freeze damage or unauthorized modifications or repairs that cause damage to RWC warranted products void any warranty coverage of those particular products. It is expressly understood that failure as a result of any freezing fluids within the pipes does not constitute a defect in material or workmanship and shall not be covered by this warranty.
5. Although RWC provides a plumbing system to facilitate a complete installation, other manufacturers tubing and/or fittings may be installed in any given installation provided manufacturing of the tubing and/or fittings demonstrates compliance with the applicable ASTM standards, and the product has been certified by a recognized third-party testing agency. The RWC product in the given installation will continue to be covered under this warranty. **NOTE**: RWC will be responsible only for proven defects in material or workmanship in RWC products. Problems in products manufactured by another company should be reported to that manufacturer.

How Do You Get Service?

In order to be eligible for service under this warranty you must return the defective product (with shipping charges prepaid) to the original place of purchase. You also must include the model number of the product, the original date of purchase, proof of purchase and the nature of the problem. Products returned without shipping charges prepaid will be refused. For questions or inquires to the Manufacturer, in the U.S. call 1-877-700-4242 and in Canada 1-888-820-0120.

What Will RWC Do?

If, after inspection, we find that a product covered by this limited warranty has failed due to a defect in material or workmanship during the specified warranty period, we will repair or replace, at our sole option, free of charge, the defective product during normal working hours and through a place of business as determined by RWC. This shall constitute the sole and exclusive remedy for any defective product.

What Does This Warranty Not Cover?

RWC shall not be responsible for any incidental, indirect, contingent, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if these warranted products do not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, adverse chemical environments, or any other circumstances over which has no control. This limitation applies even if RWC could have foreseen or has been advised of the possibility of these damages. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product.

How Does State/Provincial Law Apply?

Some States/Provinces do not allow limitations on how long an implied warranty lasts, and some States/Provinces do not allow the exclusion or limitation of incidental or consequential damages. Therefore, the above limitations may not apply to you. This Limited Warranty gives you the specific legal rights, and you may have other rights that vary from State/Province to State/Province. You should consult applicable State/Provincial laws to determine your rights.

SO FAR AS IS CONSISTENT WITH APPLICABLE STATE/PROVINCIAL/FEDERAL LAW, THE EXPRESS WARRANTY SET FORTH HEREIN IS THE ONLY WARRANTY GIVEN BY RWC WITH RESPECT TO THE SHARKBITE® AND CASH ACME® PRODUCTS AND RWC MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

SharkBite®
Plumbing Solutions

RWC.com
Reliance Worldwide Corporation

Reliance Worldwide USA
2727 Paces Ferry Road SE Suite 1800 Building 2
Atlanta, GA 30339
Phone: 1-877-700-4242 • Fax: 1-877-700-4280
www.rwc.com

SharkBite Plumbing Solutions
SharkBite 2XL

www.sharkbite.com

Manufactured and Distributed by Reliance Worldwide Corporation

v. 4.0

AC Wire-in Combination Carbon Monoxide & Smoke Alarm

– 120VAC Direct Wire with Battery Backup
– Alarm/Voice message warning system
– Intelligent Sensor Technology

Part Number 900-0114A **Model KN-COSM-IBA**

Voice Warning
Warns of hazard by announcing "Fire!" or "Warning, Carbon Monoxide".

Peak Level Memory
Alerts user when the unit has detected CO concentrations of 100ppm or higher.

Hush™ Button
Silences the unit during nuisance alarm situations.
(Smoke must be present before hush is activated)

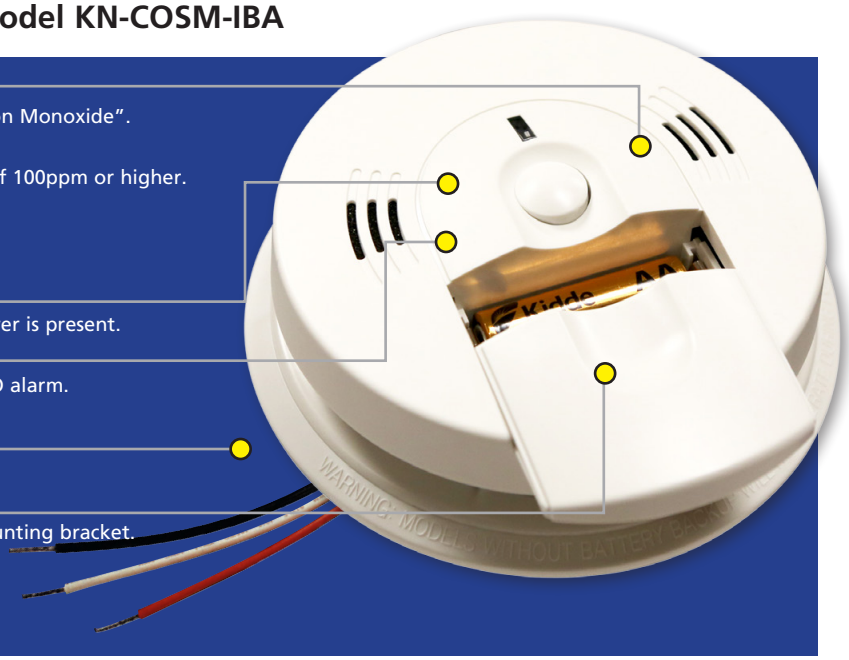
Two LED's
Red LED indicates alarm mode, Green LED indicates AC power is present.

Test/Reset Button Functions
- Tests the units electronics and resets the unit during CO alarm.
- Activates Hush Feature and Peak Level Memory.

Adjustable Mounting Bracket
Allows for easy installation and alignment.

Front Load Battery Door
Replace the 2 AA batteries without disconnecting from mounting bracket.

Alerts user to replace CO alarm after 10 years of operation



Description

The Kidde 900-0114A uses breakthrough technology to offer a fast response to real fires, including smoldering and fast-flaming, as well as protect you from carbon monoxide and dramatically reduce the chance of nuisance alarms. The Intelligent sensor technology combines the detection capabilities of an ionization smoke sensor – which is more likely to detect smaller, less visible fire particles, like those produced by flaming fires – with that of an electrochemical sensor, which is used to detect CO. Since carbon monoxide is present in all fires, having both detection chambers work together in one alarm is a breakthrough in the fire safety industry. When either sensor notices a potential hazard, it will communicate with the other. Depending on what is detected, the alarm will adjust its smoke sensitivity in order to better discriminate between a real hazard and a false one. This constant communication enhances the alarm's overall performance in all fires, and significantly reduces the potential for a nuisance alarm.

Leading authorities recommend that both ionization and photoelectric smoke alarms be installed to help insure maximum detection of the various types of fires that can occur within the home. Ionization sensing alarms may detect invisible fire particles (associated with fast flaming fires) sooner than photoelectric alarms. Photoelectric sensing alarms may detect visible fire particles (associated with slow smoldering fires) sooner than ionization alarms.

Alarm Warnings

Fire: The red LED will flash and be accompanied by three long alarm beeps followed by a verbal warning message "FIRE!". The alarm pattern will repeat until smoke is eliminated.

Carbon Monoxide: Four short alarm beeps followed by a verbal warning "WARNING! CARBON MONOXIDE!" This continues until the unit is reset or the CO is eliminated.

Low Battery: One chirp followed by warning "LOW BATTERY." The red LED light will flash. This pattern will continue every minute for at least seven days. Under battery power, the "LOW BATTERY" voice only occurs once every 15 minutes.

Voice Hush Indication: "HUSH MODE ACTIVATED" and "HUSH MODE CANCELLED" voice announcement.

Peak Level Memory: If the alarm had detected a CO level of 100ppm or higher when the Test/Reset button is pressed, the unit will announce "CARBON MONOXIDE PREVIOUSLY DETECTED" to warn of the CO incident.

Features and Benefits

- **Smart Interconnect™** – Interconnects up to 24 Kidde devices (of which 18 can be initiating).
- **Battery Backup (2-AA batteries included)** – Provides protection during power outages.
- **Front Loading Battery Door** – Replace the backup batteries without disconnecting from mounting bracket
- **Battery Lockout System** – The battery door will not close unless the batteries are properly installed.
- **Alarm Tamper Resist** – Helps deter from tampering and theft.
- **Adjustable Mounting Bracket** – Makes installation fast and easy. Works with existing smoke and combination smoke and CO mounting brackets.
- **Peak Level Memory** – Announces "CARBON MONOXIDE PREVIOUSLY DETECTED" if alarm has detected a CO level of 100ppm or higher since it was last reset.
- **Hush™ Feature** – Silences nuisance alarms for approximately 9 minutes. (Smoke must be present before Hush™ is activated)
- **Ionization Sensor Technology** – Ideal for detecting fast flaming and other types of fires.
- **Test Button Functions:** – Tests the unit for proper operation
  – Peak Level memory – Resets the Carbon Monoxide alarm
- **Green LED** – Illuminates to indicate the unit is receiving AC power. Flashes once every 60 seconds to indicate battery only mode. Flashes once per second during alarm to indicate initiating alarm. Flashes once every 16 seconds to indicate smoke or CO previously detected. Flashes every 2 seconds while the alarm is in HUSH™ mode.
- **Red LED** – When a dangerous level of smoke or carbon monoxide is detected the red LED will flash. If the unit malfunctions, the red LED will flash and the unit will chirp every 30 seconds.

10 YEAR LIMITED WARRANTY

SIGNALING UL LISTED

AC Wire-in Combination Carbon Monoxide & Smoke Alarm

Part Number 900-0114A
Model KN-COSM-IBA

Architectural and Engineering Specifications

The combination smoke and carbon monoxide alarm shall be Kidde model KN-COSM-IBA or approved equal. It shall be powered by 120VAC, 60Hz source with two AA battery backup. The temperature operating range shall be between 40˚F and 100˚F (4˚C and 38˚C) and the humidity operating range shall be 10% - 95% relative humidity, non-condensing.

The unit shall incorporate an ionization smoke sensor with nominal sensitivity of 0.89%/ft. The CO sensor shall be of a fuel cell design and shall meet the sensitivity requirements of Underwriters Laboratories UL2034 Single and Multiple Station Carbon Monoxide Detectors.

The combination alarm can be installed on the surface of any wall or ceiling following the UL/NFPA/Manufacturer's recommended placement guidelines. The alarm can be installed on any standard single gang electrical box, up to a 4" octagon junction box. The electrical connection (to the alarm) shall be made with a plug-in connector. The unit shall provide optional tamper resistance that deters removal of the unit from the wall or ceiling. No additional pieces shall be required to activate this feature.

A maximum of 24 Kidde devices can be interconnected in a multiple station arrangement. The interconnect system must not exceed the NFPA (National Fire Protection Association) limit of 18 initiating devices, of which 12 can be smoke alarms. With 18 initiating devices (smoke, heat, CO, etc), interconnected, it is still possible to interconnect 6 strobe lights and or relay modules.

The alarm shall include a test button that will electronically simulate the presence of smoke and CO and cause the unit to go into both modes of alarm. This sequence tests the unit's electronics to ensure proper operation.

The CO sensor will not alarm to levels of CO below 30 ppm and will alarm in the following time range when exposed to the corresponding levels of CO.

70 ppm CO Concentration	60 – 240 minutes
150 ppm CO Concentration	10 – 50 minutes
400 ppm CO Concentration	4 – 15 minutes

The combination alarm shall have two methods of warning for danger: a piezoelectric horn that is rated at 85 decibels at 10 feet and a voice warning that identifies the danger. For a CO incident, the horn will sound in the repetitive manner – four (4) fast beeps, a short pause, four (4) fast beeps, a short pause. In between, the unit will announce "Warning Carbon Monoxide!" In a Smoke incident, the horn will sound in the repetitive manner – three (3) beeps, a pause, three (3) beeps, a pause. In between, the unit will announce "FIRE!"

The unit shall incorporate a 2 LED display. A green LED will be steady on when AC power is present, flash every 60 seconds when in battery only mode, every second to indicate alarm memory, and every 2 seconds to indicate the Hush" mode is active. A red LED will flash in unison with the alarm sounder pattern.

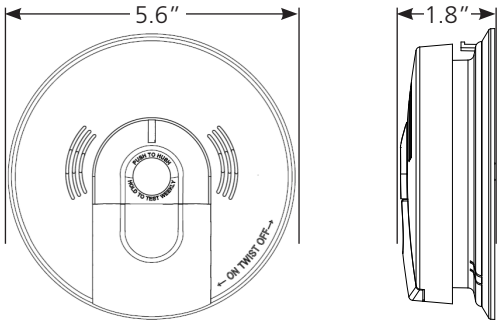
The unit shall include the Hush™ feature that silences the unit for approximately 9 minutes if a nuisance alarm condition occurs. The Green LED on the alarm will flash every 2 seconds while in Hush™ and will automatically reset itself. It also provides voice annunciation of "HUSH MODE ACTIVATED" when Hush™ is activated and "HUSH MODE CANCELLED" when the Hush cycle ends.

The unit shall also indicate a low battery warning utilizing each of the following methods: a brief alarm chirp, the voice announcement of "Low Battery!"

The unit shall at a minimum meet the requirements of UL 2034, UL217, NFPA72, (chapter 11 2002 edition) The State of California Fire Marshall, NFPA101 (One and two family dwellings) Federal Housing Authority (FHA), Housing and Urban Development (HUD). It shall also include a 10-year manufacturer's limited warranty.

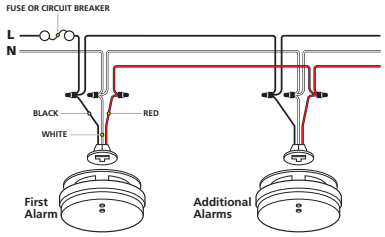
Technical Specifications

Power Source:	120VAC, 60Hz 45mA max per alarm 2 AA battery backup
Smoke Sensor:	Ionization
CO Sensor:	Electrochemical
Audio Alarm:	85dB at 10ft
Temperature Range:	40˚F (4.4˚C) to 100˚F (37.8˚C)
Humidity Range:	10%-95% relative humidity, non-condensing
Size:	5.6" in diameter x 1.8" depth
Weight:	.75 lb
Wiring:	Quick connect plug with 6" pigtails
Interconnects:	Up to 24 Kidde devices (of which 18 can be initiating)
Warranty:	10 year limited



Installation of Smoke Alarm

The combination alarm should be installed to comply with all local codes having jurisdiction in your area, Article 760 of the National Electric Code, and NFPA 72. Make certain all alarms are wired to a single, continuous (non-switched) power line, which is not protected by a ground fault interrupter. A maximum of 1000 ft. of wire can be used in the interconnect system. Use standard UL listed household wire (18 gauge or larger as required by local codes).



Ordering Information

Ordering Number	UPC	I 2 of 5	Pack Config	Pack Qty	Dimensions (w x d x h inches)	Weight	Cartons/ Pallet
21006377-N	0-47871-16377-9	100-47871-16377-6	BOX	Master Pack (6 Units)	6.6 x 13.5 x 6.2	6.7	126
21008495-N	0-47871-18495-8	100-47871-18495-5	CLAM	PDQ (2 Units)	7.8 x 4.5 x 11.8	1.5	180

Distributed by:

1016 Corporate Park Drive
Mebane NC 27302
1-800-880-6788 www.Kidde.com

solaredge

INVERTERS

SolarEdge Single Phase Inverters

For North America

SE3000A-US / SE3800A-US / SE5000A-US / SE6000A-US /
SE7600A-US / SE10000A-US / SE11400A-US

The best choice for SolarEdge enabled systems

- Integrated arc fault protection (Type 1) for NEC 2011 690.11 compliance
- Superior efficiency (98%)
- Small, lightweight and easy to install on provided bracket
- Built-in module-level monitoring
- Internet connection through Ethernet or Wireless
- Outdoor and indoor installation
- Fixed voltage inverter, DC/AC conversion only
- Pre-assembled Safety Switch for faster installation
- Optional – revenue grade data, ANSI C12.1

Single Phase Inverters for North America

SE3000A-US / SE3800A-US / SE5000A-US / SE6000A-US / SE7600A-US / SE10000A-US / SE11400A-US

	SE3000A-US	SE3800A-US	SE5000A-US	SE6000A-US	SE7600A-US	SE10000A- US	SE11400A-US	
OUTPUT								
Nominal AC Power Output	3000	3800	5000	6000	7600	9980 @ 208V 10000 @240V	11400	VA
Max. AC Power Output	3300	4150	5400 @ 208V 5450 @240V	6000	8350	10800 @ 208V 10950 @240V	12000	VA
AC Output Voltage Min.-Nom.-Max.[1] 183 - 208 - 229 Vac	-	-	✓	-	-	✓	-	
AC Output Voltage Min.-Nom.-Max.[1] 211 - 240 - 264 Vac	✓	✓	✓	✓	✓	✓	✓	
AC Frequency Min.-Nom.-Max.[1]	59.3 - 60 - 60.5 (with HI country setting 57 - 60 - 60.5)							Hz
Max. Continuous Output Current	12.5	16	24 @ 208V 21 @ 240V	25	32	48 @ 208V 42 @ 240V	47.5	A
GFDI Threshold	1							A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes							Yes
INPUT								
Maximum DC Power (STC)	4050	5100	6750	8100	10250	13500	15350	W
Transformer-less, Ungrounded	Yes							
Max. Input Voltage	500							Vdc
Nom. DC Input Voltage	325 @ 208V / 350 @ 240V							Vdc
Max. Input Current[2]	9.5	13	16.5 @ 208V 15.5 @ 240V	18	23	33 @ 208V 30.5 @ 240V	34.5	Adc
Max. Input Short Circuit Current	45							Adc
Reverse-Polarity Protection	Yes							
Ground-Fault Isolation Detection	600kΩ Sensitivity							
Maximum Inverter Efficiency	97.7	98.2	98.3	98.3	98	98	98	%
CEC Weighted Efficiency	97.5	98	97.5 @ 208V 98 @ 240V	97.5	97.5	97 @ 208V 97.5 @ 240V	97.5	%
Nighttime Power Consumption	< 2.5					< 4		W
ADDITIONAL FEATURES								
Supported Communication Interfaces	RS485, RS232, Ethernet, ZigBee (optional)							
Revenue Grade Data, ANSI C12.1	Optional[3]							
Rapid Shutdown – NEC 2014 690.12	Functionality enabled when SolarEdge rapid shutdown kit is installed[4]							
STANDARD COMPLIANCE								
Safety	UL1741, UL1699B, UL1998 , CSA 22.2							
Grid Connection Standards	IEEE1547							
Emissions	FCC part15 class B							
INSTALLATION SPECIFICATIONS								
AC output conduit size / AWG range	3/4" minimum / 16-6 AWG					3/4" minimum / 8-3 AWG		
DC input conduit size / # of strings / AWG range	3/4" minimum / 1-2 strings / 16-6 AWG					3/4" minimum / 1-2 strings / 14-6 AWG		
Dimensions with Safety Switch (HxWxD)	30.5 x 12.5 x 7.2 / 775 x 315 x 184					30.5 x 12.5 x 10.5 / 775 x 315 x 260		in / mm
Weight with Safety Switch	51.2 / 23.2		54.7 / 24.7			88 .4 / 40.1		lb / kg
Cooling	Natural Convection				Natural convection and internal fan (user replaceable)	Fans (user replaceable)		
Noise	< 25					< 50		dBA
Min.-Max. Operating Temperature Range	-13 to +140 / -25 to +60 (-40 to +60 version available[5])							˚F / ˚C
Protection Rating	NEMA 3R							

(1) For other regional settings please contact SolarEdge support.
(2) A higher current source may be used; the inverter will limit its input current to the values stated.
(3) Revenue grade inverter P/N: SExxxxA-US000NNR2 (for 7600W inverter:SE7600A-US002NNR2).
(4) Rapid shutdown kit P/N: SE1000-RSD-S1.
(5) -40 version P/N: SExxxxA-US000NNU4 (for 7600W inverter:SE7600A-US002NNU4).

SUNSPEC ALLIANCE RoHS

BIPV Laminate Specification

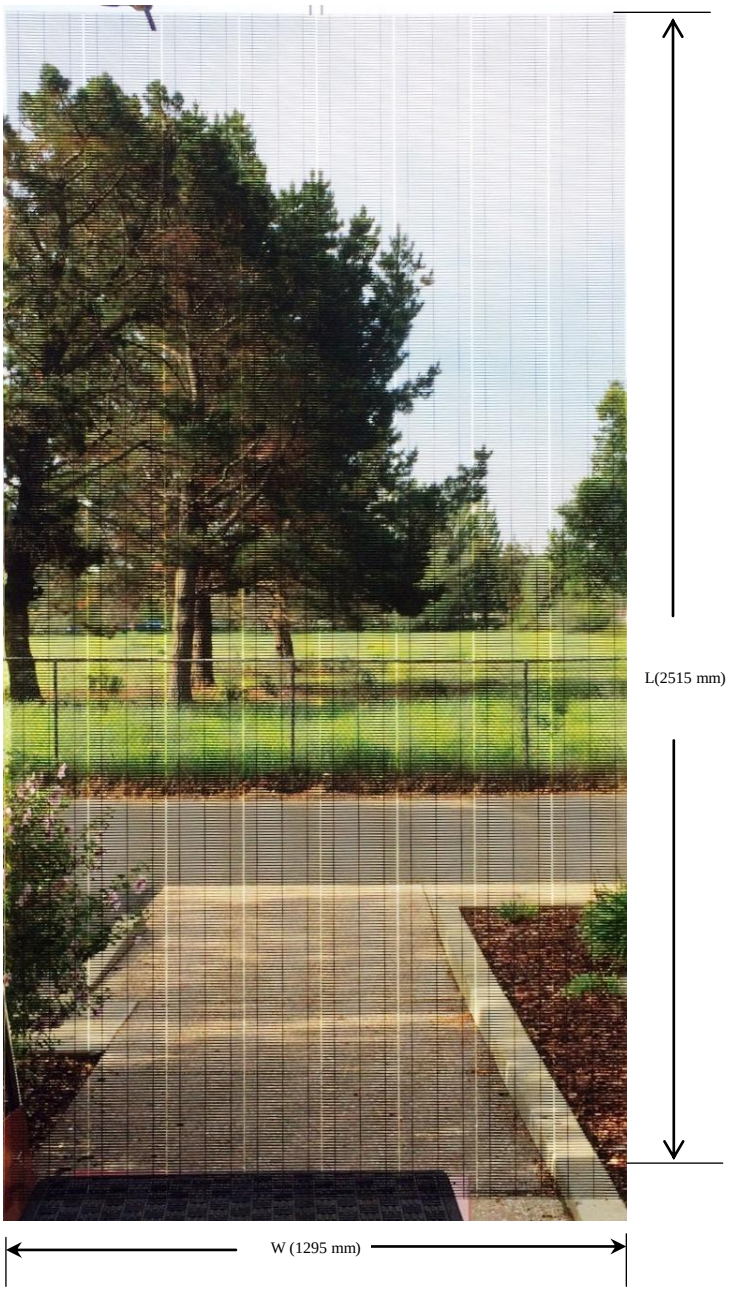
Solaria's BIPV Laminates combine solar energy generation with optimized lighting and heat control for architectural applications that demands significantly enhanced aesthetic quality for a truly integrated and environmentally friendly product. These laminates use Solaria's patent protected technology, combined with proven reliability and efficiency of crystalline silicon technology in high volume production. The laminates are designed to be used as is or incorporated into conventional insulated glass units for curtain walls, windows, and skylight systems.

The following table and schematic covers the Mechanical and Electrical attributes of a typical BIPV configuration from Solaria's product offering. The BIPV product comes in wide selection of sizes and performance specifications for architects and designers. Please contact Solaria for more details and requirements.

Glazing Specifications	
Outer Glass	¼" (6mm) Ultra-clear
Inner Glass	¼" (6mm) Ultra-clear
Visual Transparency	40 ~50%
Strip Length	156 mm
Strip Width	2.5 – 3.1 mm
Strip Pitch	5.8 mm
Encapsulant	PVB
Junction Box	Low-Profile, edge
Connectors	MC4

Mechanical Specifications	
Length (L)	99" (2515 mm)
Width (W)	51" (1296 mm)
Thickness	½" (13 mm)
Weight (Max)	220 lbs (100 kg)

Electrical Specifications	
Power (Pmp)	20~200 W
Efficiency (Aperture)	7 ~ 10%
Operating Temp	-40C – 80C
Max System Voltage	600 VDC
Max Series Fuse	15 A



Solaria BIPV used in IGU's can incorporate variable glass and coatings to optimize SHGC, U_{vis}, T_{vis} and W_p per project requirements.

Solaria Corporation 6200 Paseo Padre Parkway, Fremont, CA 94555 P: (510) 270-2500 F: (510) 793-8388 www.solaria.com

Solaria BIPV Product Specification

Mechanical Specification (Size)*	SBIPV 1	SBIPV 2	SBIPV 3	SBIPV 4	SBIPV 5	SBIPV 6
Length	41" (1033mm)	41" (1033mm)	41" (1033mm)	78.7" (2000mm)	78.7" (2000mm)	99" (2514mm)
Width (mm)	14.4" (365mm)	26.8"(680mm)	39.3"(998mm)	39.3"(998mm)	51"(1295mm)	51"(1295mm)
Thickness (Laminate)	13 mm	13 mm	13 mm	13 mm	13 mm	13 mm
Thickness (Double Glazed)	40mm	40mm	40mm	40mm	40mm	40mm
Weight (Kg)	25.7 lb (11.7 kg)	47.9 lb (21.8 kg)	70.2 lb (32 kg)	135 lb (61.3 kg)	175 lb (79.5 kg)	220 lb (100kg)

Electrical Specification**	SBIPV 1	SBIPV 2	SBIPV 3	SBIPV 4	SBIPV 5	SBIPV 6
Power in STC (W)	20	40	60	120	160	200
Voc (V)	15.4	15.4	15.4	30.7	30.7	38.4
Isc (Amp)	1.67	3.33	5	5	6.67	6.67
NOCT © C	55	55	55	55	55	55
Series Fuse Rating (Amp)	15	15	15	15	15	15
J Box	Edge Mounted	Edge Mounted	Edge Mounted	Edge Mounted	Edge Mounted	Edge Mounted
Connector	MC4	MC4	MC4	MC4	MC4	MC4

** Certified for Maximum System Voltage of 600 V DC

Laminate Glazing Specification		
Single Laminate		
Outer Glass	6mm Thick	Ultra Clear
Inner Glass	6mm Thick	Ultra Clear (Outer Surface Low e Coated)
SHGC	< 0.3	
U Value	Winter: 0.79, Summer 0.38	
VLT	0.40	
IGU With Laminated Outboard		
WattaVu Laminated Outer Glass	6mm Outer/PVB/6mm Inner	Ultra Clear
3 rd Lite	6mm, Inner Surface Low e Coated	Ultra Clear
SHGC	0.27	
U Value	Winter: 0.31, Summer: 0.29	
VLT	0.35	

***Please contact Solaria Corporation for custom BIPV sizes**

TALCO Fire Systems
RESIDENTIAL & COMMERCIAL FIRE PUMP SPECIALISTS
6040 NE 112TH AVE. PORTLAND, OREGON 97220
PHONE: 800-878-8055 WWW.TALCOFIRE.COM

HOME HYDRANT
NFPA-13D Packaged Residential Fire Pump & Tank

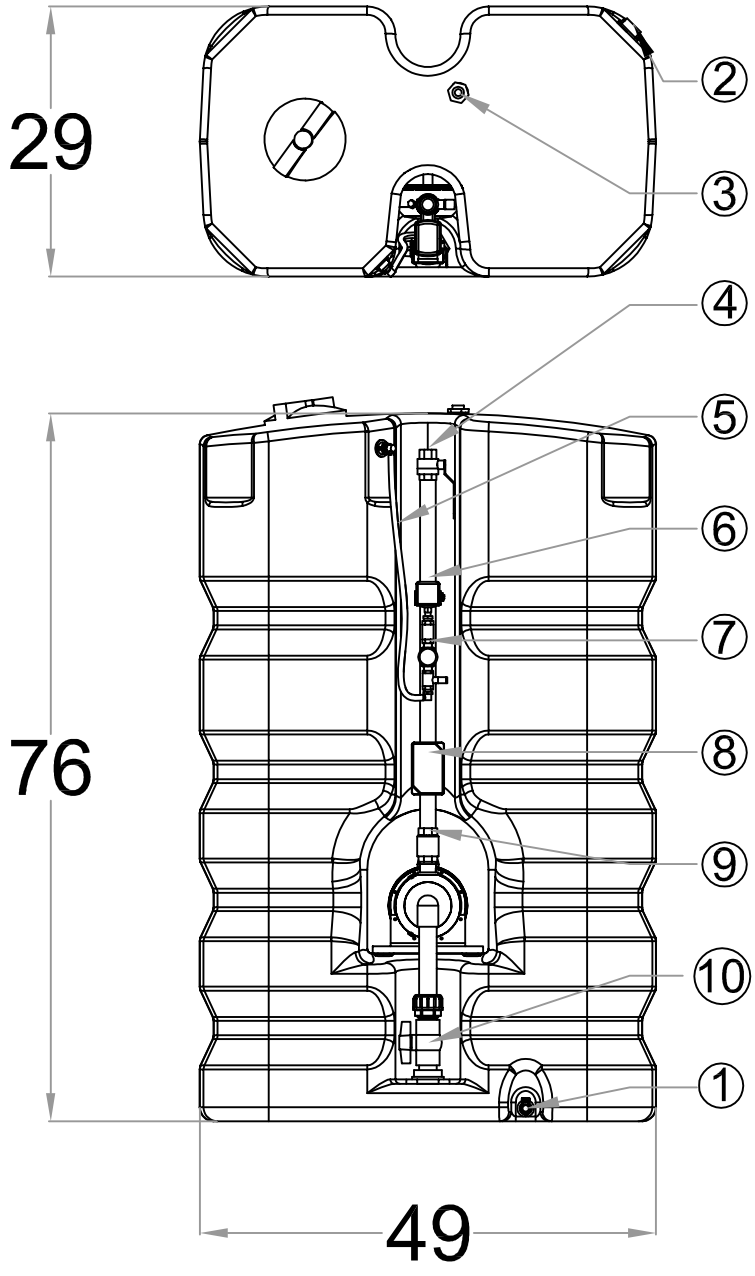
HH3-150C

40GPM @ 40PSI

350 Gallon Water Tank
① Tank Drain ½"(GHT)
② Overflow Fitting 1"(NPT)
③ Auto-Fill Valve ¾"(NPT

1.5HP Electric Motor
240 Volt Single-Phase
8.1 Amp (Full Load)

1 ¼" Discharge (NPT)
Smart Riser Control System
④ Isolation Ball Valve
⑤ Test Line/System Drain
⑥ 40-60 Pressure Switch
⑦ Pressure Gauge
⑧ Flow Switch
⑨ Discharge Check Valve
⑩ Suction Shut-off Valve



Performance

Performance values based on multiple pump tests. Not for certification purposes.

GPM	0	20	25	30	35	40	45
PSI	47	45	44	43	41	40	39