

Fixtures

Toilet - Kohler 76395-0
Toilet Tank - Kohler 18647-NA
30" Jute Vanity - Kohler 99540-1WA
Vanity Top - Kohler 5422-S33
Jute Bar Pull - Kohler 99688-HF1
Lavatory - Kohler 5403-P5-0
Lavatory Faucet - Kohler T14415-4-CP
Valve - Kohler 410-K-NA
Lavatory Drain - Kohler 7124-A-CP
TP Holder - Kohler 73147-CP
Towel Bar - Kohler 73143-CP
Showerhead - Kohler 939-CP
Valve Trim - Kohler TS73115-4-CP
Shower Arm - Kohler 99690-CP
Valve - Kohler 8304-KS-NA

Appliances

Zehnder ERV Unit
Air Handler, Unico IS30G080
Supply Grille, Unico, 2.5" outlet, white
Exhaust Grille, Titus, 6x6, FS300
Induction Cook Top, Beko
Induction Cook Top, Beko, CTI30400
Wall Oven, Beko, BW0S30100
Range hood, Broan 273003
Refrigerator, Freezer, Marvel 24" ML24RAP3LP
Refrigerator, Freezer, Marvel 24" ML24FAP2RP
Dishwasher, Beko DWS55100FB
Clothes Washer, Beko WM984005X
Clothes Dryer, Beko HPD24412W



SunPower® E-Series Commercial Solar Panels | E20-327-COM

More than 20% Efficiency

Captures more sunlight and generates more power than conventional panels.

High Performance

Delivers excellent performance in real-world conditions, such as high temperatures, clouds and low light.^{1,2,4}

Commercial Grade

Optimized to maximize returns and energy production, the E-Series panel is a bankable solution for commercial solar applications.



Maxeon® Solar Cells: Fundamentally better
Engineered for performance, designed for reliability.

Engineered for Peace of Mind

Designed to deliver consistent, trouble-free energy over a very long lifetime.^{3,4}

Designed for Reliability

The SunPower Maxeon Solar Cell is the only cell built on a solid copper foundation. Virtually impervious to the corrosion and cracking that degrade conventional panels.³

#1 Rank in Fraunhofer durability test.⁹
100% power maintained in Atlas 25+ comprehensive durability test.¹⁰

High Performance & Excellent Reliability



SPR-E20-327-COM

High Efficiency⁵

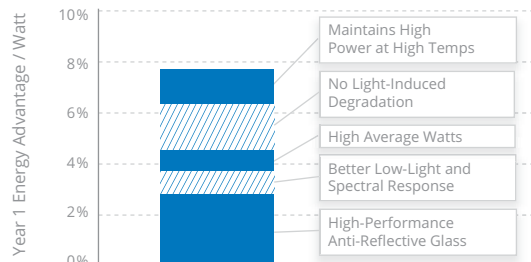
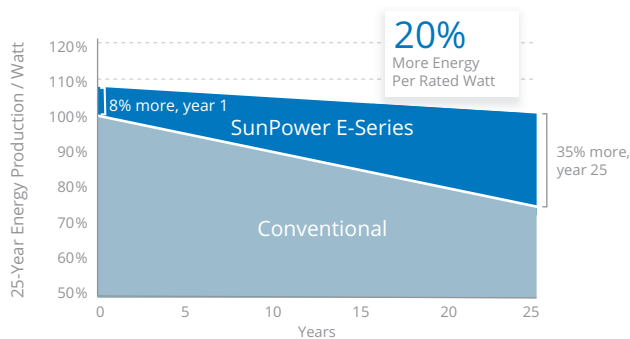
Generate more energy per square foot

E-Series commercial panels convert more sunlight to electricity by producing 31% more power per panel¹ and 60% more energy per square foot over 25 years.^{1,2,3}

High Energy Production⁶

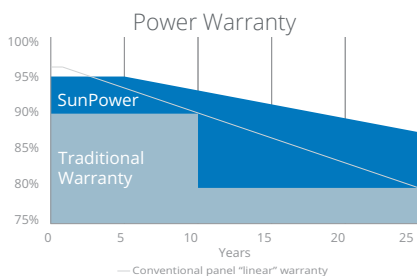
Produce more energy per rated watt

More energy to power your operations. High year-one performance delivers 7-9% more energy per rated watt.² This advantage increases over time, producing 20% more energy over the first 25 years to meet your needs.³

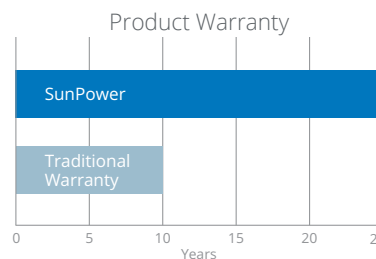


SunPower® E-Series Commercial Solar Panels | E20-327-COM

SunPower Offers The Best Combined Power And Product Warranty



More guaranteed power: 95% for first 5 years,
-0.4%/yr. to year 25⁷



Combined Power and Product defect 25-year coverage⁸

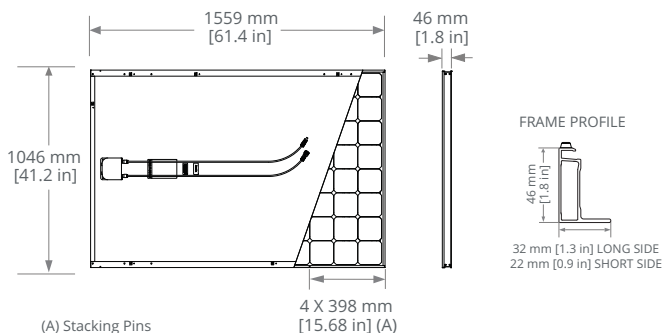
Electrical Data	SPR-E20-327-COM SPR-E19-310-COM	
	Nominal Power (P _{nom}) ¹¹	327 W
Power Tolerance	+5/-3%	+5/-3%
Avg. Panel Efficiency ¹²	20.3%	19.3%
Rated Voltage (V _{mpp})	54.7 V	54.7 V
Rated Current (I _{mpp})	5.98 A	5.67 A
Open-Circuit Voltage (V _{oc})	64.9 V	64.4 V
Short-Circuit Current (I _{sc})	6.46 A	6.05 A
Max. System Voltage	1000 V UL & 1000 V IEC	
Maximum Series Fuse	15 A	
Power Temp Coef.	-0.35% / °C	
Voltage Temp Coef.	-176.6 mV / °C	
Current Temp Coef.	2.6 mA / °C	

Tests And Certifications	
Standard Tests ¹³	UL1703 (Type 2 Fire Rating), IEC 61215, IEC 61730
Quality Certs	ISO 9001:2008, ISO 14001:2004
EHS Compliance	RoHS, OHSAS 18001:2007, lead free, REACH SVHC-163, PV Cycle
Sustainability	Cradle to Cradle Certified™ Silver (eligible for LEED points) ¹⁴
Ammonia Test	IEC 62716
Desert Test	10.1109/PVSC.2013.6744437
Salt Spray Test	IEC 61701 (maximum severity)
PID Test	Potential-Induced Degradation free: 1000 V ⁹
Available Listings ¹⁵	UL, TUV, JET, MCS, CSA, FSEC, CEC

Operating Condition And Mechanical Data	
Temperature	-40° F to +185° F (-40° C to +85° C)
Impact Resistance	1 inch (25 mm) diameter hail at 52 mph (23 m/s)
Appearance	Class B
Solar Cells	96 Monocrystalline Maxeon Gen II
Tempered Glass	High-transmission tempered anti-reflective
Junction Box	IP-65, MC4 compatible
Weight	41 lbs (18.6 kg)
Max. Load	Wind: 50 psf, 2400 Pa, 244 kg/m ² front & back Snow: 112 psf, 5400 Pa, 550 kg/m ² front
Frame	Class 2 silver anodized; stacking pins

REFERENCES:

- All comparisons are SPR-E20-327 vs. a representative conventional panel: 250 W, approx. 1.6 m², 15.3% efficiency.
- Typically 7-9% more energy per watt, BEW/DNV Engineering "SunPower Yield Report," Jan 2013.
- SunPower 0.25%/yr degradation vs. 1.0%/yr conv. panel. Campeau, Z. et al. "SunPower Module Degradation Rate," SunPower white paper, Feb 2013; Jordan, Dirk "SunPower Test Report," NREL, Q1-2015.
- "SunPower Module 40-Year Useful Life" SunPower white paper, May 2015. Useful life is 99 out of 100 panels operating at more than 70% of rated power.
- Second highest, after SunPower X-Series, of over 3,200 silicon solar panels, Photon Module Survey, Feb 2014.
- 8% more energy than the average of the top 10 panel companies tested in 2012 (151 panels, 102 companies), Photon International, Feb 2013.
- Compared with the top 15 manufacturers. SunPower Warranty Review, May 2015.
- Some restrictions and exclusions may apply. See warranty for details.
- 5 of top 8 panel manufacturers tested in 2013 report, 3 additional panels in 2014. Ferrara, C., et al. "Fraunhofer PV Durability Initiative for Solar Modules: Part 2". Photovoltaics International, 2014.
- Compared with the non-stress-tested control panel. Atlas 25+ Durability test report, Feb 2013.
- Standard Test Conditions (1000 W/m² irradiance, AM 1.5, 25° C). NREL calibration Standard: SOMS current, LACCS FF and Voltage.
- Based on average of measured power values during production.
- Type 2 fire rating per UL1703:2013, Class C fire rating per UL1703:2002.
- See salesperson for details.
- Only SPR-E20-327-COM has MCS certification.



Please read the safety and installation guide.

See www.sunpower.com/facts for more reference information.
For more details, see extended datasheet: www.sunpower.com/datasheets.

Document # 505701 Rev G /LTR_US



SolarEdge Single Phase StorEdge™ Solutions for North America



STOREDGE™

SolarEdge StorEdge™ Solutions Benefits:

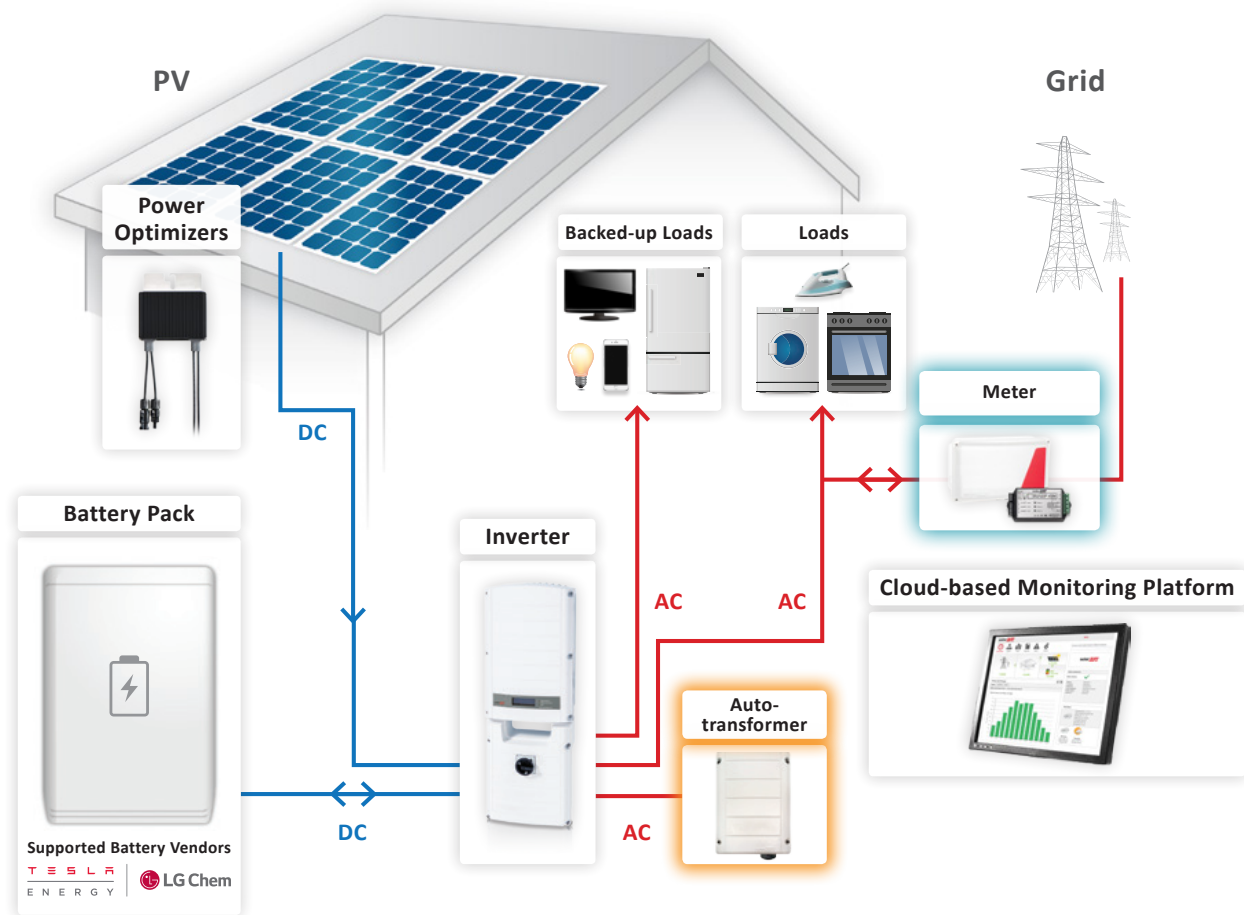
- **More Energy** - DC-coupled architecture stores PV power directly to the battery without AC conversion losses
- **Simple Design & Installation** - single inverter for PV, battery storage, grid-tied and backup applications
- **Enhanced Safety** - no high voltage during installation, maintenance or firefighting
- **Full Visibility** - monitor battery status, PV production, remaining backup power and self-consumption data



SolarEdge Single Phase StorEdge™ Solutions for North America

StorEdge™ Features:

- Smart Energy Management - export control, time-of-use shifting, maximized self-consumption, demand response and peak shaving capabilities
- Backup power - automatically provides power to backed-up loads in the event of grid interruption
- All-in-one solution uses a single DC optimized phase inverter to manage and monitor both PV generation and energy storage
- Compatible with Tesla Powerwall Home Battery and the LG Chem RESU



SolarEdge StorEdge™ Solutions for North America - Product Selector

	Grid-tied solar, backup power and smart energy management	Grid-tied solar and backup power	Grid-tied solar and smart energy management	
Single Phase StorEdge™ Inverter	✓	✓	✓	
Auto-transformer	✓	✓		
SolarEdge Electricity Meter	✓		✓	
Battery	✓	✓	✓	



SolarEdge Single Phase StorEdge Inverter for North America SE7600A-US⁽¹⁾

- Single inverter for PV, grid-tied storage and backup power
- Includes the hardware required to provide automatic backup power to backed-up loads in case of grid interruption
- Includes all interfaces needed for battery connection

SE7600A-US		
OUTPUT - AC (LOADS/GRID)		
Rated AC Power Output	7600	VA
Max AC Power Output	8350	VA
AC Output Voltage Min-Nom-Max (L-L) ⁽²⁾	211-240-264	Vac
AC Frequency Min-Nom-Max ⁽²⁾	59.3 - 60 - 60.5	Hz
Maximum Continuous Output Current @240V	32	A
GFDI	1	A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes	
Charge Battery from AC (if Allowed)	Yes	
THD	<3	%
Power factor with rated power	>0.99 (configurable; 0.9 leading to 0.9 lagging)	
Typical Nighttime Power Consumption	<5	W
OUTPUT - AC (BACKUP POWER)⁽³⁾		
Rated AC Power Output	5000 ⁽⁴⁾	VA
Max AC Power Output - Surge	7600 for 10sec	VA
AC Output Voltage Min-Nom-Max (L-L)	211-240-264	Vac
AC Output Voltage Min-Nom-Max (L-N)	105-120-132	Vac
AC Frequency Min-Nom-Max	55 - 60 - 65	Hz
Maximum Continuous Output Current @240V - Backup Mode	21	A
Max Continuous Output Current per Phase @120V	25	A
GFDI	1	A
AC Circuit Breaker	Yes	
THD	<5	%
Power factor with rated power	0.2 leading to 0.2 lagging	
Automatic switchover time	<2	sec
Typical Nighttime Power Consumption	<5	W
INPUT - DC (PV and BATTERY)		
Transformer-less, Ungrounded	Yes	
Max Input Voltage	500	Vdc
Nom DC Input Voltage	400	Vdc
Reverse-Polarity Protection	Yes	
Ground-Fault Isolation Detection	600kΩ Sensitivity	
Maximum Inverter Efficiency	98	%
CEC Weighted Efficiency	97.5	%
INPUT - DC (PV)		
Maximum DC Power (STC)	10250	W
Max Input Current ⁽⁵⁾	23	Adc
2-pole Disconnection	Yes	
INPUT - DC (BATTERY)		
Continuous Peak Power	3300	W
Number of Batteries per Inverter ⁽⁶⁾	1 2 for high capacity	
Supported Battery Types	LG Chem RESU 10H Tesla Powerwall 1	
Max Input Current	8.5	Adc
2-pole Disconnection	Yes	
DC Fuses on Plus and Minus	12A (field replaceable)	
ADDITIONAL FEATURES		
Supported Communication Interfaces	RS485 for battery, RS485, Ethernet, ZigBee (optional)	
Battery Power Supply	Yes, 12V / 53W	
Revenue Grade Data, ANSI C12.1	Optional ⁽⁷⁾	
Integrated AC, DC and Communication Connection Unit	Yes	
AC Disconnect	Yes	
Manual Inverter Bypass Switch	Yes	
DC Voltage Rapid Shutdown (PV and Battery)	Yes, according to NEC 2014 690.12	
Auto-transformer thermal protection	Yes	

⁽¹⁾ These specifications apply to inverters with part numbers SE7600A-US0XXXXX and connection unit model number BCU-1PH-USS

⁽²⁾ For other regional settings please contact SolarEdge Support

⁽³⁾ Not designed for standalone applications and requires AC for commissioning

⁽⁴⁾ The rated AC power output is the minimum between 5000VA and the battery continuous peak power

⁽⁵⁾ A higher current source may be used; the inverter will limit its input current to the values stated

⁽⁶⁾ For two batteries for double power contact SolarEdge technical support

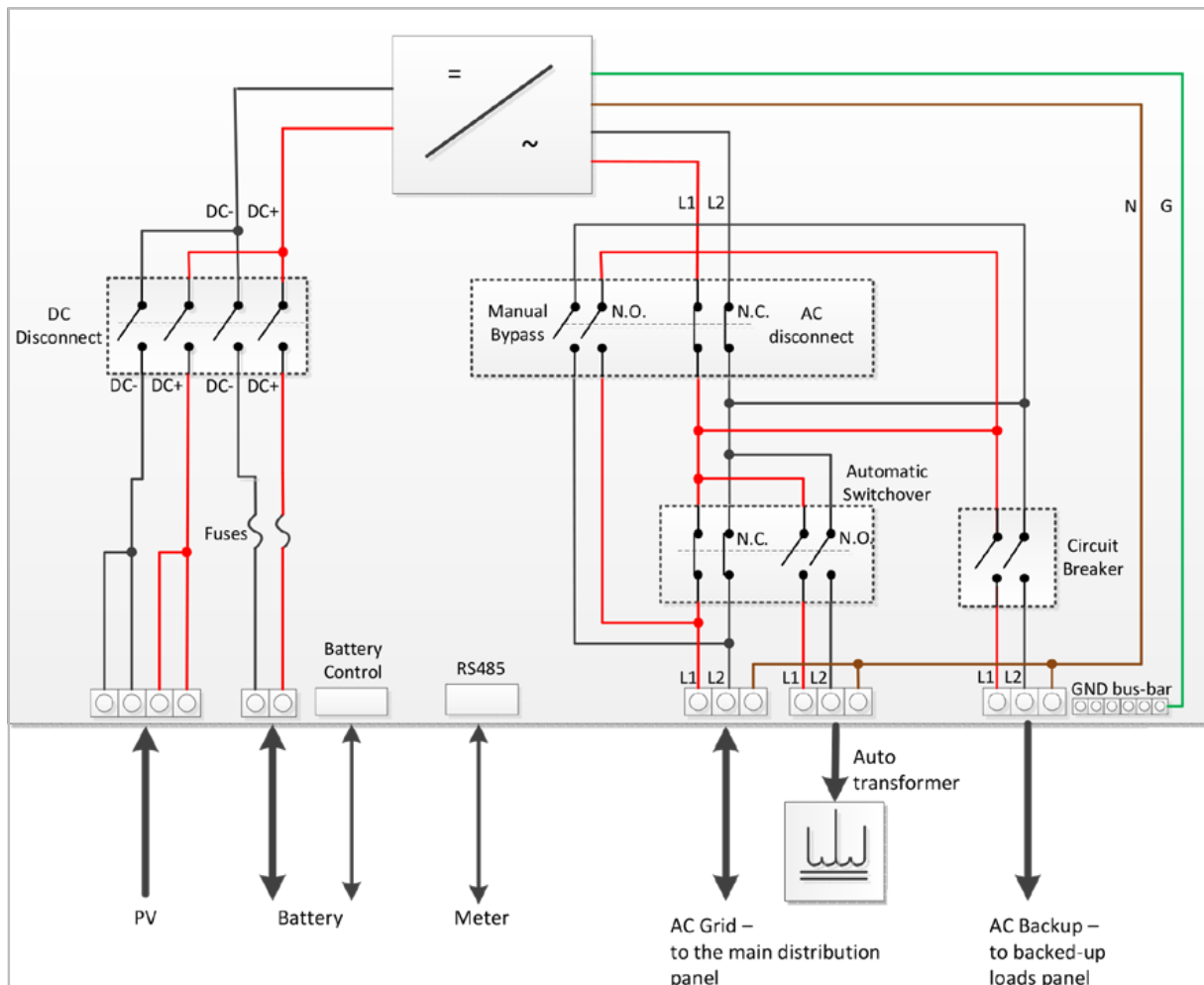
⁽⁷⁾ Revenue grade inverter P/N: SE7600A-USS02NNG2



SolarEdge Single Phase StorEdge Inverter for North America SE7600A-US

SE7600A-USS		
STANDARD COMPLIANCE		
Safety	UL1741, UL1699B, UL1998, CSA 22.2	
Grid Connection Standards	IEEE1547, Rule 21, Rule 14	
Emissions	FCC part15 class B	
INSTALLATION SPECIFICATIONS		
AC Output (Loads/Grid) conduit size / AWG range	1" / 14-6 AWG	
AC Output (Backup) conduit size / AWG range	0.75-1" knockouts / 14-6 AWG	
AC Input (Auto-transformer) conduit size / AWG range	0.75-1" / 14-6 AWG	
DC Input (PV) conduit size / AWG range	0.75" / 14-8 AWG	
DC Input (Battery) conduit size / AWG range	0.75" / 16-10 AWG	
Dimensions with Connection Unit (HxWxD)	37 x 12.5 x 7.2 / 940 x 315 x 184	in / mm
Weight with Connection Unit	58.5 / 26.5	lb / kg
Cooling	Natural convection and internal fan (user replaceable)	
Noise	<50	dBA
Min - Max Operating Temperature	-13 to +140 / -25 to +60	°F / °C
Protection Rating	NEMA 3R	

Inverter Interface





SolarEdge Auto-transformer

SEAUTO-TX-5000

SEAUTO-TX-5000		
ELECTRICAL RATINGS		
Rated Power - Continuous	5000	VA
Rated Power - Peak	7600 for 10sec	VA
Output Voltage	120/240V Split Phase	
Max Continuous Output Current per Phase @120V	25	A
Split Phase Imbalance (@Rated Power)	Yes, up to 25A difference between phases	
Thermal Protection	Yes	
INSTALLATION SPECIFICATIONS		
AC Output conduit size / AWG range	0.75" / 14-6 AWG	
Dimensions (HxWxD)	6.7 x 7.9 x 5.5 / 170 x 200 x 140	in / mm
Weight	29.7 / 13.5	lb / kg
Min - Max Operating Temperature	-13 to +140 / -25 to +60	°F / °C
Protection Rating	NEMA 3R	
Installation	Wall mounted	



SolarEdge Electricity Meter for North America

SE-MTR240-2-200-S1 / SE-MTR240-2-400-S1

For meter specifications refer to: http://www.solaredge.us/files/pdfs/products/se_electricity_meter_na.pdf





SolarEdge Power Optimizer

Module Add-On For North America

P300 / P320 / P370 / P400 / P405



POWER OPTIMIZER

PV power optimization at the module-level

- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch losses, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module-level monitoring
- Module-level voltage shutdown for installer and firefighter safety



SolarEdge Power Optimizer

Module Add-On for North America

P300 / P320 / P370 / P400 / P405

	P300 (for 60-cell modules)	P320 (for high-power 60-cell modules)	P370 (for higher-power 60 and 72-cell modules)	P400 (for 72 & 96-cell modules)	P405 (for thin film modules)	
INPUT						
Rated Input DC Power ⁽¹⁾	300	320	370	400	405	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48		60	80	125	Vdc
MPPT Operating Range	8 - 48		8 - 60	8 - 80	12.5 - 105	Vdc
Maximum Short Circuit Current (Isc)	10	11		10.1		Adc
Maximum DC Input Current	12.5	13.75		12.63		Adc
Maximum Efficiency				99.5		%
Weighted Efficiency				98.8		%
Overtoltage Category				II		
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREEDGE INVERTER)						
Maximum Output Current				15		Adc
Maximum Output Voltage	60			85		Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREEDGE INVERTER OR SOLAREEDGE INVERTER OFF)						
Safety Output Voltage per Power Optimizer				1		Vdc
STANDARD COMPLIANCE						
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3					
Safety	IEC62109-1 (class II safety), UL1741					
RoHS	Yes					
INSTALLATION SPECIFICATIONS						
Maximum Allowed System Voltage	1000					Vdc
Compatible inverters	All SolarEdge Single Phase and Three Phase inverters					
Dimensions (W x L x H)	128 x 152 x 27.5 / 5 x 5.97 x 1.08			128 x 152 x 35 / 5 x 5.97 x 1.37	128 x 152 x 50 / 5 x 5.97 x 1.96	mm / in
Weight (including cables)	630 / 1.4			750 / 1.7	845 / 1.9	gr / lb
Input Connector	MC4 Compatible		MC4 / Amphenol AH4	MC4 Compatible		
Output Wire Type / Connector	Double Insulated; MC4 Compatible		Double Insulated; MC4 / Amphenol AH4	Double Insulated; MC4 Compatible		
Output Wire Length	0.95 / 3.0		1.2 / 3.9		m / ft	
Operating Temperature Range	-40 - +85 / -40 - +185					°C / °F
Protection Rating	IP68 / NEMA6P					
Relative Humidity	0 - 100					%

⁽¹⁾ Rated STC power of the module. Module of up to +5% power tolerance allowed.

PV SYSTEM DESIGN USING A SOLAREEDGE INVERTER ⁽²⁾⁽³⁾	SINGLE PHASE HD-WAVE	SINGLE PHASE	THREE PHASE 208V	THREE PHASE 480V	
Minimum String Length (Power Optimizers)	8		10	18	
Maximum String Length (Power Optimizers)	25		25	50	
Maximum Power per String	5700 (6000 with SE7600H-US)	5250	6000	12750	W
Parallel Strings of Different Lengths or Orientations	Yes				

⁽²⁾ For detailed string sizing information refer to: http://www.solaredge.com/sites/default/files/string_sizing_na.pdf.

⁽³⁾ It is not allowed to mix P405 with P300/P370/P400/P600/P700 in one string.





SolarEdge Single Phase Inverters

SE2200H, SE3000H, SE3500H, SE3680H
SE4000H, SE5000H, SE6000H



INVERTERS

Optimized installation with HD-Wave technology

- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Extremely small, lightweight and easy to install
- High reliability without any electrolytic capacitors
- Built-in module-level monitoring
- Outdoor and indoor installation
- Compatible with the StorEdge Interface for Smart Energy Management StorEdge™ applications





Single Phase Inverters

SE2200H, SE3000H, SE3500H, SE3680H
SE4000H, SE5000H, SE6000H

	SE2200H	SE3000H	SE3500H	SE3680H	SE4000H	SE5000H	SE6000H	
OUTPUT								
Rated AC Power Output	2200	3000	3500	3680	4000	5000 ⁽¹⁾	6000	VA
Maximum AC Power Output	2200	3000	3500	3680	4000	5000 ⁽¹⁾	6000	VA
AC Output Voltage (nominal)	220 / 230							Vac
AC Output Voltage Range	184 - 264.5							Vac
AC Frequency (nominal)	50 / 60 ± 5							Hz
Maximum Continuous Output Current	10	14	16	16	18.5	23	27.5	A
Residual Current Detector / Residual Current Step Detector	300 / 30							mA
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes							
INPUT								
Maximum DC Power	3400	4650	5425	5700	6200	7750	9300	W
Transformer-less, Ungrounded	Yes							
Maximum Input Voltage	480							Vdc
Nominal DC Input Voltage	380							Vdc
Maximum Input Current	6.5	9	10	10.5	11.5	13.5	16.5	Adc
Reverse-Polarity Protection	Yes							
Ground-Fault Isolation Detection	600kΩ Sensitivity							
Maximum Inverter Efficiency	99.2							%
European Weighted Efficiency	98.3	98.8				99		%
Nighttime Power Consumption	< 2.5							W
ADDITIONAL FEATURES								
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional), WiFi (optional), Cellular (optional)							
Smart Energy Management	Export Limitation, StorEdge applications							
STANDARD COMPLIANCE								
Safety	IEC-62109-1/2, AS-3100							
Grid Connection Standards	AS-4777, VDE-AR-N-4105, VDE 0126-1-1, UTE C15-712, G83/2, G59/3, CEI-021, EN 50438, IEC61727, IEC62116, ÖNORM, TF3.2.1, C10-11, NRS 097-2-1							
Emissions	IEC61000-6-2, IEC61000-6-3, IEC61000-3-11, IEC61000-3-12, FCC Part 15 Class B							
INSTALLATION SPECIFICATIONS								
AC Output - Supported Cable Diameter	9 - 16							mm
AC - Supported Wire Cross Section	1 - 16							mm ²
DC Input	1 x MC4			2 x MC4 pair				
Dimensions (H x W x D)	280 x 370 x 142							mm
Noise	< 25							dBA
Weight	9.5							kg
Cooling	Natural Convection							
Operating Temperature Range	-20 to +60 ⁽²⁾ (-40°C option)							°C
Protection Rating	IP65 - Outdoor and Indoor							

⁽¹⁾ 4600VA in Germany
⁽²⁾ De-rating from 50°C



RoHS



FOAMULAR® 250

Extruded Polystyrene (XPS)

Rigid Foam Insulation



Description

Owens Corning® FOAMULAR® 250 Extruded Polystyrene (XPS) Insulation is a closed cell, moisture-resistant rigid foam board well suited to meet the needs for a wide variety of building applications. FOAMULAR® 250 XPS insulation is great for many residential and commercial construction applications such as wall furring, perimeter/foundation, cavity wall, pre-cast concrete, under slab, crawl spaces, sheathing and other applications.

Features

- Excellent long-term stable insulating performance at R-5' per inch
 - Exceptional moisture resistance, long-term durability
 - Lightweight, durable rigid foam panels are easy to handle and install
 - Easy to saw, cut or score
1. R means the resistance to heat flow; the higher the R-value, the greater the insulating power.

Applications

- Slows the transmission of water vapor and moisture in masonry walls
- Provides continuous insulation over wood or steel stud framing, in insulated concrete sandwich panel walls, in masonry unit cavity walls, or when used with non-penetrating, surface mounted furring systems over masonry or concrete walls
- Insulates and retains its properties in below grade perimeter and foundation applications, or directly beneath the concrete slab to complement the insulating sheathing envelope around the building framing

Physical Properties²

Property	Test Method ³	Value
Thermal Resistance ⁴ , R-value (180 day) minimum, hr·ft ² ·°F/Btu (RSI, °C·m ² /W) @ 75°F (24°C) mean temperature	ASTM C518	
3/4" Thickness		4.0 (0.70)
1" Thickness		5.0 (0.88)
1 1/2" Thickness		7.5 (1.32)
2" Thickness		10 (1.76)
2 1/2" Thickness		12.5 (2.20)
3" Thickness		15 (2.64)
4" Thickness		20 (3.52)
@ 40°F (4.4°C) mean temperature		
3/4" Thickness		4.3 (0.76)
1" Thickness		5.4 (0.95)
1 1/2" Thickness		8.1 (1.43)
2" Thickness		10.8 (1.90)
2 1/2" Thickness		13.5 (2.38)
3" Thickness		16.2 (2.85)
4" Thickness		21.6 (3.80)
Long Term Thermal Resistance, LTTR-value ⁴ , minimum hr·ft ² ·°F/Btu (RSI, °C·m ² /W) @ 75°F (24°C) mean temperature	CAN/ULC S770-03	
3/4" Thickness		N/A
1" Thickness		5.0 (0.88)
1 1/2" Thickness		7.8 (1.37)
2" Thickness		10.6 (1.87)
2 1/2" Thickness		13.4 (2.36)
3" Thickness		16.2 (2.85)
4" Thickness		22.0 (3.87)
Compressive Strength ⁵ , minimum psi (kPa)	ASTM D1621	25 (172)
Flexural Strength ⁶ , minimum psi (kPa)	ASTM C203	50 (345)
Water Absorption ⁷ , maximum % by volume	ASTM C272	0.3
Water Vapor Permeance ⁸ , maximum perm (ng/Pa·s·m ²)	ASTM E96	1.5 (86)
Dimensional Stability, maximum % linear change	ASTM D2126	2.0
Flame Spread ^{9, 10}	ASTM E84	10
Smoke Developed ^{9, 10, 11}	ASTM E84	175
Oxygen Index ¹² , minimum % by volume	ASTM D2863	24
Service Temperature, maximum °F (°C)		165 (74)
Linear Coefficient of Thermal Expansion, in/in/°F (m/m°C)	ASTM E228	3.5 x 10 ⁻⁵ (6.3 x 10 ⁻⁵)

2. Properties shown are representative values for 1" thick material, unless otherwise specified.
 3. Modified as required to meet ASTM C578.
 4. R means the resistance to heat flow; the higher the value, the greater the insulation power. This insulation must be installed properly to get the marked R-value. Follow the manufacturer's instructions carefully. If a manufacturer's fact sheet is not provided with the material shipment, request this and review it carefully. R-values vary depending on many factors including the mean temperature at which the test is conducted, and the age of the sample at the time of testing. Because rigid foam plastic insulation products are not all aged in accordance with the same standards, it is useful to publish comparison R-value data. The R-value for FOAMULAR® XPS Insulation is provided from testing at two mean temperatures, 40°F and 75°F, and from two aging (conditioning) techniques, 180 day real-time aged (as mandated by ASTM C578) and a method of accelerated aging sometimes called "Long Term Thermal Resistance" (LTTR) per CAN/ULC S770-03. The R-value at 180 day real-time age and 75°F mean temperature is commonly used to compare products and is the value printed on the product.
 5. Values at yield or 10% deflection, whichever occurs first.
 6. Value at yield or 5%, whichever occurs first.
 7. Data ranges from 0.00 to value shown due to the level of precision of the test method.
 8. Water vapor permeance decreases as thickness increases.
 9. These laboratory tests are not intended to describe the hazards presented by this material under actual fire conditions.
 10. Data from Underwriters Laboratories Inc.® classified. See Classification Certificate U-197.
 11. ASTM E84 is thickness-dependent, therefore a range of values is given.

Product and Packaging Data

Material			Packaging					
Extruded polystyrene closed-cell foam, ASTM C578 Type IV, 25 psi minimum			Shipped in poly-wrapped units with individually wrapped or banded bundles.					
Thickness (in)	Product Dimensions Thickness (in) x Width (in) x Length (in)	Pallet (Unit) Dimensions (typical) Width (ft) x Length (ft) x Height (ft)	Square feet per Pallet	Board feet per Pallet	Bundles per Pallet	Pieces per Bundle	Pieces per Pallet	Edges
3/4	3/4 x 24 x 96	4 x 8 x 8	4,096	3,072	8	32	256	Square Edge, Scored Square Edge, Tongue & Groove
	3/4 x 24 x 96 (half unit)	4 x 8 x 4	2,048	1,536	4	32	128	
	3/4 x 48 x 96	4 x 8 x 8	4,096	3,072	8	16	128	
	3/4 x 48 x 96 (half unit)	4 x 8 x 4	2,048	1,536	4	16	64	
	3/4 x 48 x 108	4 x 9 x 8	4,608	3,456	8	16	128	
	3/4 x 48 x 120	4 x 10 x 8	5,120	3,840	8	16	128	
1	1 x 24 x 96	4 x 8 x 8	3,072	3,072	8	24	192	
	1 x 24 x 96 (half unit)	4 x 8 x 4	1,536	1,536	4	24	96	
	1 x 48 x 96	4 x 8 x 8	3,072	3,072	8	12	96	
	1 x 48 x 96 (half unit)	4 x 8 x 4	1,536	1,536	4	12	48	
	1 x 48 x 108	4 x 9 x 8	3,456	3,456	8	12	96	
1 1/2	1.5 x 24 x 96	4 x 8 x 8	2,048	3,072	8	16	128	
	1.5 x 48 x 96	4 x 8 x 8	2,048	3,072	8	8	64	
2	2 x 24 x 96	4 x 8 x 8	1,536	3,072	8	12	96	
	2 x 24 x 96 (half unit)	4 x 8 x 4	768	1,536	4	12	48	
	2 x 24 x 108	4 x 9 x 8	1,728	3,456	8	12	96	
	2 x 48 x 96	4 x 8 x 8	1,536	3,072	8	6	48	
2 1/2	2.5 x 24 x 96	4 x 8 x 8	1,152	2,880	8	9	72	
	2.5 x 48 x 96	4 x 8 x 8	1,152	2,880	4	9	36	
3	3 x 24 x 96	4 x 8 x 8	1,024	3,072	8	8	64	
	3 x 48 x 96	4 x 8 x 8	1,024	3,072	8	4	32	
4	4 x 24 x 96	4 x 8 x 8	768	3,072	8	6	48	
	4 x 48 x 96	4 x 8 x 8	768	3,072	8	3	24	

Available lengths and edge configurations vary by thickness. Other sizes may be available upon request. Consult your local Owens Corning representative for availability.

- FOAMULAR® 250 XPS insulation is great for below grade applications. FOAMULAR® XPS insulation is resistant to degradation from the components of common soils and will retain its insulating performance characteristics even after prolonged exposure to moisture
- Provides a weather resistant barrier (when joints are sealed) to enhance the building's resistance to air and moisture penetration
- FOAMULAR® XPS insulation has a maximum service temperature of 165°F. Install only as much FOAMULAR® XPS insulation as can be covered in the same day. For horizontal applications, always turn the print side down so the black print does not show to the sun which may at times act as a solar collector, raising the temperature of the foam under the print to an unacceptable level. Provide a final finish covering or temporary white opaque covering to avoid possible damage when dark (non-white) surfaces are used over FOAMULAR® XPS insulation. Do not cover FOAMULAR® XPS insulation either stored (factory wrapped or unwrapped), or partially installed, with dark colored (non-white), or clear (non-opaque) coverings and leave it exposed to the sun. Examples of such coverings include but are not limited to filter fabrics, membranes, temporary tarps, clear polyethylene, etc. If improperly covered, and exposed to the right combination of sun, time and temperature, FOAMULAR® XPS insulation deformation damage may occur rapidly. See Owens Corning publication "Heat Build Up Due to Solar Exposure" (Pub. No. 10015704) for more information.
- This product is combustible. A protective barrier or thermal barrier is required to separate this product from interior living or conditioned spaces as specified in the appropriate building code.
- All construction should be evaluated for the necessity to provide vapor retarders. See current ASHRAE Handbook of Fundamentals.

Technical Information

- FOAMULAR® 250 XPS insulation is a non-structural material and must be installed on framing which is independently braced and structurally adequate to meet required construction and service loading conditions.
- FOAMULAR® XPS insulation can be exposed to the exterior during normal construction cycles. During that time some fading of color may begin due to UV exposure, and, if exposed for extended periods of time, some degradation or "dusting" of the polystyrene surface may begin. It is best if the product is covered within 60 days to minimize degradation. Once covered, the deterioration stops, and damage is limited to the thin top surface layers of cells. Cells below are generally unharmed and still useful insulation.

Standards, Codes Compliance

- Meets ASTM C578 Type IV
- UL Classification Certificate U-197¹²
- Code Evaluation Report UL ER8811-01¹²
- ASTM E119 Fire Resistance Rated Wall Assemblies¹²
- Meets California Quality Standards; HUD UM #71a
- Compliance verification by RADCO (AA-650)

¹². Visit www.owenscorning.com for more details.

Limited Warranty

FOAMULAR® XPS insulation limited lifetime warranty maintains 90% of its R-value for the lifetime of the building and covers all ASTM C578 properties. See actual warranty for complete details, limitations and requirements at www.owenscorning.com.

Environmental and Sustainability

Owens Corning is a worldwide leader in building material systems, insulation and composite solutions, delivering a broad range of high-quality products and services.

Owens Corning is committed to driving sustainability by delivering solutions, transforming markets and enhancing lives. More information can be found at www.owenscorning.com.

Notes

For additional information, refer to the Safe Use Instruction Sheet (SUIS) found in the SDS Database via <http://sds.owenscorning.com>.

Not for use in roofing. For roofing applications, use FOAMULAR® THERMAPINK® XPS insulation.

Certifications and Sustainable Features

- Certified by SCS Global Services to contain a minimum of 20% recycled content pre-consumer
- GREENGUARD Certified products are certified to GREENGUARD standards for low chemical emissions into indoor air during product usage. For more information, visit ul.com/gg
- Environmental Product Declaration (EPD) has been certified by UL Environment
- Qualified as an ENERGY STAR® product, under the U.S. Environmental Protection Agency and the U.S. Department of Energy
- Utilizing FOAMULAR® XPS insulation can help builders achieve green building certifications including the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) certification
- Approved under the Home Innovation Research Labs NGBS Green Certification Program



Home Innovation
NGBS GREEN CERTIFIED™



AVERAGE 20% RECYCLED CONTENT
PRE-CONSUMER



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Ductal[®] SOLUTIONS

**THE FONDATION LOUIS VUITTON
TAKES MATERIALS TO A NEW LEVEL**

**CLADDING:
A NEW OFFER
FOR LIGHTWEIGHT FACADES**

**ENGINEERING STRUCTURES:
UHPC IN ACTION**

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Gérard Kuperfarb
Lafarge Group Executive
Vice President, Innovation.



Jean Bouin Stadium, Paris.

Ductal® is a new material that combines the fineness of steel and the strength of concrete. Recent applications in the Fondation Louis Vuitton, the MuCEM and the Jean Bouin Stadium have demonstrated how its esthetic and technical qualities enhance architectural creativity. Ductal® is now entering a new phase in its development, with applications that will contribute to changes in the construction markets. Gérard Kuperfarb, Lafarge Group Executive Vice President - Innovation, shares his vision of the future.

“*Ductal® is an innovation that is ideal for architectural and structural creativity and for renovation, which helps to reduce construction costs and extend the usage life of buildings and structures.*”



The roof of the G&WAY DC open-air pavilion, a multi-use facility in Washington DC: architectural creativity in the heart of the city.



Ductal® is a new material that responds well to the new challenges of construction. Three of these challenges reflect our desire to supply sustainable and effective solutions for our sector.

1 - Increase infrastructure service life. For the construction of new structures and the renovation of structures built during the last century, Lafarge has chosen to work upstream, as far as possible, with architects, construction engineers, precasters and contractors.

Our ambition is to work with these people to define **construction site solutions** which, in addition to providing the best mix designs, we incorporate technical and logistical support services. Acclaimed in the United States and Canada for the renovation or replacement of hundreds of deteriorating bridges, this “products + service” innovation is today, contributing to the extended usage life of infrastructures around the world. It was because of this approach that Ductal® was chosen for the structural strengthening of the bridge decks for the Chillon Viaducts in Switzerland.

2 - Develop industrialized solutions which help reduce **the cost of construction**. With this in mind, Lafarge has designed a standard range of cladding panels for facades, intended for the external thermal insulation market. This new solution makes it possible to ensure that the facade achieves the specified energy efficiency requirements and, by speeding up the application phase, reduces construction time.



Ductal® panels contrast with glazing at the Rotman School of Management - University of Toronto, Canada.



Engineering structures: Ductal® increases the service life of infrastructures around the world - such as the Nipigon River Bridge in Ontario, Canada, opening in 2017.

3 - Make it easier to pour complex shapes that are lightweight and more creative, with new mix designs for **sprayed Ductal®** applications which are already providing solutions for the maintenance of engineered structures.

Finally, the development of digital tools such as "BIM" (Building Information Modeling) will speed up the processes of specifying and delivering Ductal® and provide users with an additional service. By creating Ductal® elements using BIM, Lafarge is taking part in the **construction industry's digital revolution**, which also makes it possible to reduce design and construction costs. This development requires greater cooperation (as far upstream as possible) between all players in the construction chain.

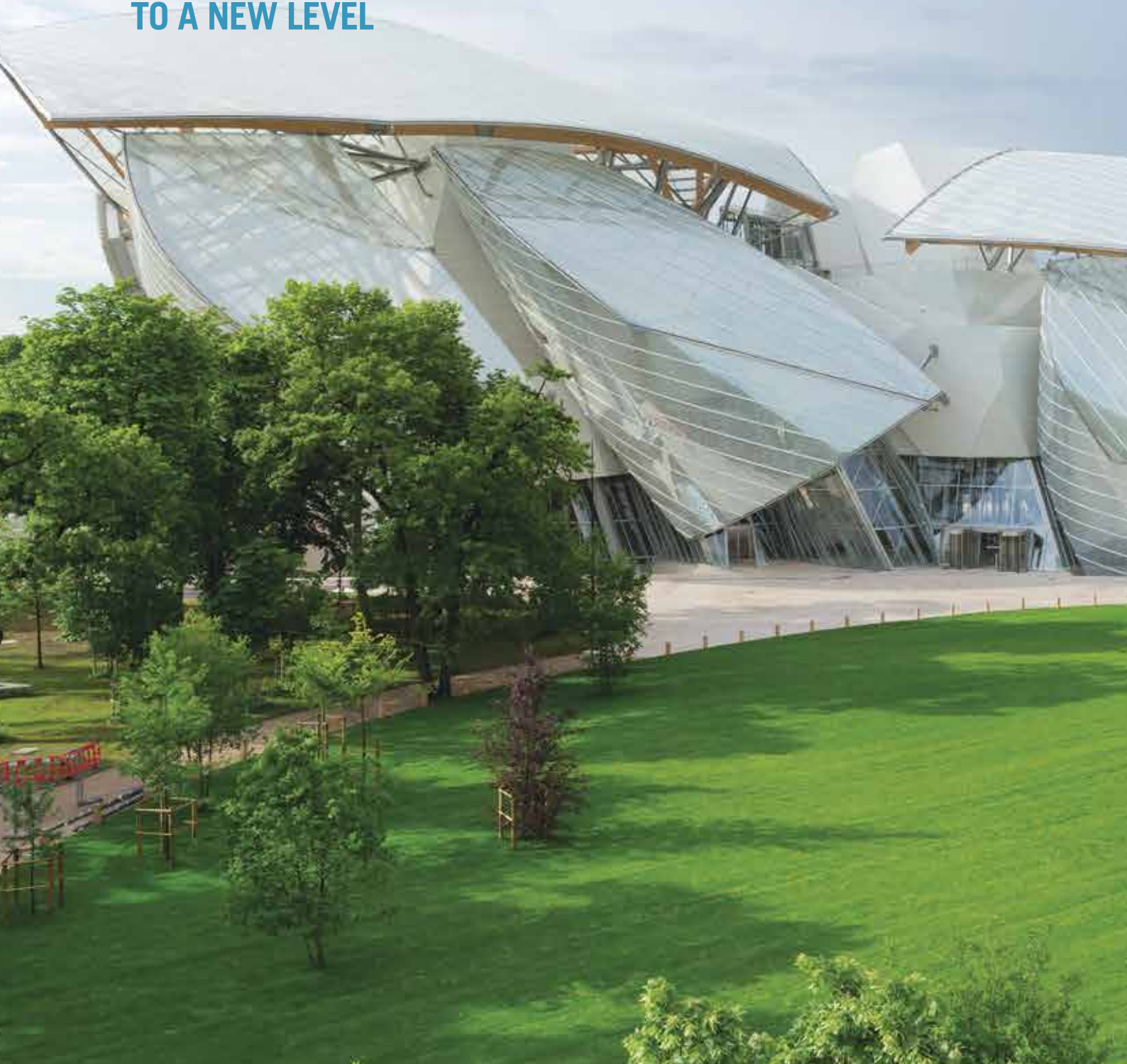
For us, Ductal® is an illustration of our capacity to innovate. Today, the material's extraordinary technical and esthetic qualities are leading to bright prospects in the energy/wind and nuclear sectors, seismic and offshore markets, building protection and physical security fields. Thanks to our innovation, our sales representatives' listening skills and our desire to advance alongside architects and project owners, we are continuing to invent new solutions to meet the needs of our fast-changing world.



Facade panels provide external thermal insulation - student residence, Paris, France.

Fondation Louis Vuitton

TEMPO, RESONANCE, PHYSICALITY,
THE FONDATION LOUIS VUITTON ALSO TAKES MATERIALS
TO A NEW LEVEL



The Fondation Louis Vuitton in Paris, France.



To bring to life the architectural project imagined by Frank Gehry and meet the expectations of Bernard Arnault for this showcase dedicated to contemporary creation, over 120 architects and engineers joined forces.

In particular, for the 18 blocks constituting the “Iceberg”, emerging from glass sails, it took six years of engineering studies to determine the solution that would provide the material effect desired by the brilliant architect: “a white porcelain-like cementitious material.”

The search for the right material and method of application was contracted to two consulting engineering firms, RFR and T/E/S/S. The process required significant prototyping, factory testing, calculations and the development of new molding and manufacturing techniques in order to create this incredible, intricate marquetry in Ductal®, using 19,072 panels.

Three key participants in this technological, collaborative experience tell us about a challenge that fully lived up to three of LVMH Group's core values: creativity, quality and determination.

Philippe Bompas (RFR) together with Bernard Vaudeville and Simon Aubry (T/E/S/S) respond to our questions.



Interplay of light, interplay of materials.

EXPERT OPINIONS

Philippe Bompas of RFR and **Bernard Vaudeville** and **Simon Aubry** of T/E/S/S.

19,000 PANELS WITH A HUGE VARIETY OF SHAPES

Was the choice of fiber-reinforced UHPC for the skin of the Iceberg the architect's original idea?

Bernard Vaudeville: Not exactly. At the outset, the first sketches imagined lacquered titanium. But then, back in 2006, Frank Gehry expressed a desire for a finish in an unpolished, white cementitious material, recalling that of his famous "Rock Vases". Considering that the Iceberg did not have any primary structural function, the search for materials was wide open (by an architect who inspires, explores possibilities and opens doors) and several solutions could have been imagined. Options such as painted or enameled aluminum, sprayed concrete, and even painted plaster were rejected one by one, whether for technical reasons or because they didn't meet the quality sought by the designer. Towards the end of 2006, just at the point when we were contemplating these questions, an exhibition called "Bétons: étonnez-vous" ("Concrete: prepare to be surprised") was running at the Paris Arts et Métiers museum. Ductal® was on display, presenting all of its formal potential. It appeared to correspond with

the architect's expectations so I contacted Paul Acker, scientific director of the Lafarge Central Research Laboratory, and Mouloud Behloul, Ductal® director for France (at the time), who set us on the trail of a casting technology that was still in its infancy, but could be perfectly suited to our project.

Simon Aubry: The idea was to cast each panel in a deformable silicone mold and place it on a template to give it the correct geometry. The process is adaptable to a vast range of surface finishes, with panels of identical dimensions. This principle proved to be perfectly compatible with Frank Gehry's project.

Bernard Vaudeville: The architect showed an interest in both the material and this method of forming it. Lafarge, working with Cogitech and ourselves, focused on developing the process to adapt it to the project and industrialize it. It was an extraordinary time, with numerous false starts. The work would come grinding to a halt and then start up again at breakneck speed! Throughout this work, there was ongoing interaction with Frank Gehry's teams and, especially, unwavering support from the owner.

“

This project required us to achieve what is best described as “detailed layout engineering”.

”

Bernard Vaudeville

Philippe Bompas: We still had to find THE solution that would enable us to satisfy multiple criteria: longevity of at least 100 years; compliance with the geometry and the precision needed for an extremely complex layout; quality of whiteness; the state of surface finishing of a “noble” material; capacity to receive water-repellent and anti-graffiti treatments and; the invisibility of attachment systems, etc. Without losing sight or consideration of the budget, which would have been vastly overrun if we had limited ourselves, for all the panels, to be working to the dimensions of the most exposed panel, or the one under the greatest stress, without making use of the resources provided by 3D modeling and BIM. This ambition, to industrialize the process down to the last detail, could only be achieved thanks to the perfect synergy between all the teams working on the project – including those at: Gehry Technologies; the prototype producer Cogitech; Patrick Mazzacane at Bonna Sabla and of course; Mouloud Behloul’s team at Lafarge; RFR and; T/E/S/S. The interaction by all these parties resulted in the development of prototypes, a new Vacuum Molding Process (“MSV”, as patented by Lafarge in 2008), testing of new panels and attachment systems and; the development of new quality control processes that had never been previously imagined.



Sculpture & museum

Frank Gehry's project draws a great deal of its originality from the structural intermingling of glass, timber, steel and mineral skin.

Many visitors have likened the Fondation Louis Vuitton to a contemporary sculpture in itself... albeit one that contains eleven exhibition galleries for contemporary art as well as a 400-seat auditorium.

The interior spaces are enveloped by a white skin with chiseled, irregular forms, hence its name, the "Iceberg". Its cladding consists of 19,072 curved panels made with Ductal® UHPC and almost all of them are different.

The openings and spaces that separate the opaque masses of the Iceberg are closed by glazed envelopes that break down into 46, diversely configured structures that are distributed throughout the building. The challenge was to combine their geometric complexity and singularity along with the very high levels of performance expected, including the facade's waterproofing, thermal insulation and fire resistance. RFR and T/E/S/S joined forces in a consortium dedicated to this project. The collaborative team, working very closely with the architects, contractors and project owner, carried out the technical design of the glass sails, their timber and steel structures, the Iceberg and its glazed facades, from the earliest stages of the project through to completion.



Marquetry in Ductal®.



This ambition to industrialize the process, down to the last detail could only be achieved thanks to the perfect synergy between all the teams working on the project.



Philippe Bompas

Can you give us a few examples of technical issues that were particularly challenging?

Bernard Vaudeville: The project required us to achieve what is best described as “detailed layout engineering”. In particular, we had to find a way to anticipate the effect of tolerances during manufacturing and installation so that we could avoid them from building up.

Philippe Bompas: Unlike other Gehry projects, particularly those using flexible sheets of steel, we couldn't rely on the overlapping of elements which would normally allow you to make small adjustments. The architect wanted the panels to meet perfectly, edge to edge, with regular joints of less than 10 mm. Bearing in mind that every panel was different, it was very ambitious! This is why we insisted on the geometrical accuracy of the panels and their supports when they were being manufactured and, of course, installed by Hofmeister.



A support structure for the panels provides a perfect geometrical reference for installation.

Bernard Vaudeville: At the feasibility study stage, we realized it was crucial to produce a support structure for the panels which would provide a perfect geometrical reference for installing them. To do this, we designed shells in aluminum (or in stainless steel in some cases) of 6 m² on average, carried out to millimeter accuracy. These shells covered the building like an armor before the Ductal® panels were hung on them, using rail.

Philippe Bompas: Undoubtedly, the beauty of the edifice also owes much to its propensity for capturing lights and playing with the contrasting shadows that the glass sails cast on the facades.

The different sources of low-angle light striking a material that Gehry wanted to be solid, alive and changing required precise, consistent manufacturing quality.

Simon Aubry: Each of the panels was scanned as it left the casting bed and subject to a visual inspection for compliance with 18 different characteristics required to meet the finishing standard.

Apart from the accuracy required with respect to handling the elements, it also had to be possible to disassemble each panel individually. This meant that the attachment system had to be flexible and each hidden clip had to be accessible in order to monitor if the panel was properly attached to the substructure. Therefore, we had to come up with a method of visual inspection through the joint.

Even though the applied surface treatments considerably reduced the need to clean the panels, it was important to ensure that the rappel line workers, who would eventually perform the facade upkeep, could support themselves - using the facade without damaging it. Furthermore, full-scale mock-up tests were conducted to determine the loads on the basis of very precise anchorage points. Calculations were also developed to: identify which panels would be under the most stress and therefore require strengthening and; identify which panels that would not require further strengthening.

All in all, was a certain degree of perfection expected?

Bernard Vaudeville: In view of the architect's creativity, the customer's requirements and the high quality we were seeking, the Fondation Louis Vuitton is obviously a project that people expect to be perfect. As far as the Iceberg was concerned, this ambition was greatly increased by the fact that we were working with a noble material - concrete. Frank Gehry was seeking precise authenticity, including the slight variations that still managed to get through the industrial process. These are tiny variations in shade or brilliance, which give the Iceberg a vibrancy and verve that matter greatly to Gehry. When you step back, Ductal® creates a precise, calm surface which echoes the curved panes of glass in the twelve sails and highlights the expansive and contrasting structure of timber and steel between the two skins. Thanks to our successful collaboration with Lafarge, we were able to meet these challenges with an acceptable solution.



The Iceberg: a propensity for capturing light and playing with contrasts.

MULTIPLE AWARDS FOR TECHNOLOGICAL INVENTIVENESS

For their work on the Fondation Louis Vuitton, Gehry Technologies received the Building Information Model (BIM) Excellence Award from the American Institute of Architects (AIA). In France, the Ministry of Ecology, Sustainable Development and Energy and the Ministry of the Industrial Recovery bestowed the Grand Prix National Engineering Award to Setec Bâtiment, Quadrature Ingénierie, RFR and T/E/S/S. The pre-caster, Bonna Sabla, also received the FIB (Fédération des Industries du Béton/Federation for Structural Concrete) Award for their innovative "MSV" vacuum molding process.

Casablanca - Morocco

Effects of the light in the largest railway station in Morocco



L-shape sunshade. Casa-Port railway station, Casablanca, Morocco.

The creation of the new Casa-Port railway station had to form part of a traditional neighborhood in Morocco's largest city. The project is part of a global scheme for urban regeneration and addresses the significant growth in traffic, which is rising to 25 million passengers per year. It also opens up prospects for future urban developments. The "passenger" building consists of a 2,500-m² hall. The facades, which are fully glazed, play with the Mediterranean luminosity: to the west, thanks to an immense mashrabiya (lattice-style

To respect the traditions of Moroccan palaces and public buildings, the architect - AREP - decided to clad the facades of a new railway station in Casablanca with a mashrabiya and sunshades in Ductal®.

wall system), protecting the passenger hall, roof and sides, by a long L-shape sunshade - all created in Ductal®. "The architects took advantage of all the qualities of Ductal®: mineral content, durability, resistance to sea salt, strength allowing elements to be very slender and thin, taking it further than what we achieved for Rabat-Salé Airport," explains Salma Ziadi, project manager for Bearch, the pre-caster of the facade elements.

"For the sunshades, the complexity lay in the architects' wish for a perfect finish on all surfaces. This requirement meant that we had to pour the elements vertically; a challenge because of their size - 4-m long, 18-cm wide and 2.5-cm thick - but we met the requirement because of Ductal®'s fluidity and self-placing properties.

A mounting system enables 3D adjustments on rails that are offset from the walkway, provided for cleaning of the glazing."

For the mashrabiya which has a void ratio of more than 40%, it was long-term durability that influenced the choice of the material. "Contrasting with neighboring buildings that are just as recent but already suffering from city-center pollution, the brightness of the white Ductal® with organic fibers gives the facade a personality worthy of the grandest Moroccan palaces," continues Ziadi. "This project heralds others that we are currently working on using Ductal®: the facade of the Rabat Sofitel and the head office of the Land Registry in the capital."

**PERFECT
FINISH QUALITY
ON ALL SURFACES**



Casa-Port - Architects: AREP - Étienne Tricaud, Philippe Druésne, Christophe Iliou and Group 3 Architects - Omar Tijani, Skander Amine, Vincent Missemer.



Foksal Gallery Foundation: a return to the mineral appearance of exposed concrete – Warsaw, Poland.

Warsaw - Poland

Concrete facade renewal

The Foksal Gallery Foundation art gallery, an iconic example of 1960s architecture, has been given a radical renovation, by reducing the weight of the facade, providing thermal insulation and restoring the mineral appearance of exposed concrete.

The twelve panels of gray Ductal® with organic fibers, measuring 7.21 m x 3.46 m, met all the challenges demanded by the project to refurbish the facade of the Foksal Gallery Foundation in Warsaw: a structural requirement to lighten the load borne by the original beams and an esthetic requirement to restore the mineral appearance of exposed concrete to improve architectural continuity with adjacent buildings.

For Laurent Fehr, of Fehr Architecture, the contractor entrusted with manufacturing and installing the panels, “only Ductal® could simultaneously fulfill these two ambitions of the Swiss architects, Diener & Diener. Working with the Ductal® team, the architect could utilize panels of very large dimensions. Each facade panel was made to measure,

to incorporate the doors and windows and produced in a range of demanding molded finishes with up to five relief patterns. Ductal® made it possible to work with these exceptional dimensions with a weight that is three times less than traditional precast concrete panels. This is mainly achieved by having a thickness of only

4 cm, which offers the additional advantage of saving space to ensure better thermal insulation.”

As the first application of UHPC in Poland, this project demonstrates how high-tech cladding can enhance the image of a building with strong connotations, and provide a suitable renewal of a mineral facade.

5 RELIEF PATTERNS PER PANEL



Panels just 4-cm thick.



The choice of color makes a big difference: mid-gray for a metallic finish or gold for a premium look - Reservoir, Villejuif, France.

France

Sparkling concrete: playing with the light

Interview with Pascal Dupont of B-ton Design

The imposing 50,000 m³ drinking water reservoir facility built by the Paris Region Water Authority in Villejuif, near Paris, sparkles day and night. Chosen by architect Giovanni Lelli, a new UHPC solution incorporating thousands of glass microbeads was designed by the concrete consultant, Pascal Dupont of B-ton Design.

How did you conceive of the idea to incorporate microbeads into a UHPC panel system?

Pascal Dupont: From their beginning, B-ton Design has focused on specifying innovative concrete solutions and esthetic treatments of concrete. A request I have heard repeatedly when visiting architects is to provide a concrete that plays with the light. After a series of successful tests in which we introduced glass during the production of UHPC panels, we were able to envision how glass microbeads on the surface might look on an industrial scale. According to Giovanni Lelli, architect and designer of the R7 reservoir in Villejuif, just outside Paris, he chose this concrete solution with a sparkling facade because, “it’s the best way of evoking sparkling, pure water”.

What motivated the use of this solution for the facade of the Villejuif reservoir?

P. D.: It was the combination of the reflecting and mineral properties. While they have excellent qualities in terms of insulation, these sparkling concrete surfaces can change appearance by playing on all the available light sources without the addition of artificial lighting.

The Villejuif project is the first of its kind on this scale, not only in terms of the size and number of sparkling panels, but also with respect to the wide range of colors used. 356 individually produced large-dimension panels (6 m x 2.5 m with a thickness of 7 cm) were used to clad the entire facade. The architects were free to personalize each precast element; to obtain panels with no hard joints by treating all of the rounded edges with glass microbeads. For Giovanni Lelli, this project revealed the huge potential of the material for design and architecture.

Why is Ductal® particularly suited to this kind of sparkling finish?

P. D.: Ductal® is a very fine-grained UHPC which provides a long-term substrate for the single layer of microbeads, minimizes wear and detachment of this layer, and makes it possible to achieve a homogenous surface aspect. The fact that it is a material with very low porosity accounts for the absence of alkali reaction between the incorporated glass and the concrete matrix.





Ductal® facade panels for a narrow, ten-story student residence building on a triangular site - Paris, France.

Cladding

All the qualities of Ductal® in a standard offer

With its R&D well proven by numerous tailor-made, high-profile projects, Lafarge is now launching a standard offer of Ductal® panels intended to meet the external thermal insulation needs of offices, apartment blocks, shopping centers and public buildings.

This is a revolution for architects seeking a mineral alternative to traditional cladding solutions, with the additional advantage of all the benefits of fiber-reinforced ultra-high performance concrete.

This is what happens when the world leader in building materials and solutions makes excellence available to everyone - at a reasonable cost.

Cladding

All the qualities of Ductal® in a standard offer

Comfort and energy savings have made external thermal insulation one of the best methods for dealing with the challenges of current energy requirements; even though facades are now required to perform new functions, they must continue to satisfy the creative requirements of designers and architects while satisfying the need for sustainable solutions that are also economical.

thanks to the possibility of process-coloring; we can offer a varied palette of colors.” This creative freedom is strengthened by the possibility of producing monolithic corner panels, which can be used for corners but also for details like window openings.

Apart from its esthetic properties, Ductal® UHPC has very low porosity, which gives it exceptional durability by comparison with other mineral materials, offering resistance to abrasion, carbonation, chloride-ion penetration and freeze-thaw conditions. This durability is backed up by reduced maintenance, thanks to the possible water-repellent and anti-graffiti surface treatments that strengthen the stability of the facade over time.

The notion of durability is even more meaningful in the context of environmental issues, particularly the need to limit the consumption of resources.

A life-cycle analysis and a life-cycle cost analysis were carried out on three cladding panel solutions: ultra-high performance concrete (UHPC), stratified (layered) laminates (HPL) and aluminum. For a number of criteria - greenhouse gas emissions, water consumption and air acidification - the impact of Ductal® panels is two to six times less than the other two materials, a decisive advantage for buildings striving for environmental excellence as well as HQE, LEED or BREEAM certification.

TAKEAWAYS

- > **A standard facade solution in Ductal® that is very competitive: from the initial purchase and throughout the lifecycle of the building**
- > **Solid partners in Europe and the United States to provide rapid response to large volumes**
- > **Unique elegance thanks to impressive dimensions, colors, textures and finishes**
- > **Exceptionally robust and very limited environmental impact**



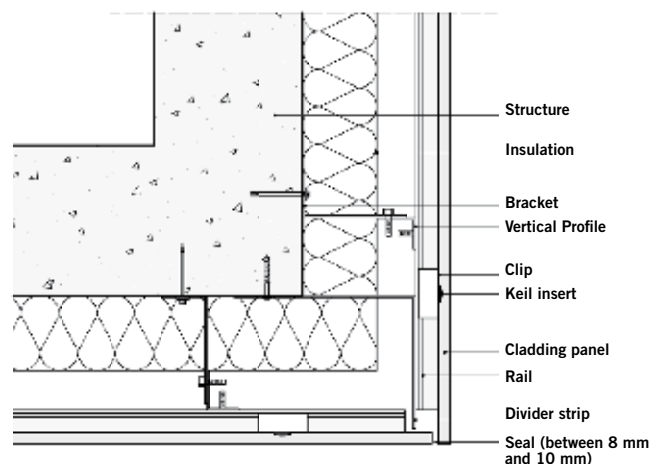
A 65-room student residence designed by Jacques Ripault Architecture.

To meet these challenges, Lafarge is launching a range of cladding products manufactured with Ductal® concrete.

“The challenge, which we have now met, involved the development of a cladding system that would allow us to provide architects with a mineral alternative that combines Ductal® performance with large-dimension panels (up to 3.6 m), classified "MO" for fire resistance and with an incomparable and varied finish, all in the form of a standard offer,” explains Émilie Hergott, Director of Ductal® for France and Export, and project manager for the Ductal® cladding project.

The fineness of the grain in Ductal® concrete makes it possible to reproduce textures with extreme precision, highlighting the regularity of the skin. “In our discussions with architects and project owners, we observed a genuine desire for the authenticity of a mineral material, which is a constituent of the majority of built space today,” continues Emilie Hergott.

“These panels are manufactured thanks to a dedicated production tool suitable for manufacturing thin flat panels. This enables us to obtain similar costs to traditional cladding while maintaining optimal surface quality and;



Outside corner, external thermal insulation system with Ductal® cladding panels.

“

A solution that delivers the detailed layout of our design and the personality that we wanted.

”

Jean Kalt
Architect



Stone-like cladding that fits seamlessly into the street facade, Paris, France.

Paris - France Stone-like cladding for a lightweight facade

A building containing eleven low-energy apartments on the east side of Paris, designed by architects Philippon-Kalt, has been planned to meet all of the environmental requirements set by the City of Paris. “These requirements often go beyond French regulations, particularly with regard to thermal efficiency,” notes Jean Kalt. “This explains our interest in industrial players capable of investing in the development of new materials and new building solutions. Our contribution to this project is a solution for a stone-like cladding applied to a lightweight timber facade; to blend into the existing streetscape and use external thermal insulation of the highest quality. The big advantage of Ductal® lies in

the thinness of the panels, which makes it possible maintain reasonable dimensions for the facade (less than 350 mm). As a very fluid material, Ductal® also has a surface quality that is visually superior to traditional concretes while retaining the authenticity of a mineral material. From our point of view, this solution delivers the detailed layout of our design and maintains the personality that we wanted for this small apartment building.”

4-story building
with 11 apartments

Architects:
Philippon-Kalt

Owner: Erilia social
housing company

Net floor area:
649 m²

Surface of facade:
150 m²

Performance:
BBC (low-energy
building), Cerqual A
Profile

Chicago - United States

A terracotta finish for a behavioral health services facility

A vacant grocery store in Rockford, Illinois, near Chicago, was transformed into a modern behavioral health services facility, the Rosecrance Ware Center.



Thin Ductal® panels create an attractive cladding solution for the new Rosecrance Ware Center - Rockford, Illinois, United States.

The new 4,050-m² building contains a spacious waiting area, offices, meeting rooms, a pharmacy and numerous examination rooms capable of serving about 5,500 clients per year.

For the facade, Saavedra Gehlhausen Architects approved the Ductal® cladding solution offered by the precaster as an economical alternative to two options presented by other manufacturers. The external cladding, covering a total area of 280 m², is comprised of about 200 precast Ductal® panels, each approximately 60 cm x 213 cm and just 1.27-cm thick - with an attractive terracotta finish, as required by the architects. The panels were installed by the precaster in November 2014, using a special hidden fastener system.

Bridges



The Pulaski Skyway Rehabilitation project in the United States was the first in North America to place Ductal® joint fill by concrete pump. The material flowed continuously along a pipe 170 m long and 7.5 cm in diameter.

Rehabilitating infrastructures **UHPC in action**

In North America, approximately 70,000 bridges must be rehabilitated or replaced in the next 10 years. About one-quarter of these structures will use a precast concrete deck system.

Lafarge is working with the Federal Highway Administration (FHWA), various U.S. Departments of Transportation, as well as the Ministries of Ontario and Quebec in Canada to determine the best in situ UHPC solutions for each specific situation: interstate and intrastate traffic, areas at risk from earthquakes, extreme climates, etc.

This important research and development, combined with our range of in situ product solutions and services, has led federal and national authorities to recognize Ductal® as the preferred UHPC solution for the sustainable and durable connection of precast bridge elements.

Most bridges in North America were designed in an era when traffic bore no comparison with what it is today. Rehabilitating them is a priority for the Federal Highway Administration (FHWA) which, for many years, has been testing solutions that, in a quest for both technical and economic performance, would address a triple challenge: safety, traffic flow management and infrastructure longevity.

“From very early on, we worked closely with the FHWA to test Ductal® joint fill on pilot projects. The solution met each of these challenges,” explains Dominique Corvez, Head of Ductal® operations for North America. “On the basis of more than 100 completed projects, a large number of states have adopted this solution, requiring Lafarge to develop an industrial-scale service that meets its criteria of reliability, quality and global offer with the a goal to respond successfully to the challenges of a world that can no longer compromise on infrastructure durability and safety.

“The experience gained shows that our solutions are highly appropriate for rehabilitating or replacing the 70,000 bridges declared structurally obsolete. Four major scenarios have already been the subject of successful experimental work.

The first of these scenarios is the sustainable rehabilitation of bridge decks (new design with a lifespan of more than 100 years).

For the rehabilitation of the Pulaski Skyway, we were awarded the contract to supply Ductal® for the second phase of work, following the success of the first phase, thereby proving that Lafarge is capable of delivering 10,000+ t of Ductal® onsite. (see www.ductal.com - Ductal® Solutions No. 15)

The specified volume of Ductal® nearly doubled when it was determined to be a suitable, cost effective material by comparison to the non-cementitious product that was originally specified. Furthermore, this project represents the first time in North America that Ductal® Joint Fill has been placed by pumping, with the material flowing non-stop along a 170-m pipe.”

For bridge owners, this project also confirms the benefits of a “One Lafarge” approach which, beyond the supply of raw materials (premix, fibers, admixtures), also means that we provide on-site, specialized technical assistance, quality assurance and the supply of a variety of special mixers in order to guarantee and simplify the application.

The second scenario is to limit traffic disruption for the users. This is a priority for transportation officials, and a growing number of them are now demanding the use of construction techniques known as “ABC” (Accelerated Bridge Construction). The challenge of an ultra-rapid rehabilitation project was met in Wampum, Pennsylvania (see the interview with Louis J. Ruzzi) and on Interstate 84, a major arterial route linking the states of New York and Pennsylvania. By opting for a solution of precast concrete deck panels with Ductal® joint fill connections instead of a cast-in-place concrete



A precast bridge deck ready for joint fill.

deck, the contractor was able to shave weeks off the schedule, resulting in reduced costs to the owner (New York State Dept. of Transportation) and reduced traffic disruption.

The third scenario is the need to respond to the risk of potential seismic activity. The rehabilitation of the Mission Bridge in British Columbia, Canada demonstrates to what extent Ductal® provides a reliable and highly durable cost-effective solution for use in high-seismic zones. (see page 21)

The fourth and final scenario is part and parcel of extreme climatic conditions across a region the size of a continent. “The Firebag River Bridge, an 80 m, single span structure in northern Alberta, Canada demonstrates Lafarge’s ability to provide on-site Ductal® solutions and services in some of the most remote locations. The project also demonstrates how we can implement casting procedures in temperatures that are way below zero Celsius,” notes Dominique Corvez. In North America, the challenge of working under extreme conditions has been overcome numerous times, in numerous remote locations by Lafarge teams and contractors.

SOLUTIONS ADOPTED BY MULTIPLE STATES IN NORTH AMERICA

“It is on the basis of more than 100 completed projects that a large number of North American states have adopted this solution, requiring Lafarge to develop an industrial-scale service that meets its criteria of reliability, quality and global offer.”

Dominique Corvez

”



Fast replacement of a structurally deficient, single-span concrete bridge: State Route 288 Main Street Bridge in Wampum, Pennsylvania.



The new structure consists of three side-by-side, 23.7-m precast modules with Ductal® UHPC connections. Each module comprises two composite steel I-beams with a concrete deck slab. Additional elements were used to assemble the substructure. ABC methods made it possible for the bridge to be reopened to traffic in less than 7 days!

SPEED MATTERS

Complete renovation in just 7 days

Two questions for **Louis J. Ruzzi**, Bridge Engineer, Pennsylvania Department of Transportation (PennDOT) District 11-0

How did you use UHPC in this project?

UHPC was used to connect the three superstructures and three approach slab units - all prefabricated elements. The prefabricated superstructure elements are modular units that consist of a full-depth, pre-decked topping supported by two steel I-beams. The approach slabs were also full-depth, prefabricated slab panels.

What are the advantages of the UHPC method?

The intended benefit of using UHPC is to accommodate the need to accelerate construction with a durable connection

for the prefabricated modular units and prefabricated approach slabs. The material (which possesses steel fibers to obtain its characteristics) is used in conjunction with reinforcing steel to create a joint that is stronger than the connected elements. It essentially transfers full moment and shear across the joint - which addresses our concerns for differential deflections causing longitudinal cracking.

The material properties offered enhanced durability properties that we, as an Owner, like to see. For example, the permeability of UHPC is essentially zero which, for a state that uses a lot

of de-icing salts, is a tremendous benefit. Because of the steel fibers and zero permeability, our concerns for the performance of the joint (if transverse cracking was to occur) were eliminated. Lastly, the manner in which we prepped the joint and installed the material offered superior bonding characteristics, meaning that any deck leakage at the precast joint interfaces and the UHPC is no longer a concern. It's all about finding better, more efficient ways to accelerate construction without forgoing quality.

HACKETTSTOWN (NEW JERSEY)

Engineering Excellence Award for the renovation of a historic bridge

Located in the Hackettstown Historic District, the Hackettstown Route 46 Bridge is a two-span 39-m structure used by more than 13,200 vehicles each day. In response to traffic and site constraints (including the important historical value), the contractors Greenman-Petersen, Inc. (GPI) of Lebanon chose a Ductal® solution for its renovation.

By specifying precast elements and state-of-the-art materials, the bridge reconstruction was completed in just 10 days, thereby minimizing the period of full road closure. The precast concrete substructure and superstructure sections were designed to be rapidly installed and connected Lafarge's Ductal® UHPC - a first for the New Jersey Department of Transportation.

It was also important for the owner and project team to learn from this project, with a goal to accelerate the renovation of other structures

facing similar challenges.

It is one of 170 civil engineering projects in the world that the ACEC (American Council of Engineering Companies) has recognized for its preeminent engineering achievements; eligible for one of the top 2015 Engineering Excellence Awards. Criteria included: project uniqueness and originality, complexity, success in meeting goals, technical innovation and economical value.

The ACEC, based in Washington, D.C., includes a membership of more than 5,000 independent engineering firms and more than 325,000 professionals whom are engaged in the development of transportation, water and energy infrastructure, along with environmental, industrial and other public and private facilities across America.

SEISMIC CHALLENGE

The Mission Bridge retrofit project combines performance with economy

Opened to traffic in 1973, the Mission Bridge is a major, four-lane road bridge just over a kilometer long in a high seismic zone that crosses the Fraser River. Its retrofit means that the bridge now complies with today's seismic requirements and can therefore continue to provide an essential road link in the event of natural disaster.

Associated Engineering reviewed the use of compaction piles which was found to be too costly and investigated the use of elliptical steel or traditional reinforced concrete jackets which would need to be massive and alter the profile of the pier and visibility at the site. The British Columbia Ministry of Transportation and Infrastructure opted for a solution that involved Ductal® jacketing of the south bank pier.

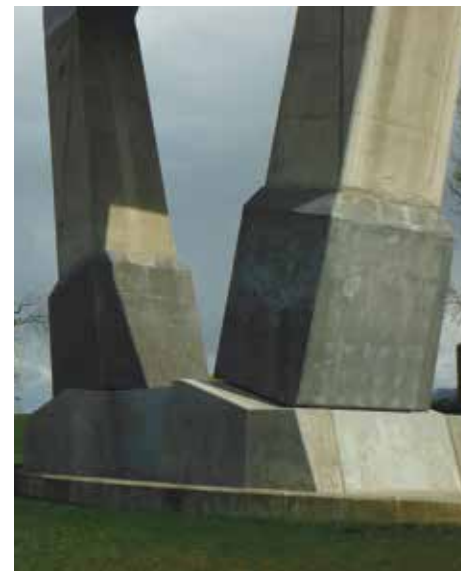
In addition to a substantial saving of \$1.5 million (CDN), Ductal® also delivers exceptional high seismic deformation capacity using a thin jacket. The project also provided the opportunity to demonstrate the effectiveness of a new Ductal® solution that can be used on similar projects in future.

The retrofit involved two tapered, rectangular columns 2.1 m x 2.6 m on a height of approximately 3.2 m from the base. The design

required the use of 25-mm diameter dowels into the existing concrete. Rebars, spaced at 230 mm in both directions, was attached to the dowels. The contractor constructed strong formwork around the columns to withstand the high pressures involved in placing the fluid concrete, and a 225-mm thick Ductal® jacket was cast.

To minimize the number of cold joints, Lafarge utilized its ready-mix concrete plant in Abbotsford, British Columbia to batch and supply a total of 18 m³ of Ductal® using two ready-mix trucks, making two trips each. This solution, which brings together different Lafarge product lines ("One Lafarge" approach), was selected instead of using portable mixers onsite. It was the first time that Ductal® has been batched in ready-mix trucks for a project in British Columbia. The formwork was then filled from the top using a standard hopper, with the casting completed in one day.

**\$1.5 MILLION
(CDN) SAVED**



Mission Bridge - Before: two columns to be retrofitted. Ductal® was delivered onsite in ready-mix trucks. After: completed columns with Ductal® jacket - British Columbia, Canada.

The Chillon Viaducts

45 mm of Ductal® makes all the difference

After nearly 50 years of service, the Chillon Viaducts in Switzerland has recently undergone a major upgrade to ensure they comply with new earthquake/seismic resistance standards, repair the effects of water ingress, make them more impervious to water, and improve their overall structural properties (following the detection of Alkali-Aggregate Reactions [AAR] in the existing concrete). A new 45-mm Ductal® bridge deck delivers an effective response to these challenges.

Here, we take a close look at this remarkable renovation and discuss what makes it a world first.



The composition of Ductal® gives it mechanical compressive strengths 6 to 8 times better than traditional concrete and flexural strengths that are up to 10 times better -Chillon, Switzerland.

Opened to traffic in 1969, the two, 2.2-km long Chillon Viaducts were named for the Château de Chillon, on which they tower above on the eastern slopes of Lake Geneva. As an official Swiss heritage site of national significance, the viaducts are truly one of the most spectacular structures of the Swiss highway system.

Construction of precast elements for this twin structure required the use of post tensioning techniques. Used by more than 50,000 vehicles per day, traffic volumes have increased significantly in recent years.

An inspection conducted in 2009 revealed that significant amounts of water had penetrated the structure in multiple locations and corroded its reinforcing bars. Furthermore, since it no longer complied with current earthquake resistance standards, the structure required major repair work that would involve changing the static system and supports beneath some of the piers. Upon commencement of work on site, hydrodemolition tests were conducted after it was determined that the structure was also affected by Alkali-Aggregate Reactions (AAR) which had compromised the mechanical properties of the concrete. If that discovery had not been made, it would probably have been necessary to completely rebuild the

structure within the next 15 years.

"The main goal of taking action was to mitigate the damaging effects of the AAR," explains Stéphane Cuennet, Structural Technical Specialist from the Office Fédéral des Routes Suisses (OFROU)*, the Federal government agency responsible for Swiss highways. "It involved strengthening and waterproofing the road slab to remove any possibility of water penetrating the concrete and reducing the extent of stresses imposed by road traffic by making the slab more rigid, thereby increasing its ultimate strength, and limiting longitudinal distortion of the bridge decks."

To meet these objectives, a UHPC solution was chosen

by a group of specialists, including engineers from the École Polytechnique Fédérale de Lausanne (EPFL): casting a 45-mm layer of Ductal® on the existing deck in order to weatherproof it and improve the structure's overall structural behavior.

"This really was the only plausible solution to guarantee a reliable rehabilitation in view of the uncertainties surrounding changes in the mechanical properties of concrete," argues Cuennet.

**TECHNICALLY
AND FINANCIALLY
EFFECTIVE**

REFERENCE POINTS

Length: **2 x 2.2 km**

Width: **2 x 12 m**

Area of Ductal® poured: **53,000 m²**

Increase in traffic: **+ 10%** in 3 years

Permitted vehicle weight increased from **24 to 40 metric tons**

General contractor: **Walo Bertschinger AG**

Project owner: **OFROU**

Project owner support: **EPFL**

Designers: **MONOD-PIGUET +ASSOCIÉS Ingénieurs Conseils S.A.**



With this knowledge, the Ductal® team at Lafarge put into place the technical resources required to define a formulation that would respond to the specific constraints of the project in terms of tensile strength, slope performance (gradients of up to 7% on the existing deck) and ease of implementation. Throughout the project, Damien Jacomo, the Ductal® Business Engineer responsible for Civil Engineering projects, and the Lafarge Ductal® team worked alongside the contractor and project owner to validate the Ductal® solution, its implementation and onsite quality monitoring.

Eugen Brühwiler, a global authority on UHPC, lecturer at EPFL and director of the structures maintenance, construction and safety laboratory, was appointed as expert consultant for the project by the OFROU: "The use of UHPC for the Chillon Viaducts is a world first, not only in terms of the area to be covered, but also the volumes to be produced and installed in such a short period of time**".

One of the remarkable benefits of the ultra-high performance concrete layer cast on the road slab is its ability to strengthen the structure against longitudinal shear forces and provide additional longitudinal rigidity with a thickness of just 45 mm, rather than the 20 cm of traditional reinforced concrete that would otherwise have been required.

This UHPC layer also makes the deck more weatherproof and therefore stops the ingress of water that could trigger a deterioration of the AAR. "The UHPC provides the perfect response to the weaknesses of ordinary concrete", continues Brühwiler. "Its composition ensures that all the spaces inside the material are occupied by fine particles. It is an extremely compact material that is very dense and impermeable to water. Thanks to the large quantity of fine steel fibers it contains, it never cracks in service."

This durable, robust solution considerably reduces the load on existing infrastructures, and is much faster to implement.

Brühwiler also believes that it offers significant financial benefits. "Contrary to what many people think, the cost of using UHPC to reinforce structures is ultimately good value, given the number of requirements it meets. The performance of this technique offers undeniable benefits but, in the end, it was purely for financial reasons that it was adopted in this instance."

* Source: *Kichoff issue 14*

** Source: *Batimag interview October 2014*

Inventing the future

Beyond the progress in both technology and performance that UHPC has offered the world of architecture and engineering for 15+ years, Ductal® reflects Lafarge's capacity for inventing the future. "Research carried out on Ductal® solutions also opens up opportunities in future energy markets, like wind power and nuclear power, as well as transportation infrastructures, offshore structures, and the security of buildings and people," says Sébastien Bernardi, Ductal® Technical Director. The R&D efforts by Lafarge engineers and technicians, combined with the proactive commitment to progress by the Groups' sales teams and our collaborators (architects, engineers, project owners) will help us to continue to develop solutions that enable the construction industry to keep pace with the new, evolving needs of our fast-changing world.

new new markets markets

> Energy

Wind power

The durability of UHPC is a major benefit

The development of energy from renewable sources is a major challenge for our planet and that challenge is being spearheaded by wind power solutions. Whether on land or offshore, wind power offers practical solutions that are growing rapidly with installed generating capacities of around 400 GW.

Until now, the majority of existing wind power solutions have used steel masts, but these are now beginning to show signs of limited performance in terms of fatigue, durability and maintenance.

Wind turbines in Ductal®? It seems obvious - if you are open to starting over from scratch, to design a solution that utilizes the full potential of Ductal®, including its exceptional mechanical performances, compressive strengths, tensile capabilities, modulus of elasticity and low creep and shrinkage.

The material's durability is clearly a major benefit, and one that has been well proven, with a great deal of feedback from its use in aggressive environments over the past two decades.

Over the long term, Ductal® offers a genuine alternative to existing energy solutions, and, with optimized design, it would extend the usage life of a wind turbine to much more than 25 years, currently the upper limit.

Therefore, an extended usage life would certainly be a decisive factor in terms of the investment and complexity required for this type of construction.



Wind turbines: responding to new demands of the energy market.

Nuclear

Sealed for the long term

Understandably, the containment vessels of nuclear reactors must meet precise/rigid criteria to ensure that they remain sealed to external air in the event of a nuclear accident. Some reactors, although they meet the appropriate criteria, have leakage rates that are now the subject of a repair program being conducted by EDF in France. The challenge of this program is to extend the operating usage life of these power plants to at least 60 years.

The power plant design most affected by this problem is one that uses double concrete wall containment vessels with no metal liner. In France, this is the case for 1,300/1,400 MW facilities that account for approximately 20% of the country's nuclear plants.

The current resin-based sealing solutions applied to the inner face do not work for the outer face without an additional treatment to prevent



The Cattenom Nuclear Power Station - Moselle, France.

blistering. Resolving this weakness significantly increases the cost of the overall solution.

The use of Ductal® for the outer face appears very promising, since it provides the required level of air seal and significantly reduces the risk of blistering. A solution has therefore been developed and evaluated in collaboration with a civil engineering firm specializing in the nuclear industry.

> Transportation



Creating transportation solutions that fit seamlessly into new urban developments - Dubai.

Urban mobility

Upgrading and development

The upgrading and development of transportation systems are major challenges for local and regional authorities, especially those in major urban centers where population densities are high.

Many cities around the world are initiating ambitious projects to upgrade and extend existing transportation networks and create new subway lines.

In this context, elevated railways offer a logical technical and economic solution, compared with underground subways.

Designing transportation solutions in Ductal® (for viaducts, bridges, stations, etc.) is a viable response to ensure improved environmental integration in a multitude of ways, such as:

- adding architectural value to viaducts and stations

- limiting or reducing noise pollution by effective containment of noise and vibration
- controlling costs in every project phase (durability, reduced maintenance, etc.)
- contributing to the process of building better cities

> Security

Protecting buildings and people

Putting very high mechanical performance to the test

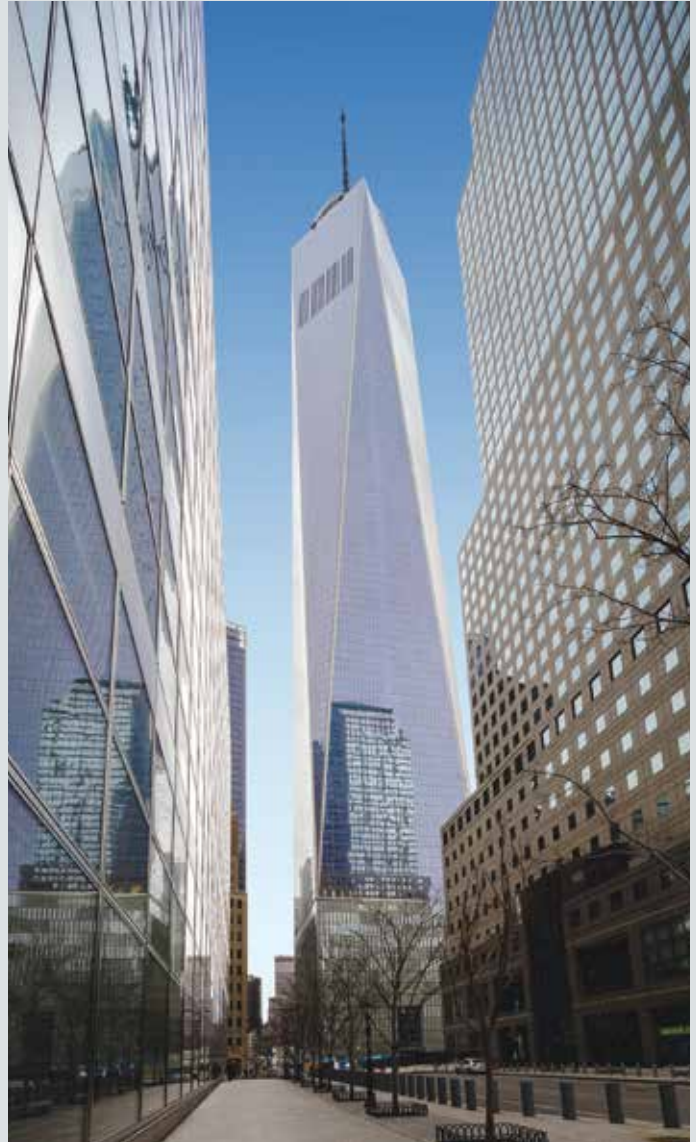
The phrase 'security of buildings and people' refers collectively to all the solutions and services that contribute to the protection of buildings and their occupants against potential threats. It could be industrial (i.e., explosion, chemical pollution, etc.) or even the risk of terrorist attack.

Safety-related projects typically address three specialties:

- hardware in the form of detection, access control, video surveillance and other systems (78%)
- alarm management, systems interface and other software (20%)
- services, such as security and remote surveillance companies (2%)

The hardware specialty covers two distinct families of technology: active devices, such as presence detectors, door and window opening detectors and surveillance cameras, and passive elements, such as building architecture, doors, windows, obstacles, etc.

The relative proportion of active devices to passive elements varies from project to project, but architectural design is becoming increasingly important. The quest to identify and develop bullet-proof and explosion-resistant construction materials then becomes crucial in the design of effective solutions to limit the collateral damage caused by shards and splinters of materials.



Freedom Tower, the first tower to be built on the World Trade Center site - New York, NY, USA.

Once again, Ductal® can offer multiple, valuable solutions for making civil and military buildings safer. Its superior mechanical performances and essential function of its embedded fibers make it possible to consider customized solutions for both new and existing buildings (i.e., architectural adaptations, major renovations, strengthening projects).

A SOLUTION FOR GREATER SECURITY

> Standardization

Regulatory standards

Standardizing the process from design to implementation

A number of countries, including China, Switzerland, the USA and France, have recently begun to draft National Standards for Ultra-High Performance Concretes (UHPCs).

The first of these draft standards is due for publication this year but they differ, particularly in terms of performance levels and applications.

To ensure consistent regulatory standards across Europe, France will soon ask the European Committee for Standardization to set up a working group to begin the process of drafting a European standard. This request is a logical next step when France publishes Europe's first National Standards for UHPCs in September this year.

Until now, the reference document for France has been the "*Ultra-High Performance Concrete Recommendations*", published by the French Civil Engineering Association (AFGC) in June 2013. However, this document does not have the status of a regulatory standard, and its scope of application is limited to UHPCs with metal fibers and characteristic compressive strengths of greater than 150 MPa. Therefore, the decision

was made to begin the process of creating a regulatory standard for France so that UHPCs can be integrated to the traditional construction sector and contribute to the facilitation of project design.

As a result, 2 standards have been drafted with significant input from Lafarge:

- 1 materials standard (NF P 18-470) entitled *Ultra-High Performance Concrete: specification, performance, production and conformity*
- 1 design standard (NF P 18-710) entitled *National Supplement to Eurocode 2. Calculations for Concrete Structures: rules specific to Ultra-High Performance Concretes*.

The materials standard applies to UHPCs with characteristic compressive strengths greater than 130 MPa, intended for use in buildings and engineered structures such as:

- precast structures and structural elements
- structures and structural elements cast on-site
- sections of structures with UHPC being cast on-site, particularly for use in joints, coatings or repairs.

It also applies to precast, non-structural or architectural elements cast on-site.

The design standard applies to structural calculations for buildings and engineered structures in non-reinforced UHPC, reinforced UHPC and prestressed UHPC applications. It defines the mechanical strength, capability for service, durability and fire resistance requirements, but covers only UHPCs with metal fibers and a characteristic compressive strengths greater than 150 MPa. A third standard for the construction of UHPC structures will be published in the near future to cover all aspects of UHPC onsite usage.

A USAGE STANDARD IN PREPARATION

DUCTAL® WORLDWIDE 244 PATENTS, 25 INVENTIONS

The Ductal® range of products and solutions has been developed over more than 10 years by Lafarge. These options are the outcome of major R&D input from the LCR (Lafarge Research Center) and its industry-recognized expertise in formulation, hydration, flow characteristics, microstructure and materials/process interactions.

This research also has led to the registration of many patents for new Ductal® inventions which currently total around 30, along with more than 244 patents worldwide. The development of Ductal® relies heavily on these patents, which are defended vigorously in the event of counterfeiting.

This patent strategy is a permanent feature of Lafarge's R&D, whereby the innovations developed continue to result in the regular filing of patents for one or two new inventions each year.



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SECTION 07210

EPS BUILDING INSULATION

Display hidden notes to specifier. (Don't know how? [Click Here](#))
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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. EPS Building Insulation for sheathing and underlayment applications.
- B. EPS Building Insulation for concrete and masonry wall applications.
- C. EPS Building Insulation for cavity wall applications.
- D. EPS Building Insulation for underslab applications.
- E. EPS Building Insulation for below grade applications.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast In Place Concrete: Perimeter and under-slab insulation installation.
- B. Section 03300 - Cast In Place Concrete: Concrete base wall.
- C. Section 03400 - Pre-Cast Concrete: Pre-cast concrete base wall.
- D. Section 05400 - Cold Formed Metal Framing.
- E. Section 04210 - Clay Masonry: Brick facing.
- F. Section 04800 - Masonry Assemblies: Masonry base wall.
- G. Section 04850 - Stone Facing.
- H. Section 06100 - Rough Carpentry.
- I. Section 06110 - Wood Framing: Wood framed base wall.
- J. Section 07260 - Vapor Retarders: Vapor retarder materials over insulation to adjacent insulation.
- K. Section 07270 - Air Barriers: Air seal materials over insulation to adjacent insulation.
- L. Section 09110 - Non-Structural Metal Framing.
- M. Section 09200 - Plaster and Gypsum Board.

N. Section 09220 - Stucco.

1.3 REFERENCES

- A. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- B. ASTM C 203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
- C. ASTM C 272 - Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions.
- D. ASTM C 303 - Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.
- E. ASTM C 518 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- F. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- G. ASTM D 1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- H. ASTM D 2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- I. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- J. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
- K. US Green Building Council.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
 - 1. EA - Energy and Atmosphere: EA Credit 1: Optimize Energy Performance: Demonstrate percentage of performance improvement that meets or surpasses ASHRAE/IESNA Standard 90.1-2004.
 - 2. Product Data for Credit MR 2.1 and 2.2: For products being recycled, documentation of total weight of project waste diverted from landfill.
 - 3. Product Data for Credit MR Credit 3.1 and 3.2: Materials Reuse: 5 percent or 10 percent.
 - 4. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation including percentages by weight of post consumer and preconsumer recycled content
 - a. Include statement indicating costs for each product having recycled content.

5. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content
 6. Product Data for Credit MR 5.1 and Credit MR 5.2: Submit data, including location and distance from Project of material manufacturer and point of extraction, harvest or recovery for main raw material.
 - a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with a minimum of 5 years documented experience in the manufacture of products specified.
- B. Installer Qualifications: Installer shall be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 1. Finish areas designated by Architect.
 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 3. Refinish mock-up area as required to produce acceptable work.
- D. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, and insulation manufacturer's installation instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in conformance with the manufacturer's instruction. Store under cover in manufacturer's unopened packaging with identification labels or markings intact until ready for installation.
- B. Products shall be fully supported in storage and prevented from contact with the ground until ready for installation.
- C. Store in a protected area and protect against exposure to sun, rain, water, dirt, mud, and other residue that may affect performance. Cover stored products with breathable protective wraps.

1.7 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within

limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. Provide the manufacturer's written 20 year warranty that Insulfoam insulations, R-Tech and InsulFoam, have no thermal drift and the installed R-value will not degrade below the published values at the time of installation. Products with warranty's based on decreasing percentage or time weighted average thermal performance provisions will not be acceptable.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Email: [request info \(info@insulfoam.com\)](mailto:info@insulfoam.com); Web: www.insulfoam.com
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 EPS BUILDING INSULATION

- A. Unfaced Flat Board Stock: InsulFoam rigid, closed cell, expanded polystyrene (EPS) boards, UL certified, complying with ASTM C 578:
 - 1. InsulFoam:
 - a. Type I.
 - b. Type VIII.
 - c. Type II.
 - d. Type IX.
 - e. Type XIV.
 - f. Type XV.
 - 2. Size:
 - a. 4 foot by 4 foot.
 - b. 4 foot by 8 foot.
 - c. Custom sizes as indicated.
 - d. Largest practical size for project.
 - 3. Thickness:
 - a. Minimum thickness of _____ inch.
 - b. Thickness required to achieve an R value of _____.
 - c. Thickness as indicated on the Drawings.
 - 4. Insect/Mold Resistant: Provide with insect and mold resistant treatments.
 - 5. Physical Properties Type I, Unfaced:
 - a. Nominal Density (pcf): 1.0 as tested in accordance with ASTM C 303.
 - b. C-Value (Conductance) BTU/(hr/ft²/degrees F) per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) C .230 @ 25 degrees.
 - 2) C .240 @ 40 degrees.
 - 3) C .260 @ 75 degrees.
 - c. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 4.35 @ 25 degrees.
 - 2) R 4.17 @ 40 degrees.
 - 3) R 3.85 @ 75 degrees.

- d. Compressive Strength, ASTM D 1621: Minimum 10 psi.
 - e. Flexural Strength, ASTM C 203: Minimum 25 psi.
 - f. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - g. Water Vapor Permeance, ASTM E 96: Maximum 5.0 perms.
 - h. Water Absorption, ASTM C 272: Maximum 4.0 percent.
 - i. Capillarity: None.
 - j. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
 - k. Smoke Developed as tested in accordance with ASTM E 84: 150 to 300.
6. Physical Properties Type VIII, Unfaced:
- a. Nominal Density (pcf): 1.25 as tested in accordance with ASTM C 303.
 - b. C-Value (Conductance) BTU/(hr/ft²/degrees F) per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) C .220 @ 25 degrees.
 - 2) C .235 @ 40 degrees.
 - 3) C .255 @ 75 degrees.
 - c. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 4.55 @ 25 degrees
 - 2) R 4.25 @ 40 degrees.
 - 3) R 3.92 @ 75 degrees.
 - d. Compressive Strength, ASTM D 1621: Minimum 13psi.
 - e. Flexural Strength, ASTM C 203: Minimum 30 psi.
 - f. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - g. Water Vapor Permeance, ASTM E 96: Maximum 3.5 perms.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 150 to 300.
7. Physical Properties Type II, Unfaced:
- a. Nominal Density (pcf): 1.5 as tested in accordance with ASTM C 303.
 - b. C-Value (Conductance) BTU/(hr/ft²/degrees F) per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) C .210 @ 25 degrees.
 - 2) C .220 @ 40 degrees.
 - 3) C .240 @ 75 degrees.
 - c. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 4.76 @ 25 degrees.
 - 2) R 4.55 @ 40 degrees.
 - 3) R 4.17 @ 75 degrees.
 - d. Compressive Strength, ASTM D 1621: Minimum 15 psi.
 - e. Flexural Strength, ASTM C 203: Minimum 35 psi.
 - f. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - g. Water Vapor Permeance, ASTM E 96: Maximum 3.5 perms.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 150 to 300.
8. Physical Properties Type IX, Unfaced:
- a. Nominal Density (pcf): 2.0 as tested in accordance with ASTM C 303.
 - b. C-Value (Conductance) BTU/(hr/ft²/degrees F) per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) R .200 @ 25 degrees.
 - 2) R .210 @ 40 degrees.
 - 3) R .230 @ 75 degrees.

- c. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) C 5.00 @ 25 degrees.
 - 2) C 4.76 @ 40 degrees.
 - 3) C 4.35 @ 75 degrees.
 - d. Compressive Strength, ASTM D 1621: Minimum 25 psi.
 - e. Flexural Strength, ASTM C 203: Minimum 50 psi.
 - f. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - g. Water Vapor Permeance, ASTM E 96: Maximum 2.0 perms.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 150 to 300.
9. Physical Properties Type XIV, Unfaced:
- a. Nominal Density (pcf): 2.50 as tested in accordance with ASTM C 303.
 - b. C-Value (Conductance) BTU/(hr/ft²/degrees F) per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) C .198 @ 25 degrees.
 - 2) C .206 @ 40 degrees.
 - 3) C .222 @ 75 degrees.
 - c. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) R 5.05 @ 25 degrees.
 - 2) R 4.85 @ 40 degrees.
 - 3) R 4.50 @ 75 degrees.
 - d. Compressive Strength, ASTM D 1621: Minimum 40 psi.
 - e. Flexural Strength, ASTM C 203: Minimum 60 psi.
 - f. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - g. Water Vapor Permeance, ASTM E 96: Maximum 2.5 perms.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 150 to 300.
10. Physical Properties Type XV, Unfaced:
- a. Nominal Density (pcf): 3.0 as tested in accordance with ASTM C 303.
 - b. C-Value (Conductance) BTU/(hr/ft²/degrees F) per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) C .196 @ 25 degrees.
 - 2) C .198 @ 40 degrees.
 - 3) C .217 @ 75 degrees.
 - c. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) R 5.10 @ 25 degrees.
 - 2) R 5.05 @ 40 degrees.
 - 3) R 4.60 @ 75 degrees.
 - d. Compressive Strength, ASTM D 1621: Minimum 60 psi.
 - e. Flexural Strength, ASTM C 203: Minimum 75 psi.
 - f. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - g. Water Vapor Permeance, ASTM E 96: Maximum 2.5 perms.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 150 to 300.
- B. Faced Flat Board Stock: R-Tech faced one side with a printed polymeric facer and the other side with a metalized polymeric facer, rigid, closed cell, expanded

polystyrene (EPS) boards, UL certified, complying with ASTM C 578:

1. R-Tech Board Stock:
 - a. R-Tech I.
 - b. R-Tech X.
 - c. R-Tech IV.
 - d. R-Tech VI.
 - e. R-Tech VII.
2. Size:
 - a. 4 foot by 4 foot.
 - b. 4 foot by 8 foot.
 - c. Custom sizes as indicated.
 - d. Largest practical size for project.
3. Thickness:
 - a. Minimum thickness of _____ inch.
 - b. Thickness required to achieve an R value of _____.
 - c. Thickness as indicated on the Drawings.
4. Insect/Mold Resistant: Provide with insect and mold resistant treatments.
5. Physical Properties: R-Tech I:
 - a. Nominal Density (pcf): 1.00 as tested in accordance with ASTM C 303.
 - b. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 4.4 @ 25 degrees.
 - 2) R 4.2 @ 40 degrees.
 - 3) R 3.9 @ 75 degrees.
 - c. Compressive Strength, ASTM D 1621: Minimum 13 psi.
 - d. Flexural Strength, ASTM C 203: Minimum 33 psi.
 - e. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - f. Water Vapor Permeance, ASTM E 96: Less than 1.0 perms.
 - g. Water Absorption, ASTM C 272: Maximum 1.0 percent.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 150 to 450.
6. Physical Properties: R-Tech X:
 - a. Nominal Density (pcf): 1.35 as tested in accordance with ASTM C 303.
 - b. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 4.8 @ 25 degrees.
 - 2) R 4.6 @ 40 degrees.
 - 3) R 4.2 @ 75 degrees.
 - c. Compressive Strength, ASTM D 1621: Minimum 15 psi.
 - d. Flexural Strength, ASTM C 203: Minimum 40 psi.
 - e. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - f. Water Vapor Permeance, ASTM E 96: Less than 5.0 perms.
 - g. Water Absorption, ASTM C 272: Maximum 3.0 percent.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 75.
 - j. Smoke Developed as tested in accordance with ASTM E 84: Less than 450.
7. Physical Properties: R-Tech IV:
 - a. Nominal Density (pcf): 1.80 as tested in accordance with ASTM C 303.
 - b. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 5.0 @ 25 degrees.
 - 2) R 4.8 @ 40 degrees.
 - 3) R 4.4 @ 75 degrees.

- c. Compressive Strength, ASTM D 1621: Minimum 25 psi.
 - d. Flexural Strength, ASTM C 203: Minimum 50 psi.
 - e. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - f. Water Vapor Permeance, ASTM E 96: Less than 1.1 perms.
 - g. Water Absorption, ASTM C 272: Maximum 3.0 percent.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 75.
 - j. Smoke Developed as tested in accordance with ASTM E 84: Less than 450.
8. Physical Properties: R-Tech VI:
- a. Nominal Density (pcf): 2.4 as tested in accordance with ASTM C 303.
 - b. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 5.1 @ 25 degrees.
 - 2) R 4.9 @ 40 degrees.
 - 3) R 4.5 @ 75 degrees.
 - c. Compressive Strength, ASTM D 1621: Minimum 40 psi.
 - d. Flexural Strength, ASTM C 203: Minimum 60 psi.
 - e. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - f. Water Vapor Permeance, ASTM E 96: Less than 1.1 perms.
 - g. Water Absorption, ASTM C 272: Maximum 0.3 percent.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 75.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 1 Less than 450.
9. Physical Properties: R-Tech VII:
- a. Nominal Density (pcf): 2.8 as tested in accordance with ASTM C 303.
 - b. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177
 - 1) R 5.1 @ 25 degrees.
 - 2) R 5.0 @ 40 degrees.
 - 3) R 4.6 @ 75 degrees.
 - c. Compressive Strength, ASTM D 1621: Minimum 60 psi.
 - d. Flexural Strength, ASTM C 203: Minimum 75 psi.
 - e. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
 - f. Water Vapor Permeance, ASTM E 96: Less than 1.1 perms.
 - g. Water Absorption, ASTM C 272: Maximum 3.0 percent.
 - h. Capillarity: None.
 - i. Flame Spread as tested in accordance with ASTM E 84: Less than 75.
 - j. Smoke Developed as tested in accordance with ASTM E 84: 1 Less than 450.
- C. Faced Fanfold Flat Board Stock: R-Tech Fanfold faced one side with a printed polymeric facer and the other side with a metalized polymeric facer, rigid, closed cell, expanded polystyrene (EPS) labor saving accordion style, UL certified, complying with ASTM C 578:
- 1. Size:
 - a. Largest practical size for project.
 - 2. Thickness:
 - a. 3/8 inch.
 - b. 1/2 inch.
 - c. 3/4 inch.
 - d. Thickness as indicated on the Drawings.
 - 3. Insect Resistant: Provide with insect resistant treatment.
 - 4. Physical Properties Type I:
 - a. Nominal Density (pcf): 1.0 as tested in accordance with ASTM C 303.

- b. C-Value (Conductance) BTU/(hr/ft²/degrees F) per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) 3/8 inch C .240 @ 40 degrees.
 - 2) 1/2 inch C .260 @ 75 degrees.
 - 3) 3/4 inch C .260 @ 75 degrees.
- c. R-Value Thermal Resistance (hr/ft²/degrees F) /BTU per inch as tested in accordance with ASTM C 518 or ASTM C 177.
 - 1) 3/8 inch R 4.17 @ 40 degrees.
 - 2) 1/2 inch R 4.17 @ 40 degrees.
 - 3) 3/4 inch R 3.85 @ 75 degrees.
- d. Compressive Strength, ASTM D 1621: Minimum 10 psi.
- e. Flexural Strength, ASTM C 203: Minimum 33 psi.
- f. Dimensional Stability, ASTM D 2126: Maximum 2 percent.
- g. Water Vapor Permeance, ASTM E 96: Maximum 1.0 perms.
- h. Capillarity: None.
- i. Flame Spread as tested in accordance with ASTM E 84: Less than 20.
- j. Smoke Developed as tested in accordance with ASTM E 84: 150 to 300.

2.3 ACCESSORIES

- A. Adhesive: Material and type compatible with EPS insulation board and acceptable to EPS insulation board manufacturer.
- B. Wall Ties: Material and type compatible with EPS insulation board and acceptable to EPS insulation board manufacturer.
- C. Mechanical Fasteners: Material and type compatible with EPS insulation board and acceptable to EPS insulation board manufacturer.
- D. Furring Channels: Material and type compatible with EPS insulation board and acceptable to EPS insulation board manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION/APPLICATION

- A. Install in accordance with manufacturer's instructions.
- B. Install faced insulation with the facing on the side recommended by the manufacturer.
- C. Insulation Board Joints: Stagger EPS insulation board joints in one direction for each course. Butt edges and ends tightly to adjacent EPS boards.

- D. Interior Wall Sheathing Installation: On exterior side of stud framing, install EPS insulation board vertically or horizontally as required. Fasten vertically 12 inches (300 mm) maximum on centers using fasteners recommended by manufacturer. On interior side of stud framing, install a minimum of 1/2 inch (12.7 mm) thick gypsum wallboard over EPS board.
- E. Interior Concrete and Masonry Walls: Install EPS insulation board directly to concrete and unit masonry substrates.
1. Remove jagged surfaces or surface irregularities prior to installation.
 2. Attach insulation by using polystyrene compatible adhesive or an approved mechanical fastener.
 3. Butt edges tightly.
 4. Mechanically attach furring strips through the insulation and into the wall substrate with approved using fasteners recommended by manufacturer.
 5. On interior side of the wall, install a minimum of 1/2 inch (12.7 mm) thick gypsum wallboard over EPS board.
- F. Cavity Walls: Install EPS insulation board on exterior surface of interior wythe of cavity wall, fitting board between wall ties and other projections and penetrations without large gaps or openings.
1. Remove jagged surfaces or surface irregularities prior to installation.
 2. Attach insulation in conformance with the applicable code.
 3. Maintain installed insulation to a point above the outer wythe as the work progresses to keep mortar from blocking the cavity.
 4. Maintain a space between the insulation and the inside face of the outer wythe of at least 3/4 inch.
 5. Stagger multiple layers of insulation. Butt edges tightly.
 6. Tape all horizontal and vertical joints in the insulation with PolyGard 136 tape.
- G. Protection Board and Perimeter Foundation Insulation: Install EPS insulation board on exterior surface of perimeter foundation walls.
1. Remove jagged surfaces or surface irregularities prior to installation.
 2. Verify that damproofing or waterproofing is fully cured prior to application over such surfaces.
 3. Attach insulation by pressing into cured damproofing or waterproofing or by using polystyrene compatible adhesive.
 4. Butt edges tightly.
 5. Apply polystyrene compatible sealant to the joint between the substrate and the insulation board to minimize water infiltration behind the insulation.
 6. Do not allow ESP insulation to be exposed for an extended period of time to protect from UV exposure and damage from other trades.
 7. Carefully backfill without displacing or damaging the insulation board.
- H. Under Slab-On-Grade: Install EPS insulation board under slab-on-grade and over properly prepared subgrade of compacted fill and vapor retarder. Place EPS board with sides and ends butted.
1. Prepare subgrade by removing surface irregularities prior to installation.
 2. Install vapor barrier over subgrade to protect against dampness and moisture penetration.
 3. If under slab waterproofing is indicated on the Drawings verify that it is fully cured prior to application.
 4. For vertical surfaces attach insulation by pressing into cured damproofing or waterproofing or by using polystyrene compatible adhesive.
 5. Butt edges tightly.
 6. For the top edge of vertical surfaces apply polystyrene compatible sealant to the joint between the substrate and the insulation board to minimize water

- infiltration behind the insulation.
7. Do not allow ESP insulation to be exposed for an extended period of time to protect from UV exposure and damage from other trades.
 8. Carefully install reinforcing and concrete without displacing or damaging the insulation board.

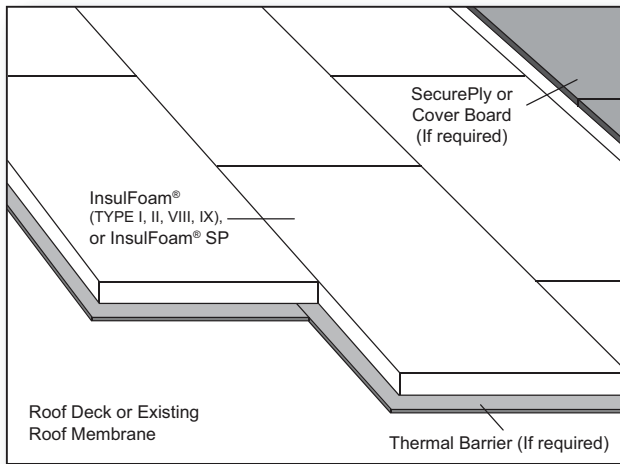
3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

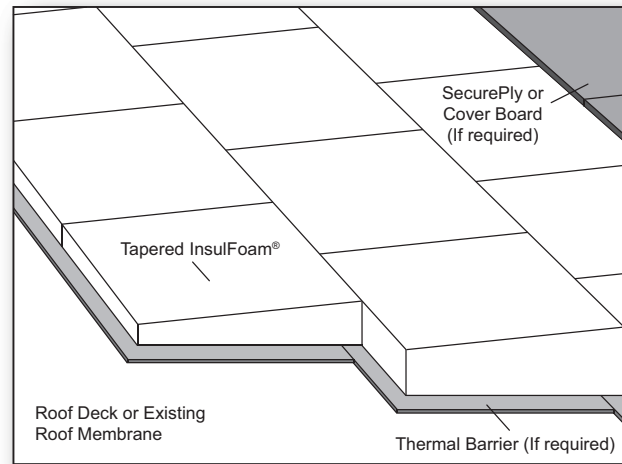
END OF SECTION

SINGLE LAYER – LOOSE LAID

Flat Insulation



Tapered Insulation



General

This specification is intended for use over any substrate suitable to receive and support a loose laid roof insulation assembly and subsequent roof membrane. It is provided to serve as a guideline for designers and installers.

Installation Considerations

- InsulFoam insulations are shipped in plastic film wraps, which are intended for temporary protection during shipping. All material should be protected from the elements and stored in a dry location.
- Install only as much insulation as can be covered by a roof membrane system, and/or made watertight by the end of each day.
- When conditions dictate, in order to prevent wind blow-off or damage during installation, the loose laid insulation should be weighed down or tacked into place with a minimal quantity of mechanical fasteners.
- InsulFoam insulations should not be exposed directly to solvent-based or petroleum-based adhesives and sealants.
- Allow approximately a 1/4" space between InsulFoam insulation and vertical surfaces or roof projections. Do not force or jam product into place.
- Review the layout of all Tapered InsulFoam systems before loading and installing panels.
- For re-cover applications, care should be taken to ensure that no moisture is trapped in the existing or new roof system.

InsulFoam insulations are compatible with most membrane systems; however, we recommend consultation with the membrane manufacturer for any limitations or approvals for use with their products.

Insulation Specifications

InsulFoam	InsulFoam SP	Tapered InsulFoam
Direct-to-Deck		
1NIL	1NSL	1NTL
DensDeck Thermal Barrier		
1DIL	1DSL	1DTL
Gypsum Thermal Barrier		
1GIL	1GSL	1GTL
Perlite Thermal Barrier		
1PIL	1PSL	1PTL

Thermal Barrier Installation (If required)

Some designs require the use of a thermal barrier between the insulation and occupied areas of the building. For guidance, consult local building codes, the membrane manufacturer and the Thermal Barrier information in the Insulfoam Roofing Manual.

Loose Laid Insulation

Install InsulFoam insulation with continuous side joints and end joints, staggered so that they are offset by a minimum of 12" from the end joints in adjacent rows. Insulation should abut tightly against adjacent boards. Joints greater than 1/2" should be filled with the same insulation that is being used in the field of the roof. If insulation is being installed over a thermal barrier, an existing layer of insulation, or under a cover board, all joints must be offset a minimum of 6" between layers. When installing InsulFoam insulations directly to a metal deck, the edges of the insulation parallel to the deck ribs must be solidly supported and centered on the ribs. Additionally, for metal deck installations, ensure that the insulation has a thickness that is adequate to span the rib openings. For acceptable minimum thicknesses of InsulFoam installed directly over

metal decks, refer to the Roof Decks section in the Insulfoam Roofing Manual.

SecurePly Installation

Some specifications require the use of a slip sheet. SecurePly should be rolled out so that it completely covers the underlying insulation. SecurePly must have 2" (minimum) side and end laps. To prevent movement from wind or roof top construction traffic, it may be necessary to tack SecurePly into place with a minimal quantity of mechanical fasteners.

When SecurePly is used in conjunction with these loose laid specifications, the insulation specification designation is to be modified with the two-letter suffix SL, to identify that SecurePly has been loosely laid over the insulation.

Cover Board Installation (If required)

Some specifications require the use of a cover board. Cover boards may be loose laid or mechanically attached over loosely laid InsulFoam or Tapered InsulFoam. For cover board installation procedures, refer to the Cover Board Specification information in the Insulfoam Roofing Manual.

When cover boards are used in conjunction with this specification, the insulation specification would be modified with a two-letter suffix to identify the cover board type and attachment method. Refer to the Cover Board Specification information.



3350 Series 3-1/2" Thermal Fixed, Casement & Projected Windows

Product Information



WINCO RESERVES THE RIGHT TO MODIFY OR CHANGE INFORMATION WITHIN THIS BOOK WHEN DEEMED NECESSARY FOR PRODUCT IMPROVEMENT

PERFORMANCE

The Series 3350 window is a thermally broken mainframe and sash that exceeds the performance specification criteria as required by ANSI/AAMA for AW (Architectural Grade) windows.

Fixed			Project Out - Awning		
AAMA Rating	AW-100		AAMA Rating	AW-120	
Air Infiltration	0.03 CFM/ft ²		Air Infiltration	0.08 CFM/ft ²	
Water	Over 12 psf		Water	Over 12 psf	
Structural	150 psf		Structural	180 psf	
CRF (AAMA 1503)	63		CRF (AAMA 1503)	61	
Center of Glass U-Value	Window U-Factor ³		Center of Glass U-Value	Window U-Factor ³	
BTU/Ft ² x F° x Hr	47" x 59" ²	60" x 99" ¹	BTU/Ft ² x F° x Hr	59" x 24" ²	60" x 36" ¹
	0.20	0.30		0.48	0.41
	0.24	0.33		0.50	0.44
	0.29	0.37		0.53	0.47
	0.34	0.41		0.56	0.51
	0.47	0.52		0.64	0.60

Project In - Hopper			Casement		
AAMA Rating	AW-100		AAMA Rating	AW-120	
Air Infiltration	0.08 CFM/ft ²		Air Infiltration	0.02 CFM/ft ²	
Water	Over 12 psf		Water	Over 12 psf	
Structural	150 psf		Structural	180 psf	
CRF (AAMA 1503)	Not Tested		CRF (AAMA 1503)	Not Tested	
Center of Glass U-Value	Window U-Factor ³		Center of Glass U-Value	Window U-Factor ³	
BTU/Ft ² x F° x Hr	59" x 24" ²	60" x 36" ¹	BTU/Ft ² x F° x Hr	24" x 59" ²	36" x 60" ¹
	0.48	0.41		0.48	0.41
	0.50	0.44		0.50	0.44
	0.53	0.47		0.53	0.47
	0.56	0.51		0.56	0.51
	0.64	0.60		0.64	0.60

This Information is based on current product design, sealed dual glazing, warm edge spacers and testing standards.

Please contact WINCO for project specific information

¹ AAMA 101 Test Size

² NFRC Gateway Test Size

³ Based on NFRC 100

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CONSTRUCTION

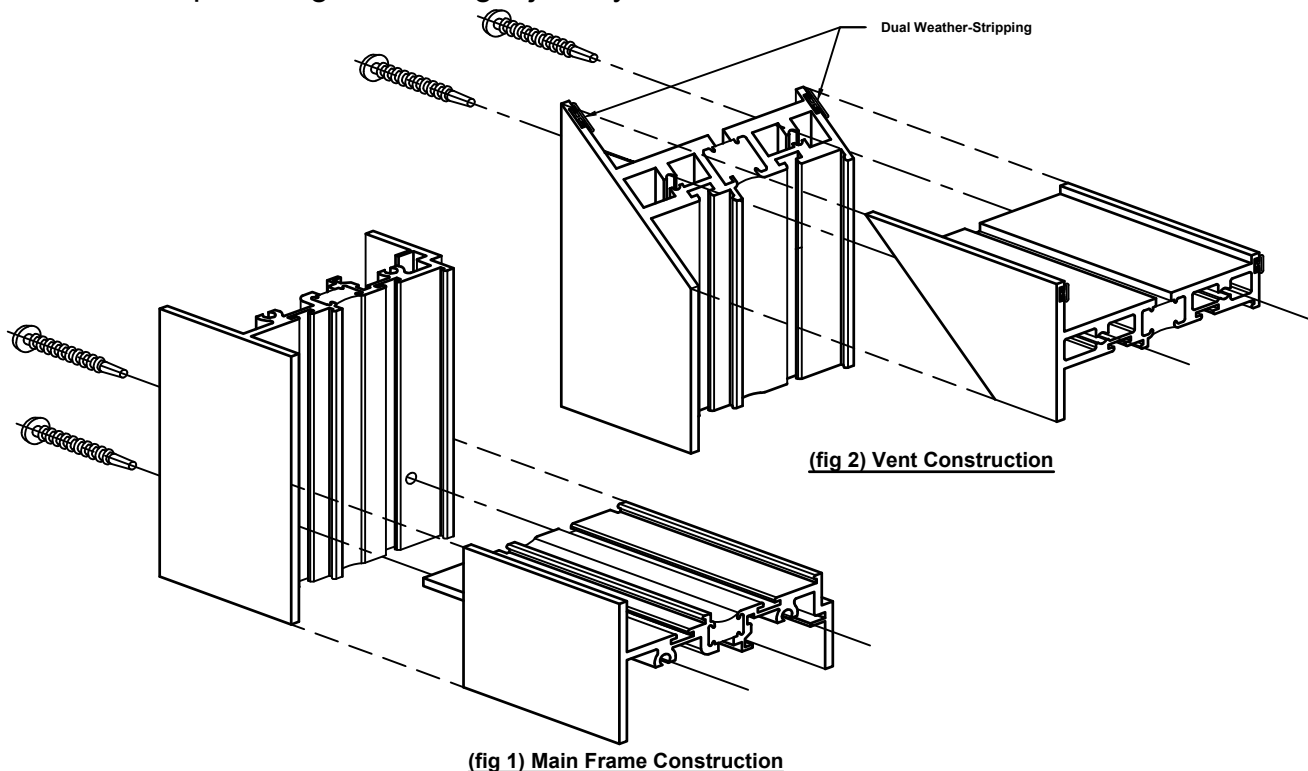
MATERIAL - The Series 3350 window is a 3-1/2" deep frame depth with a nominal wall thickness of 0.125 inch. All material is extruded from 6063-T6 alloy.

THERMAL BREAK - All framing members of the window system are thermally broken. Winco uses the Azon Azo Brader® process to mechanically condition the surface of the thermal cavity. The process runs the entire length of the extrusion and creates serrations that insure proper adhesion of the structural polymer. The structural urethane is a high density 2 part formula providing optimum thermal performance for the most demanding conditions. The combination of the conditioning of the aluminum surface along with the two part urethane allows Winco to provide a full 10 year warranty against thermal break creep and shrinkage in accordance with AAMA 505-98.

WEATHER-STRIP - All operating ventilators have a double Santoprene®, non-shrinking dual durometer, thermoplastic rubber weather-stripping around the perimeter. One interior and one exterior.

FABRICATION - The main frame corners are coped and mechanically joined using two stainless steel spline screws per corner (fig 1). The vent is a hollow tube shaped extrusion for superior strength and rigidity. Vent corners are fully mitered and mechanically joined using two stainless steel spline screws per corner, aligning the members to form a hairline joint (fig 2). All frame joints are back sealed with small joint seam sealer providing a water tight joinery.

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3350 Series 3-1/2" Thermal Fixed, Casement & Projected Windows

Product Information



GLAZING

The windows can be interior or exterior glazed with .050 thick extruded aluminum glazing beads accommodating thicknesses from 1/8" up to 2 1/4". Dual or triple glazing is an option utilizing an interior panel sash that can either be hinged with 4-bar stainless steel hinges or a more economical take out sash. Venetian blinds are available with the dual or triple glazed window options. See the quick reference chart below for all glazing options. For actual details refer to the glazing section in the back of the 3350 section for optional glazing and blind details.

Glazing Thickness	1/8"	3/16"	1/4"	7/16"	1/2"	9/16"	7/8"	1"	1-3/8"	1-3/4"	2"	2-3/8"	-	-
Monolithic	X	X	X	-	-	-	-	X	-	X	X	X	-	-
Insulated	-	-	-	-	-	-	X	X	X	X	X	X	-	-
Dual Glazed	Exterior	X	X	X	-	-	-	-	-	-	-	-	-	-
	Interior	X	X	X	X	X	X	-	-	-	-	-	-	-
Triple Glazed	Exterior	-	-	-	-	-	X	X	-	-	-	-	-	-
	Interior	X	X	X	X	X	X	-	-	-	-	-	-	-

Winco has different gaskets and glazing methods that can accommodate odd thicknesses of glass. If you do not see what you are looking for within this chart please contact your local representative for information regarding your specific project needs.

HARDWARE

All exposed locking hardware, strikes and keepers are solid white bronze alloy with US25D brushed finish. All four bar arms, casement arms, friction arms and key release limit arms are stainless steel conforming to AAMA 904.1. Five knuckle butt hinges are fabricated of 6063-T6 aluminum with nylon bushings and a stainless steel hinge pin.

Window Type	Butt Hinge	4-Bar Arms	Casement Arms	Friction Adjustable	Roto Operator	Cam Lock	Pole Ring Cam Lock	Access Control Lock	Lift Lock	Pole Ring Lift Lock	Pull Handle	Key Release Limit Arm	Fixed Limit Stop	Under Screen Push Bar
PO - Awning	-	X	-	-	O ²	X	O ³	O	O ²	O ²	O	O	O	O ⁵
PI - Hopper	-	X	-	-	-	X	O	O	O	O	-	O	O	-
Casement - Outswing w/ Butt Hinges	X	-	O	X	O ²	O	O ³	O	X	O	X	O	O	O ⁵
Casement - Inswing w/ Butt Hinges	X	-	O	X	-	O	O	O	X	O	-	O	O	-
Casement - Outswing w/ concealed Hinges	-	-	X	-	O ^{2,4}	O	O ³	O	O	O	X	O	O	O ^{2,5}
Casement - Inswing w/ concealed Hinges	-	-	X	-	-	O	O	O	X	O	-	O	O	-

X = Standard Hardware

O = Optional Hardware

Note:

- Not all hardware is compatible with each other, contact your local Winco representative for information
- Size limitations exist on some hardware, contact your local Winco representative for information
- A pole ring pull will be provided on a project out vent is optional pole ring cam locks are required and no screen is furnished
- Minimum width requirement for optional roto operators on casement windows with concealed casement arm hinging
- Under screen push bars are not recommended by Winco if optimum water performance is a requirement

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NC-82 Series 3-1/4" Thermal Terrace Doors

Product Information



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PERFORMANCE

The Series NC-82 terrace door is a thermally broken mainframe and sash that exceeds the performance specification criteria as required by ANSI/AAMA for AW (Architectural Grade) windows.

Fixed Side Lite			Single Door ((Inswing)		
AAMA Rating	C-90		AAMA Rating	AW-75	
Air Infiltration	0.03 CFM/ft ²		Air Infiltration	0.071 CFM/ft ²	
Water	Over 15 psf		Water	Over 15 psf	
Structural	150 psf		Structural	112.5 psf	
CRF (AAMA 1503)			CRF (AAMA 1503)		
Center of Glass U-Value	Window U-Factor ³		Center of Glass U-Value	Window U-Factor ³	
BTU/Ft ² x F° x Hr	²	28" x 96" ¹	BTU/Ft ² x F° x Hr	²	48" x 96" ¹
0.20			0.20		
0.24			0.24		
0.29			0.29		
0.34			0.34		
0.47			0.47		

Double Door (Inswing)		
AAMA Rating	AW-70	
Air Infiltration	0.075 CFM/ft ²	
Water	Over 15 psf	
Structural	105 psf	
CRF (AAMA 1503)		
Center of Glass U-Value	Window U-Factor ³	
BTU/Ft ² x F° x Hr	²	96" x 96" ¹
0.20		
0.24		
0.29		
0.34		
0.47		

This Information is based on current product design, sealed dual glazing, warm edge spacers and testing standards.

Please contact WINCO for project specific information

¹ AAMA 101 Test Size

² NFRC Gateway Test Size

³ Based on NFRC 100

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CONSTRUCTION

MATERIAL - The Series NC-82 Terrace Door is a 3-1/4" deep frame depth with a nominal wall thickness of .066 inch. All material is extruded from 6063-T6 alloy.

THERMAL BREAK - All framing members of the window system are thermally broken. Winco uses polyamide struts for all frame and vent extrusion profiles.

WEATHER-STRIP - All operating ventilators have a double Santoprene®, non-shrinking dual durometer, thermoplastic rubber weather-stripping around the perimeter. One interior and one exterior.

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NC-82 Series 3-1/4" Thermal Terrace Doors

Product Information



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GLAZING

The windows can be interior or exterior glazed with .055 thick extruded aluminum glazing beads accommodating thicknesses of 5/8" and 1". For actual details refer to the glazing section in the back of the NC-82 section for optional glazing and blind details.

Glazing Thickness	1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	9/16"	5/8"	3/4"	7/8"	1"	1-1/4"	1-3/8"	1-1/2"
Monolithic	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insulated	-	-	-	-	-	-	-	X	-	X	X	-	-	-
Dual Glazed	Exterior	-	-	-	-	-	-	-	-	-	-	-	-	-
	Interior	-	-	-	-	-	-	-	-	-	-	-	-	-
Triple Glazed	Exterior	-	-	-	-	-	-	-	-	-	-	-	-	-
	Interior	-	-	-	-	-	-	-	-	-	-	-	-	-

Winco has different gaskets and glazing methods that can accommodate odd thicknesses of glass. If you do not see what you are looking for within this chart please contact your local representative for information regarding your specific project needs

HARDWARE

All exposed locking hardware is aluminum. All multi point locking hardware is stainless steel conforming to AAMA 904.1. 2 knuckle butt hinges are fabricated of 6063-T6 aluminum with nylon bushings and an adjustable stainless steel hinge pin.

	2 Knuckle Butt Hinge	Paris Style Handle	Multiple Locking Points	Keyed Lock Outside	Thumb Turn Lock Outside	Keyed Lock Inside	Thumb Turn Lock Inside							
Door Type	X	X	X	X	O	O	X
Single Inswing	X	X	X	X	O	O	X							
Single Outswing	X	X	X	X	O	O	X							
Double Inswing	X	X	X	X	O	O	X							
Double Outswing	X	X	X	X	O	O	X							
NC-82 Sidelite	-	-	-	-	-	-	-							
NC-82 Transom	-	-	-	-	-	-	-							

X = Standard Hardware
O = Optional Hardware

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3350 Series

3-1/2" Heavy Commercial Thermally Improved Window

SECTION 08520 ALUMINUM WINDOWS

SERIES 3350 Thermal AW/HC___ Grade _____Windows

PART 1 GENERAL

1.01 Work Included

- A. Furnish and install aluminum architectural windows complete with hardware and all related components as shown on drawings and specified in this section.

Insert 3350 Series Thermal.

- B. All windows shall be Winco (3350) AW/HC_____. Other manufacturers requesting approval to bid their product as an equal must submit the following information fifteen days prior to close of bidding.
 - 1. A sample window (size and configuration) as per requirements of architect.
 - 2. Detail cuts and product data.
 - 3. Test reports documenting compliance with requirements of section 1.05.
 - C. Glass and Glazing
 - 1. All units shall be factory glazed.
- OR-**
- 1. Reference Section 08800 for Glass and Glazing.

1.02 Related Work

- A. Section 08400 - Entrance and Storefronts
- B. Section 08480 - Balanced Door Assemblies
- C. Section 08640 - Glazed Patio Doors
- D. Section 08652 - Replacement Windows
- E. Section 08900 - Glazed Curtain Walls
- F. Section 08960 - Slope Glazing System
- G. Section 07900 - Caulking and Sealants

1.03 Items Installed But Not Furnished

1.04 Items Installed But Not Furnished

1.05 Testing and Performance Requirements

- A. Test Units
 - 1. Air, water, and structural test unit shall conform to requirements set forth in ANSI/AAMA/NWDA 101/I.S.2-97.
- B. Test Procedures and Performances
 - 1. All windows shall conform to ANSI/AAMA/NWDA 101/I.S.2-97 requirements for referenced window type in section 1.01B. In addition, the following specific performance requirements shall be met.
 - 2. Air Infiltration Test
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 283 at static air pressure of 6.24 psf.
 - b. Air infiltration shall not exceed .1 cfm per square foot.
 - 3. Water Resistance Test
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 331 at static pressure difference of _____ psf.
 - b. There shall be no uncontrolled water leakage.
 - 4. Uniform Load Deflection Test
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 330 at a static air pressure difference (positive and negative) of ___ psf.
 - b. During the course of the test, no member shall deflect more than 1/175 of its span.

3350 Series

3-1/2" Heavy Commercial

Thermally Improved Window

5. Uniform Load Structural Test
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 330 at a static air pressure difference of ___ psf.
 - b. At conclusion of test there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms, nor any other damage, which would cause the window to be inoperable.
6. Condensation Resistance Test (CRF)
 - a. With window sash closed and locked, test unit in accordance with AAMA 1503.1.
 - b. Condensation Resistance Factor (CRF) shall not be less than ____.
7. Thermal Transmittance Test (Conductive U-Value)
 - a. With window sash closed and locked, test unit in accordance with AAMA 1503.1.
 - b. Conductive thermal transmittance (U-Value) shall not be more than ___BTU/hr/sf/ per degrees F.
8. Life Cycle Test
 - a. Tested in accordance with AAMA 910, there shall be no damage to fasteners, parts, support arms, activating mechanisms, or any other damage, which would make the window inoperable. Subsequent air infiltration and water resistance tests shall not exceed specified requirements

.*=For certified test reports consult Winco.

1.06 Quality Assurance

- A. Provide test reports from AAMA accredited laboratory certifying the performance as specified in Section 1.05.
- B. Test reports shall be accompanied by the window manufacturer's letter of certification stating that the tested window meets or exceeds the afore mentioned criteria for the appropriate ANSI/AAMA/NWDA 101/I.S.2-97.

1.07 References

1.08 Submittals

- A. Contractor or window manufacturer shall submit shop drawings, finish samples, test reports, and warranties, per requirements of architect.
 1. Shop Drawings: Include typical unit elevations, full- or half-scaled detail sections and typical installation details. Include type of glazing, screening, and window finish.
 2. Product Data: Manufacturer's specifications, recommendations and standard details for window units.
 3. Samples of materials may be requested without cost to owner, i.e. frame sections, corner samples, mullions, extrusions, anchors, and glass.

1.09 Delivery, Storage, and Handling

- A. Store and handle windows and other components in strict compliance with manufacturer's instructions.
- B. Protect units against damage from the elements, construction activities and other hazards before, during, and after installation.

1.10 Warranties

- A. Total Window System
 1. The responsible contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total window installation, which includes that of the windows hardware, glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc. as it relates to air, water and structural adequacy as called for in the specifications and approved shop drawings.
 2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at his expense during the warranty period.

3350 Series

3-1/2" Heavy Commercial

Thermally Improved Window

PART 2 PRODUCTS

2.01 Materials

- A. Aluminum
 - 1. Extruded aluminum shall be 6063-T6 alloy and temper, with a tensile strength of 24,000 PSI.
 - B. Hardware
 - 1. Locking handles shall be cam type and manufactured from a white bronze alloy with a US25D brushed finish.
 - 2. Operating arms shall consist of 4-bar stainless steel arms or equal.
 - C. Weather Strip
 - 1. All weather strip shall be double Santoprene® thermo plastic rubber or equal.
 - D. Thermal Barrier:
 - 1. Poured-in-place structural thermal barrier shall transfer shear during bending and provide composite action between frame components.
 - 2. Thermal barrier pocket on aluminum extrusions shall be Azo-Braded to create a mechanical lock to improve the adhesion properties between the polyurethane polymer and the surface of the thermal barrier pocket.
 - 3. Window manufacturer must provide a warranty from the manufacturer of the polyurethane thermal barrier that warrants against product failure as a result of thermal shrinkage beyond 1/8 inch (3.2 mm) from each end and fracturing of the polyurethane for a period not to exceed ten years from the date of window manufacture.
 - 4. Thermal barrier's made of crimped in place polyamide (insulbar®) strips are not acceptable unless all strips are covered and tooled with Dow 795 silicone caulking to eliminate water migration.
 - E. Glass
 - 1. Insulated glass shall be () as manufactured by () consisting of () exterior, () air spacer, and () interior.
- OR-**
- 1. Monolithic glass shall be ()

2.02 Fabrication

- A. General
 - 1. All aluminum frame and vent extrusions shall have a minimum wall thickness of .125".
 - 2. Depth of main frame shall not be less than 3-1/2".
 - 3. Depth of vent shall not be less than 3-5/16".
- B. Frame
 - 1. Frame components shall be assembled by means of mechanical fastening with screws. Joinery to be sealed with small joint sealant
- C. Ventilator
 - 1. All vent extrusions shall be tubular on all 4 sides.
 - 2. Vent shall present a flush condition on the exterior when closed. Overlap sash is not acceptable.
 - 3. Each corner shall be mitered and assembled by means mechanical fastening with screws. Joinery is sealed with small joint sealant.
 - 4. Each vent shall have two rows of Santoprene® weather stripping installed in a specifically designed weather strip pocket for the extrusion.
- D. Screens (**Applicable only to windows requiring screens**).
 - 1. Extruded screen frames shall be fabricated from aluminum 6063-T6.
 - a. Screen mounting holes shall be pre-drilled at the factory.
 - b. Screen mesh shall be (enter aluminum, fiberglass, or stainless steel).
 - c. Screen mesh shall be so installed that the cloth may be easily replaceable.
- E. Glazing
 - 1. All units shall be glazed with butyl tape, silicone cap bead on the exterior, with glazing vinyl and extruded snap-in aluminum glazing bead on the interior.

3350 Series

3-1/2" Heavy Commercial Thermally Improved Window

F. Finish

1. Anodic

- a. Finish all exposed areas of aluminum windows and components with electrolytically deposited color in accordance with Aluminum Association Designation AA-M10-C22-(*). Color is to be ().

Available colors are clear, light bronze, medium bronze, dark bronze, and black.

AA Designation	Description	Mills	AAMA Guide Spec.
* A41	Class I Clear Anodized	0.7 or Greater	611-98
* A31	Class II Clear Anodized	0.4 or Greater	611-98
* A44	Class I Color Anodized	0.7 or Greater	611-98
* A34	Class II Color Anodized	0.4 or Greater	611-98

-OR-

1. Painted

- a. Finish all exposed areas of aluminum windows and components with (). Color is to be ().
 (1) = (70% Kynar) AA-M12-C42-R1X & AAMA 2605-98 & ASCA 96
 (4) = (50% Kynar) AA-M12-C42-R1X & AAMA 2604-98

PART 3 EXECUTION

3.01 Inspection

A. Job Conditions

1. Verify that openings are dimensionally correct and within allowable tolerances. Openings must be plumb, level, and clean. Provide a solid anchoring surface that is in accordance with approved shop drawings.

3.02 Installation

- A. Use only skilled craftsmen for work to be done in accordance with approved shop drawings and specifications.
- B. Set square and level aligning window faces in a single plane for each opening. Windows and materials must be set square and level. Adequately anchor window so when subjected to normal thermal movement, specified building movement, and specified wind loads, so windows will maintain a permanent position.
- C. Adjust Windows for proper ease of operation after installation has been completed.
- D. Contractor furnish and apply sealant, per manufacturers recommendations, to provide a weather tight installation at all opening perimeters. Wipe off excess material and leave all exposed surfaces and joints clean and smooth.

(Winco recommends window flashings, sub-sills and end dams on all window installations).

3.03 Protection and Cleaning

- A. After completion of window installation, windows shall be inspected, adjusted, and left in working order. Windows shall be left clean, free of labels, dirt, etc. Protection from this point shall be the responsibility of the building occupant.

(Windows are a finished product and need to be treated carefully as a finished product),

Santoprene is a registered trademark of Advanced Elastomer Systems,

**=The above specifications are subject to change without notice.*



Designed to last beautifully.™

TRIM

MOULDING

DECK

PORCH

RAIL

PAVERS



AZEK Deck Install Guide

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AZEK Deck/Rim Joist Covers/Riser should be installed using the same good building principals used to install wood or composite decking and in accordance with the local building codes and the installation guidelines included below. AZEK Building Products Inc. accepts no liability or responsibility for the improper installation of this product. AZEK Deck/Rim Joist Covers/Riser may not be suitable for every application and it is the sole responsibility of the installer to be sure that AZEK Deck/Rim Joist Covers/Riser is fit for the intended use. Since all installations are unique, it is also the installer's responsibility to determine specific requirements for each Deck application. AZEK Building Products recommends that all applications be reviewed by a licensed architect, engineer or local building official before installation. If you have any questions or need further assistance, please call AZEK Customer Service at 1-877-ASK-AZEK, (877) 275-2935 or visit our website at www.azek.com.

Tools Required

AZEK Deck/Rim Joist Covers/Riser can be installed with a minimum number of readily available tools. Many other tools are available that can be used for installation. All tools should be used per applicable manufacturers' instructions. Some of the basic tool requirements:

- Cordless Driver
- Chalk Line
- Tape Measure
- Jig Saw
- Carpenter Square
- Spacing Tools
- Miter Saw
- Safety Glasses

Use the jigsaw to cut around obstructions such as posts. For best results a miter saw with a fine-toothed, carbide-tipped finish trim blade (12"-60 tooth minimum) works well for cutting. For a power miter or compound power miter saw a fine finish alternate top bevel blade is also recommended. When working with AZEK products be sure to wear proper clothing and safety equipment. Safety glasses should be used during the entire installation process. Do not use any cordless saws.



STOP! Read this section before you start!

Always make sure to visit www.azek.com to ensure you are viewing the most current installation instructions, care and cleaning, technical information and more.

AZEK Deck

AZEK does not recommend the use of rubber or vinyl products (welcome mats, planters, etc.) on deck boards. A reaction can occur that causes discoloration of the decking under the rubber/vinyl product. This is a common caution for vinyl decking products. Do NOT nail AZEK Deck boards. Cutting or drilling metal should not be done on AZEK Deck boards as metal shavings may be come hot and embed themselves into the deck boards. Always be sure to check and cut the factory cut ends of boards to ensure they are square.

Walking Surface

AZEK deck boards need to be installed embossed side up.

Static Electricity

Static build-up is a natural occurring phenomenon that can occur with many plastic products including PVC Decking. It could occur with AZEK products under the right environmental conditions.

Cantilevering

For best results, don't cantilever over 1/2".

Routing

AZEK Deck/Rim Joist Covers/Riser should not be routed with the exception of the start/stop boards in the XLM Collection (see page 6 step 8).

Color and Grain Patterns

Color variation is purely aesthetic and does not or will not affect the performance of the product.

Note

AZEK Deck is NOT intended for use as columns, support posts, beams, joist stringers, guard railing or other primary load-bearing members. AZEK must be supported by a code-compliant substructure. While AZEK products are great for deck re-planking (removing old deck surface boards and installing AZEK on code-compliant substructure), AZEK Deck Boards CANNOT be installed on top of an existing deck.

Failure to install AZEK Deck products in accordance with applicable building codes and this Installation Guide may lead to personal injury, affect deck system performance and void the product warranty.



Extreme Heat Warning

Be aware of excessive heat on the surface of AZEK products from external sources, such as but not limited to, fire or reflection of sunlight from energy-efficient window products. Low-emissivity (Low-E) glass can potentially harm AZEK products. Low-E glass is designed to prevent passive heat gain within a structure and can cause unusual heat build-up on exterior surfaces. This extreme elevation of surface temperatures, which exceeds that of normal exposure, can possibly cause AZEK products to melt, sag, warp, discolor, increase expansion/contraction, and accelerate weathering.

Current or potential AZEK customers that have concerns about possible damage by Low-E glass should contact the manufacturer of the product which contains Low-E glass for a solution to reduce or eliminate the effects of reflected sunlight.



Excessive Construction Debris

It is important during construction, the deck's surface stay clear from excessive build-up of dirt, sand, and dust from tile, concrete, landscape blocks, or any other masonry products. If these materials are not removed immediately, the deck surface will become difficult to clean and can potentially damage the deck's surface finish.

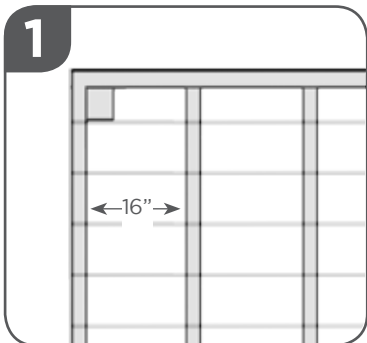
Do not use AZEK Deck as a work surface.

If a build-up does occur please refer to the Care and Cleaning section in AZEK's installation guide or website, AZEK.com.

Installation Preparation

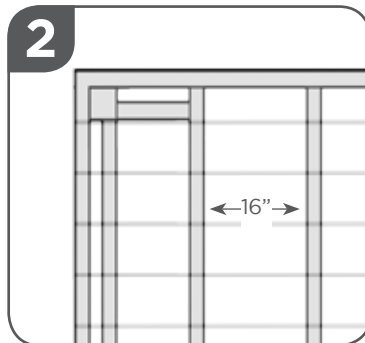
Follow these guidelines for best deck installation:

- AZEK Deck Boards are one-sided products. Deck Boards are to be installed with the grain side up for the walking surface. Rim Joist Covers are to be installed grain side out.
- AZEK Rim Joists are one-sided with exception to the XLM Collection.
- Prior to installation, check to make sure all joists are level, structurally sound, and there are no nails or screws protruding.
- Ensure that all joists are crowned correctly and that all joists are level across the top as AZEK Deck will conform to the surface contour of the substructure.
- Proper joist spacing is required for proper installation. Joist spacing should never exceed 16" on center. For a more rigid feel, 12" may be preferred.
- For best results, installing solid wood blocking between each joist, placed every 4' - 6' within the structure, can help reduce movement or twisting of the joists. Limiting joist movement can help reduce excessive gapping and also ensure more uniform finished surface of the AZEK Deck.



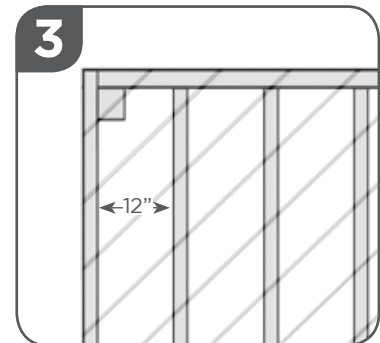
1 16" BASIC INSTALLATION SUBSTRUCTURE

16" on center maximum joists. (12" on center for commercial applications)



2 PICTURE FRAME INSTALLATION SUBSTRUCTURE

16" on center maximum joists plus additional support for picture frame structure (12" on center for commercial applications)



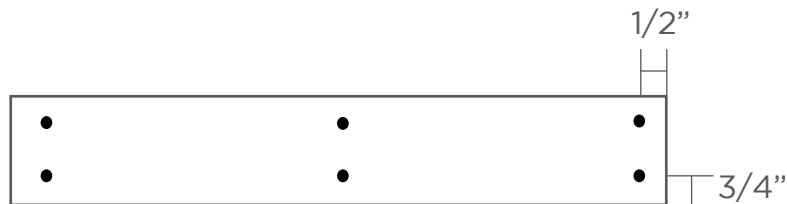
3 DIAGONAL INSTALLATION SUBSTRUCTURE

12" on center maximum joists. More severe angles may require closer joist spacing.

Expansion and Contraction

AZEK Deck/Rim Joist Covers/Riser will have expansion and contraction with changes in temperature, unlike wood whose size will fluctuate with moisture changes. The expansion and contraction encountered may result in slight gaps, which might be noticed at the ends of boards or in splice joints. Fastening the deck boards according to the Installation Guidelines will help minimize expansion and contraction.

- Expansion/contraction is most significant where extreme temperature change may exist.
- Best practice is to cut and fasten the deck boards as soon after cutting as possible.
- Install the boards together tightly at splices or miters.
- Be sure to fasten ends of boards, splices, or abutments to building or structure securely into framing using 2 screws. Position the screws at or within 1/2" of each board end or joint and 3/4" from side of deck plank.



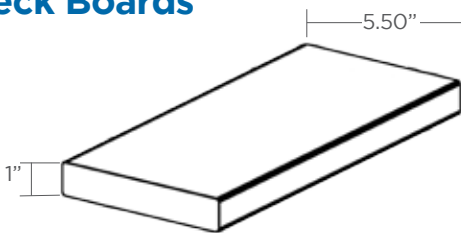
- Provide a 1/8" to 1/4" side to side gap between deck boards.
- In areas with obstructed airflow such as roofs and on-grade applications, a minimum of 1-1/2" sleeper system supported by and connected to the substructure over which the deck is built is required.
- All deck frames and substructure should be securely attached to ground footings or building structure. No floating substructures should be used (from preparation section AZEK).
- For best results, stagger splices and miters across deck surface so that all splices and miters do not break on the same joist or beam.
- To further minimize expansion and contraction, proper ventilation and air flow should be considered.
- Some area building codes may require double joisting when joining boards end to end. Double joists are always required at butt joints when using CONCEALoc. Always check with your local code authority for specific requirements before installation.

Fasteners

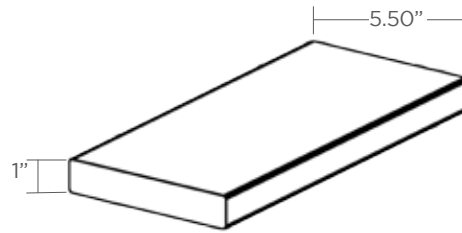
- Due to the durability of AZEK deck products, a high-quality fastener is recommended that meets the following specifications:
 - Stainless Steel
 - Minimum Screw Size: #7
 - Face screws to be a minimum length of 2 1/4"
- Be sure that screws are driven to a minimum depth of 1 1/4" into solid wood framing below the bottom of the AZEK Deck Board. This will enhance holding power and uplift resistance.
- Avoid using flathead screws. Trim head screws typically provide a better result. As always, you should try the fastener in a sample board before using on your deck.
- Be sure to install 2 screws per joist on each deck board.
- For salt water coastal applications, we suggest using the above minimum fastener requirements in 316 stainless steel.
- Color-matched stainless steel deck screws are also available. Your AZEK Building Products dealer can assist with more information on these products.
- AZEK does not recommend any fastener that is not explicitly stated in the AZEK Decking and Installation Guide. Use of any alternative fastener does not void the AZEK warranty; however, if a decking failure is caused by using one of these alternative fastening methods, any corresponding claims will be denied.
- Many of these fasteners have either not been tested, or directly affect the performance of AZEK products. As such, AZEK is not comfortable recommending them.
- Hidden Fasteners: for Arbor, Harvest and Terra Collections.
 - Tiger Claw® TC-P, Fastenmaster's Cortex®, HIDfast™, and CAMO™ fasteners are some hidden fastener systems commonly used by contractors installing AZEK Deck. Before using other types of hidden fasteners, check with the manufacturer of the fastener and/or AZEK customer service to ensure compatibility.
- **WARNING:** When installing AZEK Deck with hidden fasteners, always use a beater board against side of deck board. Do not strike deck board directly with hammer or rubber mallet.

*Tiger Claw is a registered trademark of Tiger Claw Incorporated. Cortex is a registered trademark of Handy & Harman Corporation. HIDfast is a trademark of HIDfast. CAMO is a trademark of National Nail Corporation.

Solid Deck Boards



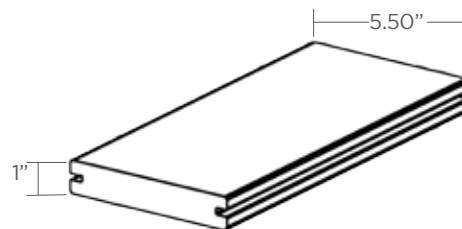
AZEK: Arbor, Harvest, & Terra



AZEK: XLM Square Shouldered

XLM Collection Grooved Deck Boards

Use AZEK CONCEALoc Hidden Fasteners. Follow the directions on the CONCEALoc bucket, box or page 6 of this guide.



AZEK: XLM Grooved

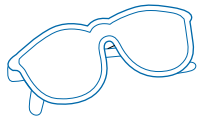
CONCEALoc® Hidden Fasteners for use with AZEK XLM Collection Deck Boards

CONCEALoc & Accessory Installation Instructions

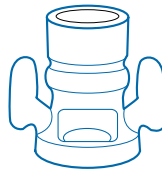
- CONCEALoc Hidden Fasteners – retail box for 100-square-foot coverage or bulk bucket for 1,000-square-foot coverage. Includes stainless steel screws.
- CONCEALoc Gun Pail – 500-square-foot coverage for use with the fastener installation gun sold separately by TigerClaw. Includes quality coated pneumatic fasteners. Stainless steel fasteners for coastal applications available through TigerClaw.
- L-Bracket – avoid face-screwing by using the L-Bracket on first and last boards or as a butt seam clip to ensure a fastener-free surface.
- CONCEALoc Router Bit – cut the correct groove dimension on a solid plank for a perfect CONCEALoc fastener fit even allows for cutting an installed plank over a joist.

CONCEALoc® Hidden Fasteners Installation Instructions

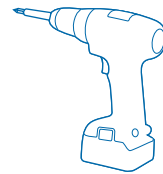
Tools Needed



Safety Glasses

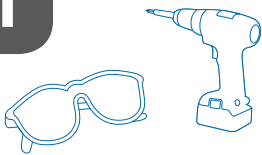


Router with Slot Cutting Blade (Optional)



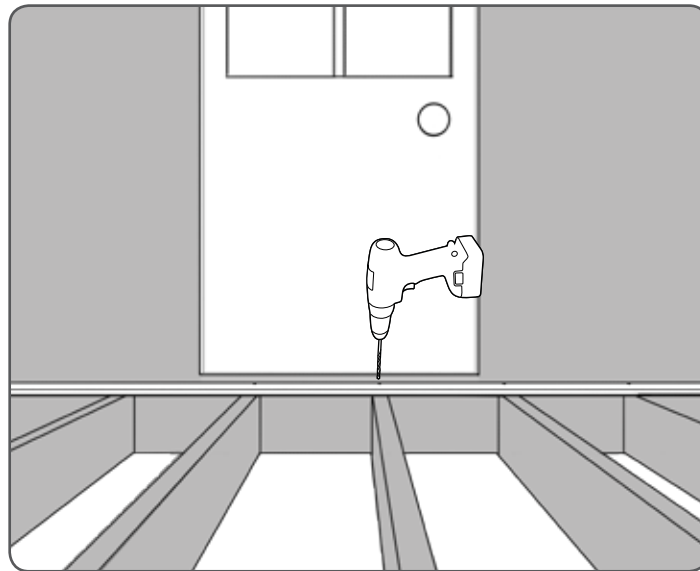
Drill

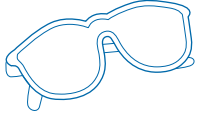
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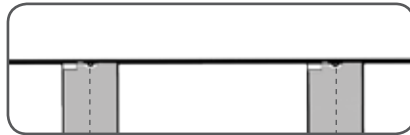
INSTALL THE FIRST PLANK

- Fasten outer edge of the first plank at each framing support 1” from the edge using #7- 2 1/4” deck screws. For a complete fastener-free surface, the L-Bracket or Cortex can be used on first and last boards.
- For further CONCEALoc L-Bracket or Cortex installation help please refer to the installation guide found in the retail packages.



CONCEALoc[®] Hidden Fasteners Installation Instructions**2****POSITION CONCEALoc FASTENERS**

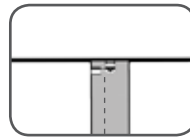
- Fully insert the CONCEALoc fastener into grooved edge of plank. Screw hole should be lined up with the center of support joist.



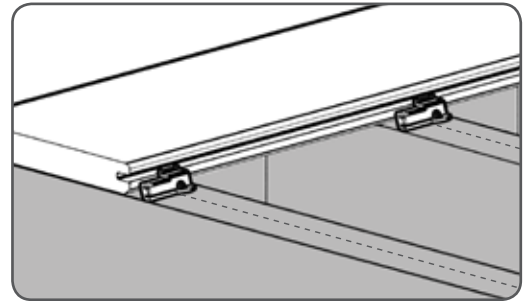
Correct



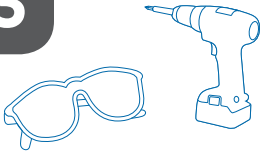
✗ Incorrect



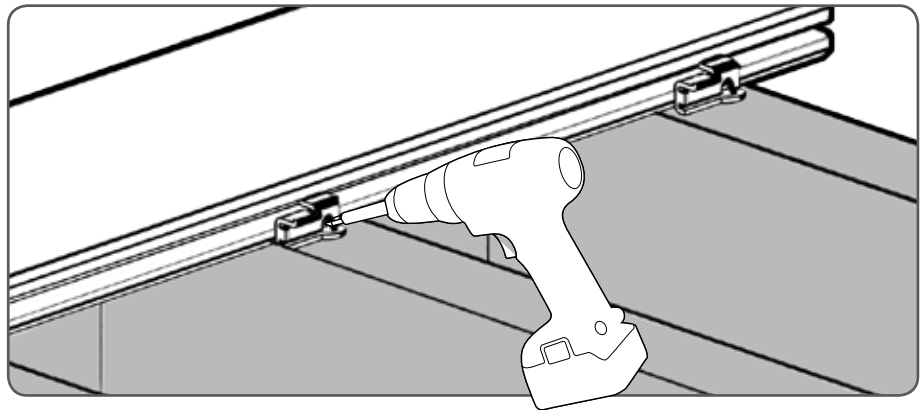
✗ Incorrect



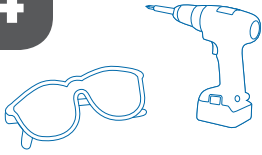
Correct

3**INSTALL CONCEALoc FASTENERS**

- Install provided screw at 45° angle through the fastener and into the joist while applying pressure on the fastener.
- Install one fastener and screw at each joist.
- Make sure fastener is in full contact with edge of plank and the screw is holding the fastener down tight to the deck board.

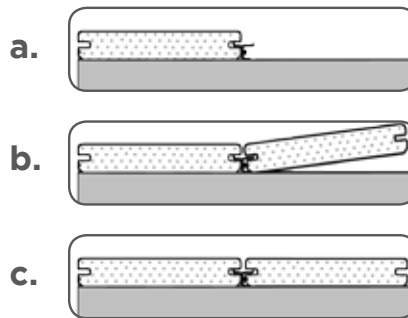


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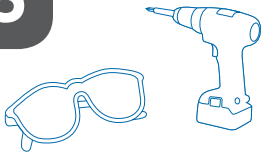


COMPLETE INSTALLATION

- Place the next plank into position against the fasteners. Slightly raise the outer edge of the plank being installed and slide it onto the fastener until the plank contacts the spacer tab. When properly installed the inserted plank should be in contact with the bent-forward spacer tab at the left end of the clip. To achieve this use a scrap piece of decking at least 24" in length and use it as a tamping block to drive the plank further onto the clip and the screw will fully engage the plank to the spacer tab if not already in contact.
- **Do not use a hammer or damage to the edge of the plank may occur.**

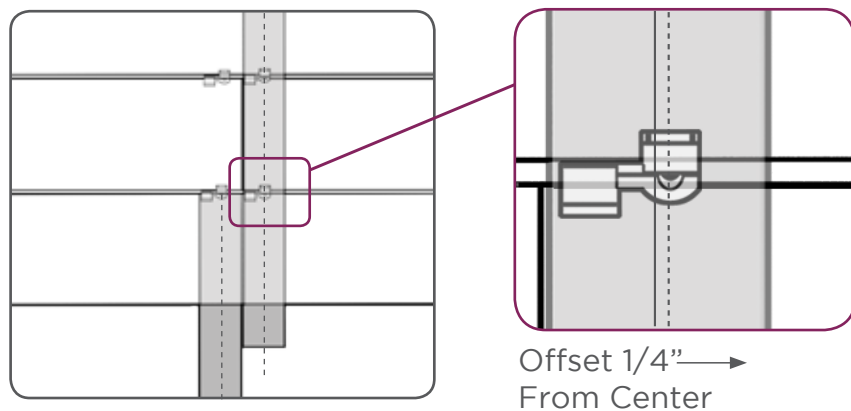


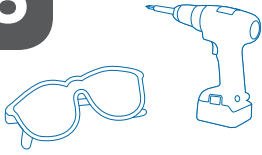
5



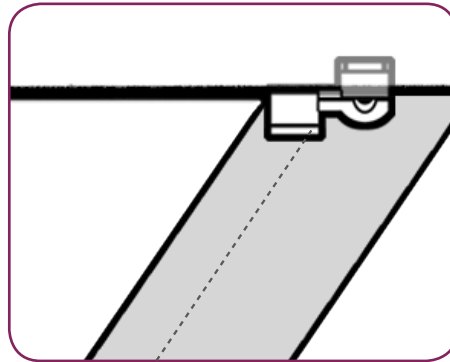
HOW TO INSTALL AT BUTT JOINTS (UNLESS USING AZEK L-BRACKET)

- Joists at butt joints must be doubled up for proper fastener attachment.
- Install fasteners as detailed below. Note that the two clips on the right are shifted approximately 1/4" to the right of center on the joists. If this is not done the spacer tab may fall within the gap of the butt joint.

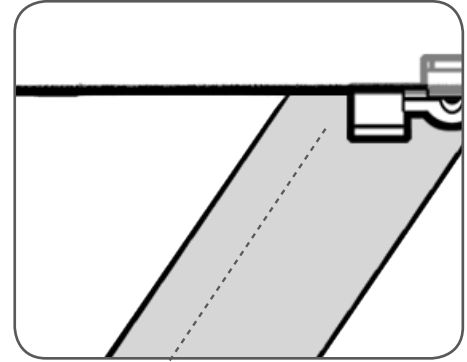


6**HOW TO INSTALL ON DIAGONAL**

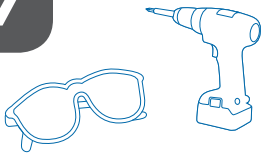
- When the deck is located in a corner of the house, start with small triangular piece of decking in the corner and work your way out.
- Offset the clip 1/2" to the right of center line of the joist, so screw will not exit the side of the joist when driven.



✗ Incorrect

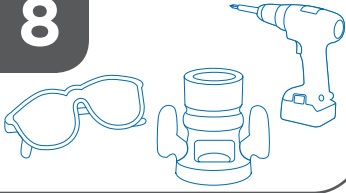


Correct: Shift over 1/2"

7**HOW TO REPLACE A PLANK**

- Make two parallel cuts down the center of the board to be replaced, then remove the center piece.
- Using a small pry bar, remove the remaining pieces of decking from the tabs.
- Using a reciprocating saw, remove the tabs on the side of the board with the screw heads showing.
- Position new board into place, and drive onto remaining tabs.
- Once the board is set into position, secure the loose edges with L-Bracket, Cortex, stainless steel, or high-quality coated deck screws.

8

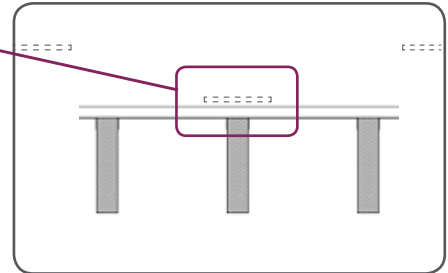
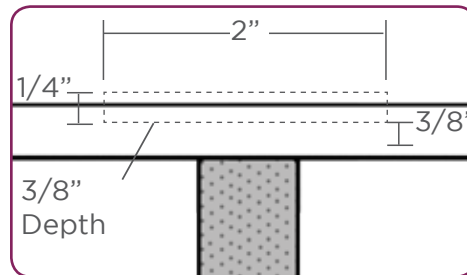


TO USE CONCEALoc[®] HIDDEN FASTENERS WITH AZEK XLM COLLECTION SOLID DECK BOARDS

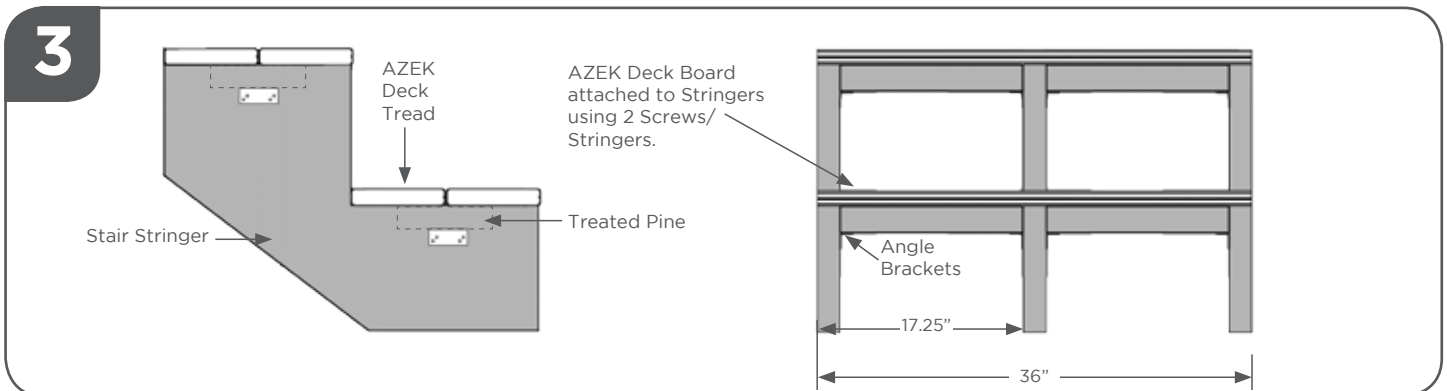
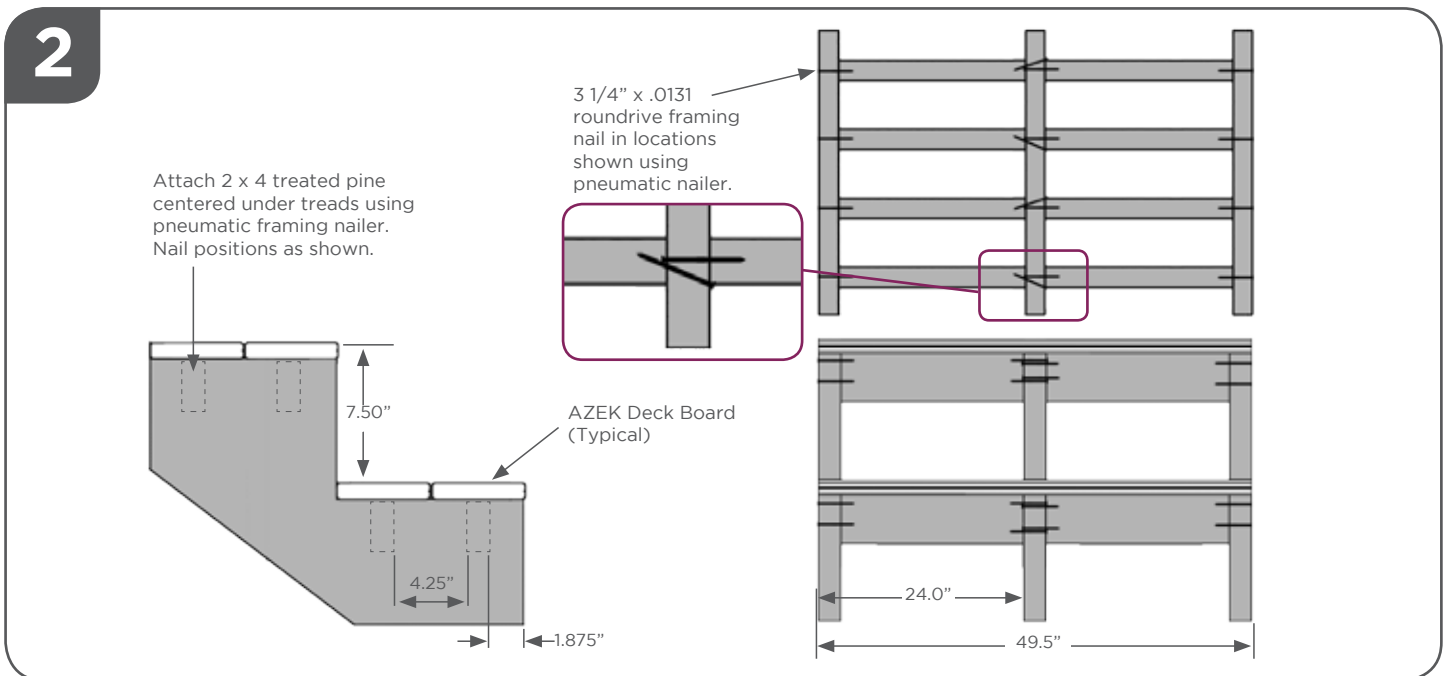
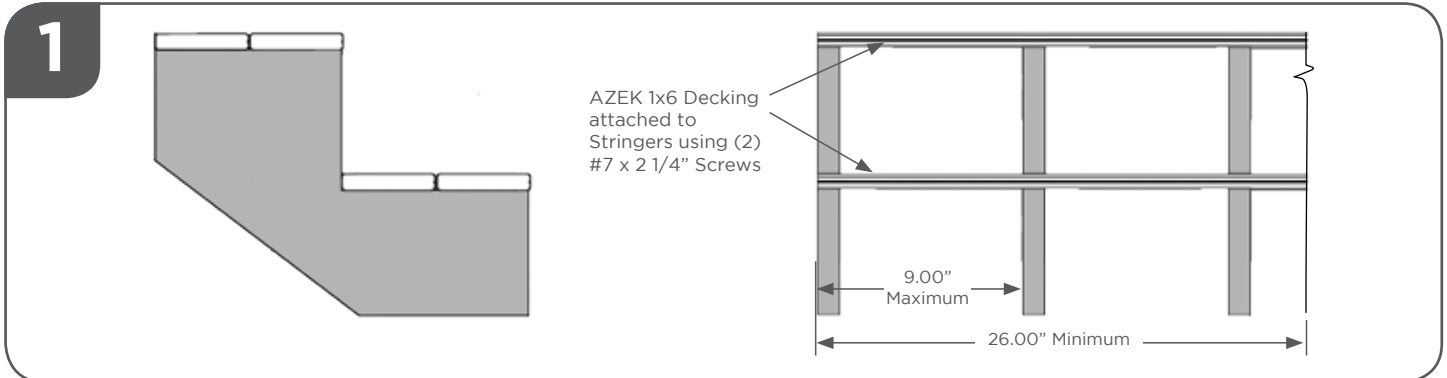
- Create a 2" long groove on the edge of the plank at every joist.
- Use AZEK's CONCEALoc Groove Cutting Router Bit or a Freud model #56-112 or Bosch model #85610M 1/4" slot cutting bit.
- Flip the plank over and start the groove 3/8" off the bottom of the plank.
- Set the depth of the cut from 7/16" to 1/2" deep.



Do not use CONCEALoc[®] Hidden Fasteners or L-Brackets for stair installation.



In order to meet the AC174 Requirement for stair loading, follow one of the methods below:



Installing Stairs

- Stairs should be constructed per local code requirements.
- Use XLM Riser Board or a AZEK ripped Rim Joist Covers for riser installation.

AZEK Deck Rim Joist Covers

- 12' lengths – 1/2" thick by 11.7" wide.

Arbor Collection

- Acacia®, Morado®, Redland Rose®, Silver Oak®

Terra Collection

- Sedona®, Tahoe®

Harvest Collection

- Clay, Brownstone, Slate Gray, Modena®, Kona®

XLM Natural (available in two surface finishes)

- Mountain Cedar, RiverRock, SandRidge

XLM Tropical (available in two surface finishes)

- Walnut Grove, RusticBark, Harvest Bronze

AZEK Stair Risers

- Use as a riser for stairs.
- Can also be used as a Rim Joist Cover for a 2x8 rim joist.
- See fastening guidelines for Rim Joist Covers
- 12' lengths and 1/2" thick x 7-1/4" wide.
 - XLM Deck Natural** (available in two surface finishes)
 - Mountain Cedar, River Rock, Sand Ridge
 - XLM Deck Tropical** (available in two surface finishes)
 - Walnut Grove, RusticBark, Harvest Bronze

Fastening Methods: AZEK Rim Joist Cover/Riser Installation Guidelines

Recommended Fasteners

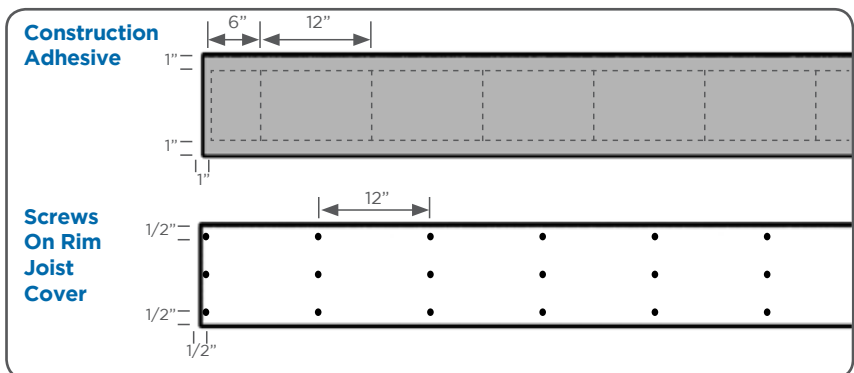
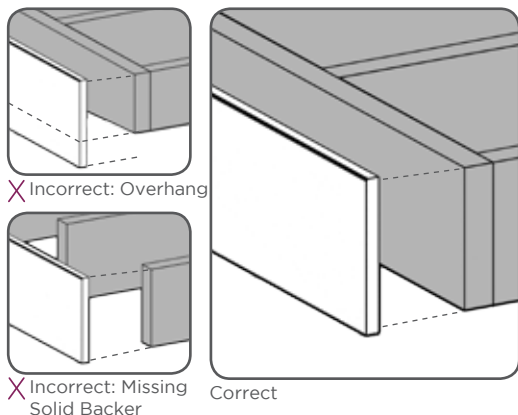
- Due to the durability of AZEK Deck products, a high-quality fastener is recommended that meets the following specifications:
 - Stainless Steel
 - Minimum Screw Size: #7
 - Face screws to be a minimum length of 1 3/4"
- Avoid using flathead screws. Trim head screws typically provide a better result. As always, you should try the fastener in a sample board before using on your deck.
- For salt water coastal applications, we suggest using the above minimum fastener requirements in 316 stainless steel.
- Color-matched stainless steel deck screws are also available. Your AZEK Building Products dealer can assist with more information on these products.

Storage

- Store rim joist cover in a cooler, shady area prior to installation.
- Store rim joist covers on a flat solid surface.

Rim Joist Cover/Riser Attachment

- Attach rim joist cover to a solid backer wide enough to support the entire width of the rim cover. Use 2 x 12 wood rim board or rip cut rim joist cover to fit exactly.
- Use a quality exterior rated construction adhesive as shown below.
- Install three (3) screws from top to bottom with top and bottom screws positioned no more than 1/2" from the edge as shown below. The third screw should be approximately centered in the board. Repeat this configuration every 12". Screws at ends of boards should be no more than 1/2" from the end.



The techniques shown above should be used for best results. Results may vary as expansion and contraction could still occur. AZEK Building Products Inc. claims no liability or responsibility for the improper installation of this product. Since all installations are unique, it is the sole responsibility of the installer to determine specific requirements in regard to each decking application. AZEK Building Products recommends that all designs be reviewed by a licensed architect, engineer or local building official before installation. Please contact AZEK Customer Service prior to installing if you have question or concerns.

Storage & Handling

- Store AZEK Deck, Porch, & Rim Joist Covers on a flat and level surface.
- Store products in a cool, shady area prior to installation.
- Do not stack bundles over 8 units high.
- Always leave factory applied protective wrap. If stored outdoors, the product must be covered with non-translucent material.
- Use care when handling product with a forklift as forks can easily damage the material.
- If banding is used, use protective corners to prevent indents from the bands.
- Avoid storing AZEK Deck, Porch, Rim Joist Covers, & Riser in areas of excessive heat.

Considerations

- Depending on environmental conditions, AZEK Deck, Porch, Rim Joist Covers, & Riser colors may appear to lighten over time as part of the natural weathering process.
- Please be aware that excessive heat build on the surface of AZEK products from external sources such as, but not limited to, fire or reflection of sunlight can potentially lead to damage. For example, sunlight which may be reflected by low-emissivity (Low-E) glass can potentially lead to damage of exterior building products, including AZEK Deck, Porch, & Rim Joist Covers, Riser, Trim, Moulding or Railing products, due to elevation of surface temperatures which far exceed that of normal exposure of the same materials to direct sunlight. Possible damage by such reflected concentrated light may include melting, sagging, warping, distortion, surface discoloration, increased expansion or contraction, and unusual weathering.
- Static build-up is a natural occurring phenomenon that can occur with many plastic products including PVC Decking. It could occur with AZEK products under the right environmental conditions
- Although AZEK Deck & Porch products are cooler to the touch than many other deckboard products in similar colors, all decking products will get hot in the sun. Additionally, the darker the decking color, the hotter it will feel.
- Always remove jobsite dust, clay, dirt, mud, and other construction products from AZEK Deck, Porch, Rim Joist Covers, & Riser quickly. Do not allow construction dirt and debris to sit on the AZEK Deck/Porch surface.
- **IMPORTANT:** Do not allow airborne dust from concrete, landscape blocks, or any masonry product to accumulate on the AZEK Deck, Porch, Rim Joist Covers, & Riser surface as it may damage the surface of the deck. Do not cut any product on or near AZEK Deck, Porch, & Rim Joist Covers.

Care & Maintenance

To keep your AZEK Deck/Porch looking its best:

- To remove rust stains, use a household cleaner such as Krud Kutter “the must for rust”.
- Avoid the use of rubber-backed mats, tarps, pool toys, and other non-porous items on the deck/porch for any extended period of time as these items may cause discoloration to the decking surface.
- Some products, such as sunblock and insect repellent, contain chemicals that may alter the surface of AZEK Deck, Porch, Rim Joist Covers, & Riser. Check product labels and consult with the manufacturer as to product compatibility with plastic materials, such as AZEK Deck, Porch, Rim Joist Covers, & Riser, prior to use on or near AZEK Deck/Rim Joist Covers.
- Do not get any PVC glue or similar product on the surface of any AZEK Decking/Porch Product as it may discolor and permanently damage the surface.
- To clean AZEK Deck/Porch, use an all-surface deck cleaner or another all-purpose cleaner such as Chomp[®] Gutter cleaner, Zep[®] 505, Simple[®] Green or Krud Kutter[®] Cleaner/Degreaser with a stiff natural fiber brush.
- Always read the cleaning product manufacturers specific information before using any product on your AZEK Deck and follow their instructions. It is also a good idea to test the cleaner on a scrap piece or inconspicuous area of the deck to make sure it does not harm the surface.
- WARNING: Keep children and pets away from cleaning products and AZEK Deck until dry.

- *Note that *composite deck* cleaners such as Corte Clean[®], Thompson’s[®] Water Seal[®] Oxy Action, Olympic[®] Premium Deck Cleaner, or other *cleaners specified as composite deck cleaners*, in powder or liquid form, **SHOULD NOT** be used with AZEK Deck/Porch. AZEK Deck/Porch is a PVC/polymer deck plank and not a wood/plastic composite.
- Store products under cover to maintain a clean surface.
- If stored outdoors, they must be covered with a non-translucent material.

Ice and Snow:

- As with any walking surface, AZEK deck products may become slippery in Winter weather. Take caution when walking on the your AZEK deck in these conditions.
- For ice removal, most products containing calcium chloride can be used without damage to the deck/porch surface.
- These products may leave a white residue which can be cleaned using the cleaning guidelines above.
- Metal shovels or plastic shovels with a metal leading edge may damage the surface of AZEK Deck and are not recommended for clearing snow from deck/porch surface.

(These guidelines may not cover every care and maintenance scenario encountered. For additional questions about care and maintenance, call (877) ASK-AZEK).

Warranty

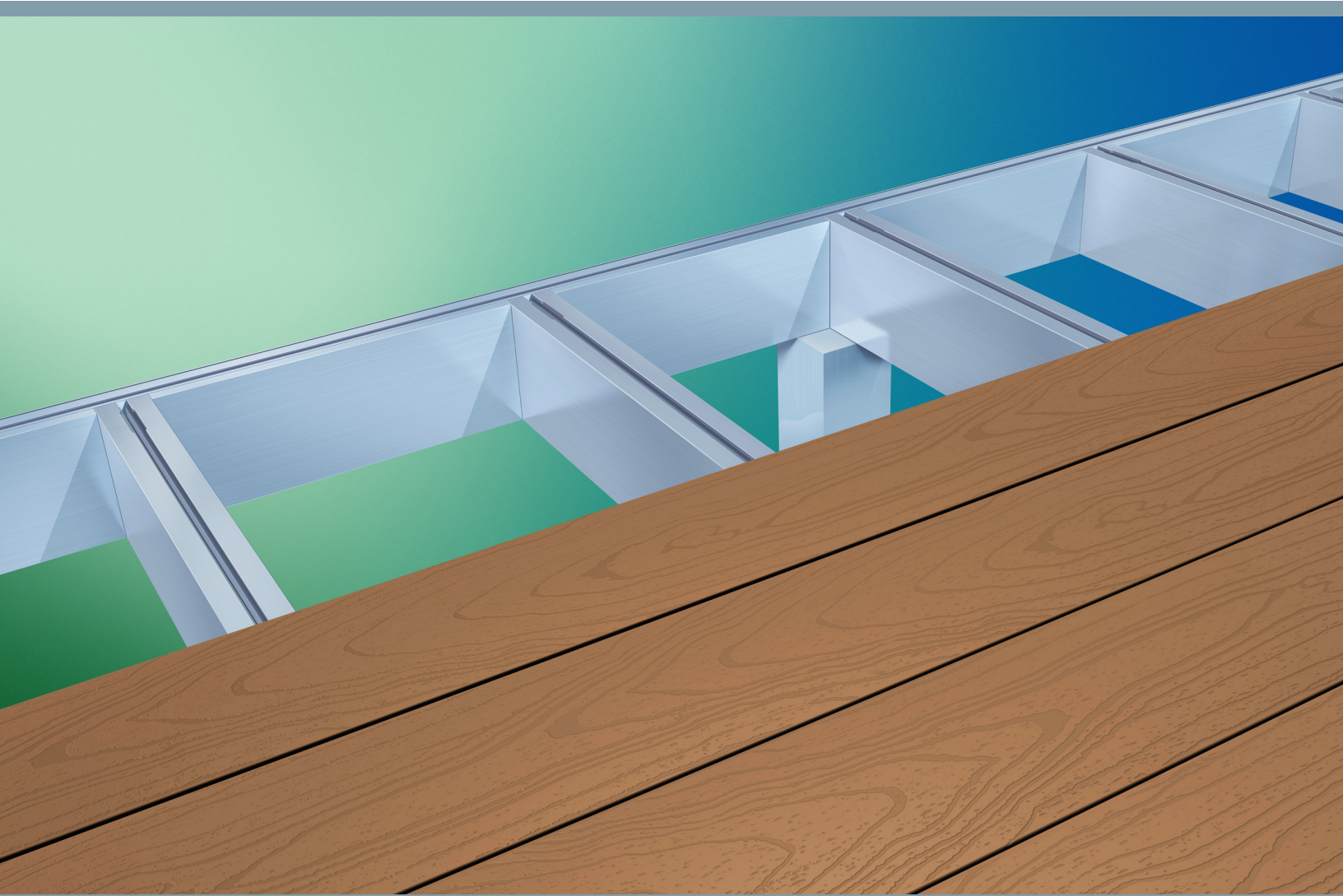
AZEK Building Products are made exclusively from technologically advanced materials designed to provide years of enjoyment. AZEK Deck products are covered by a Limited Lifetime Warranty for residential applications and a 20-year Limited Warranty for commercial applications. The warranty covers defects resulting in blistering, peeling, flaking, cracking, splitting, cupping, rotting or structural defects from termites or fungal decay.



CPG Building Products, LLC
888 North Keyser Avenue • Scranton, PA 18504
www.AZEK.com • (877) ASK-AZEK (877) 275-2935



DEXSPANTM
Extruded Aluminum Deck and Dock Framing Systems



Engineered to last. Built for life.



DEXSPAN™

Extruded Aluminum Deck and Dock Framing Systems



- Versatile custom designs
- Enduring and maintenance-free
- Stronger for longer spans
- Faster and simpler installation
- Lighter and easier to handle



The patented DexSpan™ aluminum framing system revolutionizes deck and dock framing, bringing new benefits to design, construction and lifetime cost of ownership.

Contractors and homeowners agree: DexSpan™ Extruded Aluminum Framing Systems are the first step to a better-built deck or dock.

Easier to BUILD

- Modular** pre-engineered sections go together fast
- Dex-Lock™ assembly** for rapid and precise framing
- Slide-and-Hide™ deck clips** for a clean finished look
- Lightweight aluminum** for easier material handling
- Countersunk holes** with no exposed nails, screws, bolts
- Complete line** of trim, colors and accessories

Easier to OWN

- Beautifully supports** a wide variety of decking materials and railing systems
- Concealed deck fasteners** provide the cleanest look
- Stronger and longer spans** require fewer framing posts
- Popular colors** guaranteed to last 20 years
- Long lasting** - won't warp, bow, split, mildew, rust or decay
- Low maintenance** - easy cleanup with soap and water

For more information about DexSpan™ Extruded Aluminum Deck and Dock Framing Systems, please visit our website.

dexspan.com 844-DEXSPAN (844-339-7726)

Better-built decks start with DexSpan™



Engineered to last. Built for life.

DexSpan™ extruded aluminum deck and dock framing systems are engineered to meet the demands for longer-lasting and better-looking deck construction. Now you can improve the look and performance of most any decking material with an overall lower total-cost-of-ownership. Contractors and homeowners both agree, DexSpan™ is the first step to a better-built deck.

- Stronger & Safer** - 100 lbs. per sq. ft. exceeds most codes
- Longer Spans** - 31% longer spans than treated lumber
- Versatile** - supports most types of decking and railing
- Simpler** - less tools to install and even less to maintain
- Installs Faster** - install the deck in hours, not days or weeks
- 40% Lighter** - weighs less than treated lumber on average
- Long Lasting** - won't warp, bow, split, mildew, rust or decay



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- 40% Lighter** - weighs less than treated lumber on average
- Portable** - ideal for summer setup and winter storage
- Long Lasting** - won't warp, bow, split, mildew, rust or decay



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The first step to a better-built deck

The patented DexSpan™ aluminum framing system revolutionizes deck and dock framing, bringing new benefits to design, construction and lifetime cost of ownership.

Engineered modularity shortens deck erection time from days to hours, while increasing the value of the entire finished project. The finished deck not only looks great on the surface, it is supported by a framing system that also looks great and will stay that way for decades.

Dex-Lock™ assembly assures the exact fit and secured assembly of the system's modular joist sections, adding to the strength and durability of the deck.

Exclusive Slide-and-Hide™ deck fasteners make fast work of installing decking while completely concealing the screws. The result is a clean-looking deck with no exposed screws.



1. Insert Slide-and-Hide™ fastener into slot



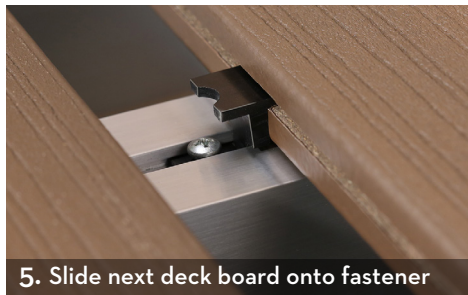
2. Slide fastener through the channel



3. Press fastener into groove in decking



4. Secure Slide-and-Hide™ with screw



5. Slide next deck board onto fastener



6. Deck secured and no exposed screws!

A wide range of standard finishes can be reviewed on our website. We can custom manufacture components to your specification and desired color.

A wide variety of decking materials and railing systems are supported by the DexSpan™ framing system, including leading brands of composite decking, treated lumber, cedar, hardwoods, PVC and aluminum decking, plus paver and granite stone systems.



DexSpan™ deck framing products are made in the USA from recycled and 100% renewable aluminum sourced in the USA

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Section XXXXXX- Vertical Living Walls

PART 1- GENERAL

1.1 SUMMARY

A. Scope

1. Work includes furnishing and installing the **VerTexx® Vertical LivingWall™ System**; including all mounting components, planting trays, **GardenSoxx®**, plants, and irrigation components, as designated on the construction drawings and as specified herein.

B. Description

1. The **VerTexx® Vertical LivingWall™ System** is made of galvanized wire panels and sturdy planting trays to easily create custom vegetated vertical walls. VerTexx trays hold 5" diameter GardenSoxx units in typical 24" lengths and can be planted with edibles, ornamentals, or natives. The GardenSoxx mesh keeps weed seeds out, and added irrigation creates a completely low-maintenance growing system. Typical VerTexx wire panel dimensions are 4' wide x 8' tall with openings of 4" W x 6" T; however, panels can be easily cut to size. The VerTexx LivingWall System is designed to be installed in accordance with these specifications and the Filtrex installation manual. VerTexx LivingWalls can be completely or partially covered in trays for full plant coverage.

1.2 SUBMITTALS

A. Shop Drawings

1. Vertical living wall design, and mounting details.

B. Product Data

1. Material description for all components including; composition, MSDS sheets, manufacturer certifications and installation information for each product specified as part of the system.

C. Planting and Irrigation Plan

1. Plant list with elevation views, approved suppliers, seasonal requirements for planting, fertilization, plant coverage targets, methods of measurement, maintenance agreements.

D. LEED Compliance

1. All information pertaining to categories, points and documentation.

1.3 DELIVERY, STORAGE, & HANDLING

- A.** Check all materials upon delivery for any damage, and to assure the proper materials and quantities have been received.

- B.** Protect the materials from damage, as damaged materials shall not be used in the project.

1.4 WARRANTY

- A.** Filtrex provides complete living wall systems. All warranties will be by project specific agreement regarding plants, stewardship and wall coverage targets established for each project.

1.5 MAINTENANCE

- A.** Maintenance and care of the vegetated portions of the wall system is essential. The initial and continuing maintenance required will depend on the plantable unit infill, type of vegetation, local weather conditions, and exposure. Filtrex International may, at its discretion, provide

maintenance review visits for the purpose of documenting the progress and condition of the completed system. At such regular visits within the first 24 months from completion, reports will be generated and shared with stakeholders as a tool to facilitate successful grow-out. Any provisions by and for the project owner, in addition to those listed above, such as % plant coverage by calendar date, shall be placed in a separate document and included with the plans and specifications of the project prior to bidding and selection of installer.

PART 2- PRODUCTS

2.1 LIVING WALL SYSTEM MANUFACTURER

A. Is VerTexx® Vertical LivingWall™ System as produced by Filtrex International:

<http://www.filtrex.com/en/products/vertexx-walls>; 314-287-4470; livingwalls@filtrex.com

1. Galvanized Steel Wire Panel product description 4x6 W4.0XW4.0 48" (+1 ½", 1 ½") X 8'-0 ½"(¼", ¼") meeting the following specifications:
 - a. Overall Dimensions: 96.5" (with 16 spaces @ 6") x 51" (with 12 spaces @ 4")
 - b. Galvanized in accordance with ASTM-A-123 or ASTM-A-153
 - c. Wire Size: 4.0 (0.226 in)
 - d. Wire Fy (Grade): 65 K.S.I (ASTM A1064)
2. Removable Closed Bottom VerTexx Planting Trays meeting the following requirements:
 - a. Injection molded, recycled, BPA free Polypropylene
 - b. Food Grade Plastic per FDA regulations
 - c. UV Stabilized for a minimum of 7 years
 - d. No Break additive for Temperature Resistance to both heat and cold
 - e. Water retention of 1/8 inch at base
 - f. Recyclable
3. GardenSoxx Mesh
 - a. 5" diameter Polypropylene mesh
 - b. Recyclable and BPA free
 - c. Conforming to Filtrex® patented mesh technology and specifications.

2.2 GROWTH MEDIA

- #### **A. Use VerTexx® GrowingMedia™ as supplied by Filtrex in order to facilitate successful grow-out and long-term coverage of the completed wall system. VerTexx® GrowingMedia™ is a specific blend of long fiber Horticultural Grade Canadian Sphagnum Peat Moss, Coarse Horticultural Grade Perlite, and Compost meeting or exceeding Filtrex® GrowingMedia™ specifications as indicated in the Filtrex Design Manual; Or be pre-approved custom growing media to meet the needs of the plants to be grown and the region of use.**
- #### **B. VerTexx® GrowingMedia™ blend will meet the following parameters:**
- | | |
|--------------------|---------------|
| 1. Total Porosity | 50-70% |
| 2. Air Space | ≥10% |
| 3. Available Water | 25-35% |
| 4. pH | 5.5-7.0 |
| 5. EC | <3.0 mmhos/cm |
- #### **C. Nutrient additions (fertilization) shall be based on lab analysis of the growing media, the needs of the plants specified, and region to be grown.**

- D. Material is to be delivered in bulk bags, or packaged in Filtrex GardenSoxx for precise, modular placement within the VerTexx[®] Vertical LivingWall™ System.

2.3 IRRIGATION

- A. VerTexx planting trays have been designed to allow for 1/4" drip irrigation tubing. See Filtrex website for details and specs at <http://www.filtrex.com/en/products/vertexx-walls>

2.4 LIGHTING

- A. For plant survival, a minimum of 150 foot candles spread evenly throughout the face of the living wall for 10-12 hours daily. For supplemental lighting, typically with a linear LED fixture, outputting a minimum of 2100 lumens per foot with the color temperature between 4100-5500K (Kelvin). When using supplemental lighting provide an adjustable timer control.
- B. Recommended Lighting Supplier
 - 1. Sunlite Science & Technology: <https://www.sunlitest.com/>
phone: 785-856-0219; email: info@sunlitest.com

2.5 LIVING WALL SYSTEM WEIGHT

- A. Maximum system weight shall not exceed 20 lbs/sf, or as directed by the Architect.

PART 3- EXECUTION

3.1 INSTALLATION

- A. To be per VerTexx Installation Guides, upon request (314-287-4470 or livingwalls@filtrex.com) and design manual at <http://www.filtrex.com/en/livingwalls/home/livingwalls-specs-and-cads>

3.2 PLANTING

- A. VerTexx Living Walls were designed to be pre-planted, grown-in prior to installation, and supplied by Filtrex, or planted onsite as specified by the designer. Always consult with the owner and/or their representatives early in the project to determine all responsible parties with regard to plants, planting, nursery time, quantity, design, maintenance, and fertilization.

3.3 IRRIGATION

- A. Install irrigation supply lines and drip emitters as required per plans and Filtrex specifications at <http://www.filtrex.com/en/livingwalls/home/livingwalls-specs-and-cads>

3.4 LIGHTING

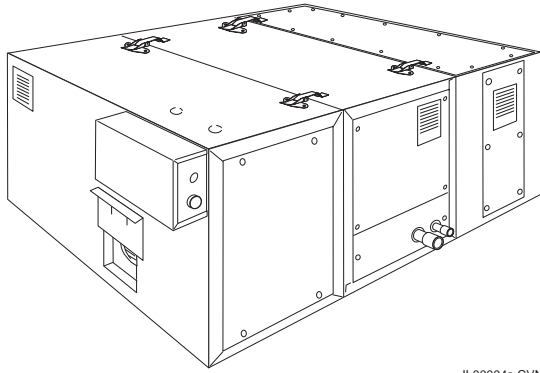
- A. Install supplemental Lighting as required per plans and manufacturers specifications.

3.5 TECHNICAL SUPPORT

- A. Filtrex LivingWalls staff is available for specification assistance and jobsite review of various installation stages at 314-287-4470 or e-mail livingwalls@filtrex.com for information and technical advice. Filtrex should be contacted at least 14 days prior to the start of construction if technical representatives are needed during the installation process.

END OF SECTION XXXXXX

The Unico System®



GENERAL

The information on the following pages is to help the installer save time, provide the best possible installation and ensure continuous trouble-free operation.

SCOPE

These instructions apply to the Unico "M" Series modular air handler units. For heat pumps, refer to *Bulletin 30-24* for additional instructions. Installation instructions for the air distribution system are covered in *Bulletin 30-05*. Before beginning any installation a detailed system layout must be done in accordance with the *System Sizing and Layout Procedure, Bulletin 40-40* and the *Component Layout Instructions, Bulletin 40-30*.

NOTICE TO INSTALLER AND EQUIPMENT OWNER: RETAIN THIS MANUAL AT THE JOB.

FULL BUILDING INSULATION IS ESSENTIAL FOR THE MOST ECONOMICAL OPERATION

GENERAL PRECAUTIONS AND SAFETY TIPS

Do not attempt to install or startup unit without first reading and understanding the appropriate sections in this manual.

Before operating, be sure the unit is properly grounded.

Installation should be in accordance with all local codes and regulations and with the National Board of Fire Underwriters regulations. In case of conflict, local codes take precedence.

All electrical wiring should be in accordance with the latest edition of the National Electrical Code and all local codes and regulations. The unit is safety certified to UL 1995 and listed with ETL.

Always install a secondary drain pan when an overflow of condensate could cause damage.

PART NUMBERS

This manual does not always include the latest revision letter when referring to *UPC* part numbers. Refer to the latest Price List and Spec Sheets for the current *UPC* revision letter. For example, in *UPC-00x* the 'x' indicates the latest revision.

INSTALLATION MANUAL

FOR

'M' SERIES MODULAR AIR HANDLER UNITS

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INTRODUCTION

The *Unico System* is a complete indoor comfort system that includes an indoor air handling unit and small duct system. The air handler and duct system were designed to operate together to provide the proper airflow in every installation. The conditioned air is supplied through a series of 2-inch ducts as a stream of air that entrains and mixes the room air. This process of aspiration produces a more even temperature distribution in the room.

The Unico 'M' Modular Series air-handling units consist of various modules that are easily latched together. The modules can be arranged in a vertical-up-flow, vertical-counter-flow and horizontal-flow configuration. They can be combined as a heating-only, cooling-only, or heating and cooling air handler unit. See Fig. 1.

All insulated *Unico System* modules feature closed-cell insulation for improved sound attenuation. There is no exposed fiberglass insulation.

Each module is available in three sizes: 2430, 3642, and 4860. Models with a 3660 model number denote that the particular unit piece may be used with the 3642 or 4860 model.

There are three basic modules: a blower module, a cooling module, and a heating module. The blower module includes the blower wheel, blower housing, motor, and electrical control box. The cooling module includes a cooling-only refrigerant coil, a heat pump coil, or a chilled water coil. The heating module is supplied as an empty cabinet with room for a slide-in hot water coil.

The modules can be arranged to provide only the options needed as shown in Figure 1 (with details on pages 26 and 27). Heating-only systems require the blower module, the heating module, and a hot water coil. Cooling-only systems include the blower module and a cooling module. For heating and cooling all the modules are combined with coils. The system may even be used for ventilation-only, using just the blower module.

Unico designed and built blowers feature direct drive motors or EC motors and are located in the air stream. Each blower wheel is balanced to Unico specifications. The blowers feature a quick twist-and-lock motor mount for easy maintenance (see page 16). The motorized blower assembly consists of the motor, which is mounted to the inlet ring, and the wheel, which is mounted to the motor shaft.

OPTIONS

Other options and modules are also available to add additional features or to simplify installation. These include an electric duct heater, multiple return plenum, and a vertical plenum stand. Please refer to the latest Unico Catalog for information on these and other options.

UNPACKING

All modules are inspected prior to shipping and are carefully packaged in individual cartons. Inspect all cartons prior to unpacking. Notify carrier of any damage.

Open each carton to remove the modules. Inspect unit for visible signs of concealed damage and notify carrier of any such damage.

All materials are sold FOB Factory and it is the responsibility of the consignee to file any claims with the delivering carrier for materials received in damaged condition.

LOCATION

Locate the air handler to minimize the number of plenum elbows and fittings while keeping the supply duct runs as short as possible. (See *Bulletin 40-30, Component Duct Layout Design*). Provide minimum clearance on both sides for servicing the unit as shown in Fig. 2.

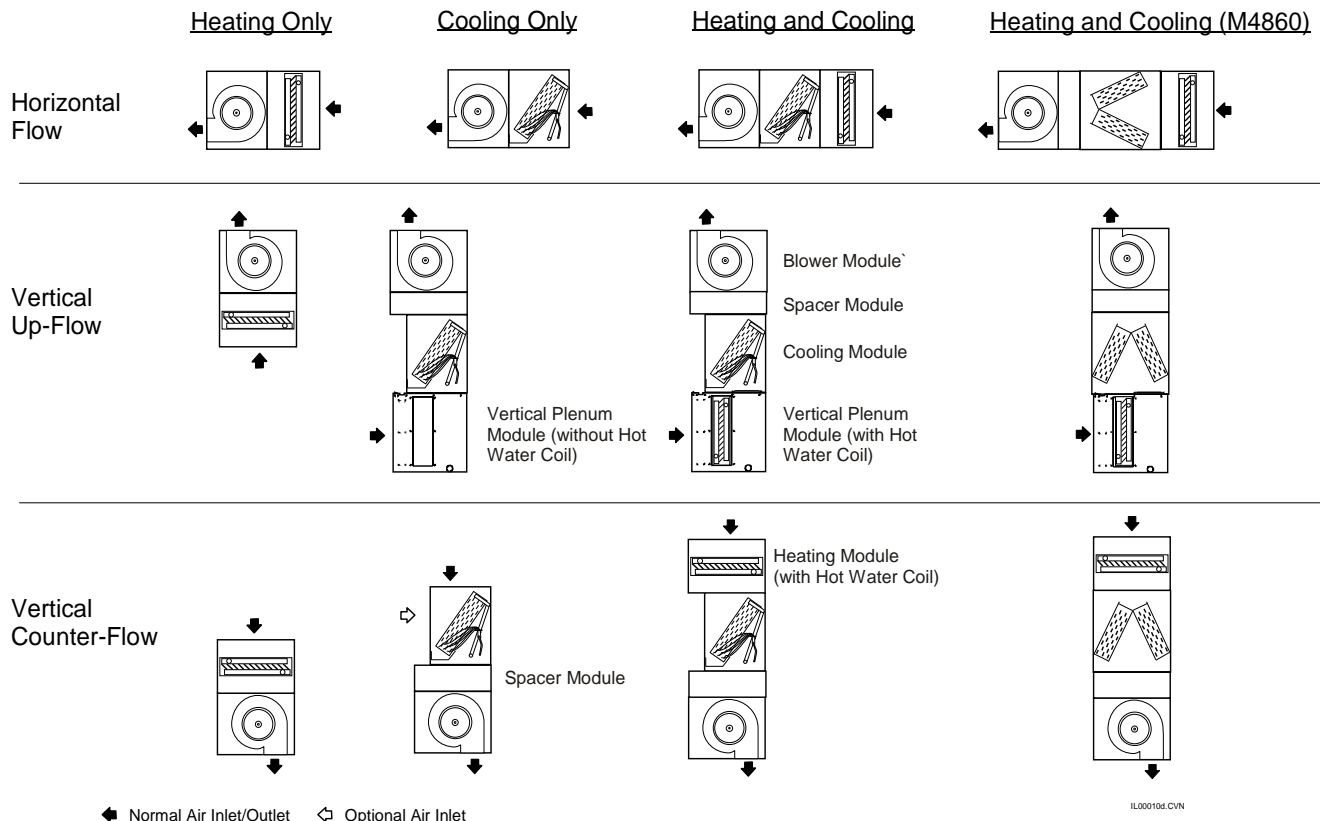


Figure 1. Basic Module Arrangement (refer to detail figures shown on Pages 26 and 27)

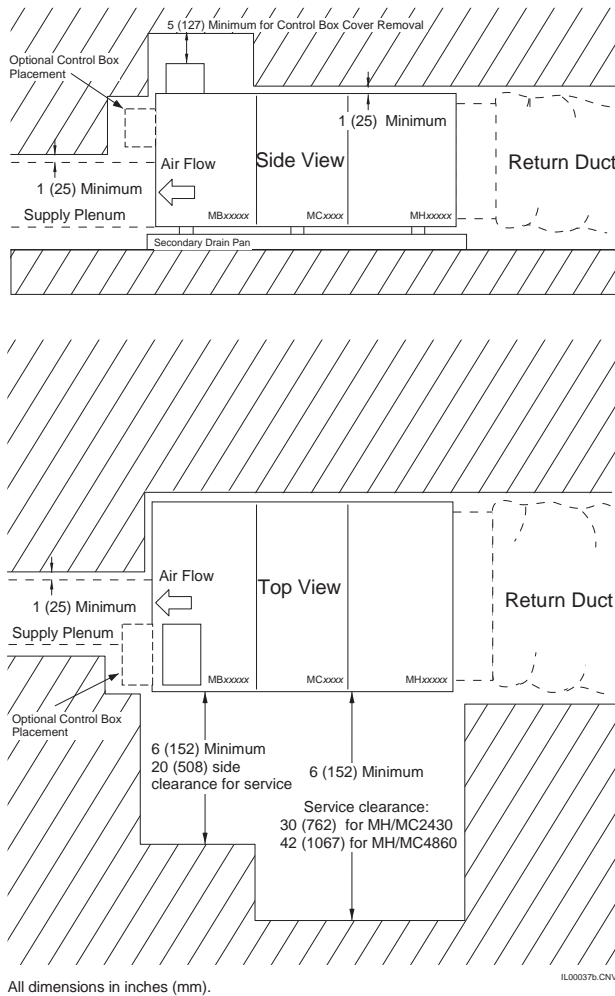


Figure 2. Minimum Clearances

If installing the unit in an attic, avoid placing the unit above a bed. The ideal location is above a central hall, a closet, a bathroom, or any normally unoccupied space.

The unit can also be installed in a closet, crawlspace, or basement. If the local codes allow, the unit may be installed in the garage provided the ductwork is well sealed, especially the return duct. Although the unit is not designed for outdoor use, it may be located outside provided adequate weather protection is used; typically a

Table 1. Return Air Box Opening

Models	Return Air Box Part No.	Size of opening inches (mm)
2430	UPC 01-2430	14 3/8 × 25 1/2 (365 × 648)
3642	UPC 01-3642	14 3/8 × 30 1/2 (365 × 775)
4860	UPC-01-4860	24 3/8 × 30 1/2 (619 × 775)
	UPC-01-4860NC	20 3/8 × 30 1/2 (518 × 775)

roof installation requires mounting on blocks with a sheet metal cover or cap to protect the unit from rain and extreme weather conditions.

Be sure to position the return air box and filter near the unit allowing at least one 90° bend in the return duct for proper acoustical performance (refer to figure 3 for a typical horizontal attic installation). The section on Return Air Ducts in the manual provides more details.

All modules except the MC4860 cooling module are designed to fit through a 14-inch (356 mm) opening, typical of a joist spaced at 16-inch (406 mm) center distance. The MC4860 module requires an 18.5-inch (470 mm) opening. If no access is provided, an opening must be cut. It is suggested to use the opening required for the return air box, especially in an attic installation. The opening for the return air box is listed in Table 1. If the joists or studs are less than 16-inches (406-mm) center-to-center or running the wrong direction it will be necessary to cut and header the joists.

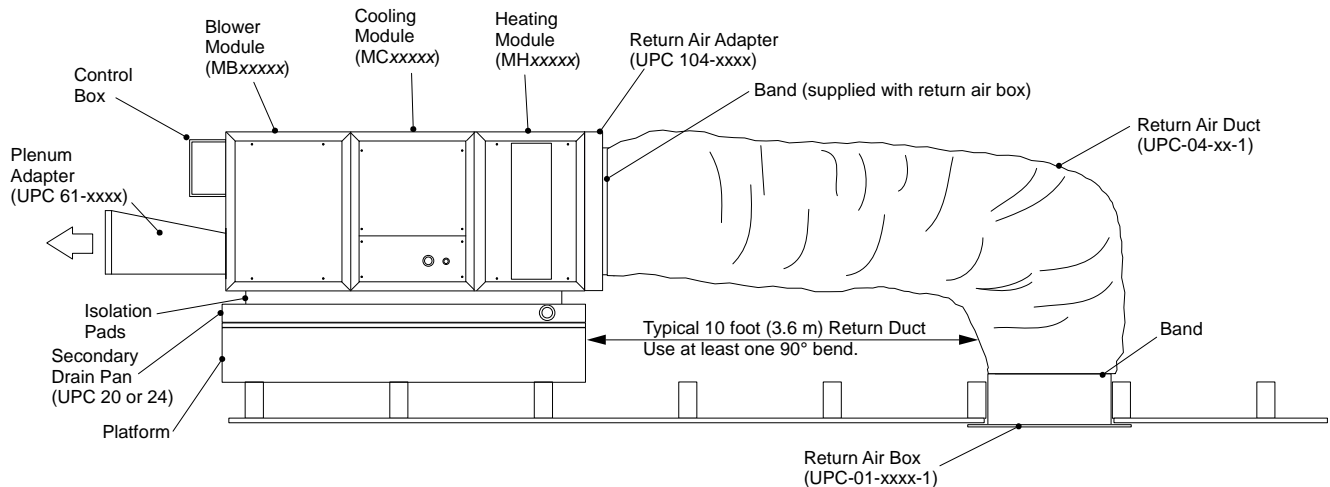


Figure 3. Typical Horizontal Attic Installation

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UNIT ASSEMBLY

The units may be assembled either horizontally or vertically. Refer to Fig. 1 for your particular flow arrangement. Assemble the units' two modules at a time. If you use a refrigerant coil, the anti-frost switch wires must be routed to the control box as you connect the modules.

Anti-Frost Switch Wires

Remove the coil access panel and unravel the anti-frost switch wires. If you use a heating module, feed the wires under the hot water coil support channel. Then feed the wires through the bushing in the motor partition panel. After routing the wires through each module, connect the modules together.

Fastening Modules Together

To fasten the modules together tilt the units to insert the connection flange over the mating flange as shown in Fig. 4. It may be necessary to squeeze the units together as you are inserting the flange to compress the rubber gaskets. If the hook flange has a small gap, use a large flat bladed screwdriver to pry the gap apart. Secure the modules together with the latches, compressing the gasket further.

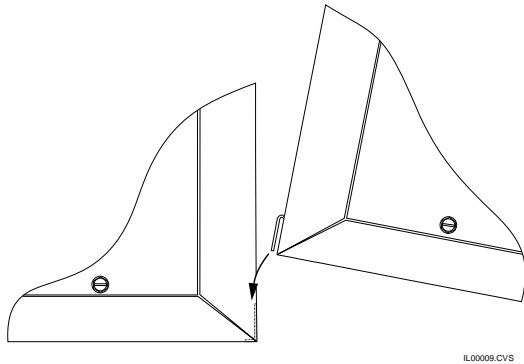


Figure 4. Module Flange Connection

EC Motor Temperature Limits

The Unico EC motor includes an electronic circuit board that is sensitive to overheating if the air temperatures surrounding the motor are above a certain value. The motor will not function above its maximum operating temperature and will have some reduction in motor life between the maximum operating temperature and the recommended temperature limit. Depending on the application, this may or may not be acceptable.

Recommended Temperature Limit

For maximum motor life, we recommend that the Unico EC motor be limited to applications with less than 130°F (54°C) air temperature. Therefore, the Unico EC motor can be used with all heat pump and electric heating applications without problem. It may also be installed with a hot water coil with air temperature leaving the coil less than 130°F (54°C). This is generally with water temperature less than 135°F (57°C) but it depends on the water and air flow. Consult the hot water coil specifications to determine air temperatures based on water flow and air flow rate.

Maximum Operating Temperature Limit

The absolute limit for the motor is 158°F (70°C) air temperature at which point the motor will automatically begin to slow down. The motor may be used in applications with air temperature around the motor between 130 to 150°F (54 to 65°C), typical for boiler systems with water temperatures between 135 and 160°F (57 to 70°C). However, expect the life of the motor to be reduced by as much as 50%. In most applications, with unit operating intermittently, the amount of time that the motor operates in heating is very small so the reduction in motor life will not be significant. Only in long continuous heating applications, will the reduction be noticeable. The reduction in motor life can be further minimized by using setback boiler temperatures while operating with maximum airflow at the highest water temperatures.

Horizontal Installations

Most systems are installed in the horizontal configuration, with the air going from right to left when looking at the connections (as shown in figure 1). All the modules are factory set for horizontal airflow. It is not recommended to flip the cooling module to reverse the flow direction of the air. When connecting the modules be sure to arrange the heating module on the inlet (return) side of the cooling module.

The 4860 cooling module also includes a spacer module which has a small drip shelf (shipped loose) that must be installed on the air exit side of the drain pan (shown in figure 5).

When installing the heat module or return air plenum module upstream of the cooling module, it is necessary to first install a hook flange to the bottom of the cooling coil (Figure 6).

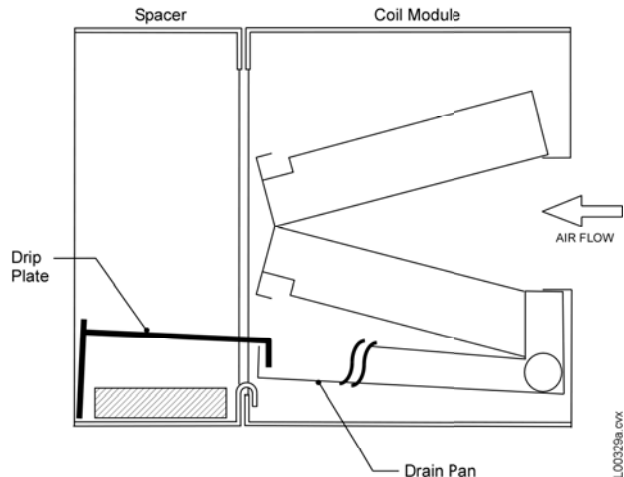


Figure 5. 4860 Drip-plate installation (horizontal applications only)

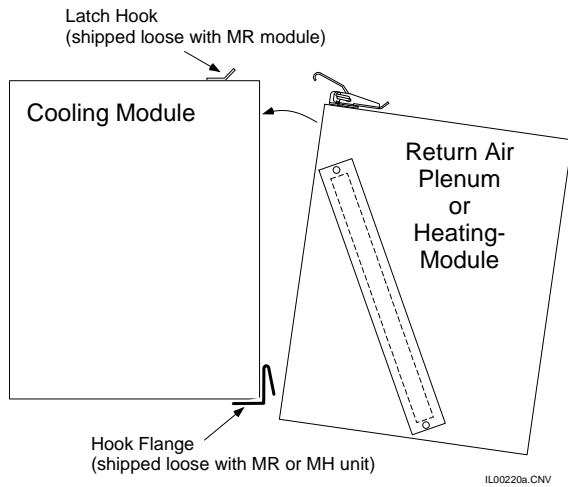


Figure 6. Hook flange location.

Vertical Installations

As shown in figure 1, the modular system can also be configured for vertical up-flow or down-flow. The arrangement of modules is different so be sure to follow these instructions.

In most cases connecting the modules is straight forward – just use the arrangement shown in figure 1. However, if you are using a 2430 or 3642 cooling module, the top and bottom access panels of the cooling module will need to be repositioned. When repositioning the bottom panel, it will be necessary to add an insulation piece and remove a portion of the existing insulation to fit properly over the default side return.

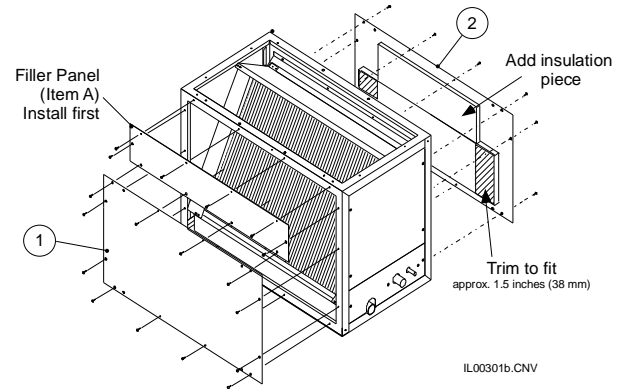
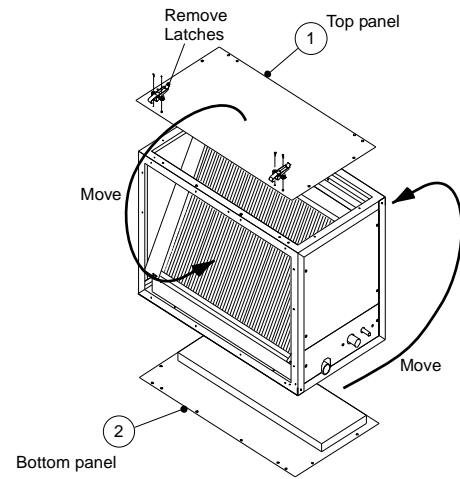
For vertical up-flow installations, we recommend using the Vertical Return Plenum Module (MV module). The spacer shown in figure 1 is included with the MV module (except for the 4860 unit, where it is included with the cooling module). If you are not using the MV module for the 2430 or 3642, you will need to use the Vertical Conversion Kit (UPC-63A or UPC-64A) and provide a field fabricated mount for the unit.

CAUTION

To allow proper condensate drainage, do not turn or rotate the 2430 or 3642 cooling module.

For vertical up-flow the return air may enter through the bottom or side return opening of the 2430 or 3642 cooling module, although the bottom opening is preferred. The 4860 cooling only has one return opening for either horizontal or vertical applications. The 4860 drain pan is 'L' shaped and will work properly when the module is turned 90 degrees.

Follow the following steps for vertical installations of cooling-only or heating-and-cooling systems:



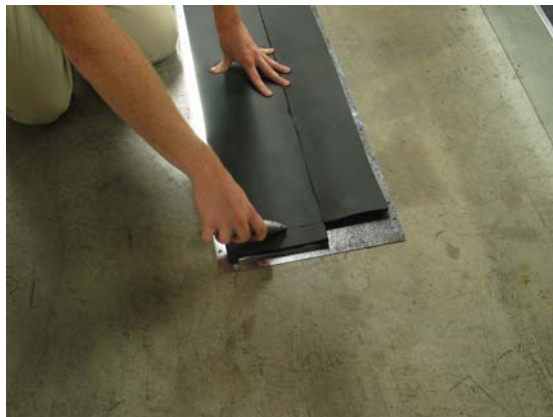
STEP 1. (2430 and 3642 only) Remove top and bottom panels and install as shown. Install filler panel (Item A) first, then the side panel (1) as shown.



Remove panel from bottom of the coil (bottom of the coil shown).



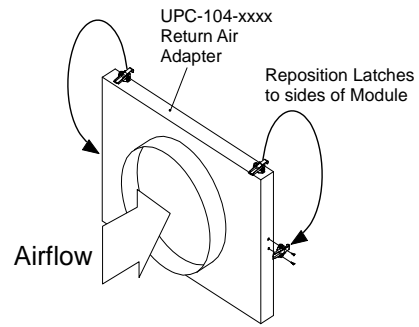
Add insulation piece (centered on the panel). This is provided with the MV2430 / MV3642 modules or UPC-63A / UPC-64A conversion kits.



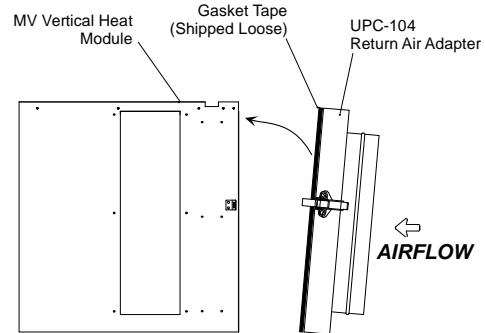
Trim insulation as shown.



Final panel assembly shown.



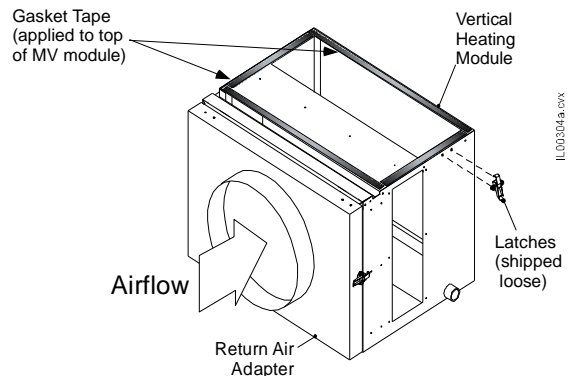
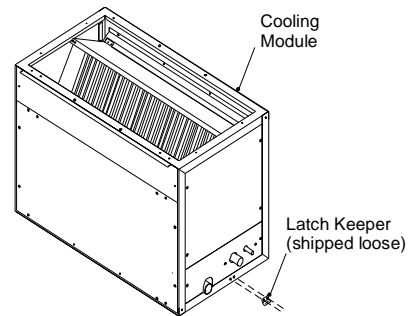
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Typical Vertical
System Layout

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STEP 2. If using the UPC-104 Adapter, reposition the latches to connect to the MV module.

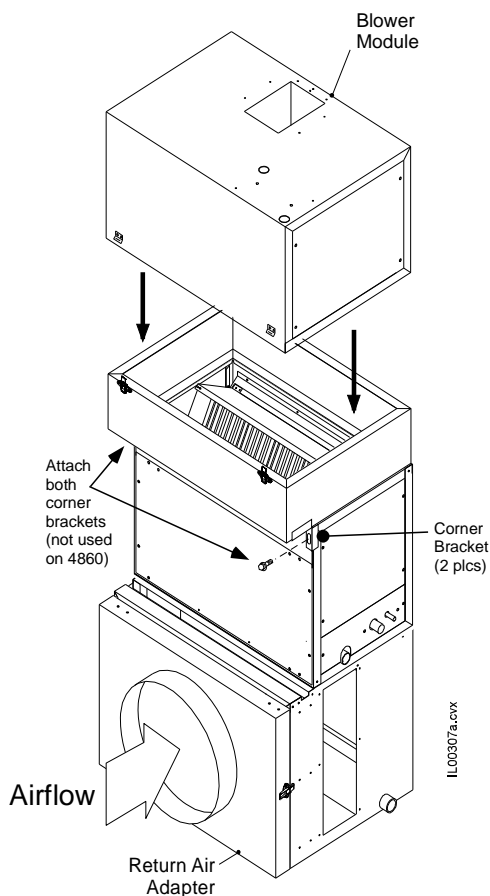


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Note: Attach Latches and Latch keepers to appropriate modules on opposite side (not shown)

STEP 3. Place cooling module on top of vertical module. Install latches and keepers as shown to secure the cooling module.

NOTE: Attach insulation gasket tape along the top opening of Cooling Module to ensure air-tight fit.



STEP 5. Place the Spacer Module on top of the cooling coil. Then place the Blower Module on top of it. Secure both modules with latches.

Heating-Only Systems For heating-only systems, the installation is similar to the cooling-only or heating-and-cooling system, except that the cooling module is removed from the system.

For the 2430 and 3642 systems with the MV unit, use a vertical spacer kit such that the spacer overhangs the back of the vertical plenum and the filter access is not covered over. Insulation gasket tape, which is shipped with the spacer module, is installed on the opening of the spacer module.

Control Box

The control box is shipped with the blower module. It can be installed on either the discharge side of the blower cabinet or on top of the blower cabinet, depending on what is most convenient.

To install, first remove the two knockouts on the side or top of the cabinet, where it will be installed. Mount the control box using four (4) sheet metal screws as shown in Fig. 7. Feed the wires from the anti-frost switch through the hole and bushing nearest the side of the unit and connect the leads to low voltage terminals 3 and 6. The motor wiring harness will slip through the other hole. Then simply connect the plug on the motor wiring harness. (For additional information see section on wiring.)

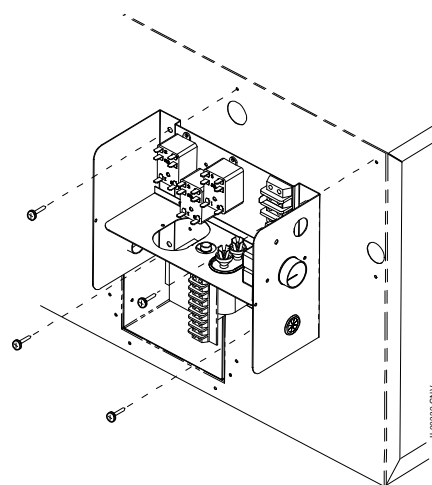


Figure 7. Mounting the Control Box.

Secondary Drain Pan

Where an overflow of condensate could cause water damage, a secondary drain pan **MUST BE INSTALLED**. Place the drain pan on the mounting base, platform or angle iron support frame. Be sure to allow enough room for the drain line and connection (refer to Table 3). The assembled unit should be placed over the secondary drain pan supported by rails with rubber pads for isolation to raise the unit above the 1.5-inch (38mm) sides of the secondary drain pan.

Table 2 shows the secondary drain pans to be used for horizontally mounted modules. For vertical up-flow arrangements that use the cooling module, the 2-module drain pans can be used where space permits and the return air is entering from the side. These pans would be over-sized compared to the footprint of the cooling module. If a smaller drain pan is necessary it should be fabricated to be at least 1/2-inch (12.7 mm) larger on each side of the bottom module.

For vertical down flow (counter flow) arrangements it is difficult to provide a secondary drain pan because of the blower discharge at the bottom. The secondary drain pan must be fabricated with an opening for the blower discharge and plenum adapter and still provide a sealed drain pan.

Table 2. Secondary Drain Pan Dimensions, inches (mm)

Unit Size	2 Modules		3 Modules	
	Part No.	Dimensions inches (mm)	Part No.	Dimensions inches (mm)
1218	UPC-94	40 x 22 (1016 x 559)		
2430	UPC 20B	27 x 29.5† (686 x 749)	UPC 20C	27 x 41.75† (686 x 1060)
3642	UPC 24B	40 x 29.5† (1016 x 749)	UPC 24C	40 x 41.75† (1016 x 1060)
4860	UPC-24C	40 x 41.75† (1016 x 1060)	UPC-24D	40 x 54† (1016 x 1372)

† NOTE — The drain fitting extends 7/8 inch (22 mm) beyond this dimension.

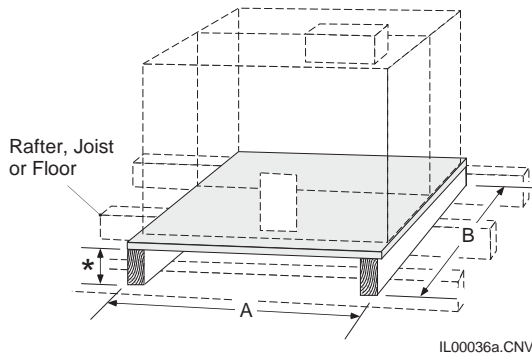
Like the modules, all the secondary drain pans except *UPC-24C, D* will fit through the return air opening. For these drain pans it will be necessary to fold the pans in order to pass through the return opening. If you are unable to use the *UPC-24D* because of space limitations, use the *UPC-24B* under the cooling and heating modules. In this case the blower module will extend beyond the secondary drain pan and should be supported with blocks or an angle iron frame.

MOUNTING

The modules come factory-ready for horizontal airflow applications and may be modified for vertical airflow arrangements (see Fig. 1) with the addition of the vertical heat module (with or without the heating coil) and the vertical spacer module.

Horizontal Platform Mounting

Mount the unit horizontally when vertical height is limited such as in an attic or crawl space. It is easiest to mount the unit on a platform but care must be taken to assure proper drain line pitch.



	2 Modules			3 Modules		
Unit	2430	3642	4860	2430	3642	4860
A	27 (690)	40 (1000)		27 (690)	40 (1000)	
B	30 (760)	42 (1070)		42 (1070)	50 (1270)	

* See Table 3

Figure 8. Typical Platform Installation

The platform height must allow for proper pitch of the condensate drain lines — at least ¼ inch drop per lineal foot (20 mm per meter). The platform can be built from a sheet of ½ inch (13 mm) plywood and stud frame. Table 3 lists the maximum horizontal drain line run for various framing materials and still provide adequate drainage.

Table 3. Horizontal Distance of Drain Piping for Different Framing Materials

Frame Lumber:	2 × 4	2 × 6	2 × 8	2 × 10
Max. Horizontal Run, ft. (m)	18 (5)	26 (8)	34 (10)	42 (13)

The platform size must allow for the number of modules being used. For dimensions for minimum platform size see Fig. 8.

Place secondary drain pan on platform and unit on top of isolation pads inside of secondary drain pan. Be sure that the unit is raised above the height of the drain pan side to allow duct connections.

Horizontal Suspended Mounting

CAUTION

Do not hang unit from top of unit cabinet as this could distort unit.

The modules can also be suspended from the ceiling or rafters. A typical suspension method is shown in Fig. 9. Screw four (4) “J” hooks into rafters. Suspend four (4) chains from “J” hooks and attach eyebolts to chains. Secure angle iron to eyebolts and place secondary drain pan on top. Put isolation pads in drain pan, making sure unit sits above sides of drain pan.

As an alternative, rest the unit on the angle iron supports and hang the secondary drain pan from the same supports. As above, install “J” hooks, chains, and angle iron. Secure angle iron to eyebolts and put isolation padding on angle iron.

Adjust the length of the eyebolts and chains so there is slight pitch towards the drain end.

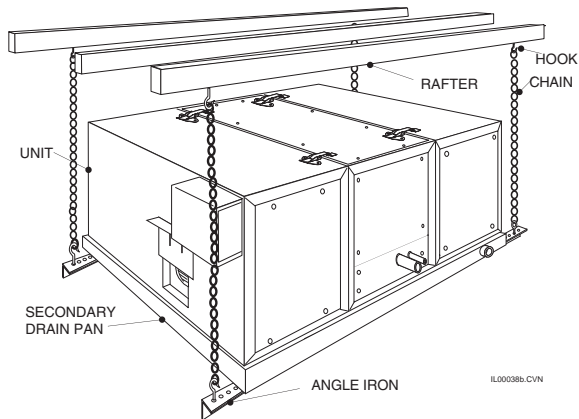


Figure 9. Typical Suspended Mounting

Vertical Airflow Installation

Because the units are top heavy, it is not recommended to suspend a vertical unit. It should be mounted on either a platform or a floor. Unico makes a module specifically for vertical installations (refer to previous section). If only a blower and heating module are being installed, fabricate a return plenum for the unit to sit upon.

Although the 2430 and 3642 modules may be assembled without a spacer module, this can severely restrict the airflow; especially if the blower needs to achieve its maximum airflow. Therefore, always use the spacer module for any vertical configuration.

DUCT CONNECTIONS

Supply Plenum

Unico has a complete line of round and square plenum adapters available as shown in figures 10 and 11. In addition, all blowers include a restrictor plate to be installed between the supply adapter and the unit. The purpose of the restrictor plate is to eliminate objectionable outlet noise because the blower is delivering more air than required. In most cases where the maximum airflow is required, the restrictor may be omitted.

To attach the plenum adapter, first install the restrictor plate. Then install the adapter with eight (8) sheet metal screws as shown in Fig. 12. Sheet metal screws for installing both are provided with the blower.

The restrictor plate is used to set the system airflow (see Fig. 13). The full open position corresponds to the highest airflow the installed duct system will allow. Set the restrictor plate to the full open position and measure the system airflow. The required system airflow is 200-250 CFM per nominal ton (27-34 L/s per nominal kW). Measure the motor amperage and use this to ensure the 200-250 CFM per nominal ton (27-34 L/s per nominal kW) has been achieved. If elevated sound levels are noticed at the outlets and there is more than 250 CFM per nominal ton (34 L/s per nominal kW), the airflow may be reduced with the restrictor plate. Always measure the system airflow by the motor amperage (see Table 4). Refer to the airflow-amperage charts provided with the blower.

Note: Do not use restrictor plate to adjust plenum static pressure. Adjust the restrictor to the proper amperage. This will assure proper airflow.

Attach the plenum to the adapter by inserting it over the supply adapter. If using sheet metal duct, use three (3) or

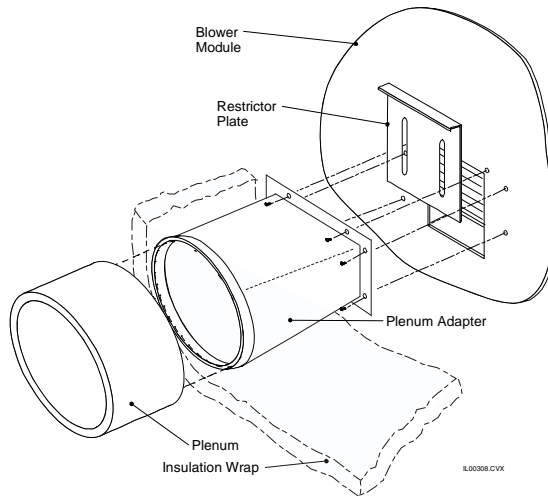


Figure 12. Supply Plenum Adapter Installation

four (4) equally spaced sheet metal screws or nails to secure the duct to the supply adapter. Then tape around the seam with UL 181A aluminum tape. Then wrap the outside of the plenum adapter with the supplied blanket insulation and secure the insulation seams with UL 181A tape.

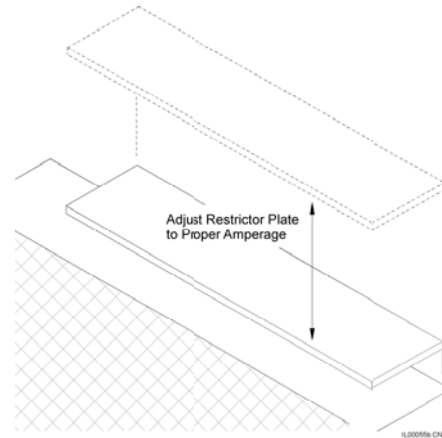


Figure 13. Restrictor Setting

		Model, UPC-61-			
		1218	2430	3642	4860
Dimension, inch (mm)	A	6.5 (165)	6 (152)	7.16 (182)	10.13 (257)
	B	3.25 (83)		6.38 (162)	
	D	7 (178)		9 (229)	
	L	12 (305)		18 (457)	

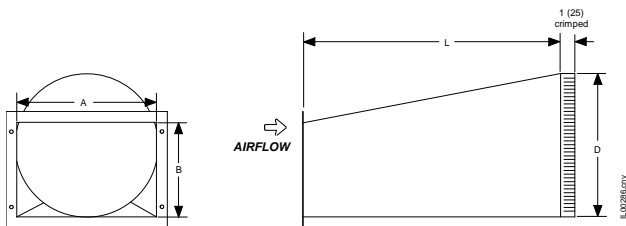


Figure 10. Round Supply Plenum Adapter Dimensions

Part No.	A, inch (mm)
UPC-62-2430	8.50 (216)
UPC-62-3642	10.50 (267)
UPC-62-4860	11.50 (292)

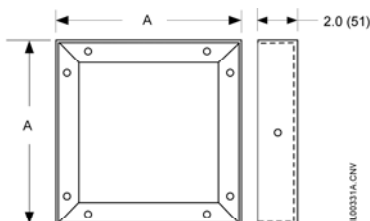


Figure 11. Square Supply Plenum Adapters

Table 4. Approximate Amperages at Given Airflows

Unit Size	Airflow, CFM (L/s)	MBxxxxL Amps @ 230V †*	MBxxxxL+CB Amps @ 230V †
4860	1250 (590)	4.1	4.1
	1000 (470)	3.5	3.3
	800 (380)	3.1	2.8
3642	1000 (470)	3.9	3.7
	900 (420)	3.6	3.4
	800 (380)	3.2	3.2
	700 (330)	3.0	2.9
2430	600 (280)	2.8	2.7
	600 (280)	2.2	1.9
	500 (240)	2.0	1.6
	400 (190)	1.8	1.4

* multiply by 1.1 if 208V

† for more exact airflow use the chart included with the blower

Return Duct

Unico supplies a return duct system but any return duct system is acceptable provided the pressure loss does not exceed 0.15 inches of water (37 Pa), including filters. The return duct should have at least one 90° bend between the unit and filter box to reduce sound transmission directly from the unit.

The Unico Return Duct system has a single return that includes the return air box with filter, the return duct, and the return air adapter (refer to Fig. 3). Multiple returns or extra long returns are possible so long as the maximum pressure loss is not exceeded. For vertical installations or tight spaces it may be necessary to fabricate a return duct system from duct board or lined metal.

The typical return duct is 10-foot (3 m) in length so it may have to be cut to avoid bunching if the distance to the unit is significantly less than 100-inches. The minimum length should be 7-feet (2 m). When given a choice, the shorter distances should be avoided as this may increase sound transmission from the unit.

Cut an opening for the return box as specified in Table 1. For the 2430 and 3642 if the joists or studs are on 16-inch (410mm) centers, there is no need to build a frame to hold the return air box. Otherwise, it will be necessary to construct a frame around the opening. For the 4860 return, it will almost always be necessary to cut and header at least one joist.

Center the return air box so the filter frame flange covers all the gaps and make sure the flange is flush against the wall or ceiling. Install the return air box against the frame using nails or screws.

Screw holes are provided in the return air box. Use the holes nearest the corners. The other holes are for mounting the filter grille. See Fig. 14.

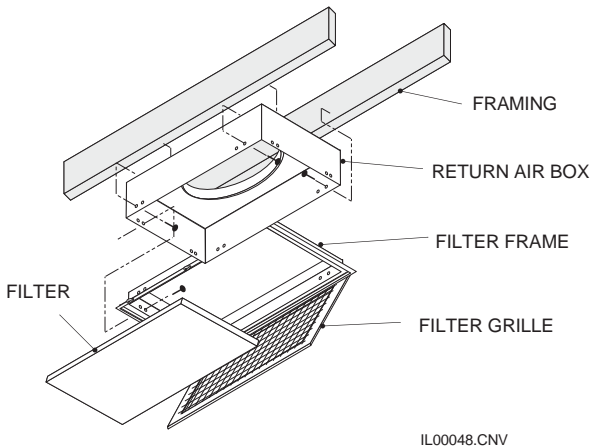


Figure 14. Return Air Box and Filter

Install filter frame into the return air box using four nails or screws. Use the holes furthest from the corners. Insert filter and hold in place by rotating metal clips. Close grille and secure with clips.

Refer to Table 5 for correct Return Duct Adapter selection. Attach the proper return duct adapter to either the Heating or Cooling Module. Then attach the return duct

to the adapter and to the return air box using the Q-bands and Q-clips.

The return air adapter ships with an insulation blanket that must be wrapped around the adapter. Tape the seams with UL 181A aluminum tape.

Table 5. Return Duct Adapter

Unit Size	Blower Module +	
	Cooling Module	Heating Module + Cooling Module
4860	UPC-59-4860	UPC-104-4860
3642	UPC-59-3642	UPC-104-3642
2430	UPC-59-2430	UPC-104-2430

Multiple Returns

If more than one return is desired, Unico has designed a return plenum (MR) module. The MR module is available in two sizes: 2430 and 3660, and it includes a central filter. The MR module is easily fitted to the air handling unit and multiple return openings may be cut in the top back or sides of the box. Refer to *Bulletin 20-20.6, Return Plenum Module*, for additional information.

PIPING

All piping must be in accordance with all local codes and ordinances.

Condensate Lines

The primary drain pan condensate connection is a 3/4-inch (19mm) female pipe thread fitting and the secondary drain pan connection is a 3/4-inch (19mm) PVC socket fitting. Elevate the unit so the condensate lines are pitched at least 1/4-inch per lineal foot (20 mm per meter). Trap the condensate line near the unit using U-trap A00924-G03 as shown in Figure 15. In some cases it may be necessary to wrap the condensate line near the unit with insulation to prevent water condensation on the outside of the pipe. In some climates or locations it may be necessary to protect trap from freezing in the winter.

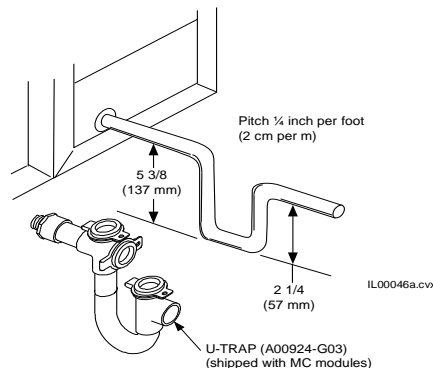


Figure 15. Typical Condensate Trap

Do not trap the secondary drain line and do not terminate line into the primary drain line. Run secondary drain line so that any drainage will be immediately known without causing damage to property. A typical location is to ter-

minate the secondary drain line above a windowsill so that the drainage splashes on the window. This will serve as an indicator that there is a problem with the primary drain. In cases where a secondary drain line cannot be run, add a float switch or a micro switch with a paper fuse.

Refrigerant Coil Connections

Note

All refrigerant coils are shipped from our factory pressurized with nitrogen. They do not contain any refrigerant.

WARNING

To prevent injury to eyes, face away from the Schrader valve when releasing nitrogen gas.

The refrigerant coils are equipped with a Schrader valve port to relieve the pressure and for factory testing purposes. It can also be used to check for leaks prior to installation. Unscrew the Schrader cap and press the depressor. **If there is no nitrogen pressure present, the coil may have developed a leak during shipment and should be returned to the point of purchase for exchange.** If pressure is present, then go ahead and relieve the pressure in the coil by continuing to press on the depressor. When all the pressure is removed cut the ends of the connections off.



Cut end of connection as shown.



Connection after the end has been cut off.

WARNING

To prevent injury, remove all pressure from coil before removing connection end caps.

CAUTION

When brazing, purge with nitrogen gas to prevent the formation of oxides.

The refrigerant lines are copper sweat connections. The liquid line is 3/8-inch (9.5mm) OD and the suction line is 7/8-inch (22mm) OD. Refer to the condensing unit manufacturer's instruction for proper line sizing information based on distance from condenser.

Install a liquid line filter drier as close to the coil module as possible to protect the evaporator from foreign object debris. For attic installations or when using long line sets, an optional moisture indicating sight glass should also be installed between the filter-drier and expansion valve, near the indoor unit.

All refrigerant coils require a thermostatic expansion valve. The valve is shipped loose and should be attached prior to charging. If the system will be using R-410a, be sure to use the R-410a valve; these can be ordered separately as shown in Table 6. Always use new Teflon seals when replacing the TXV (Unico Part No. A00809-001).



Remove nut as shown.



Remove side panels as shown.



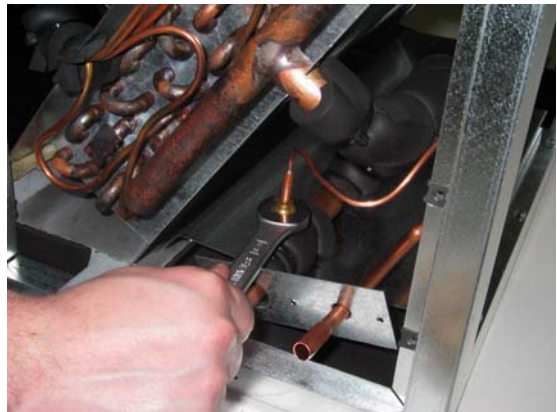
Attach and tighten lower connecting nut as shown.



Attach and tighten upper connecting nut as shown.



Route both the pressure and temperature tubes as shown.



Tighten the pressure tube nut as shown.



The thermal measuring bulb is placed as shown. It needs to be in contact with copper tube.



Secure bulb with cork tape as shown.

Table 6. Expansion Valve Model numbers

Model	Nominal Condenser Size	Valve Part Number		Nom. Valve Size
		R-22	R-410a	
<i>Air-Conditioning Only</i>				
MC2430C	2 to 2.5-ton (7 to 9 kW)	A00805-002	A00805-012	2
MC3642C	3 to 3.5 ton (10 to 12 kW)	A00805-004	A00805-014	3
MC4860C	4 to 5 ton (14 to 17 kW)	A00805-005	A00805-015	4
<i>Heat Pump Coils</i>				
MC2430H	2 to 2.5-ton (7 to 9 kW)	A00808-002	A00808-012	2
MC3642H	3 to 3.5 ton (10 to 12 kW)	A00808-004	A00808-014	3
MC4860H	4 to 5 ton (14 to 17 kW)	A00808-005	A00808-015	4

Water Connections

If you are installing the hot water coil, remove the side coil access panel and cut away the insulation. Slide the coil into the cabinet and secure with brackets supplied with the hot water coil. Install the access panel after the coil is in place.

All water connections are 7/8-inch (22mm) sweat connections. Sweat the water connections, then fill the system. Bleed the air from the coil by backing off the screw inside the bleed valve for venting (Fig. 16).

If unit is in an unconditioned space below freezing, care must be taken not to freeze the water in the coil. The best method is to use a glycol-water antifreeze solution with a freezing point below the coldest temperature expected.

After venting the chilled water coil, replace the access panel and seal around the connections with the rubber gasket provided.

Coil Cleaning

The coil should be sprayed with liquid detergent, or any commercially available evaporator cleaner solution, thoroughly and rinsed thoroughly before installation to assure proper drainage of condensate from the coil. This will eliminate blowoff and assure maximum coil performance. If not sprayed, approximately 50 hours of break-in time are required to achieve the same results.

WIRING

WARNING
Disconnect electrical supply before wiring unit to prevent injury or death from electrical shock.

All electrical wiring must comply with all local codes and ordinances. Blower module controls and components are bonded for grounding to meet safety standards UL Standard 1995 and CAN/CSA-C22.2 No. 236 and are listed by ETL. All 50 Hz units are CE marked and conform to the Low Voltage 73/23/EEC and EMC 89/336/EEC Directives.

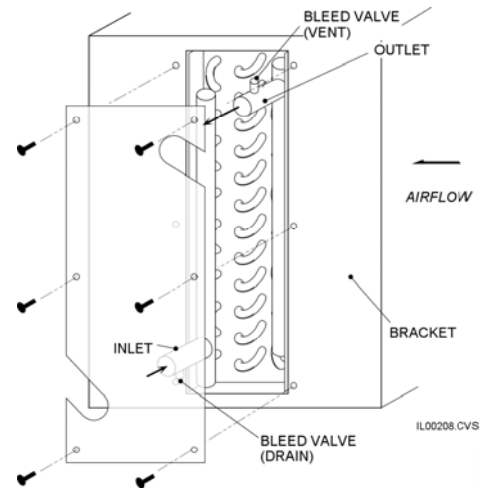
Use a separate 1 ph - 230/208V – 60/50 Hz power supply with a 15 amp breaker and appropriate wire gauge per code.

Two different control boxes are available: one with a variable ventilation speed control, one without. All standard units include a variable speed motor controller to adjust the proper airflow for constant ventilation where required by code or desired by the resident. The “ventilation” speed is adjustable down to half airflow.

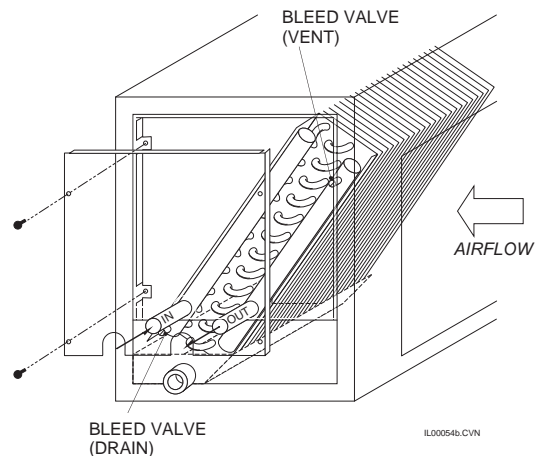
Control Box Model No.	Ventilation Control	Availability	Wiring Diagram
A00175-G02	Yes	Standard (U.S., Canada)	Fig. 20
A00175-G03	No	Special Order (Europe)	Fig. 21

The control box includes a 24-volt transformer, the necessary blower relays, and terminal blocks. Space is provided for a heat pump heating mode bypass relay (shipped with heat pump cooling module). Space is also provided for an additional double pole double throw (DPDT) relay for wiring a boiler, pump, or valve if heating with hot water.

1. First, connect the motor plug to the wiring harness from the control box.
2. Then, route the anti-frost switch lead wires (located on the refrigerant coil) through the interior of the modules to the control box. Connect the leads to terminals #3 and #6 of the Low Voltage Terminal Block. **ALL DX COILS NEED THE FROST SWITCH.**
3. Next, connect the control wiring per figures 17 through 19. For units with electric duct heaters, refer to *Bulletin 30-34*. Match thermostat anticipator settings for combined amperage load of all components, including electric heater contactors, to prevent damage to thermostat.
4. Connect power supply to terminals L1 and L2 on the high voltage terminal block. Connect a ground



(a) Hot Water Coil



(b) Chilled Water Coil

Figure 16. Water Coil Connections

wire to equipment grounding on the side of the control box near the incoming power opening.

WARNING
Be sure to insulate the unused transformer lead to prevent injury or death from electrical shock.

The low voltage transformer is factory set for a primary voltage of 230V. If power supply is 208V, remove ORANGE lead from L2 terminal and connect RED lead to L2. Insulate the connector on the unused wire lead.

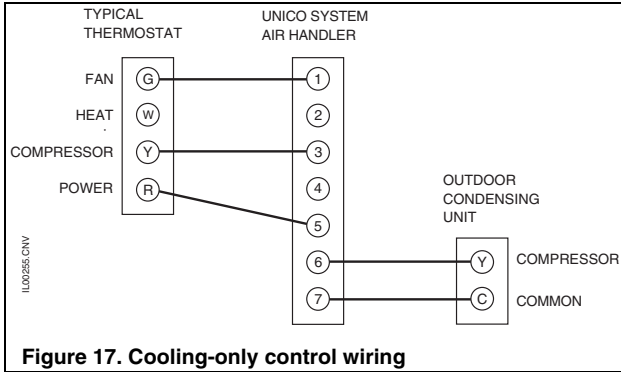


Figure 17. Cooling-only control wiring

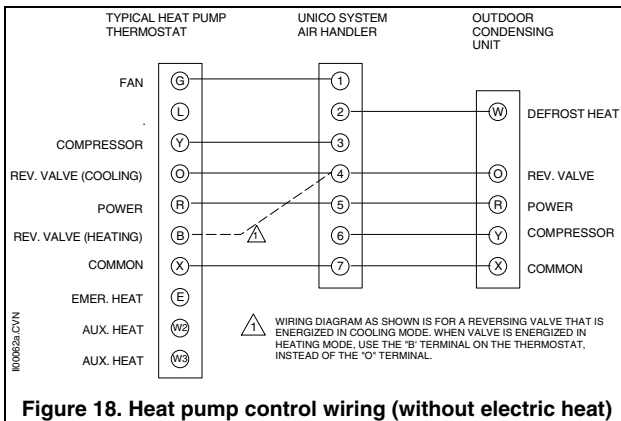


Figure 18. Heat pump control wiring (without electric heat)

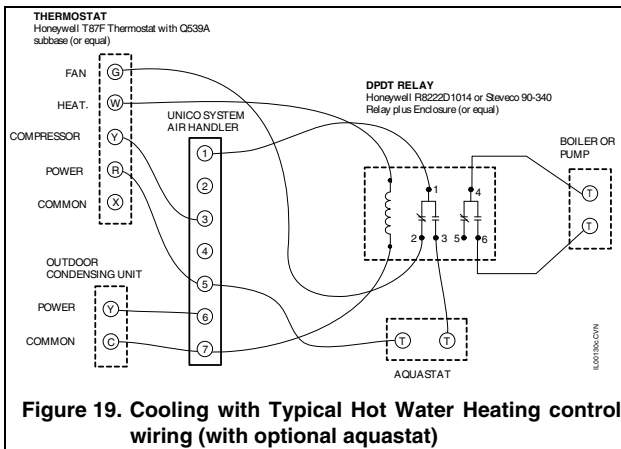


Figure 19. Cooling with Typical Hot Water Heating control wiring (with optional aquastat)

The controller is set at the factory to provide constant ventilation anytime the speed switch is turned in the ON position. To turn on or off this feature at the thermostat refer to the supplementary wiring diagrams for instructions (located near the end of this document).

Ventilation Speed Mode

The Unico System is factory configured to energize the fan at full speed whenever there is a call for heat or cool, or when the fan switch is set to ON. The unit can be set for constant ventilation at the air handler whenever the fan switch is in the AUTO position and there is no call for heat or cool. There is a variable speed switch on control box which can be adjusted for the desired speed. The variable speed control is set to the OFF setting at the factory. To enable this feature, we recommend setting it to the lowest speed (fully clockwise).

In this configuration, the ventilation speed can only be adjusted or turned off or on using this switch. This can be inconvenient if the unit is not easily accessible. To allow the user to turn the ventilation speed mode on or off at the thermostat using the FAN switch, the factory wiring can be modified as shown in figures 22 to 25, depending on the configuration. To accomplish this, two wires inside the control box must be moved as described on the wiring schematics.

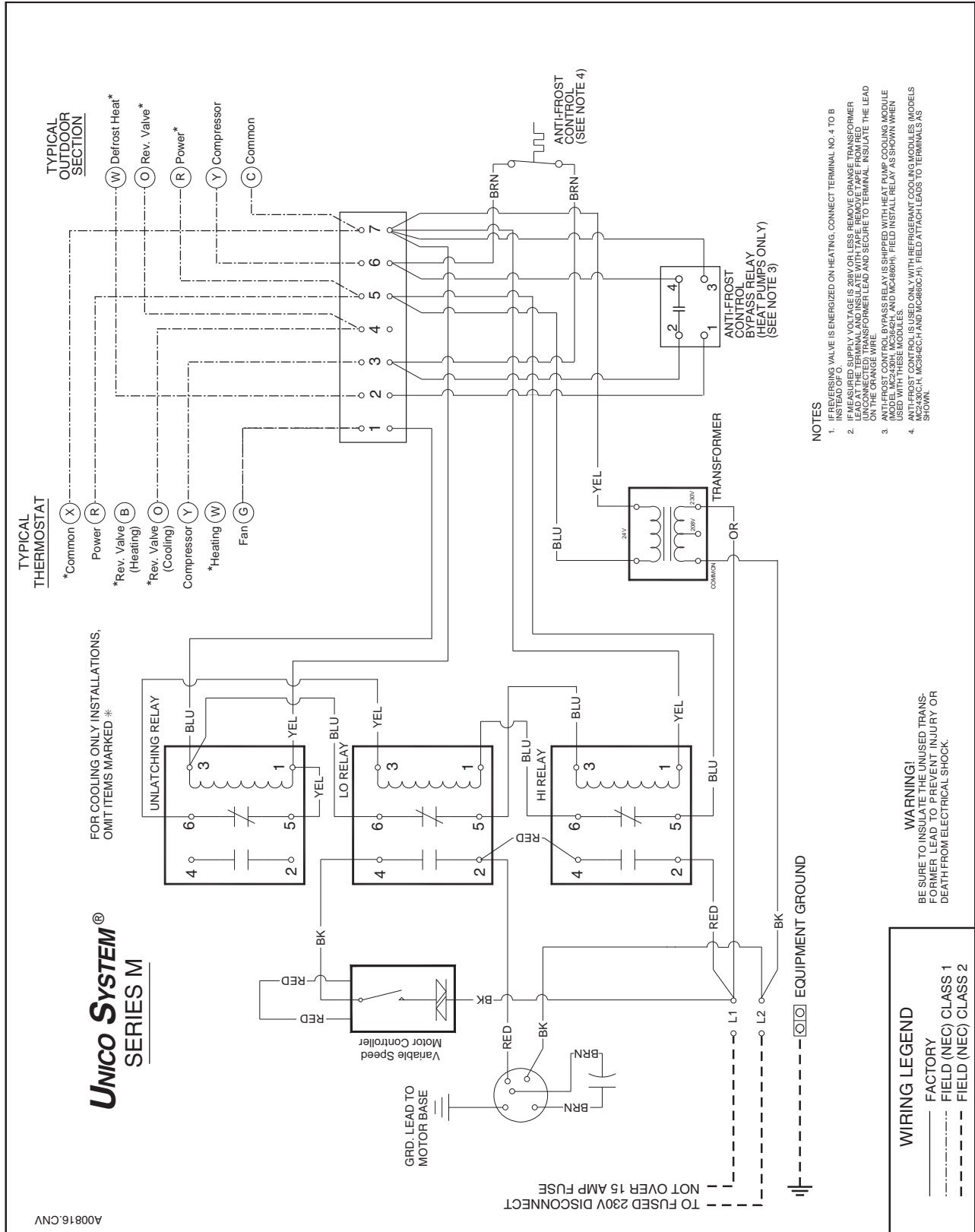


Figure 20. M Series Electrical Wiring Diagram (with Motor Controller installed) for A00175-G02 Control Box

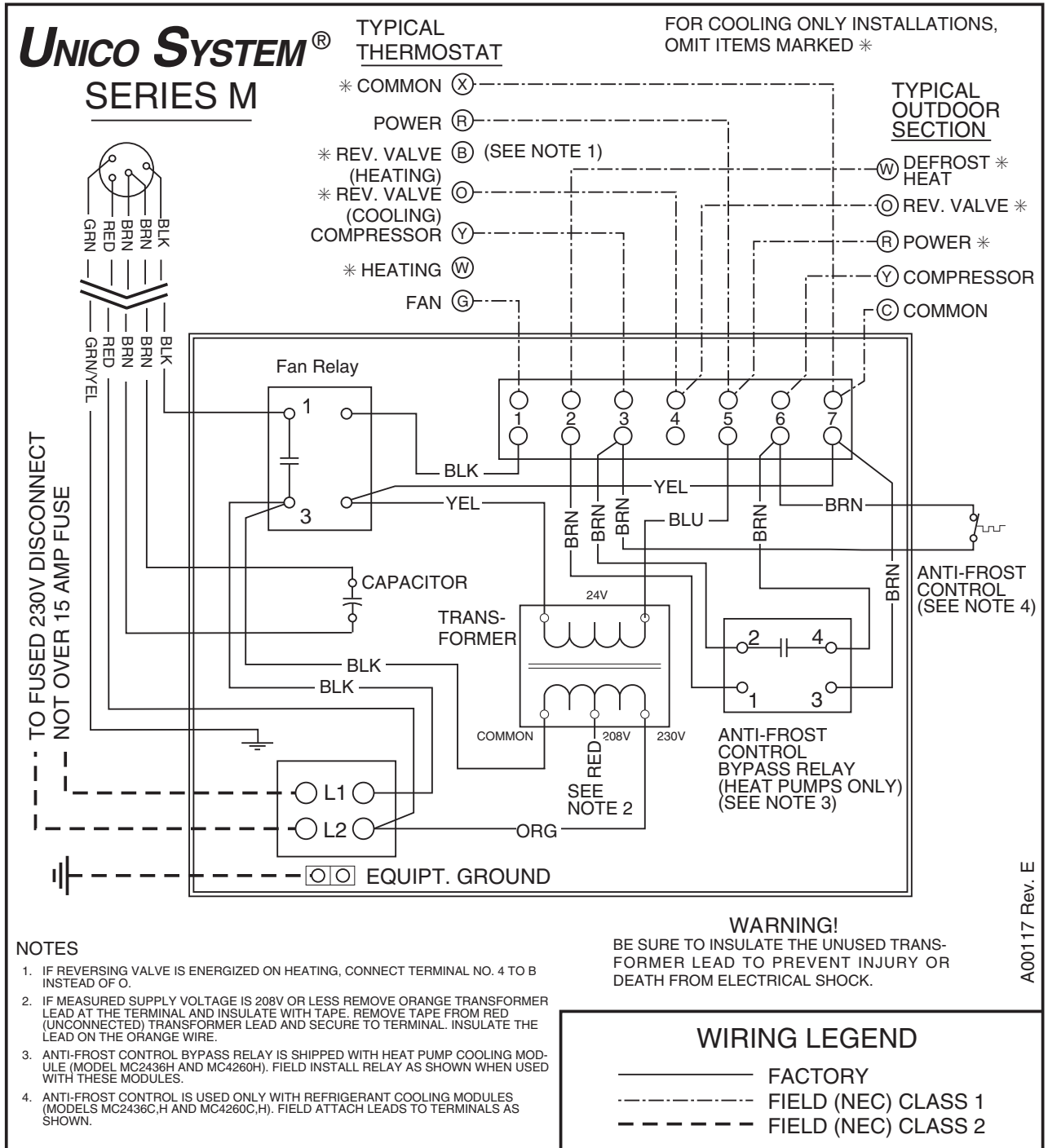


Figure 21. M Series Electrical Wiring Diagram(without Motor Controller installed) for A00175-G03 Control Box

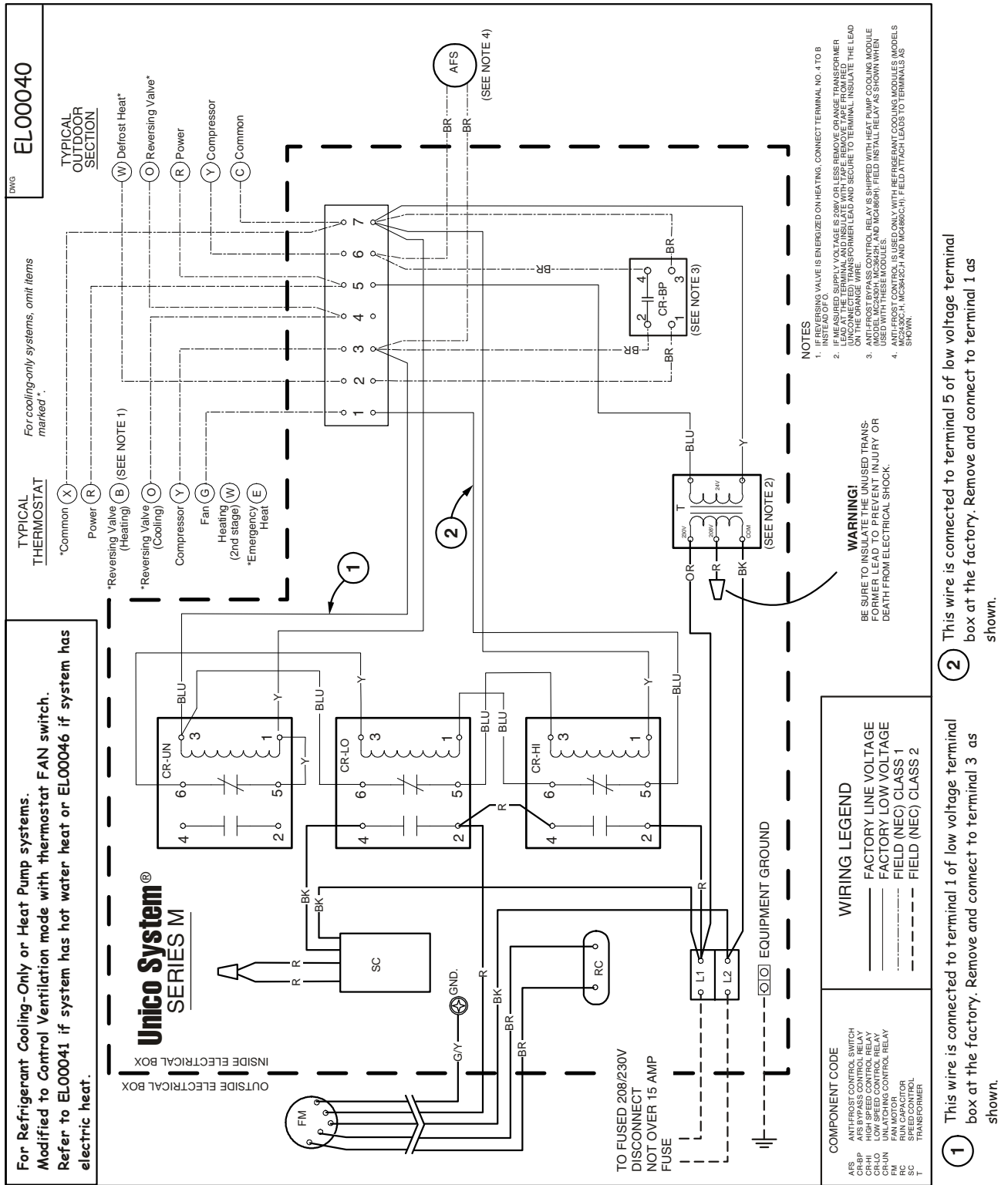


Figure 22. Wiring Schematic for Cooling-Only or Heat-Pump without Supplemental Heat (Modified to control ventilation speed mode at thermostat)

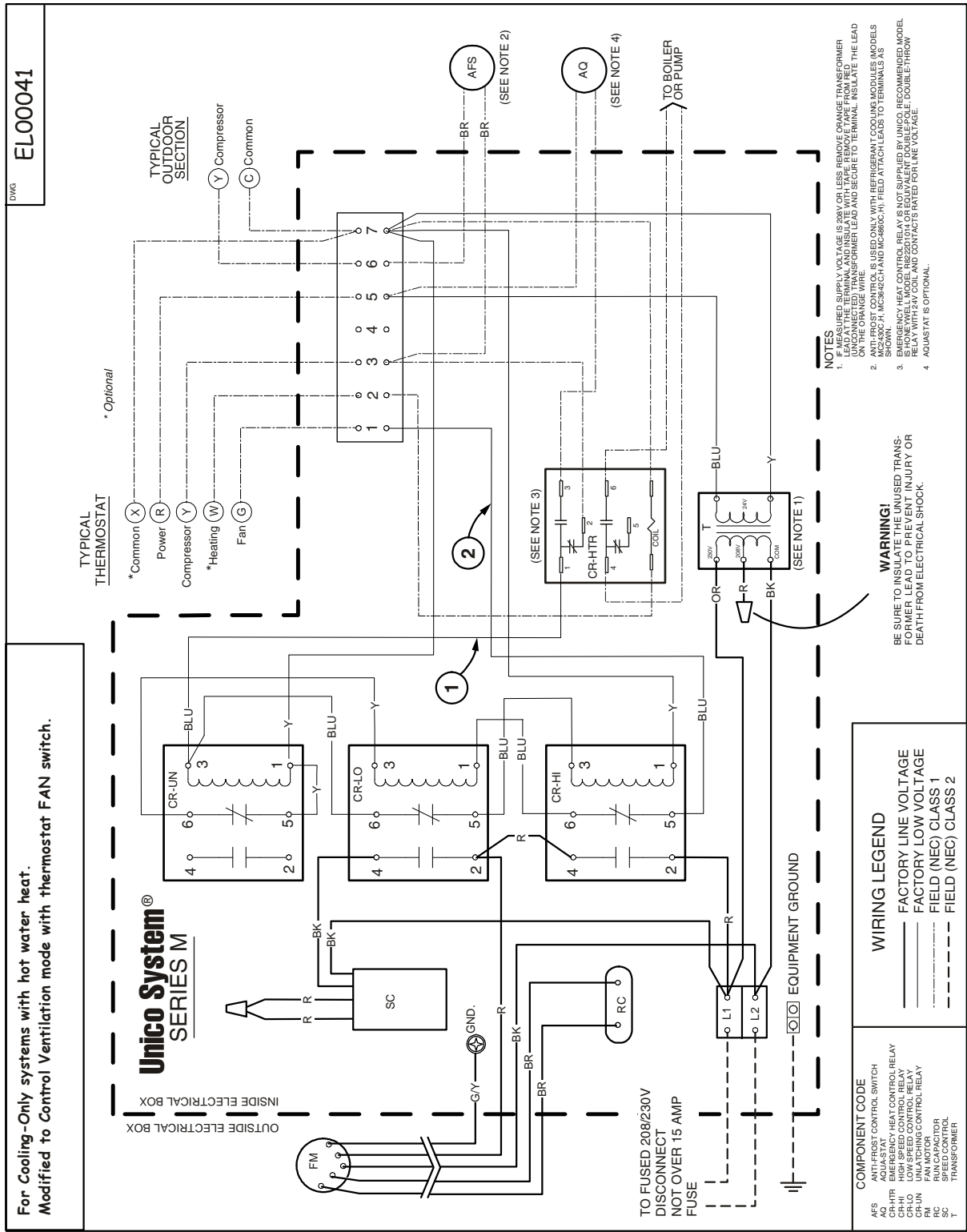


Figure 23. Wiring schematic Refrigerant Cooling with Hot Water Heat (Modified to control ventilation speed at thermostat)

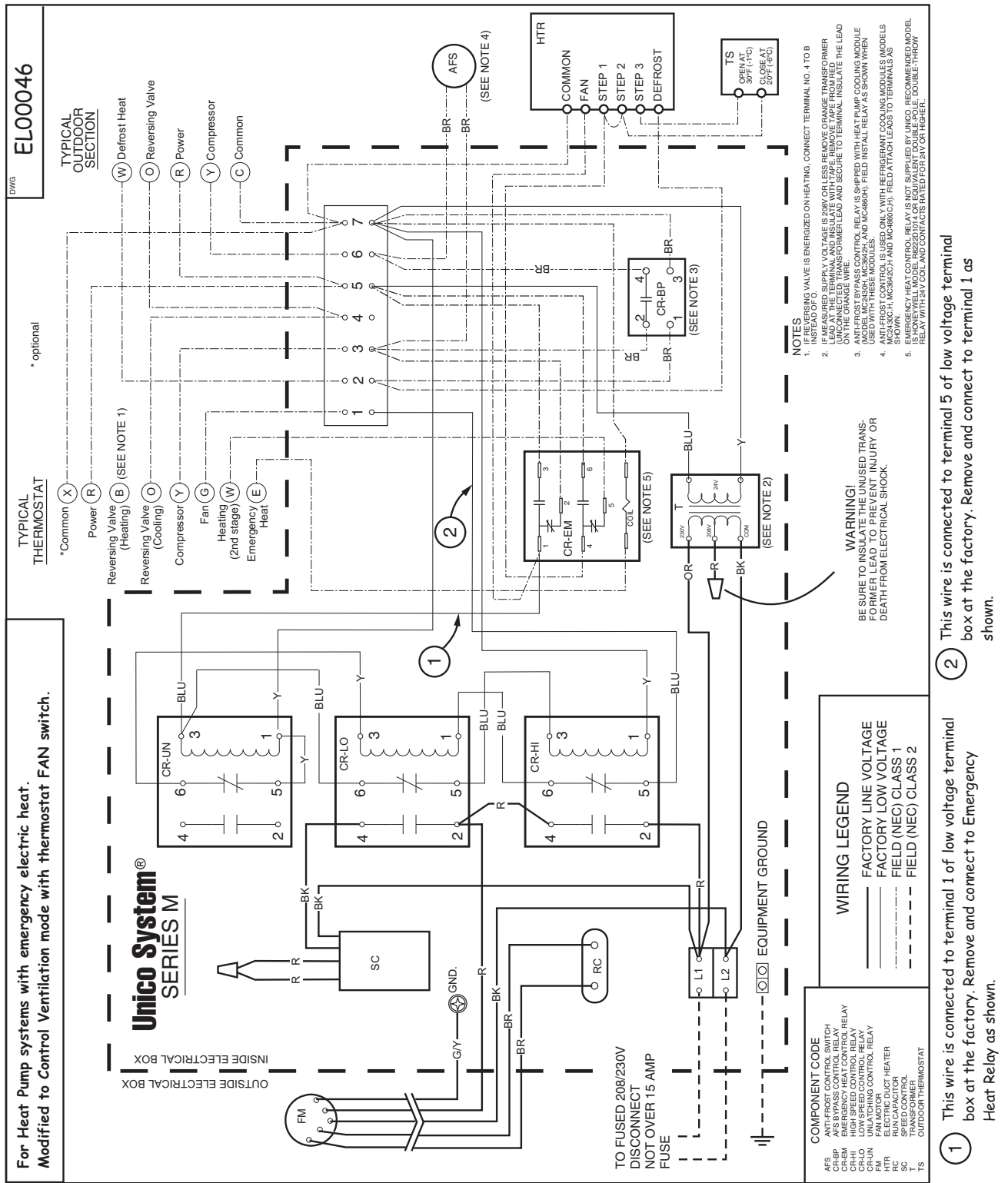


Figure 24. Wiring schematic Heat-Pump with Supplemental Electric Duct Heater (second stage) (Modified to control ventilation speed at thermostat)

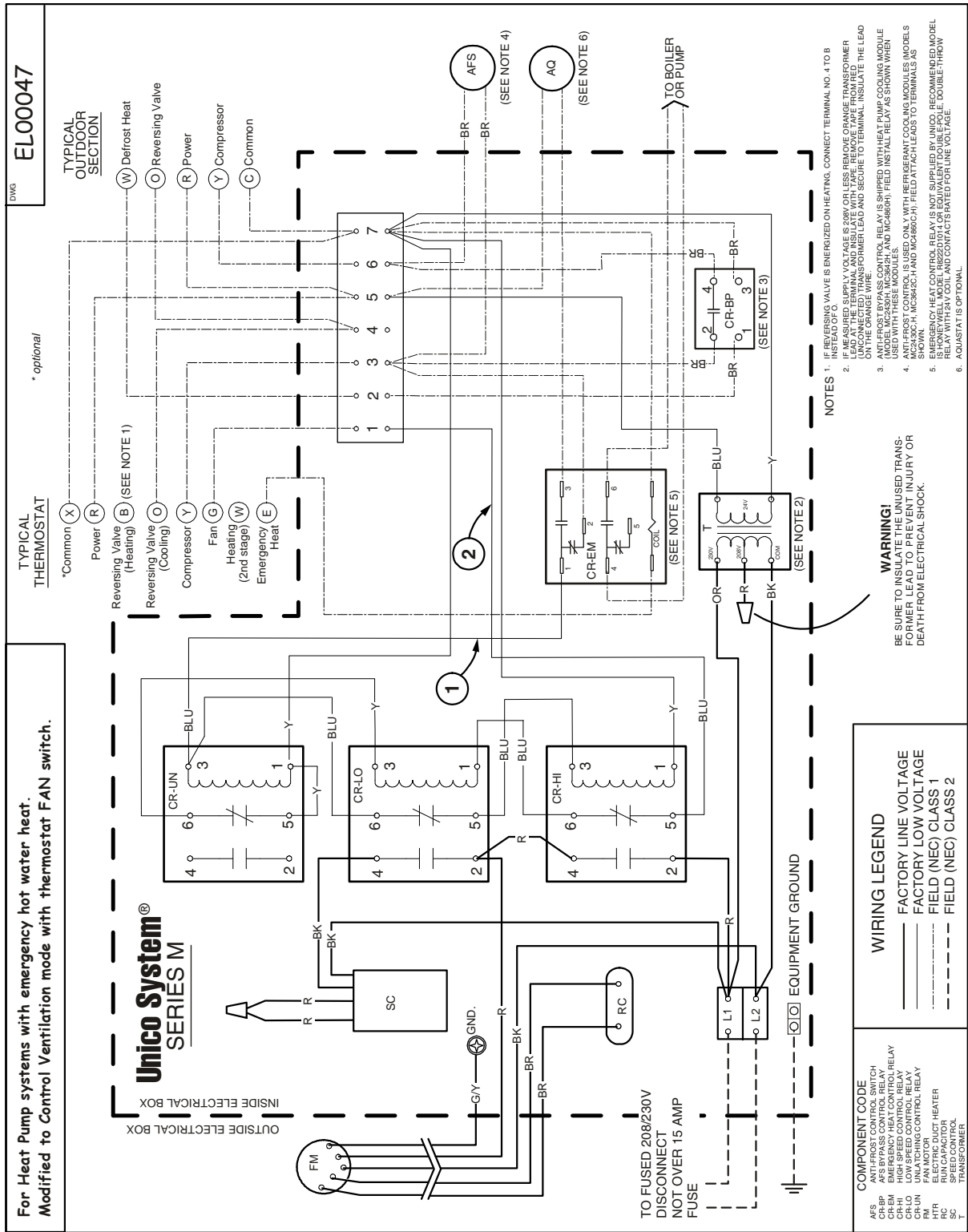


Figure 25. Wiring schematic Heat-Pump with Supplemental Hot Water Heat (second stage) (Modified to control ventilation speed at thermostat)

STARTUP

! IMPORTANT !

The most important step when installing the Unico System is making sure it has the correct airflow. Be sure to record the amperage and voltage of every system in order to verify the airflow through the unit. Also, measure the airflow at each outlet to verify the airflow in each room. Both methods are described later in this section.

Sequence of Operation

The sequence of operation depends greatly on the options installed and type of control thermostat used. Most thermostats have a fan AUTO-ON switch. When the fan switch is set to ON, the “G” circuit is closed and the blower relay is energized. The indoor blower starts after about a 20 second delay. The following paragraphs describe the sequence of operation when the fan is set to AUTO. If the fan switch is set to ON, the sequence is the same except the “G” circuit is always closed and the indoor fan is always operating.

Cooling Cycle (A/C or Heat Pump). When the thermostat calls for cooling, the “Y” and the “G” circuits are closed, and a 24 V signal is sent to the compressor contactor in the outdoor unit and fan relay in the indoor unit. After about 20 seconds, the indoor blower starts. At the same time, the compressor and outdoor fan also start. Depending on the control circuitry in the outdoor unit, there may be a time delay before the outdoor unit starts. If the system was just turned off, the time delay could be as much as five minutes. The cooling system is now operating.

For heat pump thermostats setting the switch to ‘cooling’ immediately closes the “O” circuit, which is used to energize the reversing valve solenoid if required by the heat pump. Otherwise, the “B” circuit, which closes when switched in heating, is used to energize the reversing valve solenoid. (Refer to the heat pump manufacturer’s instructions to see which mode the solenoid needs to be energized – whether in heating or cooling.)

When the thermostat is satisfied, the 24 V signals are opened and the outdoor unit stops. The indoor blower continues to operate for about 40 seconds, then stops. The system is now off.

Heating Cycle (Heat Pump). Setting the thermostat to HEATING will automatically switch the reversing valve solenoid. This setting closes the “B” circuit which sends a 24V signal to energize the solenoid if required by the heat pump. Otherwise the “B” circuit is not used and the solenoid is not energized during heating.

When the thermostat calls for heating, the “Y” and “G” circuits are closed, sending a 24 V signal to the compressor contactor in the outdoor unit and the fan relay in the indoor unit. This starts the indoor blower and the outdoor compressor. There is a time delay of about 20

seconds for the indoor unit. The heating system is now operating in stage one.

If the first stage does not satisfy the thermostat, the second stage thermostat calls for more heat. This closes the “W2” contacts and energizes the sequencer for electric heat (if installed). When the second stage thermostat is satisfied, the “W2” circuit is broken and the sequencer is de-energized. The electric heating system is now off.

When the first stage thermostat is satisfied, the 24 V signals are opened and the outdoor unit stops. The indoor blower continues to operate for about 40 seconds, then stops. The system is now off.

Heating Cycle (Electric Heat-Only). When the thermostat calls for heating, the “W” and “G” circuits are closed. The W circuit completes the 24V signal to the sequencer in the electric duct heater, which cycles on the electric heating elements. The G circuit completes the 24V signal to the fan relay in the indoor unit, which starts the indoor blower after a time delay of about 20 seconds. The heating system is now operating.

When the thermostat is satisfied, the 24 V signals are opened and the indoor blower stops after about 40 seconds. At the same time the sequencer cuts the power to the electric elements. The system is now off.

Note: Use a thermostat designed for electric heat. A normal heating-cooling thermostat will not close the “G” circuit on heating.

Ventilation Cycle. When the thermostat is satisfied and the fan switch is set to “AUTO”, the “G” circuit is open so that power to the motor goes through the variable speed controller and the motor runs at reduced speed. The speed controller is set by the installer to a specific speed. (The factory default setting for the speed control is “OFF”.)

Using the typical wiring schematic, the fan will operate continuously if the variable speed control is switched on. It will either operate at normal speed (full speed) or at a reduced speed. Use the alternate wiring diagram to allow the user to turn the ventilation mode off at the thermostat. To turn it off simply move the fan switch to the AUTO position.

Checking Air Flow

CAUTION

Do not operate blower with free discharge or low static pressures (below 1-inch w.c. (250 Pa)) to prevent motor from overloading.

After the system is installed and before charging system, check for proper airflow. Record the position of the restrictor plate, the plenum static pressure, and the motor amperage. With this information, the amount of airflow can be determined.

As a recommended further check on airflow, use a v-ometer to measure the airflow from each outlet. The most convenient instrument to use is a hand held vane type velocity meter that fits directly over the outlet. The Turbo-Meter (Davis Instruments Catalog No. DS105I07) or equivalent meter will give a direct LED readout on the Knots (FPM x 100) setting, when multiplied by 2 gives the CFM of the outlet within an accuracy of 10%. (Multiply 'knots' by 0.94 to obtain L/s.) Refer to Tech-note 113 for more information.

By measuring and totaling the airflow of all outlets, the total airflow of the system can be closely approximated and provide a crosscheck for the airflow determined from the motor amperage using the airflow-amperage table that is shipped with the Blower module.

Note: These tables are for the specific motor installed in each blower module. Be sure the table used applies to the correct model number that is shown on the table.

Use Table 7 to correct the airflow.

Check Static Pressure Measure the external static pressure (see the following section) in the supply plenum at least two feet (610 mm) from the unit and verify that it is within the allowable range.

With the restrictor plate positioned according to table 4, the plenum static pressure should be 1.4 to 1.6 inches of water column (350 to 400 Pa). If the plenum size is 9-inch (229mm) diameter, the plenum static pressure will be a little greater, about 1.8 inches of water column (450 Pa).

It is not necessary to measure the return duct static pressure unless it was field fabricated. The maximum return static pressure (including filters) should be 0.15 inches of water (37 Pa). If it is greater than 0.15 inches of water column, add the return system pressure drop to the supply plenum static pressure to get the total static pressure drop.

For example: If the supply static pressure is measured to be 1.6 inches w.c. and the return system pressure drop is 0.25 inches w.c, the total static pressure drop is: $1.6 + 0.25 = 1.85$. In this case the static pressure is too high.

If the restrictor plate is not positioned according to Table 4, the static pressure reading is not an effective indicator of airflow although it should still be recorded. In this case, measuring motor amperage is the only reliable indicator.

Check Motor Amperage. Remove the control box cover and measure the current with an amp meter and compare to the Motor Amperage-Airflow table enclosed as a separate sheet in the Blower Module carton.

Check Outlet Airflow. Measure and record the air flow from each outlet with a TurboMeter (refer to *Tech Note 113, How to Measure Outlet Airflow*, for more information). Place the TurboMeter against each outlet, centered as best possible and record the "knots". Multiply the knots by 2 to obtain CFM, then sum all the outlets. The sum is the total airflow; this can be compared to the outlet indicated by the amperage. A significant difference could indicate duct leakage.

How to Measure Static Pressure Measure the supply plenum static pressure at least 18-inches (457mm) from the unit, but before any tee or elbow. A distance of between 2 and 3-feet (0.6 to 0.9m) is best. Use an inclined manometer capable of reading at least 2.5 inches of water column (622 Pa), such as Dwyer Instrument's model 109 manometer. Be sure to zero the scale and level the manometer.

A magnehelic gauge that measures up to at least 2.5 inches of water may also be used.

Use a metal tube, typically ¼-inch (6mm) diameter, to measure the static pressure. Determine where you want it and cut or punch a small hole in the duct. Make the hole the same size as the metal tube to prevent leakage. Insert the metal tube 1-inch (25mm) so that the tip of the tube is flush to inside wall of the duct and perpendicular to the air stream as shown in Fig. 26.

Attach the metal tube to the manometer using a rubber hose (usually supplied with the manometer). Record the pressure.

Note: If the tube is not perpendicular to the air stream, the reading will be in error. You will get a higher reading if the tube is angled toward the air stream.

Table 7. Airflow Troubleshooting Chart

Problem	Probable Cause	Remedy
Low Static, Low Amperage	Restrictor set too low. Blocked filters, restriction in return duct. Low Voltage. Blower Wheel not aligned properly. Dirty blower wheel.	Open restrictor to table 4 setting. Clear restriction. Check with local utility. Center wheel inside of inlet ring. Position on shaft for 1/8 inch (3 mm) clearance from inlet ring. Clean wheel.
Low static, high amperage	Large number of outlets. Restrictor setting to high.	Close restrictor to proper amperage, or Add balancing orifices to outlets. Close restrictor to obtain proper amperage.
High Static, Low Amperage	Restrictive duct system.	Add outlets, add splitter vane in tee, reduce the number of tees and elbows in plenum, increase plenum size to 9" equivalent, or Open restrictor to proper amperage.

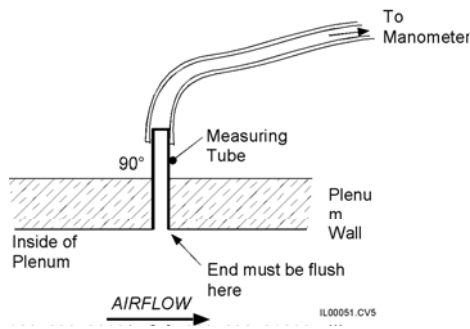


Figure 26. Measuring Plenum Static Pressure

In the absence of a manometer you can build a simple but less accurate manometer in one of two ways. One way is to use a short piece of ruler or yardstick and clear plastic tubing as shown in Fig. 27.

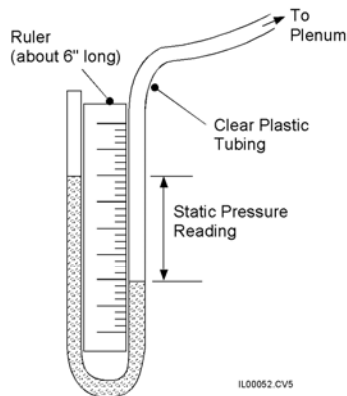


Figure 27. U-Tube Manometer

Setting the Ventilation Speed. Constant ventilation is optional. To enable constant ventilation, simply turn the variable speed control knob clockwise. The lowest speed that produces some amount of air circulation is best. This is usually the lowest speed position (as far clockwise as possible). The controller may also be set at any other speed but it is not necessary for ventilation.

Charging the System

DO NOT VENT REFRIGERANT TO THE ATMOSPHERE!! It is a violation of federal law and in some cases local ordinances also. Always use a refrigerant recovery or recycling device.

If charging a heat pump, refer to *Bulletin 30-24, Instructions for "M" Series Modular Heat Pump Systems*. The following procedure is only valid for charging the system during the cooling mode.

To check for proper charge record the refrigerant pressures and temperatures. Check the refrigerant charge by measuring the amount of sub-cooling (or 'approach' temperature for some condensing units). If the outdoor manufacturer does not have sub-cooling or "approach" temperature charts, then be sure that the sub-cooling is between 3 and 8 °F (2 to 5°C). For long refrigerant lines or when the evaporator is above the condenser, the sub-cooling should be close to 8°F; otherwise, aim for the low end of the range.

After the refrigerant lines and evaporator have been carefully leak tested and evacuated, release the R22 operating charge in the condensing unit. The system is now ready for refrigerant charge adjustment. If the coil is equipped with a threaded TXV, always verify that the threads are tight and do not leak.

Start up the system and check line voltage to assure it is within acceptable limits for the system as dictated by the condensing unit manufacturer. Run the system for 20 to 30 minutes to get reasonably stabilized conditions. Do not attempt to adjust charge with outdoor temperature below 75°F (24°C). An outdoor temperature of 75 to 85°F (24 to 29°C) is preferred.

If the system charge must be checked when the outdoor temperature is below 80°F (26.7°C), block the condenser coil until the head pressure is approximately equal to what its charging chart specifies for an 85°F (29°C) day.

For heat pumps always check the charge in cooling mode. If this is not possible because of low outdoor temperatures, charge the system in the heating mode, but return later when the weather is warmer before the system is switched to cooling.

Sub-cooling Method Many condensing unit manufacturers publish the amount of sub-cooling that the condenser will produce. Follow their instructions to charge the unit. Typical sub-cooling values will be between 3 and 8°F (2 to 5°C). The unit should ALWAYS have some amount of sub-cooling. To be sure there is enough sub-cooling, especially if the unit is in a hot attic, check the liquid line sight glass near the evaporator for bubbles or measure the refrigerant liquid line pressure and temperature AT THE EVAPORATOR.

To measure sub-cooling use the following procedure:

1. Measure and record the liquid line pressure using an accurate refrigerant gauge. Record the corresponding saturation temperature for this pressure (see Table 8).
2. Measure and record the liquid line temperature using an accurate metal or glass thermometer, or thermocouple. Tape or strap the sensor firmly against the surface of the liquid line and cover with insulation.
3. Determine the sub-cooling with the following equation:

$$\begin{array}{r} \text{Saturated Temperature} \\ - \text{Liquid Line Temperature} \\ = \text{Subcooling} \end{array}$$

If the sub-cooling temperature at the condenser is low, the system is undercharged and refrigerant must be added.

CAUTION

TO PREVENT DAMAGE TO THE COMPRESSOR, DO NOT ADD LIQUID CHARGE INTO SUCTION PORT.

If it is high, the system is overcharged and some refrigerant must be removed and collected in an empty refrigerant container. **DO NOT RELEASE REFRIGERANT INTO THE ATMOSPHERE.**

In some cases, such as in a hot attic, the liquid line will pick up heat and lose its sub-cooling. This will be apparent if the sub-cooling at the evaporator is low. In these cases, the liquid line should be insulated or strapped to the suction line and both insulated. The same problem can occur for long refrigerant lines; in this case, increase the size of the liquid line to reduce the pressure drop.

CAUTION

TO MAINTAIN PROPER HEAT PUMP OPERATION, DO NOT STRAP THE LIQUID AND SUCTION LINES TOGETHER FOR HEAT PUMP SYSTEMS.

Superheat Method Do not charge the system based on superheat. Superheat measurements should only be used to verify that the expansion valve is working properly. If is more than expected please refer to the *Technote* on troubleshooting expansion valves.

The superheat should be between 8 to 12°F (4 to 7°C) at the indoor coil. In some cases, particularly for the larger capacity match-ups (i.e. 3 ton and 5 ton), a superheat of 15 to 18°F (8 to 10°C) is satisfactory. It is not uncommon to measure a superheat above 20 to 25°F (11 to 14°C) at the condensing unit.

Be aware that the superheat value is also dependent on the outdoor air temperature. At lower air temperatures the superheat will be higher than at higher air temperatures. If the condenser ambient temperature is between 75 and 85°F (24 to 29°C), superheat should be approximately 10 to 12°F (5 to 7°C). If the outdoor temperature is between 85 and 105°F (29 to 40°C), superheat should be approximately 8 to 10°F (4 to 5°C).

To measure the superheat, use the following:

1. Measure and record the suction pressure at the evaporator outlet using an accurate refrigerant gauge. If this is not possible, measure the pressure at the service port on the suction valve fitting at the condensing unit and add the estimated pressure loss in the suction line between the condensing unit and evaporator. Record the corresponding saturation temperature for this pressure (see Table 8).
2. Measure the suction line temperature at the evaporator outlet using an accurate metal or glass thermometer, or thermocouple. Insert the thermometer under the insulation on the suction line and tape firmly against the surface of the suction tube.
3. Determine the superheat with the following equation:

$\begin{aligned} & \text{Suction Line Temperature} \\ - & \text{Saturated Temperature} \\ = & \text{Superheat} \end{aligned}$

Charging by Gauge Pressures It is not possible to charge the system by gauge pressures. Gauge pressure should only be used to verify the system is working properly

The Unico System will show a lower suction pressure during the cooling mode than a conventional system. Generally, it will be 10 to 15 psi (70 to 100 kPa) less. For example, a normal suction pressure for the Unico System will be about 65 psig (450 kPa) with an 85 to 95°F (29 to 35°C) outdoor temperature. Expect lower pressures when the outdoor temperatures are lower.

The head pressures should be similar to a conventional system when in the cooling mode.

Using a Low Ambient Control Kit

Since the Unico System operates at colder coil temperatures (in cooling mode), an anti-frost switch is installed on the coil to prevent coil freeze-up. In certain instances, such as when the outdoor ambient temperature is low, the condensing unit will cycle on the anti-frost switch. This may reduce the cooling capacity at a time when the cooling load is still fairly high. To provide better control and comfort, install a *low ambient control* on the condensing unit. Typically, a low ambient control is necessary when operating the unit at outdoor temperatures below 80°F (26.6 °C), especially for a 5-ton nominal capacity system.

These controls come in different configurations such as the Hoffman Controls Corp. series 800AA-head pressure control. This control modulates the outdoor fan to maintain a minimum liquid line temperature. Other controls may cycle the fan on/off. In either case check with the condensing unit manufacturer to determine what controls are compatible with the condensing unit.

R-410A, Puron® Refrigerant

Puron is a registered trade name for refrigerant R-410A by Suva, a Dupont Company, which is an alternate to refrigerant R-22.

In 1987, scientists and government officials met in Montreal in response to the growing pressure to preserve the earth's ozone layer. The outcome of the meeting was the Montreal Protocol - an internationally binding action plan to eliminate ozone-harming chemicals. *Chlorofluorocarbons* (CFCs) - such as R-12 - were targeted first since they caused the most damage to the environment. A cap was placed on the production of CFC's and in 1996, by law, all manufacturing was required to cease.

The Montreal Protocol's next phase-out targets are *hydro chlorofluorocarbons* (HCFCs), including R-22, the primary refrigerant in residential heating & air conditioning products.

The 1990 Clean Air Act in conjunction with the Montreal Protocol, established January 1, 2010 as the date when the U.S. will ban the manufacturing of products using HCFCs. The same document bans the manufacture of R-22 in 2020. Thereafter, only recycled R-22 can be

used. The phase-out schedule is timed so that R-22 is available for expected lifespan of the R-22 equipment.

The *Unico System* is completely compatible with R-410A. Using R-410A with the *Unico System* is a simple matter of changing the expansion valve. The refrigerant coil is shipped with an R-22 expansion valve that must be changed to an R-410A expansion valve for the correct tonnage needed.

Maintenance

When service is required to the motor or the wheel, the entire assembly may be removed as a unit (see figure 28). The blower assembly unit is accessible from the piping connection side of the unit. It is not necessary to access both sides of the unit. Nor is it necessary to disconnect any module or ducting.

To remove the motor and blower wheel assembly, loosen the six (6) screws fastening the motorized blower assembly to the blower housing. Twist the motorized blower assembly counter-clockwise (CCW) and pull the assembly away from the blower housing.

CAUTION

TO PREVENT DAMAGE TO THE WHEEL BALANCE, DO NOT GRAB THE ASSEMBLY BY THE WHEEL OR SET THE ASSEMBLY DOWN SUCH THAT THE WHEEL IS SUPPORTING THE ASSEMBLY. ALWAYS SET THE ASSEMBLY DOWN WITH THE WHEEL ON TOP.

Once the assembly is removed, the proper service may be performed. If the wheel is to be changed, it may simply be removed from the motor shaft by loosening the motor set screw and pulling the blower wheel off the motor shaft. If the motor is to be changed, first the blower wheel must be removed as mentioned above, and then the screws fastening the motor to the inlet ring must be removed.

To re-install the motorized blower assembly back into the blower housing, follow the steps mentioned above in reverse order.

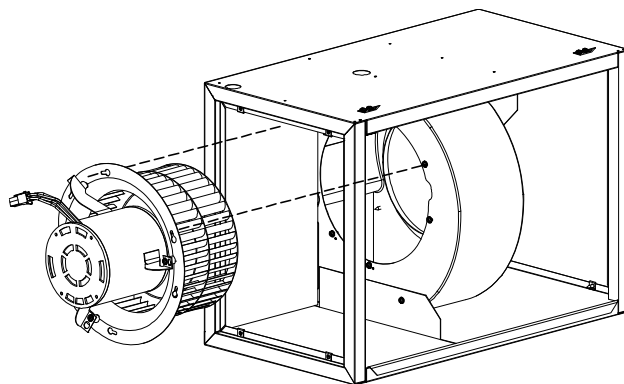


Figure 28. Removal of the Motorized Blower Assembly

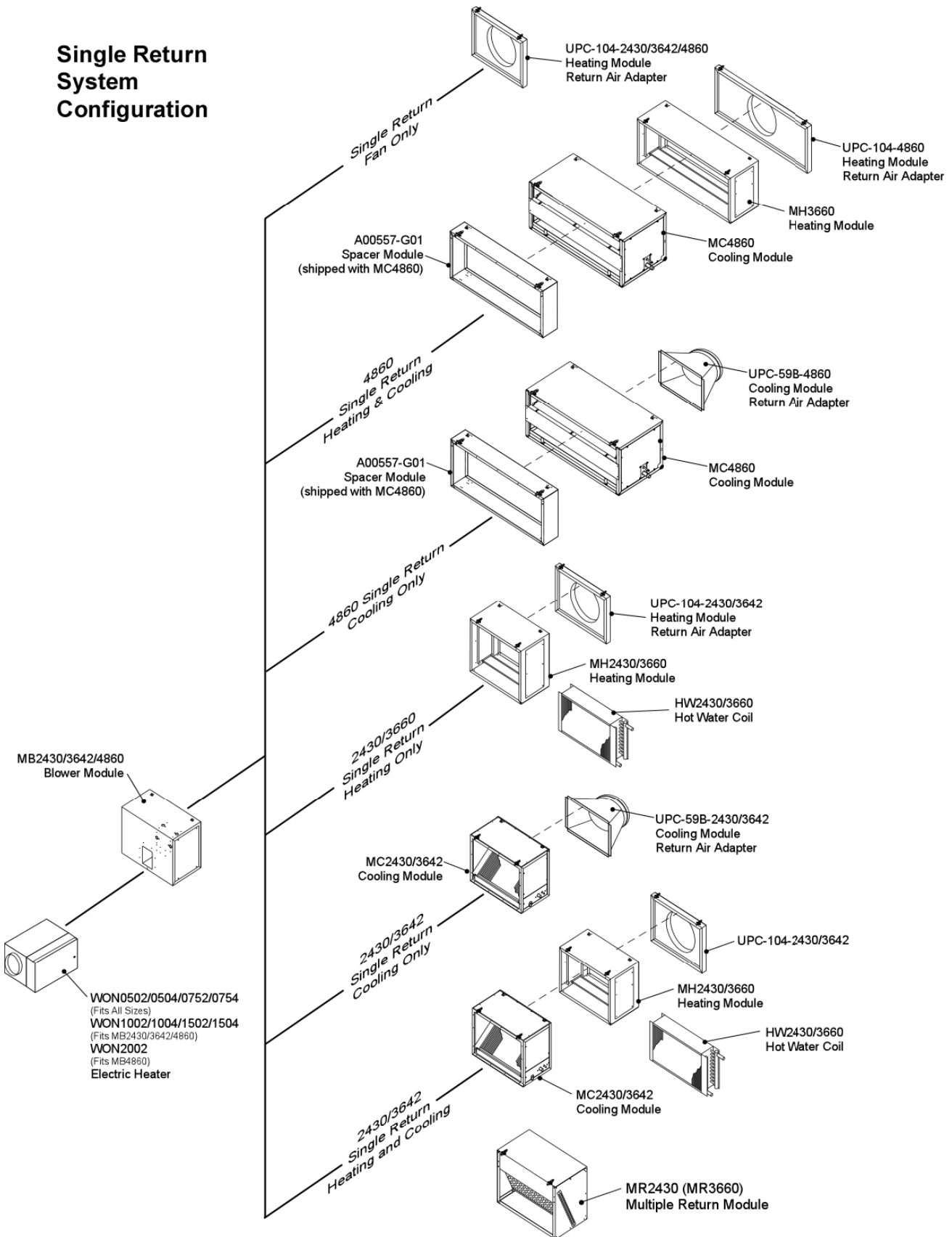
Table 8a. R-22 / 410A Saturation Pressure – Temperature (English units)

°F	psig	
	R-22	R-410A
0	24.0	48.4
2	25.7	51.1
4	27.4	53.8
6	29.2	56.6
8	31.0	59.4
10	32.8	62.4
12	34.8	65.4
14	36.8	68.6
16	38.8	71.8
18	40.9	75.1
20	43.1	78.5
22	45.3	82.1
24	47.6	85.7
26	50.0	89.4
28	52.4	93.2
30	55.0	97.2
32	57.5	101.
34	60.2	105.
36	62.9	110.
38	65.7	114.
40	68.6	119.
42	71.5	123.
44	74.5	128.
46	77.6	133.
48	80.8	138.
50	84.1	143.
55	92.6	156.
60	102.	170.
.	.	.
.	.	.
90	168.	274.
95	182.	295.
100	196.	317.
105	211.	341.
110	226.	365.
115	243.	391.
120	260.	418.
125	278.	447.
130	297.	477.

Table 8b. R-22 / 410A Saturation Pressure – Temperature (SI units)

°C	kPa (gauge)	
	R-22	R-410A
-18	163	330
-17	174.	347
-16	184	363
-15	195	380
-14	206	398
-13	217	416
-12	229	434
-11	241	453
-10	253	473
-9	266	493
-8	279	513
-7	293	534
-6	306	556
-5	320	578
-4	335	601
-3	350	624
-2	365	648
-1	381	673
0	397	698
1	413	723
2	430	750
3	447	777
4	465	804
5	483	833
6	501	861
7	520	891
8	540	922
9	559	953
10	580	984
12	622	1050
14	665	1120
.	.	.
.	.	.
30	1090	1780
32	1150	1880
34	1220	1980
36	1290	2090
38	1360	2200
40	1430	2320
42	1510	2440
44	1590	2560
46	1670	2690
48	1750	2820
50	1840	2960
52	1930	3100
54	2030	3250

Single Return System Configuration

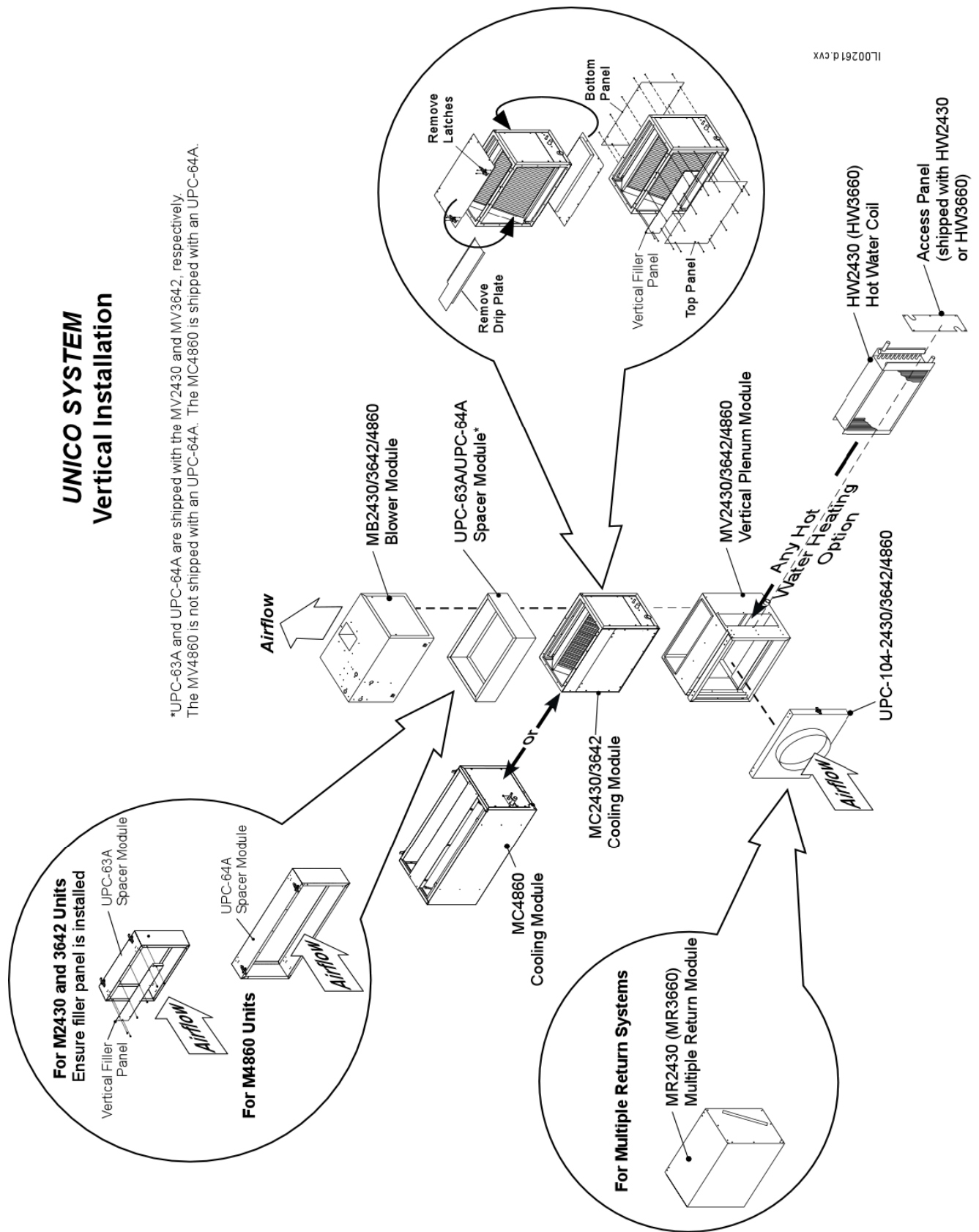


If using multiple returns replace single return adapter with the correct MRxxxx module, where xxxx stands for unit size.

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Figure 29. Horizontal Configuration Chart

UNICO SYSTEM Vertical Installation



*UPC-63A and UPC-64A are shipped with the MV2430 and MV3642, respectively. The MC4860 is not shipped with an UPC-64A.

Figure 30. Vertical Configuration Chart

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Use

The Zehnder ComfoAir 200 comfort ventilation unit was developed for use in residential settings with high ventilation demand. It combines maximum comfort, simple operation and high efficiency with flexible integration into building services. The ComfoAir 200 ventilation unit moves 118 cfm of air at an external pressure of 0.80" wc.

Efficiency

The integrated cross-counterflow heat exchanger achieves efficiencies of up to 95%. For user comfort this means no unpleasant draft effects, because the supply air is heated almost to room temperature even when external temperatures are around freezing.

Fans

The two supply and extract fans are driven by efficient DC motors. Differential pressures in the supply and extract air distribution systems can be compensated thanks to direct control. The especially quiet fans can be adjusted to the required volumetric flow in 1% increments. The air volumes of the selectable stages can be set to between 29 cfm and 118 cfm on the Zehnder ComfoAir 200.

Filters

The ComfoAir 200 ventilation unit is equipped with a class G4 filter (MERV 7/8). An optional F7 pollen filter (MERV 13) is available for outside air.

Installation

The Zehnder ComfoAir 200 ventilation unit is characterised by its compact design. The supply and extract air connections are located on the top of the unit, those for the outside and exhaust air are on the bottom. The ventilation unit is suitable for ceiling and wall installation.

Operation

The ventilation unit is controlled using a control unit commonly employed in living areas. The ComfoAir 200 is controlled by the CC-Ease control unit as standard.

Servicing

Servicing of the Zehnder ComfoAir CA 200 ventilation unit is limited to regular replacement and cleaning of the filter integrated in the front of the unit. The heat exchanger should be cleaned every 3-4 years depending on how dirty the outside air is. Please see the unit manual for additional servicing tasks.



CC-Ease remote control



Remote-controlled unit

Frost protection

If the ventilation unit is operated without preheating, the condensate in the extract air may freeze. The frost protection setting prevents this by variably reducing the supply air volume. In order to ensure reliable operation even at extreme outside temperatures, an optional integrated, electrical preheater register is available.

Bypass

During summer nights and in the transition periods with strong sunshine, living areas often become too warm, while the outside air remains pleasantly cool. In this case heat removal by what is known as *free cooling* helps: The cooler outside air is fed to the rooms in the living area, bypassing the heat exchanger. The Zehnder ComfoAir 200 ventilation unit is equipped with an automatic bypass for just this purpose. The bypass is a standard component and takes 100% of the extract air past the heat exchanger. The personal comfort temperature is adjustable.

Options

- **Moisture recovery with the Zehnder enthalpy exchanger**
The Zehnder enthalpy plate exchanger provides a hygienic ideal solution for excessively dry air in winter. Not only heat, but also up to 65% of the moisture contained in the extract air is transferred from the extracted air to the supply air. Supply and extract air flows are kept completely separate so there is no transfer of odors or bacteria.
- **Wireless remote control**
More installation freedom. With the Zehnder wireless remote control the ventilation unit can be wirelessly controlled from several switching points distributed throughout the house or flat.
- **Chimney sweep control**
The ventilation system can be installed in a home with an open flue fireplace. This must be registered in the control unit. This prevents a controller-related negative pressure. In a frost protection situation both fans are stopped. Pure supply or extract air mode is not possible and the intact fan is also switched off if a fault occurs.

Technical specifications

Unit dimensions	
Max. air volume	118 cfm
Min. air volume	29 cfm
Height	47.25"
Width	21.40"
Depth	12.50"

Benefits

- Comfort ventilation up to 118 cfm
- Heat recovery with an efficiency of up to 95%
- Low power consumption thanks to EC direct current motors
- Automatic 100% summer bypass
- Infinitely variable frost protection function: efficient even at low temperatures
- Quick, safe installation and servicing
- Simple operation
- Integrated preheater (optional)
- Controls can be expanded by wireless remote control
- Digital control unit: CC-Ease
- CO₂ control (optional)
- With weekly timer as standard
- Chimney sweep control

Article numbers

L = supply air left, R = supply air right, V = integrated electric preheater register

Product	Article number	Reference number
ComfoAir 200 L Luxe	471 229 710	9280
ComfoAir 200 R Luxe	471 229 715	9276
ComfoAir 200 VL Luxe	471 229 810	9281
ComfoAir 200 VR Luxe	471 229 815	9338
ComfoAir 200 L Luxe Enthalpy	471 229 959	9357
ComfoAir 200 R Luxe Enthalpy	471 229 955	9364
ComfoAir 200 VL Luxe Enthalpy	471 229 470	9422
ComfoAir 200 VR Luxe Enthalpy	471 229 475	9423

Accessories

ComfoControl Ease control unit	655 010 100	9257
Housing for on-wall mounting for CC-Ease control unit	659 000 250	9259
Wireless remote control	655 000 755	9238

Filters

Filter for ComfoAir 200 G4 (MERV 7/8)	400 100 015	9282
Filter for ComfoAir 200 F7 (MERV 13)	400 100 018	9283

Function

- Frost protection function/automatic defrost
- Supply and extract air separate and infinitely variably programmable
- Switch on and off delay for bathroom switch
- Adjustable comfort temperature
- Filter replacement indicator
- Supply and extract air can be switched off separately

Description**Comfort ventilation unit ComfoAir 200 Luxe**

The Zehnder ComfoAir 200 is a centralised, compact ventilation unit with heat recovery and integrated summer bypass. This ventilation unit is eminently suited to new buildings as well as in renovation projects. The ComfoAir 200 can be installed as a wall-hanging unit or horizontally below the ceiling. It is connected by 4 DN 5"/6"/6.3" pipe connections on the top and bottom of the unit. The housing, made of galvanised or painted sheet steel, is acoustically and thermally insulated. EC direct current fans guarantee power-saving operation and provide high electrical efficiency. Supply and exhaust fans can be controlled separately and can be precisely adjusted to the balance air volume to within one percent. The core of the ComfoAir 200 is the plastic cross-counterflow heat exchanger with up to 95% heat recovery. It is controlled by the cabled ComfoControl Ease control unit, which is connected to the ventilation unit by an on site cable. All operating statuses and error messages can be read from the control unit display. The filters are replaced easily from the front by the user without opening the unit.

Options:

- Integrated electrical preheater (CA 200 VL and CA 200 VR)
- Remote control via wireless remote control (3 stages and intermittent ventilation)
- Class F7 pollen filter (MERV 13) available

Controller features:

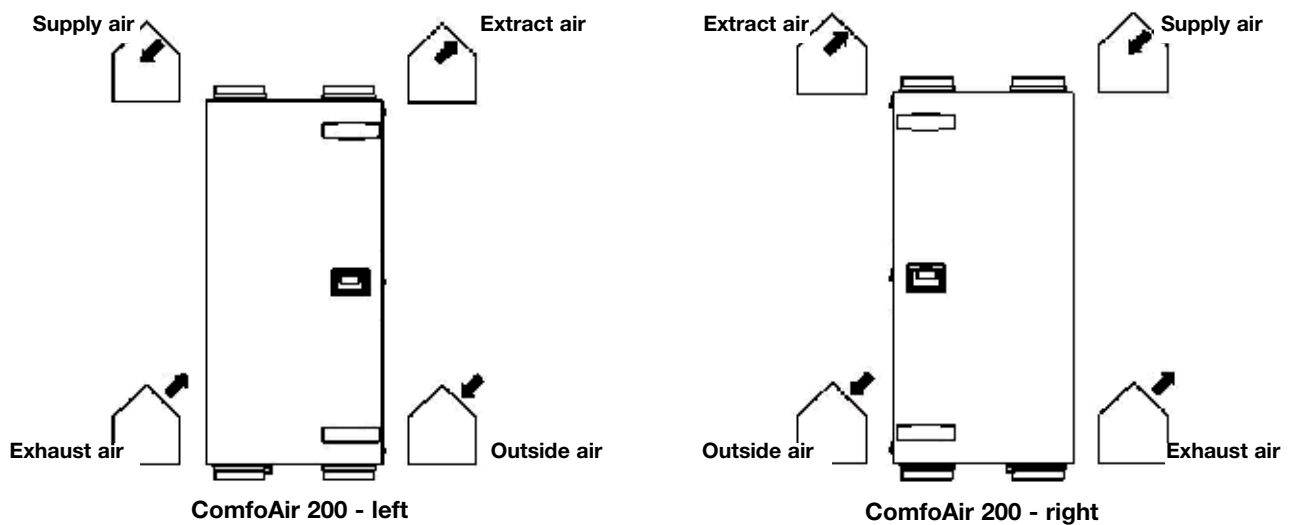
- Automatic frost protection controller
- Timer-controlled filter servicing display
- With automatic and temperature-controlled 100% summer bypass
- Fault history including the last three error messages
- Supply and extract fans can be activated separately.
- Connection option for external intermittent ventilation switch
- Comfort temperature controller
- Chimney sweep control
- Weekly timer programmes

Descriptions

Technical specifications

Heat exchanger:	Plastic
Fans:	EC direct current radial fans
Filters:	Extract air: G4 (MERV 7/8) Outside air: G4 (MERV 7/8) (optional F7 pollen filter (MERV 13))
Condensate connection:	20 mm
Air duct connections:	2x top, 2x bottom DN 5"/6"/6.3"
Electrical connection:	230 V, 50-60 Hz
Temperature range:	44.6 °F to 104 °F
Acoustic performance (min./max.):	Extract air 30 dB(A)/57 dB(A) Supply air 36 dB(A)/73 dB(A)
Heat recovery:	Up to 95%
Volumetric flow:	Maximum 150 cfm at 0.50" wc external Minimum 29 cfm at 0.02" wc external
Power consumption:	Maximum 143 Watt Minimum 9 Watt
Dimensions:	Height: 43.5" (with connections: 47.3") Width: 21.4", Depth 12.7"
Weight:	66.2 lb

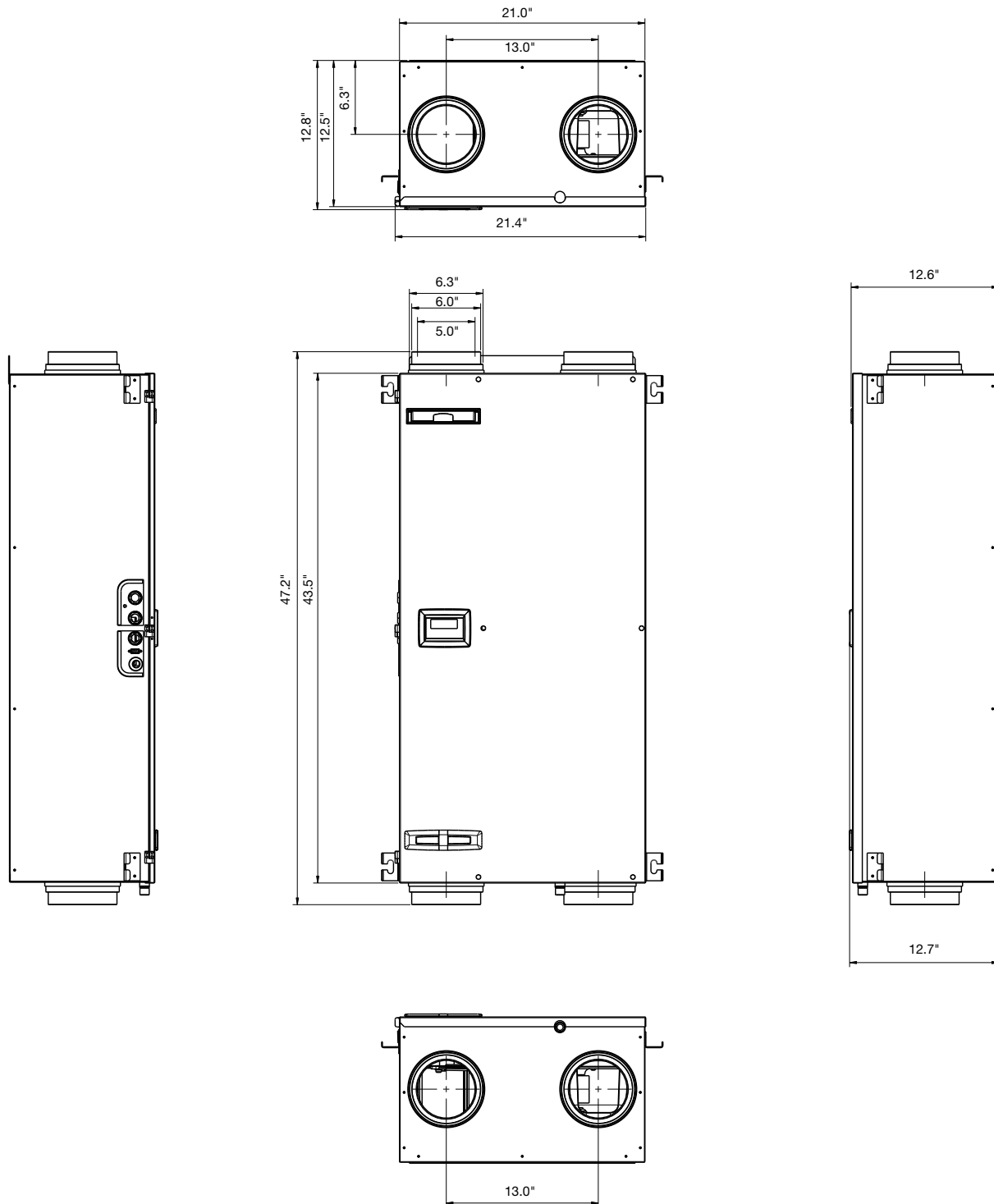
Air direction



Ventilation unit

Zehnder ComfoAir 200

Dimensions



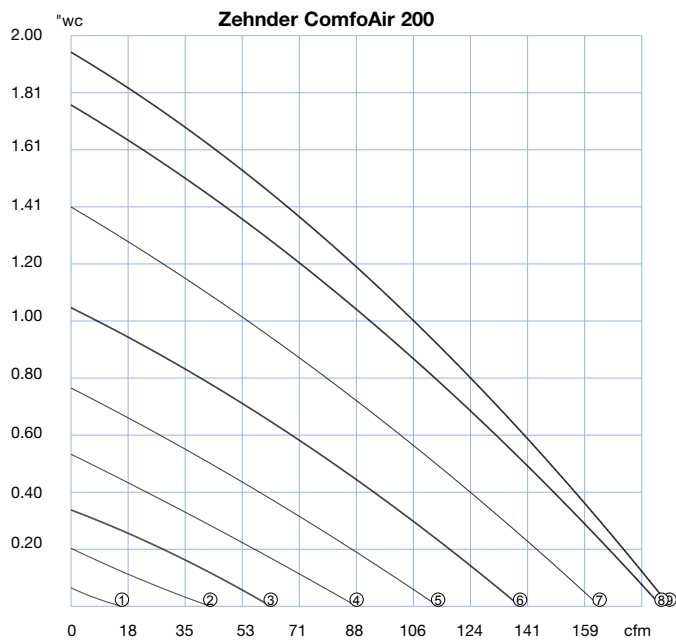
Ventilation unit

Zehnder ComfoAir 200

Stage	Setting	Capacity	Pressure	Power consumption	Current consumption	COS ϕ (-)	Installed noise level		Weight lb
	Percent	Qv	ΔP_{st}	W	A		Extract air	Supply air	
	%	cfm	"wc				dB(A)	dB(A)	

Zehnder ComfoAir 200

(1)	15%	12	0.012	9	0.08	0.48	30	36	66.2
(2)	30%	35	0.028	14	0.11	0.54	35	46	
(3) Low	40%	53	0.060	20	0.16	0.55	37	53	
(4)	50%	71	0.120	30	0.25	0.52	43	59	
(5)	60%	91	0.180	46	0.37	0.55	47	63	
(6) Medium	70%	109	0.281	68	0.55	0.54	51	66	
(7)	80%	127	0.402	98	0.77	0.55	54	69	
(8) High	90%	144	0.482	128	0.99	0.56	56	72	
(9) Maximum	100%	150	0.502	143	1.1	0.57	57	73	



Sound, supply air

Ventilation unit Type	Speed	Acoustic performance at the supply air connection at a distance of 0ft						
		125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
ComfoAir 200	1	41.1	39.6	35.2	30	20.8	12.9	8.7
ComfoAir 200	2	50.3	48.8	44.4	39.2	30	22.1	17.9
ComfoAir 200	3	56	54.8	50.7	48.3	39.4	33.7	24.6
ComfoAir 200	4	61.3	60.4	54.7	54.9	46.1	42.2	35.7
ComfoAir 200	5	66.5	65.4	58.1	58.6	51.8	48.1	43.5
ComfoAir 200	6	69.4	69.3	61.1	61.1	56.5	52.5	49
ComfoAir 200	7	73.2	72.2	63.8	63.4	60.9	56.4	53.6
ComfoAir 200	8	74.9	75.2	66.2	64.9	64	59.1	57
ComfoAir 200	9	75.9	75.9	67.5	65.7	64.8	60.1	58.1

Sound, extract air

Ventilation unit Type	Speed	Acoustic performance at the extract air connection at a distance of 0ft						
		125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
ComfoAir 200	1	43.4	35.2	18.4	12.8	3.2	7.3	14.9
ComfoAir 200	2	47.6	39.4	22.6	17	7.4	11.5	19.1
ComfoAir 200	3	47.5	43.6	28.2	24.7	11.5	11.5	19
ComfoAir 200	4	52	50.1	33.1	31.2	17.4	12.4	18.7
ComfoAir 200	5	57	53.4	39.9	34.4	22.8	14.5	18.8
ComfoAir 200	6	60.1	58	40.6	37	27.3	18.4	19.2
ComfoAir 200	7	63.1	60.8	41.7	38.5	30.5	22.2	19.6
ComfoAir 200	8	65.1	62.8	44.9	40.4	33.3	25.9	20.3
ComfoAir 200	9	65.2	63.9	46.3	41.3	34.3	27.3	21

Sound, unit emission

Ventilation unit Type	Speed	Acoustic performance at the extract air connection at a distance of 0ft					
		125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	db(A)
ComfoAir 200	2	28.5	35.2	23.1	14.5	10.5	23.9
ComfoAir 200	3	34.6	39.4	27.3	19.8	11.8	29.1
ComfoAir 200	4	40.3	43.6	32.4	24.9	18.9	34.6
ComfoAir 200	5	45.3	50.1	35.6	28.7	24.5	39
ComfoAir 200	6	46.8	53.4	43.5	31.9	28.5	43.3
ComfoAir 200	7	49.7	58	41.4	34.1	31.9	44.3
ComfoAir 200	8	52.3	60.8	43.6	36	34.6	46.7
ComfoAir 200	9	53.8	62.8	44.7	36.7	35.5	47.9

ZA-CSY-FLYERTS106, V1211, en_us, subject to changes



Customer Manual



HOT SERIES
(High Output Temperature)

Geothermal Water to Water Heat Pump

- R-134A Refrigerant
- 2 Ton to 20 Ton Single Speed

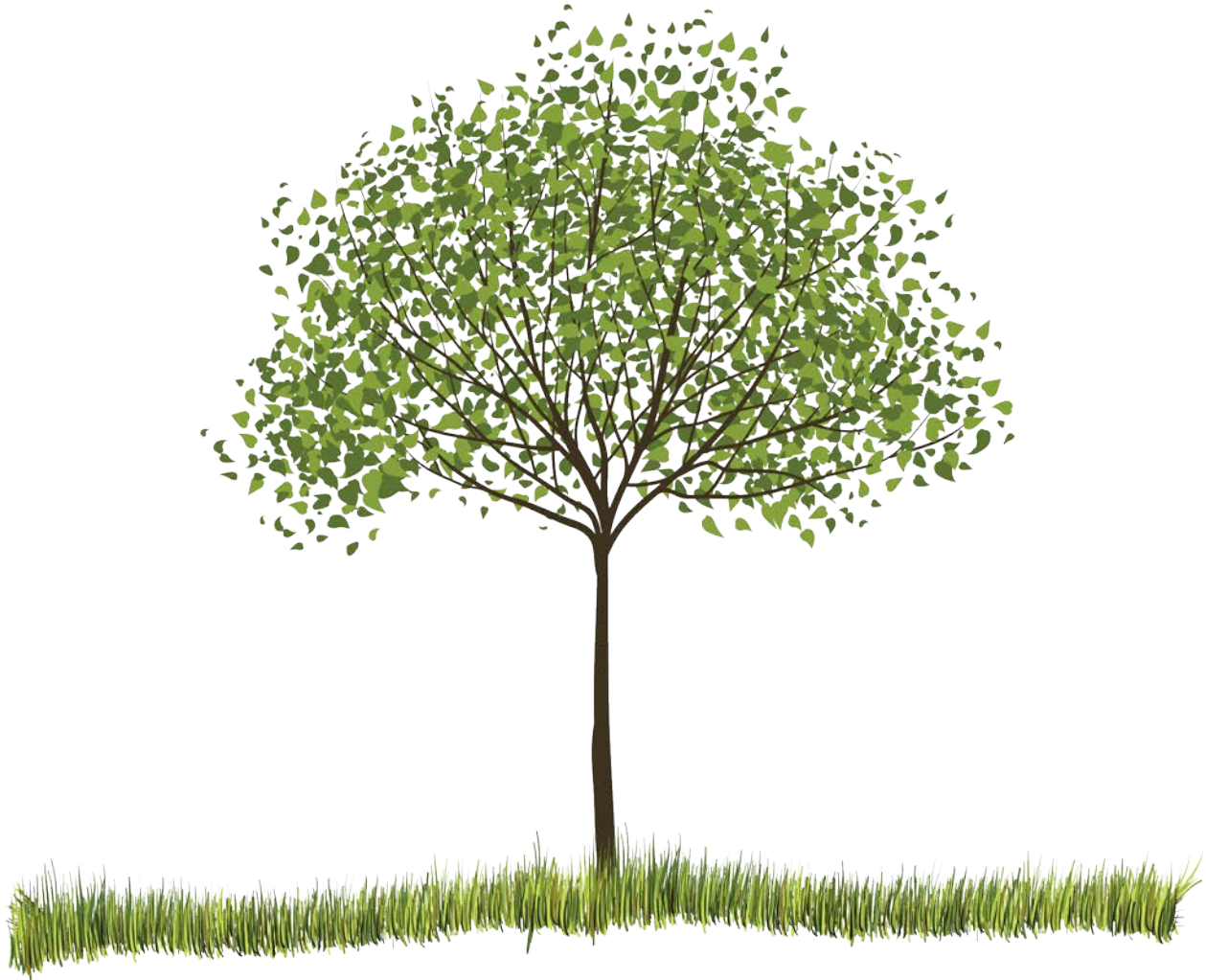


Change is in the Air

You are about to experience a level of comfort and efficiency that many people don't even know exist.

Thank You!

Your investment Helps Everyone!



Your decision to own a Hydro-Temp system puts you in a unique position. Geothermal heat-pumps are known for being GREEN, however green usually means giving something up. In your case not only will you be helping the environment now and for the future, you are providing yourself with the most comfortable indoor environment available today. It is not often you can make an impact on others by providing for yourself.



Thank you for purchasing your new Hydro-Temp geothermal heat pump.

For your convenience please take a minute to record some critical information that could be very beneficial in the future.

Customer Name: _____

Customer Phone Number: _____

Dealer Name: _____

Dealer Phone Number: _____

Date of Installation: _____

Model number: _____

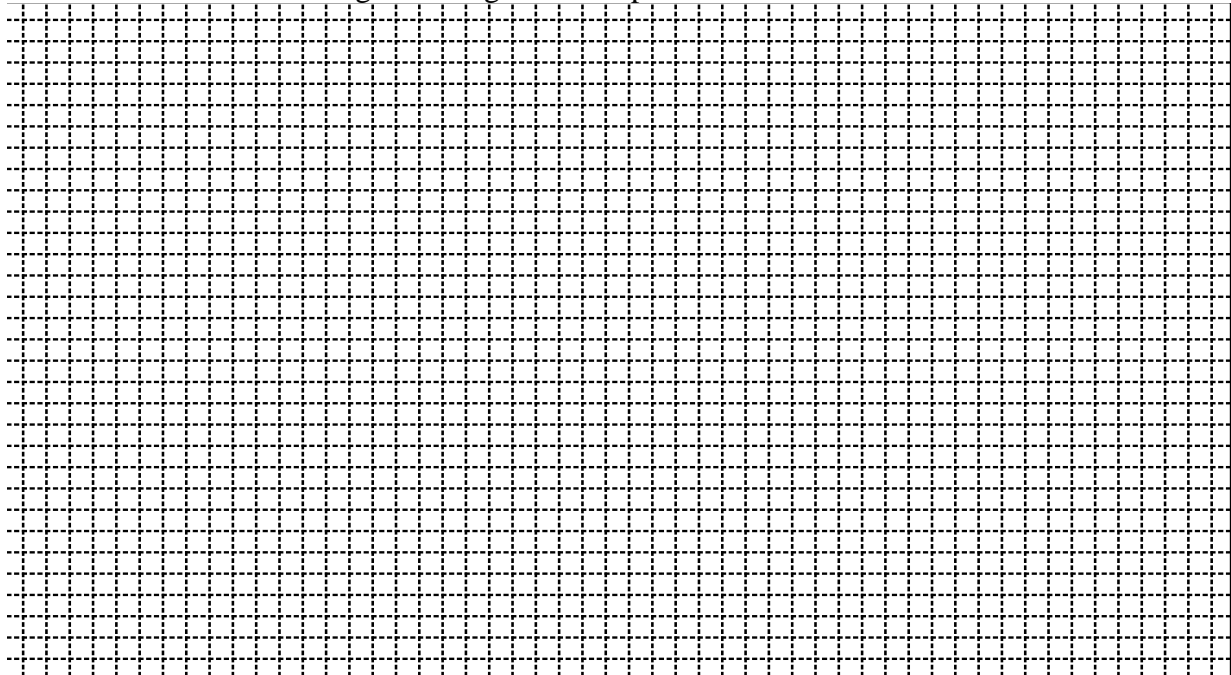
Warranty Information: _____

Serial number _____

Ground loop / Well Water information:

- Well Water: Gallons per minute _____ Discharge into _____
- Horizontal Loop: # of Circuits _____ Circuit length one way _____ ft Average depth _____ ft
- Vertical Loop: # of Circuits _____ Circuit length one way _____ ft
- Pond Loop: # of Circuits _____ Total length per Circuit _____ ft Depth where sunk _____ ft
- Other _____

Use this area to make a rough drawing of the loop in relation to the home.



One block equals _____ feet

Notes:

TABLE OF CONTENTS

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MODEL NOMENCLATURE

V **X** **X** **1** **XXXX** **X** **X** **X** **1** **X** **X** **XXX**

SERIES:
 C = COMMERSIAL
 R = RESIDENTIAL
 V = V-STAR

COMPRESSOR SPEEDS:
 A = SINGLE SPEED
 B = TWO SPEED
 C = THREE SPEED
 D = FOUR SPEED
 E = FIVE SPEED
 F = SIX SPEED
 G = SEVEN SPEED
 H = EIGHT SPEED
 M = MULTI-SPEED
 V = VARIABLE
 X = NON-APPLICABLE

C = CORNER CONSOLE
 H = HORIZONTAL
 L = LONG CONSOLE
 N = NARROW CONSOLE
 O = COMPACT HORIZONTAL
 P = COMPACT VERTICAL
 R = ROOF TOP
 S = SPLIT
 V = VERTICAL
 W = WATER TO WATER
 F = COUNTER FLOW

REFRIGERANT:
 1 = R410A
 2 = R22
 3 = R134A
 4 = R407C
 X = IF NON-APPLICABLE

UNIT BTU OUTPUT:
 BTU X 1000

AIR FLOW DIRECTION:
 X = Unknown at the time of submittal
 A = UPFLOW-RIGHT RETURN
 B = UPFLOW-LEFT RETURN
 C = UPFLOW-BACK RETURN
 D = UPFLOW-TOP RETURN
 E = UPFLOW FRONT (CORNER CONSOLE ONLY)
 F = HORIZONTAL FLOW-RIGHT RETURN
 G = HORIZONTAL FLOW-LEFT RETURN
 H = HORIZONTAL FLOW-BACK RETURN
 I = HORIZONTAL FLOW/ FRONT
 J = COUNTER FLOW-RIGHT RETURN
 K = COUNTER FLOW-LEFT RETURN
 L = COUNTER FLOW-COUNTER RETURN
 M = COUNTER FLOW-BACK RETURN
 N = END RETURN & SUPPLY – LEFT RETURN, RIGHT SUPPLY
 O = END RETURN & SUPPLY – RIGHT RETURN, LEFT SUPPLY

STRIP HEAT:
 XXX = NO STRIP HEAT
 005 = 5KW
 010 = 10KW
 015 = 15KW
 020 = 20KW
 OR TOTAL KW

WATER SOURCE:
 W = OPEN LOOP/WELL WATER
 C = CLOSED LOOP
 T = COOLING TOWER
 X = IF NON-APPLICABLE

Microprocessor:
 X = TERMINAL STRIP
 1 = GEORGIA CONTROL/HYDRO-TEMP
 2 = AUTOMATED LOGIC/583
 3 = AUTOMATED LOGIC/6126
 4 = END USER DDC

VOLTAGE/PHASE:
 1 = 208/230V-1 PHASE
 2 = 115V-1PHASE
 3 = 208/230V-3 PHASE
 4 = 460V-3 PHASE
 5 = 575V-3 PHASE
 6 = 265/277V-1 PHASE
 7 = 380V - 3 PHASE

HOT WATER OPTIONS:
 X = NO HOT WATER
 B = DESUPERHEATER AND INFLOOR*
 C = DESUPERHEATER AND POOL HEATING*
 D = DESUPERHEATER
 E = HYDROZONE AND DESUPERHEATER*
 F = HYDROZONE AND INFLOOR*
 G = HYDROZONE AND POOL HEATING*
 H = HYDROZONE
 I = INFLOOR
 J = INFLOOR AND POOL HEATING*
 O = DHW PRIORITY AND HYDROZONE*
 P = DHW PRIORITY
 Q = DHW PRIORITY AND INFLOOR*
 R = DHW PRIORITY AND POOLING HEATING*
 S = POOL HEATING
 (SELECT ONLY ONE)
 *THIS OPTION IS NOT AVAILABLE IN CONSOLE OR COMPACT MODELS

WATER PLUMBING LOCATION:
 R = WATER THROUGH RIGHT SIDE
 L = WATER THROUGH LEFT SIDE
 B = WATER THROUGH BACK
 C = WATER THROUGH BOTTOM
 T = WATER THROUGH TOP
 F = WATER THROUGH THE FRONT
 X = NO WATER/UNKNOWN PLUMBING LOCATION

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Contact Information:

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 P.O. Box 566
 3636 Hwy 67 South
 Pocahontas, AR 72455
 870-892-8343
www.Hydro-Temp.com

Do not install, operate, or maintain this equipment before carefully reading the instruction manual. Additional copies of this manual are available from the installing dealer or from *Hydro-Temp™* Corporation. Save these and any other operating instructions for yourself and any future owners of this equipment.

1.0 Transportation & Storage

Move and store units in an upright position. Do not stack units. Inspect shipment for shipping damage and check packing slip for accuracy. Any equipment or cartons in question should be removed from the packing and physically inspected. If any damage is detected, the carrier should make a note on the delivery slip acknowledging the damage.

During freezing conditions special consideration should be made to prevent unit damage. **If a unit is taken to the job site or put in storage, anti-freeze will need to be pumped into the water coils to prevent freezing.** Failure to do this will void warranty.

2.0 Electrical Hazard Warnings

THE FOLLOWING IS A GENERAL WARNING STATEMENT WHICH SHOULD BE READ AND UNDERSTOOD BEFORE OPERATING YOUR NEWHYDRO-TEMP™ UNIT.

There are no end user maintenance items inside the cabinet of the unit. If the unit operates unusually or develops a leak, turn off all electrical power to unit and call your service technician.



ELECTRIC SHOCK CAN KILL!!

- Always protect yourself and others. Always turn off system power before removing panels. Some units may have more than one or two power supplies.
- Keep all covers and panels in place at all times. Do not open panel/doors. Removing panel/doors present an Electric shock and/or pinch hazard.
- Do not stick hands into return or any other opening.
- All repairs, electrical or mechanical, should be attempted only by trained *Hydro-Temp™* technicians. In the event of a unit problem, do not reset the equipment before correcting the problem. Equipment failure due to resetting without first correcting the problem will not be covered by the warranty.
- The presence of water around the base of the unit constitutes an electrical hazard. Turn off the power to the unit as soon as water leakage is discovered and call a service technician immediately.

3.0 Preventative Maintenance

YOUR *HYDRO-TEMP™* WATER SOURCE HEAT PUMP HAS BEEN BUILT TO BE VIRTUALLY MAINTENANCE FREE IF PROPERLY MAINTAINED. THERE ARE ONLY A FEW THINGS YOU NEED TO DO TO KEEP YOUR SYSTEM RUNNING AS EFFICIENTLY AS POSSIBLE.

IT'S STRONGLY RECOMMENDED TO HAVE THE SYSTEM CHECKED ONCE A YEAR BY A TRAINED SERVICE PROFESSIONAL. MANY INSTALLING DEALERS OFFER PREVENTATIVE MAINTENANCE CHECKS.

WARNING! BEFORE PERFORMING SERVICE OR MAINTENANCE ON THE SYSTEM, TURN OFF ALL BREAKERS INCLUDING MAIN POWER AND POWER TO OPTIONAL AUXILIARY HEATER. WAIT FIVE MINUTES BEFORE REMOVING ANY PANELS TO ALLOW POWER TO DISSIPATE FROM VARIABLE FREQUENCY DRIVES. ELECTRICAL SHOCK CAN CAUSE PERSONAL INJURY OR DEATH.

DO NOT OPEN PANELS/DOORS! DANGER OF ELECTRICAL SHOCK AND/OR PINCH HAZARD!

- Give the unit an occasional visual check. Look for water around the base of the unit and listen for any unusual noises.
- Closed loop systems are a sealed system unless an auto purge tank is used. If totally sealed they require no physical maintenance short of visual inspection for leaks. If your system was installed with an auto purge tank / kit it is recommended to check the fluid level in the tank once a month when you replace the air filter. Ensure the fluid level in the tank is between $\frac{1}{2}$ and $\frac{3}{4}$ of the way full. It should be rare to have to add fluid after the first year. If you are required to add fluid more than a few times after the first year contact the installing dealer to have the anti-freeze levels checked. Never fill more than $\frac{3}{4}$ of the way full to prevent over flow.



IMPORTANT NOTICE: UNITS THAT UTILIZE GROUND LOOPS OR CHILLED WATER LOOPS MUST MAINTAIN A MINIMUM OF 20% METHANOL OR 25% PROPYLENE GLYCOL

AS AN ANTIFREEZE SOLUTION IN THE UNIT AND GROUND LOOP AT ALL TIMES. FAILURE TO DO SO WILL ALLOW REFRIGERANT TEMPERATURES TO DROP, CAUSING INTERNAL FREEZING OF THE UNIT TO OCCUR, CAUSING SEVERE DAMAGE TO THE UNIT. **DAMAGE TO THE UNIT CAUSED BY FAILURE TO MAINTAIN PROPER ANTIFREEZE LEVELS IS NOT COVERED UNDER WARRANTY.**

- Open loop systems require well water to be pumped through the system. For this reason Hydro-Temp recommends the installing dealer to install isolation valves and a water strainer on the entering water line feeding water to the Hydro-Temp system. Be aware of the location of these components in the event the strainer needs to be cleaned more often than once a year during your preventive maintenance check. Be aware of all isolation valves so cleaning can be done with minimal water spillage. It's a good idea to be familiar with the location of the isolation valves in the event of a major waterleak. All open loop systems have a discharge water line that discharges the water to a discharge well, creek, pond, etc. **Check local state and county codes for proper discharge of water.** Be aware of discharge location and check occasionally to insure proper drainage is occurring. During the winter, insure discharge is protected from freezing. Do not attach any kind of sprinkler to the end of the discharge water line as the increase in back pressure will result in decreased water flow and damage the Hydro-Temp system.
- Most systems are now equipped with controllers that allow for a system lock out feature. If the system trips a protective limit switch 3 consecutive times the system will lockout. If the system locks out power will need to be cycled to reset the lockout. Before resetting the lockout you must always insure the problem causing the lockout has been repaired. If unsure consult your installing dealer before resetting the lockout.
- Be aware of all breaker locations. Some systems may have two breakers for the compressor section.

ADDITIONAL REMINDERS:

Chemicals, cleaners, inhibitors or other products that corrode or attack copper (such as Trisodium Phosphate) should never be placed into the water circulation loop(s) connected to the Hydro-Temp equipment or stored in the same room as the Hydro-Temp equipment. Failure to follow this requirement will void the equipment warranty.

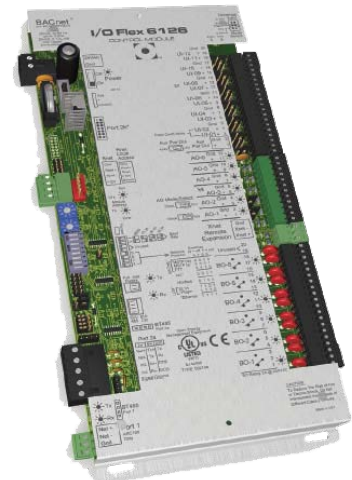
Protect the *Hydro-Temp™* unit from freezing temperatures. If the system is in your attic or outside special precautions may need to be taken to ensure freeze protection.

The *Hydro-Temp™* unit should never be exposed to a dirty or dusty air environment. Dust, such as sawdust or sheet rock dust, can damage the electrical components. Simply place a cover (tarp, etc.) over the unit when construction or any other dust producing job is being done in the area of the *Hydro-Temp™* unit.

- If the unit is ever moved from its original location, never lay it on its side. Never jar or drop the unit during transport. This is a sealed refrigeration system; rough handling may cause the system to develop a leak. Once removed, protect the system from freezing. Anti-freeze may need to be flushed into the plumbing. When being reinstalled, anti-freeze levels will need to be checked.
- All plumbing from the Hydro-Temp system to the hot water tank may require a licensed plumber. If any repairs are ever needed, insure all plumbing is done / maintained with **copper tubing only**. **Do not use PVC, CPVC, PEX or any other plastic pipe.**
- Keep an accurate service record. Keep a copy of all service reports with this booklet.

4.0 Controls and Touch Screen Display

On systems with controllers a **master switch** is located on the front right corner of the unit. The purpose of the switch is to disable the unit from running without turning off the power. Caution **MUST** be taken when opening the unit for service work as the master switch does not disconnect power. The unit is still powered with the master switch off. This switch is useful when needing to shut down the system for filter replacement or system operation is not needed but thermostats are to remain powered.



4.1 Thermostat / Tank sensor

Most water to water systems do not require a thermostat like you are accustomed to seeing mounted on the wall. These systems will have a sensor that gets mounted on the tank / buffer tank. It's very important to insure the sensor is making good contact with the surface of the tank. It's also a good idea to insure the sensor will not come loose by putting some sort of sealant on the sensor then covering the sensor with insulation. Inspect the sensor periodically to insure good surface contact, if the sensor comes loose damage could be caused to the system.

4.1.2 Protostar Equipment Touch Display / Monitoring System (Option)

The Protostar touch screen display is custom programmed to fit the needs of the hot water heating system. The Equipment Touch will provide real time system information. It will include navigation buttons to access graphics and text screens that show real time readings from the system including safety switch status, compressor status, etc. Password protected factory screens are also created to edit factory settings if needed.

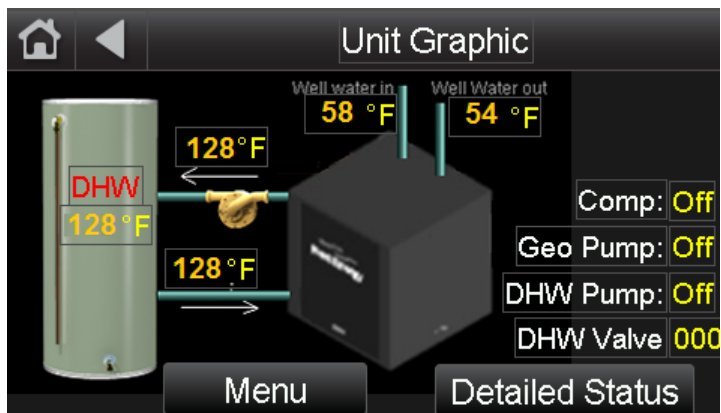


4.1.3 Protostar Equipment Touch Display / Home Screen

The home screen (Shown above) will show the current tank temperature, compressor status and pump status.

4.1.4 Protostar Equipment Touch Display / Unit Graphic Screen

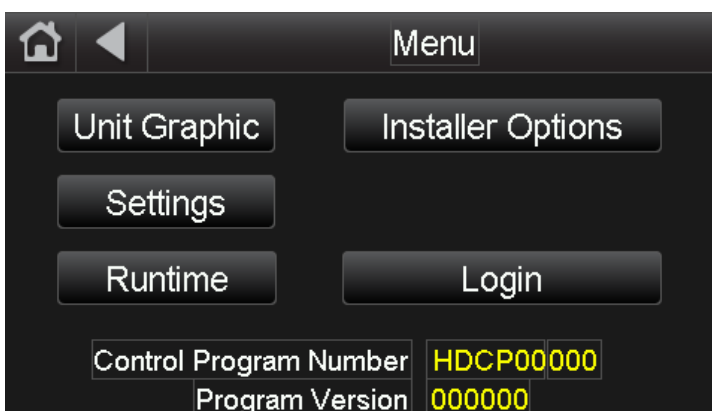
The Unit Graphic screen shows a graphic of the system with real time temperature values and component status.



4.1.5 Protostar Equipment Touch Display / Menu Screen

The Menu Screen shows buttons to access all available screens. Some screens may be password protected.

Also displayed at the bottom will be the control program number and program version.



4.1.6 Protostar Equipment Touch Display / Settings Screen

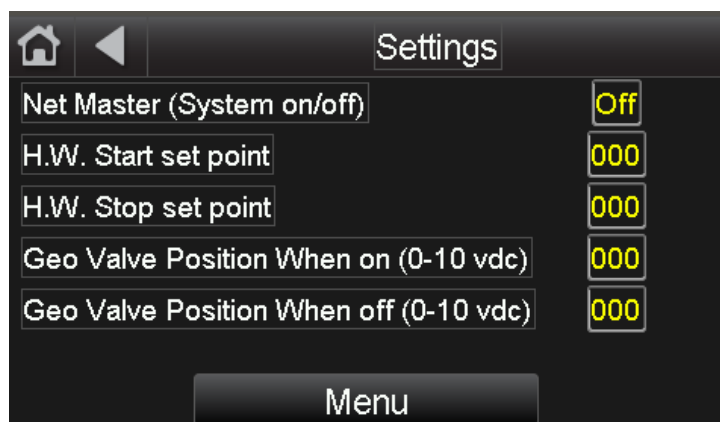
The Settings screen allows the end user a way to adjust system set points.

Net Master – should always be on for normal system operation. Turning this off will disable the system.

Hot water Start – The temperature the system will kick on to make hot water.

Hot water stop – The temperature the system will shut off when making hot water.

Geo valve position settings allows installing contractor to set the geo loop valve positions.



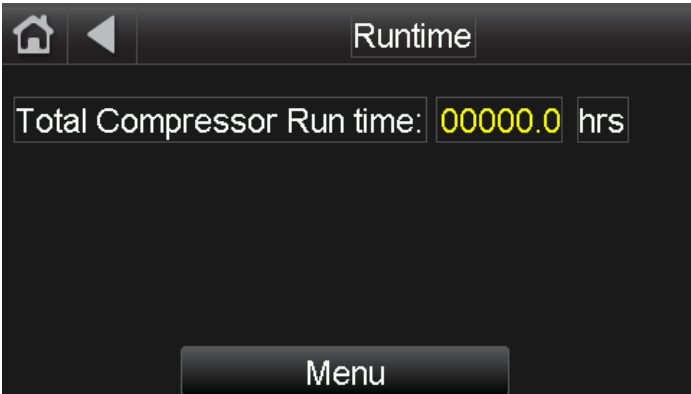
4.1.7 Protostar Equipment Touch Display / Detailed status Screen

The detailed status screen shows the status of all input, outputs and system safeties.

Master Switch status	Off	Off
Enable status	Tripped##	
Limit Delay (0 = no delay)	000.0	
Enable Delay (0 = no delay)	000.0	
Compressor status	Off	
Compressor High Pressure	000.0 psi	
Hot Water Loop Pump status	Off	
Geo/Grnd Loop Pump status	Off	
Geo/Grnd Loop valve status	00.0	
Hot Water Mod valve (0-10)	00.0	vdc
Hot Water Tank Temp	000.0 °F	
Hot water inlet Temp	000.0 °F	
Hot Water outlet Temp	000.0 °F	
Geo Entering water Temp	000.0 °F	
Geo Exiting water Temp	000.0 °F	
Freeze protection Temp	000.0 °F	
Sensor check status	Tripped##	
Compressor oil Float (option)	Tripped##	
High Pressure SW status	Off##	
High Pressure SW trips	00.00	
Low Pressure SW status	Off##	
Low Pressure SW trips	00.00	
Limit lockout status	LocOUT	
Freeze prot lockout status	Off##	

4.1.8 Protostar Equipment Touch Display / Compressor runtime screen

The run time screen shows the time in hours the compressor has ran.



Fittings

Part Number	Description	Quantity
A2631252	Manifold Supply and Return Ball Valves, set of 2	2
A2670601	EP Heating Manifold Assembly with Flow Meter, 6-loop	1
Q4690625	ProPEX Ring with Stop, 5/8"	12
Q4020625	5/8" ProPEX Fitting Assembly, R20 Thread	12
A4133210	Brass Manifold Adapter, R32 x 1" Adapter or 1 1/4" Fitting Adapter	4
A2670401	EP Heating Manifold Assembly with Flow Meter, 4-loop	1
Q4020500	1/2" ProPEX Fitting Assembly, R20 Thread	8
Q4690512	ProPEX Ring with Stop 1/2" (blue print)	8

Accessories

Part Number	Description	Quantity
E6122000	Brass Manifold Pressure Test Kit	2
A5500625	1" PVC Elbow for 5/8" PEX Bend Support	12
A7031000	Fixing Wire (1000/pkg)	2
A5500500	3/4" PVC Elbow for 3/8" and 1/2" PEX Bend Support	8
E6061000	Tube Uncoiler	1
E6081128	Tube Cutter (plastic) for up to 1" PEX (3/4" MLC Tubing)	1

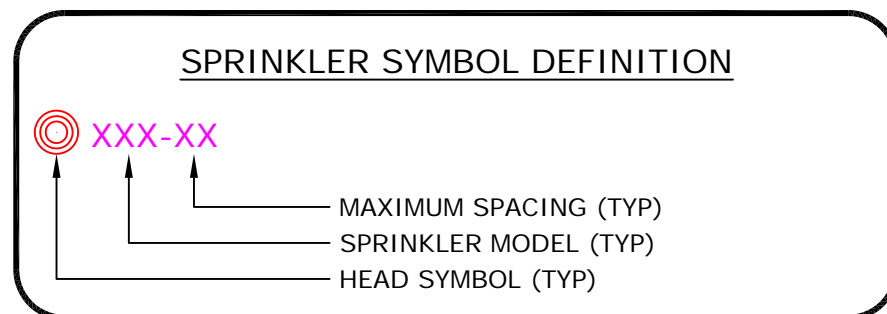
Tubing

Part Number	Description	Quantity
A1220625	5/8" Wirsbo hePEX plus, 1,000 ft. coil	1
A1250625	5/8" Wirsbo hePEX plus, 300 ft. coil	2
A1260500	1/2" Wirsbo hePEX, 500 ft. coil	2

Controls

Part Number	Description	Quantity
A3030522	Two-wire Thermal Actuator (for EP Heating Manifold)	10

Markup Legend	
Delete Line	
Add Line	
Add Tee	
Add Elbow	
Add Coupling	
Add Head	
Delete Head	
Move Head	



COLOR/LINETYPE LEGEND	
	BLUE LINES= FEED TO FIXTURES (BATH, SHOWER, ETC.).
	GREEN LINES= INTERLEVEL CONNECTIONS/SUPPLY.
	BLACK LINES= SPRINKLER HEAD TO SPRINKLER HEAD.
	= 1/2" PIPE SIZE
	= 3/4" PIPE SIZE
	= 1" PIPE SIZE
	= 1-1/4" PIPE SIZE

Multipurpose Fire Safety Systems
 The Uponor Residential Fire Safety System is a residential fire protections system installed in combination with the cold side of the domestic potable water system. Only licensed contractors trained by Uponor can install this system.

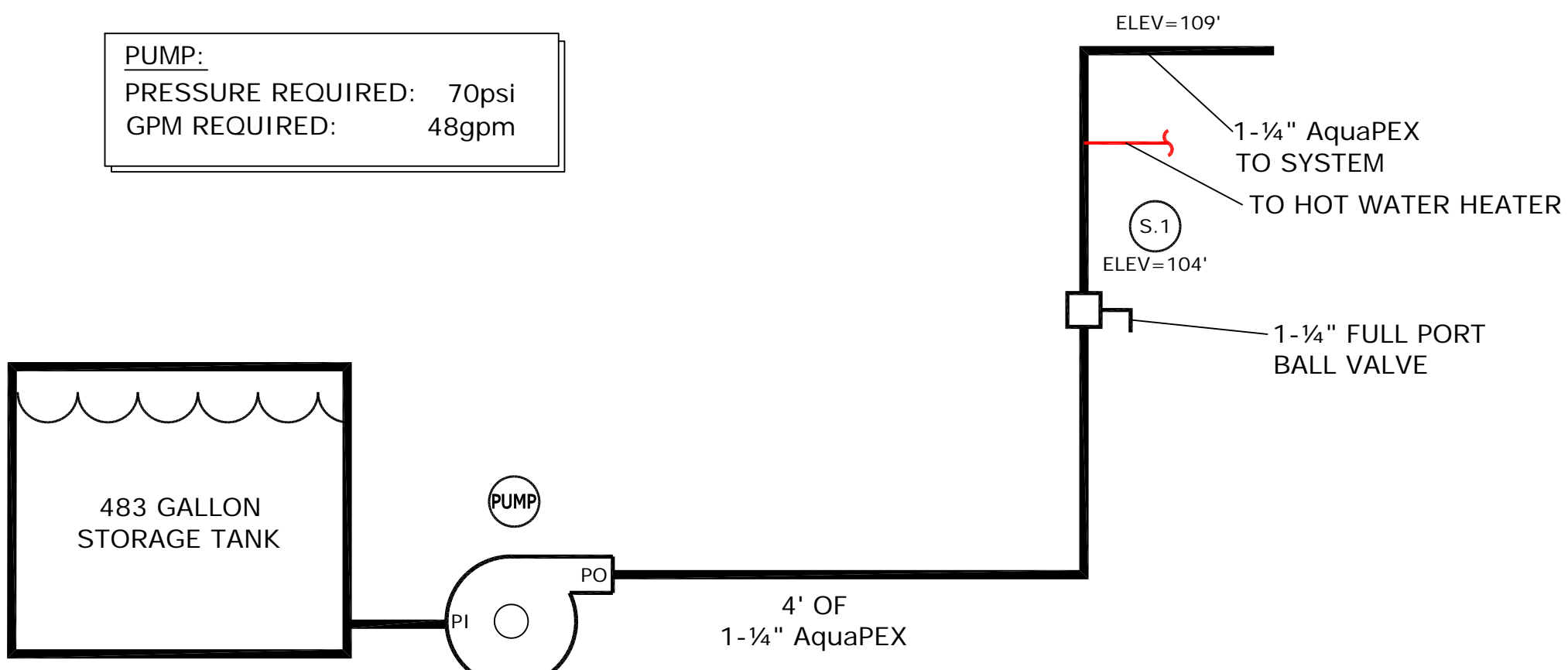
What to do if Changes are Required
 If any features or obstructions require the addition or deletion of sprinkler heads, or significant relocation of sprinkler heads, contact the Uponor Design Department to determine if observed changes require a redesign (888.594.7726).

MOST HYDRAULICALLY REMOTE HEADS			
HEAD #	GPM	PRESSURE REQ'D AT STREET	
1 HEAD H.7	24	47.77	
2 HEAD H.7 & H.3	48.3264	62.51	

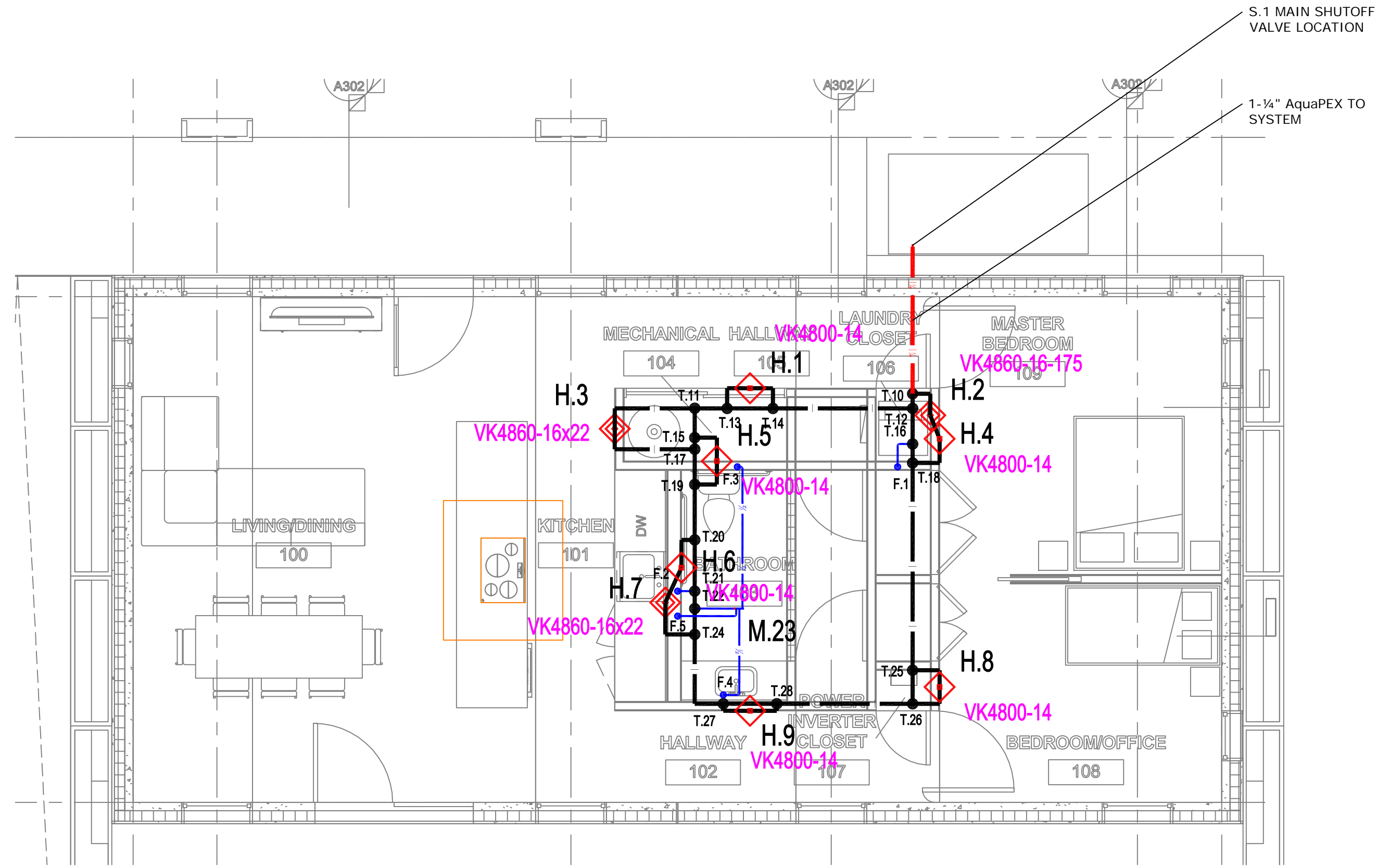
- 6 VIKING Model VK4800-< Residential Concealed HSW-Deflector 4-6 below Clg K=4, 165F°, 3/8" Orifice, Maximum Spacing 14'x14' Sprinkler head demand: 13 gpm @ 10.6
- 1 VIKING Model VK4860-< Residential HSW-Deflector 4-6 below Clg K=4, 175F°, 3/8" Orifice, Maximum Spacing 16'x16' Sprinkler head demand: 13 gpm @ 10.6
- 2 VIKING Model VK4860-< Residential HSW-Deflector 4-6 below Clg K=4, 155F°, 3/8" Orifice, Maximum Spacing 22'x16' Sprinkler head demand: 24 gpm @ 36

WELL CASING AND/OR TANK TO PROVIDE 483 GALS OF STORAGE. WELL PUMP TO PROVIDE MINIMUM 48.326GPM @ 62.51 PSI AT MANIFOLD S.1

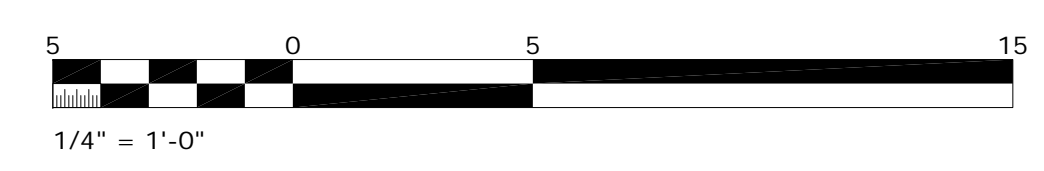
PUMP:
 PRESSURE REQUIRED: 70psi
 GPM REQUIRED: 48gpm



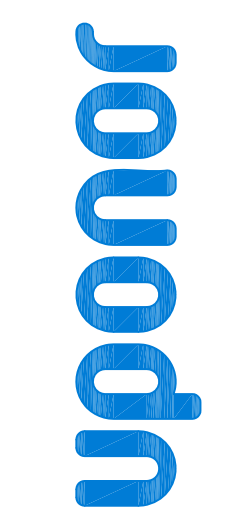
2 WATER SERVICE DETAIL
 F100 NTS



1 MAIN LEVEL
 F100 1/4" = 1'-0"



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SALES REP:

WUSTL SOLAR DECATHALON
 1 BROOKINGS DRIVE
 ST LOUIS, MO 63103

PROJECT NUMBER:	21738F	COMPANY:	WASHINGTON UNIVERSITY
DRAWN BY:	PATRICK BROWN	CONTACT:	TIM MICHELIS
CHECKED BY:	BRETT KOTULA	CONTACT PH. NUMBER:	314.644.0000
CERTIFICATION LEVEL:	SET IV	ALLIANCE ID:	TBD
CERTIFICATION NUMBER:	113889	PLOT DATE:	2/15/17
SQUARE FEET:	188 SQ. FT.	SHEET SCALE:	1/4" = 1'-0"
NO.	DATE	REVISIONS	DESCRIPTION

SHEET DESCRIPTION
 MAIN LEVEL

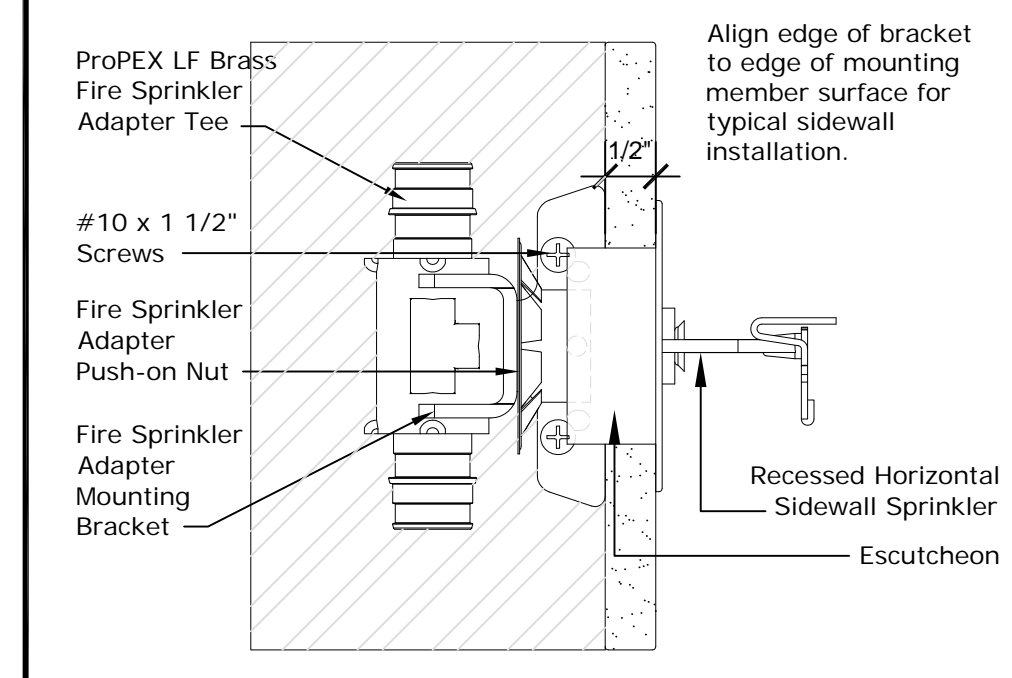
SHEET NUMBER
 F100

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AquaSAFE™ GENERAL NOTES:

- THIS SYSTEM IS DESIGNED AS PER NFPA 13D 2016 EDITION AS A RESIDENTIAL MULTIPURPOSE SYSTEM SECTION 3.3.11.3.
- UPONOR COMPANY RESERVES THE EXCLUSIVE RIGHTS TO ALL DETAILS AND DRAWINGS AS SHOWN ON THIS SHEET. THESE DETAILS AND DRAWINGS ARE PROPRIETARY INFORMATION OF UPONOR COMPANY AND UNAUTHORIZED USE MAY BE SUBJECT TO PROSECUTION TO THE FULL EXTENT OF THE LAW.
- THE DESIGN OF THIS SYSTEM IS DICTATED BY SPECIFIC CEILING HEIGHTS AND ROOM SIZES. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT THE CONDITIONS SHOWN ON THESE PLANS ARE EXACTLY AS THEY EXIST IN THE FIELD. DEVIATIONS FROM THE DESIGN MAY CAUSE THE SYSTEM TO BE UNABLE TO CONTROL A FIRE. IF THE BUILDING CONSTRUCTION DIFFERS FROM THE FIRE SPRINKLER PLAN, CONTACT THE SYSTEM DESIGNER IMMEDIATELY.
- THIS SYSTEM AND THE ACCOMPANYING HYDRAULIC CALCULATIONS ARE DESIGNED IN COMPLIANCE WITH NFPA 13D 2016 EDITION.
- "STAND-ALONE" OR "MULTIPURPOSE, WET PIPE" SYSTEMS ARE NOT PERMITTED TO USE ANTI-FREEZE.
- MODIFICATIONS ARE PROHIBITED. SPRINKLERS THAT HAVE BEEN PAINTED, CAULKED, MODIFIED OR DAMAGED MUST BE REPLACED.
- WATER SHUT OFF VALVE IS NOT PERMITTED THAT ISOLATES THE SPRINKLER SYSTEM.
- OWNERS MANUAL MUST BE PROVIDED TO THE OWNER.
- AT THE MAIN SHUT OFF VALVE, A TAG OR A SIGN STATING THE FOLLOWING IS REQUIRED: "WARNING, THE WATER SYSTEM FOR THIS HOME SUPPLIES FIRE SPRINKLERS THAT REQUIRE CERTAIN FLOWS AND PRESSURES TO FIGHT A FIRE. DEVICES THAT RESTRICT THE FLOW OR DECREASE THE PRESSURE OR AUTOMATICALLY SHUT OFF THE WATER TO THE FIRE SPRINKLER SYSTEM, SUCH AS WATER SOFTENERS, FILTRATION SYSTEMS AND AUTOMATIC SHUT OFF VALVES, SHALL NOT BE ADDED TO THIS SYSTEM WITHOUT REVIEW OF THE FIRE SPRINKLER SYSTEM BY A FIRE PROTECTION SPECIALIST. **DO NOT REMOVE THIS SIGN**".
- ALL INTERIOR PIPING TO BE UPONOR "AquaPEX®" UNLESS NOTED.
- UPONOR "AquaPEX" TUBING TO BE SUPPORTED PER NFPA 13D AND MANUFACTURER'S RECOMMENDATIONS.
- MINIMUM SPACING BETWEEN SPRINKLERS IS 8'-0" REFER TO SPACING CHARTS FOR MAXIMUM SPACING BETWEEN SPRINKLERS AND FROM WALLS. SPRINKLER HEAD MANUFACTURERS MAY HAVE MORE RESTRICTIVE SPACING LIMITATIONS.
- SPRINKLERS ARE NOT NECESSARILY CENTERED IN ROOMS DUE TO LIGHT FIXTURES OR OTHER CEILING MOUNTED OBSTRUCTIONS.
- THE PLUMBING TIE IN CONNECTIONS ARE SCHEMATIC IN NATURE AND CAN BE INSTALLED OFF THE SPRINKLER LOOP ANYWHERE BETWEEN SPRINKLER TO SPRINKLER CONNECTION.
- THIS SUGGESTED LAYOUT IS BASED UPON INFORMATION PROVIDED BY OTHERS. CHANGES IN CONSTRUCTION OR FIELD CONDITIONS MAY OCCUR WHICH MAY REQUIRE CHANGES TO THE LAYOUT. IT IS THE RESPONSIBILITY OF THE INSTALLER TO NOTIFY UPONOR TECHNICAL SERVICES OF SUCH CHANGES.
- NFPA 13D 8.2.5* OBSTRUCTIONS TO RESIDENTIAL SPRINKLERS
 - 8.2.5.6* SHADOW AREAS SHALL BE PERMITTED IN THE PROTECTION AREA OF A SPRINKLER AS LONG AS THE CUMULATIVE DRY AREAS DO NOT EXCEED 15 FT² PER SPRINKLER.
 - 8.2.5.7 SMALL AREAS CREATED BY ARCHITECTURAL FEATURES, SUCH AS PLANTER BOX WINDOWS, BAY WINDOWS, AND SIMILAR FEATURES, SHALL BE EVALUATED AS FOLLOWS:
 - WHERE NO ADDITIONAL FLOOR AREA IS CREATED BY THE ARCHITECTURAL FEATURE, NO ADDITIONAL SPRINKLER PROTECTION IS REQUIRED.
 - WHERE ADDITIONAL FLOOR AREA IS CREATED BY AN ARCHITECTURAL FEATURE, NO ADDITIONAL SPRINKLER PROTECTION IS REQUIRED, PROVIDED ALL OF THE FOLLOWING CONDITIONS ARE MET:
 - THE FLOOR AREA SHALL NOT EXCEED 18 FT² (1.7 M²)
 - THE FLOOR AREA SHALL NOT BE GREATER THAN 2 FT IN DEPTH AT THE DEEPEST POINT OF THE ARCHITECTURAL FEATURE TO THE PLANE OF THE PRIMARY WALL WHERE MEASURED ALONG THE FINISHED FLOOR.
 - THE FLOOR SHALL NOT BE GREATER THAN 9 FT IN LENGTH WHERE MEASURED ALONG THE PLANE OF THE PRIMARY WALL.
 - MEASURED FROM THE DEEPEST POINT OF THE ARCHITECTURAL FEATURE TO THE SPRINKLER SHALL NOT EXCEED THE MAXIMUM LISTED SPACING OF THE SPRINKLER.
 - THE HYDRAULIC DESIGN SHALL NOT BE REQUIRED TO CONSIDER THE AREA CREATED BY THE ARCHITECTURAL FEATURE.
- NFPA 13D 8.3 LOCATION OF SPRINKLERS.
 - 8.3.1 SPRINKLERS SHALL BE INSTALLED IN ALL AREAS EXCEPT WHERE OMISSION IS PERMITTED BY 8.3.2 THROUGH 8.3.8.
 - 8.3.2 SPRINKLERS SHALL NOT BE REQUIRED IN BATHROOMS OF 55 FT² (5.1 M²) AND LESS
 - 8.3.3 SPRINKLERS SHALL NOT BE REQUIRED IN CLOTHES CLOSETS, LINEN CLOSETS, AND PANTRIES THAT MEET ALL OF THE FOLLOWING CONDITIONS:
 - THE AREA OF THE SPACE DOES NOT EXCEED 24 FT² (2.2 M²).
 - THE WALLS AND CEILINGS ARE SURFACED WITH NONCOMBUSTIBLE OR LIMITED-COMBUSTIBLE MATERIALS AS DEFINED IN NFPA 220, STANDARD ON TYPES OF BUILDING CONSTRUCTION.
 - 8.3.4* SPRINKLERS SHALL NOT BE REQUIRED IN GARAGES, OPEN ATTACHED PORCHES, CARPORTS, AND SIMILAR STRUCTURES
 - 8.3.5 SPRINKLERS SHALL NOT BE REQUIRED IN ATTICS WITH OR WITHOUT STORAGE, PENTHOUSE EQUIPMENT ROOMS, ELEVATOR MACHINE ROOMS, CONCEALED SPACES DEDICATED EXCLUSIVELY TO AND CONTAINING ONLY DWELLING UNIT VENTILATION EQUIPMENT, FLOOR/CEILING SPACES, ELEVATOR SHAFTS, CRAWL SPACES, AND OTHER CONCEALED SPACES THAT ARE NOT USED OR INTENDED FOR LIVING PURPOSES.
 - 8.3.5.1 SUCH SPACES THAT CONTAIN FUEL-FIRED EQUIPMENT SHALL ALSO COMPLY WITH 8.3.5.1.1 OR 8.3.5.1.2.
 - 8.3.5.1.1 WHERE THE FUEL-FIRED EQUIPMENT IS ABOVE ALL OF THE OCCUPIED AREAS OF THE DWELLING UNIT, NO SPRINKLER PROTECTION SHALL BE REQUIRED IN THE CONCEALED SPACE.
 - 8.3.5.1.2 WHERE FUEL-FIRED EQUIPMENT IS BELOW OR ON THE SAME LEVEL AS OCCUPIED AREAS OF THE DWELLING UNIT, AT LEAST ONE QUICKRESPONSE INTERMEDIATE TEMPERATURE SPRINKLER SHALL BE INSTALLED ABOVE THE EQUIPMENT OR AT THE WALL SEPARATING THE SPACE WITH THE FUEL-FIRED EQUIPMENT FROM THE OCCUPIED SPACE.
 - 8.3.6 SPRINKLERS SHALL NOT BE REQUIRED IN COVERED, UNHEATED PROJECTIONS OF THE BUILDING AT ENTRANCES/EXITS AS LONG AS THE DWELLING UNIT HAS ANOTHER MEANS OF EGRESS.
 - 8.3.7 SPRINKLERS SHALL NOT BE REQUIRED FOR CEILING POCKETS THAT MEET THE FOLLOWING CONDITIONS:
 - THE TOTAL VOLUME OF ALL UNPROTECTED CEILING POCKETS IN A COMPARTMENT DOES NOT EXCEED 100 FT³ (2.83 M³).
 - THE ENTIRE FLOOR UNDER THE UNPROTECTED CEILING POCKET IS PROTECTED BY THE SPRINKLERS AT THE LOWER CEILING ELEVATION.
 - * THE INTERIOR FINISH OF THE UNPROTECTED CEILING POCKET EXCLUDING DECORATIVE TREATMENTS IS NONCOMBUSTIBLE OR LIMITED-COMBUSTIBLE MATERIAL.
 - SKYLIGHTS NOT EXCEEDING 32 FT² (2.97 M²) SHALL BE PERMITTED TO HAVE A PLASTIC COVER.
 - 8.3.8 SPRINKLERS SHALL NOT BE REQUIRED IN CLOSETS IN GARAGES AND EXTERIOR CLOSETS (REGARDLESS OF SIZE) LOCATED ON EXTERIOR BALCONIES, EXTERIOR BREEZEWAYS/CORRIDORS, OR ACCESSED FROM OUTDOORS WHERE THE CLOSET DOES NOT HAVE DOORS OR UNPROTECTED PENETRATIONS DIRECTLY INTO THE DWELLING UNIT.
 - 8.3.9 SPRINKLERS SHALL BE INSTALLED IN ANY CLOSET USED FOR HEATING AND/OR AIR-CONDITIONING EQUIPMENT, WASHERS AND/OR DRYERS, OR WATER HEATERS EXCEPT AS ALLOWED BY 8.3.8.
- INSULATION GUIDE LINES PER NFPA 13D.
 - 9.1.1* WET PIPE SYSTEMS IN AREAS ABOVE 40°F. A WET PIPE SYSTEM SHALL BE PERMITTED TO BE TO BE USED WHERE ALL PIPING IS INSTALLED IN AREAS MAINTAINED ABOVE 40°F, INCLUDING AREAS PROPERLY INSULATED TO MAINTAIN 40°F.
 - A 9.1.1 IN AREAS SUBJECT TO FREEZING, CARE SHOULD BE TAKEN IN UNHEATED ATTIC SPACES TO COVER SPRINKLER PIPING COMPLETELY WITH INSULATION. INSTALLATION SHOULD FOLLOW THE GUIDELINES OF THE INSULATION MANUFACTURER. FIGURE A.9.1.1(A) THROUGH FIGURE A.9.1.1(F) SHOW SEVERAL METHODS THAT CAN BE CONSIDERED. THESE ARE FOR ILLUSTRATIVE PURPOSES ONLY. CONSULTATION WITH THE GENERAL CONTRACTOR AND/OR OWNER IS RECOMMENDED TO ENSURE PROPER METHODS AND MATERIALS ARE USED TO MAKE SURE 40°F WILL BE MAINTAINED.

Horizontal Sidewall Sprinkler Placement



Insulation Recommendations

In areas subject to freezing, care should be taken in unheated attic spaces to cover Uponor AquaPEX tubing completely with insulation. Insulation should follow the guidelines of the insulation manufacturer. See Uponor Document "Uponor AquaSAFE Attic Insulation Guidelines" for attic installation guidelines (provided in Contractors Documents package or online at www.Uponorpro.com).

Extreme Temperature Installations

AquaSAFE Residential Fire Safety systems are often installed in attics or other areas exposed to temperature extremes of heat and/or cold. Follow the recommended extreme weather installation instructions to isolate and protect system components from extreme temperatures. Because this system also delivers domestic cold water directly to plumbing fixtures, Uponor highly recommends that you protect the tubing with adequate insulation in warm weather areas to minimize heating of the cold water supply.

Installation methods include, but are not limited to:

- Tenting over the fire sprinkler piping.
- Additional layers of batt insulation.
- Increased depth of blown-in insulation.

Caution: If you will be installing spray foam insulation, make sure to protect all components during application. Consult with the spray foam manufacturer to ensure compatibility with all products before application.

Consultation with local building officials is encouraged to ensure compliance with local building codes.

Bending PEX Tubing

The minimum bend radius of Uponor PEX tubing in any direction is six times the outside diameter (6 x OD). Bend supports are available for 3/8", 1/2", 3/4" and 1" Uponor AquaPEX tubing to facilitate 90-degree rigid bends.

Recommended Tubing Length Between Fittings	
Fitting Size	Minimum Tubing Length
3/8" ProPEX Fitting	2"
1/2" ProPEX Fitting	2 1/2"
3/4" ProPEX Fitting	3 1/2"
1" ProPEX Fitting	4 1/2"
1 1/4" ProPEX Fitting	5 1/2"

Exposed Installation Requirements.

Uponor AquaPEX™ tubing (white) and ProPEX™ EP Fittings and ProPEX™ Brass Fittings are approved for exposed installation where the following conditions are met. (UL 1821 Approved)

Exposed Wood Joist Ceiling Assemblies.

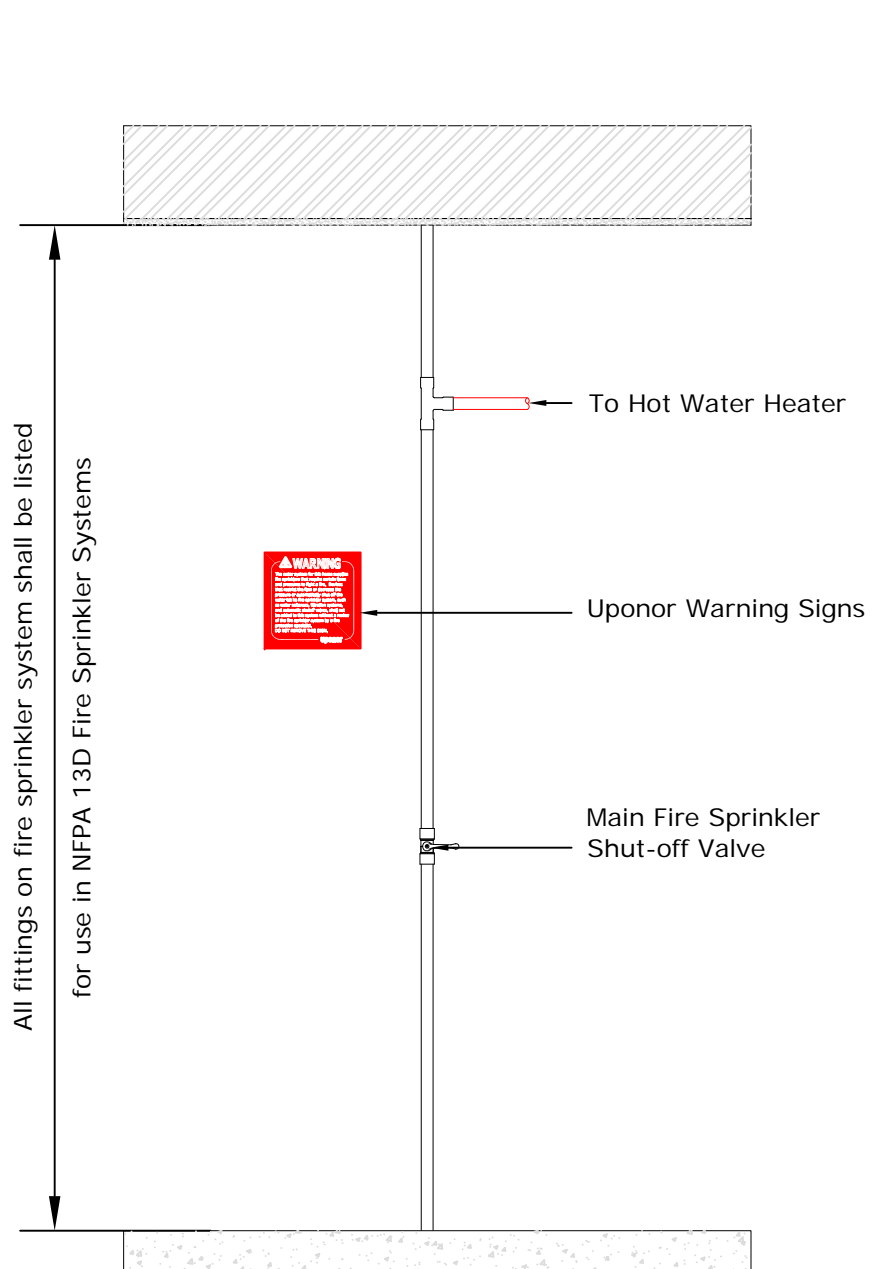
- Joists are of dimensional lumber, engineered wood, wood I-joist or open web wood joists.
- Joist are of depths from 6-16 inches (152-204 mm).
- Joist are of spacing from 12-24 inches (305-610 mm) on center.
- Joists can be exposed after installation.
- Metal pipe hangers spaced at maximum 24 inches (610 mm) on center are used.
- Listed residential automatic sprinklers of maximum activation temperature rating of 155°F (68°C).

Metal Tubing Support.

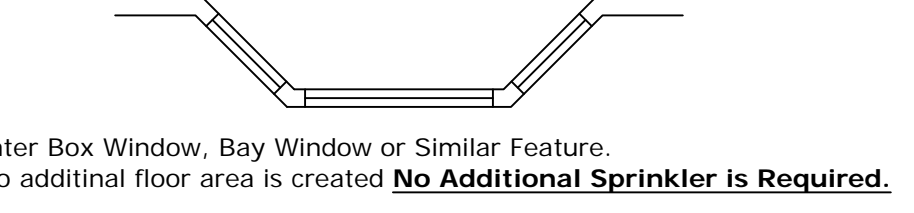
- Metal tubing supports designed for plastic tubing shall be used.
- Do not use supports that will damage the tubing. Inspect metal supports for sharp edges.
- Do not rigidly anchor Uponor AquaPEX™ tubing with supports. Allow enough tubing for freedom of movement to expand and contract.

Standard Riser Assembly

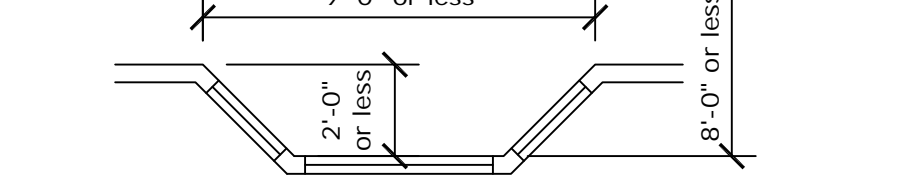
In a multi-purpose system a single control valve controls both domestic and fire safety needs.



See General Notes 8.2.5.7 for Architectural Feature Requirements



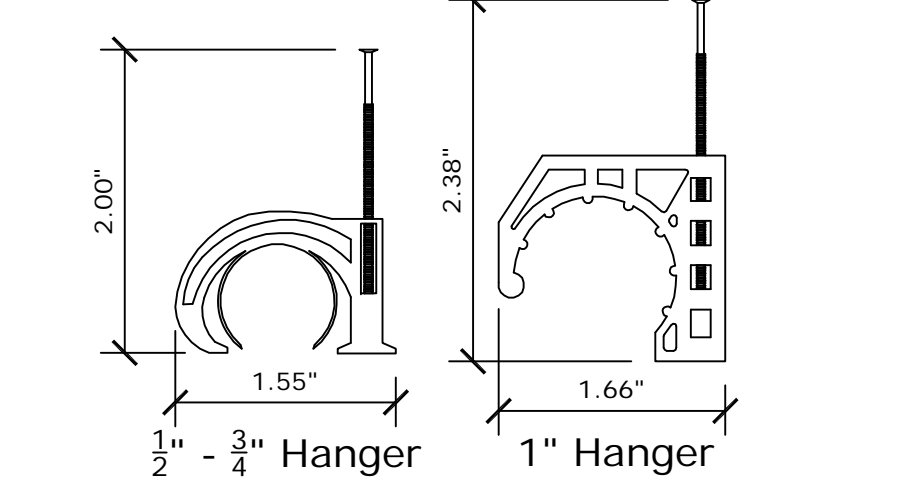
If additional floor area is created, **No Additional Sprinkler is Required.**



If additional floor area is created, Cannot exceed 18 ft², be more than 2'-0" deep, more than 9'-0" wide and be with in the coverage area of the sprinkler. **No Additional Sprinkler is Required.**

NFPA 13D Table 7.5.5.3 Distances From Heat Sources

Heat Source	Ordinary Temp.	Intermediate Temp.
	135° - 170°	175° - 225°
Side of Fireplace	36"	12"
Front of Fireplace	60"	36"
Wood Burning Stove	42"	12"
Kitchen Range	18"	9"
Wall Oven	18"	9"
Hot Air Flues	18"	9"
Uninsulated Heat Ducts	18"	9"
Uninsulated Hot Water Pipes	12"	6"
Side of Hot Air Diffuser	24"	12"
Front of Hot Air Diffuser	36"	18"
Hot Water Heater	6"	3"
Furnace	6"	3"
50W-250W Light Fixture	6"	3"
250W-499W Light Fixture	12"	6"



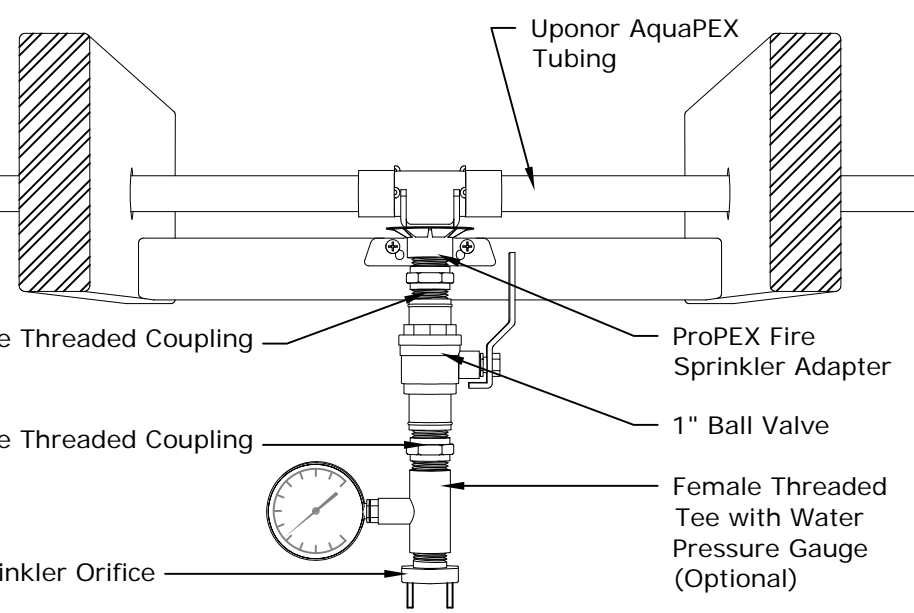
Tubing Support Spacing:

(Anchor AquaPEX Tubing Securely Enough to Support the Tubing, Yet Relaxed Enough to Allow the Tubing to Expand and Contract)

- Along Horizontal Runs, Install Supports Every 32", if Horizontal Runs are Continuously Supported, Place Tubing Supports at Six-Foot Intervals.
- Along Vertical Runs, Install Supports Every Four to Five Feet, at Each Floor and at a Mid-story Guide.

In-line Flow Test

The In-line Flow Test can be constructed on site. It performs a flow test to ensure proper system operation and flow (see **Figure F001-8**).



Flow Test

To ensure the system provides enough water for proper fire sprinkler performance, you should conduct a flow verification test.

Note: The NFPA 13D Installation Standard does not require flow verification.

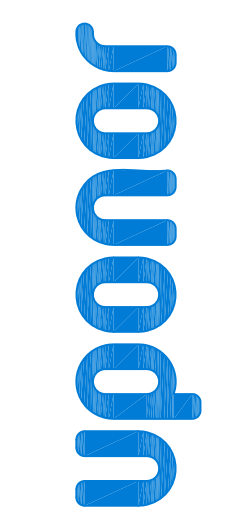
Before performing a flow verification test, confirm the water pressures by contacting the Water and Sewer Department of your local city. Ensure the available water pressure matches the pressure used in the system design.

Note: The sprinkler plan indicates the most hydraulically remote sprinkler (or pair of sprinklers). For test requirements on other sprinklers, consult your local code.

Note: It is a good idea to notify the fire inspector at least 24 hours prior to performing a flow verification test. This may speed up the inspection process and eliminate the need to repeat the test for the inspector.

Note: See "AquaSAFE Flow Test Instruction Sheet" (Provided in Contractors Documents package or online at www.Uponorpro.com) for more information on Flow Test Setup, Assembly, Performing the Test and Troubleshooting. If there are any questions please contact Uponor.

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DRAWN BY:	PATRICK BROWN	CONTACT:	TIM MICHELIS
CHECKED BY:	BRENT KOTULA	CONTACT PH. NUMBER:	314.644.0000
CERTIFICATION LEVEL:	SET IV	ALLIANCE ID:	TBD
CERTIFICATION NUMBER:	113889	PLOT DATE:	2/15/17
SQUARE FEET:	180 SQ. FT.	SHEET SCALE:	1/4" = 1'-0"
NO.	DATE	REVISIONS	DESCRIPTION

SHEET DESCRIPTION

GENERAL NOTES & DETAILS

SHEET NUMBER

F001