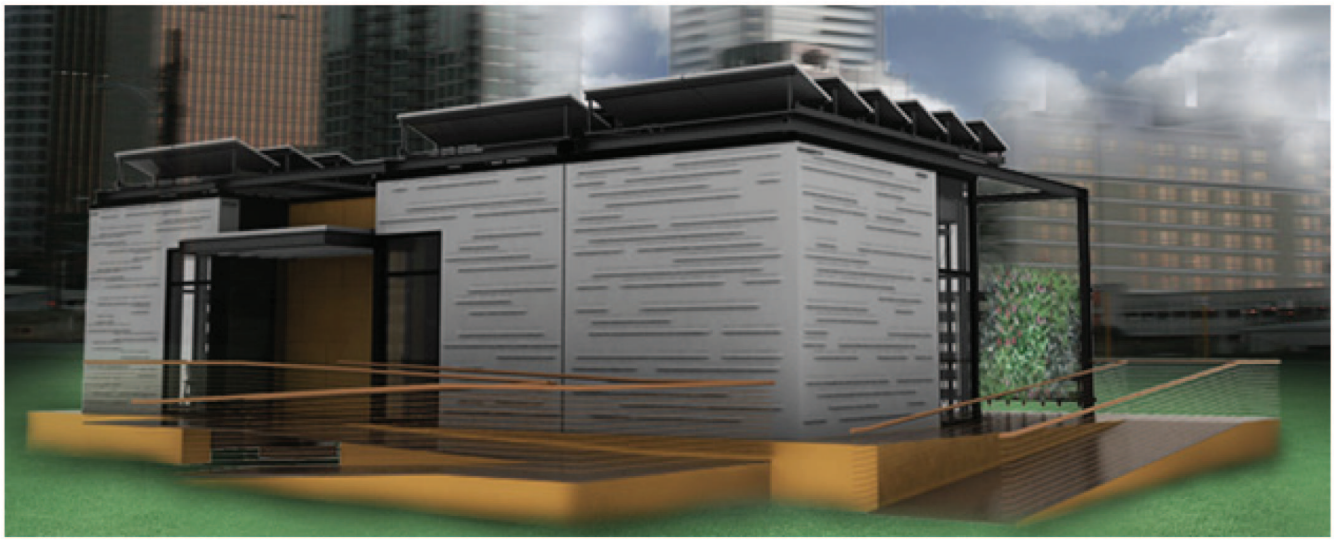
U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2013

The University of North Carolina at Charlotte

Urban Eden

As-Built Project Manual
August 22, 2013



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01 Summary of Changes

Significant changes to the project manual that have occurred between submissions have been outlined below. The Construction Drawings should also be reviewed for relevant revisions.

AUGUST 22, 2013 REVISIONS – AS-BUILT SUBMISSION

The Project Manual has been updated from the previous issue. Revisions include:

- Form liners were not used in the pouring of concrete
- Manufacturers for the PV rack and track systems were changed
- Plant wall components were amended
- Exterior improvements were modified
- Spray insulation was not used during construction
- Tile was not used in the kitchen
- Skim coat was used on the interior exposed concrete
- Plumbing fixtures were amended
- Lighting fixtures were updated
- The following sections have been removed from the Manual
    - 08 11 13 Hollow Metal Doors and Frames

Significant changes to the project manual that have occurred between submissions have been outlined below. The Construction Drawings should also be reviewed for relevant revisions.

APRIL 5, 2013 REVISIONS – CONSTRUCTION DOCUMENT RESUBMISSION

The Project Manual has been updated from the previous issue. Revisions include:

- Quantity Take-off has been updated.
- Structural Calculations have been updated
- The following sections have been added to the Manual
    - 05 50 00 Metal Fabrications
    - 06 40 00 Architectural Woodwork
    - 07 19 00 Water Repellents
    - 08 11 13 Hollow Metal Doors and Frames
    - 08 40 50 Aluminum Entrances, Curtain Walls, and Windows
    - 09 22 16 Non-Structural Metal Framing
    - 09 91 00 Painting
    - 11 31 00 Residential Appliances
    - 22 05 00 Common Work Results For Plumbing
    - 23 05 00 Common Work Results for HVAC
    - 23 05 13 Common Motor Requirements for HVAC Equipment
    - 23 05 23 General-Duty Valves for HVAC Piping
    - 23 05 93 Testing, Adjusting, and Balancing for HVAC
    - 23 21 13 Hydronic Piping
    - 23 82 36 Fin Tube Radiation Heat Exchanger
    - 26 05 00 Common Work Results for Electrical
    - 26 24 16 Panelboards
    - 26 28 13 Fuses
    - 26 28 16 Enclosed Switches and Circuit Breakers
- The following sections have been removed from the Manual
    - 06 41 00 Architectural Wood Casework
    - 08 05 00 Windows
    - 08 70 00 Hardware
    - 08 80 00 Glazing
    - 11 30 00 Residential Equipment
    - 23 38 00 Ventilation Hoods
    - 26 05 33 Raceway and Boxes for Electrical Systems
    - 26 24 00 Switchboards and Panelboards
    - 26 28 00 Low Voltage Circuit Protective Devices

Significant changes to the project manual that have occurred between submissions have been outlined below. The Construction Drawings should also be reviewed for relevant revisions.

FEBRUARY 14, 2013 REVISIONS – CONSTRUCTION DOCUMENT SUBMISSION

The Project Manual has been updated from the previous issue. Revisions include:

- Corrugated roof deck has been removed. It was replaced with CEMCO Sure-span Light Gauge Steel Floor Joist System.
- The geopolymer floor system for the mechanical/bathroom core has been changed to a steel frame with CEMCO Sure-span Light Gauge Steel Floor Joist System.
- Cable railing system has been changed to a wooden handrail system.
- Polishing ponds were removed and replaced with planter boxes.
- Design of plant wall has been finalized.
- Quantity Take-off has been updated.
- The following sections have been removed from the Manual
    - 05 52 00 Metal Railings
    - 07 42 00 Phenolic Wall Panels
    - 10 57 00 Closet and Utility Shelving
    - 12 35 00 Specialty Casework
    - 12 40 00 Furnishings and Casework
    - 12 45 00 Bedroom Furnishings
    - 12 93 00 Site Furnishings

Significant changes to the project manual that have occurred between submissions have been outlined below. The Construction Drawings should also be reviewed for relevant revisions.

NOVEMBER 20, 2012 REVISIONS – 80% D.O.E. RESUBMISSION

The Project Manual has been updated from the previous issue. Revisions include:

- For reasons primarily concerning construction detailing, the glazing layout has been altered.
- These glazing revisions led to some small design adjustments such as a change in guttering method.
- The wall system for the mechanical/bathroom core has been changed from SIPS to double metal stud frame.
- Our application to classify geopolymer concrete as an Alternate material under IRC R104.11 has been accepted by Tom Meyers.
- Project Manual formatting problems have been resolved.
- The following sections have been removed from the Manual:
    - 01 14 00 Work Restrictions
    - 06 05 73 Wood Treatment
- The following sections have been added to the Manual:

01 30 00 Administrative Requirement
06 16 00 Sheathing
06 20 00 Finish Carpentry
06 41 00 Architectural Wood Casework
06 46 00 Wood Trim
07 80 00 Fire and Smoke Protection
08 14 00 Wood Doors
08 70 00 Hardware
09 64 00 Wood Flooring
10 28 00 Toilet, Bath, and Laundry Accessories
10 44 16 Fire Extinguishers
12 36 00 Countertops
12 40 00 Furnishings and Accessories
12 44 00 Bathroom Furnishings
12 45 00 Bedroom Furnishings
12 93 00 Site Furnishings
13 34 00 Fabricated Engineered Structures
21 13 13 Wet-Pipe Sprinkler
23 01 70 Operation and Maintenance
23 07 00 HVAC Insulation
23 09 00 Instrumentation and Control Devices For HVAC
23 56 13 Heating Solar Vacuum-Tube Collector
26 28 00 Low-Voltage Circuit Protective Devices
26 31 00 Facility Electric Power
26 51 00 Interior Lighting
26 56 00 Exterior Lighting
26 56 29 Landscape Lighting
28 31 00 Fire Detection and Alarm
32 93 00 Plants

- The following sections have been renamed:
    - 03 45 00 Precast Structural Concrete to Precast Architectural Concrete
    - 05 52 13 Stainless Steel Tube Railing to Pipe and Tube Railings
    - 23 81 26 Mini-Split Heat Pump to Split-System Air Conditioners
    - 23 83 00 Radiant Heating Hydronic Piping to Radiant Heating Units

OCTOBER 11, 2012 REVISIONS – 80% D.O.E. SUBMISSION

The Project Manual has been updated from the previous issue. Revisions include:

- Though the basic layout remains the same, the construction logic has been altered. The project now consists of four separate pods to be built and shipped individually and connected on site using a crane.
- In the previous submission, our building envelope was SIPS construction. This has been changed to a combination of insulated precast concrete panels with composite metal decking and SIPS. The cement in our concrete is a geopolymer mix replacing conventional Portland cement. Our mix has been developed and extensively tested in the lab of Dr. Brett Tempest at UNC Charlotte. We have been in contact with the Solar Decathlon administration about this material choice and stand ready to supply any additional materials testing as required.
- Since the last submission, we have developed a PV support system that allows movement of the PV array for seasonal shading of the southern patio and to expose the roof surface for radiant heat transfer for summer cooling (see next revision). The system consists of a post and beam support structure constructed of steel I-beams and a rolling PV array rack.
- We have added a capillary tube radiant heating and cooling system to supplement our conventional heat pump and ERV HVAC. Arrays of small diameter (1/6”) capillary tubes are embedded in the interior wythe of concrete in the walls and set in plaster in a drop-ceiling cloud above our living, kitchen, and bedroom pods. The tubes are plumbed to flat plate heat exchangers on the roof allowing heat transfer from the walls/ceiling to the roof at night for radiant cooling in the summer and from the roof to the walls/ceiling during the day for radiant heating during the winter.
- The name of our project has changed from the AIM house to the Urban Eden House.

02 Rules Compliance Checklist

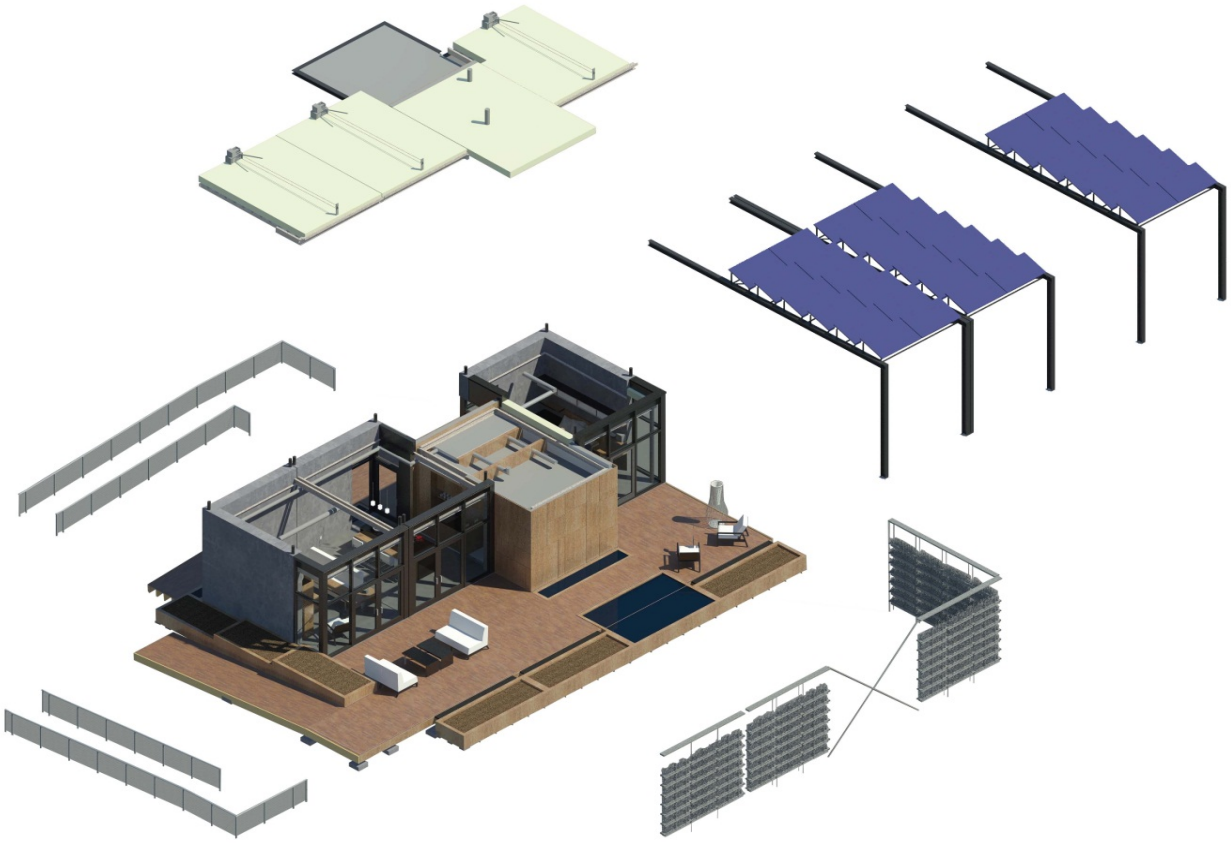
Abbreviations: PM = Project Manual CD = Construction Documents SP = Specifications Section .

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	CD O-101
Rule 4-2	Construction Equipment	Specifications for heavy machinery	PM SP 01 54 19
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	CD C-101
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	C 501 CD S-101
Rule 4-5	Generators	Specifications for generators (including sound rating)	PM SP 01 51 13
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	CD P-101
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	Div. 22 & 32
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists	PM (Appendix A)
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot	C 501
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	G 201-202
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	N/A
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that will be stamped by the qualified, licensed design professional in the stamped structural submission; the stamped submission shall consist entirely of sheets that also appear in the drawings and project manual	Complete CDs will be stamped
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G 101
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	N/A

Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G 102-103
Rule 7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	CD L-101
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	PM SP 26 31 00
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	E 102 A 112
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	PM SP Div. 26
Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	N/A
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	N/A
Rule 8-5	Village Grid	Completed interconnection application form	PM Chapter 7
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	CD E-101
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	PM SP Div. 26
Rule 8-5	Village Grid	One-line electrical diagram	CD E-601
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	PM Chapter 7
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	CD A 101 CD G 103
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	CD A-201
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	CD P-101 and A 101
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. PDT or between 8 a.m. and 4 p.m. solar time on October 1	CD P-101 and A 101
Rule 9-2	Team-Provided Liquids	Quantity, specifications , and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	P. 16

Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	CD P-101
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	N/A
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	N/A
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	PM SP Div. 22
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	PM SP Div. 22
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	CD G 102-103

03 Structural Calculations



LOCATION OVERVIEW AND DESIGN CRITERIA

The goal is to perform the structural design for a highly energy efficient, custom-designed, single-family residence to perform during the Solar Decathlon 2013 competition in Irvine, California. One of the key structural features we are proposing is that the bearing walls be made of geopolymer concrete, which has been the subject of Dr. Brett Tempest's research at The University of North Carolina at Charlotte. With the continued emphasis on sustainability, the UNC Charlotte team has chosen to display geopolymer concrete as one of the key innovative features in our house. The geopolymers are from a class of aluminosilicate materials mainly found in the byproduct fly ash. These are used to completely replace the Portland cement in the mix design. Benefits include substantially reducing carbon dioxide emissions, greater fire and corrosion resistance, lower shrinkage, and compressive and tensile strengths equivalent to or higher than those in a normal Portland cement mix. From a structural design standpoint, the design will be carried out in the same manner as if a normal Portland cement concrete was being used.

Extensive performance testing on the material, both at UNC Charlotte and in labs around the world, has already been completed. We also stand ready to perform additional testing as required. As of 11/20/2012, our application to classify geopolymer concrete as an Alternate material under IRC R104.11 has been accepted by Tom Meyers (Approval Letter can be found in Appendix A).

DESIGN CODES

Also included are the 2013 Solar Decathlon Draft Building Code and the Solar Decathlon Draft Rules. Although these are both drafts, they can be taken for now as the final editions, as the committee has assured us that any changes in the final drafts will be minimal. Of particular interest to the reviewer is Section 5: Structural in the Building Code. This contains the overall guidelines for the structural design of the house and the minimum design loads that are to be used.

It is important to note that many of these minimum loads are based on ASCE 7-10. Also, the 2012 International Residential Code has been referenced for the seismic design loads. However, ASCE 7-10 has been used in its entirety for all design purposes, including minimum design loads and seismic design. The committee has said using ASCE 7-10 in the 2012 editions for all design purposes will satisfy all Building Code requirements.

The house will need to meet all design requirements to both perform during the competition in Irvine and be permanently placed in Charlotte, North Carolina. A final location in Charlotte is still yet to be determined. Therefore, minimum loading considerations were based on the worst-case location. For example, the design wind load will be worse in Charlotte, but the seismic requirements will obviously be based on Irvine.

SPECIFIC ISSUES

Six heat exchangers are located on the roof; one is located on each module and three are located on the wetcore. Each exchanger is approximately four feet by eight feet in dimension, white in color, and are wrapped in plastic sheathing.

The P.V. panels are be placed on a track system on beams that results in two concentrated point loads at the connections on the top of the walls and also in the connection to the concrete at its base. For a better understanding of this system, please see the attached renderings.

As mentioned earlier, the wall system are made from geopolymer concrete, and the design procedure is the same as if it were made from Portland cement concrete, as the geopolymer has either similar or superior properties.

The foundation is comprised of steel bearing plates. The weight of the house will be able to resist the overturning forces.

SUBMITTAL MATERIALS

Submittal #1 is meant to serve strictly as the preliminary load analysis. There has been no structural design calculations performed. ASCE 7-10 has been used to determine the minimum loads to be used for the structural design. Submittal #2 will contain all corrections and/or additions to Submittal #1 and get into the structural design calculations for the house.

STRUCTURAL NARRATIVE FOR LATERAL LOADS

The lateral design load the structure is required to handle is taken as either the equivalent horizontal seismic force or the wind force for the particular region. Both were calculated in accordance with ASCE 7-10 (see structural design load calculations) and it can be seen that the seismic load controls with an equivalent horizontal force of approximately 32 kip. This force must be able to be applied in all four directions when considering the design of the structure.

In the north and south direction, the load is applied to the PV rib beams spanning the roof and outdoor deck. These beams carry the seismic force as an axial load, which is transferred to the geopolymer wall system through the connection points along the roof parapet. The inner wythe of concrete, acting as the main structural component of the wall system, is designed with a carbon fiber reinforcing adequate of handling these forces. Finally, the load is transferred from the wall, through the grade beam, and into the concrete bearing pads that make up the foundation.

In the east and west direction, the carbon fiber reinforcement in the geopolymer wall system will be designed to handle the flexural bending induced by the seismic load. Similarly, this load will be transferred through the walls into the grade beam and finally to the concrete bearing pads into the ground.

STRUCTURAL DESIGN GUIDELINES

Applicable Codes and Standards

A. 2013 Solar Decathlon Building Code (SDBC)
B. 2012 International Residential Code (IRC) of the International Code Council with amendments
C. ASCE 7-10, Minimum Design Loads for Building and Other Structures
D. ACI 318-11, Building Code Requirements for Structural Concrete and Commentary

Structural Loading

A. Dead Loads
   a. Roof
      i. Metal Roof Deck 2 psf
      ii. Roof Insulation 5 psf
   b. P.V. Panels 5 psf
   c. Interior Floor 15 psf
   d. Means of Egress 10 psf
   e. Exterior Deck 10 psf
   f. Mechanical 15 psf

B. Live Loads
   a. Roof 20 psf
   b. Interior Floors 50 psf
   c. Means of Egress 100 psf
   d. Exterior Deck 100 psf
   e. Mechanical 100 psf

C. Snow Loads
   a. Ground Snow Load, Pg 10 psf (Charlotte)

*See further snow load calculations on pages 6 through 8 made in accordance with ASCE 7-10, Chapter 7

D. Wind Loads
   a. Risk Category II
   b. Basic Wind Speed 115 mph (Charlotte)
   c. Exposure Category C

*See wind load calculations for the MWFRS on pages 9 through 11 made in accordance with ASCE 7-10, Chapter 28 (Envelope Procedure), Part 2 for Low-Rise Buildings.

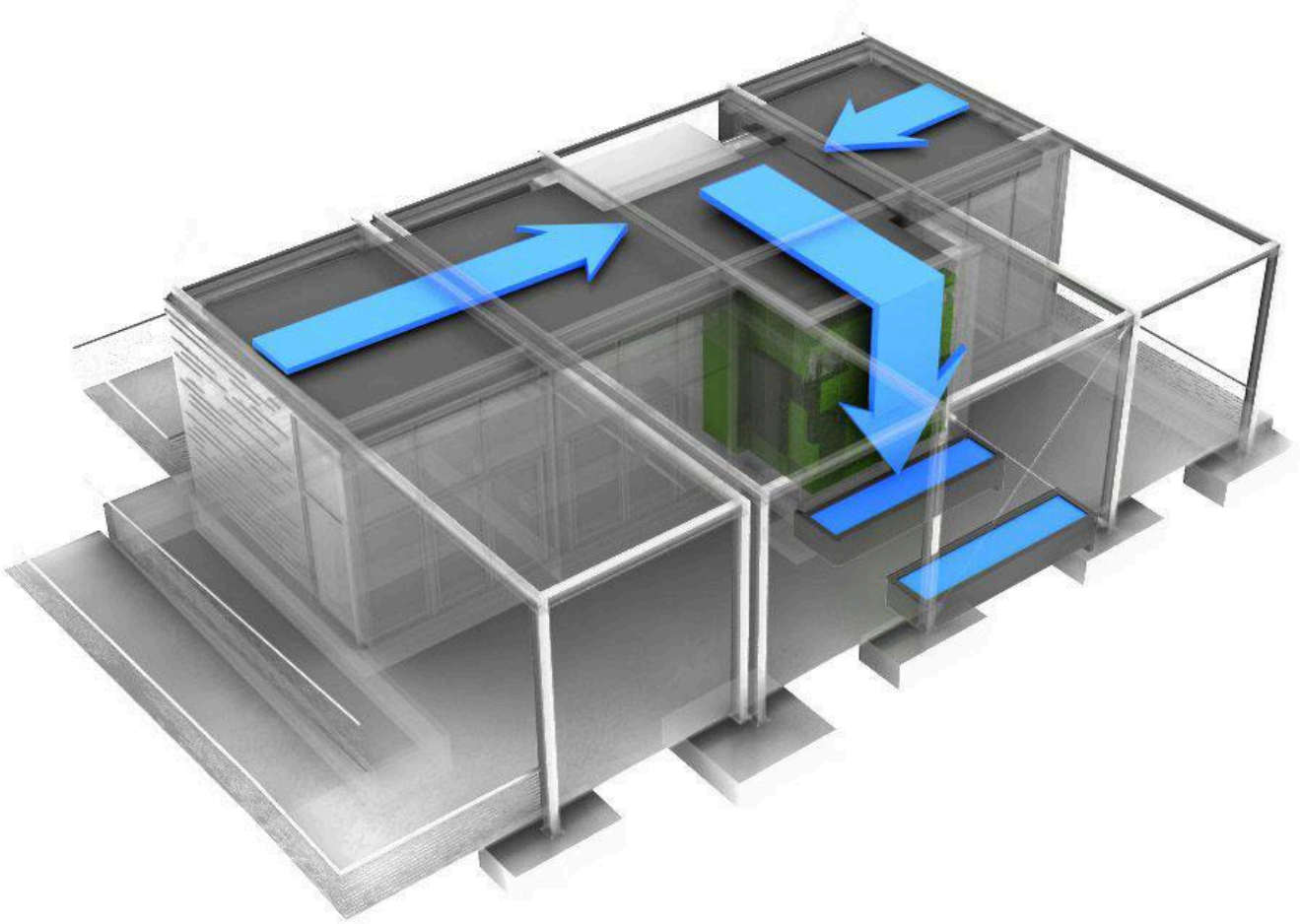
*See wind load calculations for C&C on pages 12 through 13 made in accordance with ASCE 7-10, Chapter 30 (Envelope Procedure), Part 2 for Low-Rise Buildings.

E. Seismic Loads
   a. Short period map value, Ss 150 %g
   b. 1-Second period map value S1 75 %g
   c. Assumed Site Class (Soil Factor) D
   d. Seismic Design Category D
   e. Seismic Force Resisting System Intermediate Precast Shear Walls

*See seismic load calculations for Irvine, California on pages 14 through 15 made in accordance with ASCE 7-10.

Note: Structural Calculations can be found in Appendix A

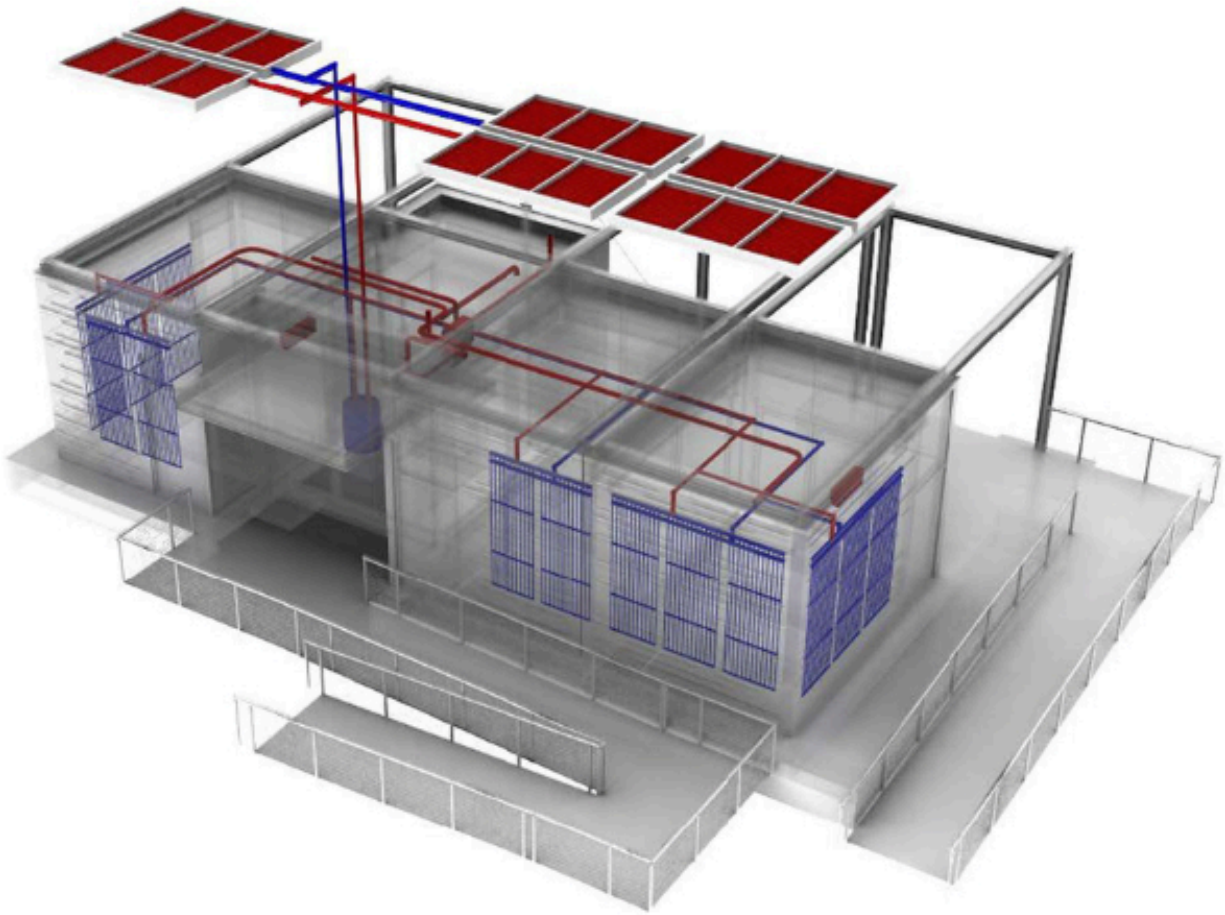
04 Detailed Water Budget



Water Budget Table

Function	Water Use (Gallons)	Calculations	
		Gallons	Events
Hot Water Draws	330	15	16
Laundry	104	13	8
Dishwasher	55	11	5
Water Vaporization	5	1 ¼	4
Fire Protection	300	300	1
Testing	TBD	TBD	1
Initial DHW Tank Fill	60	60	1
Safety Factor	25	25	1
Total Water Required	**879**		

05 Summary of Unlisted Components



All electrical components carry an approved testing agency's listing per Section 6-7 of the SD2013 Building Code.

06 Summary of Reconfigurable Features

A summary of all reconfigurable features affecting SD2013 Rules 6-2 and Appendix B-2 are outlined below.

RECONFIGURABLE FEATURES AFFECTING ANSI Z765-2003

There are no reconfigurable features that affect ANSI Z765-2003

DEMONSTRATION OF RECONFIGURABLE FEATURES FOR JURY TOURS

During the course of public and jury tours, team members will demonstrate multiple reconfigurable features of the Urban Eden home. Each has been outlined below:

1. *Entertainment Center / Murphy Bed*

   This element is located on the West wall of the living room. The entertainment center functions as the central focus of the living room and encompasses shelving, storage cabinets, a rotating front panel, and a Murphy bed. The large front panel of the entertainment center swings open 90 degrees so that it is parallel with the glass curtain wall and the TV can be viewed from the outdoor area. With the panel fully open, the Murphy bed behind it can swing down to create a guest bed area. The open front panel covers up the glass curtain wall, creating privacy for the bed.

   For public tours, the typical configuration of the Entertainment Center is in the closed position, with the bed folded up and the front panel closed.

   During Jury tours, the reconfigurable features will be demonstrated. During Public Tours, information about this reconfigurable feature will be communicated through signage and a short animation that will be submitted and approved as part of Team Urban Eden's Public Exhibit deliverable.

   During the Movie Viewing sub-contest the front panel will be rotated 90 degrees so that the movie can be watched from the outdoor living room. The Murphy bed will be pulled down into the open position to demonstrate the guest bedroom adaptability of the Urban Eden house.

2. *Dining Table*

   The home includes a reconfigurable dining table that collapses into a bar that tucks under the kitchen island. The table seats eight people with 4 sitting on a bench and 4 in chairs. During public and jury tours, a decathlete will explain that the center leaf of the table can be removed, stowed it in its place on the counter side, and the table can collapse to become a bar. A decathlete will also explain that the bench can be reconfigured as tables for the living room and that the four chairs can be stacked into two, creating seating for the bar.

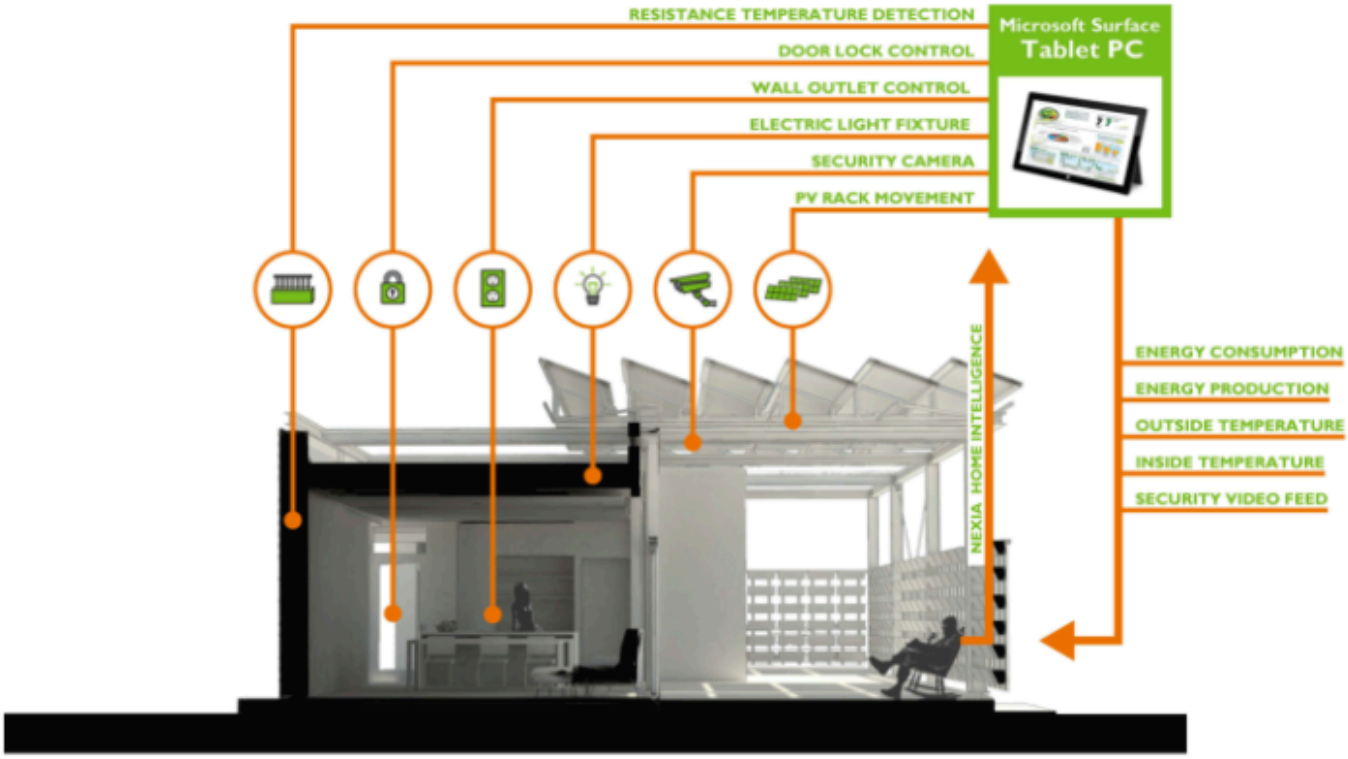
3. *Office/ Murphy Bed*

The bedroom module is an adaptable space that turns into an office when the murphy bed is folded up during the day. An office desk descends from the east wall to allow for a more dynamic space so you can have an in-home office with a separate entry for clients. The wardrobe wraps around from the east wall onto the North wall allowing for extra storage space for clothes as well as two ottomans that can be pulled up to the desk and used for extra seating. For public tours, the typical configuration will be with the murphy bed in the open position and the desk folded closed.

4. *Translating PV Rack*

The translating PV rack provides shade on the southern façade of the house in the summer and can be retracted onto the roof during the winter to allow sun to shine into the home providing added heat. Moving the PV rack off of the roof during the night enables radiant cooling to dissipate heat retained within the capillary tubes of the house. Corrugated metal sheets, located on the bottom of the PV rack, provide shelter on the patio and will double the amount of rain capture as it guides water back onto the roof.

07 Interconnection Application Form



PV SYSTEMS

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
BOSCH	BOSCH Solar Module c-Si M 60 NA42117	9,180 Watts

*Note: Refer to SP Section # 26 31 00 – Photovoltaic Collectors

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
POWER-ONE	PVI-3.0-OUTD-S-US	600V	3 KW	1
POWER-ONE	PVI-6000-OUTD-US	600V	6 KW	1

Total AC power of all inverters is 9kW

REQUIRED INFORMATION

	Location
One-Line Electrical Schematic	E-601
Calculations of service/feeder net computed load and neutral load (NEC 220)	PM p.22
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	G-102 G-103

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

Service Feeder Calculations					
System	**Equipment**	**NEC Code**	**Formula**	**Power (VA)**	
General Loads	General Lighting		800 SQFT x 3VA/SQFT	2400	VA
	Small Appliance Circuits	220.52 - A	2 x 1500VA	3000	VA
	Laundry - Washer	220.52	1 x 1500VA	1500	VA
	Kitchen - Cooktop	220.53	7704VA x (100%)	7704	VA
	Kitchen - Dishwasher	220.53	1800VA x (75%)	1800	VA
	Kitchen - Downdraft	220.53	1800VA x (100%)	1800	VA
	Kitchen - Oven	220.53	3864VA x (100%)	3864	VA
	Exterior - PV Motor	430.24	7609VA x (125%)	9512	VA
	Mechanical - Water Heater	430.24	6000VA x (100%)	6000	VA
	Laundry - Dryer	220.54	6000VA x (100%)	6000	VA
			Subtotal (VA)	**43580**	**VA**
			100% for the first 10kVA	**10000**	
			40% after 10kVA	**13432**	
			Demand for All General Loads	**23432**	**VA**
	Mechanical - ERVs	220.82	180VA x (100%)	180	VA
	Mechanical - Mini-Split Pumps	220.82	4800VA x (100%)	4800	VA
	Mechanical - Fan	220.82	600VA x (100%)	600	VA
	Mechanical - Actuators	430.24	720VA x (100%)	720	VA
	Mechanical - Water Pump	430.24	1000VA x (100%)	1000	VA
	Mechanical – Cap. Tube Pump	430.24	600VA x (100%)	600	VA
			Total Power (VA)	**31332**	**VA**
		Total Current (A)	**Total Power (VA) / 240**	**130.55**	**A**
			Main Service Circuit Breaker	**150**	**A**
Neutral Conductor	General Lighting	220.61	800 SQFT x 3VA/SQFT	2400	VA
	Small Appliance Circuits	220.61	2 x 1500VA	3000	VA
	Kitchen - Cooktop	220.61	7704VA x (70%)	5393	VA
	Laundry - Dryer	220.61	6000VA x (70%)	4200	VA
	Kitchen - Dishwasher	220.61	1800VA x (70%)	1260	VA
			Total Neutral Load (VA)	**16253**	**VA**

	Total Current (A)	**Total Power (VA) / 240**	**67.72**	**A**

08 Energy Analysis Results and Discussion

8.1 INTRODUCTION

8.1.1 Project Background

UNC Charlotte's Urban Eden home is designed to knowingly work with the forces of nature instead of fighting against them. It is meant to be a comfortable extension of the environment instead of a retreat from it. Mixing modern technology with techniques used for thousands of years, the Urban Eden home uses the environment to its advantage to first minimize its need for external energy and then maximize efficiency. As these hybrid strategies get more advanced, a cost analysis is required to determine whether they are cost effective.

A thorough energy analysis was executed to understand the energy consumption implications of each aspect of the design. After the competition, the house will be brought back to Charlotte, NC to be used as a research lab; therefore, it is studied in the climate of Irvine, California and Charlotte, North Carolina.

Our team is a synthesis of multiple interdisciplinary research groups, each one influencing the aspects of the house that affect its energy usage. To incorporate innovative ideas from every member of the team, multiple modeling strategies were used to identify the most beneficial ones.

8.1.2 Key Sustainable Innovations

A. Geopolymer Cement Concrete

Geopolymer cement concrete is made by reacting aluminate and silicate bearing materials with a caustic activator. Commonly, waste materials such as coal combustion fly ash or slag from iron and mental production are used. Instead of traditional Portland cement, our house will use fly ash-based geopolymer cement in a precast concrete wall system.
Experts estimate that Portland cement production is responsible for about 7 percent of carbon dioxide emissions from human sources. And manufacturing a ton of cement takes about 6.5 billion BTU's of energy. By completely eliminating Portland cement from its composition, the geopolymer cement concrete becomes a much greener product, reducing both energy consumption and carbon dioxide emissions in its production while recycling a waste product (fly ash) to beneficial use.

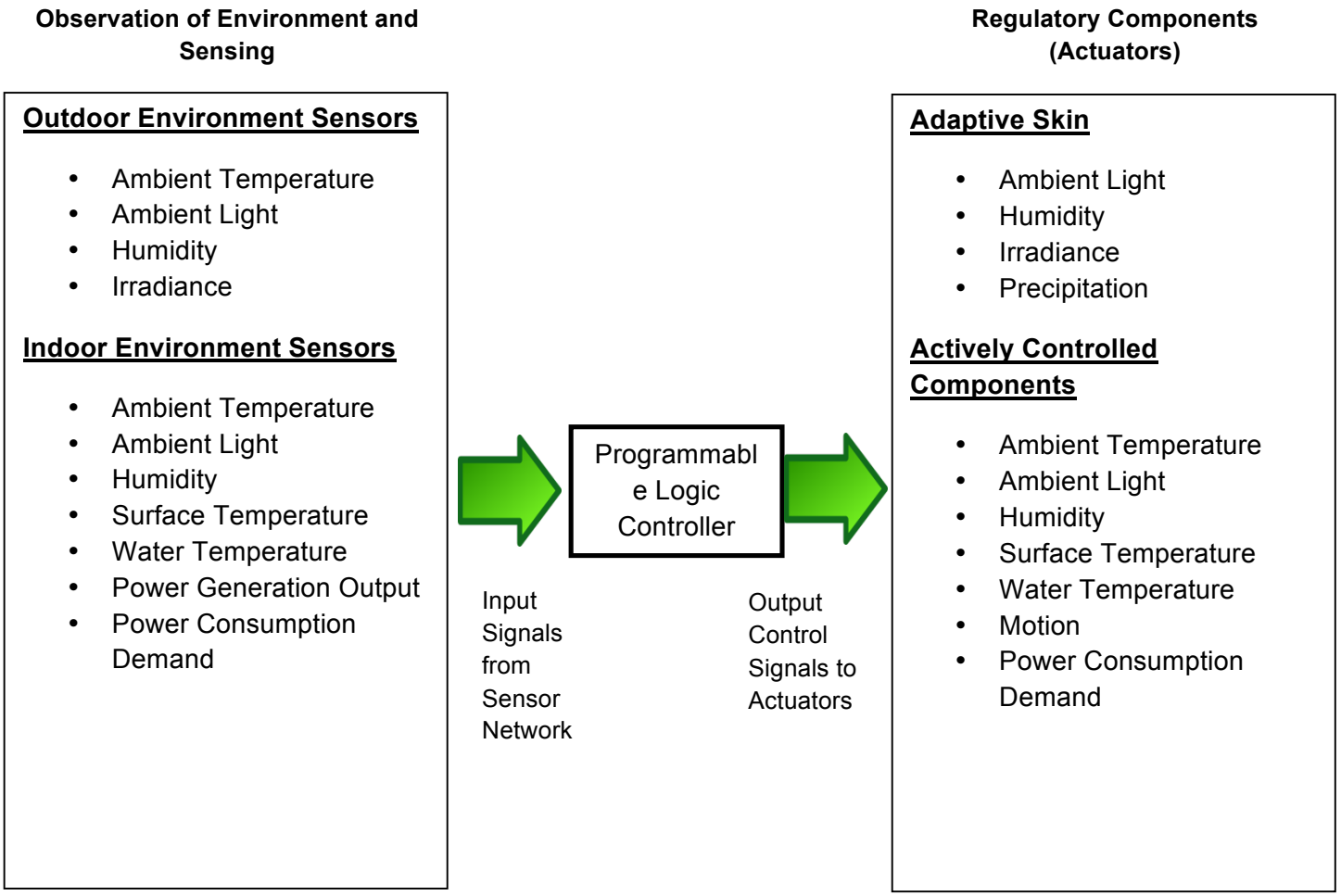
B. Capillary Tube System

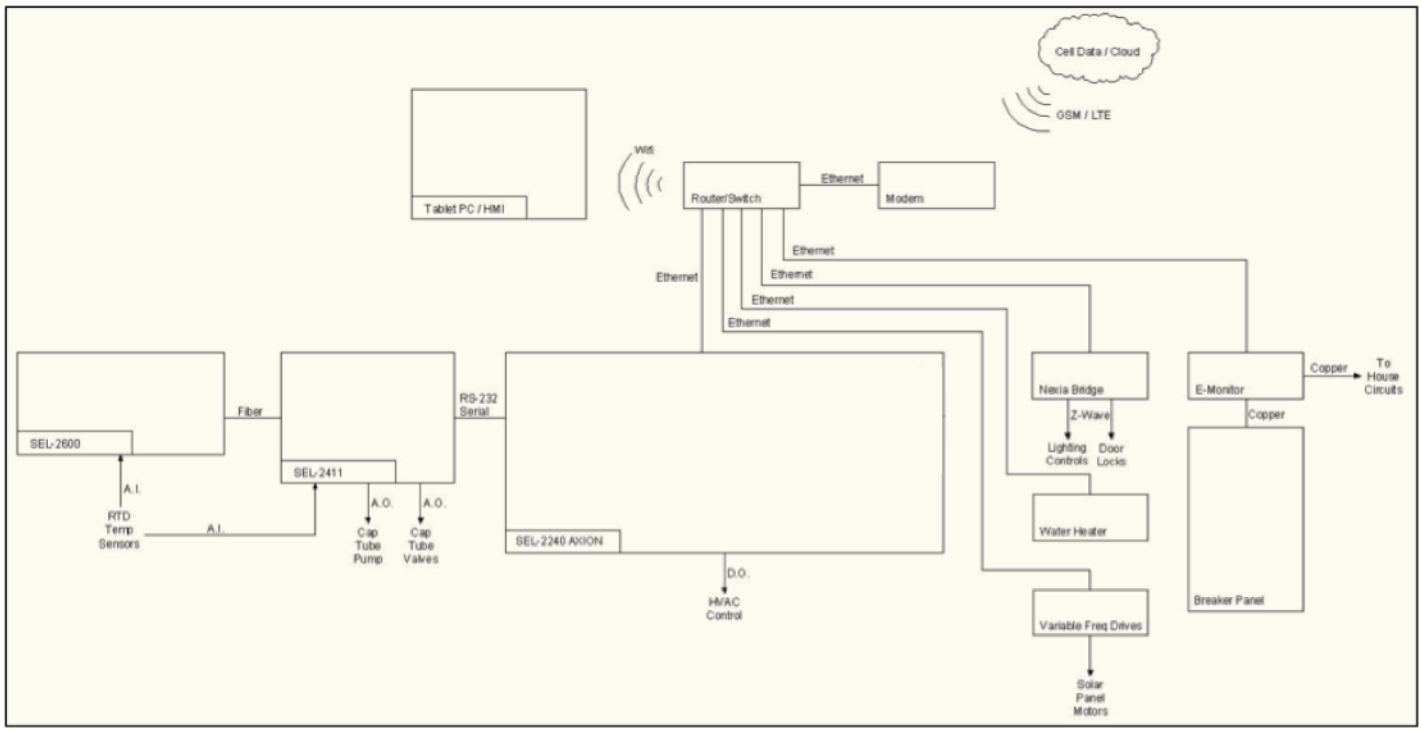
By means of a roof heat exchange system, passively heated and cooled water will be circulated, in a controllable manner, through a capillary tube system embedded in the geopolymer cement concrete walls. By augmenting the passive performance of thermal mass through the precise control of wall temperature, this system will achieve thermal comfort with minimal non-renewable energy consumption.

C. Dashboard and Control System

Our team will develop an innovative dashboard and control system that:

- Helps occupants understand the system of energy flows and reserves (thermal and electrical) in the house.
- Helps occupants understand how their behavior affects the energy performance of the house.
- Recommends and/or automatically controls actions that improve the performance of the house.
- Provides automated and/or supervisory control over the various working systems of the house (capillary tube system, HVAC, lighting, door locks, etc.).
- Will include a tablet PC Interface, which will consist of the dashboard and a controls HMI (Human Machine Interface).





Controls System Connection Layout

8.2 INITIAL DESIGN CONSIDERATIONS

8.2.1 The Passivhaus Standard

Before any energy modeling or climate analysis was done, an overall design theme was created based off of one simple idea: the house is continuously transferring energy to and from the environment, and it is our job to precisely regulate this energy exchange to naturally maintain comfort. This fundamental idea is behind all of our passive strategies and techniques and leads to our highly integrated and efficient design.

8.2.2 Strategic Window Placement

Our approach starts from basic climactic principles: the main source of energy on planet earth is the sun, and in the northern hemisphere during the winter, most of its radiation is received on the southern façade of buildings. In Irvine and Charlotte, in the winter this heat is utilized by south-facing windows. In the summer, this solar gain is not desirable and can be easily avoided by overhangs on the roof, which are long enough to block the summer sun. The strategic placement of windows also allows the house to be autonomously daylit during the daytime.

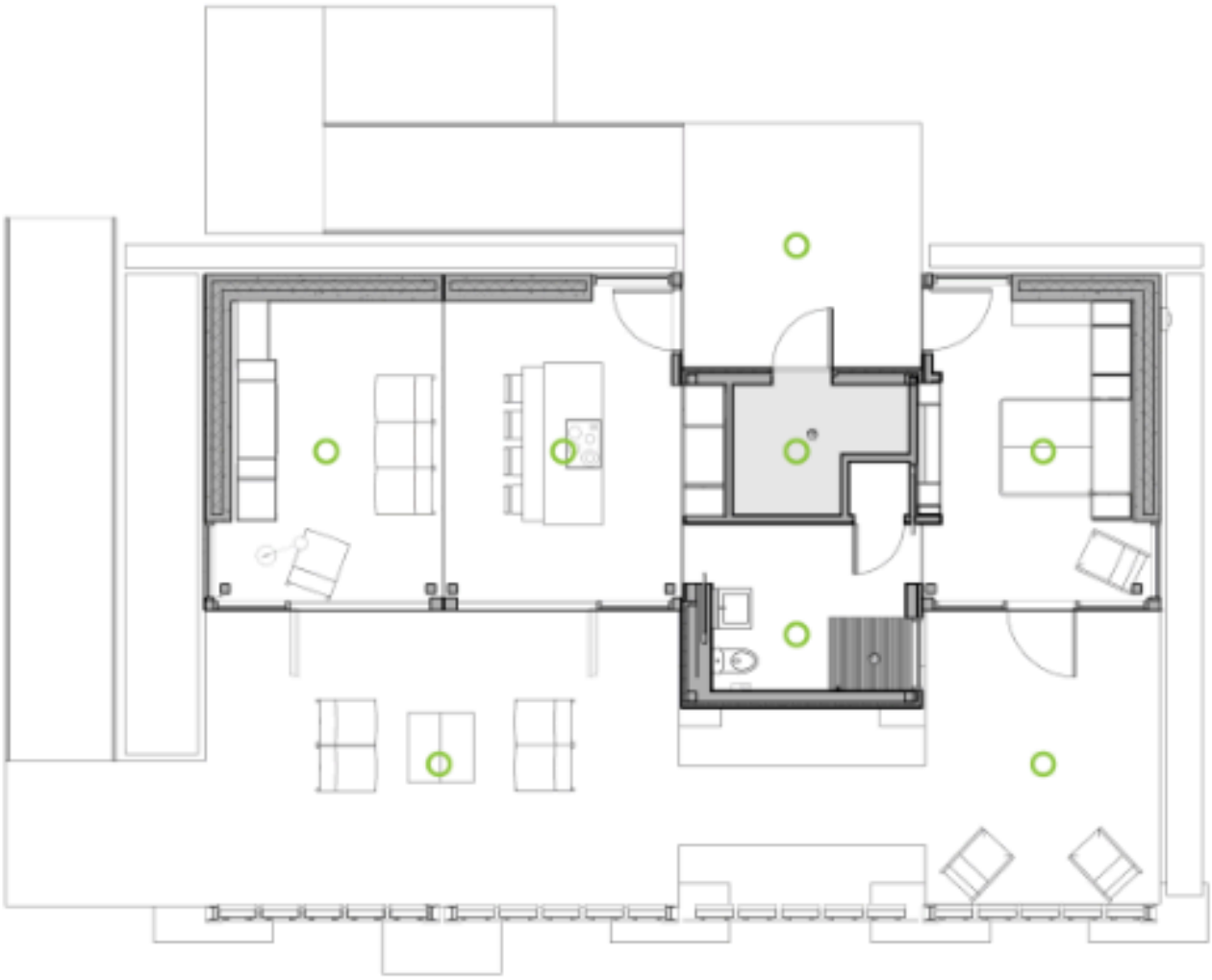


Figure 8.1: It can be seen here that the south facing wall is completely made of glass which has a major impact on the operation of the house.

8.2.3 Adaptable PV Rack Mounting System for Shading

Lastly, a 8.7-kilowatt array of photovoltaic panels provides power to the house. Being fixed at an angle equal to the latitude, the array receives maximum solar exposure that rivals a sun-tracking array of the same size. The array of photovoltaic panels can be moved to provide the desired amount of shading to the windows and outdoor living area. This variable shading ability is crucial and allows the shading ratio to be optimized at different times of the year to minimize the heating and cooling loads.

8.2.4 Radiant Thermal Storage

The oldest trick in the passive design arsenal is thermal mass storage or the relationship between heat and temperature. Since a massive object can absorb large amounts of heat without rising much in temperature, it is able to build up heat energy and still maintain its temperature gradient with the outside environment. It effectively stores energy in the form of heat and will release it once the ambient temperature drops. This simple fact is exploited in the Urban Eden house by using thick concrete slabs for the walls. The concrete used is custom made high-density fly ash based concrete which is conveniently being researched here at UNCC. The high-density concrete stays cool throughout the day while absorbing heat and is not warm enough to release the heat until the house needs it at night.

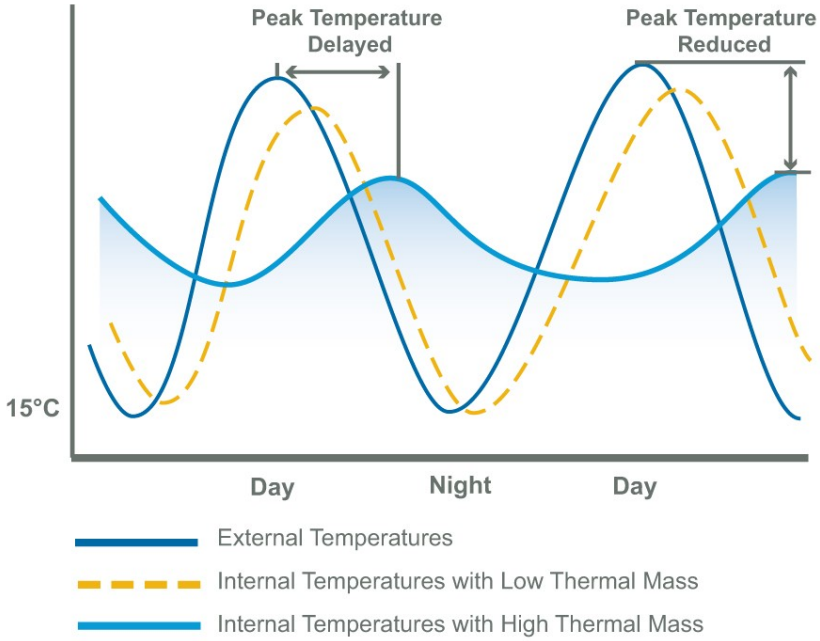


Figure 8.2: The time delay and damping effect of thermal mass is clearly illustrated in this diagram.

The major innovation in the Urban Eden house is combining thermal mass storage with a state of the art zoned capillary tube system. Evacuated tubes solar collectors will heat up a working fluid to be transferred into capillary tubes. The tubes are one eighth of an inch in diameter and placed close together to maximize surface area. One section of the capillary tubes is located behind a thin sheet of drywall in the ceiling. This section will be used when the heat transfer is needed immediately. The rest of the capillary tubes are embedded three inches deep in the concrete walls. These are used when the available energy is needed at a later time. The walls are sectioned so they can be used separately which allows precise control over the mean radiant temperature.

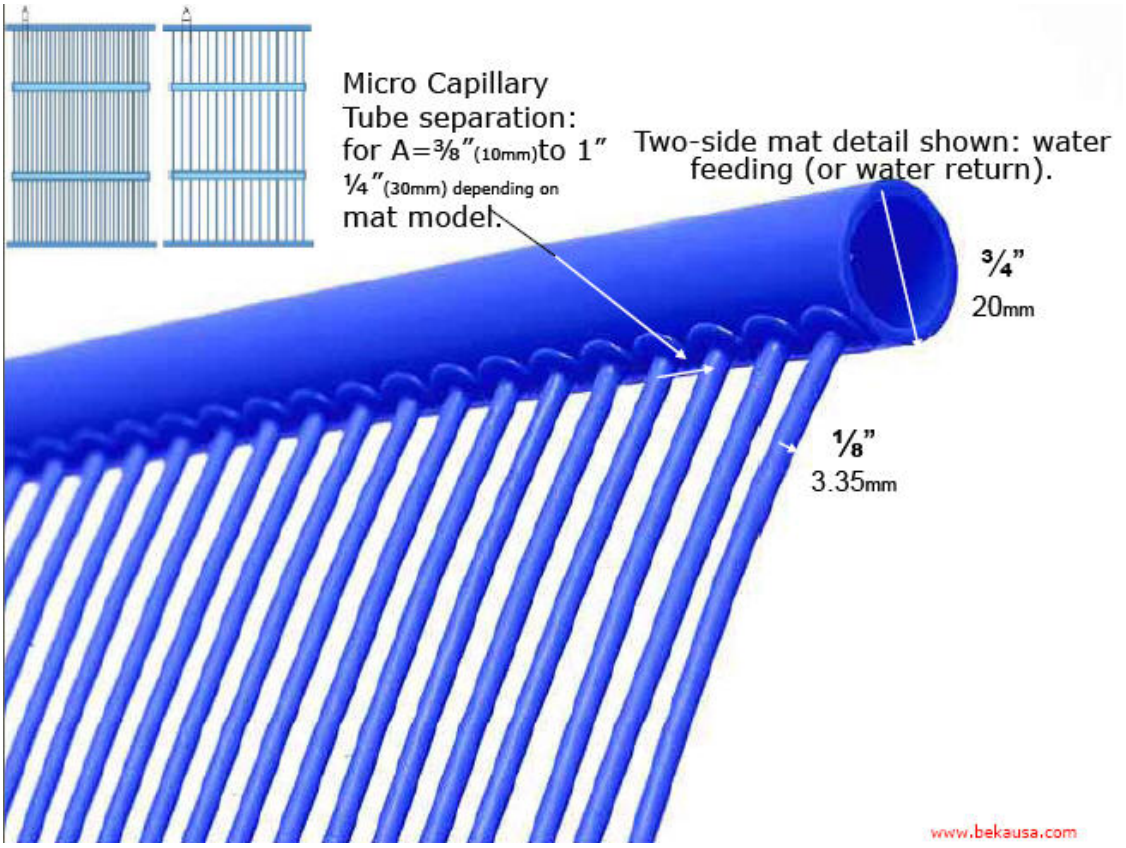


Figure 8.3: An example of the capillary tubes, which are embedded in the walls.

8.2.5 Climate Considerations

Since the house will only be in Irvine for two weeks in October, it is primarily designed for the slightly more extreme Charlotte climate. Figures 8.6 and 8.7 demonstrate that Charlotte has more Heating Degree Days and Cooling Degree Days than Irvine, CA. Therefore, it will be able to perform well in the competition and back home. In addition, our shading design will work well in both Charlotte and Irvine because these cities are close in latitude and have similar heating and cooling periods of the year (Figures 8.4 and 8.5).

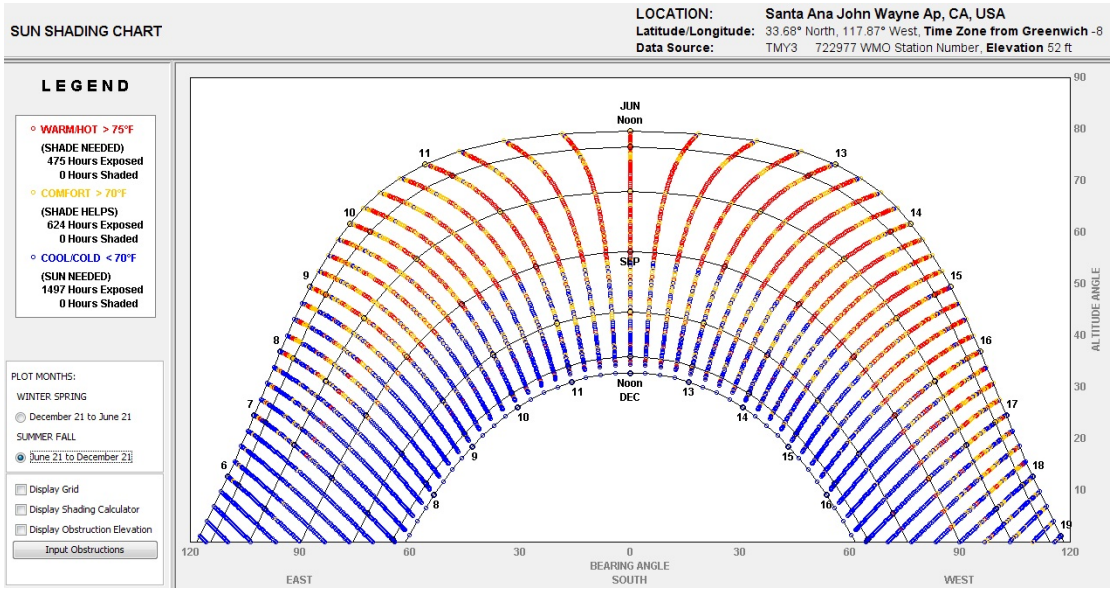


Figure 8.4: Sunpath chart for Charlotte, NC

Figure 8.5: Sunpath chart for Irvine, CA

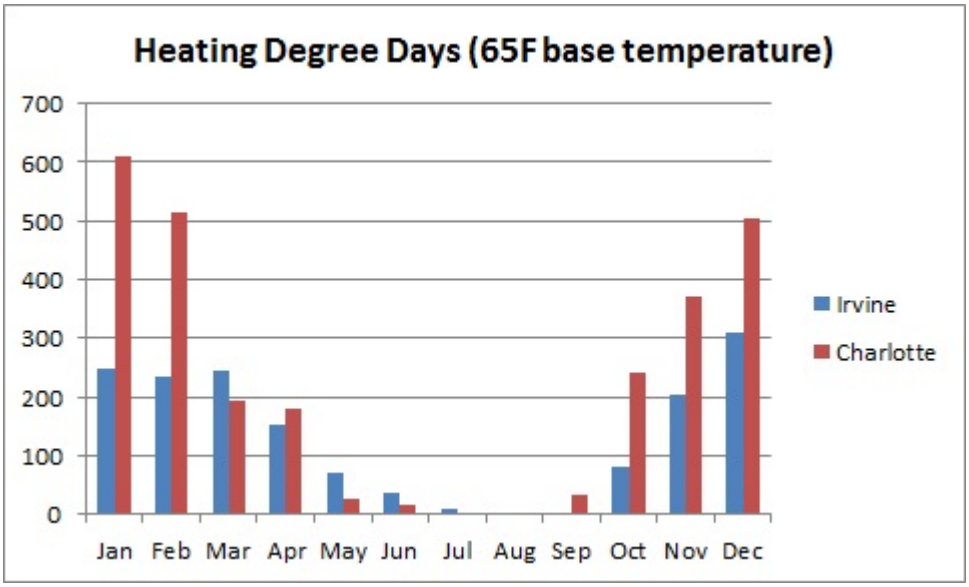


Figure 8.6: Heating Degree Days for Charlotte, NC and Irvine, CA

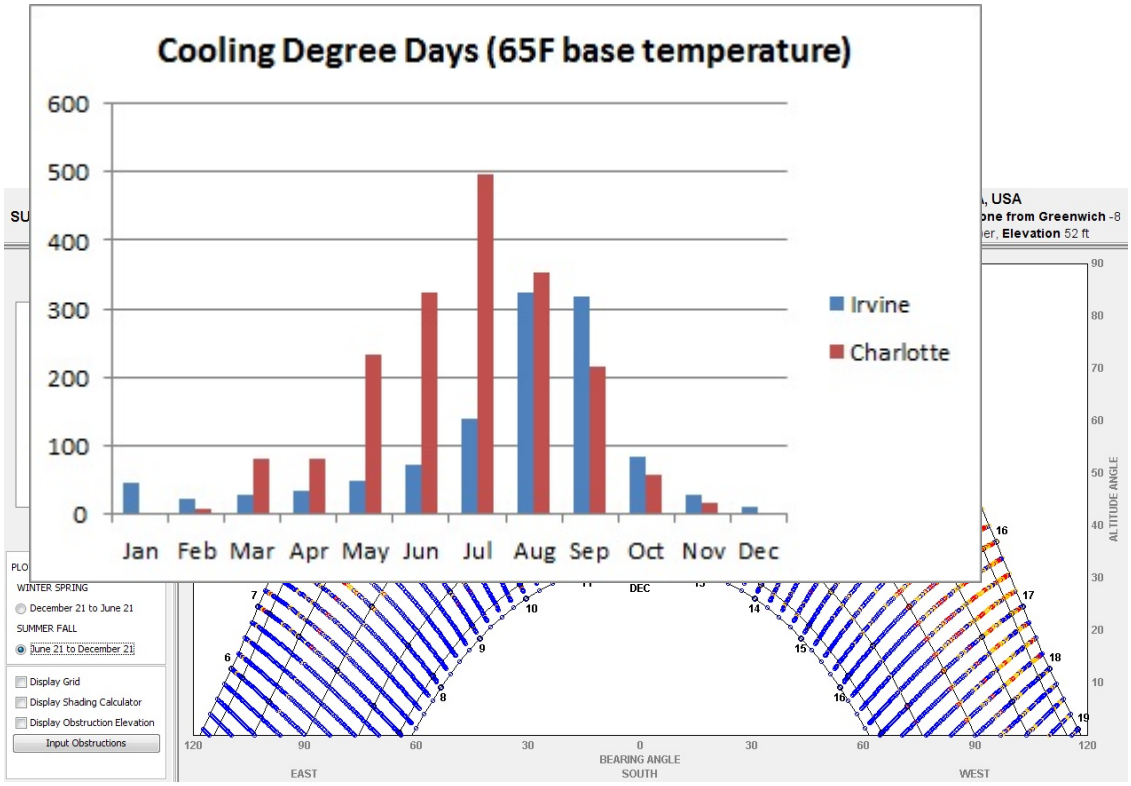


Figure 8.7: Cooling Degree Days for Charlotte, NC and Irvine, CA

8.2.6 Miscellaneous

Along with the thermal gains from the climate there are others that sometimes have an even greater impact on the energy usage of the house. Lighting and electrical loads from appliances and personal wall outlets are one of the highest consumers of energy in the house. People also contribute to thermal gains and have a major role in producing latent loads within the house. This requires dehumidification which is supplied by the heat pump units.

8.3 ENVELOPE PARAMETERS AND ANALYSIS

8.3.1 Important Envelope Parameters

By calculations similar to the ACCA Residential Load Calculation Manual J, important envelope parameters can be quickly identified for further analysis. Once completed, calculations will be displayed in the appendix of this section along with assumptions.

8.3.1.1 Insulation

By maximizing insulation in the walls, ceiling, and floor, a solid starting point for energy modeling is established. The R-values of the wall, ceiling, and floor, are about 30, 55 and 30 respectively and are made up of mostly high density concrete and extruded polystyrene insulation. The total areas of the wall, ceiling, and floor are 628, 750, and 750 square feet respectively. The total heat loss through the walls, ceiling, and floor is equal to 1.674 kBtu/hr. In this case the energy transfer through the insulated surfaces is relatively small.

8.3.1.2 Ventilation

Since continuous ventilation is required by the ASHRAE code 62.2, some of the conditioned air will be constantly lost and replaced with unconditioned air. This causes a slight increase in both the heating and cooling loads. To meet the code the Urban Eden house requires about 23 CFM of ventilation. Supplying this ventilation and recovering some of the lost energy is ERV which will run at 50 CFM. The required rate of ventilation is doubled because the return duct is located in the bathroom supplying its 50 CFM exhaust requirement. This heat loss of this ventilation is calculated to equal 1.7 kBtu/hr. The effect of the ventilation requirement has about the same impact on the loads as the insulation.

8.3.1.3 Infiltration

In a house with an average annual tightness of .34 air exchanges per hour, the effect on the loads is comparable to the ventilation calculated to be 1.3 kBtu/hr. The Urban Eden house is designed to achieve an average annual infiltration rate of .03 air changes per hour. In that case the effect on the load is negligible and is calculated to be 115 Btu/hr. Since this parameter is not certain it is modeled at a couple different values.

8.3.1.4 Windows

After a simple calculation it is easily seen that the windows are the critical factor in the design. They take up an area of about four hundred square feet which is comparable to the wall area

and have an R-value that is about 10 times less when considering a good quality double pane window. 75% of the windows are on the southern wall where most of the solar radiation is directed. This situation is perfect for passive winter heating but is a major problem in the summer especially in Charlotte. The solution to this problem can be found in two places, the window construction and more importantly the window shading. Shading provides an easy way to block undesired solar gain and can cut the cooling load in half. With an R-value of 9.25 quoted by Intus Windows, the total heat loss through all of the windows is 1.468 kBtu/hr. This is even less than the load contributed by the insulation and ventilation showing that with high quality windows the loads can be kept down while still retrieving plenty of sunlight.

8.3.2 Energy Model Analysis

So far, all of the energy modeling was done with NREL's BEopt program which interfaces with EnergyPlus. After outlining the critical parameters and understanding the basics of passive design, the BEopt computer model provided the speed and detail necessary to optimize the final design. Below are the significant input parameters of the Urban Eden house and its output in BEopt compared to the Standard.

- Wall R-30
- Floor R-30
- Roof R-55
- Continuous Ventilation 100% of ASHRAE 62.2 25 CFM
- Heat Pump Hot Water Heater
- Solar Water Collector 100 ft^2
- Window Shading: Summer 90%
  Winter 5%
- Passivhaus Tightness 0.03 ACH
- Window U-Value 0.2

8.3.2.1 Energy Model Results

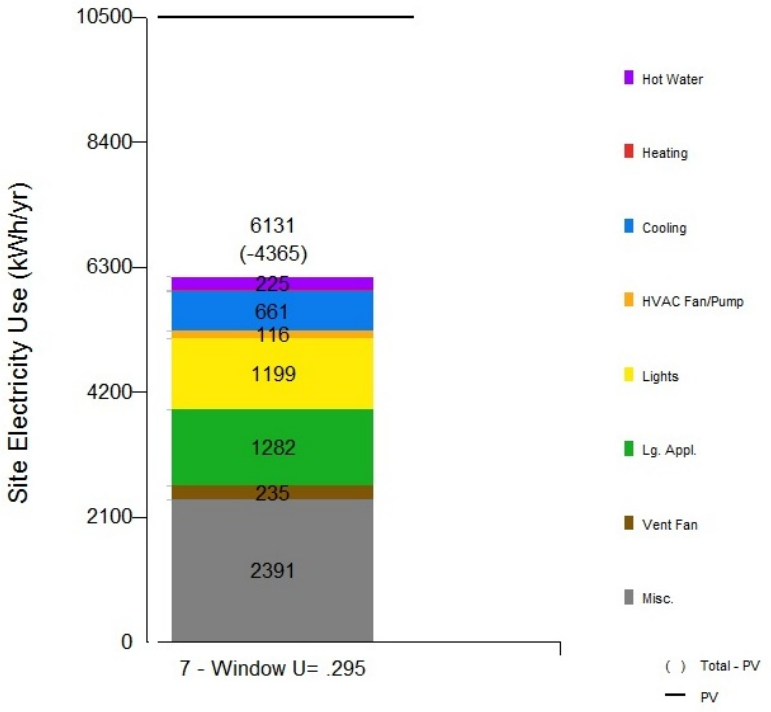


Figure 8.8: Simulation Results for Irvine: Annual End Energy Consumption by End Use.

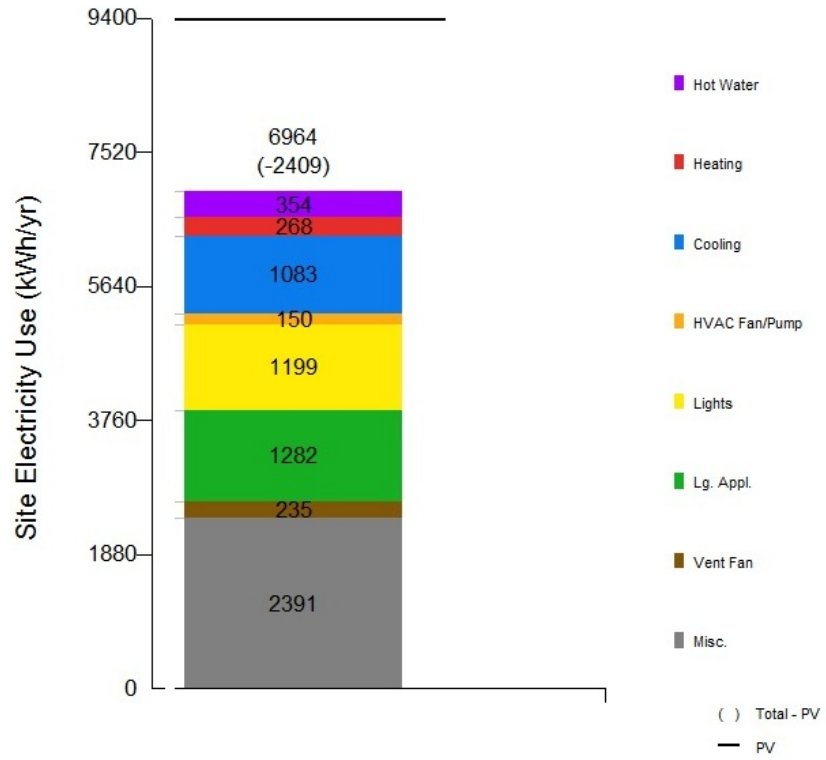


Figure 8.9: Simulation Results for Charlotte: Annual End Energy Consumption by End Use.

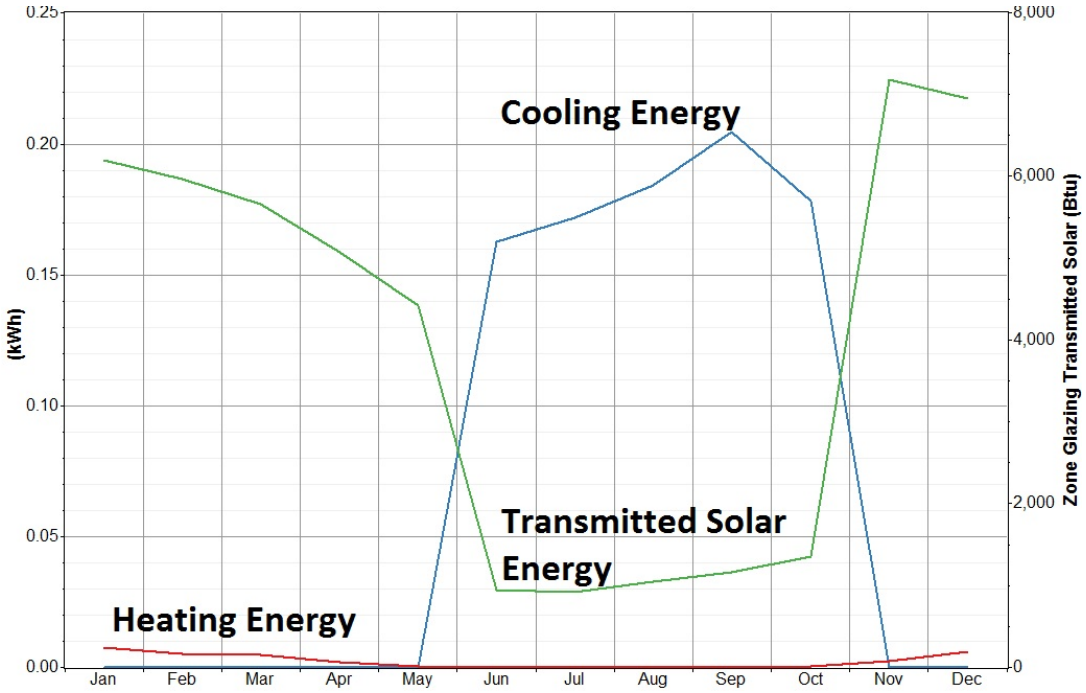


Figure 8.10: Simulation Results for Irvine - Monthly Heating, Cooling, and Transmitted Solar Energy

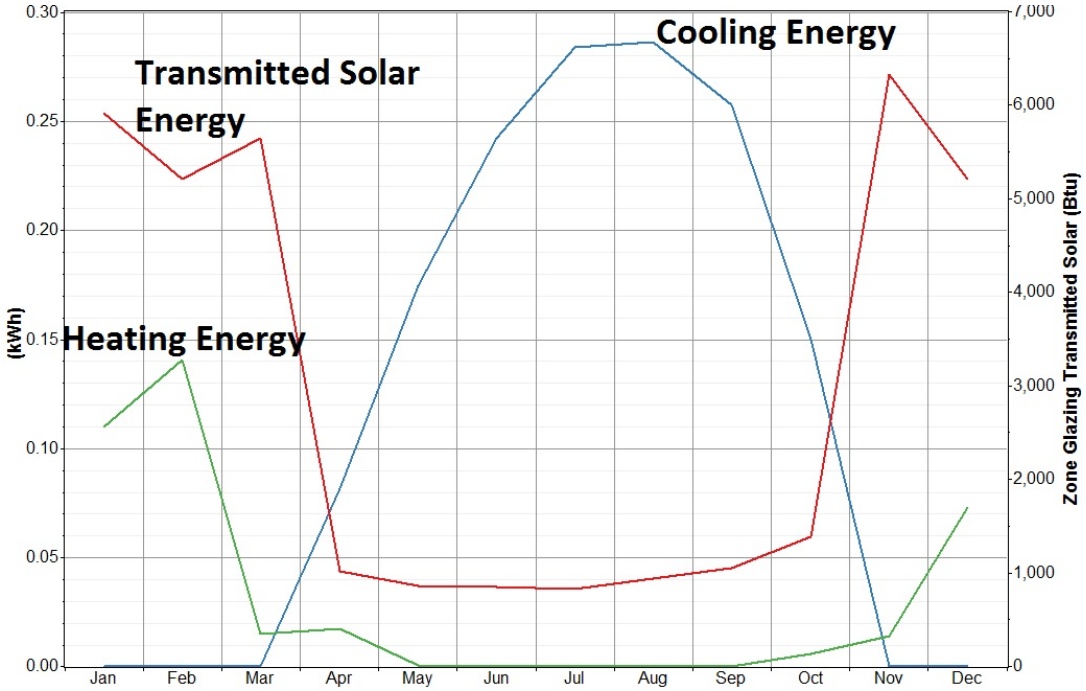


Figure 8.11: Simulation Results for Charlotte - Monthly Heating, Cooling, and Transmitted Solar Energy

8.3.3 Mechanical System Sizing

The mechanical system must be designed to cover all the loads in the house without considering passive/hybrid techniques.

3.A1 MathCAD calculations

UNCC Solar Decathlon Mechanical Load Calculations

Materials	R-Values(per in)	Thicknesses(in)		
		Walls	Floor	Ceiling
1) GeoPolymer Concrete	R1 := .066			
2) Extruded Polystyrene	R2 := 5	WT1 := 6	FT1 := 6	CT2 := 10
3) Cement Backer	R3 := .32	WT2 := 6	FT2 := 6	$CT6 := \frac{5}{8}$
4) Thinset Mortar	R4 := 0.4		FT3 := .5	$CT7 := \frac{5}{8}$
5) Ceramic Tile	R5 := 0.08		FT4 := .25	$CT8 := \frac{5}{8}$
6) Wood Fiberboard	R6 := 2.7		FT5 := .25	
7) Fiberglass Board	R7 := 4.5			
8) Metal	R8 := 0			

Total R-Values

Walls	RW := WT1·R1 + WT2·R2	RW = 30.396
Floor	RF := FT1·R1 + FT2·R2 + FT3·R3 + FT4·R4 + FT5·R5	RF = 30.676
Ceiling	RC := CT2·R2 + CT6·R6 + CT7·R7 + CT8·R8	RC = 54.5

Insulation

U-Values

$UW := \frac{1}{RW}$ $UF := \frac{1}{RF}$ $UC := \frac{1}{RC}$

Average Temp Differances

WinterT := 39 ΔTw := 73 − WinterT

SummerT := 85 ΔTs := SummerT − 73

Winter	Summer	Areas
WallLoss := UW·ΔTw	WallGain := UW·ΔTs	WallArea := 685
FloorLoss := UF·ΔTw	FloorGain := UF·ΔTs	FloorArea := 750
CeilingLoss := UC·ΔTw	CeilingGain := UC·ΔTs	CeilingArea := 750

InsulationLoss := WallLoss·WallArea + FloorLoss·FloorArea + CeilingLoss·CeilingAr

InsulationGain := WallGain·WallArea + FloorGain·FloorArea + CeilingGain·CeilingA

Insulation Heat Gain/Loss(Btu/hr)

InsulationLoss = 2.065×10^3 InsulationGain = 728.957

Infiltration and Ventilation(Btu/hr)

VentilationCFM := 50 ACH := .03 Volume := 750·9

Winter Heat Loss

InfiltrationLoss := .0167ACH·Volume·ΔTw = 114.979

VentilationLoss := VentilationCFM·ΔTw = 1.7×10^3

Summer Heat Gain

InfiltrationGain := 0.0167·ACH·Volume·ΔTs = 40.581

VentilationGain := VentilationCFM·ΔTs = 600

Windows

U := 0.106 WindowArea := 400 SHGC := 0.369

Winter WindowLoss := U·ΔTw·WindowArea = 1.442×10^3

Summer WindowGain := U·ΔTs·WindowArea = 508.8

TotalLoss := InsulationLoss + InfiltrationLoss + VentilationLoss + WindowLoss

TotalGain := InsulationGain + InfiltrationGain + VentilationGain + WindowGain

Total Winter Heat Loss(kBtu/hr)

TotalLoss = 5.322×10^3

The total winter loss is very close to the heating capacity output from BEopt

Total Summer Heat Gain(kBtu/hr)

TotalGain = 1.878×10^3

The total summer gain is significantly lower than the cooling capacity output in BEopt. This is because the calculation here does not take into account the solar radiation, it is only based off of the average outside temperature in the summer.

8.4 ENERGY BUDGETING AND COMPETITION MODEL

Device	Power Deman	Day 11 (hrs)	Day 11 Energy	Day 12 (hrs)	Day 12 Energy	Day 13 (hrs)	Day 13 Energy	Day 14 (hrs)	Day 14 Energy	Day 15 (hrs)	Day 15 Energy	Day 16 (hrs)	Day 16 Energy	Day 17 (hrs)	Day 17 Energy	Day 18 (hrs)	Day 18 Energy	Day 19 (hrs)	Day 19 Energy
System																			
Lighting	1000	3.5	3500	3.5	3500	3.5	3500	3.5	3500	3.5	3500	3.5	3500	4	4000	4	4000	3.5	3500
Miscellaneous Loads	200	1	200	1	200	1	200	1	200	1	200	1	200	1	200	1	200	1	200
Mechanical Room																			
Elector Pump	450	0.25	112.5	0.25	112.5	0.25	112.5	0.25	112.5	0.25	112.5	0.25	112.5	0.25	112.5	0.25	112.5	0.25	112.5
Main Water Pump	1500	1	1500	2	3000	2	3000	2	3000	1	1500	2	3000	2	3000	2	3000	2	3000
Axion PLC	100	24	2400	24	2400	24	2400	24	2400	24	2400	24	2400	24	2400	24	2400	24	2400
Nilan VP-18	2300	5	11500	3	6900	3.5	8050	4.5	10350	5	11500	4.5	10350	3.5	8050	4.5	10350	4.5	10350
Kitchen																			
Refrigerator Freezer	300	6	1800	8	2400	8	2400	8	2400	8	2400	8	2400	8	2400	8	2400	8	2400
Dishwasher	400	1	400	1.5	600	0	0	1.5	600	0	0	1.5	600	0	0	1.5	600	1.5	600
Cooktop	2275	2	4550	1	2275	0	0	1	2275	2	4550	0	0	2	4550	0	0	1	2275
Oven	2100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Microwave	1000	2	2000	0.5	500	0	0	0	0	2	2000	0.2	200	2	2000	0	0	0	0
Bedroom																			
Clothes Dryer	1500	0	0	0.6	900	0.6	900	0.6	900	0	0	1.2	1800	0	0	1.2	1800	0.6	900
Clothes Washer	800	0	0	1	800	1	800	1	800	0	0	2	1600	0	0	2	1600	1	800
Living Room																			
HMI Screen	100	1	100	1	100	1	100	1	100	1	100	1	100	1	100	1	100	1	100
Television	120	0	0	3	360	4	480	4	480	7	840	6	720	6	720	7	840	3	360
Blu-Ray Player	20	0	0	3	60	4	80	4	80	7	140	6	120	3	60	7	140	3	60
Sound Bar	30	0	0	3	90	0	0	0	0	3	90	3	90	6	180	0	0	0	0
Computer	120	0	0	7	840	11	1320	12	1440	9	1080	8	960	9	1080	11	1320	7	840
Internet Router	5	24	120	24	120	24	120	24	120	24	120	24	120	24	120	24	120	24	120
Bathroom																			
Daily Energy Consumption (Wh)			28182.5		25157.5		23462.5		28757.5		30532.5		28272.5		28972.5		28982.5		28017.5

Total Energy Use (9 Days)	250338	*W*
Avg. Daily Energy Req'd	27815.3	*W*
Avg. Daily Daylight Hours (Charlotte)	4.5	*Hours*
Required PV Array Size	6181.17	*W*
Efficiency	0.85	
Corrected PV Size	7271.97	*W*
Total Surplus Demand	1090.8	*W*

09 Quantity Takeoff

SECTION #	SECTION TITLE	DESCRIPTION	Quantity	Unit	MANUF.	MODEL #
Division 00 Procurement and Contracting Requirements						
00 01 01	Project Title Page		N/A	N/A	N/A	
	Table of Contents		N/A	N/A	N/A	
00 01 15	List of Drawing Sheets		N/A	N/A	N/A	
00 31 00	Available Project Information		N/A	N/A	N/A	
Division 01 General Requirements						
01 11 00	Summary of Work	Includes Work Restrictions	N/A	N/A	N/A	
01 20 00	Price and Payment Procedures		N/A	N/A	N/A	
01 25 00	Substitution Procedures		N/A	N/A	N/A	
01 30 00	Administrative Requirements	Project Management and Coordination	N/A	N/A	N/A	
		Project Web Site	N/A	N/A	N/A	
		Construction Progress Schedule	N/A	N/A	N/A	
		Submittals Schedule	N/A	N/A	N/A	
		Survey and Layout Data	N/A	N/A	N/A	
		Mockups and Field Samples	N/A	N/A	N/A	
01 50 00	Temporary Facilities and Controls		N/A	N/A	N/A	
01 51 13	Temporary Electricity	Receptacles: 20A 125V Duplex, 30A 125V Locking Plug, 30A 125/250V Locking Plug	5	Ea.	UltraTech International	UTI-2351
		Honda Generator Engine GX390	3	Ea.	Honda Power Equipment	EU6500IS
01 54 19	Temporary Cranes	130 Ton, Telescopic Crane	2	Day	Liebherr International	
01 60 00	Product Requirements	Owner-Furnished Products, Product Options, etc	N/A	N/A	N/A	
01 73 00	Execution	Application, Erection, Installation, Bracing, Cutting & Patching, etc	N/A	N/A	N/A	
01 74 19	Construction Waste Management and Disposal		N/A	N/A	N/A	
Division 02 Existing Conditions						
02 43 13	Building Relocation		N/A	N/A	N/A	
Division 03 Concrete						
03 45 00	Precast Geopolymer Concrete	Precast geopolymer Wall panels, 12' x 13'	28	Cubic yards	Metromont	
		Precast geopolymer floors	18	Cubic yards		
Division 05 Metals						
05 12 00	Structural Steel Framing	HSS 4*4*1/2" - Short PV rack building columns	11	L.F.	Steel Fab	
		HSS 6*6*1/2" - Main building columns	91	L.F.		
		W 8*18 - Exterior PV rack support columns and beam	216	L.F.		
		4" Metal ceiling joists spaced 24" o.c.	320	L.F.		
		S1 Entrance canopy ceiling- spacing at 16" o.c.	40	L.F.		
		W 12*22 Wet core frame beams	71	L.F.		
		S1 Wet Core floor joists - 16" o.c.	132	L.F.		
		HSS 8*2*1/4" - Entry Canopy Roof	72	L.F.		
		6" Light Gauge Metal Framing (includes wall height in calc.) - Wet core	324	L.F.		
		8" Light Gauge Metal Framing (includes wall height in calc.) - Wet core	351	L.F.		
		Structural steel member, 100-ton project, 1 to 2 story building, W12x22, roof frame steel, shop fabricated, incl shop primer, bolted connections	144	L.F.		
Division 06 Wood, Plastics and Composites						
06 10 00	Rough Carpentry	Roof-mounted Curbs, Roofing Nailers, Concealed Wood Blocking, Nailers, and supports	150	L.F.	GENERIC	
06 11 00	Wood Framing	2"*8" Treated - 8' long (Deck Construction)	80	Ea.		
		2"*8" Treated - 12' long (Deck Construction)	46	Ea.		
		2"*12" Treated - 8' long (Deck Construction)	45	Ea.		
		2"*12" Treated - 10' long (Deck Construction)	20	Ea.		
		2"*12" Treated - 12' long (Deck Construction)	90	Ea.		
		2"*12" Treated - 14' long (Deck Construction)	8	Ea.		
		1"*4" Spruce - 16' long (Deck Construction)	20	Ea.		
		2"*6" Spruce - 12' long (Deck Construction)	6	Ea.		
		2" x 6" Floor joists (Floor of house)	528	L.F.	GENERIC	
		2"*4" Spruce - studs (Planter Construction)	32	Ea.	GENERIC	

SECTION #	SECTION TITLE	DESCRIPTION	Quantity	Unit	MANUF.	MODEL #
		2"*4" Spruce - studs (Rear water feature)	137	L.F.	GENERIC	
06 15 33	Wood Patio Decking	Patio Decking and Ramp Decking	1100	S.F.	WorldClassSuppply.com	
		Patio Decking for planter/ water feature facing	414	S.F.		
06 16 00	Sheathing	3/4" thick OSB (Roof)	816	S.F.	GENERIC	
		3/4" fire resistant Plywood walls (Mechanical Room)	280	S.F.		
		1/2" OSB - 4'*8' sheets (Deck)	64	S.F.		
		3/4" fire resistant Plywood -(parapet walls)	300	S.F.		
Division 07	**Thermal and Moisture Protection**					
07 13 00	Sheet Waterproofing	Spray (Water features)	230	S.F.	Grace Construction Prodcuts	Spray for walls
07 21 00	Thermal Insulation	Wall Insulation, Rigid, extruded polystyrene, 6" thick	720	S.F.	Dow, Inc.	
		Floor Rigid extruded polystyrene, 6" thick	816	S.F.	Dow, Inc.	
		Roof Deck Insulation,extruded polystyrene, 10" thick,	816	S.F.	Dow, Inc.	
		Polystyrene insulation	700	S.F.	Dow, Inc.	
07 25 00	Weather Barriers	Elastomeric sheet waterproofing, polyvinyl chloride sheets, plain, 10 mils thick	800	S.F.	Grace Construction Products	
07 54 00	Thermoplastic Membrane Roofing	Polyvinyl-chloride roofing, (PVC), heat welded seams, reinforced, 0.40 P.S.F., partially adhered with mechanical fasteners, 60 mils	950	S.F.	Dow, Inc.	
			9.5	Sq.	Sika Sarnafil, Inc.	
07 62 00	Sheet Metal Flashing and Trim	Sheet metal flashing, stainless steel, flexible sheets, .025" thick, 24 gauge, including up to 4 bends	60	S.F.	Sarnafil	
07 71 00	Roofing Finish and Capping	Fascia, steel, galv. & enameled, stock, long panels, excl. furring	150	L.F.		
07 95 13	Expansion Joint Cover Assemblies	Expansion joint assemblies, floor cover, aluminum, 2" space	38	L.F.	BALCO, INC.	
	Expansion joint	Expansion joint assemblies, floor cover, aluminum, 2" space	84	L.F.		
08 14 00	Wood Doors	unfinished mahogany door 36" x 80"h x 2-1/4" thick; unfinished mahogany 4-1/2" matching jamb; 8 stainless steel plaques (exterior side of door only); clear laminated security glass 1/4" thick; weatherstripping; 1 stainless steel bar handle length 39" diameter 2"			Foret, Inc.	
08 50 00	Windows	101-A= Glazed Door w/ Transon Above	1	Ea.		
		101-B= Lower Sash Operable: Outswing Casement w/ 30 degree opening limit	1	Ea.		
		102-A= Lower Sash Operable: Outswing Casement w/ 30 degree opening limit	1	Ea.		
		102-B= Window Wall w/ Glazed Bi-fold Doors	1	Ea.		
		102-C= Window Wall w/ Glazed Bi-fold Doors	1	Ea.		
		103-A	1	Ea.		
		105-A= Window Wall w/ Glazed Door	1	Ea.		
		105-B= Lower Sash Operable: Outswing Casement w/ 30 degree opening limit	1	Ea.		
		105-C= Glazed Door w/ Transon Above	1	Ea.		
		105-D= Lower Sash Operable: Outswing Casement w/ 30 degree opening limit	1	Ea.		
	Doors	101-A= By Window Supplier- Re; 7/ A602	1	Ea.		
		102-A= Bi-Fold Doors by window supplier - Re: 3/A602	1	Ea.		
		102-B= Bi-Fold Doors by window supplier - Re: 2/A602	1	Ea.		
		103-A= Pocket Door- Match Wood Wall Panels Both Sides	1	Ea.		
		103-B= Pocket Door- Match Wood Wall Panels Both Sides	1	Ea.		
		104-A= Match Wood wall panels on bath 103 side, paint laundry 104 side	1	Ea.		
		105-A= By window supplier- Re: 1/A602	1	Ea.		
		105-B= By window supplier- Re: 1/A602 - Sim opp hand	1	Ea.		
		106-A= Insulated clad exterior with rain screen wood panels	1	Ea.		
08 70 00	Hardware	Laundry Door Hardware, Slide 06	1	Kit	3 Form	
		Bathroom Door Hardware Slie 01	1	Kit		
09 29 00	Gypsum Board	Partition Wall, interior, standard, taped both sides, installed on & incl. steel studs, 16" O.C., 8' to 12' high, 1/2" gypsum drywall (Laundry)	90	S.F.	USG / National	
		Cloud System Finish	528	S.F.		
09 30 00	Tiling	Unity Porcelain Tile, 12"*24" Beige (bathroom/laundry floors)	111	S.F.	Daltile	
		Unity Porcelain Tile, 12"*24" Ash Grey (bathroom walls)	270	S.F.	Daltile	
		Kitchen, Staal Stainless Steel Mosaic Tile, 5/8" straight mosiaic	72	S.F.	Ann Stacks	
		Polyblend sanded grout-floor	1	Ea.	GENERIC	
		Polyblend non sanded grout-wall	1	Ea.		

SECTION #	SECTION TITLE	DESCRIPTION	Quantity	Unit	MANUF.	MODEL #
		Fiber cement underlayment, 5/8"thick (bath & Laundry Floors)	111	S.F.	Certain Teed	
		Fiber cement underlayment, 5/8"thick (bathroom Walls)	270	S.F.		
09 54 00	Specialty Ceilings	Gypsum board base with capliary tubes embeded in plaster (see cloud system finish)	480	S.F.	Certain Teed	
09 64 00	Wood Flooring	Thermally Modified Ash 3/4"x 5" by random lengths (Interior)	600	S.F.	WorldClassSuppply.com	
		Thermally Modified Ash 7/8" x 5-1/2" by random lengths (Exterior) (See Wood Patio Decking: Division 6)	1500	S.F.	WorldClassSuppply.com	
10 28 00	Toilet, Bath and Laundry Accessories	Aquia Paper Holder, Polished Chrome	1	Ea.	Toto	YP416
		Aquia Towel Bar, Polished Chrome	1	Ea.	Toto	YB416
		Aquia Towel Holder/ Ring, Polished Chrome	1	Ea.	Toto	YR416
		Aquia Robe Hook, Polished Chrome	2	Ea.	Toto	YH416
11 31 00	Residential Equipment	Electric Cooktop - Frigidaire - FGIC 3067 M	1	Ea.	Electrolux	FGIC 3067 M
		Electric wall oven - Frigidaire - FGEW 3045 K	1	Ea.		FGEW 3045 K
		Microwave ovens- residential appliances, minimum - FGMO 205k	1	Ea.		FGMO 205 K
		Overheand Exhaust Hood - FHPC 3660 L S - Frigidaire	1	Ea.		FHPC 3660 L S
		Refrigerator/ Freezer - Bloomberg - BRFB 0900	1	Ea.		BRFB 0900
		Dishwasher, built-in, energy-star qualified, Frigidaire - FFBD 1821 M	1	Ea.		FFBD 1821 M
		Washing machine, energy star, front loading, minimum - Frigidaire - FAFW 3921 NW 7001 L	1	Ea.		FAFW 3921 NW 7001 L
12 35 00	Specialty Casework	3/4" Birch Veneer Plywood (Custom Raw Boxes for Casework)	35	Ea.		
		3/4" Plyboo - 4'*8' Panels (Doors and Exposed walls for Casework)	20	Ea.		
		1/2" Plyboo - 4'*8' Panels (Interior and Exterior Wall Panels)	40	Ea.		
		1" Plyboo - 4'*8' Panels (Dining Table)	1	Ea.		
	Countertop	Richlite- Stratum	1	Ea.	Richlite	
13 00 00	Special Construction	Micromax AC Inverter Duty Motor	3	Ea.	Marathon Electric Motors	Y500
		60:1 Worm Gearbox	3	Ea.	Automation Direct	WG-175-060-R
		GS2 Series Drive	3	Ea.	Automation Direct	GS2-10P2
		Hydro-Service Chain	90	L.F.	Renold Jeffrey	ANSI 40 (ISO 606) 1-fach
		16 Tooth Sprocket	6	Ea.	Martin Sprocket	40BS16, 40BB16
		Trolley	24	Ea.	McMaster Carr	3626T11
		Strut	180	L.F.	McMaster Carr	3548T37
21 13 13	Wet-pipe Sprinkler System	Tyco rapid response residential sprinklers - TY2524	12	Ea.	Tyco	TY 2524
	Response System	Tyco Rapid response residential control panel	1	Ea.	Tyco	
	Sprinkler Piping	Pipe Main Sch 40 stainless steel - 1.25"	36	L.F.		
		Pipe Sch 40 stainless steel - 1"	24	L.F.		
		Tee Sch 40 stainless steel tee - 1.25" (3 way)	3	Ea.		
		Tee Sch 40 stainless steel tee - 1.25" (4 way)	2	Ea.		
		Elbow Sch 40 stainless steel 1.25" - 90 degree	12	Ea.		
		Stainless steel fasteners quantity	20	Ea.		
		Stainless steel hangers	20	Ea.		
		Connections 1.25 inch stainless steel Quick connectors	4	Ea.		
	Pump	Pump Unit CB Manufacturers 13D-70/310 5 hp fire pump	1	Ea.		
		Backflow preventer	1	Ea.		
	Kiddle 2A: 10: B:C	4 lb Fire extinguisher	1	Ea.		

SECTION #	SECTION TITLE	DESCRIPTION	Quantity	Unit	MANUF.	MODEL #
220500	Meters and Gages for Plumbing Piping	Water Pressure Gauge and Water Flow Rate Meter	1	Ea.	Toro	995-01SKU397-654
	Hangers ans Supports for Plumbing Piping and Equipment	PEX wall support talons 3/4th	1	Ea.	Rifeng	HTALON07
	Facility Drainage Piping Cleanouts	Cleanout Plug, 3 In, MPT, ABS, 180 Deg F	1	Ea.	Generic	
221005	PVC piping	ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 for not less than 150 psi (1 034 kPa) pressure rating	300	L.F.		
	Pipe Fittings	ASTM D2466, PVC	30	Ea.		
	Joints	Solvent welded, with ASTM D2564 Solvent cement	30	Ea.		
221219	Facility Potable Water Storage Tanks	Potable-water supply storage tank - 1500 gallon silo tanks	1	Ea.		
221316	Sanitary Waste and Vent Piping	Piping: PVC pipe and fittings ASTM D 1785, Schedule 40, plain ends, 1 1/4", 1 ½", 2" and 3" diameter	200	L.F.		
221363	Facility Graywater Tank	Graywater storage tank - 1500 gallon silo tank	1	Ea.		
		Evacuation pump - M. Quik Jon Ultima 204	1	Ea.		
221416	Rainwater Leaders (For roof)		3	Ea.		
223300	Electric Domestic Water Heaters	Hybrid electric-heat pump water heater, (capacity: 50 gallons; DIMENSIONS 66" x 25" diameter; energy factor 2.5; 2,950 Whrs)	1	Ea.	Vaughn	S50WHPT3838I
224000	Plumbing Fixtures	Kitchen Sink: 9 1/2"*25"*22" - K-3894	1	Ea.	Kohler	K-3894
		Kitchen, Simplice Pull-Down Spout Faucet, 15 3/8" x 8" x 8"	1	Ea.	Kohler	K-596-CP
		Bathroom, Helix Ecopower Faucet, Polished Chrome	1	Ea.	Toto	TEL3GW10
		Bathroom, Aquia Two Way Volume Control, Polished Chrome	1	Ea.	Toto	TS416D2
		Bathroom, Legato Ceiling Mount Showerhead with LED Lighting, 11" diameter	1	Ea.	Toto	TS624KG
		Bathroom, Larissa Vessel Lavatory	1	Ea.	Toto	LT523 (G)
		Bathroom, Aquia Dual Flush Toilet (#01 cotton color)	1	Ea.	Toto	CST412MF
230713	Duct Insulation	Mineral fiber blanket insulation	as needed			
230719	HVAC piping insulation	Flexible elastomeric insulation	as needed			
232113	Hydronic piping	Automatic Flow Control Balancing Valves, Pressure-reducing valves, safety valves, expansion tanks, air separators, buffer tanks				
232123.16	Hydronic pumps, base mounted centrifugal	Capillary tube system circulation pump, vertical multistage pump	1	Ea.	Bell & Gossett	3SV2GA4F10
232113.23	Above Ground Hydronic Piping	Capillary Tube Mats (Supply header diameter at 20 mm and capillary tube diameter at 3.35 mm)	13	Ea.	M. Beka	K.S.15
232116	Hydronic piping specialties	Multiport Tee Manifolds (Outlets: 3, Loop Size: ½" MPT, Max Temperature/Pressure: 210°F at 150 psi, CAN/CSA B137.5, ASTM F1960, ASTM F877, Max Flow: 7.5 gpm (8 fps), 3.75 gmp (4 fps), Finish: Engineered Plastic)	2	Ea.		
		8 Port Manifold (Outlets: 8, Loop Size: ½" MPT, Supply Size: ¾" MPT, Max. Temperature/Pressure: 210°F at 150 psi, Standards: CAN/CSA B137.5, ASTM F877, Max Flow: 21 gallons, Finish: Copper)	2	Ea.		
		6 Port Manifold (Outlets: 6, Loop Size: ½" MPT, Supply Size: ¾" MPT, Max Temperature/Pressure: 210°F at 150 psi, Standards: CAN/CSA B137.5, ASTM F877, Max Flow: 21 gallons, Finish: Copper)	2	Ea.		
		5 Port Radiant Manifold with Isolation Valves (Outlets: 5, PEX Size: 3/8" MPT, 1/2" MPT, 5/8" MPT, 5/16" MPT, Loop Thread/Supply Thread: R20, R32, Finish: Brass)	2	Ea.		
		Capillary Storage Tank (25 gal, 1. Diameter: 22" MPT, Length: 28-1/2" MPT, Max Temperature: 180°F, Working Pressure: 150 psi, Weight: 100 lbs)	1	Ea.		
233100	HVAC Ducts and Casings	Double-Wall Spiral Duct, 28-14 gauge galvanized steel, 1 inch fiberglass insulation	75	L.F.	Ingersoll Rand/ Large Distributer	TS416D2
233300	Air Duct Accessories	Automated mechanical dampers (single blade mechanically operated damper, adjustable to allow/restrict the flow of air through a particular duct)	5	Ea.	Ingersoll Rand/ Large Distributer	TS624KG
233700	Air inlets and outlets	Diffusers: 8" to 4" dia, (1 ea.) 6" to 5" dia, (1 ea.) 6" to 4"	6	Ea.		
233800	Ventilation Hoods	Glass Canopy Island Hood - 36" stainless steel			Frigidaire	FHPC 3660 LS
237200	Heat-Wheel Air-to-Air Energy-Recovery Equipment	Heat recovery package, air to air, enthalpy recovery wheel, 1000 max CFM	1	Ea.	Ingersoll Rand/Trane	
238126	Split-system air conditioners	Split ductless system, cooling only, single zone, ceiling mount, 2 ton cooling	2	Ea.	Ingersoll Rand/Trane	
238236	Fin Tube Radiation Heat Exchanger	Thermafin Absorber Plates. Each with dimensions: 44.225" (W) x 96" (L)	6	Ea.	Alternate Energy Technologies (AET)	AP-4010C
238300	Radiant Heating Units	BEKA Capillary Tubing system, 3" thick mats	1460	S.F.	Beka USA	N/A
238416	Dehumidifier	Dehumidifier	1	Ea.	Ultra Aire 70H	4029870
		Dehumidifier External Control	1	Ea.	Ultra Aire 70H	4028539

SECTION #	SECTION TITLE	DESCRIPTION	Quantity	Unit	MANUF.	MODEL #
25 01 00	Operation and Maintenance of Integrated Automation	"Spec Only" - No products				
25 50 00	Integrated Automation Facility Controls	SEL-2240 Axion Programmable Logic Controller	1	Ea.	SEL	
		ROUTER: NEGEAR WNR3500L-100NAS Wireless-N Router	1	Ea.	Negear	
		USER INTERFACE: Samsung Series 7 Slate Tablet PC	1	Ea.	Samsung	
		THERMOCOUPLES: Thermocouple Type-K Glass Braid Insulated 36"	25	Ea.		
25 90 00	Integrated Automation Control Sequences	"Spec Only" - No products				
26 05 19	Low Voltage Electrical Power Conductors and Cables	PV Cabling, Southwire 10 Gauge 3-Conductor NM-B Cable, 600 Volts, 3 Copper Conductor	200	L.F.		
		PV Cabling, Cerrowire 6 Gauge 3-Conductor NM-B Wire, 600 Volts, 3 Copper Conductor	50	L.F.		
		Receptacles Cabling, Cerrowire 14-2 MC Aluminum Cable, PVC and Nylon, 600 Volts	300	L.F.		
		Receptacles Cabling, Cerrowire 14/3 NM-B Wire, 19 MIL, 14 gauge, 600 Volts	300	L.F.		N/A
		Receptacles Cabling, Cerrowire 12-2 MC Aluminum Cable, PVC and Nylon, 600 Volts	300	L.F.		
		Inductive Loads Cabling, Cerrowire 12-2 MC Aluminum Cable, PVC and Nylon, 600 Volts	150	L.F.		
		Main Service Feed, Southwire 4 Gauge Stranded Bare Copper Cable, 600 Volts	50	L.F.		
		Lighting, Cerrowire 14-2 MC Aluminum Cable, PVC and Nylon, 600 Volts	300	L.F.		
26 24 00	Switchboards and Panelboards	Main Circuit Breaker Panel, Single phase, 3-wire, 120/240 VAC, 200 Amps and 22K AIC rating	1	Ea.		N/A
26 27 13	Low-Voltage Distribution Equipment	Electric Meter				
26 27 73	Door Chimes					
26 28 00	Low-Voltage Circuit Protective Devices	Switches and Circuit Breakers				
26 31 00	Photovoltaic Collectors	Photovoltaic module, Max Power: 260 W, Max Power Voltage: 30.71 V (Bosch Solar Module c-Si M 60 EU42117)	36	Ea.	SolarHot	
		Power Inverters, Max recommended PV power: 7500 W, Max DC Voltage: 600V (SUNNY BOY 6000 – US)	1	Ea.	SMA America, LLC	
		Power Inverters, Max recommended PV power: 4750 W, Max DC Voltage: 500V (SUNNY BOY 3000 – US)	1	Ea.	SMA America, LLC	
		Daetwyler Angle	108	Ea.	Daetwyler	
		Daetwyler Aluminum Extrusion	400	L.F.	Daetwyler	
		Daetwyler Click-Clock Clamps-End Clamps	72	Ea.	Daetwyler	
		Daetwyler Click-Clock Clamps-Mid Clamps	36	Ea.		
		Hammer Screws and Nuts	216	Ea.		
26 50 00	Kitchen Power Pop-Up Receptacle	Recessed Pop-Up Receptacle with Duplex GFCI and Nickel Finish Cover	6	Ea.	Thomas & Betts	
	Lighting	Living/Kitchen/Bathroom/Bedroom, Eco-downlight Adjustable LED, 12 58" x 10 3/8"	30	Ea.	CSL	EU42177
		Kitchen, Flourescent under cabinet, 42.5" w	1	Ea.	Seagull Lighting	SUNNY BOY 6000- US
		Kitchen Island, Uni-Light Pendant, 4.4" diam x 6.5" H	3	Ea.	Bruck	SUNNY BOY 3000-US
		Bathroom, 2 square strip wall light, 38"	2	Ea.	Artimede	Remove
		Bathroom, M100 LED Surface/Pendant Mount, 1'-8' x 2 3/8" x 4"	2	Ea.	Selux	ADD
		Bedroom, Wall Shade 12.9" h, 11" diam, flurorescent bulbs (13W)	2	Ea.	Tolomeo	ADD
		EXTERIOR: Unilight -Selux	15	Ea.	Lumiere	ADD
27 05 13	Communication Services	Dialtone, T1, DSL, Cable, or Satellite	1	Ea.		
27 20 00	Data Communications	Network, Switches, Hubs, etc	1	Ea.		
28 31 00	Fire Detection and Alarm	First Alert Ionization Smoke Alarms 9120 B (smoke detector) interconnected	3	Ea.	Lowes	9120 B
32 93 00	Plants	Grenadine	14	Ea.		
		Common ivy	28	Ea.		
		Blue flax lilies	21	Ea.		
		Red sensation	14	Ea.		
		Oregano	6	Ea.		
		Sage	4	Ea.		
		Parsley	6	Ea.		
		Mint	4	Ea.		9120B
		Chives	10	Ea.		
		Peppers	10	Ea.		
		Trailing tomatoes	11	Ea.		
		Bulls Blood	33	Ea.		
		Spinach	55	Ea.		
		Lettuce	55	Ea.		

SECTION #	SECTION TITLE	DESCRIPTION	Quantity	Unit	MANUF.	MODEL #
		Onions	66	Ea.		
		Rosemary "Blue Lagoon"	14	Ea.		
		Vinca Major	7	Ea.		
		Santa Barbara daisy	14	Ea.		
		Lavender	14	Ea.		
		Blizard White	14	Ea.		
		Strawberries	18	Ea.		
		Basil	3	Ea.		

10 Construction Specifications

DIVISION 00

DIVISION 01

DIVISION 02

DIVISION 03

DIVISION 05

DIVISION 06

DIVISION 07

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

LIST OF SECTIONS:

SECTION 00 01 01 – PROJECT TITLE PAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 PROJECT MANUAL REVIEW SET – FOR CONSTRUCTION

A. Project Name: Urban Eden, University of North Carolina Charlotte 2013 Solar Decathlon

B. Owner: University of North Carolina Charlotte

C. Address: 9201 University City Blvd, Charlotte, North Carolina 28223-0001

D. Architect: University of North Carolina Charlotte Solar Decathlon Team

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 00 01 01

SECTION 00 01 15 - LIST OF DRAWING SHEETS

PART 1 - GENERAL:

1.01 SECTION INCLUDES

1.02 DRAWINGS CONSIST OF THE FOLLOWING CONTRACT DRAWINGS AND OTHER DRAWINGS OF TYPE INDICATED:

G-001 COVER
G-001 TABLE OF CONTENTS
G-002 GENERAL NOTES AND SYMBOLS
G-101 FINISHED SQUARE FOOTAGE COMPLIANCE PLAN
G-102 EGRESS PLAN
G-103 ADA TOUR ROUTE COMPLIANCE PLAN
G-201 SOLAR ENVELOPE COMPLIANCE ELEVATIONS
G-202 SOLAR ENVELOPE COPMLIANCE ELEVATIONS

C-101 GROUND CONTACT PLAN
C-501 LOT CONDITION ADJUSTMENT

L-101 LANDSCAPE AND PLANTING SITE PLAN
L-602 PLANTING SCHEDULES

S-101 FOUNDATION PLAN
S-102 DECK FRAMING PLAN

A-101 SITE PLAN
A-111 FIRST FLOOR PLAN
A-112 ROOF PLAN
A-201 SITE ELEVATIONS
A-202 SITE ELEVATIONS
A-213 INTERIOR ELEVATIONS
A-214 INTERIOR ELEVATIONS
A-301 BUILDING SECTIONS
A-302 BUILDING SECTIONS
A-303 BUILDING SECTIONS
A-310 WALL SECTONS
A-311 WALL SECTIONS
A-312 WALL SECTIONS
A-313 WALL SECTIONS
A-314 WALL SECTIONS
A-315 WALL SECTIONS
A-316 WALL SECTIONS
A-333 ROOF SECTIONS
A-411 DECKING & RAMPS
A-412 DECKING & RAMPS
A-501 PLAN DETAILS
A-502 PLAN DETAILS
A-511 SECTION DETAILS
A-512 SECTION DETAILS
A-513 CONNECTION DETAILS
A-514 SECTION DETAILS
A-531 WINDOW DETAILS
A-541 DOOR DETAILS
A-551 PV MOUNTING DETAILS
A-601 WINDOW AND DOOR SCHEDULES

I-001 INTERIOR SYMBOLS AND NOTES
I-101 INTERIOR DESIGN PLAN
I-102 INTERIOR FURNISHING PLAN
I-103 INTERIOR FURNITURE PLAN EXTENDED
I-104 FINISH PLAN
I-105 INTERIOR DESIGN REFLECTED CEILING PLAN
I-201 INTERIOR DESIGN ELEVATIONS
I-202 INTERIOR DESIGN ELEVATIONS
I-203 INTERIOR DESIGN ELEVATIONS
I-401 LARGE-SCALE INTERIOR DESIGN PLANS
I-501 INTERIOR DESIGN DETAILS
I-502 INTERIOR DESIGN DETAILS
I-601 INTERIOR DESIGN SCHEDULES

F-101 FIRE SUPRESSION RCP

P-105 CAPILARY SYSTEM PLAN
P-106 PLUMBING PLAN

M-101 HVAC EQUIPMENT AND DISTRIBUTION PLAN
M-201 MECHANICAL ELEVATIONS
M-402 DEHUMIDIFIER PLAN
M-601 SCHEDULES

E-001 ELECTRICAL SYMBOLS AND NOTES
E-101 ELECTRICAL DISTRIBUTION PLAN
E-102 PV WIRING PLAN
E-103 RECEPTACLE PLAN
E-105 SITE LIGHTING PLAN
E-601 ONE-LINE DIAGRAM
E-602 THREE-LINE DIAGRAM

O-101 ARRIVAL SEQUENCE PLANS
O-103 SITE LOCATION

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF DOCUMENT 00 01 15

SECTION 00 31 00 - AVAILABLE PROJECT INFORMATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SUMMARY

A. This Document and its referenced attachments are part of the Procurement and Contracting Requirements for Project. They provide Owner's information for the Bidder's convenience and are intended to supplement rather than serve in lieu of the Bidder's own investigations. They are made available for the Bidder's convenience and information but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. Preliminary project schedule including design and construction milestones have been prepared by Owner / Project Manager and are available upon request.

C. Survey information that includes information on existing conditions at the Orange County Great Park, California was prepared by The U.S. Department of Energy Solar Decathlon 2013, and is available for viewing at the office of the Project Manager.

D. Permit Application: Complete building permit application and file with authorities having jurisdiction within five days of the date of execution of the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF DOCUMENT 00 31 00

DIVISION 01 - GENERAL REQUIREMENTS

LIST OF SECTIONS:

SECTION 01 11 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. Only authorized construction personnel, subcontractors, and UNC Charlotte Solar Decathlon team members and faculty are allowed on site during construction unless otherwise authorized by the UNC Charlotte Solar Decathlon team.

1.03 UNAUTHORIZED ACCESS:

A. Any persons attempting to access the site without authorization are to be asked to leave in a polite manner. Failure to leave will result in their expulsion.

1.04 CRIMINAL ENTRY:

A. If unauthorized personnel refuse to leave, or if there are visible signs of theft and/or criminal entry, the police shall be notified immediately.

1.05 REFERENCES

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted before the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1.06 SUMMARY

A. Mission: The Urban Eden team will design and deliver compelling, innovative technologies in an environmentally conscious, affordable, energy efficient, marketable and modular solar powered home prototype while training the next generation of leaders in sustainable architecture, engineering, and business. Our primary goal is to synthesize innovative technology and beautiful design, creating an intimate relationship between technology and design that exhibits the environmentally sustainable home of the future.

PART 2 - COORDINATION WITH OCCUPANTS

2.01 REQUIREMENTS:

A. University of North Carolina Charlotte Solar Decathlon team members and construction personnel are to comply with any requests made by UNC Charlotte. The job site remains the property of the University of North Carolina Charlotte at all times during construction and is to be treated as such.

PART 3 - USE OF SITE

3.01 REQUIREMENTS:

A. The site is to be used only for construction of Urban Eden and storage of related materials unless otherwise authorized. Construction personnel may not sleep overnight in, dwell within, or otherwise occupy the job site without authorization.

3.02 SPECIAL EVENTS:

A. The site will be used several times during construction to house special events, which showcase The Urban Eden Home. Construction may be halted during these events. Notification will be given by project management as to the date of such events and their impact on construction

END OF SECTION 01 11 00

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 ALLOWANCES

A. Advise Architect of the date when selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

D. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

E. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight and delivery to Project site.

F. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.03 UNIT PRICES

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

B. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

C. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

1.04 ALTERNATES

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

B. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

C. Notification: Immediately following award of the Contract, notify each party involved, in writing, whether alternates have been accepted, rejected, or deferred for later consideration.

1.05 PAYMENT PROCEDURES

A. Submit a Schedule of Values at least seven days before the initial Application for Payment. Break down the Contract Sum into at least one line item for each Specification Section in the Project Manual table of contents. Coordinate the schedule of values with Contractor's construction schedule.
   1. Arrange schedule of values consistent with format of AIA Document G703
   2. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
   3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   4. Provide separate line items in the schedule of values for initial cost of materials and for total installed value of that part of the Work.

5. Provide a separate line item in the schedule of values for each allowance.

B. Application for Payment Forms: Use forms provided by Owner as form for Applications for Payment.

C. Submit three copies of each application for payment according to the schedule established in Owner/Contractor Agreement.
   1. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor.

   2. With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

   3. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

      a. Include insurance certificates, proof that taxes, fees, and similar obligations were paid, and evidence that claims have been settled.

      b. Include affidavit of payment of debts and claims on AIA Document G706.

      c. Include affidavit of release of liens on AIA Document G706A.

      d. Include consent of surety to final payment on AIA Document G707.

      e. Submit final meter readings for utilities, a record of stored fuel, and similar data as of the date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 20 00

SECTION 01 25 00- PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SUMMARY

A. This section includes all requirements for product substitution for Urban Eden.

1.03 GENERAL PRODUCT REQUIREMENTS

A. Packaging and Labels: Deliver items in original, undamaged, factory packaging with complete manufacturer's labels.

B. Permanent Labels, Trade Marks, & Trade Names: Locate in inconspicuous locations acceptable to the architect.

C. VOC Content: Use VOC-free items to the greatest extent possible. When VOC-free is not available or is impractical, use items with lowest VOCs.

D. Formaldehyde Content: Use formaldehyde-free items to the greatest extent possible. When formaldehyde-free is not available or is impractical, use items with lowest VOCs.

E. Adhesives: Use nonflammable, water resistant adhesives.

F. Odors: Use odor-free items to the greatest extent possible. When odor is unavoidable, submit sample and obtain preapproval prior to purchase in quantity.

1.04 SUBSTITUTION REQUIREMENTS

A. Substitution Conditions: Substitutions are discouraged, except under the following conditions:

1. Specified item is no longer available.

2. Specified item is incorrect, inappropriate, or incompatible.

3. Substitution offers substantial advantage in quality, time, or cost.

4. Submittal is related to an "or equal" clause in specifications.

B. Substitution Requirements Apply To:

1. Proprietary "named" specification when submitted item is not listed in the specifications.

All deviations from contract documents.

C. Substitution Procedure Requirements:

D. Identify the substitution condition [listed above in “A”].

E. Refer to specification section, article, paragraph numbers, product names, and models.

F. Certify that proposed substitution is coordinated with all related and adjacent work.

G. Provide complete and total cost change information related to the proposed substitution.

H. Appearance Characteristics: For items visible in the completed work, appearance is an important substitution evaluation factor. The architect will decide if a proposed substitution has acceptable appearance. Proposed substitutions may be rejected for appearance alone.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 PROJECT MANAGEMENT AND COORDINATION

A. Subcontract List: Submit a written summary identifying individuals or firms proposed for each portion of the Work.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. List e-mail addresses and telephone numbers.

C. Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.

D. Requests for Information (RFIs): On discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI. Use forms acceptable to UNC Charlotte.

E. Project Web Site: Use the Project Web site for purposes of hosting and managing project communication and documentation until Final Completion.

1. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.

F. Schedule and conduct progress meetings at Project site at regular intervals. Notify Owner and Architect of meeting dates and times. Require attendance of each subcontractor or other entity concerned with current progress or involved in planning, coordination, or performance of future activities.

1. Record minutes and distribute to everyone concerned, including Owner and Architect.

1.03 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

B. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

1. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

a. Submit 3 copies of each action submittal. Architect will have 2 copies.

b. Submit 2 copies of each informational submittal. Architect will not return copies.

c. Architect will return submittals, without review, received from sources other than Contractor.

C. Paper Submittals: Place a permanent label or title block on each submittal for identification. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect. Include the following information on the label:

1. Project name.

a. Date.

b. Name and address of Contractor.

c. Name and address of subcontractor or supplier.

d. Number and title of appropriate Specification Section.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with unique identifier, including project identifier, Specification Section number, and revision identifier.

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

E. Identify options requiring selection by Architect.

F. Identify deviations from the Contract Documents on submittals.

G. Contractor's Construction Schedule Submittal Procedure:

1. Submit required submittals in the following format:

a. Working electronic copy of schedule file, where indicated.

b. PDF electronic file.

c. Two paper copies.

2. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

a. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

b. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

PART 2 - PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly to the Project's SkyDrive specifically established for Project.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2.02 ACTION SUBMITTALS

A. Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

B. Product Data: Mark each copy to show applicable products and options. Include the following:

1. Manufacturer's written recommendations, product specifications, and installation instructions.

2. Wiring diagrams showing factory-installed wiring.

3. Printed performance curves and operational range diagrams.

4. Testing by recognized testing agency.

5. Compliance with specified standards and requirements.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (762 by 1067 mm). Include the following:
1. Dimensions and identification of products.

2. Fabrication and installation drawings and roughing-in and setting diagrams.

3. Wiring diagrams showing field-installed wiring.

4. Notation of coordination requirements.

5. Notation of dimensions established by field measurement.

D. Samples: Submit Samples for review of kind, color, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed. Include name of manufacturer and product name on label.
1. If variation is inherent in material or product, submit at least three sets of paired units that show variations.

2.03 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.

B. Qualification Data: Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

2.04 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

2.05 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type schedule within [**30**] days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

C. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

D. Recovery Schedule: When periodic update indicates the Work is [**14**] or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and indicate date by which recovery will be accomplished.

PART 3 - EXECUTION

3.01 SUBMITTAL REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Architect will review each action submittal, make marks to indicate corrections or modifications required, will stamp each submittal with an action stamp, and will mark stamp appropriately to indicate action.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.02 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribute copies of approved schedule to Owner, Architect, subcontractors, testing and inspecting agencies, and parties identified by Contractor with a need-to-know schedule responsibility. When revisions are made, distribute updated schedules to the same parties.

END OF SECTION 01 30 00

SECTION 01 50 00- TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for temporary utilities, support facilities, and security and protection facilities.

1.02 SUMMARY

A. The Solar Decathlon temporary facilities and controls that are only used for the purposes of the competition in Irvine, C.A. and do not apply to the affordability contest of the Urban Eden House.

B. This section includes the temporary facilities and controls that are used for the purposes of the Solar Decathlon competition in Irvine, C.A.

1.03 SECTION REQUIREMENTS

A. Accessible Temporary Egress: Comply with applicable provisions in ICC/ANSI A117.1.

1.04 RELATED SECTIONS

A. Section 01 51 13 – Temporary Electricity

B. Section 01 54 19 – Temporary cranes

PART 2 - PRODUCTS

2.01 TEMPORARY FACILITIES

A. Provide tool trailer, storage and fabrication sheds, and other support facilities as necessary for construction operations. Store combustible materials apart from building.

B. Provide temporary floor cover and allow for solar decathlon organizer-supplied walkway during construction.

2.02 EQUIPMENT

A. Fire Extinguishers per the Urban Eden House Health and Safety Plan:

1. Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures. Refer to section 10 44 16 Fire Extinguishers.

B. Generator: Refer to Section 01 51 13 - Temporary Electricity

PART 3 - EXECUTION

3.01 GENERAL

A. Install temporary service or connect to electrical service.

B. Arrange with event organizers for time when service can be interrupted for the period of grid-tie assembly to connect Urban Eden to the village grid on day 5 of the competition.

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

D. Comply with the Urban Eden House Health and Safety Plan.

3.02 SUPPORT FACILITIES INSTALLATION

A. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

3.03 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

B. Maximum pressure on grass to be less than 1500 psf for Solar Decathlon competition.

C. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

3.04 OPERATION, TERMINATION, AND REMOVAL

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

END OF SECTION 01 50 00

SECTION 01 51 13- TEMPORARY ELECTRICITY

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SUMMARY

A. This section includes the temporary electricity that is only used for the purposes of the competition in Irvine, California and does not apply to the affordability contest of The Urban Eden House.

1.03 SYSTEM DESCRIPTION

A. Supply a mobile generator to be used for power tools and construction lights during standalone assembly and standalone disassembly as well as times permitted by the DOE.

B. Provide a spill containment pan to be used with the generator.

1.04 SUBMITTALS

C. Product data, information on decibel levels showing the generator shall meet the National Park Service and dB noise regulation stated in 36CFR2.12

D. Maximum 60 dB at 15 feet under full load.

1.05 RELATED SECTIONS

A. Section 01 50 00 – Temporary Facilities and Controls

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Honda Power Equipment

4900 Marconi Drive

Alpharetta, GA 30005-8847

Phone: 770-497-6400

www.hondapowerequipment.com

B. UltraTech International, Inc

11542 Davis Creek Court

Jacksonville, FL 32256

Phone: 800-764-9563

www.spillcontainment.com

2.02 BASIS OF DESIGN:

A. Honda Generator Engine GX390

1. Model Number: EU6500IS
2. Location: Construction Staging Area
3. Dimensions L x W x H: 33.5” x 26.4” x 27.5”
4. Dry Weight: 260 lbs.
5. 6500 Watts, 120/240V
6. Receptacles: 20A 125V Duplex, 30A 125V Locking Plug, 30A 125/250V Locking Plug
7. Noise Level: 60 dB @ rated load or 52 dB @1/4 load at 25 feet
8. Fuel: 4.5 gallons with 4.7 hours @rated load, 14.0 hours @ 1/4 load

B. Ultra Tech Containment

1. Model Number: UTI-2351
2. Dimensions L x W x H: 54” x 29-3/4” x 3-1/2”
3. Weight: 102 lbs.
4. Containment Capacity: 75 gal

END OF SECTION 01 51 13

SECTION 01 54 19 – TEMPORARY CRANES

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SUMMARY

A. Structural Performance: Temporary cranes will withstand structural loads and lifts incurred in lifting, placing, and handling of all modular components.

B. Submittals: Product Data, and structural analysis data signed and sealed by a qualified professional engineer registered in the state where the project is located.

1.03 RELATED SECTIONS

A. Section 01 50 00 – Temporary Facilities and Controls

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Liebherr International.

2.02 EQUIPMENT

A. 130 ton, Telescopic Crane.

1. Boom extension: 60 m

2. Lattice Jib: 33m

2.03 OPERATION

A. Carrier Engine/Output: Liebherr 6-cylinder, Turbo-Diesel 500 hp

B. Crane Engine/Output: Liebherr 4-cylinder, turbo-Diesel, 145 kW

C. Operational Weight: 60,000 kg

D. Total Counterweight: 42 ton

PART 3 - EXECUTION

3.01 PREPARATION

A. Prepare ground by cleaning, removing projections, clearing obstructions, and cordoning off safe working zone, and as otherwise recommended in temporary crane manufacturer's written instructions.

3.02 INSTALLATION

A. Ground crane securely in place, per operational specifications.

B. Allow only licensed operators to operate machinery, manage lifts, and issue signals and commands.

C. Ensure placement of modular components complies with foundational spacing and load requirements.

D. Coordinate operations with structural requirements per specifications of structural engineer and crane operator.

E. Correct deficiencies in or remove and reinstall temporary cranes that do not comply with requirements.

END OF SECTION 01 54 19

DIVISION 02 -
EXISTING CONDITIONS

LIST OF SECTIONS:

SECTION 02 43 13- BUILDING RELOCATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SUMMARY

A. This section includes the methods, equipment and schedules necessary for the transportation of the Urban Eden House from Charlotte, NC to Irvine, C.A. and back to Charlotte.

1.03 SYSTEM DESCRIPTION

A. All building components are permanently mounted on custom-built steel trailers of standard sizes.

B. The 3 House trailers and 1 Flex OM trailer will be pulled by semi-trucks. The Department of Transportation (DOT) has established these vehicle limits:

1. 102 inches wide, 13.5 feet in height, and 80,000 pounds gross weight.

These limits can be exceeded as individual states have the right to issue temporary oversize and/or overweight permits.

C. The 6 OM trailers will be pulled by any standard Medium Duty 3/4 - 1 ton truck.

1.04 DESIGN REQUIREMENTS

A. The Urban Eden House is designed as a group of connectable parts, each of which shall not exceed the allowable dimensions of a flatbed truck, nor shall it exceed the allowable dimensions for highway transportation under federal highway laws. All components shall not exceed 13 ft 6 in height from ground when resting on the bed of the trucks.

B. The OMs are designed to sit on standard 8’ wide trailers, which can legally be pulled by medium duty trucks. All components of the trailer shall not exceed the allowable dimensions for highway transportation under federal highway laws.

1.05 SUBMITTALS

A. Site Operations and Transportation Plan Solar Decathlon 2013: include trailer specifications, route information, delivery information and site operations.

1.06 PERFORMANCE REQUIREMENTS

A. The Urban Eden as a whole must perform identically before and after transportation and re-construction.

B. The Urban Eden as a series of parts shall be transported using specified packing and securing methods and no components shall be damaged during transportation.

PART 2 - PRODUCTS

2.01 QUALITY ASSURANCE

A. Ensure that product is in proper and good working order before accepting the delivery of the product.

2.02 DELIVERY, STORAGE & HANDLING

A. The exact time of delivery to Irvine, CA shall be coordinated with the team's and the organizer's schedule.

B. Additional transportation:

1. Conditioned flower trucks for all plants.

2. Covered trailers for straw bales and the vegetated protected membrane roof materials.

3. Trailer for tools.

Moving truck for furnishings

C. All trailers shall be wrapped with waterproof wrapping to protect the canopy, the decking, and finish surfaces. For the three main house trailers, temporary structure shall be constructed at marriage lines to protect the interior of the trailers.

2.03 INSTALLATION

A. The Urban Eden House and all of its components shall be disassembled, reassembled, packed, secured, and shipped by designated

END OF SECTION 02 43 13

DIVISION 03 – CONCRETE

LIST OF SECTIONS:

SECTION 03 45 00 – PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Architectural precast concrete floor and wall panels; with integral insulation.

B. Concrete Reinforcing

C. Thermal Insulation (Ridged Board Insulation)

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Wind Loads: 11 kip

2. Seismic Load: 32 kip

3. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerance, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:

a. Upward and downward movement of ½ in.

4. Thermal Movement: Provide for in-plane thermal movements resulting from annual ambient temperature change of 80 °F.

1.03 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2008.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

D. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2011a.

E. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy Coated Reinforcing Steel Bars ; 2001 (Reapproved 2007).

F. ASTM A 615/A Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

G. ASTM A 706/A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

H. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes

I. ASTM A 185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

J. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

K. ASTM C 1602/C1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

L. ASTM C 979 Standard Specification for Pigments for Integrally Colored Concrete

M. ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

N. ASTM A 469 Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

O. ASTM A 123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

P. ASTM A 153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

Q. ASTM F 2329 Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

R. ASTM D 2240 Standard Test Method for Rubber Property—Durometer Hardness

S. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

T. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

U. ASTM A 775/A775M Standard Specification for Epoxy-Coated Steel Reinforcing Bars

V. ASTM C 1611/C1611M Standard Test Method for Slump Flow of Self-Consolidating Concrete

W. ASTM C 1712 Standard Test Method for Rapid Assessment of Static Segregation Resistance of Self-Consolidating Concrete Using Penetration Test

X. ASTM C 1610/1610M Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique

Y. ASTM C 1621/C1621M Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring

Z. ASTM C 42/C42M Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

AA. ASTM A 780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

BB. AASHTO M 251 Standard Specification for Plain and Laminated Elastomeric Bridge Bearings.

CC. AWS C5.4 Recommended Practices for Stud Welding

DD. AWS D1.1/D1.1M Structural Welding Code - Steel

EE. AWS D1.4 Structural Welding Code - Reinforcing Steel.

FF. DOD-P21035A SPECIFICATION GALVANIZING REPAIR COATING

GG. SSPC- Paint 20 ZINC-RICH COATING (TYPE I _ INORGANIC AND TYP

HH. PCI TR-6 Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants

II. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products; Precast/Prestressed Concrete Institute; 2007.

JJ. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; Seventh Edition, 2010.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years after completion of structure.

B. Design Mixture: For each precast concrete mixture. Include results of compressive strength and water-absorption tests.

C. Shop (Erection) Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross-sections of each unit. Indicate aesthetic intent including joints, rustications or reveals, and extent and location of each surface finish. Indicate details at building corners.

1. Indicate separate face and backup mixture locations and thicknesses.

2. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.

3. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.

4. Indicate plans and/or elevations showing unit location and dimensions, erection sequences, and bracing plan for special conditions.

5. Indicate location of each architectural precast concrete unit by same identification mark placed on unit.

D. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Architect and SUBMIT DESIGN CALCULATIONS AND Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

E. Samples: Design reference samples for initial verification of design intent, approximately 12 x 12 x 2 in. representative of finishes, color, and textures of exposed surfaces of architectural precast concrete units.

F. When back face of precast concrete unit is to be exposed, include Samples illustration workmanship, color, and texture of the backup concrete as well as facing concrete.

G. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel certification.

1.05 QUALITY ASSURANCE

A. Erector Certification: A precast concrete erector with erecting organization and all erecting crews Certified and designated, prior to beginning work at project site, by PCI's Certificate of Compliance to erect Category S2, Complex Structural Systems, for load-bearing members.

B. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in producing architectural precast concrete units similar to those indicated for this Project and with a record of successful in-service performance.

1. Assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of

architectural precast concrete that are similar to those indicated for this Project in material, design, and extent.

1. Participates in PCI's Plant Certification program and is designated a PCI-Certified plant for Group A, Category A1 – Architectural Cladding and Loadbearing Units.

2. Has sufficient production capacity to produce required units without delaying the Work.

D. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, PCI Design Handbook – Precast Prestressed Concrete, applicable of architectural precast concrete units indicated.

E. Quality-Control Standards: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for type of units required, comply with PCI MNL 117, Manual for Quality Control and Plants and Production of Architectural Precast Concrete Products.

F. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel"; and AWS D1.4, "Structural Welding Code – Reinforced Steel."

G. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of two sample panels approximately 16 ft in area for review by Architect. Incorporate full-scale detail of architectural features, finishes, textures, and transitions in the sample panel.

H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping, or other physical damage.

B. Place stored units so identification marks are clearly visible, and units can be inspected.

C. Deliver architectural precast concrete units in such quantities and at such times to ensure compliance with the agreed project schedule and proper setting sequence and also to limit unloading units temporarily on the ground or other re-handling.

D. Support units during shipment on non-staining shock- absorbing material.

E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that could cause cracking or damage.

F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.01 FABRICATORS

A. Architectural Precast Concrete:

1. Fabricator: Metromont Precast Building Solutions. www.metromont.com

2.02 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.03 REINFORCEING MATERIALS

A. Epoxy-Coated Reinforcing Bars: ASTM A 615/A, Grade 60 ASTM A 706/A 706M, deformed bars, ASTM A

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

C. Stainless Steel Reinforcing Bars: ASTM A 276 , (2205 (S31803) , or Type 316LN (S31653), or 18Cr-3Ni-12Mn (S24000), or Type 304LN (S30453)).

D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.04 CONCRETE MATERIALS

A. Fly Ash Class F ASTM C 618, Class F.

B. Sodium Hydroxide

C. Sodium Silicate

D. Normal weight Aggregates: Except as modified by PCI MNL117, ASTM C 33, with coarse aggregates complying with Class 5S. Provide and stockpile fine and coarse aggregate for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixtures Coarse Aggregates: Selected, hard, and durable; free of material that reacts with fly ash, sodium hydroxide and sodium silicate or causing staining; to match selected finish sample.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with ASTM C 1602/C 1602M and chemical limits of PCI MNL 117.

F. Coloring Admixture: Titanium Dioxide at 5%, whitening agent

G. Surface Finish Aggregate: Conforming to sample in office of Architect.

2.05 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

B. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A or C, (ASTM F 568M, Property Class 4.6) carbon-steel, hex-bolts and studs; carbon-steel nuts (ASTM A 563/A, Grade A); and flat, unhardened steel washers (ASTM F 844).

C. Deformed-Steel Wire or Bar Anchors: ASTM A 469 or ASTM A 706/A 706M.

D. Zinc-Coated Finish: For steel items in exterior walls and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M, after fabrication, ASTM A 153/A 153M, or ASTM F 2329 as applicable.

1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel content of steel to less than 0.03% or to between 0.15 and 0.25% or limit sum of silicon content and 2.5 times phosphorous content to 0.09%

E. Galvanizing Repair Paint: High zinc-dust-content paint with dry film containing not less than 94% zinc dust by weight, and complying with DOD-P21035A or SSPC-Paint 20. Comply with manufacturer's requirements for surface preparation.

2.06 BEARING PADS AND OTHER ACESSORIES

A. Provide one of the following bearing pads for architectural precast concrete units (as recommended by precast concrete fabricator for application):

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100% polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer according to ASTM D 2240, minimum tensile strength 2250 psi (15.5 MPa) per ASTM D 412.

2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D 2240. Capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking,

splitting, or delaminating in the internal portions of the pad. Test one specimen for each 200 pads used in the Project.

3. Cotton-Duck-Fabric–Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer according to ASTM D 2240. Conforming to Division II, Section 18.10.2 of AASHTO LRFD Bridge Design Specifications, or Military Specification, MIL-C-882E.

4. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plates, or random-oriented, fiber-reinforced elastomeric pads, of type required for in-service stress.

5. High-Density Plastic: Multimonomer, non-leaching, plastic strip capable of supporting loads with no visible overall expansion.

B. Precast Concrete Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.07 INSULATED PANEL ACCESSORIES

A. Expanded-Polystyrene Board Insulation: ASTM C 578, Type IX, 1.80 lb/ft^3 (29kg/m^3); square edges; with a thickness of 6 in.

B. Wythe Connectors: Epoxy Coated Interlaid Carbon Fiber Mesh, manufactured to connect Wythe's of precast concrete panels.

2.08 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for pre-stressing and de-tensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and pre-stressing tendons by release agent.

B. Maintain molds to provide completed architectural precast concrete units of shape, lines, and dimensions indicated, within fabrication tolerance specified.

1. Form joints are not permitted on faces exposed to view in finished work.

2. Edge and Corner Treatment: Uniformly chamfered.

2.09 CONCRETE MIXTURES

A. Prepare design mixtures to match Architect's sample or for each type of precast concrete required.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast concrete plant personnel at architectural precast concrete fabricator's option.

C. When included in design mixtures, add other admixtures to concrete according to manufacturer's written instructions.

2.10 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on Contract Drawings.

D. Cast in openings larger than 10 in. (250 mm) in any dimension. Do not drill or cut openings or pre-stressing strand without of Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

2. Accurately position, support, and secure reinforcement against displacement during concrete- placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

3. Place reinforcing steel and pre-stressing tendon to maintain at least 3/4 in. (19 mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1 1/2 in. (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing

concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation and erection stresses, and specified in-place loads, whichever governs.

G. Cast-in Hydronic Piping according to drawings.

H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

J. Thoroughly consolidate placed concrete by internal and/or external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

K. Comply with PCI MNL 117 procedures for hot- and cold-weather concrete placement.

L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until the compressive strength is high enough to ensure that stripping does not have an effect on the performance or appearance of final product.

2.11 INSULATED PANEL CASTING

A. Cast and screed Wythe supported by mold.

B. Place insulation boards, abutting edges and ends of adjacent boards. Insert Wythe connectors in between insulation, and consolidate concrete around connectors according to connector manufacturer’s written instructions.

C. Cast and screed top wythe to meet required finish.

2.12 FABRICATION TOLERANCE

A. Fabricate architectural precast concrete units of shapes, lines and dimensions indicated, so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or Minus 1 in. (±25 mm).
2. Inserts: Plus or Minus 1/2 in. (±13 mm).
3. Handling Devices: Plus or Minus 3 in. (±75 mm).
4. Reinforcing Steel and Welded Wire Reinforcement: Plus or Minus 1/4 in. (±6 mm) where position has structural implications or affects concrete cover; otherwise, Plus or Minus 1/2 in. (±13 mm).
5. Reinforcing Steel Extending out of Member: Plus or Minus 1/2 in. (±13 mm) of plan dimensions.
6. Tendons: Plus or Minus 1/4 in. (±6 mm), perpendicular to panel; Plus or Minus 1 in. (±25 mm), parallel to panel.
7. Location of Rustication Joints: Plus or Minus 1/8 in. (±3 mm).
8. Location of Opening within Panel: Plus or Minus 1/4 in. (±6 mm).
9. Location of Flashing Reglets: Plus or Minus 1/4 in. (±6 mm).
10. Location of Flashing Reglets at Edge of Panel: Plus or Minus 1/8 in. (±3 mm).
11. Reglets for Glazing Gaskets: Plus or Minus 1/8 in. (±3 mm).
12. Electrical Outlets, Hose Bibs: Plus or Minus 1/2 in. (±13 mm).
13. Location of Bearing Surface from End of Member: Plus or Minus 1/4 in. (±6 mm).
14. Allowable Rotation of Plate, Channel Inserts, Electrical Boxes: 2-degree rotation or 1/4 in. (6 mm) maximum measured at perimeter of insert.
15. Position of Sleeve: Plus or Minus 1/2 in. (±13 mm).
16. Location of Window Washer Track or Buttons: Plus or Minus 1/8 in. (±3 mm).

2.13 FINISHES

A. Exposed panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample.

B. Finish exposed surfaces back of architectural precast concrete units to match approved design reference sample.

2.14 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete also test and inspect according to PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete" and ASTM C 1611/C 1611M, ASTM C 1712, ASTM C 1610/1610M, and ASTM C 1621/C 1621M.

B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) concrete strength requirements.

C. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, fabricator will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318/ACI 318M.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.

2. Cores will be tested in an air-dry condition.

3. Strength of concrete for each series of three cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.

4. Test results will be reported in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:

   a. Project identification name and number.

   b. Date when tests were performed.

   c. Name of precast concrete fabricator.

   d. Name of concrete testing agency.

   e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of

break; compressive strength at breaks, corrected for length diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

E. Acceptability: Architectural precast concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled, or cracked units may be repaired, if repaired units match the visual mock-up. The Architect reserves the right to reject any unit if it does not match the accepted sample panel or visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.01 PREPERATION

A. Furnish anchorage devices for precast concrete units to be embedded in or attached to the building structural frame or foundation before start of such Work. Provide locations, setting diagrams, templates and instructions for the proper installation of each anchorage device.

3.02 ERECTION

A. Erect architectural precast concrete level, plumb, and square within the specified allowable erection tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Install steel or plastic spacing shims as precast concrete units are being erected. Tack welds steel shims to each other to prevent shims from separating.

2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

3. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.

4. Unless otherwise indicated, provide for uniform joint widths of 3/4 in. (19 mm).

B. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop (Erection) Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.

1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.

C. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 requirements for welding, welding electrodes, appearance of welds, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage during field welding or cutting operations and provide noncombustible shields as required.

2. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS

3. Clean weld-affected metal surfaces with chipping hammer followed by brushing and then apply a minimum 0.004-in.-thick (0.1 mm) coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A 780.

4. Visually inspect all welds critical to precast concrete connections. Visually check all welds for completion and remove, re-weld or repair all defective welds, if services of AWS-certified welding inspector are not furnished by Owner.

D. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, check bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25% of bolts at random by calibrated torque wrench.

3.03 ERECTION TOLERANCES

A. Erect architectural precast concrete unit's level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.04 REPAIR

A. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.

B. Repair damaged units to meet acceptability requirements of PCI MNL 117.

C. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 ft (6 m).

D. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with specified requirements.

3.05 CLEANING

A. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, dirt, stains and other markings.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.

Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 45 00

DIVISION 05 - METALS

LIST OF SECTIONS

SECTION 05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Steel Angles

B. Steel Plates

C. Steel Columns

1.02 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2005.

B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2005.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

D. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.

C. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel Angles and Plates: ASTM A36/A36M.

B. Rolled Steel Structural Shapes: ASTM A992/A992M.

2.02 MANUFACTURER:

A. Howard Steel Inc. www.howardsteelinc.com

PART 3 - EXECUTION

3.01 ERECTION

A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

END OF SECTION 05 12 00

SECTION 05 31 00 – STEEL DECKING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Roof deck.

B. Bearing plates and angles.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel ; 2008.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process ; 2011.

C. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute ; 2007.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.

B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, cellular raceways and outlet box locations, pertinent details, and accessories.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

1.04 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

A. Nucor-Vulcraft Group ; www.vulcraft.com.

B. Deck Types: Select and design metal deck in accordance with SDI Design Manual.

2.02 PRODUCT

A. Model: 3N Roof Deck:

1. Calculate to structural working stress design and structural properties specified.

2. Maximum Vertical Deflection of Roof Deck: 1/240 of span.

3. Roof Deck is Non-composite type, fluted steel sheet:

B. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.

1. Nominal Height: 3 inch

2. Profile: Fluted; SDI WR.

3. Formed Sheet Width: 24 inch (600 mm).

4. Side Joints: Punch Lock.

5. End Joints: Lapped, mechanically fastened.

2.03 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.

1. Manufacturer: Steel Fab

2. Product: To be determined

B. Fasteners: Galvanized hardened steel, self-tapping.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. Clinch lock seam side laps.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of cold-formed metal framing units include the following:

1. Load-bearing punched channel studs.

C-shaped load-bearing steel studs.

1.02 SUBMITTALS

A. Product Data: Submit product information and installation instructions from manufacturers for each item of cold-formed metal framing and accessories.

B. Shop Drawings: Shop drawings shall include placing drawings for framing members showing size and gauge designations, number, type, location, and spacing.

1. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

C. Welding Certificates: Provide certificate signed by Contractor certifying that welders comply with requirements specified under “Quality Assurance” Article, prior to performing work.

1.03 QUALITY ASSURANCE

A. Component Design: Calculate structural properties of studs and joists in accordance with the American Iron and Steel Institute (AISI), "Specification for Design of Cold-Formed Steel Structural Members."

B. Welding Standards: Comply with applicable provisions of ANSI/AWS D1.1 “Structural Welding Code-Steel”, and ANSI/AWS D1.3 “Structural Welding Code-Sheet Steel.”

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved, and if pertinent, has undergone recertification.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type, and grade. Store off the ground in a dry ventilated space or protect with impervious covering. Protect metal framing units from rusting and damage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

1. Dale Industries, Inc.
2. Dietrich Industries, Inc.
3. USG Industries
4. Unimast, Inc.
5. Wheeling Corrugating Co.

2.02 METAL FRAMING

A. System Components: Manufacturers' standard load-bearing steel studs and joists of type, size, shape, and gauge as indicated. With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, reinforcements, shoes, clip angles, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.

B. Materials and Finishes:

1. For 16 gauge and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi, ASTM A 446 Grade C.
2. For 18 and 20 gauge units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi, ASTM A 446 Grade A.
3. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.
4. Finish of installation accessories to match that of main framing components, unless otherwise indicated.

C. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

D. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.

E. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.03 FABRICATION

A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true-to-line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.

1. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.

B. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Do not field weld units of 20 gauge or lighter. Wire tying of framing members is not permitted.

1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting weld work.

Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions.

C. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true-to-line of 1/8 inch in 10 feet.

PART 3 - EXECUTION

1.01 INSTALLATION

A. General: Install cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, in accordance with manufacturer's recommendations and the requirements of this Section.

1. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

2. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting weld work.

a. Where weld throat is not shown on the Contract documents, the weld throat shall be at least as large as the thickness of the thinnest sheet joined. All welds shall provide complete fusion of the sheets without "blow-out."

3. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions.

B. Exterior Wall Runner Tracks: Install continuous 6-inch wide tracks. Align tracks accurately to layout at base and tops of studs.

1. Secure tracks as recommended by stud manufacturer for type of construction involved, spacing not to exceed 24 inches o.c. for nail or power-driven fasteners, or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.

2. All track butt joints, abutting pieces of track shall be securely anchored to a common structural element or they shall be spliced together.

C. Wall Studs: Secure 3-5/8-inch studs to top and bottom runner tracks, except where provisions for structure vertical movement is provided on drawings, by either welding or screw fastening at inside or outside flanges.

1. Space studs at 12-inches o.c. Stagger studs so the opposite face of every other stud is flush with the opposite side runner track, resulting in the stud spacing being 24-inches o.c. on both sides of the wall.

2. Where stud system abuts structural columns or walls, including precast concrete walls, use two studs oriented with the 3-5/8-inch face flush with each face of the runner track.

3. Axially loaded studs shall have full bearing against the inside web of top and bottom tracks. Splices in axially loaded studs are not permitted.

D. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations.

E. Frame wall openings larger than 2'-0" square with double stud at each jamb of frame, except where more than two studs are either shown or indicated in manufacturer's instructions.

1. Install runner tracks and jack studs above door openings, and above and below wall openings.

2. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall.

3. Secure stud system wall opening frame in manner indicated.

F. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

G. Install horizontal bridging in all load-bearing and exterior stud wall systems, with two (2) equally spaced rows for walls less than 10 feet high and rows spaced not more than 48 inches o.c. at walls higher than 10 feet.

H. Horizontal Bridging is not required for non-loadbearing interior stud walls unless noted on the drawings.

I. Provisions for structure vertical movement shall be provided where indicated on the drawings.

J. All welds shall be touched up using zinc-rich paint.

K. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.

1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

L. Installation of Joists: Install level, straight, and plumb, complete with bracing and reinforcing as indicated on drawings. Provide not less than 1-1/2 inch end bearing.

1. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by joist manufacturer.

2. When required, reinforce joists at interior supports with single short length of joist section located directly over interior support, snap-on shoe, 30 percent side-piece lapped reinforcement, or other method recommended by joist manufacturer.

3. Secure joists to interior support systems to prevent lateral movement of bottom flange.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Miscellaneous steel framing and supports.

B. Miscellaneous steel trim.

C. Loose bearing and leveling plates.

D. Aluminum Extrusions for rainscreen attachment.

1.02 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

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

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Material: Galvanized steel, ASTM A 653/A 653M, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness unless otherwise noted.

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

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

2.03 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

   1. Provide stainless-steel fasteners for fastening aluminum.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.04 MISCELLANEOUS MATERIALS

A. Epoxy Zinc-Rich Primer: Compatible with topcoat.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.05 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.06 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

2.07 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim.

D. Prime miscellaneous steel trim with zinc-rich primer.

2.08 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.09 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.11 ALUMINUM FINISHES

A. Mill Finish

2.12 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
   a. Interior Steel shall be painted with SW Moderne White 6168
   b. Exterior Steel shall be painted with SW Sealskin 7675

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.02 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

LIST OF SECTIONS

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Roof-mounted curbs.

B. Roofing nailers.

C. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard ; 2009.

B. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association ; 2010.

C. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce) ; 2005.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Manufacturer: Any

B. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.

2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org)

and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

a. Lumber fabricated from old growth timber is not permitted.

b. Dimension lumber for concealed application

3. Sizes: Nominal sizes as indicated on drawings, S4S.

4. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No. 2 or Standard Grade.

2. Boards: Standard or No. 3.

2.02 CONSTRUCTION PANELS

A. Roof Sheathing: Particleboard, ANSI A208.1, Grade M-3 EXTERIOR GLUE

2.03 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 - EXECUTION

3.01 INSTALLATION – GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fire-blocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.03 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.04 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.

B. Nail panels to framing; staples are not permitted.

3.05 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.06 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 74 19 – Construction Waste Management and Disposal.

B. Comply with applicable regulations.

C. Do not burn scrap wood on project site.

D. Do not burn scraps that have been pressure treated.

E. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

F. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

G. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

SECTION 06 11 00 – WOOD FRAMING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data. Shop Drawings.

B. Provide dressed lumber marked with grade stamp of inspection agency.

1.02 RELATED REQUIREMENTS

C. All wood framing including details for bridging, blocking, fire stopping, etc., shall conform to the latest edition of the “National Design Specification for Wood Construction” and its supplements and shall be installed in accordance with the NFPA “Manual for House Framing”.

D. Fastening shall be in accordance with the most restrictive of: The International Building Code 2009, the 1992 CABO for 1 and 2 family dwelling, or the manufacturer’s recommended fastening schedules.

PART 2 - PRODUCTS

2.01 LUMBER

A. Dimensional Lumber:

1. Maximum Moisture Content: 19 percent

B. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3

C. Framing Other Than Non-Load-Bearing Interior Partitions: Douglas fir larch: WCLIB or WWPA

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

E. Species:

1. Rafters and Joists: Southern Yellow Pine

2. Beams, Girders, and Headers: Southern Yellow Pine

3. Studs and Plates: Southern Yellow Pine

4. Timbers 5-Inch Nominal (117-mm Actual) Size and Thicker:

a. Douglas fir-larch,

b. Douglas fir-larch (north), or

c. Douglas fir-south

d. NLGA, WCLIB, or WWPA

e. Maximum Moisture Content: 23 percent

F. Miscellaneous Lumber:

1. Standard, Stud, or No. 3 grade with 19 percent maximum moisture content of any species.

2. Provide for nailers, blocking, and similar members.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All flush-framed connections shall be made with approved galvanized steel joist or beam hangers, minimum 18 gauge, installed according to manufacturer's recommendations.

B. Where framing lumber is flush framed to microlam, steel or flitch-plate girder, set these girders 1/4" clear (min.) below top of framing lumber, to allow for shrinkage.

C. Stud walls are to be constructed of 2"x4" at 16" o.c. at the interior and 2"x6" at 16" o.c. at the exterior, unless noted otherwise on plan.

D. Use double studs at ends of wall and ends of wall openings.

E. Use double trimmers and headers at all floor openings where beams are not designated.

F. Bridging for spans up to 14 ft., provide 1 row.

G. Bridging for spans over 14 ft., provide 2 rows.

H. Built-up beams less than 8" deep shall be spiked together with two (2) 16d nails at 16" o.c.

I. Built-up beams greater than 8" deep shall be spiked together with three (3) 16d nails at 16" o.c.

J. No joists shall be cut or notched without approval.

END OF SECTION 06 11 00

SECTION 06 15 33 – WOOD PATIO DECKING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Thermally modified solid ash exterior decking.

1.02 SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Thermory Decking by Thermory USA, LLC

2.02 LUMBER, GENERAL

A. Maximum Moisture Content: Equalized at 6%

2.03 WOOD DECKING

A. Board Decking: Thermally treated American Ash

B. Board Size: 1.02 inch thick by x 5-3/4 inch wide

C. Finish: Natural finish selected by Owner

2.04 DIMENSION LUMBER FRAMING

A. Refer to Section 06 10 00 - Rough Carpentry

2.05 FASTENERS

A. General: Provide fasteners of size and type recommended by manufacture, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Use stainless steel unless otherwise indicated.

2.06 CONCEALED DECKING FASTENERS

Deck Splines: Decking manufacturer stainless steel concealed splines that fit in grooves routed into the sides of decking material and are fastened to deck framing with screws. Splines provide uniform spacing of decking material.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Secure decking to framing with deck clips deck tracks.

C. Install metal framing anchors to comply with manufacturer's written instructions.

D. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated on drawings

END OF SECTION

SECTION 06 16 00 – SHEATHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Products and accessories for Walls and Roof Sheathing

PART 2 - PRODUCTS

2.01 MANUFACTURERS: ANY

2.02 MATERIALS

A. Wood panel products, general

1. Plywood: DOC PS 1.

B. Wall Sheathing

1. Plywood: 1/2” thick, 32/16 span rating

C. Roof Sheathing

1. Plywood: 5/8” thick, 48/24 span rating

2.03 ACCESSORIES

A. Fasteners: 8d common nails at 4” o.c. at each sheet perimeter and 12” o.c.

B. Adhesives for Field Gluing Panels to Framing: BF Goodrich PL400 or equal

PART 3 - EXECUTION

3.01 INSTALLATION

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

B. "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

C. Wall and Roof Sheathing Fastening Methods:

1. Nail to wood framing.

2. Screw to cold-formed metal framing.

END OF SECTION 06 16 00

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SUBMITTALS

A. Samples for hardwood veneer plywood paneling and moldings and trim.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

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

B. Softwood Plywood: DOC PS 1.

C. MDF: ANSI A208.2, Grade 130

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

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

F. Certified Wood: Wood-based materials produced from tropical forests shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

2.02 INTERIOR STANDING AND RUNNING TRIM

A. Wood Moldings: WMMPA WM 4 made to patterns in WMMPA WM 12 from kiln-dried stock.
   1. Softwood Moldings for Transparent Finish: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine

   2. Hardwood Moldings for Transparent Finish: Red oak, White maple, Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar

3. Moldings for Painted Finish: P-Grade

4. Base: WM 623, ogee base.

5. Shoe Mold: WM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round shoe.

6. Casing: WM 376, beaded-edge casing.

7. Stop: WM 946, ogee stop.

8. Chair Rail: WM 297.

2.03 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock panels complying with HPVA HP-1, made without urea-formaldehyde adhesive.

1. Manufacturers: One of the following:

a. Chesapeake Hardwood Products, Inc.

b. Georgia-Pacific Corp.

c. Holland Southwest International.

2. Face Veneer Species: Plain sliced hickory.

3. Veneer Matching: Selected for similar color and grain.

4. Thickness: **1/8 inch (3.2 mm)**.

5. Face Pattern: Manufacturer's standard [**V**] [**channel**]-grooved pattern, with grooves at edges, center, and third points of panels, and at other locations to provide pattern resembling random width boards.

MISCELLANEOUS MATERIALS

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

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

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

PART 3 - EXECUTION

3.01 INSTALLATION

A. Condition interior finish carpentry in installation areas for 24 hours before installing.

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

C. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.
   1. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

D. Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long except where necessary. Stagger joints in adjacent and related trim. Cope at returns and inside corners and miter at outside corners.

E. Seal joints at inside and outside corners and at trim locations.

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

G. Railings: Secure wall rails with metal brackets. Fasten freestanding railings to newel posts and to trim at walls with glue and countersunk-head wood screws or rail bolts.
   1. For exterior railings fit balusters to ramp and deck, glue, and nail in place.
      a. Let balusters into railings and glue in place.

END OF SECTION 06 20 00

SECTION 06 40 00 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Exterior Architectural Woodwork

1. Wood Rainscreen panels

B. Interior Architectural Woodwork

1. Architectural Wood Casework.

2. Wood Wall and Ceiling Panels

1.02 ACTION SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1.03 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 WOOD RAINSCREEN PANELS

A. Panels: Lamboo Pressed Panels, by Lamboo Incorporated

1. 3/4 inch thick

B. Panel Supports: Extruded aluminum as indicated in Section 05 50 00 - Metal Fabrications

2.02 INTERIOR ARCHITECTURAL WOOD CASEWORK

A. Grade: Custom.

B. Type of Construction: Frameless.

C. Cabinet and Door and Drawer Front Interface Style: Flush overlay.

D. Wood for Exposed Surfaces: Lamboo Pressed Panels, by Lamboo Incorporated

1. 3/4 inch thick

E. Semiexposed Surfaces: Provide surface materials indicated below:

1. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber.
2. Drawer Bottoms: Hardwood plywood.

F. Cabinet Hardware and Accessories

1. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.
2. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
3. Shelf Rests: BHMA A156.9, B04013; metal.
4. Drawer Slides: BHMA A156.9.

a. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
b. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
c. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.

2.03 WOOD WALL AND CEILING PANELS

A. Panels: Lamboo Pressed Panels, by Lamboo Incorporated

1. 3/4 inch thick

B. Stain: Water-Based Nano-Polymer Acrylic Sealer

1. Dries clear, glossy finish

2. low VOC, low odor

3. sand Lamboo panels prior to staining, apply first coat of sealer with soft cloth and let dry for 40 minutes. Sand with 200 grit sand-paper before applying second coat. Apply second coat of stain and let dry.

2.04 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

B. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.05 FABRICATION

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

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.01 PREPARATION

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

3.02 EXTERIOR WOOD RAINSCREEN INSTALLATION

A. Install rainscreen panels level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut panels to fit adjoining work. Seal cuts as recommended by manufacturer.

3.03 ARCHITECTURAL WOOD CASEWORK INSTALLATION

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

B. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

D. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.04 INTERIOR WALL AND CEILING PANEL INSTALLATION

A. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch.

B. Anchor paneling to supporting substrate with concealed panel-hanger clips and blind nailing. Do not use face fastening.

END OF SECTION

SECTION 06 46 00 - WOOD TRIM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Standing and running trim, jambs, and frames.

B. Submittals: Shop Drawings and Samples showing the full range of colors, textures, and patterns available for each type of finish

1.02 Quality assurance

A. Installer Qualifications: Fabricator of products.

B. Environmental Limitations for Interior Wood Trim: Do not deliver or install interior wood trim until building is enclosed, wet work is completed, and HVAC system is operating.

PART 2 - PRODUCTS

2.01 WOOD TRIM

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

B. Certified Wood: Wood shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

C. Interior Trim: Premium grade, made from any closed-grain hardwood

2.02 MATERIALS

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

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

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

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

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

F. Fasteners for Exterior Wood Trim:
   1. Nails: Aluminum hot-dip galvanized or stainless steel.
   2. Screws: Aluminum bronze hot-dip galvanized or stainless steel.

2.03 FABRICATION

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

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

2.04 SHOP PRIMING

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

B. Backprime with one coat of sealer or primer, compatible with finish coats. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.05 SHOP FINISHING OF INTERIOR WOOD TRIM

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

B. Shop finish transparent-finished interior wood trim at fabrication shop.
   1. Apply one coat of sealer or primer to concealed surfaces of wood trim. Apply two coats to end-grain surfaces.
   2. Apply a wash coat sealer to wood trim made from closed-grain wood before staining and finishing.
   3. After staining, if any, apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.

C. Transparent Finish:
   1. Finish: System - 4, water-based latex acrylic.

PART 3 - EXECUTION

3.01 INSTALLATION

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

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

C. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

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

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

F. Exterior Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

G. Interior Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than **36 inches (900 mm)** long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

END OF SECTION 06 46 00

DIVISION 07 - THERMAL & MOISTURE PROTECTION

LIST OF SECTIONS

SECTION 07 19 00 - WATER REPELLENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Penetrating water-repellent treatments for the vertical precast concrete surfaces.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 PENETRATING WATER REPELLENTS

A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 600 g/L or less of VOCs.

1. Basis of Design: PROSOCO, Inc.; Siloxane WB Concentrate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in representative locations by method recommended by manufacturer.
2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
4. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

3.02 PREPARATION

A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.

B. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.03 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using low-pressure spray to the point of saturation. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Precast Concrete: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.04 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

1. Glass-Fiber Blanket Insulation
2. Rigid Insulation

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Location of use: used in flooring system and wetcore

1. Thickness: 6 inches

2.02 RIGID INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.

5. Owens Corning.

B. Rigid Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Location of use: walls of the concrete and roofing system

1. Thickness:

a. Wall use: 6 inches

b. Ceiling use: 10 inches

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.02 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION

SECTION 07 25 00 – WEATHER BARRIERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls

B. Vapor Retarders. Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1.02 RELATED REQUIREMENTS

A. Section 07 54 00 - Thermoplastic Membrane Roofing: Vapor retarder installed as part of roofing system.

1.03 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

1.04 REFERENCE STANDARDS

A. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials ; 2010.

B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs ; 2011.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on material characteristics.

C. Shop Drawings: Provide drawings of special joint conditions.

D. Manufacturer's Installation Instructions: Indicate preparation.

1.06 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 - PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

2.02 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Vapor Retarder Sheet Type Grace Ice & Water Shield: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for application indicated. Single ply polyethylene is prohibited.

B. Manufacturer: Grace Construction Products

a. Water Vapor Permeance: 0.3 perm (17 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Self-Adhesive Sheets:

1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.

2. Lap sheets shingle-fashion to shed water and seal laps air tight.

3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that all laps are firmly adhered with no gaps or fishmouths.

4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.

5. At wide joints, provide extra flexible membrane allowing joint movement.

3.04 FIELD QUALITY CONTROL

A. Do not cover installed weather barriers until required inspections have been completed.

3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 07 25

SECTION 07 54 00 – THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.

B. Vapor retarder.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings and reglets

C. Section 22 10 05 - Plumbing Piping

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation ; 2011be1.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing ; 2008.

C. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing ; 2011.

D. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association ; Fifth Edition, with interim updates.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

C. Specimen Warranty: For approval.

D. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section:

B. Approved by membrane manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture.

1.07 WARRANTY

A. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.

1. Warranty Term: 20 years.

2. For repair and replacement include costs of both material and labor in warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. PVC Membrane Materials:

1. Manufacturer: Sika Sarnafil, Inc : www.sarnafilus.com.

a. Product: G410 EnerySmart Roof Membrane

B. Insulation:

1. Manufacturer: DOW Chemical Company.

2.02 ROOFING – MECHANICALLY ATTACHED

A. Thermoplastic Membrane Roofing: One ply membrane, over insulation.

B. Roofing Assembly Requirements:

C. Insulation Thermal Value (R), minimum: 50; provide insulation of thickness required.

D. Acceptable Insulation Types - Tapered Application: Any of the types specified.

1. Tapered extruded polystyrene board.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:

1. Material: Polyvinyl chloride copolymer alloy complying with ASTM D4434/D4434M.

2. Reinforcing: Internal fabric.

3. Thickness: 0.060 inch (1.5 mm), minimum.

4. Sheet Width: Factory fabricated into largest sheets possible.

5. Solar Reflectance: 0.83, minimum, initial, and 0.7, minimum, 3-year, certified by Cool Roof Rating Council.

6. Thermal Emissivity: 0.9, minimum, initial, and 0.86, minimum, 3-year, certified by Cool Roof Rating Council.

7. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: As recommended and approved by membrane manufacturer.

D. Vapor Retarder: Refer to section 07 25 00 Weather Barriers

1. Fire-retardant adhesive.

E. Deck Sheathing: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 5/8 inch (16 mm) thick.

1. Manufacturers: Georgia-Pacific DensDeck Prime (www.densdeck.com)

F. Tapered Board: Slope as indicated; minimum thickness 1/4 in (___ mm); fabricate of fewest layers possible.

1. Board Edges: Square.

2. Compressive Resistance: 40 psi (276 kPa).

3. Water Absorption, maximum: 0.3 percent, volume.

4. Manufacturers: DOW Chemical Company.

a. Product: Dow Roofmate

2.04 ACCESSORIES

A. Prefabricated Roofing Expansion Joint Flashing: As specified in Section 07 71 00 Roof Specialties.

B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

C. Insulation Adhesive: As recommended by insulation manufacturer.

D. Sealants: As recommended by membrane manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION – GENERAL

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.02 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.03 METAL DECK PREPARATION

A. Install deck sheathing on metal deck:

1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.

B. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.

C. Tape joints.

3.04 VAPOR RETARDER AND INSULATION – UNDER MEMBRANE

A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.

1. Extend vapor retarder under cant strips and blocking to deck edge.

2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

C. Attachment of Insulation: Embed insulation in adhesive in full contact, in accordance with roofing and insulation manufacturers' instructions.

1. Adhesive Manufacturer: DOW Chemical Company

2. Product: Insta-stik Quick set Commercial Roof Adhesive

D. Lay subsequent layers of insulation with joints staggered minimum 6 inch (150 mm) from joints of preceding layer.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

G. Do not apply more insulation than can be covered with membrane in same day.

3.05 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Mechanically attached.

D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (75 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

E. At intersections with vertical surfaces:

1. Extend membrane over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.

a. Fully adhere flexible flashing over membrane and up to nailing strips.

b. Secure flashing to nailing strips at 4 inches (100 mm) on center.

c. Insert flashing into reglets and secure.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Install roofing expansion joints where indicated. Make joints watertight.

1. Install prefabricated joint components in accordance with manufacturer's instructions.

H. Coordinate installation of roof drains and sumps and related flashings.

END OF SECTION 07 54 00

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and other items indicated in Schedule.

B. Reglets and accessories.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process ; 2011.

B. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association ; 2003.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

PART 2 - PRODUCTS

2.01 SHEET MATERIALS

A. Manufacturer: Sarnfil www.usa.sarnafil.sika.com

B. Product: Sarnaclad

C. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal, shop pre-coated with PVC coating.

1. PVC (Polyvinyl Chloride) Coating: 20mil unsupported Sarnafil membrane laminated to one side

2.02 ACCESSORIES

A. Fasteners: Galvanized steel , with soft neoprene washers.

B. Sealant: Type ____ specified in Section 07 90 05.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.04 GUTTER AND DOWNSPOUT FABRICATION

A. Downspout Boots: Steel.

B. Seal metal joints.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Secure gutters and downspouts in place using concealed fasteners.

E. Connect downspouts to downspout boots. Seal connection watertight.

END OF SECTION 07 62 00

SECTION 07 71 00 – ROOF SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Roof control and expansion joint covers.

B. Roof-edge specialties.

C. Scuppers.

1.02 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual details.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Control and Expansion Joint Covers:

1. Manufacturer: Sika Sarnafil ;

a. Product: 4-1 Sarnaflash Expansion joint

b. usa.sarnafil.sika.com

2.02 COMPONENTS

A. Control and Expansion Joint Covers: Composite construction of 10 inch wide flexible PVC flashing of white color each edge seamed to the roof membrane, designed for nominal joint width of 2 inch (50 mm). Include special formed corners, tees, intersections, each sealed watertight.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

END OF SECTION 07 71 00

SECTION 07 80 00 – FIRE AND SMOKE PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SUMMARY

A. Interior finish should not readily contribute to fire growth. The doors and whatever else is wood should have some fire retardant abilities. The structure is made of concrete, and concrete is non-combustible. The structural steel needs to have some retardant finish as well.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

2.01 INSTALLATION

A. Sprayed on by products manufacturer or installation team/contractor.

END OF SECTION 07 80 00

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Silicone joint sealants.

B. Urethane joint sealants.

C. Latex joint sealants.

1.02 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers eight samples of materials that will contact or affect joint sealants. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.03 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

C. Preconstruction compatibility and adhesion test reports.

D. Preconstruction field-adhesion test reports.

1.04 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Final Acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.02 SILICONE JOINT SEALANTS

A. Neutral-Curing Silicone Joint Sealant (SS-3): ASTM C 920.

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

a. Dow Corning Corporation; “795 Silicone”.
b. Pecora Corporation; “895 NST Silicone”.
c. Tremco Incorporated; “Spectrem 2 Silicone”.

2. Type: Single component (S) or multicomponent (M).
3. Grade: Nonsag (NS).
4. Class: 50.
5. Uses Related to Exposure: Nontraffic (NT).
6. Joint-Sealant Color: As selected from manufacturer's full range of colors.

B. Neutral-Curing Silicone Joint Sealant (SS-4): ASTM C 920.

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

   a. Dow Corning Corporation; “786 Silicone Sealant”.
   b. Pecora Corporation; “898”.
   c. Tremco Incorporated; “Proglaze”.

2. Type: Single component (S).
3. Grade: Nonsag (NS).
4. Class: 25.
5. Uses Related to Exposure: Nontraffic (NT).
6. FDA Approved.
7. Joint-Sealant Color: As selected from manufacturers full range of colors.
8.

2.03 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant (US-1): ASTM C 920.

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

   a. BASF Building System; “Sonolastic NP-1”.
   b. Pecora Corporation; “DynaTrol I-XL”.
   c. Tremco Incorporated; “Dymonic FC”.

2. Type: Single component (S) or multicomponent (M).
3. Grade: Nonsag (NS).
4. Class: 50.
5. Uses Related to Exposure: Nontraffic (NT).
6. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

2.04 LATEX JOINT SEALANTS

A. Latex Joint Sealant (LS-1): Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

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

   a. DAP Products, Inc; “ALEX® Acrylic Latex Caulk”.
   b. Pecora Corporation; “AC-20® + Silicone”.
   c. Tremco Incorporated; “Tremflex® 834”.

2. Joint-Sealant Color: White.

2.05 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330; Type C (closed-cell material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.06 MISCELLANEOUS MATERIALS

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

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained

or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

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

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.

G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.03 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 5 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

3.04 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints in vertical surfaces and horizontal nontraffic surfaces.

1. Interior Joint Locations:

a. Tile control and expansion joints.
b. Other joints as indicated.

2. Joint Sealant: Silicone - SS-3.

B. Joint-Sealant Application: Mildew-resistant silicone interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated.

2. Joint Sealant: Silicone SS-4

C. Joint Sealant Application: Joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Interior and exterior joints between precast concrete.

2. Joint Sealant: Urethane US-1

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces

1. Joint Locations:

a. Perimeter joints of exterior openings where indicated.
b. Perimeter joints between interior wall surfaces and frames of interior doors.

2. Joint Sealant: Acrylic latex or siliconized acrylic latex LS -1

END OF SECTION

SECTION 07 95 13 – EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Expansion joint assemblies for floor, wall, and roof surfaces.

1.02 RELATED REQUIREMENTS

A. Section 07 71 00 - Roof Specialties: Roof joint covers.

1.03 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, and available colors and finish .

C. Manufacturer's Installation Instructions: Indicate rough-in sizes; provide templates for cast-in or placed frames or anchors; required tolerances for item placement.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Expansion Joint Cover Assemblies:

1. Manufacturer: Balco Inc www.balcousa>com

Product: Model FCWW-2-SIL.

2.02 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.

1. Joint Dimensions and Configurations: As indicated on drawings.

B. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.

C. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.

D. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.

E. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

F. Floor Joint Covers: Coordinate with indicated floor coverings.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 allow, T6 temper.

B. Anchors and Fasteners: As recommended by cover manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.

C. Rigidly anchor to substrate to prevent misalignment.

END OF SECTION 07 95 13

DIVISION 08 – OPENINGS

LIST OF SECTIONS

SECTION 08 14 00 - WOOD DOORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Solid-core doors with bamboo veneer faces.

1.02 SUBMITTALS

A. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of mortises and holes for hardware.
2. Dimensions and locations of cutouts.
3. Undercuts.
4. Requirements for veneer matching.
5. Doors to be factory finished and finish requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham Wood Doors; an Assa Abloy Group company.
4. Mohawk Doors; a Masonite company.
5. Oshkosh Door Company.
6. VT Industries, Inc.

2.02 FLUSH WOOD DOORS, GENERAL

A. WDMA I.S.1-A Performance Grade:

1. Standard Duty unless otherwise indicated.

B. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2, made with binder containing no urea-formaldehyde.

2.03 VENEER-FACED DOORS

A. Interior Solid-Core Doors:

1. Grade: Custom (Grade A faces).
2. Veneer Skin: 1/8 inch thick bamboo Component Material by Lamboo Inc.
3. Core: Particleboard.
4. Construction: Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.

2.04 HARDWARE

A. Pocket Doors
1. Overhead sliding door hardware by Hafele
2. Door pull
3. Privacy Lock

B. Swing Door - Laundry
1. Passage latch set
2. Hinges

C. Swing Door - Mechanical Room
1. Privacy latch set
2. Hinges

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.

END OF SECTION

SECTION 08 40 50 - ALUMINUM ENTRANCES, CURTAIN WALLS, AND WINDOWS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Glazed aluminum curtain walls.

B. Glazed aluminum entrances

C. Glazed aluminum windows.

1.02 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: For each exposed finish required.

D. Delegated-Design Submittal: For glazed aluminum assemblies indicated compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.05 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum assemblies that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazed aluminum assemblies.

B. General Performance:

1. Glazed aluminum assemblies shall withstand movements of supporting structure including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

2.02 MANUFACTURERS

A. Basis-of-Design Products by Intus Windows.

1. Swinging Entrances: AWS/ADS 65
2. Folding Entrances: ASS 70 FD
3. Curtain walls: FW 50+
4. Fixed and Outswing Windows: AWS/ADS 65

2.03 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Powder-coat finish.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2.04 GLAZING

A. Glazing: Glazing types as indicated on drawings.

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.05 HARDWARE

A. Hardware by aluminum assembly manufacturer

1. Swinging Entrances

   a. Barrel hinges
   b. Single point lock with cylinder to be keyed to match University standard
   c. Manufacturer standard lever handles
   d. Manufacturer standard weather gasket
   e. Closer
   f. Low Profile threshold

2. Folding Entrances

   a. Single point lock with cylinder to be keyed to match University standard
   b. Manufacturer standard weather gasket
   c. Low Profile threshold

3. Outswing Windows

   a. Barrel hinges
   b. Single point lock with cylinder to be keyed to match University standard
   c. Manufacturer standard lever handles
   d. Position limiter to limit opening of unit to 30percent.
   e. Manufacturer standard weather gasket

2.06 ACCESSORIES

A. Screens: Provide framed insect screens for each operable window. Frame to match window finish.

B. Aluminum Trim as indicated on drawing. Finish to match windows.

2.07 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 08 80 00 "Glazing."

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.08 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils.

1. Color and Gloss: Black.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum assemblies to exterior.

D. Install components plumb and true in alignment with established lines and grades.

END OF SECTION

DIVISION 09 - FINISHES

LIST OF SECTIONS

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Non-load-bearing steel framing systems for interior gypsum board assemblies.

B. Suspension systems for interior gypsum ceilings and soffits.

1.02 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 FRAMING SYSTEMS

A. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.

1. Minimum Base-Metal Thickness: 0.027 inch.
2. Depth: 3-5/8 inches and 6 inches.

B. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.018 inch.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: 7/8 inch.

2.02 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.02 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Interior gypsum board.

1.02 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corp.
2. Georgia-Pacific Gypsum LLC.
3. National Gypsum Company.
4. Temple-Inland.
5. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Moisture-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.02 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.

2.03 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape for Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.04 AUXILIARY MATERIALS

A. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

B. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).

C. Acoustical Joint Sealant: As indicated in Section 07 92 00 - Joint Sealants

PART 3 - EXECUTION

3.01 APPLYING AND FINISHING PANELS

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

E. Prefill open joints and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

H. Protect adjacent surfaces from joint compound and texture finishes and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board application.

I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Tile for Bathroom Floor

B. Tile for Bathroom Wall

C. Surface Preparation Products: Backerboards. Self-Leveling Underlayments, Waterproofing and Anti-Fracture Membranes. Sound Reduction Mat Underlayments

D. Setting Materials: Architecturally Engineered Mortar Systems, Thin-Set Mortars, Specialty Mortars, Ceramic Tile Adhesives.

E. Colored Tile Grouts- Sanded, Non-Sanded and Epoxy Grouts

1.02 SUBMITTALS

A. Submit under provisions of Section 01 30 00 Administrative Requirements.

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

1.03 QUALITY ASSURANCE

A. Manufacturer Qualification: Company specializing in manufacturing the products of this section with minimum ten years documented experience

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience

C. Mock-Up: Provide a mock-up of evaluation of surface preparation techniques and application workmanship

1. Locate mock-ups on site in locations and size directed by Architect

2. Finish areas designated by Architect

3. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect

4. Refinish mock-up area as required to produce acceptable work

5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of work

D. Conduct conference at Project site to comply with requirements of Division 1 Section 'Project Meetings'

PART 2 - PRODUCTS

2.01 TILE

A. Bathroom Floor

1. Manufacturer: Daltile
2. Product: Textured Field Tile
3. Product Number: P402
4. Color: Grigio
5. Size: 24" x 24"
6. Square Footage: 89 sq. ft.

B. Bathroom Wall

1. Manufacturer: Daltile
2. Product: Unpolished Field Tile
3. Product Number: P401
4. Color: Beige
5. Size: 6" X 24"
6. Square Footage: 192 sq. ft.

2.02 INSTALLATION MATERIALS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, 1/2 inch (12.7 mm) thick.

1. Manufacturer: Custom Building Products; Wonderboard.

B. Fiber-Cement Underlayment: ASTM C 1288, 1/2 inch (12.7 mm) thick.

1. Acceptable Manufacturers:

a. CertainTeed Corp.; FiberCement Underlayment

b. James Hardie; Hardiebacker

C. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall have a VOC content of 65 g/L or less.

D. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall comply with Green Seal's GS-36 and with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Waterproofing Membranes for Thin-Set Installations: ANSI A118.10, [fabric-faced chlorinated polyethylene, PVC, or polyethylene sheet product] [fabric-reinforced modified bituminous product] [fabric-reinforced liquid-latex or elastomeric polymer product] [unreinforced liquid-latex or elastomeric polymer product] [urethane waterproofing and adhesive].

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

1. Thin-Set Mortar Type: Dry-set portland cement.

2. Thin-Set Mortar Type for Wood Subfloors: EGP latex-portland cement.

3. Water-Cleanable, Tile-Setting Epoxy:

4. Organic Adhesive: ANSI A136.1, Type I.

5. Grout Type: Water-cleanable epoxy

6. Stone Floor Sealer: Colorless, slip and stain resistant, not affecting color or physical properties of stone surfaces.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.

D. Install cementitious backer units and fiber-cement underlayment and treat joints according to ANSI A108.11.

E. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

F. Install waterproofing to comply with ANSI A108.13.

G. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

H. Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).

I. Apply sealer to cleaned stone tile flooring according to sealer manufacturer's written instructions.

J. Retain applicable methods in subparagraphs under four paragraphs below; see TCA's Handbook for guidance.

K. Interior Floor Tile Installation Method(s):

1. Over Concrete Subfloors: [TCA F111 (cement mortar bed with cleavage membrane)] [TCA F112 (cement mortar bed bonded to concrete)] [TCA F113 (thin-set mortar)] [TCA F114 (cement mortar bed with cleavage membrane, epoxy grout)] [TCA F115 (thin-set mortar, epoxy grout)] [TCA F116 (organic adhesive)] [TCA F116 except use water-cleanable epoxy adhesive] [TCA F131 (epoxy adhesive, epoxy grout)] [TCA RH115 (thin-set mortar; electric radiant system encapsulated in thin-set mortar)].

2. Over Waterproof Membranes on Concrete Subfloors: [TCA F121 (cement mortar bed)] [TCA F122 (thin-set mortar)].

L. Interior Wall Tile Installation Method(s):

1. Over Concrete and Masonry: [TCA W202 (thin-set mortar)] [TCA W211 (cement mortar bed, bonded to concrete or masonry)] [TCA W221 (cement mortar bed on metal lath)] [TCA W222 (one-coat cement mortar bed on metal lath)] [TCA W223 (organic adhesive)].

2. Over Wood Studs or Furring: [TCA W221 (cement mortar bed on metal lath)] [TCA W222 (one-coat cement mortar bed on metal lath)] [TCA W223 (organic adhesive on solid backing)] [TCA W231 (cement mortar bed)] [TCA W243 (thin-set mortar on gypsum board)] [TCA W244 (thin-set mortar on cementitious backer units or fiber cement underlayment)] [TCA W245 with thin-set mortar (thin-set mortar on glass-mat, water-

resistant backer board)] [TCA W245 with organic adhesive (organic adhesive on glass-mat, water-resistant backer board)].

3. Over Metal Studs or Furring: [TCA W221 (cement mortar bed on metal lath)] [TCA W222 (one-coat cement mortar bed on metal lath)] [TCA W223 (organic adhesive on solid backing)] [TCA W241 (cement mortar bed)] [TCA W242 (organic adhesive on gypsum board)] [TCA W243 (thin-set mortar on gypsum board)] [TCA W244 (thin-set mortar on cementitious backer units or fiber cement underlayment)] [TCA W245 with thin-set mortar (thin-set mortar on glass-mat, water-resistant backer board)] [TCA W245 with organic adhesive (organic adhesive on glass-mat, water-resistant backer board)].

4. Shower Wall Installations, [Wood] [Metal] Studs or Furring: [TCA B411 (cement mortar bed)] [TCA B412 (thin-set mortar on cementitious backer units or fiber cement underlayment)] [TCA B419 with thin-set mortar (thin-set mortar on glass-mat, water-resistant backer board)] [TCA B419 with organic adhesive (organic adhesive on glass-mat, water-resistant backer board)].

5. Shower Receptor and Wall Installations, Concrete or Masonry: [TCA B414 (cement mortar bed)] [TCA B421 (thin-set mortar over waterproof membrane)] [TCA B422 (thin-set mortar over waterproof membrane with integrated bonding flange for bonded membranes)].

6. Shower Receptor and Wall Installations, [Wood] [Metal] Studs or Furring: [TCA B414 (cement mortar bed)] [TCA B415 (thin-set mortar on cementitious backer units or fiber cement underlayment)] [TCA B420 (thin-set mortar on glass-mat, water-resistant backer board)] [TCA B421 (thin-set mortar over waterproof membrane on cementitious backer units or fiber cement underlayment)] [TCA B422 (thin-set mortar over waterproof membrane with integrated bonding flange for bonded membranes on cementitious backer units or fiber cement underlayment)].

3.02 INSTALLATION AND MAINTENANCE

A. Ceramic Tile - Routine Care

1. Contaminants and spills on a glazed ceramic tile are, generally, easier to clean then other, more impervious surfaces. Glazed tile products should be cleaned routinely with an all-purpose, low VOC household or commercial cleaner. The product chosen should also be grout joint cleaning compatible. The type of product may vary depending on the tile application and use. A multipurpose spray cleaner, which removes soap scum, hard water deposits, and mildew designed for every-day use, can be used on wall tile areas in residential baths and showers.

2. The entire area should be cleaned and scrubbed with cleaner solution through the use of a cotton mop, cloth, sponge, or non-metallic brush. The

entire area should be rinsed with clean water to remove any cleaning solution residue. Remember that you should sweep or vacuum floor areas prior to cleaning to remove any dust or debris. Routine cleaners should never contain hazardous or polluting products including, but not limited to acids or ammonia. Acids can damage the grout and the glazed surface of the tile, and ammonia can discolor the grout.

3. Unglazed tile should be cleaned routinely with concentrated tile cleaners that have a neutral pH for safe regular use. These cleaners are better suited at removing grease, oils and normal spills from unglazed products. Again these products will vary depending on the application, amount of traffic and the use. The product chosen should also be compatible with cleaning the grout joints at the same time.

B. Removal of Sealers/Waxes/Floor Finishes:

1. If you need to remove a topical sealer or floor wax from a ceramic tile you should use a Tile Sealer & Adhesive remover. Always test a small area first. Apply a liberal amount of undiluted sealer & adhesive remover to a manageable area. Allow setting without drying until coating or residue softens. Reapply if necessary until sealer softens and can be removed. If necessary, agitate with white nylon scrub pad. Wipe up the residue with a cotton towel or sponge. Rinse thoroughly with clean water. Do not use on natural stone products.

C. Glass Tiles

1. For routine cleaning, use any non-abrasive cleaning compound recommended for either glass or tile

2. Metal Signatures/Metal Ages/Urban Metals

3. To clean, use a liquid non-abrasive household cleaner.

4. DO NOT use scouring pads, steel wool, sandpaper or other abrasive products.

5. Avoid cleaners containing ammonia, bleach, abrasives, or other hazardous/polluting compounds.

6. Always test in small inconspicuous area while using a new cleaner to ensure compatibility.

D. Ceramic Tile - Grout Care

1. Grout is the material used to fill the spaces between the individual tiles. Grout comes in many colors. While color is important to the final finished look of the tile installation, it has little effect on the functionality of the grout. The purpose of grout is, simply, to fill the joint between the tiles and becomes a permanent, integral component of the finished installation.

2. Only the grout needs to be sealed, not glazed floor or wall tiles. Grout to be sealed seventy-two hours after installation.

3. Refer to the manufacturer warranty, technical & product information for specific details on product installation, useful life, and product applications (including any warnings) before use.

E. Grout Maintenance:

1. Neither sealing the grout nor using a 100% Epoxy Grout will guarantee against surface build-up or discoloration of the grout. Grout needs to be cleaned on a periodic basis to remove any surface build-up. Routine grout cleaning can be done with a daily concentrated household or commercial cleaner depending on the application. When heavy duty grout cleaning is required, you will need to use a professional strength Tile & Grout Cleaner that is capable of removing grease, soap scum, body oil, mildew stains, algae, and synthetic or acrylic waxes from the grout joints. However, such a product should contain non-polluting chemicals and low VOC levels. This type of product can be purchased from most Home Centers, or through your local professional Floor Covering Dealer.

1. Grout Color Restoration:

a. When grout has been stained to the point that it cannot be maintained or returned to its natural color, you can return the grout back to its original color or any other color through the use of a "grout stain". Grout Stains are epoxy-based products that are specifically designed to penetrate into the grout and seal the surface with a permanent color. Once the grout has been stained there is no need to seal it any further with a penetrating/impregnating sealer. Prior to staining, the grout joint should be cleaned thoroughly to remove any dirt, oils, grease or sealers with a professional strength Tile & Grout Cleaner. This can be purchased from most Home Centers or through your local Professional Floor Covering Dealer.

F. Ceramic Tile - New Installations

1. Immediately after tile has been properly installed and grouted, the new installation should be covered with brown paper to protect it from debris during the remaining construction process. The grout joints should be dampened daily with clear water using a clean sponge or mop during the first 7 days. This procedure facilitates the grout cure and color lock. The paper will allow for two important things:

a. to protect the newly installed tile grout and

b. to allow moisture to escape from the grout as it cures further protecting the look and utility of the floor. This is an important step in achieving color consistency. Never use plastic or non-absorbent

materials to protect freshly installed tile. These types of non-absorbent products will trap moisture causing the grout to discolor during the curing period. The protective brown paper should remain until construction is complete and the floor is opened for intended (post-construction) use.

G. Post-Grout Clean-Up:

1. Grout haze is a film that has been left behind on the surface of the tile as part of the final grouting process. Usually this is buffed off the surface after the grout has achieved its initial 12 to 24 hour cure. The removal of the haze is often difficult when buffing with a clean rag or floor machine. Cementitious grout haze can be successfully removed with "Sulfamic" acid, which is a mild acid that attacks and breaks down cement smears. There are several products on the market called grout haze removers, which usually contain Sulfamic acid. Sulfamic acid can also be purchased in powder form and mixed with water to different strengths by qualified professionals. Similarly, 100% Solids Epoxy Grout haze can be removed with an Epoxy Haze Remover. These removers are formulated to safely and quickly remove cured epoxy haze from new tile installations. Their unique formulation will soften most epoxy hazes for easy removal without damaging the grout or tile, usually in one application. Sulfamic acid or grout removers should never be used on Natural Stone products.

END OF SECTION 09 30 00

SECTION 09 54 00 - SPECIALTY CEILINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

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

2.02 CEILING SUSPENSION SYSTEM

A. Ceiling Suspension System: Wide-face, direct-hung system; ASTM C 635, intermediate duty structural classification.
   1. Manufacturers: One of the following:
   2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:
      a. Armstrong World Industries, Inc.
      b. CertainTeed Corp.
      c. Chicago Metallic Corporation.
      d. USG Interiors, Inc.; Subsidiary of USG Corporation.
   3. Face Design: Flat, flush
   4. Face Finish: Painted white

B. Attachment Devices: Sized for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.

C. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

a. Size: Provide yield strength at least 3 times the hanger design load (ASTM C 635, Table 1, Direct Hung), but not less than [**0.106-inch- (2.69-mm-)**] [**0.135-inch- (3.5-mm-)**] diameter wire.

D. Access: Identify access tiles with manufacturer's standard unobtrusive markers for each access unit.

2.03 MISCELLANEOUS MATERIALS

A. Acoustical Tile Adhesive: Type recommended by acoustical tile manufacturer, bearing UL label for Class 0-25 flame spread.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install acoustical ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Adhesive Installation: Install acoustical tile by bonding to substrate, using amount of adhesive and procedure recommended in writing by tile manufacturer and as follows:
1. Install splines in joints between tiles; maintain bottom surface of tiles in a level plane.

2. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.

C. Arrange / Install directionally patterned ceiling tile units as indicated on Drawings.

END OF SECTION 09 54 00

SECTION 09 64 00 - WOOD FLOORING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Thermally modified solid ash wood flooring.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type of wood flooring and accessory.

PART 2 - PRODUCTS

2.01 WOOD FLOORING

A. Basis of Design: Thermally modified hardwood flooring by Thermory USA, LLC

1. Thickness: 3/4 inch
2. Face Width: 5 inches.
3. Lengths: Lengths required to form pattern indicated.
4. Finish: Tango

B. Fasteners: As recommended by manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with flooring manufacturer's written installation instructions.

B. Provide expansion space at walls and other obstructions and terminations of flooring as indicated on Drawings.

C. Solid-Wood Flooring: Blind nail or staple flooring to substrate.

1. For flooring of face width more than 3 inches:

a. Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
b. Install no fewer than two countersunk nails at each end of each piece, spaced not more than 16 inches along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

3.02 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material.

END OF SECTION

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface preparation and the application of paint systems on the following substrates:

1. Steel.
2. Galvanized metal.
3. Gypsum board.

B. Painting of mechanical and electrical components indicated in Drawings and Specifications, including but not limited to tanks, saddles, fans, and equipment.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

A. Apply benchmark samples of each paint system indicated and each color and finish selected to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Owner will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

   a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
   b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.

PART 2 - PRODUCTS

2.01 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected from manufacturer's full range.

2.02 MANUFACTURER

A. Subject to compliance with requirements, manufacturers with products of acceptable design include:

1. Benjamin Moore & Co. (BM).
2. Glidden Professional.
3. ICI Paints (ICI).
4. Sherwin-Williams Company (SW).
5. TNEMEC (TN).

2.03 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.04 EXTERIOR PRIMERS/SEALERS

A. Galvanized Metal Primer

1. SW: Macropoxy 646 Fast Cure Epoxy, B58-600/B58V600

2.05 INTERIOR PRIMERS/SEALERS

A. Metal Primer:

1. SW: Ken Kromik Universal Metal Primmer B50 Series.

B. Galvanized Metal Primer

1. SW: Macropoxy 646 Fast Cure Epoxy, B58-600/B58V600

C. Interior Latex Wall Primer:

1. SW: PrepRite 200 Latex Wall Primer B28W200.

2.06 EXTERIOR PAINTS

A. Acrylic Polyurethane Enamel Topcoat:

1. SW: Hi-Solids Polyurethane S/G B65-350/B60V30
   a. SW Sealskin 7675

2.07 INTERIOR PAINTS

A. Latex Enamel:

1. Ceiling: SW: ProMar 200 Latex Eg-Shel Bright White
2. Walls: SW Eminence Latex Eg-Shell Moderne White 6168

B. Dry Fall Paint:

1. SW: Waterborne Acrylic Dry Fall Eg-Shel B42 Series.

C. Waterborne Epoxy Coating:

1. SW: Water Based Catalyzed Epoxy B70 Gloss.

D. Alkyd Enamel:

1. SW: Industrial Enamel VOC Compliant B54Z Series.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Interior exposed concrete surfaces shall be treated with a skim coat as to create a smooth uniform surface for the paint.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:

a. Uninsulated metal piping.

b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Tanks that do not have factory-applied final finishes.
e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:

a. Switchgear.
b. Panelboards.
c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
d. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

G. Paint all surfaces not indicated to receive other finish.

3.03 EXTERIOR PAINTING SCHEDULE

A. Galvanized Steel

1. Polyurethane, Pigmented Coating System:

a. Prime Coat: Galvanized Metal Primer.
b. Topcoat: Polyurethane Enamel, 2.5 mil DFT.

B. Non-structural Galvanized-Metal Substrates:

1. Prime Coat: Galvanized Metal Primer, 3 mil DFT.
2. Intermediate Coat: Polylamide Epoxy Intermediate Coat, 4.5 mil DFT.
3. Topcoat: Acrylic Polyurethane Enamel, 4.5 mil DFT.

3.04 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Prime Coat: Metal Primer, 3 mil DFT.

2. Intermediate Coat: Alkyd Enamel 2 mil DFT.
3. Topcoat: Alkyd Enamel, 2 mil DFT.
   a. SW Moderne White 6168

B. Galvanized Steel

1. Polyurethane, Pigmented Coating System:

   a. Prime Coat: Galvanized Metal Primer.
   b. Topcoat: Waterborne Acrylic Dry Fall

C. Gypsum Board Substrates:

1. Latex System:

   a. Prime Coat: Interior latex primer/sealer, 1.4 mil DFT.
   b. Intermediate Coat: Interior latex enamel matching topcoat, 1.3 mil DFT.
   c. Topcoat: Interior latex. Sheen as indicated, 1.3 mil DFT.

2. Epoxy system:

   a. Prime Coat: Interior latex primer/sealer, 1.4 mil DFT.
   b. Intermediate Coat: Waterborne Epoxy Gypsum Board Coating, 5 mil DFT.
   c. Topcoat: Waterborne Epoxy Gypsum Board Coating, 5 mil DFT.

END OF SECTION

DIVISION 10 - SPECIALTIES

LIST OF SECTIONS

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES
A. Toilet, Bathroom, and Laundry Accessories

1.02 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 WATER CLOSET ACCESSORIES

A. Toilet Tissue Dispenser
1. Product: Toto; Y_416 Series
2. Type: Single-roll dispenser.
3. Mounting: Recessed.
4. Material: Polished Chrome
5. Capacity: Designed for 5-inch- (127-mm-) diameter-core tissue rolls.

B. Waste Receptacle
1. Material and Finish: Stainless steel, No. 4 finish (satin).

2.02 BATH ACCESSORIES

A. Robe Hook
1. Basis-of-Design Product: Toto; YH416- Robe Hook
2. Description: Single-prong unit.
3. Material and Finish: Polished Chrome

B. Towel Bar
1. Basis-of-Design Product: Toto; YB416- Towel Bar 24”
2. Description: 3/4-inch- (19-mm-) round tube with circular end brackets .
3. Mounting: Flanges with concealed fasteners.

4. Length: 24 inches (610 mm)

5. Material and Finish: Polished Chrome

C. Towel Ring
1. Basis-of-Design Product: Toto; YR416

2. Description: Pin projecting approximately 1-3/4 inches (63 mm) from wall with square with rounded edges ring.

3. Pin Material and Finish: Polished Chrome

4. Ring Material and Finish: Matching pin.

2.03 LAUNDRY ACCESSORIES

2.04 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T6 or 6463-T6.

C. Sheet Steel: ASTM A 1008/A 1008M, 0.0359-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

F. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.

G. Tempered Glass: ASTM C 1048, Kind FT (fully tempered).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

J. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10 28 00

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.02 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.03 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.04 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.02 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide 10 HI SA80 ABC labeled by JL Industries, Inc.; a division of the

Activar Constrcution Products Group or comparable product by one of the following:

a. Amerex Corporation.
b. Guardian Fire Equipment, Inc.
c. JL Industries, Inc.; a division of the Activar Construction Products Group.
d. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
e. Larsens Manufacturing Company.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated 10 lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.03 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

DIVISION 11 - EQUIPMENT

LIST OF SECTIONS

SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Cooking appliances.

B. Kitchen exhaust ventilation.

C. Refrigeration appliances.

D. Cleaning appliances.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Field quality-control reports.

C. Warranties: Sample of special warranties.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

1.06 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 COOKTOPS

A. Electric Cooktop

1. Basis-of-Design Product: Gallery Model FGIC3067M by Frigidaire
2. Electric Burner Elements: Four, induction-type burners.
3. Top Material: Black Ceramic glass.
4. ADA Compliant
5. Voltage Rating: 120/240V, 60Hz

2.02 WALL OVENS

A. Electric Wall: One-oven unit.

1. Basis-of-Design Product: Gallery Model FGEW3045K by Frigidaire
2. Mounting: Built-in undercounter.
3. Capacity: 4.2 cubic feet.
4. Material: Stainless steel
5. ADA Compliant
6. Voltage Rating: 120/240V, 60Hz, 20 Amp
7. Material: Stainless steel.

2.03 MICROWAVE OVENS

A. Microwave Oven:

1. Basis-of-Design Product: Model FGMO205K
2. Mounting: Wall cabinet.
3. Capacity: 2.0 cu. ft..
4. Exhaust Fan: Nonvented, recirculating type with charcoal filter and with manufacturer's standard capacity.
5. Microwave Power Rating: 1,700 W.
6. Voltage Rating: 120V/60Hz/15 or 20 A
7. Material: Stainless steel.
8. Trim Kit: Stainless Steel 27 inch trim kit face plate for built-in installation. Part Number: MWTK27

2.04 KITCHEN EXHAUST VENTILATION

A. Overhead Exhaust Hood

1. Basis-of-Design Product: Model FHPC3660L S by Frigidaire
2. Type: Glass Suspended-island-canopy, exhaust-hood system.

3. Exhaust Fan: Built into hood and with 400 CFM capacity.

    a. Venting: Nonvented, recirculating type with charcoal filter.

4. Finish: Stainless steel.

2.05 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom.

1. Basis-of-Design Product: Bloomberg BRFB0900
2. Type: Built in.
3. Storage Capacity:

    a. Refrigeration Compartment Volume: 6.64 cubic feet
    b. Freezer Volume: 1.55 cubic feet.

4. General Features:

    a. Interior light in refrigeration compartment.
    b. Automatic defrost.
    c. Interior light in freezer compartment.

5. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
6. Front Panels: Wood panels to match kitchen cabinets.

2.06 DISHWASHERS

A. Dishwasher:

1. Basis-of-Design Product: Model FFBD1821M by Frigidaire
2. Type: Built-in undercounter.
3. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
4. Front Panel: Wood panel to match kitchen cabinets.
5. ADA Compliant

2.07 CLOTHES WASHERS AND DRYERS

A. Clothes Washer:

1. Basis-of-Design Product: Affinity Model FAFW3921NW by Frigidaire.
2. Type: Stacking, front-loading unit.
3. Capacity: 3.7 cu. ft.

4. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
5. Appliance Finish: Baked enamel, White.

B. Clothes Dryer:

1. Basis-of-Design Product: Affinity Model FAQE7001L by Frigidaire
2. Type: Stacking, frontloading, electric unit.
3. Capacity: 7.0 cu. ft.
4. Features:

   a. Interior drum light.
   b. Stacking kit to stack dryer over washer. Part Number: STACKIT 4X

5. Appliance Finish: Baked enamel, White.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Utilities: Comply with plumbing and electrical requirements.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations.
2. Operational Test: After installation, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

END OF SECTION

DIVISION 12 - FURNISHINGS

LIST OF SECTIONS

SECTION 12 36 00 - COUNTERTOPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Paper Composite Countertops for architectural casework

1.02 SUBMITTALS

A. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

B. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: Stratum by Richlite.

2.02 COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at cove and top.
3. Endsplash: None.

2.03 COUNTERTOP MATERIALS

A. Paper Composite Sheets: Celllose or hemp-fiber paper heat pressed with phenolic resin; color consistent throughout thickness.

1. Surface Burning Characteristics: Flame spread 30, maximum; smoke developed 30, maximum; when tested in accordance with ASTM E 84.
2. Density: 75 pcf minimum
3. Water Absorption: 0.36 percent of 1 inch thickness, unsealed material, 24 hour fully submerged test.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

END OF SECTION

SECTION 12 44 00 - BATHROOM FURNISHINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Architectural Built-Ins and Kitchen Cabinets

1.02 SUBMITTALS

A. Shop Drawings

B. Samples showing the full range of colors available for each type of finish

PART 2 – PRODUCTS

2.01 MANUFACTURED UNITS

A. Bathroom Vanity
   1. Manufacturer: WetStyle; M Collection
      a. Freestanding Vanity, M2418 FS
      b. Wall-mount Vanity, M4810 WM
   2. Color: Walnut Veneer Chocolate
   3. Hardware:
      a. Manufacturer: Hefele American Company
      b. Recessed Magnetic Catches – Under Veneer Magnet
      c. Product Number: 246.70.004

B. Recessed Mirror Cabinet (Bathroom)
   1. Manufacturer: WetStyle; M Collection
      a. Product Number: M4630 ME-REC
      b. Color: Walnut Veneer Chocolate

PART 3 - EXECUTION

3.01 INSTALLATION

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

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

C. Install cabinet's level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

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

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

F. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
   1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with [No. 10 wafer-head screws sized for **1-inch (25-mm)** penetration into wood framing, blocking, or hanging strips] [No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish] [toggle bolts through metal backing or metal framing behind wall finish].

END OF SECTION 12 93 00

DIVISION 13 –

SPECIAL CONSTRUCTION

LIST OF SECTIONS

SECTION 13 34 00 – FABRICATED ENGINEERED STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Architect/Engineer-fabricated Photovoltaic Track System

B. Plant Wall components and hardware

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures. Section 07120- Fluid applied waterproofing

B. Product Data: Submit manufacturer's complete product literature for specified hardware items, detailed installation diagrams and instructions

1. Preparation instructions and recommendations

2. Storage and handling requirements and recommendations

3. Installation methods

C. Samples

1. Submit samples upon request

2. Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

3. After approval, samples will be returned for incorporation into work

D. Templates: Submit templates detailing installation procedures, including layout, dimensions and placement of hardware

E. Closeout Submittals: Submit the following:

F. Warranty: Manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Photovoltaic Track System

1. Manufacturer: Farris Fab & Machine Inc.
    a. Contact: 1006 West Academy Street, Cherryville, NC; Telephone: (704) 629-4879, E-mail: info@farrisfab.com; website: www.farrisfab.com
2. PV Track Galvanized steel

B. Plant Wall Components and Hardware

1. 4” Steel Channel
    a. Quantity: 15 at 20’ cut to various lengths
2. 3”x 5/16” Steel flat bar
    a. Quantity: 1 at 20’ cut to various lengths
3. 1/2”x2” Hex Bolts
    a. Quantity: 84
4. 1/2"x2.5” Carriage Bolts
    a. Quantity: 168
5. 1/2” washers
    a. Quantity: 504
6. 1/2” nuts
    a. Quantity: 252
7. 5/8”x1.5” Hex bolts
    a. Quantity: 8
8. 5/8”x5” Hex bolts
    a. Quantity: 4
9. 5/8” washers
    a. Quantity: 24
10. 5/8” nuts
    a. Quantity: 12
11. 2x6 Viance Ecolife treated lumber
    a. Quantity: 60 pieces cut and ripped to size

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance

1. Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions and Hager SPEC-DATA sheets.

2. Do not proceed with work until defects or conditions which would adversely affect quality, execution and permanence of finished tile work are corrected (ANSI A108.3)

3.02 EXAMINATION

A. Site Verification of Conditions:

1. Verify that substrate conditions are acceptable for product installation in accordance with manufacturer's instructions

B. Clean surfaces thoroughly prior to installation

C. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under project conditions

3.03 INSTALLATION

A. Assemble in accordance with manufacturer's instructions

3.04 ADJUSTING

A. Adjust hardware components to allow for smooth, unobstructed door operation

3.05 PROTECTION

A. Protect installed products until completion of project

B. Touch up, repair or replace damaged products before Substantial Completion

3.06 FIELD QUALITY CONTROL

A. Site Tests, Inspection: Inspect completed assembly for proper level and alignment, after installation and prior to final acceptance. Report component damage to [Supplier] []

3.07 COMPLETION & CLEANUP

A. Proceed in accordance with Section 01 74 00 - Cleaning and Waste Management

B. Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment

END OF SECTION 13 34 00

DIVISION 21 - FIRE SUPPRESSION

LIST OF SECTIONS

SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pump

B. Pipes and Fittings

C. Sprinklers

D. Valves

E. Warning Sign

1.02 SUBMITTALS

A. Product data and system design for sprinkler heads, piping, valves, fittings, and controls

1. Submit drawings and calculations according to NFPA 13 D to Authorities having Jurisdiction, the fire department, and Agency for New Construction for review and approval.

2. Submit test reports as described in NFPA 13 D

3. Comply with NFPA 13 D

4. UL listed

5. Comply with IRC Building and Fire Codes

B. Calculations

1. The pump has to be able to provide 13 gpm to 2 sprinkler heads for 7 minutes. Total required tank capacity = 182 gallons.

2. Every room and livable area has to have a sprinkler, besides water closet.

3. Hydraulic Calculations were performed on January 18, 2013. Results confirmed pump has to supply 26 gpm at 27 psi (62 ft.) using 1 ¼” mains and 1” lines between sprinklers

PART 2 - PRODUCTS

2.01 PUMP

A. Basis-of-Design: CB Manufacturers 13D-70/310

1. Able to supply fire protection system at 7 psi residual pressure

B. Basic System Includes:

1. Stainless Steel Pump Components (340L)
2. Stainless Steel Sensing Line (316)
3. Pressure Switch (pre-wired to motor): factory set at 40psi ON and 60 psi OFF, cut in setting range 5-60 psi w/20-30psi differential, cut out range 25-80psi
4. Industrial grade, unidirectional, non-overloading motor
5. Discharge Check Valve
6. Lockable/Indicating Control Valve (Per NFPA 13D)
7. Liquid filled gauge
8. Drain
9. All piping/valves are bronze/brass
10. Stainless-lined Expansion Tank (pre-charged and re-chargeable to 35psi, minimizes surges, stored energy acts like jockey pump)

C. Basic System Specifications:

1. Suction Connection: 1.25”
2. Discharge connection: 1 ¼” fnpt
3. 1 PH/60 hz ODP continuous duty unidirectional motors
4. Std voltage 230V 9per NDPA 13D
5. 5 hp and 7.5 hp incorporates auxiliary motor starts in addition to the pressure switch
6. 5 hp and 7.5 hp includes adjustable overload protection\

D. For 1 hp, 8.6 service factor amps required at 230 V

2.02 PIPES AND FITTINGS

A. Black Sch 40 or Galvanized for Potable Connections Steel Pipe

B. Sch 40 listed fittings

C. Domestic plumbing pipes shall comply with Plumbing Authority

2.03 SPRINKLERS

A. Tyco Residential Fire Sprinklers (TY2524), concealed pendent, 155 degrees F, K=4.9

1. Sprinkler Escutcheons

B. Tyco Brass Upright, quick response, 155 degrees F, K=4.9

2.04 VALVES

A. Control Assembly: Equal to AGF Model 8000 Riser Pack

1. Flow Switch

2. Pressure Gauge

3. Test Connection

2.05 WARNING SIGN

A. States - 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 a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign.

PART 3 – INSTALLATION

A. Pump unit needs to be installed in mechanical room or under the house according to manufacturer's specifications.

B. Sprinkler heads will be installed in the light cloud. A 2.5" hole needs to be prefabricated for the heads. Install with manufacturer's specifications.

C. Piping needs to be installed in accordance with NFPA 13 and NFPA 13D. The pipes will need to protrude through the interior walls with quick connects available for fast assembly on the site. Piping will be fastened to the ceiling using approved and listed fittings/hangers.

D. The sprinkler riser will be located in the mechanical room and will be in accordance with NFPA 13D.

END OF SECTION 21 13 13

DIVISION 22 - PLUMBING

LIST OF SECTIONS

SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Piping materials and installation instructions common to most piping systems

B. Transition fittings

C. Dielectric fittings

D. Mechanical sleeve seals

E. Sleeves

F. Escutcheons

G. Grout

H. Equipment installation requirements common to equipment sections

I. Painting and finishing

J. Concrete bases

K. Supports and anchorages

1.02 SUBMITTALS

A. Product Data: For the following:

1. Transition Fittings

2. Dielectric fittings

3. Mechanical sleeve seals

4. Escutcheons

B. Welding certificates

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that are equal to the specified product,

that may be incorporated into the Work include, but are not limited to, the manufactures specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings

2.03 JOINING MATERIALS

A. Refer to individual Division 22 piping sections for special joining materials not listed below

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents

1. ASME B16.2, nonmetallic, flat, asbestos-free, 1/8-inch (3.2 mm) maximum thickness unless thickness or specific material is indicated

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B 813

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656

2.04 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Dresser Industries, Inc.; DMD Div.

c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.

d. JCM Industries

e. Smith-Blair, Inc.

f. Viking Johnson

2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling

3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling

4. Above ground Pressure Piping: Pipe fitting

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end

1. Manufacturers:

a. Eslon Thermoplastics

C. Plastic-to-Metal Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end

1. Manufacturer:

a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut

1. Manufacturers:

a. NIBCO INC.

b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Fernco, Inc.

c. Mission Rubber Company

d. Plastic Oddities, Inc.

2.05 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials

B. Insulating Material: Suitable for system fluid, pressure, and temperature

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C)

1. Manufacturers:

a. Capitol Manufacturing Co.

b. Central Plastics Company

c. Eclipse, Inc.

d. Epco Sales, Inc.

e. Hart Industries, International, Inc.

f. Watts Industries, Inc.; Water Products Div.

g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.

b. Central Plastics Company

c. Epco Sales, Inc.

d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers

1. Manufacturers:
    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company
    d. Pipeline Seal and Insulator, Inc.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C)

1. Manufacturers:
    a. Calpico, Inc.
    b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C)

1. Manufacturers:
    a. Perfection Corp.
    b. Precisions Plumbing Products, Inc.
    c. Sioux Chief Manufacturing Co., Inc.
    d. Victaulic Co. of America

2.06 MECHANICAL SLEECE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe

3. Pressure Plates: Carbon steel or stainless steel. Include two for each sealing element

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element

2.07 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.08 EXCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation piping and an OD that completely covers opening

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish

C. One-piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish

D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish

E. One-Piece, Floor-Plate Type: Cast-iron floor plate

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw

2.09 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications

2. Design Mix: 5000psi (34.5-MPa), 28-day compressive strength

3. Packaging: Premixed and factory packaged

PART 3 - EXECUTION

3.01 PIPING SYSTEMS – COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal

F. Install piping to permit valve servicing

G. Install piping at indicated slopes

H. Install piping free of snags and bends

I. Install fittings for changes in direction and branch connections

J. Install piping to allow application of insulation

K. Select system components with pressure rating equal to or greater than system operating pressure

L. Install chrome plated escutcheons for penetrations of walls, ceilings, and floors

M. Sleeves are not required for core-drilled holes

N. Permanent sleeves are not required for holes formed by removable PE sleeves

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs

1. Cut sleeves to length for mounting flush with both surfaces

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified

2. Install sleeves in new walls and slabs as new walls and slabs are constructed

3. Install sleeves that are large enough to provide ¼-inch (6.4 mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150)

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section “Joint Sealants” for materials and installations

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter

2. Install cast-iron “wall pipes” for sleeves 6 inches (150 mm) and larger in diameter

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron “wall pipes” for sleeves. Seal pipe penetrations with firestop materials. Refer to Division 07 Section “Penetration Firestopping” for materials

R. Verify final equipment locations for roughing-in

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe

C. Remove scale, slag, dirt, and debris, from inside and outside of pipe and fittings before assembly

D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA’s “Copper Tube Handbook”, using lead-free solder alloy complying with ASTM B32

E. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook”, “Pipe and Tube” Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 “Quality Assurance” Article

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants to bolt threads

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes

3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2855.

5. PVC Nonpressure Piping: Join according to ASTM D2855.

6. PVC to ABS Nonpressure Transition Pittings: Join according to ASTM D 3138 Appendix

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment

2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations

D. Install equipment to allow right of way for piping installed at required slope

3.05 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections “Interior Painting” and “Exterior Painting”

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish

3.06 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer’s written instructions and according to seismic codes at Project.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section “Metal Fabrications” for structural steel

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1

3.08 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors

B. Clean surfaces that will come into contact with grout

C. Provide forms as required for placement of grout

D. Avoid air entrapment during placement of grout

E. Place grout, completely filling equipment bases

F. Place grout on concrete bases and provide smooth bearing surface for equipment

G. Place grout around anchors

H. Cure placed grout

END OF SECTION 22 05 00

SECTION 22 10 05 – PLUMBING PIPING

PART 2 - GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.

B. Sanitary sewer.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

PART 2 - PRODUCTS

2.01 SANITARY SEWER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 for not less than 150 psi (1 034 kPa) pressure rating.

B. Fittings: ASTM D2466, PVC.

C. Joints: Solvent welded, with ASTM D2564 Solvent cement.

2.02 WATER PIPING, ABOVE GRADE

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

1. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

2. Sleeve pipes passing through partitions, walls and floors.

3. Pipe Hangers and Supports:

4. Install in accordance with ASME B31.9.

3.03 TOLERANCES

B. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.

END OF SECTION 22 10 05

SECTION 22 11 16- DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Supply Piping

B. Supply Piping Fittings and Supports

C. Fittings and Connections

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.03 SUBMITTALS

A. Product Data, Shop Drawings

1. Record Documents:

2. Manufacturer's warranty form in which manufacturer agrees to repair or replace components which fail in materials or workmanship within specified warranty period.

1.06 WARRANTY

A. Warranties: Provide standard manufacturer's written warranty, without monetary limitation, signed by manufacturer agreeing to promptly repair or replace products that fail in materials or workmanship for the period of 7 years for compressor, 5 years for parts

PART 2 - PRODUCTS

2.01 PIPING

A. PEX Tubing

1. Shall conform to ASTM F876, International Plumbing Code (IPC) and meet standard grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with TR-4/03

2. Inlet line must be a minimum of ¾”

2.02 SUPPLY PIPING FITTINGS AND SUPPORTS

A. Installations conform to Manufacturer's Installation Guide

2.03 FITTINGS AND CONNECTIONS

A. Includes connections between appliances and piping sections, as well as plumbing valves and flow controls

B. Conforms to CSA B125-1, ASME A112.18.1, ASTM F1960, ASTM F877, ASSE 1061, NSF 61

2.04 DOMESTIC BOOSTER PUMP

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with requirements in Division 22 – Section on "Common Work Results for Plumbing" for basic piping, pipe joint, pipe hanger, and support devices installation requirments

A. Installation of PEX tubing must be in accordance with the tubing manufacturer's recommendations.

B. PEX tubing should not be installed within 6 inches of gas appliance vents or within 12 inches of any recessed light fixtures.

C. Do not expose PEX tubing to direct sunlight for more than 30 days.

D. Maximum length of individual runs is 25 ft.

E. PEX tubing should be supported every 32 inches when running horizontally, every 4-6 feet vertically

F. Do not use supports that are too small or can cut, scratch or in any way damage the tubing

G. Recommended to allow 1/8" of slack per foot of installed tubing (or approximately 1.5" per every 10ft.)

END OF SECTION 22 11 16

SECTION 22 12 19 – FACILITY POTABLE-WATER STORAGE TANKS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Potable Water Supply Storage Tank

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.03 SUBMITTALS

A. Product Data

1.05 WARRANTY

A. Warranties: Provide standard manufacturer's written warranty

PART 2 - PRODUCTS

2.01 POTABLE WATER SUPPLY STORAGE TANK

A. Vertical White Tank, 1550 Gallon

1. Dimensions: 87” diameter x 67” height
2. 16” opening
3. Fill openings and drain openings are no less than 8” in diameter
4. 2” Outlet/Drain
5. Manufacturer: ASC Agri Supply, Item # 22850

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of units should be level and plumb.

B. Installation of units must be in accordance with the manufacturer’s recommendations.

END OF SECTION 22 12 19

SECTION 22 13 16- SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Piping

1.02 RELATED DOCUMENTS

A. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.03 SUBMITTALS

A. Product Data and drawings

1.03 WARRANTY

A. Warranties: Provide standard manufacturer's written warranty

PART 2 - PRODUCTS

2.01 SANITARY SEWER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 for not less than 150psi (1034 kPa) pressure rating

B. Fittings: ASTM D2466, PVC

C. Joints: Solvent welded, with ASTM D2564 Solvent cement

D. PVC pipe and fittings ASTM D 1785, Schedule 40, plain ends, for the following diameters

1. 1 ¼ “ diameter PVC Pipe
2. 1 ½“ diameter PVC Pipe
3. 2” diameter PVC Pipe
4. 3” diameter PVC Pipe

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with requirements in Division 22 - Section on “Common Work Results for Plumbing” for basic piping installation requirements.

B. Comply with requirements in Division 22 - Section on “Common Work Results for Plumbing” for pipe hanger and support devices.

C. Comply with requirements in Division 22 - Section on “Common Work Results for Plumbing” for basic piping joint construction.

D. Gray and waste water piping will be installed in a channel cut out within the floor insulation.

E. Gray and waste drainage and vent piping are to be installed at the following minimum slopes, unless otherwise indicated.

F. 1/8” per ft slope downward in direction of flow for 3” pipes.

G. ¼” per ft slope downward in direction of flow for 2” pipes or smaller.

H. Vent Piping: Both vents can be run together in the ceiling to allow for one vent through the roof.

END OF SECTION 22 13 16

SECTION 22 13 63 – FACILITY GRAY WATER TANK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Black and Grey Water Storage Tanks

B. Evacuation Pump

C. UV Sterlizers

PART 2 – PRODUCTS

2.01 GRAYWATER STORAGE TANK

A. Vertical White Tank, 1550 Gallon

1. Dimensions: 87” diameter x 67” height
2. 16” opening
3. Fill openings and drain openings are no less than 8” in diameter
4. 2” Outlet/Drain
5. Manufacturer: ASC Agri Supply, Item # 22850

2.02 EVACUATION PUMP

B. M. Quik Jon Ultima 204

1. Dimensions: 19” x 19”

a. Electrical Requirements: 230 V/ 1 PH/ 60 HZ/ ½ hp

2.01 UV STERILIZERS

A. Manufacturer: Brace System.

1. Product: RGW-350
2. Q max: 23.8 gpm
3. 1 HP
4. 60 Hz, 1 Ph, 115 V,

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Anchor tank and pump sufficiently to substrate to eliminate movement

D. Provide and install vents as required by code and manufacturer recommendations

END OF SECTION 22 13 63

SECTION 22 33 00 – RESIDENTIAL ELECTRIC DOMESTIC WATER HEATERS

PART 1 – SECTION INCLUDES

A. Heat Pump Hot Water Heater

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Vaughn Heat Pump Hot Water Heater Model #S50WHPT3838I Data Sheet and Installation Guide

C. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.03 SUBMITTALS

A. Product Data. Including capacity, temperature setting range, control type, dimensions, and power ratings.

1.04 WARRANTY

A. Warranties: Provide standard manufacturer's written warranty

PART 2 - PRODUCTS

2.01 HEAT PUMP WATER HEATERS

A. Electrical Requirements:

1. 208V/240V 60 Hz Dedicated 30 Amp Min
2. Electrical consumption: 2,950 W*hrs
3. Energy Factor (hybrid mode): 2.5
4. Unit Capacity: 50 gallons
5. Dimensions: 66in x 25” Diameter
6. Operating Air Temperature Range: 40° F to 120° F (Unit operates in Standard/Electric Mode outside of this range)

7. These units are designed to meet or exceed ANSI requirements and have been tested according to D.O.E. testing procedures and meet or exceed energy efficiency requirements of NAECA, ASHREA, Standard 90, ICC Code and all state energy performance criteria for energy consuming appliances

8. CULUS listed, AHRI Certified

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be executed as per installation manuals provided by Vaughncorp.

B. Water heater shall be installed level and plumb.

C. Water heater shall be set at 120 degrees F.

D. Computer will determine mode, most commonly set to Hybrid and Vacation mode.

END OF SECTION 22 33 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Faucets.

B. Lavatories.

C. Shower Accessories

D. Kitchen sinks.

E. Dishwasher air-gap fittings.

F. Water closets.

G. Supply fittings.

H. Waste fittings.

1.02 SECTION REQUIREMENTS

A. Submittals:

1. Product Data for each type of plumbing fixture, including trim, fittings, accessories, appliances, appurtenances, equipment, and supports.

2. Documentation indicating flow and water consumption requirements.

3. Faucets.

4. Lavatories.

5. Shower Accessories

6. Kitchen sinks.

7. Dishwasher air-gap fittings.

8. Water closets.

9. Supply fittings.

10. Waste fittings.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

2.02 KITCHEN SINK

A. Basis-of-Design Product: Kohler

1. Vault: Top-Mount/Under-Mount Kitchen Sink ADA

a. Dimensions: 9 ½” x 25” x 22”

b. Product: K-3894

2. Simplice Pull-Down Kitchen Sink Faucet

a. Dimensions: 15 3/8” x 8” x 8”

b. Product: K-596

2.03 SHOWER HEAD

A. Basis-of-Design Product: Kohler

1. Contemporary Round Rain Showerhead, 10” Diameter

a. Product #: K-13688

b. Finish: Polished Chrome

c. Flow rate: 2.5 gpm

2. Shower control System:

a. Kohler, Purist Thermostatic trim set, lever handle

b. Product: K-T14488-4

c. Finish: Polished Chrome

2.04 TOILET

A. Basis-of-Design Product: Kohler

1. Persuade Circ dual flush toilet
2. Product: K-3753
3. Finish: White
4. Flow rate: 1.6 gpm

B. Toilet Seat:

1. Kohler Brevia Q2 Advantage Toilet Seat
2. Product: K-4774, elongated closed front
3. Finish: White

2.05 LAVATORY

A. Basis-of-Design Product: Kohler

B. Inscribe Wading Pool Bathroom Sink

1. Dimensions: 16.5” diameter
2. Product #: K-2388
3. Finish: White

C. Faucets: ASME A112.18.1

1. Kohler Purist Wall Mounted Bathroom Sink Faucet Polished Chrome
   a. Trap: Chrome-plated with slip-joint inlet and wall flange.
   b. Supply and Drain Insulation: Soft-plastic covering; removable at stops.
   c. Fixture Support: Hanger plate for wall-mounting, lavatory-type fixture. Include rectangular steel uprights and feet.

PART 3 - EXECUTION

3.01 INSTALLATIONS

A. Install fitting insulation kits on fixtures for people with disabilities.

B. Install fixtures with flanges and gasket seals.

C. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

D. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

E. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

F. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

G. Fasten wall-mounted fittings to reinforcement built into walls.

H. Fasten counter-mounting plumbing fixtures to casework.

I. Secure supplies to supports or substrate within pipe space behind fixture.

J. Set shower receptors and mop basins in leveling bed of cement grout.

K. Install individual supply inlets, supply stops, supply risers, and tubular brass traps with cleanouts at fixture.

L. Install water-supply stop valves in accessible locations.

M. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes unless otherwise indicated.

N. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.

O. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install [in sink deck] [on countertop at sink] <Insert location>. Connect inlet hose to dishwasher and outlet hose to disposer.

P. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.

R. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

S. Install piping connections between plumbing fixtures and piping systems and plumbing equipment. Install insulation on supplies and drains of fixtures for people with disabilities.

END OF SECTION 22 40 00

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

LIST OF SECTIONS:

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. This Section is not meant to supersede or otherwise override any other specific HVAC section that may include similar information. Whenever conflicting information, requirements and or results are encountered, the specific specification, NOT this common work results section, should be adhered to. If any confusion still remains, consult the engineer.

B. This Section includes the following: (All may not apply. Refer to drawings)

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. HVAC demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and

conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:
   a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:
   a. Thompson Plastics, Inc.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:
   a. NIBCO INC.
   b. NIBCO, Inc.; Chemtrol Div.

2.05 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   e. Hart Industries, International, Inc.
   f. Watts Industries, Inc.; Water Products Div.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.

2.06 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel or Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.08 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.09 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 HVAC DEMOLITION (REFER TO DRAWINGS FOR EXTENT OF DEMOLITION IF ANY)

A. Refer to drawings for extent of demolition. Demolition may not be a part of this contract.

B. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

C. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

D. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type with spring clips.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:
   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
   g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
   h. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
   i. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
   b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.09 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.02 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) or less, above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and

environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Motors shall be premium efficiency.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Iron, grooved-end butterfly valves.
4. High-performance butterfly valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Iron globe valves.

1.02 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.03 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.04 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every [10] plug valves, for each size square plug-valve head.

5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.

3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.

h. Stem: Bronze.
i. Ball: Chrome-plated brass, vented.
j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.03 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig (1035 kPa).
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material ASTM A 536, ductile iron.
   e. Seat: EPDM. MOLDED IN SEAT
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Aluminum bronze.

B. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig (1035 kPa).
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 536, ductile iron.
   e. Seat: EPDM. MOLDED IN SEAT
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Nickel-plated[or -coated] ductile iron.

C. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.

h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 536, ductile iron.
e. Seat: EPDM. MOLDED IN SEAT
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.04 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig (1200 kPa).
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.

g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-67, Type I.
b. NPS 8 (DN 50) and Smaller CWP Rating: 300 psig (2070 kPa).
c. NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
d. Body Material: Coated, ductile iron.
e. Stem: Two-piece stainless steel.
f. Disc: Coated, ductile iron.
g. Seal: EPDM.

2.05 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-68.
b. CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.

B. Class 300, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.

c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-68.
b. CWP Rating: 720 psig (4965 kPa) at 100 deg F (38 deg C).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel, cast iron, or ductile iron.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.

2.06 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.

d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

2.07 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.
   f. Ends: Flanged.
   g. Trim: Composition.
   h. Seat Ring: Bronze.
   i. Disc Holder: Bronze.
   j. Disc: PTFE or TFE.
   k. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-71, Type I.
   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
   d. Body Design: Clear or full waterway.
   e. Body Material: ASTM A 126, gray iron with bolted bonnet.

f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

2.08 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded[or solder joint].
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron[, bronze, or aluminum].

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 2.

b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded[or solder joint].
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[, bronze, or aluminum].

C. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron[, bronze, or aluminum].

D. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron[, bronze, or aluminum].

2.09 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-70, Type I.
   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Disc: Solid wedge.
   h. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.

d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bray Controls; a division of Bray International.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty; a division of SPX Corporation.
g. NIBCO INC.
h. Tyco Valves & Controls; a unit of Tyco Flow Control.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-70, Type I.
   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Disc: Solid wedge.
   h. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded[or solder joint].

e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron[, bronze, or aluminum].

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded[or solder joint].
   e. Stem: Bronze.
   f. Disc: PTFE or TFE.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron[, bronze, or aluminum].

C. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 300 psig (2070 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[, bronze, or aluminum].

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   a. Standard: MSS SP-85, Type I.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bray Controls; a division of Bray International.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Steam Specialty; a division of SPX Corporation.
   g. NIBCO INC.
   h. Tyco Valves & Controls; a unit of Tyco Flow Control.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball butterfly gate and globe valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service except Steam: Globe or ball valves.
4. Pump-Discharge Check Valves:
   a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.05 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS RS, bronze.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM seat, ductile-iron disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, EPDM seat, ductile-iron disc.
4. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 175 CWP.
5. Iron Swing Check Valves: Class 125, metal seats.

3.06 CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM seat, ductile-iron disc.
2. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, EPDM seat, ductile-iron disc.
3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 175 CWP.
4. Iron Swing Check Valves: Class 125, metal seats.

3.07 HEATING-WATER AND SOLAR WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, [NRS] [RS].
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM seat, ductile-iron disc.

3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, EPDM seat, ductile-iron disc.
4. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 175 CWP.
5. Iron Swing Check Valves: Class 125, metal seats.

END OF SECTION 23 05 23

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.
b. Variable-flow hydronic systems.

1.02 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.03 SUBMITTALS

A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Certified TAB reports.

D. Sample report forms.

E. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.04 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

B. TAB Conference: Meet with Construction Manager and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager and Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.05 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.06 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:

- Palmetto
- TAB Services
- Medley and Assoc.

3.02 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts and /or Nonmetal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.03 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.04 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors.
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and

devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. For variable-air-volume systems, develop a plan to simulate diversity.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.06 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow. Document all cases of this exception on reports.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.08 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Construction Manager.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

    a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.

3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.14 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.15 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.16 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Inlet vane settings for variable-air-volume systems.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches (mm), and bore.
   i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.

2. Motor Data:

   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches (mm), and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

   a. Total air flow rate in cfm (L/s).
   b. Total system static pressure in inches wg (Pa).
   c. Fan rpm.
   d. Discharge static pressure in inches wg (Pa).
   e. Filter static-pressure differential in inches wg (Pa).
   f. Preheat-coil static-pressure differential in inches wg (Pa).
   g. Cooling-coil static-pressure differential in inches wg (Pa).
   h. Outdoor airflow in cfm (L/s).
   i. Return airflow in cfm (L/s).
   j. Outdoor-air damper position.
   k. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.

c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

H. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

I. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

K. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.17 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

   a. Measure airflow of at least 25 percent of air outlets.
   b. Measure water flow of at least 25 percent of terminals.
   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   d. Verify that balancing devices are marked with final balance position.
   e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Construction Manager and Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager and Commissioning Authority.
3. Construction Manager and Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.18 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00 – HVAC INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Insulation Materials

1.02 RELATED SECTIONS

A. Section 23 31 00 – HVAC DUCTS AND CASING

1.03 SUMMARY

A. Section Includes:

1. Duct Insulation Material

1.04 REFERANCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

1. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.05 QUALITY ASSURANCE

A. Insulation will be examined for any cracks or breaks before installation

1.06 SUBMITTALS

A. Product Data

1. Detailed mechanical drawings will be submitted to qualified engineer indicating where duct insulation will be required.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Flexible tubular insulation

1. One inch thick R-5 per inch

PART 3 - EXECUTION

3.01 INSTALLATION

A. Insulation is to be installed on all ducts either fully or partially exposed to outside conditions including:

1. Ducts inside mechanical room.

2. Exhaust and Supply of the ERV which are located outside of the building envelope.

a. Ducts are to be sealed prior to installation of the insulation as stated in section 23 31 00 – HVAC DUCTS AND CASING

END OF SECTION 23 07 00

SECTION 23 09 00 – INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. HVAC Sensors

B. Control Dampers

C. Control Fans

1.02 SUBMITTALS

A. Product data

B. Mechanical drawings mechanical closet section

C. Control Panel drawings

PART 2 - PRODUCTS

2.01 MECHANICAL DAMPERS

A. (2 ea.) 5” dia

B. Manufacturer: Honeywell

C. Product Number: ARD5

2.02 INLINE DUCT FAN

A. (2 ea.) 5” dia

B. Manufacturer:

C. Product Number:

2.03 DRY BULB TEMPERATURE SENSORS

A. Included thermostat temperature sensor

1. See Trane mini-split data sheet

a. (4 ea.) Thermocouples

2. Locations: return duct entrance, bedroom, living room, mechanical room

3. Manufacturer:

4. Product Number:

2.04 HUMIDITY AND TEMPERATURE SENSORS

A. Humidity and Temperature Sensor

1. Manufacturer: Omega
2. Model Number: HX94AVW

B. Wall Mount Temperature Sensor

1. Manufacturer: Trane

C. Temperature Sensor

1. 15’ Lead
    a. Manufacturer: Omega
    b. Model Number: ON-950-43999
2. 20’ Lead
    a. Manufacturer: Omega
    b. Model Number: ON-950-44000
3. 4’ Lead
    a. Manufacturer: Omega
    b. Model Number: ON-950-44001

PART 3 - EXECUTION

3.01 INSTALLATION

A. Thermocouples and humidistat

1. Threaded into the ducting wall and sealed as stated in section 23 31 00 – HVAC DUCTS AND CASING
    a. Mechanical dampers and fans
2. Appropriate holes for the mechanical dampers and fans will be cut into their respective walls in the mechanical room. See mechanical room drawings.
3. Components will be secured in place with epoxy based binder
4. Mechanical dampers and fans will be seals as stated in section 23 31 00 – HVAC DUCTS AND CASING

3.02 TESTING

A. Components will be tested prior to installation to ensure proper operation.

1. Sensors will be calibrated according to manufacturer's instructions.

END OF SECTION 23 09 00

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating, and condensate drain piping.

1.02 OPERATING AND MAINTENACE MANUAL

A. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals.

1.03 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.04 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe fitting pressure classes with products specified in related Sections.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

D. Coordinate installation of pipe sleeves for penetrations through floor assemblies.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Automatic Flow Control Balancing Valves:

   a. Flow Design, Inc.
   b. Griswold Controls.
   c. Hays Fluid Controls.

2. Pressure-Reducing Valves:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Conbraco Industries, Inc.
   d. ITT Bell & Gossett; ITT Fluid Technology Corp.
   e. Spence Engineering Company, Inc.
   f. Watts Industries, Inc.; Watts Regulators.

3. Safety Valves:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Conbraco Industries, Inc.
   d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
   e. Kunkle Valve Division.
   f. Spence Engineering Company, Inc.

4. Expansion Tanks:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. ITT Bell & Gossett; ITT Fluid Technology Corp.
   d. Taco, Inc.

5. Air Separators:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. ITT Bell & Gossett; ITT Fluid Technology Corp.
   d. Taco, Inc.

6. Buffer Tanks:

   a. Cemline Corp.

2.02 STEEL PIPE AND FITTINGS

A. PE Pipe: ASTM D 3035, SIDR Numbers 5.3, 7, 9, or 11.5; with PE compound number required to achieve required system working pressure.

1. Molded PE Fittings: ASTM D 2683 or ASTM D 3261, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. Hard Copper Tube: ASTM B 88, Types L (ASTM B 88M, Types B), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Flexible Connectors: Stainless-steel.

2.03 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.

B. Expansion Tanks: Welded carbon steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

C. Tangential-Type Air Separators: Welded black steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger; threaded blowdown connection.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Geothermal heat pump piping: PE piping.

B. Condensate Drain Lines: Drawn-temper copper tubing with soldered joints.

C. Minimum pipe size: 0.75 inches.

3.02 PIPING INSTALLATIONS

A. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

B. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

3.03 TERMINAL EQUIPMENT CONNECTIONS

A. Install control valves in accessible locations close to connected equipment.

B. Install ports for pressure and temperature gages at coil inlet connections.

3.04 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Isolate test source and allow to stand for four hours. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

    a. Cap and subject underground piping to static water pressure of 50 psig (345 kPa) above maximum operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours.

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.05 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and bleed air completely.
5. Set temperature controls so all coils are calling for full flow.
6. Lubricate motors and bearings.

END OF SECTION 23 21 13

SECTION 23 31 00 – HVAC DUCTS AND CASING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Duct material.

B. Insulated double-wall round duct.

C. Flat rectangular duct.

D. Installation.

1.02 SUBMITTALS

A. Product Data

B. Detailed mechanical drawings of the supply and return system in its entirety. The drawings will be submitted to an engineer for approval.

1.06 DELIVERY, STORAGE AND HANDLING

A. The ducting will be pre-assembled, installed, and transported with its designated module. Upon arrival the joints separated for transportation will be re-assembled to the same standards as all other connections.

1.07 EXTRA MATERIALS

A. Flexible ducting: elbows, 45 degree joints

B. Additional fasteners: sheet metal screws, ducting tape

PART 2 - PRODUCTS

2.01 DUCT MATERIALS

A. Double-Wall Spiral Duct

1. Galvanized steel duct: 28-14 gauge
2. Insulation: 1 inch fiberglass
3. Duct Fittings
4. Pressed elbow, reducers, tee splits
5. Duct Accessories
6. Fasteners: Sheet metal screws, bolts

7. Hanger rod: Threaded on both ends

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Ducts will be installed and sealed in accordance with national standards.

C. Open ducts will be covered or plugged with caps during construction to prevent unnecessary material from entering the duct.

D. Ducts will be joined using slip joints and flange-to-flange joints.

E. Double nuts and/or lock washers will be used on all hanger rods

F. Plenum door will be arranged so that the static pressure generated by the fan will hold the door closed.

G. Remote dampers will be installed where needed.

3.02 TESTING

A. Pitot static tube will be used to measure output pressure of the duct system, and will be compared to the expected output range to ensure there are no pressure losses at the connections.

END OF SECTION 23 31 00

SECTION 23 33 00 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Automated mechanical dampers

B. Self-sealing foam tape

C. Flexible 90 and 45 degree bends

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.04 QUALITY ASSURANCE

A. All connections made with self-sealing rubber tape will be inspected for leaks.

B. All automated mechanical dampers will be tested via the control system before they are sealed in the duct system.

1.05 SUBMITTALS

A. Product Data

1.06 DELIVERY, STORAGE AND HANDLING

A. Self-sealing foam tape will be used on slip-joints and flange-to-flange joints at inter-connection between modules once the solar house arrives on site.

PART 2 - PRODUCTS

2.01 AUTOMATED MECHANICAL DAMPERS

A. Single blade mechanically operated damper.

B. Dampers are adjustable to allow/restrict the flow of air through a particular duct.

2.02 SELF-SEALING FOAM TAPE

A. The self-sealing foam tape will be used to create gaskets between joint connections that are not sealed. These non-sealed connections will be found only at connections between modules of the house.

B. Made from molded foam with an adhesive backing.

2.03 FLEXIBLE 90 AND 45 DEGREE BENDS

A. The flexible 90 and 45 degree bends will be used in the unlikely case that elbow and 45 degree fitting don't fit on site.

B. The flexible bends will be insulated to prevent heat loss through the ducting.

PART 3 - EXECUTION

3.01 PREPARATION

A. All fitting between modules will be inspected before transportation occurs to ensure proper assembly on site.

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. Permanent fixtures are found at the edge of each module. The foam tape will be used on slip-joints and flange-to-flange joints that are used as connections between modules.

C. Flexible ducting will be limited to the least possible use to minimize losses in the ducting.

D. All automated mechanical dampers will be installed and tested before the ducts are sealed to ensure proper operation.

3.03 TESTING

A. All connections made using the foam tape will be thoroughly inspected to ensure there are no pressure losses.

B. Multiple combinations of non-flexible ducting will be tested before a flexible duct is used.

END OF SECTION 23 33 00

SECTION 23 37 00 – AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Diffusers

B. Grilles

1.02 RELATED SECTIONS

A. Section 23 31 00 – HVAC DUCTS AND CASING

B. Section 23 38 00 – VENTILATION HOODS

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.04 SUBMITTALS

A. Product data

B. Mechanical drawings, show detailed views of all diffusers and grilles

PART 2 - PRODUCTS

2.01 DIFFUSERS

A. 8” to 4” dia

B. (1 ea.) 6” to 5” dia

C. (1 ea.) 6” to 4”

2.02 SUPPLY GRILLES

A. (2 ea.) Supply outlets to mini-split heat pumps

1. See mechanical drawings detail section

2. Rooftop supply inlet

2.03 RETURN GRILLES

A. Bathroom return inlet

1. See Section 23 38 00 – VENTILATION HOODS

PART 3 - EXECUTION

3.01 INSTALLATION

A. Diffusers and Grilles are to be installed according to the manufacturer's instructions

B. Diffusers and Grilles are to be sealed as stated in section 23 31 00 – HVAC DUCTS AND CASING

3.02 TESTING

A. Diffusers and Grilles will be tested prior to installation to ensure proper air flow and distribution

END OF SECTION 23 37 00

SECTION 23 41 00 – HVAC AIR-CLEANING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 SUMMARY

A. This section includes the particulate air filtration systems that are used in the house.

1.04 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.05 QUALITY ASSURANCE

A. The air will be tested in North Carolina to ensure the air filtration system is operating properly

1.06 SUBMITTALS

A. Product Data

B. Record Documents

1. Manufacturer's warranty form in which manufacturer agrees to repair or replace components which fail in materials or workmanship within specified warranty period.

2. Operation and Maintenance Data:

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations:

END OF SECTION 23 41 00

SECTION 23 72 00 –AIR-TO-AIR ENERGY-RECOVERY EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Energy Recovery Ventilator

1.02 REFERENCE STANDARDS

A. Comply with NFPA 70, "National Electrical Code”

1.03 QUALITY ASSURANCE

A. Manufacturer QA

1.04 SUBMITTALS

A. Product Data, Shop Drawings

B. Record Documents:

1. Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1.05 WARRANTY

A. Warranties: Provide standard manufacturer's written warranty, without monetary limitation, signed by manufacturer agreeing to promptly repair or replace products that fail in materials or workmanship for the period of 7 years for compressor, 5 years for parts

PART 2 - PRODUCTS

2.01 ENERGY RECOVERY VENTILATOR

A. Trane FreshEffects Air Ventilator

1. Product: # TERV100A9P00A

B. Variable speed energy recovery ventilator providing filtration and ventilation.

C. Provide unit with stand alone controller.

D. Mechanical contractor to mount unit temperature and humidity sensors provided.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install unit per Manufacturer's instructions under supervision of HVAC contractor.

END OF SECTION 23 72 00

SECTION 23 81 26 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 REFERENCE STANDARDS

A. Comply with NFPA 70, "National Electrical Code”

1.03 QUALITY ASSURANCE

A. Manufacturer QA

1.04 SUBMITTALS

A. Product Data, Shop Drawings

B. Record Documents:

1. Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1.05 WARRANTY

A. Warranties: Provide standard manufacturer's written warranty, without monetary limitation, signed by manufacturer agreeing to promptly repair or replace products that fail in materials or workmanship for the period of 7 years for compressor, 5 years for parts

PART 2 - PRODUCTS

2.01 OUTDOOR COMPRESSOR

A. Trane Contura 3G Mini-Split Compressor Outdoor Unit – 4TXK8509A10N0BA

1. 3,000-9,600 BTU capacity, 22 SEER, Variable Speed Compressor

2.02 INDOOR HEAT PUMP

A. Trane Contura 3G High-Wall Mini-Split Indoor Unit – 4MXW8509A10N0BA

1. 3,000-9,800 BTU capacity, 14 Liters/hr dehumidification, variable airflow

2.03 INSTALLATION MATERIALS

A. Connection Pipe

B. Must follow these specifications: length: 25', Outer Diameter Liquid Pipe: 1/4", Outer Diameter Gas Pipe: 3/8", Max Height Distance: 65', Max Length Distance: 100', Gas Additional Charge: 0.2 ounces/ft.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be executed as per installation manuals provided by the Manufacturer.

1. Set units level, plumb, and true to line, without warp or rack of products and anchor securely in place as described in manufacturer's specifications.

2. Correct deficiencies in or remove and reinstall units that do not comply with requirements.

3. Repair, refinish, or replace products or finishes damaged during installation or transit, as directed by Architect.

END OF SECTION 23 81 26

SECTION 23 82 36 – FIN TUBE RADIATION HEAT EXCHANGER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rooftop fin tube plate

B. Connecting pipes, connectors and distributing headers.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 SUMMARY

A. This section includes the particulate fin tube system that is used on roof of the house.

1.04 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.05 QUALITY ASSURANCE

A. The fin tube system will be tested in North Carolina to ensure the closed loop flow circuit is operating properly

1.06 SUBMITTALS

A. Product Data

B. Record Documents

1. Manufacturer's warranty form in which manufacturer agrees to repair or replace components which fail in materials or workmanship within specified warranty period.

2. Operation and Maintenance Data:

PART 2 - PRODUCTS

2.01 GENERAL

A. PEX pipe at 1 inch diameter

B. Tee and elbow connectors at various locations

C. Matco-Norca 1 ¼" header

2.02 PRODUCTS

A. Alternate Energy Technologies (AET)/Thermafin Absorber Plate – model AP-4010C.

B. Each plate has dimension of 44.225 inch (W) x 118.625 inch (L).

1. Quantity: 6

2. Location: All exchangers are located on the roof

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations

END OF SECTION 23 82 36

SECTION 23 83 00– RADIANT-HEATING UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Capillary Tubes

1.02 RELATED DOCUMENTS

A. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.03 QUALITY ASSURANCE

A. Manufacturer QA

1.04 SUBMITTALS

A. Product Data

1.05 WARRANTY

A. Warranties: Provide standard manufacturer's written warranty

PART 2 - PRODUCTS

2.01 CAPILLARY TUBES FOR COOLING AND HEATING

A. BEKA Capillary Tubing System – model K.S 15 (specially designed for plaster ceilings and surface heating)

1. 3” thick mats, 44x44
2. http://www.achrnews.com/articles/beka-usa-radiant-tube-mats

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of units should be level and plumb.

1. Installation of units must be in accordance with the manufacturer's recommendations.

END OF SECTION 23 83 00

SECTION 23 84 16 – DEHUMIDIFIERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Dehumidifying Equipment

1.02 RELATED SECTIONS

A. Section 23 31 00 – HVAC DUCTS AND CASING

B. Section 23 33 00 – DUCT ACCESSORIES

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

1. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

1.04 QUALITY ASSURANCE

A. Quality of performance is assured by the manufacturer through the product warranty.

1.05 SUBMITTALS

A. Product Data

1. Mechanical drawing shows location of dehumidifier

PART 2 - PRODUCTS

2.01 DEHUMIDIFIER

A. Manufacturer: Ultra Aire 70H

B. Product Number: 4029870

2.02 DEHUMIDIFIER EXTERNAL CONTROL

A. Manufacturer: Ultra Aire

B. Product Number: 4028539

PART 3 - EXECUTION

3.01 INSTALLATION

A. Dehumidifier is to be installed according to manufacturer's instructions.

END SECTION 23 84 16

DIVISION 25 - INTEGRATED AUTOMATION

LIST OF SECTIONS

SECTION 25 50 00 – INTEGRATED AUTOMATION FACILITY CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Home Automation System (HAS)

B. Graphical User Interface (GUI)

1.02 SUMMARY

A. User control over Heating Ventilation Air Conditioning (HVAC) and Capillary Tube systems

B. GUI accessed from tablet computer (Tablet PC)

C. Observe/ Monitor home energy consumption

D. Automated control over the HVAC and Capillary Tube systems.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

1. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

2. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

3. National Electric Code (NEC)

4. International Building Code (IBC)

5. IEEE 802.11 Wireless Local Area Network (WLAN) standard

1.04 DEFINITIONS

A. RTAC – Real Time Automation Controller

1. PLC – Programmable Logic Controller

2. Tablet PC – A personal computer that consists of only a screen which facilitates both feedback to the user in the form of a visual display and control of the PC by the user through the use of either resistive touch (stylus), capacitive touch (Finger), or both.

1.05 QUALITY ASSURANCE

A. SEL performs rigorous testing on all products as well as provides direct contact to SEL Engineers when product support is required.

1. Extensive testing performed on sensors and tablet by UNC Charlotte Solar Decathlon Team

1.06 SUBMITTALS

A. Record Documents

1. Manufacturer's warranty form in which manufacturer agrees to repair or replace components that fails in materials or workmanship within specified warranty period.

1.07 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling will be in accordance with the rules and regulations put forth by the Department of Energy Solar Decathlon

1.08 WARRANTY

A. Products used in this system will be covered by the warranty provided by the device's respective manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 DEVICES

A. SEL-2240 Axion Programmable Logic Controller

1. https://www.selinc.com/SEL-2240/

2. Real Time Automation Controller (RTAC) module

3. 2 Ethernet Ports

4. 4 Serial Ports

5. Digital Input Module

6. Analog Input Module

B. SEL-2411 Programmable Analog and Digital I/O

1. 10 RTD Inputs
2. 4 Analog Inputs
3. 4 Analog Outputs
4. 125V Digital I/O

C. SEL-2600A RTD Sensor Input Module
1. 12 3-Wire PT 100 RTD Inputs

D. Nexia Bridge
1. Ethernet Connectable
2. Operates on Z-Wave Wireless Protocol

E. 12-Port Managed Network Switch
1. 12 Base 10/100 Ethernet Ports
2. Integrated Network Management

F. NETGEAR WNR3500L-100NAS Wireless-N Router
1. Wireless Local Area Network (WLAN) hub
2. Wireless N300 rating
3. IEEE 802.11b/g/n
4. WPA2-PSK Security protocol
5. Four 10/100/100M LAN ports
6. One 10/100/1000M WAN port

G. Microsoft Surface Pro Tablet PC
1. Windows 8 Operation System (64-bit)
2. Microsoft Silverlight installed
3. Touch screen interface
4. Resistive touch (stylus) capacitive touch (finger) or both
5. Storage: 64 GB

H. Omega 3-Wire Platinum 100ohm RTDs
1. Resistance Temperature Detectors

2. Used to measure dry-bulb temperature

PART 3 - EXECUTION

3.01 PREPARATION

A. Obtain various equipment and software

B. Lab test and design HMI dashboard configuration

C. Set up communication network and ensure all devices are interconnected and capable of communicating with one another

D. Determine and test compatibility of sensors with Digital I/O and Analog-in modules

3.02 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations

C. All Connections shall be made with the modular design of the house in mind

D. Mount sensors for adequate operating environment

E. Install and configure equipment in equipment cabinet

3.03 TESTING

A. Test all devices and features

B. Assure all connections and functions are reliable

C. Identify any areas in which performance concerns need to be addressed and correct accordingly

3.04 TRAINING

A. Educate all team members on system operation

END OF SECTION 25 50 00

DIVISION 26 - ELECTRICAL

LIST OF SECTIONS

SECTION 26 05 00- COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.02 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.03 SUBMITTALS

A. Product Data: For sleeve seals.

1.04 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. All work shall be tested and inspected. Coordinate testing dates and requirements with SCO inspectors and the architect and engineer. All tests and inspections shall be scheduled in advance. The State Electrical Inspector is the Authority Having Jurisdiction for electrical inspections. It is the responsibility of the electrical contractor to notify the Office of the State Electrical Inspector to schedule required inspections including rough-in, above ceiling and final inspections.

E. Division of Work: Refer to detail on the drawings for division of work and provide division of work per the North Carolina SCO Guidelines.

1. All individual motor starters and drives for mechanical equipment shall be furnished and installed under Mechanical Division.
2. Under Electrical Division, power wiring shall be provided up to a termination point consisting of a junction box, trough starter, VFD, or disconnect switch. Under Division 26, line side terminations shall be provided.
3. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Mechanical Division.
4. Duct smoke detectors shall be furnished and wired by fire alarm contractor, installed by Mechanical contractor. Fire alarm AHU shut down circuits shall be wired from the fire alarm control panel to a terminations point, adjacent to the AHU control, under the fire alarm contractor. AHU control wiring from the termination point to the equipment shall be under Mechanical Contractor. Refer to all drawings for locations of duct type smoke detectors, and provide coordination with mechanical contractor. All code required duct type smoke detectors shall be provided. Provide remote alarm light, test and reset switch for each detector.
5. Equipment less than 110 volts, and associated with Mechanical equipment, shall be furnished, installed, and wired under Mechanical Division.
6. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed under Mechanical Division.
7. Roof mounted exhaust fans with built in disconnects provided under Mechanical Division, or door provided with built in outlet shall be wired under Division 26 to the line side of the disconnect switch or the outlet. A disconnect switch shall be provided Under Division 26 if the fan is not provided with a built in disconnect switch. In this case, wiring from the switch to the fan shall be under Mechanical Division.
8. The sequence of control for all equipment shall be as indicated on Mechanical Division drawings and specifications.

9. All sprinkler flow and tamper switches shall be furnished and installed under Mechanical Division, fire protection, and wired under fire alarm division.

F. Provide 1/4” and 1/8” scaled coordination drawings. Coordination drawings shall indicate all electrical devices, systems and equipment, including telecommunications, lighting, power, fire alarm, low voltage signaling and communications devices and systems, and shall be coordinated with other trades, including HVAC, Plumbing, Piping, Fire Protection, Audio Video, Structural, and other building elements.

PART 2 - PRODUCTS

2.01 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.03 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Comply with NFPA 70E.

C. Comply with the Energy Independence and Security Act, effective date January 1, 2009.

D. Comply with the latest edition of the National Electrical Code, all state code requirements, including the State Construction Office and State Electrical Inspector and State Fire Alarm Inspector.

E. Testing: Provide testing for the following systems:

1. All current carrying conductors shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt megger. The procedures listed below shall b followed:

    a. Minimum readings shall be one million or more ohms for #6 AWG wire and smaller, 250,000 ohms for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor.
    b. After all fixtures, devices and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. The contractor

shall test each conductor separately to the panel and until the low readings are found. The contractor shall then correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panelboard is achieved with only the neutral feeder disconnected.

c. At final inspection, the contractor shall furnish a megger and show the engineer of record and the State Construction Office representatives that the panelboards comply with the above requirements. The contractor shall furnish a hook on type ammeter and voltmeter to take current and voltage readings as directed.

d. Ground system testing shall include testing by a ground resistance tester. Where systems show resistance to ground is over 25 ohms, appropriate action shall be taken to reduce the resistance to 25 ohms or less, by driving additional ground rods. Compliance shall be demonstrated by additional testing.

2. Circuit Breaker tests: Testing shall be performed on service circuit breakers and distribution breakers on site. Testing shall be performed by a qualified factory technician at the job site. All readings shall be tabulated and included in the owner's manuals.

   a. Phase tripping tolerance.
   b. Trip time per phase in seconds.
   c. Instantaneous trip amperes per phase.
   d. Insulation resistance in megohms at 100 volts phase to phase and line to load.

3. Ground Fault Protection System tests:

   a. The ground fault protection on circuit breakers shall be performance tested in the field and properly calibrated and set in accordance with the coordination study.

4. Documentation:

   a. All tests specified shall be completely documented indication time of day, date, temperature and all pertinent test information.
   b. All required documentation of readings indicated above shall be submitted to the engineer of record and the owner, prior to, and as one of the prerequisites for final acceptance of the project.

F. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

G. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

H. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

I. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-

inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.03 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

1.02 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.05 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.02 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

1. Joints in solid conductors shall be spliced using Ideal or equivalent by 3M and T&B, wirenuts or connectors in junction boxes, outlet boxes, and lighting fixtures.
2. Sta-kon or other permanent type crimp connectors will not be permitted for branch circuit connections.
3. Joints in stranded conductors shall be splice by an approved mechanical connector and gum rubber tape or friction tape.

4. Solderless mechanical connectors for splices and taps, provided with UL approved insulating covers, may be used instead of mechanical connectors plus tape.
5. Conductors in all cases shall be continuous from outlet to outlet and no splicing shall be made except with outlet or junction boxes troughs and gutters.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; Class B stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN or XHHW, single conductors in raceway

B. Exposed Feeders: Type THHN-THWN or XHHW, single conductors in raceway

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN or XHHW, or XHHW, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN or XHHW, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN or XHHW, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN or XHHW, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN or XHHW, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Voltage Drop:

1. Conductors for branch circuits shall be sized for voltage drop not exceeding 3% at the farthest outlet of power, heating, and lighting loads, or any combination of such loads. The maximum total voltage drop on both feeders and branch circuits to the farthest outlet shall not exceed 5%.
2. Where the conductor length from the panelboard to the first outlet on a 277 volt circuit exceeds 125 feet, the branch circuit conductor from the panelboard to the first outlet shall not be smaller than #10 AWG.
3. Where the conductor length from the panelboard to the first outlet on a 120 volt circuit exceeds 50 feet, the branch circuit conductor from the panelboard to the first outlet shall not be smaller than #10 AWG.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Provide individual neutral for each circuit feeding electronic equipment.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

C. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both wall surfaces.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

    a. Lighting controls
    b. Feeders and service entrance conductors
    c. Panelboards
    d. Photovoltaic panels and inverters
    e. Green monitoring system
    f. UPS system

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.02 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. RGS: Rigid Steel conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. NBR: Acrylonitrile-butadiene rubber.

H. RNC: Rigid nonmetallic conduit.

1.03 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

    a. Duct entry provisions, including locations and duct sizes.
    b. Frame and cover design.
    c. Grounding details.
    d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Qualification Data: For professional engineer and testing agency.

E. Source quality-control test reports.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Maverick Tube Corporation.
4. O-Z Gedney; a unit of General Signal.
5. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated RGS or IMC

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel plated hexagonal compression type. No pot metal, set screw or indented type couplings shall be utilized.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.02 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anamet Electrical, Inc.; Anaconda Metal Hose.
2. Arnco Corporation.
3. CANTEX Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSYS, Inc.
7. Lamson & Sessions; Carlon Electrical Products.
8. RACO; a Hubbell Company.
9. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.03 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum and riser installation.

2.04 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R as indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.05 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

2.06 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.

7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum, with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.07 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

5. Cover Legend: Molded lettering, **"ELECTRIC."**, **"TELEPHONE."**
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation.
   d. NewBasis.

2.08 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

2.09 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: RGS or IMC.
2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
3. Underground Conduit: RNC, Type EPC-40 PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
6. Application of Handholes and Boxes for Underground Wiring:

    a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
    b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units SCTE 77, Tier 8 structural load rating.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: RGC or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.02 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

J. No raceways may be installed in slabs.

K. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

C. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

J. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.02 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.04 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.07 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.08 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, type 1.
b. Outdoor Locations: NEMA 250, type 4X.
c. Other Wet or Damp Indoor Locations: NEMA 250, type 4.
d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Hinged Front Cover: Entire front trim hinged to box and with standard hinged door within hinged trim cover.
3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Finishes:

a. Panels and Trim: steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.
c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

6. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: Top and bottom.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Door in door construction, secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or as indicated on the drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door in door construction secured with flush latch with tumbler lock; keyed alike.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip: 120 trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: two normally open and normally closed contact(s) that operate with switch handle operation.

2.05 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Comply with NECA 1.

3.03 IDENTIFICATION

A. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.06 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed controllers switches.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Coordination charts and tables and related data.
5. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Coordination charts and tables and related data.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.04 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than [100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.05 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance and feeders over 600 A: Class L, time delay, 200 KA interrupting rating.
2. Feeders less than 600 A: Class RK1, time delay or Class J, time delay, 200 KA interrupting rating.
3. Motor Branch Circuits: Class RK5, time delay, 200 KA interrupting rating.
4. Comply with NEC article 110-9 and 240-60b.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.04 IDENTIFICATION

A. Install labels for identification and indicate fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.02 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.04 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.07 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw,600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate

indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.02 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 600 or 240 -V ac, voltage and ampere sizes as indicated on the drawings; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 600 or 240 -V ac, voltage and ampere sizes as indicated on the drawings; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, five wire or four-wire receptacle as indicated on the drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

B. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 26 31 00 - PHOTOVOLTAIC COLLECTORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. PV modules
2. Accessories
3. Power Inversion Equipment

1.02 DEFINITIONS

A. CEC: California Energy Commission.

B. ETFE: Ethylene tetrafluoroethylene.

C. FEP: Fluorinated ethylene propylene.

D. IP Code: Required ingress protection to comply with IEC 60529.

E. MPPT: Maximum power point tracking.

F. PTC: USA standard conditions for PV.

G. PV: Photovoltaic.

H. STC: Standard Test Conditions defined in IEC 61215.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For PV modules.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Detail fabrication and assembly.
4. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.

1.06 WARRANTY

A. Manufacturer's Special Materials and Workmanship Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.

1. Manufacturer's materials and workmanship warranties include, but are not limited to, the following:

a. Faulty operation of PV modules.

B. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.

1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:

a. Specified minimum power output to 80 percent or more, for a period of 20 years.

PART 2 - PRODUCTS

2.01 PHOTOVOLTAIC (PV) MODULES

A. Single PV Panels

1. Maximum Power: 255 W
2. Maximum Power Voltage: 30.51 V
3. Open Circuit Voltage: 38.00 V at standard test conditions
4. Short Circuit Current: 8.92 A
5. Module Efficiency: 19%
6. Basis of design: Provide PV module equal or equivalent to:

    a. Bosch Solar Module c-Si M 60 NA42117

2.02 ACCESSORIES

A. Mounting Hardware

1. Schletter Angle

    a. Required for mounting the Schletter Aluminum Extrusion at an angle.
    b. 3/16” Steel that is bent and slotted for hammer screws and nuts.

2. Schletter Aluminum Extrusion

    a. Required for mounting photovoltaic panels as a connecting rail for the Click-Clock Clamps and the Schletter Angle.

3. Schletter Click-Clock Clamps-End Clamps and Mid Clamps

    a. Required to clamp the photovoltaic modules onto the Schletter Aluminum Extrusion.
    b. Fasten until a “Click” sound is heard.

4. Hammer Screws and Nuts

    a. Required to bolt the Schletter Angle to the Schletter Aluminum Extrusion

2.03 POWER INVERSION EQUIPMENT

A. Power-One Aurora Inverters

1. PVI-6000-TL

    a. Max recommended PV power (@ module STC) – 8000 W
    b. Max DC Voltage – 600V
    c. MPPT Voltage Range – 200V – 530V
    d. Max Input Current – 36A
    e. AC Grid Frequency – 57.0 – 60.5 Hz
    f. AC Voltage Output – 240 VAC

g. UL1741

2. PVI-3.0-TL

a. Max recommended PV power (@ module STC) – 4000 W
b. Max DC Voltage – 600V
c. MPPT Voltage Range – 160V – 530V
d. Max Input Current – 20A
e. AC Grid Frequency – 57.0 – 60.5 Hz
f. AC Voltage Output – 240 VAC
g. UL1741

2.04 PHOTOVOLTAIC TRACK MOTORS AND EQUIPMENT

A. IronHorse Rolled Steel AC Motors: 3-Phase

1. 56C Frame TEFC Motors

2. Horsepower: 1/3 horsepower

B. GS2 AC Drives

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations:

1. Clean mounting locations from debris on portable track.
2. Bolt all U-Feet from the Tilt Leg Kit parallel to the support beam.
3. Loosely bolt all of the Tilt Leg into the appropriate U-Feet.
4. Bolt the XRS Rails through the slots on the Tilt Legs.
5. Set legs to 20° from the horizontal and tighten all bolts.
6. Gently place the photovoltaic panels onto the XRS Rails.
7. Bolt the End Clamps to the XRS Rails to secure the photovoltaic panel.
8. Bolt the Mid Clamps in-between each photovoltaic panel.

END OF SECTION 26 10 00

SECTION 26 50 00 – LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Interior Lighting Fixtures

B. Exterior Lighting Fixtures

1.02 SECTION REQUIREMENTS

A. Submittals: Product Data for each luminaire, including lamps.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fixtures, Emergency Lighting Units, Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Exterior Luminaires: Comply with UL 1598 and listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

F. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.03 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Retain this article if manufacturer is responsible for selecting poles and other luminaire support components and certifying them to suit wind, ice, and other load conditions as expressed in AASHTO LTS-4-M. Delete if structural considerations have been applied by the design team in selecting "basis-of-design" or proprietary pole products, and these products have been identified in the Exterior Lighting Device Schedule or in details on Drawings. See Editing Instructions No. 1 and No. 2 in the Evaluations.

B. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

C. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

D. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

2.04 BALLASTS

A. Ballasts for Linear Fluorescent Lamps:

1. Electronic: Comply with ANSI C82.11; instant-start type.

   a. Sound Rating: A, except B for T12/HO and T12/Slimline lamp ballasts.

   b. BF: 0.85 or higher.

   c. Power Factor: [**0.95**] [**0.98**] or higher.

2. luminaires controlled by occupancy sensors shall have programmed-start ballasts.

3. Electromagnetic: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

4. For Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

5. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures [**0 deg F (minus 18 deg C)**] [**minus 20 deg F (minus 29 deg C)**] and higher.

6. Dimmer Controlled: Electronic type.

   a. Dimming Range: 100 to [**5**] percent of rated lamp lumens.

b. Ballast Input Watts: Can be reduced to [**20**] percent of normal.

c. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

B. Ballasts for Compact Fluorescent Lamps: Electronic programmed rapid-start type, complying with ANSI C 82.11.

1. Lamp end-of-life detection and shutdown circuit.

2. Automatic lamp starting after lamp replacement.

3. Sound Rating: A.

4. BF: 0.95 or higher unless otherwise indicated.

5. Power Factor: [0.95] [0.98] or higher.

C. Internal-Type Emergency Fluorescent Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.

2. Night-Light Connection: Operate one fluorescent lamp continuously.

3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.

5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.05 EXIT SIGNS

A. Internally Lighted Signs: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.

2. Lamps for AC Operation: LEDs, 70,000 hours minimum of rated lamp life.

2.06 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

4. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.07 LAMPS

A. Compact Fluorescent Lamps: Four-pin, CRI 80 (minimum), color temperature 3500 > K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts] unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).

2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).

3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).

4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).

5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).

6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).

7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

2.08 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. LED Fixture 1 –Type C; Lithonia, RAZ24

1. Mounting: Under cabinet

2. Volts: 120v

B. LED Fixture 2 – Type C1; Lithonia, RAZ12

1. Mounting: Under cabinet

2. Volts: 120v

C. LED Fixture 3 -- Lithonia RAZILS26

1. Mounting: Under cabinet

2. Volts: 120v

D. LED Fixture 4 – Type P; Sistemalux, 01-120V-11

1. Mounting: Pendant

2. Volts: 120v

E. LED Fixture 5 – Type R; Prescolite, LC6LC-120-DM-6LCLED-6-35K-8-BLANK-WH-WT-B6

F. LED Fixture 6 – Type R1; Finelite, HP-4 R-7'-SO-3500-120V-SC-C3F

1. Mounting: Recessed

2. Volts: 120v

G. LED Fixture 7 – Type R2; Finelite, HP-4 R-6'- SO-3500-120V-SC-C3F

1. Mounting: Recessed

2. Volts: 120v

H. LED Fixture 8 – Type W; Finelite, HP-4 R-4'- SO-3500-120V-SC-C3F

1. Mounting: Wall Recessed

2. Volts: 120v

I. LED Fixture 9 – Type W1; Lithonia, WL4 25L D20 LP835 NX

1. 2. Mounting: Wall Mounted

2. Volts: 120v

J. LED Fixture 10 – Type W2; Heafele, LOOX LED 2018

1. Mounting: Wall Mounted

2. Volts: 12v

K. LED Fixture 11 – Philips Ledalite TruGroove

1. Mounting: Linear recessed

2. Volts: 10v

L. LED Fixture 12 – Philips eW Graze Powercore 523-000030-02, 4'

1. Mounting: Surface mount

2. Volts: 120v

M. LED Fixture 13 – Type W1; Edge Lighting, TV-W-L1-SA

1. Mounting: Wall

2. Volts: 12v

N. LED Fixture 14 – Type R; Finelite, HP-4 R-4'-SO-3500-120V-SC-C3F

1. Mounting: Recessed

2. Volts: 120

O. LED Fixture 15 – CSL; PDQ24-S-O-20-NW

1. Mounting: Under Gutter

2. Volts: 24vO.

P. LED Fixture 16 – Kim Lighting KLV721/3L3K/BK

1. Mounting: surface mount

2. Volts: 12v

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate ceiling-mounted luminaires with ceiling construction, mechanical work, and security and fire-prevention features mounted in ceiling space and on ceiling.

B. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

C. Comply with NFPA 70 for minimum fixture supports.

D. Seismic Protection: Luminaire attachments to building walls and ceilings shall comply with seismic criteria in Section 260500 "Common Work Results for Electrical."

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

F. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

G. Adjust aimable lighting fixtures to provide required light intensities.

3.02 POLE INSTALLATION

A. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

C. Embedded Poles: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Backfill in 6-inch (150-mm) layers and thoroughly tamp each layer.

2. Fill hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi (20 MPa) at 28 days, and finish in a dome above finished grade.

D. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with [pea gravel] <Insert material> to a level 1 inch (25 mm) below top of concrete slab.

E. Ground metal poles. Install grounding electrode for each pole, unless otherwise indicated.

END OF SECTION 26 50 00

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

LIST OF SECTIONS

SECTION 28 31 00 – FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire Alarms

1.01 REFERENCES

A. Reference Standards NFPA 72, NFPA 70

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: The architects and fire protection engineers will choose best location for fire alarms. There is no exact location, but in the center of the room would be best.

1.03 SUBMITTALS

A. System Operating Description and Product Data

B. Submittals to AHJ: A submittal needs to go to the authority having jurisdiction for Irvine, California. One for the local fire department and also the New Construction Authorities.

1.04 QUALITY ASSURANCE

A. System will comply with National Fire Protection Association Code 72: National Fire Alarm and Signaling Code

B. The components will be UL listed.

C. Electrical components, devices and Accessories: Listed in NFPA 70: National Electrical Code and by a certified testing agency and marked for intended location and its application

PART 2 - PRODUCTS

2.01 SMOKE ALARM

A. First Alert Ionization Smoke Alarms 9120B (smoke detector) interconnected

1. Input: 120V AC ~, 60 Hz, 0.04A

2. AC Powered Ionization Smoke alarm with Silence and Latching Features

PART 3 - EXECUTION

3.01 INSTALLATIONS

A. Measurements

1. Fire Alarms have to meet NFPA 70. They cannot be installed in places that don't have air movement (dead air spaces). Therefore install on ceiling 4 feet off the wall, and according to manufacturer's specifications.

a. The smoke alarms need to be installed into the light clouds.

END OF SECTION 28 31 00

DIVISION 32 - EXTERIOR IMPROVEMENTS

LIST OF SECTIONS

SECTION 32 93 00 PLANTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Plants

B. Soil Materials

C. Planting Accessories

1.02 SUBMITTALS

A. Submit list of plant life sources.

1.03 REFERENCE STANDARDS

A. ASTM C33 – Standard Specification from Concrete Aggregates

1.04 QUALITY ASSURANCE

A. Nursery Qualifications: Armstrong Garden Centers and Growers

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect and maintain plant life until planted.

B. Deliver plant life materials immediately prior to placement. Keep plants moist.

PART 2 - PRODUCTS

2.01 PLANTS

A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

1. Althernanthera Ficoida (Grenadine)
2. Hedera Helix (common ivy)
3. Dianella (blue flax lilies)
4. Cordyline Australis (Red Sensation)
5. Origanum Vulgare (Oregano)
6. Salvia Officinalis (Sage)
7. Petroselinum (Parsley)
8. Mentha Piperita/Mentha Spicata (Mint)

9. Ocimum basilicum (Basil)
10. Peppers
11. Trailing Tomatoes
12. Bulls Blood
13. Spinach
14. Lettuce
15. Onions
16. Rosmarinus Officinalis (Rosemary “Blue Lagoon”)
17. Vinca Major (Greater Periwinkle)
18. Erigeron Karninskianus sf (Santa Barbara Daisy)
19. Lavandule Species Sf (Lavender)
20. Pelargonium Peltatum (Geranium Ivy Blizzard White)
21. Liriope Gigantea (Giant Lilyturf)
22. Calamagrostis x Acutiflora (Feather Reed Grass)
23. Muhlenbergia capillaris (Purple Muhly Grass)
24. Ophiopogon japonicus (Mondo Grass a.k.a. Monkey Grass)

2.02 SOIL MATERIALS

A. Pea Gravel: Clean and graded, washed river-run gravel, ASTM C33, Size No 7

B. Mulch: Shredded bark mulch (not bark dust or bark chips) shall be used.

C. Sand: Clean and graded, washed sand, all passing a No. 4 US Standard sieve, and conforming generally to ASTM C33.

2.03 ACCESSORIES

A. Stakes: Softwood lumber, pointed end.

B. Planters: Vertical Gardening Systems, Wall Garden

1. Dimensions: 600mm depth x 200mm width x 200mm height

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that prepared planters are ready to receive work.

B. Saturate soil with water to test drainage.

3.02 PLACING PEA GRAVEL

A. Install topsoil into planters intended for the wetland, to a minimum thickness of 16 inches (410 mm).

3.03 PLACING MULCH

A. Install mulch into planters intended for the wetland, to minimum thickness of 2 inches (50 mm).

B. Install mulch around and on top of vegetable and herb pots.

3.04 PLACING SAND

A. Install sand into planters intended for the wetland, to a minimum thickness of 2 inches (50mm).

3.05 PLANTING

A. Place plants for best appearance for review and final orientation by Architect.

B. Set plants vertical.

END OF SECTION 32 93 00

Appendix A: Structural Calculations

- Snow Load Analysis
  - Ground Snow load, $p_g = 10$ psf (Charlotte) (Fig. 7-1)
  - Exposure Factor, C_e (7.3.1)
    - Assume Terrain Category C
    - Assume partially exposed
    - $C_e = 1.0$ (Table 7-2)
  - Thermal Factor, C_t (7.3.2)
    - $C_t = 1.0$ (Table 7-3)
  - Importance Factor, I_s (7.3.3)
    - Risk Category II (Table 1.5-1)
    - Snow Importance Factor, $I_s = 1.00$ (Table 1.5-2)
  - Flat Roof Snow Load, p_f (7.3)
    - $p_f = 0.7 C_e C_t I_s p_g = 0.7(1.0)(1.0)(1.0)(10\ psf)$ (7.3-1)
    - $p_f = 7$ psf
  - Snow Drift calculation for wind east to west
    - please refer to ASCE 7-10, Figure 7-8
    - leeward drift height ($l_u = 24'$)
      - $h_d = [(0.43\sqrt[3]{l_u})(\sqrt[4]{p_g + 10})] - 1.5$ (Fig. 7-9)
        $h_d = [(0.43)\sqrt[3]{24}\,)(\sqrt[4]{10+10}\,)] - 1.5$
        $h_d = 1.12'$
    - low roof balanced snow load
      - $C_s = 1.0$ ($0°$ slope)
      - $p_s = C_s p_f = (1.0)(7\ psf) = 7$ psf (Eq. 7.4-1)

- Snow density, γ
  - $\gamma = 0.13 p_g + 14 \leq 30$ pcf (Eq. 7.7-1)

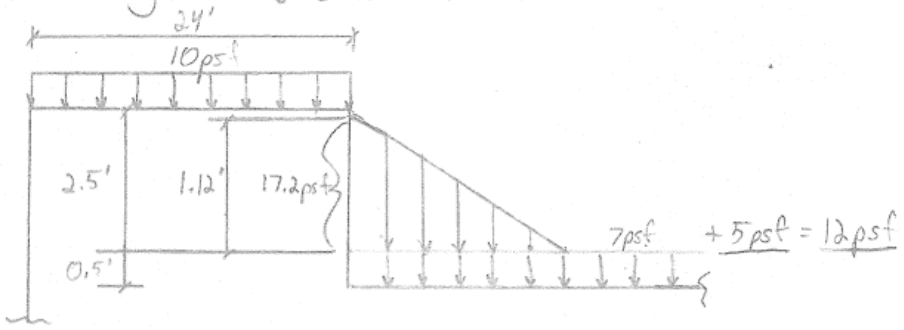
    $\gamma = 0.13(10\text{ psf}) + 14$

    $\gamma = 15.3$ pcf ≤ 30 pcf ok ✓
- balanced snow load height, h_b
  - $h_b = \frac{p_s}{\gamma} = \frac{7\text{ psf}}{15.3\text{ pcf}} = 0.46'$ (7.7.1)

    Say $h_b = 0.5'$
- $h_c = 3' - h_b = 3' - 0.5 = 2.5'$
- Snow drift width, w
  - $h_d < h_c \therefore w = 4h_d$ (7.7.1)
  - $w = 4(1.12') = 4.48'$

    Say $w = 4.50'$
- drift surcharge load
  - $p_d = h_d \gamma = (1.12')(15.3\text{ pcf})$ (7.7.1)

    $p_d = 17.2$ psf
- ASCE Figure 7-8 (N.T.S.)



- Rain on Surcharge Load
  - for $\theta = 0°$ and $p_g = 10$ psf, add a 5 psf surcharge to the balanced load case (7.10)

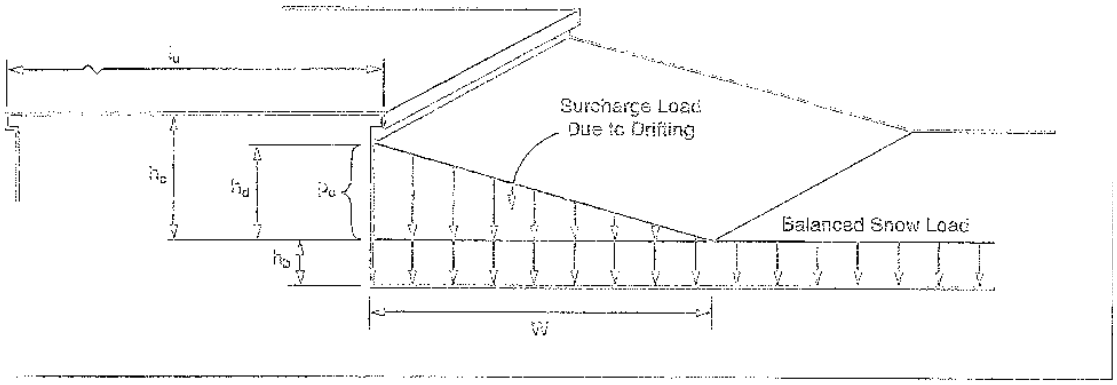
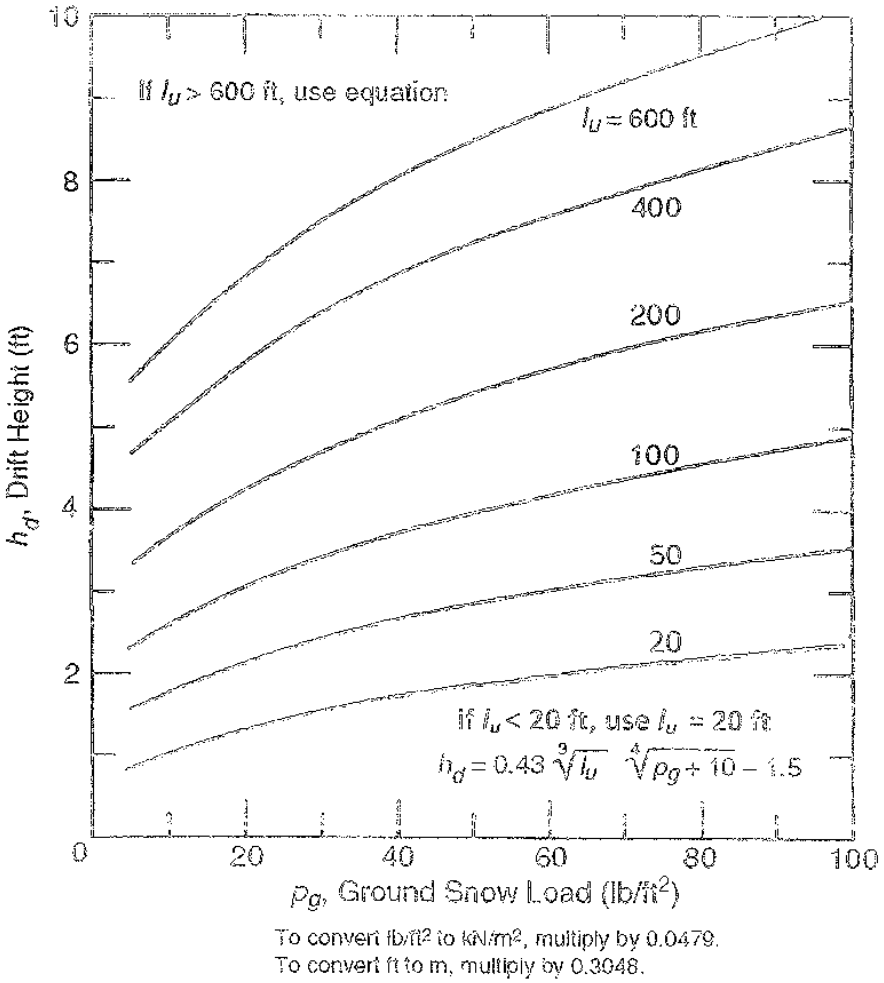


FIGURE 7-8 Configuration of Snow Drifts on Lower Roofs.



To convert lb/ft² to kN/m², multiply by 0.0479.
To convert ft to m, multiply by 0.3048.

FIGURE 7-9 Graph and Equation for Determining Drift Height, h_d.

- Wind Load Analysis

  - using ASCE 7-10, Chapter 28 (Envelope Procedure), Part 2 for enclosed simple diaphragm low-rise buildings

  Step 1

  - Risk Category II (Table 1.5-1)

  Step 2

  - Basic Wind Speed, V = 115 mph (Charlotte) (Fig. 26.5-1A)

  Step 3

  - Wind directionality factor, $K_d = 0.85$ (Table 26.6-1)
  - Exposure Category C (26.7.3)
  - Topographic Factor, $K_{zt} = 1.00$ (Fig. 26.8-1)

  Step 4

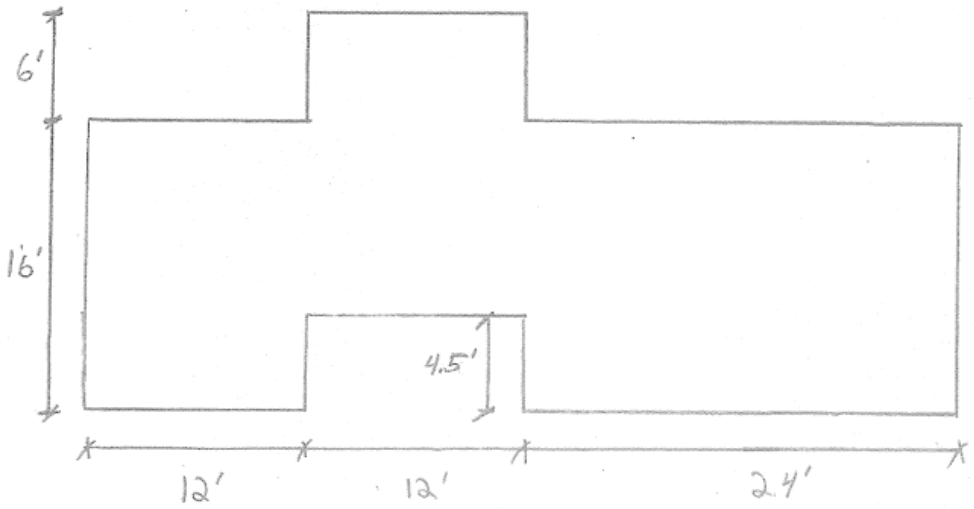
  - Case A/B for $\theta = 0°$
    - Horizontal Pressures
      - Zone A, $p_{s30} = +21$ psf (Fig. 28.6-1)
      - Zone C, $p_{s30} = +13.9$ psf (Fig. 28.6-1)
    - Vertical Pressures
      - Zone E, $p_{s30} = -25.2$ psf (Fig. 28.6-1)
      - Zone G, $p_{s30} = -17.5$ psf (Fig. 28.6-1)
    - Overhang
      - Zone G_{OH}, $p_{s30} = -27.6$ psf (Fig. 28.6-1)

  Step 5

  - $\lambda = 1.21$ (Fig. 28.6-1)

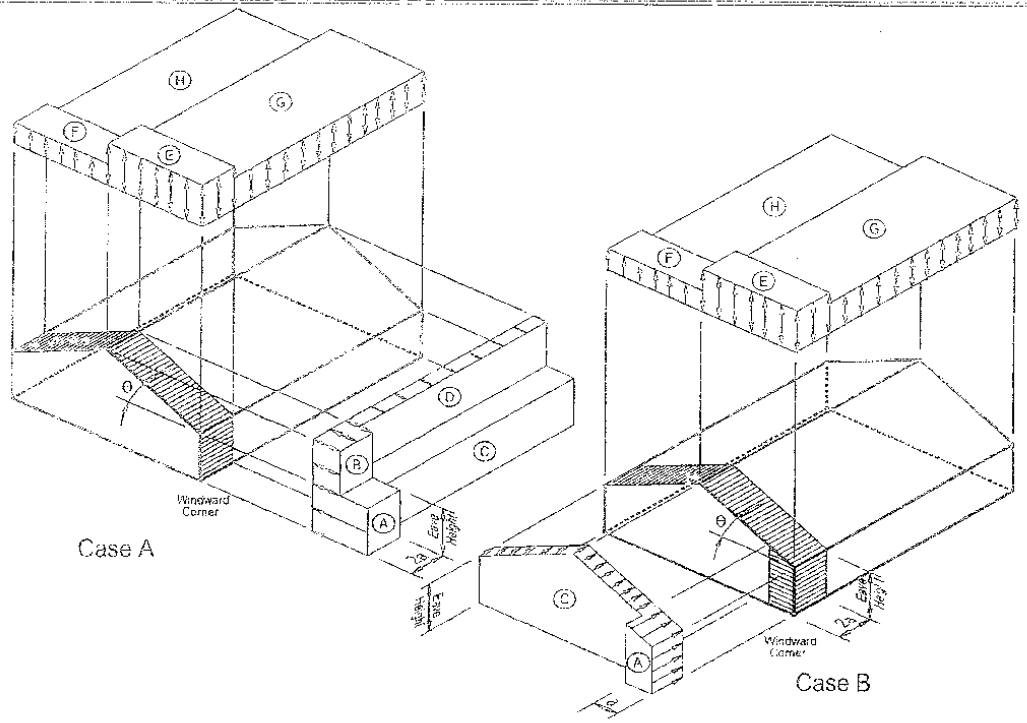
Step 6

- Case A/B for $\theta = 0°$, $p_s = \lambda K_{zt} p_{s30}$, where $K_{zt} = 1.00$
  - Horizontal Pressures
    - Zone A, $p_s = (+21 \text{ psf})(1.21) = \underline{+25.5 \text{ psf}}$ (Eq. 28.6-1)
    - Zone C, $p_s = (+13.9 \text{ psf})(1.21) = \underline{+16.9 \text{ psf}}$ (Eq. 28.6-1)
  - Vertical Pressures
    - Zone E, $p_s = (-25.2 \text{ psf})(1.21) = \underline{-30.5 \text{ psf}}$ (Eq. 28.6-1)
    - Zone G, $p_s = (-17.5 \text{ psf})(1.21) = \underline{-21.2 \text{ psf}}$ (Eq. 28.6-1)
  - Overhang
    - Zone G_{OH}, $p_s = (-27.6 \text{ psf})(1.21) = \underline{-33.4 \text{ psf}}$ (Eq. 28.6-1)
- a-zones
  - a = least of $\begin{cases} (0.1)(22') = \underline{2.2'} \\ (0.4)(15') = 6' \end{cases}$ (Fig 28.6-1)
  - $2a = \underline{4.4'}$ (Fig. 28.6-1)



- Is each corner location considered an a-zone with respect to each wind direction?

Main Wind Force Resisting System – Method 2		h ≤ 60 ft.
Figure 28.6-1	Design Wind Pressures	Walls & Roofs
Enclosed Buildings		



Notes:

1. Pressures shown are applied to the horizontal and vertical projections, for exposure B, at h=30 ft (9.1m). Adjust to other exposures and heights with adjustment factor λ.
2. The load patterns shown shall be applied to each corner of the building in turn as the reference corner. (See Figure 28.4-1)
3. For Case B use $\theta = 0°$.
4. Load cases 1 and 2 must be checked for $25° < \theta \leq 45°$. Load case 2 at 25° is provided only for interpolation between 25° and 30°.
5. Plus and minus signs signify pressures acting toward and away from the projected surfaces, respectively.
6. For roof slopes other than those shown, linear interpolation is permitted.
7. The total horizontal load shall not be less than that determined by assuming $p_S = 0$ in zones B & D.
8. Where zone E or G falls on a roof overhang on the windward side of the building, use E_{oh} and G_{oh} for the pressure on the horizontal projection of the overhang. Overhangs on the leeward and side edges shall have the basic zone pressure applied.
9. Notation:
   - *a*: 10 percent of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).
   - *h*: Mean roof height, in feet (meters), except that eave height shall be used for roof angles ≤10°.
   - *θ*: Angle of plane of roof from horizontal, in degrees.

- Wind Analysis for Components and Cladding

- using ASCE 7-10, Chapter 30, Envelope Procedure Part 2 for Low-Rise Buildings (Simplified)

Step 1

- Risk Category II (Table 1.5-1)

Step 2

- Basic Wind Speed, V = 115 mph (Charlotte) (Fig. 26.5-1A)

Step 3

- Exposure Category C (26.7.3)
- Topographic Factor, $K_{zt} = 1.00$ (Fig. 26.8-1)

Step 4

- for $\theta = 0°$
  - Zone 1/4, $p_{net30} = -21.8$ psf (Fig. 30.5-1)
  - Zone 2/5, $p_{net30} = -25.8$ psf
  - Zone 3; $p_{net30} = -23.2$ psf

Step 5

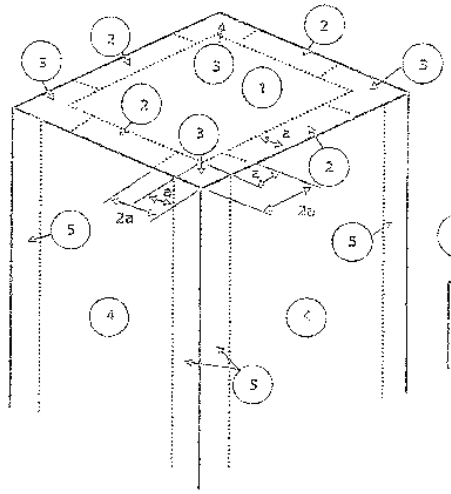
- $\lambda = 1.21$ (Fig. 30.5-1)

Step 6

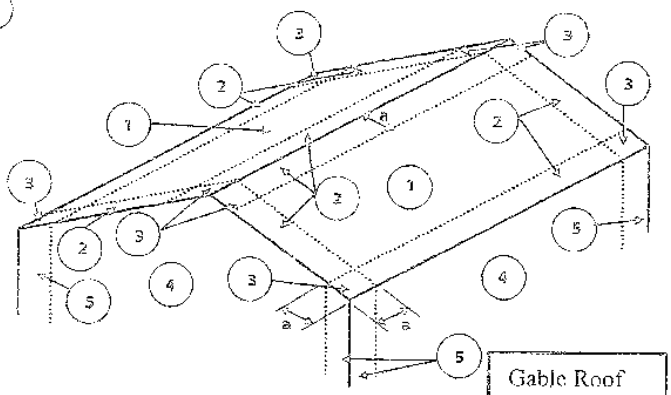
- for $\theta = 0°$, $p_{net} = \lambda K_{zt} p_{net30}$, where $K_{zt} = 1.00$
  - Zone 1/4, $p_{net} = (-21.8 \text{ psf})(1.21) = \underline{-26.4 \text{ psf}}$ (Eq. 30.5-1)
  - Zone 2/5, $p_{net} = (-25.8 \text{ psf})(1.21) = \underline{-31.3 \text{ psf}}$ (Eq. 30.5-1)
  - Zone 3, $p_{net} = (-23.2 \text{ psf})(1.21) = \underline{-28.1 \text{ psf}}$ (Eq. 30.5-1)

- a-zones
  - a = least of $\begin{cases} (0.1)(22') = \underline{2.2'} \\ (0.4)(15') = 6' \end{cases}$

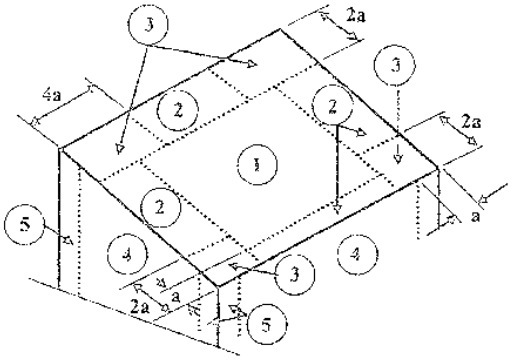
Components and Cladding – Part 1		h ≤ 160 ft.
Table 30.7-2	C & C Zones	C&C
Enclosed Buildings		Wall and Roof Pressures



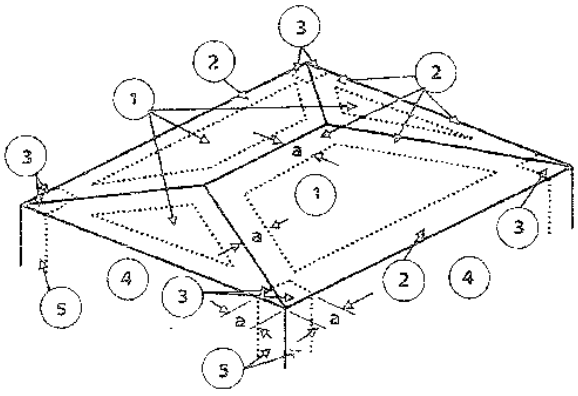
Flat Roof
θ < 10 deg



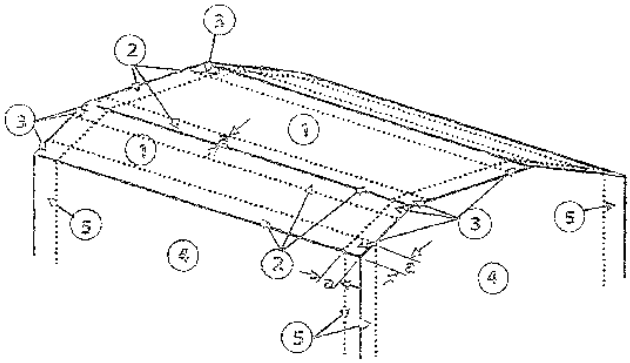
Gable Roof



Monoslope Roof



Hip Roof



Mansard Roof

- Seismic Load Analysis
  - use ASCE 7-10, Chapter 12.8 : Equivalent Lateral Force Procedure
  - Spectral Response Acceleration Factors
    - S_s = 150% g (Fig. 22-1)
    - S_1 = 75% g (Fig. 22-2)
  - Site Coefficients
    - Assume site class D (11.4.2)
    - F_a = 1.0 (Table 11.4-1)
    - F_v = 1.5 (Table 11.4-2)
  - Adjusted Spectral Response Acceleration Factors
    - $S_{MS} = F_a S_s = (1.0)(1.50) = 1.50$ (Eq. 11.4-1)
    - $S_{M1} = F_v S_1 = (1.5)(0.75) = 1.13$ (Eq. 11.4-2)
  - Design Spectral Acceleration Factors
    - $S_{DS} = \frac{2}{3}(S_{MS}) = (2/3)(1.50) = 1.00$ (Eq. 11.4-3)
    - $S_{D1} = \frac{2}{3}(S_{M1}) = (2/3)(1.13) = 0.76$ (Eq. 11.4-4)
  - Response Modification Factor, R
    - Seismic Design Category D
    - use intermediate precast shear walls, R=4 (Table 12.2-1)
  - Importance Factor (11.5.1)
    - Risk Category II (Table 1.5-1)
    - I_e = 1.00 (Table 1.5-2)
  - Seismic Response Coefficient (12.8.1.1)
    - $C_s = \frac{S_{DS}}{\left(\frac{R}{I_e}\right)} = \frac{1.00}{\left(\frac{4}{1.0}\right)} = 0.25$ (Eq. 12.8-2)

- Check C_s limit
  - $C_t = 0.02$ (Table 12.8-2)
  - $x = 0.75$ (Table 12.8-2)
  - $h_n = 15'$
  - $T = C_t h_n^x = (0.02)(15')^{0.75} = 0.152\,s$ (Eq. 12.8-7)
  - $T_L = 8s$ (Fig. 22-12)
  - upper bound limit
    - $C_s = \frac{S_{D1}}{T\left(\frac{R}{I_e}\right)}$ for $T < T_L$ (Eq. 12.8-3)

      $C_s = \frac{0.76}{(0.152s)\left(\frac{4}{1.0}\right)} = 1.25 > 0.25$, OK ✓
  - lower bound limit
    - $C_s = 0.044 S_{DS} I_e \geq 0.01$ (Eq. 12.8-5)

      $C_s = 0.044(1.0)(1.0) = 0.044 < 0.25$, OK ✓
    - $S_1 > 0.6g$, check $C_s = \frac{0.5(S_1)}{\left(\frac{R}{I_e}\right)}$ (Eq. 12.8-6)

      $C_s = \frac{0.5(0.75)}{\left(\frac{4}{1}\right)} = 0.094 < 0.25$, OK ✓

- Seismic Base Shear
  - $w = 150\,psf$ (preliminary estimate for now)
  - Square footage of house $\approx 780\,sf$
  - $W = (150\,psf)(780\,sf) = 117^k$ (12.7.2)
  - $V = C_s W = (0.25)(117^k) \approx \boxed{30^k}$ (Eq. 12.8-1)

Appendix B: Mechanical Load Calculations

B.1 CHARLOTTE LOAD CALCULATIONS

UNCC Solar Decathlon Mechanical Load Calculations

Materials **R-Values**

1) GeoPolymer Concrete $R1 := 0.66 \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

2) Extruded Polystyrene $R2 := 5 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

3) Cement Backer $R3 := .32 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

4) Thinset Mortar $R4 := 0.4 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

5) Ceramic Tile $R5 := 0.08 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

6) Wood Fiberboard $R6 := 2.7 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

7) Fiberglass Board $R7 := 4.5 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

8) Metal $R8 := 0 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

Thicknesses

Walls	Floor	Ceiling
$WT1 := 6in$	$FT1 := 6in$	$CT2 := 10in$
$WT2 := 6in$	$FT2 := 6in$	$CT6 := \frac{5}{8}in$
	$FT3 := .5in$	$CT7 := \frac{5}{8}in$
	$FT4 := .25in$	$CT8 := \frac{5}{8}in$
	$FT5 := .25in$	

Total R-Values

Walls $RW := WT1 \cdot R1 + WT2 \cdot R2$ $RW = 33.96 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu}$

Floor $RF := FT1 \cdot R1 + FT2 \cdot R2 + FT3 \cdot R3 + FT4 \cdot R4 + FT5 \cdot R5$ $RF = 34.24 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu}$

Ceiling $RC := CT2 \cdot R2 + CT6 \cdot R6 + CT7 \cdot R7 + CT8 \cdot R8$ $RC = 54.5 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu}$

U-Values

$UW := \frac{1}{RW}$ $UF := \frac{1}{RF}$ $UC := \frac{1}{RC}$

Insulation

Average Temp Differances

$WinterT := 22\,°F \qquad \Delta Tw := 73\,°F - WinterT$

$SummerT := 93\,°F \qquad \Delta Ts := SummerT - 73\,°F$

$WallLoss := UW \cdot \Delta Tw \qquad WallGain := UW \cdot \Delta Ts \qquad WallArea := 685 ft^2$

$FloorLoss := UF \cdot \Delta Tw \qquad FloorGain := UF \cdot \Delta Ts \qquad FloorArea := 750 ft^2$

$CeilingLoss := UC \cdot \Delta Tw \qquad CeilingGain := UC \cdot \Delta Ts \qquad CeilingArea := 750 ft^2$

$InsulationLoss := WallLoss \cdot WallArea + FloorLoss \cdot FloorArea + CeilingLoss \cdot CeilingAr$

$InsulationGain := WallGain \cdot WallArea + FloorGain \cdot FloorArea + CeilingGain \cdot CeilingA$

$$InsulationLoss = 2.848 \times 10^3 \cdot \frac{Btu}{hr} \qquad InsulationGain = 1.117 \times 10^3 \cdot \frac{Btu}{hr}$$

Ventilation

$VentilationCFM := 50 \qquad Volume := 750 \cdot 9 \cdot ft^3$

$$VentilationLoss := \left(VentilationCFM \cdot \frac{\Delta Tw}{\Delta °F} \right) \frac{Btu}{hr} = 2550 \cdot \frac{Btu}{hr}$$

$$VentilationGain := \left(VentilationCFM \cdot \frac{\Delta Ts}{\Delta °F} \right) \frac{Btu}{hr} = 1000 \cdot \frac{Btu}{hr}$$

Window Conduction

$$U := 0.2 \cdot \frac{Btu}{ft^2 \cdot hr \cdot \Delta°F} \qquad WindowArea := 400 \cdot ft^2 \qquad SHGC := 0.5$$

$$WindowCondLoss := U \cdot \Delta Tw \cdot WindowArea = 4.08 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WindowCondGain := U \cdot \Delta Ts \cdot WindowArea = 1.6 \times 10^3 \cdot \frac{Btu}{hr}$$

Window Radiation

$$SummerRad := \frac{2026}{24} \frac{Btu}{ft^2 \cdot hr}$$

estimated values averaged from multiple sources

$$WinterRad := \frac{731}{24} \frac{Btu}{ft^2 \cdot hr}$$

$$SummerShading := .5 \qquad WinterShading := .5$$

1 = No Shading
0 = Full Shading

$$SummerRadGain := SummerRad \cdot WindowArea \cdot SHGC \cdot SummerShading = 8.442 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WinterRadGain := WinterRad \cdot WindowArea \cdot SHGC \cdot WinterShading = 3.046 \times 10^3 \cdot \frac{Btu}{hr}$$

Detailed Infiltration and Ventilation (Btu/hr)

$$Volume_i := \frac{Volume}{ft^3}$$

$$Con := \frac{60}{(Volume_i)}$$

$DoorArea := 4.0833333 \cdot 8$

Walls

$af_w := .009$

$Leak_w := af_w \cdot 685 = 6.165$

Windows

$af_{wind} := .02$

$Leak_{wind} := af_{wind} \cdot 400 = 8$

Doors

$af_d := .06$

$Leak_d := af_d \cdot DoorArea = 1.96$

Envelope Penetrations

Pipe Penetrations

$af_p := .16$ $num_p := 8$

$Leak_p := af_p \cdot num_p = 1.28$

Duct Penetrations

$af_{duc} := .25$ $num_{duc} := 4$

$Leak_{duc} := af_{duc} \cdot num_{duc} = 1$

Vents and Exhaust Fans

Kitchen Fan

$af_{kf} := .8 \qquad num_{kf} := 1$

$Leak_{kf} := af_{kf} \cdot num_{kf} = 0.8$

Dryer Vent

$af_{dv} := .47 \qquad num_{dv} := 1$

$Leak_{dv} := af_{dv} \cdot num_{dv} = 0.47$

Water Heater

$af_{wh} := 3 \qquad num_{wh} := 2$

$Leak_{wh} := af_{wh} \cdot num_{wh} = 6$

$Leak_{tot} := Leak_{w} + Leak_{wind} + Leak_{d} + Leak_{p} + Leak_{duc} + Leak_{kf} + Leak_{dv} + Leak_{wl}$

$Leak_{tot} = 25.675$

Solution

Winter Wind CFM/Sq_in Factor

$Factor_W := 1.6$

Winter Infiltration (AC/Hr)

$ACH_W := Leak_{tot} \cdot Factor_W \cdot Con + .1 = 0.4652$

Summer Wind CFM/Sq_in Factor

$Factor_S := .6$

Summer Infiltration (AC/Hr)

$ACH_S := Leak_{tot} \cdot Factor_S \cdot Con + .1 = 0.2369$

Detailed Infiltration

$$InfiltrationLoss := \left(.0167 ACH_W \cdot Volume_i \cdot \frac{\Delta Tw}{\Delta^\circ F}\right)\frac{Btu}{hr} = 2.674 \times 10^3 \cdot \frac{Btu}{hr}$$

$$InfiltrationGain := \left(0.0167 \cdot ACH_S \cdot Volume_i \cdot \frac{\Delta Ts}{\Delta^\circ F}\right)\frac{Btu}{hr} = 534.166 \cdot \frac{Btu}{hr}$$

Internal Sensible and Latent Heat Gain Calcualtion

Internal Gain : Literature

The contributions of occupants, lighting, and appliance gains to peak sensible and latent loads can be estimated as

qig,s = 136 + 2.2*Acf* + 22*Noc* (30)

qig,l = 20 + 0.22*Acf* + 12*Noc* (31)

where

qig,s = sensible cooling load from internal gains, W

qig,l = latent cooling load from internal gains, W

Acf = conditioned floor area of building, m2

Noc = number of occupants (unknown, estimate as *Nbr* + 1)

Equations (30) and (31) and their coefficients are derived from Building America (2004) load profiles evaluated at 4:00 P.M., as documented

by Barnaby and Spitler (2005). Predicted gains are typical for U.S. homes. Further allowances should be considered when unusual lighting intensities or other equipment are in continuous use during peak cooling hours. In critical situations where intermittent high occupant density or other internal gains are expected, a parallel cooling system should be considered.

For room-by-room calculations, *qig,s* should be evaluated for the entire conditioned area, and allocated to kitchen and living spaces.

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Calculation

$$A_{cf} := 750\text{ft}^2$$

$$N_{oc} := 3$$

$$\text{SensibleGain} := \left(136 + 2.2\cdot\frac{A_{cf}}{m^2} + 22\cdot N_{oc}\right)\cdot W = 1212.3\cdot\frac{\text{Btu}}{\text{hr}}$$

$$\text{LatentGain} := \left(20 + .22\cdot\frac{A_{cf}}{m^2} + 12\cdot N_{oc}\right)\cdot W = 243.385\cdot\frac{\text{Btu}}{\text{hr}}$$

Load Analysis and Totals

Heating Load

$$InsulationLoss = 2.848 \times 10^3 \cdot \frac{Btu}{hr}$$

$$VentilationLoss = 2.55 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WindowCondLoss = 4.08 \times 10^3 \cdot \frac{Btu}{hr}$$

$$InfiltrationLoss = 2.674 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WinterRadGain = 3.046 \times 10^3 \cdot \frac{Btu}{hr}$$

Cooling Load

$$InsulationGain = 1.117 \times 10^3 \cdot \frac{Btu}{hr}$$

$$VentilationGain = 1 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WindowCondGain = 1.6 \times 10^3 \cdot \frac{Btu}{hr}$$

$$InfiltrationGain = 534.166 \cdot \frac{Btu}{hr}$$

$$SummerRadGain = 8.442 \times 10^3 \cdot \frac{Btu}{hr}$$

$$SensibleGain = 1.212 \times 10^3 \cdot \frac{Btu}{hr}$$

$$LatentGain = 243.385 \cdot \frac{Btu}{hr}$$

$$TotalLoss1 := InsulationLoss + VentilationLoss + WindowCondLoss + InfiltrationLoss$$

$$TotalGain1 := InsulationGain + VentilationGain + WindowCondGain + SummerRadG$$

$$TotalGain2 := InfiltrationGain + SensibleGain + LatentGain$$

$$TotalGain := TotalGain1 + TotalGain2$$

$$TotalLoss := TotalLoss1 - WinterRadGain$$

Peak Loads In Charlotte

$$Tons \equiv 12000 \frac{Btu}{hr}$$

Heating

$$TotalLoss = 9105.994 \cdot \frac{Btu}{hr}$$

Cooling

$$TotalGain = 1.179 \cdot Tons$$

B.2 IRVINE LOAD CALCULATIONS

UNCC Solar Decathlon Mechanical Load Calculations

Materials **R-Values**

1) GeoPolymer Concrete $R1 := 0.66 \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

2) Extruded Polystyrene $R2 := 5 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

3) Cement Backer $R3 := .32 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

4) Thinset Mortar $R4 := 0.4 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

5) Ceramic Tile $R5 := 0.08 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

6) Wood Fiberboard $R6 := 2.7 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

7) Fiberglass Board $R7 := 4.5 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

8) Metal $R8 := 0 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu \cdot in}$

Thicknesses

Walls	Floor	Ceiling
$WT1 := 6in$	$FT1 := 6in$	$CT2 := 10in$
$WT2 := 6in$	$FT2 := 6in$	$CT6 := \frac{5}{8}in$
	$FT3 := .5in$	$CT7 := \frac{5}{8}in$
	$FT4 := .25in$	$CT8 := \frac{5}{8}in$
	$FT5 := .25in$	

Total R-Values

Walls $RW := WT1 \cdot R1 + WT2 \cdot R2$ $RW = 33.96 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu}$

Floor $RF := FT1 \cdot R1 + FT2 \cdot R2 + FT3 \cdot R3 + FT4 \cdot R4 + FT5 \cdot R5$ $RF = 34.24 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu}$

Ceiling $RC := CT2 \cdot R2 + CT6 \cdot R6 + CT7 \cdot R7 + CT8 \cdot R8$ $RC = 54.5 \cdot \frac{hr \cdot ft^2 \cdot \Delta°F}{Btu}$

U-Values

$UW := \frac{1}{RW}$ $UF := \frac{1}{RF}$ $UC := \frac{1}{RC}$

Insulation

Average Temp Differances

$WinterT := 39\,°F \qquad \Delta Tw := 73\,°F - WinterT$

$SummerT := 85\,°F \qquad \Delta Ts := SummerT - 73\,°F$

$WallLoss := UW \cdot \Delta Tw \qquad WallGain := UW \cdot \Delta Ts \qquad WallArea := 685 ft^2$

$FloorLoss := UF \cdot \Delta Tw \qquad FloorGain := UF \cdot \Delta Ts \qquad FloorArea := 750 ft^2$

$CeilingLoss := UC \cdot \Delta Tw \qquad CeilingGain := UC \cdot \Delta Ts \qquad CeilingArea := 750 ft^2$

$InsulationLoss := WallLoss \cdot WallArea + FloorLoss \cdot FloorArea + CeilingLoss \cdot CeilingAr$

$InsulationGain := WallGain \cdot WallArea + FloorGain \cdot FloorArea + CeilingGain \cdot CeilingA$

$InsulationLoss = 1.898 \times 10^3 \cdot \frac{Btu}{hr} \qquad InsulationGain = 670.038 \cdot \frac{Btu}{hr}$

Ventilation

$VentilationCFM := 50 \qquad Volume := 750 \cdot 9 \cdot ft^3$

$VentilationLoss := \left(VentilationCFM \cdot \frac{\Delta Tw}{\Delta °F} \right) \frac{Btu}{hr} = 1700 \cdot \frac{Btu}{hr}$

$VentilationGain := \left(VentilationCFM \cdot \frac{\Delta Ts}{\Delta °F} \right) \frac{Btu}{hr} = 600 \cdot \frac{Btu}{hr}$

Window Conduction

$$U := 0.2 \cdot \frac{Btu}{ft^2 \cdot hr \cdot \Delta°F} \qquad WindowArea := 400 \cdot ft^2 \qquad SHGC := 0.5$$

$$WindowCondLoss := U \cdot \Delta Tw \cdot WindowArea = 2.72 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WindowCondGain := U \cdot \Delta Ts \cdot WindowArea = 960 \cdot \frac{Btu}{hr}$$

Window Radiation

$$SummerRad := \frac{2310}{24} \frac{Btu}{ft^2 \cdot hr}$$

extreme values averaged from multiple sources

$$WinterRad := \frac{911}{24} \frac{Btu}{ft^2 \cdot hr}$$

$$SummerShading := .5 \qquad WinterShading := .5$$

1 = No Shading
0 = Full Shading

$$SummerRadGain := SummerRad \cdot WindowArea \cdot SHGC \cdot SummerShading = 9.625 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WinterRadGain := WinterRad \cdot WindowArea \cdot SHGC \cdot WinterShading = 3.796 \times 10^3 \cdot \frac{Btu}{hr}$$

Detailed Infiltration and Ventilation (Btu/hr)

$$Volume_i := \frac{Volume}{ft^3}$$

$$Con := \frac{60}{(Volume_i)}$$

$$DoorArea := 4.0833333 \cdot 8$$

Walls

$$af_w := .009$$

$$Leak_w := af_w \cdot 685 = 6.165$$

Windows

$$af_{wind} := .02$$

$$Leak_{wind} := af_{wind} \cdot 400 = 8$$

Doors

$$af_d := .06$$

$$Leak_d := af_d \cdot DoorArea = 1.96$$

Envelope Penetrations

Pipe Penetrations

$$af_p := .16 \qquad num_p := 8$$

$$Leak_p := af_p \cdot num_p = 1.28$$

Duct Penetrations

$$af_{duc} := .25 \qquad num_{duc} := 4$$

$$Leak_{duc} := af_{duc} \cdot num_{duc} = 1$$

Vents and Exhaust Fans

Kitchen Fan

$af_{kf} := .8 \qquad num_{kf} := 1$

$Leak_{kf} := af_{kf} \cdot num_{kf} = 0.8$

Dryer Vent

$af_{dv} := .47 \qquad num_{dv} := 1$

$Leak_{dv} := af_{dv} \cdot num_{dv} = 0.47$

Water Heater

$af_{wh} := 3 \qquad num_{wh} := 2$

$Leak_{wh} := af_{wh} \cdot num_{wh} = 6$

$Leak_{tot} := Leak_{w} + Leak_{wind} + Leak_{d} + Leak_{p} + Leak_{duc} + Leak_{kf} + Leak_{dv} + Leak_{wl}$

$Leak_{tot} = 25.675$

Solution

Winter Wind CFM/Sq_in Factor

$Factor_W := 1.6$

Winter Infiltration (AC/Hr)

$ACH_W := Leak_{tot} \cdot Factor_W \cdot Con + .1 = 0.4652$

Summer Wind CFM/Sq_in Factor

$Factor_S := .6$

Summer Infiltration (AC/Hr)

$ACH_S := Leak_{tot} \cdot Factor_S \cdot Con + .1 = 0.2369$

Detailed Infiltration

$$InfiltrationLoss := \left(.0167 ACH_W \cdot Volume_i \cdot \frac{\Delta Tw}{\Delta °F}\right)\frac{Btu}{hr} = 1.783 \times 10^3 \cdot \frac{Btu}{hr}$$

$$InfiltrationGain := \left(0.0167 \cdot ACH_S \cdot Volume_i \cdot \frac{\Delta Ts}{\Delta °F}\right)\frac{Btu}{hr} = 320.5 \cdot \frac{Btu}{hr}$$

Internal Sensible and Latent Heat Gain Calcualtion

Internal Gain : Literature

The contributions of occupants, lighting, and appliance gains to peak sensible and latent loads can be estimated as

qig,s = 136 + 2.2*Acf* + 22*Noc* (30)

qig,l = 20 + 0.22*Acf* + 12*Noc* (31)

where

qig,s = sensible cooling load from internal gains, W

qig,l = latent cooling load from internal gains, W

Acf = conditioned floor area of building, m2

Noc = number of occupants (unknown, estimate as *Nbr* + 1)

Equations (30) and (31) and their coefficients are derived from Building America (2004) load profiles evaluated at 4:00 P.M., as documented

by Barnaby and Spitler (2005). Predicted gains are typical for U.S. homes. Further allowances should be considered when unusual lighting intensities or other equipment are in continuous use during peak cooling hours. In critical situations where intermittent high occupant density or other internal gains are expected, a parallel cooling system should be considered.

For room-by-room calculations, *qig,s* should be evaluated for the entire conditioned area, and allocated to kitchen and living spaces.

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Calculation

$$A_{cf} := 750\text{ft}^2$$

$$N_{oc} := 3$$

$$\text{SensibleGain} := \left(136 + 2.2\cdot\frac{A_{cf}}{m^2} + 22\cdot N_{oc}\right)\cdot W = 1212.3\cdot\frac{\text{Btu}}{\text{hr}}$$

$$\text{LatentGain} := \left(20 + .22\cdot\frac{A_{cf}}{m^2} + 12\cdot N_{oc}\right)\cdot W = 243.385\cdot\frac{\text{Btu}}{\text{hr}}$$

Load Analysis and Totals

Heating Load

$$InsulationLoss = 1.898 \times 10^3 \cdot \frac{Btu}{hr}$$

$$VentilationLoss = 1.7 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WindowCondLoss = 2.72 \times 10^3 \cdot \frac{Btu}{hr}$$

$$InfiltrationLoss = 1.783 \times 10^3 \cdot \frac{Btu}{hr}$$

$$WinterRadGain = 1.112 \times 10^3\,W$$

Cooling Load

$$InsulationGain = 670.038 \cdot \frac{Btu}{hr}$$

$$VentilationGain = 600 \cdot \frac{Btu}{hr}$$

$$WindowCondGain = 960 \cdot \frac{Btu}{hr}$$

$$InfiltrationGain = 320.5 \cdot \frac{Btu}{hr}$$

$$SummerRadGain = 9.625 \times 10^3 \cdot \frac{Btu}{hr}$$

$$SensibleGain = 1.212 \times 10^3 \cdot \frac{Btu}{hr}$$

$$LatentGain = 243.385 \cdot \frac{Btu}{hr}$$

$$TotalLoss1 := InsulationLoss + VentilationLoss + WindowCondLoss + InfiltrationLoss$$

$$TotalGain1 := InsulationGain + VentilationGain + WindowCondGain + SummerRadG$$

$$TotalGain2 := InfiltrationGain + SensibleGain + LatentGain$$

$$TotalGain := TotalGain1 + TotalGain2$$

$$TotalLoss := TotalLoss1 - WinterRadGain$$

Peak Loads In Irvine

$$Tons \equiv 12000 \frac{Btu}{hr}$$

Heating	Cooling
$TotalLoss = 4305.385 \cdot \frac{Btu}{hr}$	$TotalGain = 1.136 \cdot Tons$

B.3 HIGH MASS CAPILLARY TUBE CALCULATIONS

James Polk
Gengbei Shi

Solar Decathlon: Wall-Capillary Fluid Wall Heat

Date: 02-12-12 Page 1 of 17

Calculation: Wall and Tube Temperature

Given: (10% Propylene Glycol)

1) Water Specific Heat (@ 60 F):

$$Cp_{w\_gl} := .98\frac{Btu}{lbm\cdot\Delta^\circ F} = 4.1031\cdot\frac{kJ}{kg\cdot K}$$

2) Average Cooling Cycle Wall Temperature (Starts at 70F, ends at 73F):

$$T_{wall} := 71.5\,^\circ F$$

3) Concrete Thermal Conductivity:

$$k_{conc} := .29\frac{W}{m\cdot K}$$

http://www.engineeringtoolbox.com/thermal-conductivity-d_429.html

4) Capillary Tube Wall Thermal Conductivity:

$$k_{tube} := .17\frac{W}{m\cdot K}$$

http://www.engineeringtoolbox.com/overall-heat-transfer-coefficient-d_434.html

5) Water Glycol Thermal Conductivity (@ 30 F)

$$k_{w\_gl} := .50822\frac{W}{m\cdot K} = 0.294\cdot\frac{Btu\cdot ft}{hr\cdot ft^2\cdot R}$$

https://dow-answer.custhelp.com/app/answers/detail/a_id/5176/~/lttf---thermal-conductivity-of-aqueous-dowfrost---si-units

5) Tube Dimensions

$OD := 3.35mm = 0.132\cdot in$ (outer diameter)

$t_{tube} := .5mm = 0.0197\cdot in$ (tube wall thickness)

$ID := OD - 2\cdot t_{tube} = 0.093\cdot in$ (inner diameter)

6) Capillary Tube Wall Section Mat Area

$L_{tube} := 1100mm \quad h_{tube} := 1250mm$

$L_{tube\_2} := 1010mm \quad L_{tube\_3} := 850mm$

$A_{mat} := h_{tube}\cdot L_{tube} = 14.8\cdot ft^2$

$A_{mat\_2} := h_{tube}\cdot L_{tube\_2} = 13.589\cdot ft^2$

$A_{mat\_3} := h_{tube}\cdot L_{tube\_3} = 11.437\cdot ft^2$

7) Capillary Tube Wall Total Area:

$num_{sections} := 8$

$A_{mats\_1} := A_{mat}\cdot num_{sections}\cdot 2 = 236.806\cdot ft^2$

$num_{sections\_2} := 3$

$A_{mats\_2} := A_{mat\_2}\cdot num_{sections\_2}\cdot 2 = 81.537\cdot ft^2$

$num_{sections\_3} := 2$

$A_{mats\_3} := A_{mat\_3}\cdot num_{sections\_3}\cdot 2 = 45.747\cdot ft^2$

$A_{mats} := A_{mats\_1} + A_{mats\_2} + A_{mats\_3}$

$A_{mats} = 364.089\cdot ft^2$

Given Con't:

8) Exchange Surface Area Factor, Exchange Surf. Area

$K_{ex} := .71$

$A_{ex} := A_{mats} \cdot K_{ex} = 258.503 \cdot ft^2$

(** For case where 2 of the removed mats are replaced)

9) Concrete Wall Thickness:

$x_{wall.1} := 3.5in = 0.089\,m$

$x_{wall.2} := 1.75in = 0.044\,m$

10) Density of water @ 46 F

$\rho_{H2O} := 62.4 \frac{lbm}{ft^3}$

11) Density of mixture @ 60 F

$G_{w\_gl} := 1.008$

$\rho_{w\_gl} := \rho_{H2O} \cdot G_{w\_gl} = 62.899 \cdot \frac{lbm}{ft^3}$

http://www.engineeringtoolbox.com/propylene-glycol-d_363.html

12) Volumetric Flow Rate Factor

$F_{Vdot} := \frac{8 \frac{L}{min}}{165 ft^2}$

13) Ambient Temperature (Average summer conditions from weather data):

$T_{amb\_avg} := 69\,°F$

14) Mixture-Water Viscosity Ratio (35F)

$K_v := 2$

15) System Operating Pressure

$P_{sys} := 2.25bar$

Find: a) Determine appropriate water-propylene glycol mass flow rate
b) Size capillary tube system pump
c) Determine water-propylene glycol entrance and exit temperatures
d) Balance wall and fin HT rates
e) Determine pump run time
f) COP of Capillary Tube System

ORIGIN ≡ 1 lbm ≡ lb lb_f ≡ lbf kJ ≡ 1000J psia ≡ psi wf := "Water,en"

MJ := 1000000J

Assume: 1) Steady Conditions 2) ΔKE=ΔPE=0 3) Window Curtain is present 4) Wall start temperature is same as indoor air temperature 5) Capillary tubes are well insulated (adiabatic) on one side 6) Constant Surface Temperature for tubes in walls 7) Laminar Flow of fluid in capillary tubes 8) Constant surface temperature for finned tube exchanger 9) Perfect fluid mixing in well insulated tank

Governing Equations & Properties:

$Q_{sys} - W_{sys} = m_{dot}(h_1 - h_2)$ Energy Balance

Analysis,

Given recommended Beka volumetric flow rate factor:

$V_{dot} := F_{Vdot} \cdot A_{mats} = 4.663 \cdot \frac{gal}{min}$

$m_{dot} := V_{dot} \cdot \rho_{w\_gl} = 39.212 \cdot \frac{lbm}{min}$

Mass Flow Rate Divisions

$A_{east} := 6 \cdot A_{mat} = 88.802 \cdot ft^2$

$A_{west} := 6 \cdot A_{mat} = 88.802 \cdot ft^2$

$A_{northL} := 6 \cdot A_{mat\_2} = 81.537 \cdot ft^2$

$A_{northM} := 4 A_{mat} = 59.202 \cdot ft^2$

$A_{northR} := 4 \cdot A_{mat\_3} = 45.747 \cdot ft^2$

$Vdot_{east} := F_{Vdot} \cdot A_{east} = 1.137 \cdot \frac{gal}{min}$

$Vdot_{west} := F_{Vdot} \cdot A_{west} = 1.137 \cdot \frac{gal}{min}$

$Vdot_{northL} := F_{Vdot} \cdot A_{northL} = 1.044 \cdot \frac{gal}{min}$

$Vdot_{northM} := F_{Vdot} \cdot A_{northM} = 0.758 \cdot \frac{gal}{min}$

$Vdot_{northR} := F_{Vdot} \cdot A_{northR} = 0.586 \cdot \frac{gal}{min}$

$Vdot_{total} := Vdot_{east} + Vdot_{west} + Vdot_{northL} + Vdot_{northR} + Vdot_{northM} = 4.663 \cdot \frac{gal}{min}$ checks

$mdot_{east} := Vdot_{east} \cdot \rho_{w\_gl} = 260.284 \cdot \frac{kg}{hr}$

$mdot_{west} := Vdot_{west} \cdot \rho_{w\_gl} = 9.564 \cdot \frac{lbm}{min}$

$10 \frac{lbm}{min} = 272.155 \cdot \frac{kg}{hr}$

$mdot_{northL} := Vdot_{northL} \cdot \rho_{w\_gl} = 8.781 \cdot \frac{lbm}{min}$

$mdot_{northM} := Vdot_{northM} \cdot \rho_{w\_gl} = 6.376 \cdot \frac{lbm}{min}$

$mdot_{northR} := Vdot_{northR} \cdot \rho_{w\_gl} = 4.927 \cdot \frac{lbm}{min}$

$mdot_{total} := mdot_{east} + mdot_{west} + mdot_{northL} + mdot_{northM} + mdot_{northR} = 39.212 \cdot \frac{lbm}{min}$ checks

Required Pump Power (Assuming Water Properties - Conservative Estimate)

System Pressure Losses

Capillary Tube Height Pressure Loss

$$\frac{v_1^2}{2} + g \cdot z_1 \cdot \frac{P_1}{\rho_1} = \frac{v_2^2}{2} + g \cdot z_2 + \frac{P_2}{\rho_2}$$ Bernoilli

Assume: $P1 := 3bar$

$$P2\_1 := \left(\frac{P1}{\rho_{w\_gl}} - g \cdot 10ft\right) \cdot \rho_{w\_gl} = 2.699 \cdot bar \qquad P2\_2 := \left(\frac{P1}{\rho_{w\_gl}} - g \cdot 12ft\right) \cdot \rho_{w\_gl} = 2.639 \cdot bar$$

$$P_{height\_1} := (P1 - P2\_1) \cdot 2 = 0.602 \cdot bar \qquad P_{height\_2} := (P1 - P2\_2) = 0.361 \cdot bar$$

$$P_{height} := P_{height\_1} + P_{height\_2} = 0.964 \cdot bar$$ (Total vertical head loss)

Beka Manual Capillary Tube Pressure Losses

Pressure loss determination

8	Length of connecting pipe	m		$l_{con} := 34ft$
9	Resistance in the pipe -> from diagram 2	Pa/m		$R_{con} := 50\frac{Pa}{m}$
10	Pressure loss in the pipe = pipe length * resistance	Pa		$P_{con} := l_{con} \cdot R_{con}$ $P_{con} = 518.16\,Pa$
11	Pressure loss of the mat -> with value of line 2 from the diagram 1	Pa		(Use 7m length) $P_{mat} := 12500 \cdot Pa$
12	Addition for pressure loss of fittings (recomm.: 30% addition to pipe)	Pa		$P_{fit} := P_{con} \cdot .3$ $P_{fit} = 155.448\,Pa$
13	Addition for heat transfer station (recomm:for zone valves 500-1000 Pa for mains regulating valves 700 - 1500 Pa for heat exchanger approx. 4000 Pa	Pa		$P_{station} := 7500Pa$
14	Total pressure loss	Pa		

$P_{pipe} := (P_{con} + P_{mat} + P_{fit} + P_{station}) \cdot K_v = 5.997\,psia$ (Total Piping and fitting head loss)

$P_{total} := P_{pipe} + P_{height} = 19.975 \cdot psi$ Total Capillary Tube System Pressure Drop, note that fin tube pressure drop was found to be negligible

$P_{total} = 1.377 \cdot bar$

Need to determine water-proplene glycol convection coefficient:

$Nu_D = \frac{h_{w\_gl} \cdot D_{tube}}{k_{w\_gl}}$ $Nu_D := 3.66$ Equation 8.55, pg 477 (Incropera, 5th)

$h_{w\_gl} := \frac{Nu_D \cdot k_{w\_gl}}{ID} = 791.526 \cdot \frac{W}{m^2 \cdot K}$ 90-10 Water-Propylene Glycol Convection Coefficient (Forced)

Case 1 (60 F Ambient) Wall Heat Transfer Balance

Need to determine temperature difference accross finned tube array:

$P_{netloss\_1} := 7900 \frac{Btu}{hr}$ _____Fin tube radiation HT rejection rate
(Needs to equal wall conduction rate)

$Q = m_{dot} \cdot C_p \cdot \Delta T$

$mdot_{fins\_1} := 22.018 \frac{lbm}{min}$

$\Delta T\_1 := \frac{P_{netloss\_1}}{mdot_{fins\_1} \cdot Cp_{w\_gl}} = 6.102 \cdot \Delta °F$ $V_{dot\_fins\_1} := \frac{mdot_{fins\_1}}{\rho_{w\_gl}} = 2.619 \cdot \frac{gal}{min}$

Need average fluid temperature,

$T_{fluid\_1} := 37.5 °F$

$T_{c\_1} := T_{fluid\_1} - \Delta T\_1 = 31.398 \cdot °F$

Where: (Assuming negligible fluid temperature increase in pump),

Given $T_{H\_1} := 41 °F$

$T_{fluid\_1} = T_{H\_1} \cdot \left(\frac{m_{dot}}{mdot_{fins\_1} + m_{dot}} \right) + T_{c\_1} \cdot \left(\frac{mdot_{fins\_1}}{mdot_{fins\_1} + m_{dot}} \right)$

$T_{H\_1} := Find(T_{H\_1})$

$T_{H\_1} = 40.926 \cdot °F$

$T_{fluid\_wall\_1} := \frac{T_{H\_1} + T_{fluid\_1}}{2} = 39.213 \cdot °F$

Need Overall Heat Transfer Coefficient for wall side,

$$Q_{wall} = U \cdot A \cdot \left(T_{wall} - T_{fluid}\right)$$

Need Overall Heat Transfer Coefficient for wall side (Applicable for all cases),

$$Q_{wall} = U \cdot A \cdot \left(T_{wall} - T_{fluid}\right)$$

$$A_{tube\_avg} := \left[\frac{(ID + OD)}{2}\right] \cdot \pi \cdot L_{tube} = 15.266 \cdot in^2 \qquad \frac{k_{tube}}{t_{tube}} = 340 \cdot \frac{W}{m^2 \cdot K}$$

$$U_1 := \frac{1}{\frac{1}{h_{w\_gl}} + \frac{\ln\left(\frac{OD}{ID}\right) \cdot A_{tube\_avg}}{2\pi \cdot k_{tube} \cdot L_{tube}} + \frac{x_{wall.1}}{k_{conc}}} = 3.218 \cdot \frac{W}{m^2 \cdot K} \qquad \frac{1}{\left(\frac{\ln\left(\frac{OD}{ID}\right) \cdot A_{tube\_avg}}{2\pi \cdot k_{tube} \cdot L_{tube}}\right)} = 336.483 \cdot \frac{W}{m^2 \cdot K}$$

$$U_2 := \frac{1}{\frac{1}{h_{w\_gl}} + \frac{\ln\left(\frac{OD}{ID}\right) \cdot A_{tube\_avg}}{2\pi \cdot k_{tube} \cdot L_{tube}} + \frac{x_{wall.2}}{k_{conc}}} = 6.349 \cdot \frac{W}{m^2 \cdot K} \qquad \frac{k_{conc}}{x_{wall.1}} = 3.262 \cdot \frac{W}{m^2 \cdot K} \text{ (Limiting Factor)}$$

$$\frac{k_{conc}}{x_{wall.2}} = 6.524 \cdot \frac{W}{m^2 \cdot K}$$

$$Q_{wallcheck\_1} := \left(U_1 \cdot \frac{A_{ex}}{2} + U_2 \cdot \frac{A_{ex}}{2}\right) \cdot \left(T_{wall} - T_{fluid\_wall\_1}\right) = 7030.627 \cdot \frac{Btu}{hr}$$

$$E_{rej\_1} := \frac{3 \cdot 3.5779 \cdot 10^7 J}{3} = 35.779 \cdot MJ$$ (Energy required for 2 F wall Temperature rise)

$$Time\_1 := \frac{E_{rej\_1}}{Q_{wallcheck\_1}} = 4.823 \cdot hr$$ (Pump run time)

Case 2 (69 F Ambient) Wall Heat Transfer Balance

Need to determine temperature difference accross finned tube array:

$P_{netloss\_2} := 7100 \frac{Btu}{hr}$ _____Fin tube radiation HT rejection rate (Needs to equal wall conduction rate)

$Q = m_{dot} \cdot C_p \cdot \Delta T$

$mdot_{fins\_2} := 14.754 \frac{lbm}{min}$

$\Delta T\_2 := \frac{P_{netloss\_2}}{mdot_{fins\_2} \cdot Cp_{w\_gl}} = 8.184 \cdot \Delta°F$ $V_{dot\_fins\_2} := \frac{mdot_{fins\_2}}{\rho_{w\_gl}} = 1.755 \cdot \frac{gal}{min}$

Need average fluid temperature,

$T_{fluid\_2} := 41 °F$

$T_{c\_2} := T_{fluid\_2} - \Delta T\_2 = 32.816 \cdot °F$

Where: (Assuming negligible fluid temperature increase in pump),

Given $T_{H\_2} := 41 °F$

$T_{fluid\_2} = T_{H\_2} \cdot \left(\frac{m_{dot}}{mdot_{fins\_2} + m_{dot}} \right) + T_{c\_2} \cdot \left(\frac{mdot_{fins\_2}}{mdot_{fins\_2} + m_{dot}} \right)$

$T_{H\_2} := Find(T_{H\_2})$

$T_{H\_2} = 44.079 \cdot °F$

$T_{fluid\_wall\_2} := \frac{T_{H\_2} + T_{fluid\_2}}{2} = 42.54 \cdot °F$

$$Q_{wallcheck\_2} := \left(U_1 \cdot \frac{A_{ex}}{2} + U_2 \cdot \frac{A_{ex}}{2}\right) \cdot \left(T_{wall} - T_{fluid\_wall\_2}\right) = 6306.261 \cdot \frac{Btu}{hr}$$

$$E_{rej\_2} := \frac{3 \cdot 3.5779 \cdot 10^7 J}{3} = 35.779 \cdot MJ$$ (Energy required for 2 F wall Temperature rise)

$$Time\_2 := \frac{E_{rej\_2}}{Q_{wallcheck\_2}} = 5.378 \cdot hr$$ (Pump run time)

Case 3 (80 F Ambient) Wall Heat Transfer Balance

Need to determine temperature difference accross finned tube array:

$P_{netloss\_3} := 6300 \frac{Btu}{hr}$ _____Fin tube radiation HT rejection rate
(Needs to equal wall conduction rate)

$Q = m_{dot} \cdot C_p \cdot \Delta T$

$mdot_{fins\_3} := 20.53 \frac{lbm}{min}$

$$\Delta T\_3 := \frac{P_{netloss\_3}}{mdot_{fins\_3} \cdot Cp_{w\_gl}} = 5.219 \cdot \Delta°F \qquad V_{dot\_fins\_3} := \frac{mdot_{fins\_3}}{\rho_{w\_gl}} = 2.442 \cdot \frac{gal}{min}$$

Need average fluid temperature,

$T_{fluid\_3} := 44.5\,°F$

$T_{c\_3} := T_{fluid\_3} - \Delta T\_3 = 39.281\,°F$

Where: (Assuming negligible fluid temperature increase in pump),

Given $T_{H\_3} := 41\,°F$

$$T_{fluid\_3} = T_{H\_3}\cdot\left(\frac{m_{dot}}{mdot_{fins\_3} + m_{dot}}\right) + T_{c\_3}\cdot\left(\frac{mdot_{fins\_3}}{mdot_{fins\_3} + m_{dot}}\right)$$

$T_{H\_3} := \text{Find}(T_{H\_3})$

$T_{H\_3} = 47.232\,°F$

$$T_{fluid\_wall\_3} := \frac{T_{H\_3} + T_{fluid\_3}}{2} = 45.866\,°F$$

Need Overall Heat Transfer Coefficient for wall side,

$$Q_{wall} = U\cdot A\cdot\left(T_{wall} - T_{fluid}\right)$$

$$Q_{wallcheck\_3} := \left(U_1\cdot\frac{A_{ex}}{2} + U_2\cdot\frac{A_{ex}}{2}\right)\cdot\left(T_{wall} - T_{fluid\_wall\_3}\right) = 5581.895\cdot\frac{Btu}{hr}$$

$$E_{rej\_3} := \frac{3\cdot 3.5779\cdot 10^7\,J}{3} = 35.779\,MJ$$ (Energy required for 2 F wall Temperature rise)

$$Time\_3 := \frac{E_{rej\_3}}{Q_{wallcheck\_3}} = 6.075\,hr$$ (Pump run time)

Pump Flow Rate (Case of 60 F)

$mdot_{fins\_max} := 22.018 \frac{lbm}{min}$ (60 F Ambient)

$mdot_{all} := m_{dot} + mdot_{fins\_max} = 61.23 \frac{lbm}{min}$ Total Pump Mass Flow Rate for sizing

$V_{dot\_all} := \frac{mdot_{all}}{\rho_{w\_gl}} = 7.282 \frac{gal}{min}$ Total Pump Volume Flow Rate for sizing

$h_{loss} := \left(\frac{P_{total}}{1.008 \cdot .434 \cdot psi} \right) ft = 45.659 \cdot ft$ Total Pump Head Loss $P_{total} = 19.975 \cdot psia$

$h_{pump} := \left(\frac{P_{sys}}{1.008 \cdot .434 \cdot psi} \right) ft = 74.596 \cdot ft$ Total Pump Head for sizing $P_{sys} = 32.633 \cdot psia$

$h_{net} := h_{pump} - h_{loss} = 28.937 \cdot ft$ Net Pressure @ Suction Head

$\rho_{H2O} \cdot g \cdot 10in = 0.361 \cdot psia$

$h_{tank} := \left(\frac{\rho_{H2O} \cdot g \cdot 10in}{1.008 \cdot .434 \cdot psi} \right) ft = 9.905 \cdot in$ Water Tank Head (Note not 10 in bc we have a mixture, not pure water)

$$C_v := \frac{\frac{V_{dot\_all}}{\frac{gal}{min}} \cdot \sqrt{G_{w\_gl}}}{\sqrt{\frac{P_{total}}{psi}}} = 1.636$$ Main Electronic Control Valve Max Flow Coefficient Value

Case 1 (60 F Ambient) Performane

$$COP\_1 := \frac{Q_{wallcheck\_1}}{.3hp} = 9.21 \qquad COP\_mini := 3.5$$

$$EER\_1 := COP\_1 \cdot 3.412 = 31.426 \quad EER\_mini := 14.2$$

$$\%\_diff\_COP\_1 := \frac{COP\_mini - COP\_1}{COP\_mini} = -163.156 \cdot \%$$

$$\%\_diff\_EER := \frac{EER\_mini - EER\_1}{EER\_mini} = -121.311 \cdot \%$$

Case 2 (69 F Ambient) Performane

$$COP\_2 := \frac{Q_{wallcheck\_2}}{.3hp} = 8.262 \quad COP\_mini = 3.5$$

$$EER\_2 := COP\_2 \cdot 3.412 = 28.188 \quad EER\_mini = 14.2$$

$$\%\_diff\_COP\_2 := \frac{COP\_mini - COP\_2}{COP\_mini} = -136.043 \cdot \%$$

$$\%\_diff\_EER\_2 := \frac{EER\_mini - EER\_2}{EER\_mini} = -98.509 \cdot \%$$

Case 3 (80 F Ambient) Performane

$$COP\_3 := \frac{Q_{wallcheck\_3}}{.3hp} = 7.313 \quad COP\_mini = 3.5$$

$$EER\_3 := COP\_3 \cdot 3.412 = 24.95 \quad EER\_mini = 14.2$$

$$\%\_diff\_COP\_3 := \frac{COP\_mini - COP\_3}{COP\_mini} = -108.93 \cdot \%$$

$$\%\_diff\_EER\_3 := \frac{EER\_mini - EER\_3}{EER\_mini} = -75.707 \cdot \%$$

Moving Forward (For average case, Case 2 - 69 F ambient),

$.3hp = 223.71\,W$ Where this pump is

$.25hp = 186.425\,W$ System could benefit if pump size reduced to .25 hp

$$COP\_opt_{\_25\_2} := \frac{Q_{wallcheck\_2}}{.25hp} = 9.914$$ (Average - Case 2)

$$EER\_opt_{\_25\_2} := COP\_opt_{\_25\_2} \cdot 3.412 = 33.826$$

Discussion:

Three methods were devised to provide the needed efficiency gains in the system to bring system efficiency well above that of the mini split systems: A: Reduce pressure drops in tubing networks by making revisions; B: Increase our heat transfer rate from the wall to the tubes by using better properties and wall-tube interface equations and slightly increasing mat surface area; C: Find a pump that uses less energy (Grundfos, Wilo, Bell & Gosset). After incorporating these changes the system now meets desired requirements.

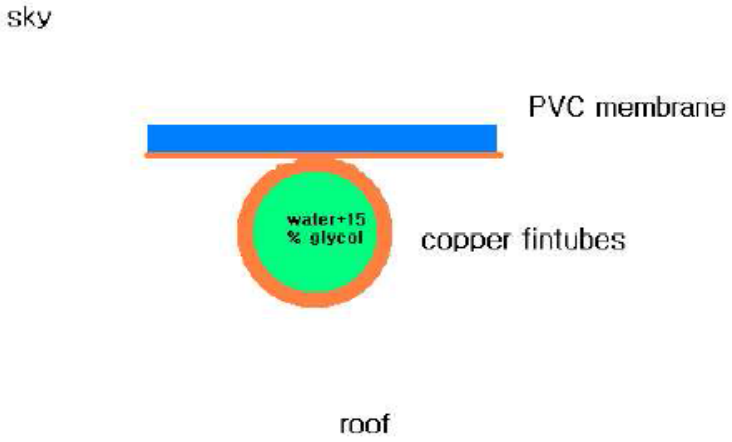
B.4-1 ROOFTOP HEAT EXCHANGER CALCULATIONS (T → Q)

Gengbei Shi
James Polk

Solar Decathlon:
Fintubes as roof radiant cooling system under summer night conditions

Date: 02-05-2013

Schematic cross-sectional view of roof membran+fintube composite structure



Comment: this is a comprehensive heat transfer problem having conduction (fluid to fin, fin to membrane), heat convection (between air and membrane top surface) and radiation (fin to sky, membrane to sky), within a composite strcture (fluid in fin, fin under PVC membrane.

Goal: solve the radiative heat transfer rate from PVC membrane.

Given conditions:

Sky emissivity

$\varepsilon_{sky} := 0.74$

Stefan-Boltzmann constant

$\sigma := 5.67 \cdot 10^{-8} \frac{W}{m^2 \cdot K^4}$

Three ambient air temperatures

$T_{amb1} := 60\,°F = 288.706\,K$ $T_{amb2} := 69\,°F = 293.706\,K$ $T_{amb3} := 80\,°F = 299.817\,K$

Sky background temperature with cloud coverage (based on Goforth's model)

$T_{sky1} := \varepsilon_{sky}^{.25} \cdot T_{amb1} = 267.771\,K$ $T_{sky2} := \varepsilon_{sky}^{.25} \cdot T_{amb2} = 272.408\,K$

$T_{sky3} := \varepsilon_{sky}^{0.25} \cdot T_{amb3} = 278.076\,K$

In English units:

$T_{sky1} = 22.317 \cdot °F \quad T_{sky2} = 30.665 \cdot °F \quad T_{sky3} = 40.867 \cdot °F$

Reference: Mark. A Goforth et al., "Cloud Effects on Thermal Downwelling Sky Radiance", Proc. SPIE, Thermosense XXIV, Vol 4710-27, 2002

Preset PVC membrane temperature and final iterated results (for steady state accuracy)

$T_{mem1} := 278.717K \quad T_{mem2} := 279.731K \quad T_{mem3} := 281.008K$

PG-water fluid temperature $T_f := 43\,°F = 279.261\,K$ (desired temperature of cooled liquid)

Radiative heat transfer conditions:

Copper fintube surface emissivity

$\varepsilon_{cop} := 0.08$

EnergySmart White membrane solar reflectance

$\rho_{mem\_w} := 0.83$

Radiation average temperature between fintube and sky:

$$T_{avg1} := \frac{(T_f + T_{sky1})}{2} = 273.516\,K$$

$$T_{avg2} := \frac{(T_f + T_{sky2})}{2} = 275.835\,K$$

$$T_{avg3} := \frac{(T_f + T_{sky3})}{2} = 278.669\,K$$

Case 1: PVC membrane transmissivity = 0 due to its 6-fold thickness of the fin (0.06" vs 0.01"), and reflectivity to copper fin surface remains the same as solar reflectance. Energy that is not reflected is absorbed by membrane.

Radiation heat transfer coefficient between the copper fin and the sky (with PVC membrane in between):

$$h_{r1} := 4 \cdot \varepsilon_{cop} \cdot \sigma \cdot (1 - \rho_{mem\_w}) \cdot T_{avg1}^{3} = 0.063 \cdot \frac{W}{m^2 \cdot K}$$

$$h_{r2} := 4 \cdot \varepsilon_{cop} \cdot \sigma \cdot (1 - \rho_{mem\_w}) \cdot T_{avg2}^{3} = 0.065 \cdot \frac{W}{m^2 \cdot K}$$

$$h_{r3} := 4 \cdot \varepsilon_{cop} \cdot \sigma \cdot (1 - \rho_{mem\_w}) \cdot T_{avg3}^{3} = 0.067 \cdot \frac{W}{m^2 \cdot K}$$

Case 2: PVC membrane transmissivity =1, all energy emitted by copper fin gets through.

$$h_{r4} := 4 \cdot \varepsilon_{cop} \cdot \sigma \cdot T_{avg1}^{3} = 0.371 \cdot \frac{W}{m^2 K} \qquad h_{r5} := 4 \cdot \varepsilon_{cop} \cdot \sigma \cdot T_{avg2}^{3} = 0.381 \cdot \frac{W}{m^2 K}$$

$$h_{r6} := 4 \cdot \varepsilon_{cop} \cdot \sigma \cdot T_{avg3}^{3} = 0.393 \cdot \frac{W}{m^2 K}$$

Mean temperature between membrane and sky

$$T_{mean1} := \frac{(T_{mem1} + T_{sky1})}{2} = 273.244\,K$$

$$T_{mean2} := \frac{(T_{mem2} + T_{sky2})}{2} = 276.07\,K$$

$$T_{mean3} := \frac{(T_{mem3} + T_{sky3})}{2} = 279.542\,K$$

PVC membrane emissivity $\varepsilon_{mem} := 0.90$

Radiative heat transfer coefficient between memrane and sky

$$h_{r\_mem1} := 4 \cdot \varepsilon_{mem} \cdot \sigma \cdot T_{mean1}^{3} = 4.164 \cdot \frac{W}{m^2 \cdot K} \qquad h_{r\_mem2} := 4 \cdot \varepsilon_{mem} \cdot \sigma \cdot T_{mean2}^{3} = 4.295 \cdot \frac{W}{m^2 \cdot K}$$

$$h_{r\_mem3} := 4 \cdot \varepsilon_{mem} \cdot \sigma \cdot T_{mean3}^{3} = 4.459 \cdot \frac{W}{m^2 K}$$

Radiative heat transfer bewteen fine and membrane is ignored due to minimal temperature difference and their dominating heat conduction

Comment: h_r (fin to sky), in either case, is very small compared to h_r (membrane to sky) (1.5-8.9%), thus to simply the analysis and calculation the fin's radiative heat exchange with the sky is ignored. The majority of the heat transferring from copper fin to sky will be through the membrane.

Convetive heat tranfer conditions:

Air Prandtl number at 300K

$Pr := 0.708$

Roof total length:

$L_{roof} := 17ft$

Air dynamic viscosity at 300K

$$\nu_{air} := 15.69 \cdot 10^{-6} \frac{m^2}{s}$$

North Carolina average wind speed

$$v_{wind} := 10.853 \frac{ft}{s}$$

Reynolds number at roof edge L

$$Re_{L.roof} := \frac{v_{wind} \cdot L_{roof}}{\nu_{air}} = 1.092 \times 10^{6}$$

Average Nusselt number at roof

$$Nu_{avg} := 0.664 \cdot Re_{L.roof}^{0.5} \cdot Pr^{0.333} = 618.631$$

Air thermal conductivity at 300K

$$k_{air} := 0.02624 \frac{W}{m \cdot K}$$

Average convective heat transfer coefficient at roof:

$$h_{avg} := Nu_{avg} \cdot \frac{k_{air}}{L_{roof}} = 3.133 \cdot \frac{W}{m^2 \cdot K}$$

Conductive heat transfer conditions:

PVC membrane

$$t_m := 0.06in = 1.524 \times 10^{-3} m$$

Tube fine thickness

$$t_f := 0.01in = 2.54 \times 10^{-4} m$$

Copper thermal conductivity

$$k_{cop} := 401 \frac{W}{m \cdot K}$$

(http://www.engineeringtoolbox.com/thermal-conductivity-d_429.html)

Thermal conductivity for PVC membrane as composite material

$$k_{mem} := 0.15 \frac{W}{m \cdot K}$$

(source: Sika's engineer answer)

Energy governing equation on PVC membrane (balanced state):

Q_conduction + Q_convection + Q_radiation = 0

Find: the steady state heat transfer rate from roof fintubes that are covered by adhering PVC membrane.

Calculation

Average fin radiative heat transfer through membrane sheild (small):

$$q_{rad\_fin1} := h_{r1} \cdot (T_f - T_{sky1}) = 0.725 \cdot \frac{W}{m^2}$$

$$q_{rad\_fin2} := h_{r2} \cdot (T_f - T_{sky2}) = 0.444 \cdot \frac{W}{m^2}$$

$$q_{rad\_fin3} := h_{r3} \cdot (T_f - T_{sky3}) = 0.079 \cdot \frac{W}{m^2}$$

thermal resistance of copper fin:

$$R_{fin} := \frac{t_f}{k_{cop}} = 6.334 \times 10^{-7} \cdot \frac{m^2 \cdot K}{W}$$

thermal resistance of PVC membrane

$$R_{mem} := \frac{t_m}{k_{mem}} = 0.01 \cdot \frac{m^2 \cdot K}{W}$$

comparing two thermal resistance:

$$\frac{R_{mem}}{R_{fin}} = 1.604 \times 10^{4}$$

Due to copper's high thermal conductivity, temperature of the fin bottom surface (i.e. junction part with the tube) can be regarded as the same as fluid's. T_fin_bottom=T_f

Three steady state membrane top surface temperatures (iterated to converge):

$$T_{mem\_ss1} := \frac{\left[\frac{T_f}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} + T_{amb1} \cdot h_{avg} + T_{sky1} \cdot h_{r\_mem1}\right]}{\left[\frac{1}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} + h_{avg} + h_{r\_mem1}\right]} = 279.088\ K$$

$$T_{mem\_ss1} = 42.689 \cdot °F$$

$$T_{mem\_ss2} := \frac{\left[\frac{T_f}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} + T_{amb2} \cdot h_{avg} + T_{sky2} \cdot h_{r\_mem2}\right]}{\left[\frac{1}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} + h_{avg} + h_{r\_mem2}\right]} = 279.411\ K$$

$$T_{mem\_ss2} = 43.269 \cdot °F$$

$$T_{mem\_ss3} := \frac{\left[\frac{T_f}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} + T_{amb3} \cdot h_{avg} + T_{sky3} \cdot h_{r\_mem3}\right]}{\left[\frac{1}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} + h_{avg} + h_{r\_mem3}\right]} = 279.819\ K$$

$$T_{mem\_ss3} = 44.004 \cdot °F$$

Comment: These 3 steady state (SS) temperatures are iterated results to converge and equate the preset membrane temperatures T_mem1, T_mem2 and T_mem3.

Conductive heat transfer rates from fin to membrane surface under 3 different ambient temperatures

$$q_{cond\_fin1} := \frac{(T_{mem\_ss1} - T_f)}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} = -17.001 \cdot \frac{W}{m^2}$$

T_amb = 60F

(negative means membrane gains heat)

$$q_{cond\_fin2} := \frac{\left(T_{mem\_ss2} - T_f\right)}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} = 14.709 \cdot \frac{W}{m^2}$$ T_amb = 69F

(positive means membrane lost heat to fin)

$$q_{cond\_fin3} := \frac{\left(T_{mem\_ss3} - T_f\right)}{\left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)} = 54.879 \cdot \frac{W}{m^2}$$ T_amb = 80F

Average comprehensive heat transfer from membrane to sky/ambience:

when T_amb= 60F

radiative heat transfer from PVC membrane to sky:

$$q_{rad\_mem1} := h_{r\_mem1} \cdot \left(T_{mem\_ss1} - T_{sky1}\right) = 47.13 \cdot \frac{W}{m^2}$$ *Positive means dissipation

Convetive heat transfer from PVC membrane to ambience:

$$q_{conv\_mem1} := h_{avg} \cdot \left(T_{mem\_ss1} - T_{amb1}\right) = -30.129 \cdot \frac{W}{m^2}$$ *Negative means gain

Double check the actual radiative heat transfer from the membrane using energy balance

$$q_{rad\_mem1\_act1} := -\left(q_{cond\_fin1} + q_{conv\_mem1}\right) = 47.13 \cdot \frac{W}{m^2}$$ (correct)

Similarly, when T_amb=69F

$$q_{rad\_mem2} := h_{r\_mem2} \cdot \left(T_{mem\_ss2} - T_{sky2}\right) = 30.074 \cdot \frac{W}{m^2}$$

$$q_{conv\_mem2} := h_{avg} \cdot \left(T_{mem\_ss2} - T_{amb2}\right) = -44.783 \cdot \frac{W}{m^2}$$

Double check with energy balance

$$q_{rad\_mem2\_act2} := -\left(q_{cond\_fin2} + q_{conv\_mem2}\right) = 30.074 \cdot \frac{W}{m^2}$$ (correct)

when T_amb=80F

$$q_{rad\_mem3} := h_{r\_mem3} \cdot \left(T_{mem\_ss3} - T_{sky3}\right) = 7.77 \cdot \frac{W}{m^2}$$

Double check with energy balance:

$$q_{conv\_mem3} := h_{avg} \cdot \left(T_{mem\_ss3} - T_{amb3}\right) = -62.649 \cdot \frac{W}{m^2}$$

$$q_{rad\_mem2\_act3} := -\left(q_{cond\_fin3} + q_{conv\_mem3}\right) = 7.77 \cdot \frac{W}{m^2} \qquad \text{(correct)}$$

in current situation, most heat conducted from fin to membrane will disspate as radiation

In English units, the three steady state heat transfer rates are:

$$q_{rad\_mem1} = 14.94 \cdot \frac{Btu}{ft^2 \cdot hr} \qquad q_{rad\_mem2} = 9.533 \cdot \frac{Btu}{ft^2 \cdot hr} \qquad q_{rad\_mem3} = 2.463 \cdot \frac{Btu}{ft^2 \cdot hr}$$

Comment: as ambient temperatures increase from 60 F to 80 F, the radiant heat transfer rate per square foot is also reduced. This is due to the reduced temperature difference between the membrane and sky.

In English units, the three steady state membrane temperatures are:

$$T_{mem\_ss1} = 42.689 \cdot °F \qquad T_{mem\_ss2} = 43.269 \cdot °F \qquad T_{mem\_ss3} = 44.004 \cdot °F$$

sky temperatures are:

$$T_{sky1} = 22.317 \cdot °F \qquad T_{sky2} = 30.665 \cdot °F \qquad T_{sky3} = 40.867 \cdot °F$$

Supplemental calculation: Radiative heat transfer based on Mark Goforth's model

Reference:

Mark. A Goforth et al., "Cloud Effects on Thermal Downwelling Sky Radiance", Proc. SPIE, Thermosense XXIV, Vol 4710-27, 2002

"Temperature and Radiation" by Mike Luciuk,

http://www.asterism.org/tutorials/tut40RadiationTutorial.pdf

Given

Relative humidity (June) $RH := 70$ Cloud Cover - (summer average) $C_c := 0.3$

Cloud height factor - Moderate (Luciuk) $K_c := 0.18$

Governing equation of radiative heat transfer in this model turns to be:

Q_net = Q_loss +Q_gain

Calculation

Name membrane temperature differently with 3 different ambient temperatures

compare with presive resutls :

$T_{sur1} := 271.904K$ $T_{sur1} = 29.757 \cdot °F$ $T_{mem\_ss1} = 279.088\ K$ $T_{mem\_ss1} = 42.689 \cdot °F$

$T_{sur2} := 272.476K$ $T_{sur2} = 30.787 \cdot °F$ $T_{mem\_ss2} = 279.411\ K$ $T_{mem\_ss2} = 43.269 \cdot °F$

$T_{sur3} := 273.187K$ $T_{sur3} = 32.067 \cdot °F$ $T_{mem\_ss3} = 279.819\ K$ $T_{mem\_ss3} = 44.004 \cdot °F$

q_loss is defined as follows in Goforth's model

$$q_{loss1} := \varepsilon_{mem} \cdot \sigma \cdot T_{sur1}^{4} = 278.925 \cdot \frac{W}{m^2} \qquad q_{loss2} := \varepsilon_{mem} \cdot \sigma \cdot T_{sur2}^{4} = 281.28 \cdot \frac{W}{m^2}$$

$$q_{loss3} := \varepsilon_{mem} \cdot \sigma \cdot T_{sur3}^{4} = 284.227 \cdot \frac{W}{m^2}$$

q_gain is defined as follows in Goforth's model:

$$q_{gain1} := \left(1 - \rho_{mem\_w}\right) \cdot \left(1 + K_c \cdot C_c^{2}\right) \cdot 8.78 \cdot 10^{-13} \cdot \left(\frac{T_{sky1}}{K}\right)^{5.852} \cdot RH^{0.07195} \cdot \frac{W}{m^2} = 33.185 \cdot \frac{W}{m^2}$$

$$q_{gain2} := \left(1 - \rho_{mem\_w}\right)\cdot\left(1 + K_c\cdot C_c^{\,2}\right)\cdot 8.78\cdot 10^{-13}\cdot\left(\frac{T_{sky2}}{K}\right)^{5.852}\cdot RH^{0.07195}\cdot\frac{W}{m^2} = 36.693\cdot\frac{W}{m^2}$$

$$q_{gain3} := \left(1 - \rho_{mem\_w}\right)\cdot\left(1 + K_c\cdot C_c^{\,2}\right)\cdot 8.78\cdot 10^{-13}\cdot\left(\frac{T_{sky3}}{K}\right)^{5.852}\cdot RH^{0.07195}\cdot\frac{W}{m^2} = 41.393\cdot\frac{W}{m^2}$$

The energy balance equation requires to solve a non-linear equation with T^4, where the non-linear equation coefficients are:

$$C_1 := \varepsilon_{mem}\cdot\sigma = 5.103\times 10^{-8}\,\frac{kg}{K^4\cdot s^3} \qquad C_2 := h_{avg} + \frac{1}{\left(\frac{t_m}{k_{mem}} + \frac{t_f}{k_{cop}}\right)} = 101.552\,\frac{kg}{K\cdot s^3}$$

when T_amb=60F

$$C_3 := -q_{gain1} - \frac{T_f}{\frac{t_m}{k_{mem}} + \frac{t_f}{k_{cop}}} - h_{avg}\cdot T_{amb1} = -2.842\times 10^{4}\,\frac{kg}{s^3}$$

comment: exact T_sur as solution should make right side of equation be zero, a numerical value should get right side value as close to zero within allowed precision:

$$C_1\cdot T_{sur1}^{\,4} + C_2\cdot T_{sur1} + C_3 = -530.976\,\frac{kg}{s^3}$$

when T_amb=69F

$$C_4 := -q_{gain2} - \frac{T_f}{\frac{t_m}{k_{mem}} + \frac{t_f}{k_{cop}}} - h_{avg}\cdot T_{amb2} = -2.844\times 10^{4}\,\frac{kg}{s^3}$$

$$C_1\cdot T_{sur2}^{\,4} + C_2\cdot T_{sur2} + C_4 = -489.705\,\frac{kg}{s^3}$$

when T_amb=80F

$$C_5 := -q_{gain3} - \frac{T_f}{\frac{t_m}{k_{mem}} + \frac{t_f}{k_{cop}}} - h_{avg}\cdot T_{amb3} = -2.847\times 10^{4}\,\frac{kg}{s^3}$$

$$C_1\cdot T_{sur3}^{\,4} + C_2\cdot T_{sur3} + C_5 = -438.399\,\frac{kg}{s^3}$$

compare model based on h_r:

$$q_{netlossRAD1} := q_{loss1} - q_{gain1} = 245.74 \cdot \frac{W}{m^2} \qquad q_{rad\_mem1} = 47.13 \cdot \frac{W}{m^2}$$

$$q_{netlossRAD2} := q_{loss2} - q_{gain2} = 244.587 \cdot \frac{W}{m^2} \qquad q_{rad\_mem2} = 30.074 \cdot \frac{W}{m^2}$$

$$q_{netlossRAD3} := q_{loss3} - q_{gain3} = 242.835 \cdot \frac{W}{m^2} \qquad q_{rad\_mem3} = 7.77 \cdot \frac{W}{m^2}$$

Radiative energy difference between the two models:

$$\sigma 1\% := \frac{\left(q_{netlossRAD1} - q_{rad\_mem1}\right)}{q_{netlossRAD1}} \cdot 100 = 80.821$$

$$\sigma 2\% := \frac{\left(q_{netlossRAD2} - q_{rad\_mem2}\right)}{q_{netlossRAD2}} \cdot 100 = 87.704$$

$$\sigma 3\% := \frac{\left(q_{netlossRAD3} - q_{rad\_mem3}\right)}{q_{netlossRAD3}} \cdot 100 = 96.8$$

Membrane surface temperature between the two models:

$$\sigma 4\% := \frac{\left(T_{mem\_ss1} - T_{sur1}\right)}{T_{sur1}} \cdot 100 = 2.642 \qquad \sigma 5\% := \frac{\left(T_{mem\_ss2} - T_{sur2}\right)}{T_{sur2}} \cdot 100 = 2.545$$

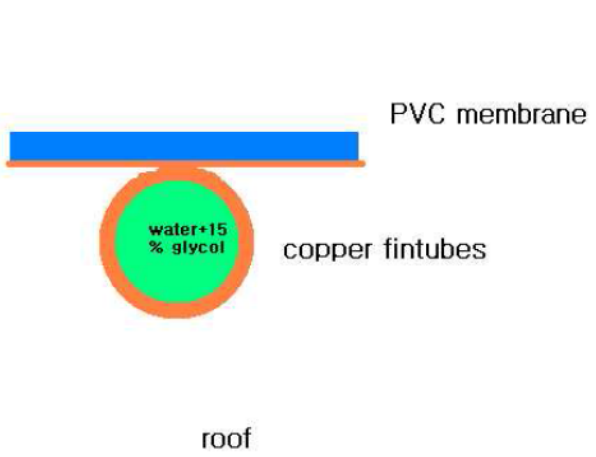
$$\sigma 6\% := \frac{\left(T_{mem\_ss3} - T_{sur3}\right)}{T_{sur3}} \cdot 100 = 2.428$$

Comment: while the temperature differences between the two models are small under 3 ambitent temperatures, the radiative heat transfer rates from membrane in the two models matches with larger gaps.

B.4-2 ROOFTOP HEAT EXCHANGER CALCULATIONS (Q → T)

Gengbei Shi Solar Decathlon: Date: 02-011-2013
James Polk Fintubes as roof radiant cooling system (Reverse: from Q_rad to T_f)

Schematic cross-sectional view of roof membran+fintube composite structure



Given conditions:

Sky emissivity

$\varepsilon_{sky} := 0.74$

Stefan-Boltzmann constant

$\sigma := 5.67 \cdot 10^{-8} \frac{W}{m^2 \cdot K^4}$

Three ambient air temperatures

$T_{amb1} := 60\,°F = 288.706\,K$ $T_{amb2} := 69\,°F = 293.706\,K$ $T_{amb3} := 80\,°F = 299.817\,K$

Sky background temperature with cloud coverage (based on Goforth's model)

$T_{sky1} := \varepsilon_{sky}^{.25} \cdot T_{amb1} = 267.771\,K$ $T_{sky2} := \varepsilon_{sky}^{.25} \cdot T_{amb2} = 272.408\,K$

$T_{sky3} := \varepsilon_{sky}^{0.25} \cdot T_{amb3} = 278.076\,K$

10-90 PG-water freezing point: 26F

In English units:

$T_{sky1} = 22.317 \cdot °F$ $T_{sky2} = 30.665 \cdot °F$ $T_{sky3} = 40.867 \cdot °F$

Copper fintube surface emissivity

$\varepsilon_{cop} := 0.08$

G 410 EnergySmart White membrane solar reflectance

$\rho_{mem\_w} := 0.1$

Vendor's weighted solar refelctance is 0.83 , the value here is conservative for night sky radiation.

Preset total heat loss Q_rad per pod $Q_{rad1} := 7900\frac{Btu}{hr}$ $Q_{rad2} := 7100\frac{Btu}{hr}$ $Q_{rad3} := 6300\frac{Btu}{hr}$

Total fintubes top surface area per pod (1 AE-24 abosorber plates per pod and 2 pods total)

$A_{plates} := 3 \cdot 2 \cdot 44.225 \cdot 118.625 in^2 = 20.308\, m^2$

$A_{plates} = 218.591 \cdot ft^2$

Density of 10% PG-water $\rho := 62.899\frac{lbm}{ft^3}$

Heat capacity of 10% PG-water $C_p := 0.98\frac{Btu}{lbm \cdot (\Delta°F)}$

Preset roof radiative heat transfer rate:

PVC membrane emissivity $\varepsilon_{mem} := 0.90$

$q_{rad1} := \frac{Q_{rad1}}{A_{plates}} = 114.009 \cdot \frac{W}{m^2}$

$q_{rad2} := \frac{Q_{rad2}}{A_{plates}} = 102.463 \cdot \frac{W}{m^2}$

$q_{rad3} := \frac{Q_{rad3}}{A_{plates}} = 90.918 \cdot \frac{W}{m^2}$

Relative humidity (June) $RH := 70$

Cloud Cover - (**NC** summer average) $C_c := 0.3$

Cloud height factor - Moderate (Luciuk) $K_c := 0.18$

Governing equation of radiative heat transfer in this model turns to be:

Q_net = Q_loss +Q_gain

q_gain is defined as follows in Goforth's model:

$$q_{gain1} := (1 - \rho_{mem\_w}) \cdot 8.78 \cdot 10^{-13} \cdot \left(\frac{T_{sky1}}{K}\right)^{5.852} \cdot RH^{0.07195} \cdot \frac{W}{m^2} = 172.887 \cdot \frac{W}{m^2}$$

$$q_{gain2} := (1 - \rho_{mem\_w}) \cdot 8.78 \cdot 10^{-13} \cdot \left(\frac{T_{sky2}}{K}\right)^{5.852} \cdot RH^{0.07195} \cdot \frac{W}{m^2} = 191.161 \cdot \frac{W}{m^2}$$

$$q_{gain3} := (1 - \rho_{mem\_w}) \cdot 8.78 \cdot 10^{-13} \cdot \left(\frac{T_{sky3}}{K}\right)^{5.852} \cdot RH^{0.07195} \cdot \frac{W}{m^2} = 215.644 \cdot \frac{W}{m^2}$$

(another method to calculate q_gain)

$$q_{gain4} := \left(1 - \rho_{mem\_w}\right)\varepsilon_{sky}\cdot\sigma\cdot T_{sky1}^{4} = 194.138\cdot\frac{W}{m^2}$$

$$q_{gain5} := \left(1 - \rho_{mem\_w}\right)\cdot\varepsilon_{sky}\cdot\sigma\cdot T_{sky2}^{4} = 207.94\cdot\frac{W}{m^2}$$

$$q_{gain6} := \left(1 - \rho_{mem\_w}\right)\cdot\varepsilon_{sky}\cdot\sigma\cdot T_{sky3}^{4} = 225.794\cdot\frac{W}{m^2}$$

$$T_{mem1} := \left(\frac{q_{rad1} + q_{gain1}}{\varepsilon_{mem}\cdot\sigma}\right)^{0.25} = 273.826\,K \qquad T_{mem1} = 33.216\cdot°F$$

$$T_{mem2} := \left(\frac{q_{rad2} + q_{gain2}}{\varepsilon_{mem}\cdot\sigma}\right)^{0.25} = 275.418\,K \qquad T_{mem2} = 36.082\cdot°F$$

$$T_{mem3} := \left(\frac{q_{rad3} + q_{gain3}}{\varepsilon_{mem}\cdot\sigma}\right)^{0.25} = 278.403\,K \qquad T_{mem3} = 41.455\cdot°F$$

Convetive heat tranfer conditions:

Air Prandtl number at 300K

$$Pr := 0.708$$

Roof total length:

$$L_{roof} := 17ft$$

Air dynamic viscosity at 300K

$$\nu_{air} := 15.69\cdot 10^{-6}\,\frac{m^2}{s}$$

North Carolina average wind speed

Reynolds number at roof edge L

$v_{wind} := 10.853 \frac{ft}{s}$

$Re_{L.roof} := \frac{v_{wind} \cdot L_{roof}}{\nu_{air}} = 1.092 \times 10^{6}$

Average Nusselt number at roof

$Nu_{avg} := 0.664 \cdot Re_{L.roof}^{0.5} \cdot Pr^{0.333} = 618.631$

Air thermal conductivity at 300K

$k_{air} := 0.02624 \frac{W}{m \cdot K}$

Average convective heat transfer coefficient at roof:

$h_{avg} := Nu_{avg} \cdot \frac{k_{air}}{L_{roof}} = 3.133 \cdot \frac{W}{m^2 \cdot K}$

Conductive heat transfer conditions:

PVC membrane

$t_m := 0.06in = 1.524 \times 10^{-3} m$

Tube fine thickness

$t_f := 0.01in = 2.54 \times 10^{-4} m$

Copper thermal conductivity

$k_{cop} := 401 \frac{W}{m \cdot K}$

(http://www.engineeringtoolbox.com/thermal-conductivity-d_429.html)

Conservative estimate of thermal conductivity for PVC membrane as composite material

$k_{mem} := 0.15 \frac{W}{m \cdot K}$ (Source: Sika engineer's answer)

Energy governing equation on PVC membrane (balanced state):

Q_conduction + Q_convection + Q_radiation = 0

$T_{f1} := \left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}} \right) \cdot \left[h_{avg} \cdot \left(T_{mem1} - T_{amb1} \right) + q_{rad1} \right] + T_{mem1} = 274.511 K$

$T_{f1} = 34.449 \cdot °F$

$T_{amb1} = 60 \cdot °F$

$T_{f2} := \left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}} \right) \cdot \left[h_{avg} \cdot \left(T_{mem2} - T_{amb2} \right) + q_{rad2} \right] + T_{mem2} = 275.877 K$

$T_{f2} = 36.908 \cdot °F$

$T_{amb2} = 69 \cdot °F$

$$T_{f3} := \left(\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}\right)\cdot\left[h_{avg}\cdot\left(T_{mem3} - T_{amb3}\right) + q_{rad3}\right] + T_{mem3} = 278.645\ K$$

$$T_{f3} = 41.891\cdot °F$$

$$T_{amb3} = 80\cdot °F$$

$$T_{i\_f1} := 37.5\ °F$$

$$T_{o\_f1} := 2\cdot T_{f1} - T_{i\_f1} = 31.398\cdot °F \qquad m_{dot1} := \frac{Q_{rad1}}{C_p\cdot\left(T_{i\_f1} - T_{o\_f1}\right)} = 22.018\cdot\frac{lbm}{min}$$

$$T_{i\_f2} := 41\ °F$$

$$T_{o\_f2} := 2T_{f2} - T_{i\_f2} = 32.816\cdot °F \qquad m_{dot2} := \frac{Q_{rad2}}{C_p\cdot\left(T_{i\_f2} - T_{o\_f2}\right)} = 14.754\cdot\frac{lbm}{min}$$

$$T_{i\_f3} := 44.5\ °F$$

$$T_{o\_f3} := 2T_{f3} - T_{i\_f3} = 39.281\cdot °F \qquad m_{dot3} := \frac{Q_{rad3}}{C_p\cdot\left(T_{i\_f3} - T_{o\_f3}\right)} = 20.53\cdot\frac{lbm}{min}$$

$$V_{dot} := \frac{m_{dot3}}{\rho} = 2.442\cdot\frac{gal}{min}$$

Important: EnergySmart White membrane IR transmissivities (low as 0 or high as 1)

$$q_{cond1} := \frac{T_{mem1} - T_{f1}}{\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}} = -67.393\cdot\frac{W}{m^2}$$

$$q_{conv1} := h_{avg}\cdot\left(T_{mem1} - T_{amb1}\right) = -46.615\cdot\frac{W}{m^2} \qquad -\left(q_{cond1} + q_{conv1}\right) = 114.009\cdot\frac{W}{m^2}$$

$$q_{cond2} := \frac{T_{mem2} - T_{f2}}{\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}} = -45.171\cdot\frac{W}{m^2}$$

$$q_{conv2} := h_{avg}\cdot\left(T_{mem2} - T_{amb2}\right) = -57.292\cdot\frac{W}{m^2} \qquad -\left(q_{cond2} + q_{conv2}\right) = 102.463\cdot\frac{W}{m^2}$$

$$q_{cond3} := \frac{T_{mem3} - T_{f3}}{\frac{t_f}{k_{cop}} + \frac{t_m}{k_{mem}}} = -23.832 \cdot \frac{W}{m^2}$$

$$q_{conv3} := h_{avg} \cdot (T_{mem3} - T_{amb3}) = -67.086 \cdot \frac{W}{m^2} \qquad -(q_{cond3} + q_{conv3}) = 90.918 \cdot \frac{W}{m^2}$$

Rough estimate of fin top surface temperature (neglecting radiation heat transfer between membrane and fin):

$$T_{fin1} := q_{cond1} \cdot \left(\frac{t_m}{k_{mem}}\right) + T_{mem1} = 273.141\,K$$

$$T_{fin2} := q_{cond2} \cdot \left(\frac{t_m}{k_{mem}}\right) + T_{mem2} = 274.959\,K$$

$$T_{fin3} := q_{cond3} \cdot \left(\frac{t_m}{k_{mem}}\right) + T_{mem3} = 278.16\,K$$

Rough estimation of heat emitted from fin to sky:

PVC membrane transmissivity

lower end: $\tau_0 := 0$ This is the real case and is already considered in previous calculations

upper end: $\tau_1 := 1$

$$q_{rad1\_fin2sky} := 4\varepsilon_{cop} \cdot \tau_1 \cdot \sigma \cdot \left(\frac{T_{fin1} + T_{sky1}}{2}\right)^3 \cdot (T_{fin1} - T_{sky1}) = 1.928 \cdot \frac{W}{m^2}$$

$$q_{rad2\_fin2sky} := 4\varepsilon_{cop} \cdot \tau_1 \cdot \sigma \cdot \left(\frac{T_{fin2} + T_{sky2}}{2}\right)^3 \cdot (T_{fin2} - T_{sky2}) = 0.949 \cdot \frac{W}{m^2}$$

$$q_{rad3\_fin2sky} := 4\varepsilon_{cop} \cdot \tau_1 \cdot \sigma \cdot \left(\frac{T_{fin3} + T_{sky3}}{2}\right)^3 \cdot (T_{fin3} - T_{sky3}) = 0.033 \cdot \frac{W}{m^2}$$

ratio to radiative heat transfer into the sky:

$$\frac{q_{rad1\_fin2sky}}{q_{rad1}} = 0.017 \qquad \frac{q_{rad2\_fin2sky}}{q_{rad2}} = 9.258 \times 10^{-3} \qquad \frac{q_{rad3\_fin2sky}}{q_{rad3}} = 3.622 \times 10^{-4}$$

CONCLUSION: RADIATIVE HEAT TRANSFER FROM FIN TO SKY DIRECTLY THROUGH MEMBRANE CAN BE NEGLECTED DUE TO ITS VERY SMALL QUANTITY EVEN AT THE CASE OF THE MOST TANSMISSIVE MEMBRANE.

Appendix C: Product Data Sheet

Intus Windows

PHPP INPUTS

Intus Premmier 78 Alu, Cora

#	Type Frame	U_f-Value Frame	R_f-Value Frame	Frame Dimensions* Width - Left	 Width - Right	 Width - Below	 Width - Above	Thermal Bridge Y_{Spacer}
		BTU/hr.ft^2.F	hr.ft^2.F/BTU	in	in	in	in	BTU/hr.ft.°F
1	**Premmier 78 Alu (tilt/turn), jambs, head**	**0.211**	**4.74**	**4.65**	**4.65**	**n/a**	**4.65**	**0.0220**
1	**Premmier 78 Alu (tilt/turn), sill with cut out**	**0.282**	**3.55**	**n/a**	**n/a**	**5.79**	**n/a**	**0.0220**
2	**Premmier 78 Alu (fixed)**	**0.211**	**4.74**	**3.19**	**3.19**	**3.19**	**3.19**	**0.0220**

*installation gap size 3/8" to 1/2" is not included in the frame dimension and need to be added by user.

** installation psi value needs to be determined and entered by PHPP user.

Glazing inputs

#	Type Glazing options	SHGC*	U_g-Value	R_g-Value	VT, %
	High SHGC		BTU/hr.ft^2.F	hr.ft^2.F/BTU	
	Triple Glazing				
1	SuperH4x18x4x20x4 Low E	**0.621**	**0.123**	**8.13**	**0.733**
4	4LowE x16x4x16x4Low E	**0.494**	**0.106**	**9.43**	**0.709**
	Low SHGC				
1	Sunguard6x18x4x18x4Low E	**0.369**	**0.106**	**9.43**	**0.619**

*- SHGC for glazing only

**- more glazing options available upon request.

***- All calculations compliant with EU , EN 410, EN 673 and EN 12412:2003 calculation standards.

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INSTALLATION GUIDE

Tilt/turn Windows
Balcony doors
Bi-fold doors
Tilt/slide doors
Lift/slide doors (see supplement guide)

Installer and Builder Information
* Always provide a copy of these instructions for the current or future building owner.

WARNING:
* If your abilities do not match this procedure's requirements, contact an experienced contractor.

* Every wall assembly and installation is different. Please consult Intus Windows supplier, contractor, architect or structural engineer prior to the product installation. Intus Windows has no responsibility to the post-manufactured assembly and installation of Intus products.

* Unless specifically ordered, Intus windows and doors are not equipped with safety glass and if broken, could fragment causing injury. Many laws and building codes require safety glass in locations adjacent to or near doors. Intus windows and doors are available with safety glass that may reduce the likelihood of injury when broken.

* Laminated safety glass is not standard and must be special ordered. Check your local building code.

* Do not apply any type of film to glass. Thermal stress conditions resulting in glass damage could occur.

* Metal fasteners and other hardware components may corrode when exposed to preservative treated lumber. Obtain and use the appropriate metal fasteners and hardware. Failure to use the appropriate materials for the installation may cause a failure resulting in injury, property or product damage.

* Follow instruction from sealant and flashing manufacturer regarding material application and compatibility with this product.

* Do not carry door unit horizontally, exterior side down. Door panels may swing open causing product damage and/or severe injury.

* Plan sizing of rough opening and clearance from exterior finishing systems to allow for normal materials shrinkage or shifting (e.g. wood structure with brick veneer; allow adequate clearance at sill).

* Refer to the Technical Installation requirements section for technical specifications regarding the installation of this product. These installation requirements as well as the details in this section must be followed to achieve the advertised design pressure (DP) rating of this product.

* It is the responsibility of the builder, installer and subcontractors to protect the interior and exterior of windows or doors from contact with harsh chemical washes, construction material contamination and moisture. Damage to glazing, hardware, weather strip and cladding/wood can occur. Protect with painters tape and/or protective sheathing as required. Follow all guidelines regarding material use, preparation, personal safety and disposal.

Warning
Always practice safety! Wear the appropriate eye, ear and hand protection, especially when working with power tools.

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Tools required for installation:

1. **Drill**
2. **Hammer drill**
3. **Drill**
4. **4‘ Level**
5. **Glass handling tool with suction cups.**
6. **Shims, blocks**
7. **Foam gun**
8. **Soft rubber hammer**
9. **Flat and Philips screw driver**
10. **Drill bit for metal Ø 1/4“ in diameter and drill bit for wood or concrete Ø 1/4“ in diameter .**
11. **Tape measure**
12. **Pencil**
13. **Putty knife**
14. **Pry bar**

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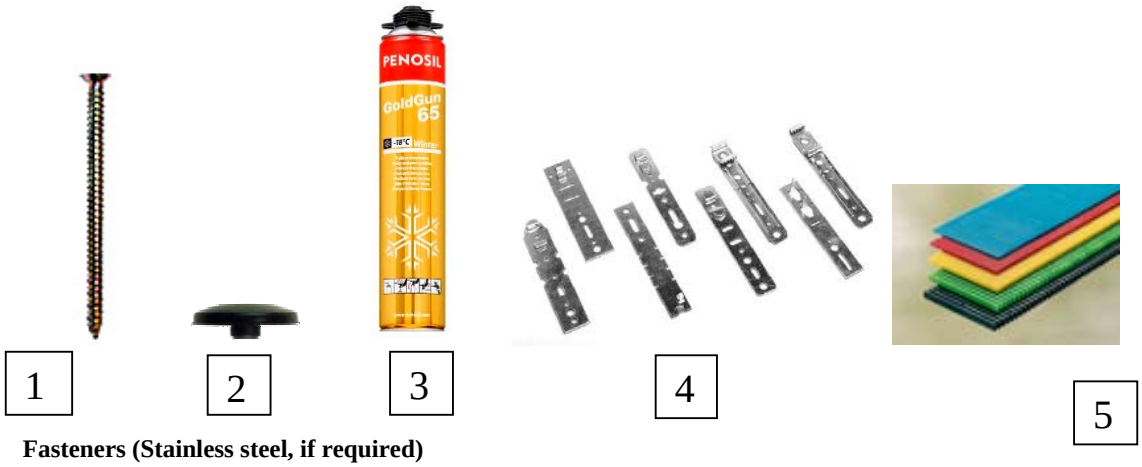
Supplies required for installation:



1. **Fasteners (Stainless steel, if required)**
2. **Screw caps**
3. **Low expanding foam**
4. **Mounting brackets**
5. **Shims**
6. **Sealant**

Requirements for the rough opening:

- No chips, hollows, grout deposits and other particles larger (deeper) than 6/32" (5 mm) shall be present at the edges and surfaces of external and internal reveals;

Surfaces contaminated with grease shall be degreased. Dry parts of surfaces shall be treated by means of binding substances.

- Before using insulating materials, dust and mud shall be cleaned off of erection spaces, window holes and structural surfaces, and in winter – snow, ice, white frost shall be cleaned off, the surface shall be heated.

Rough opening shall have 3/8" to 5/8" installation gap on all sides.

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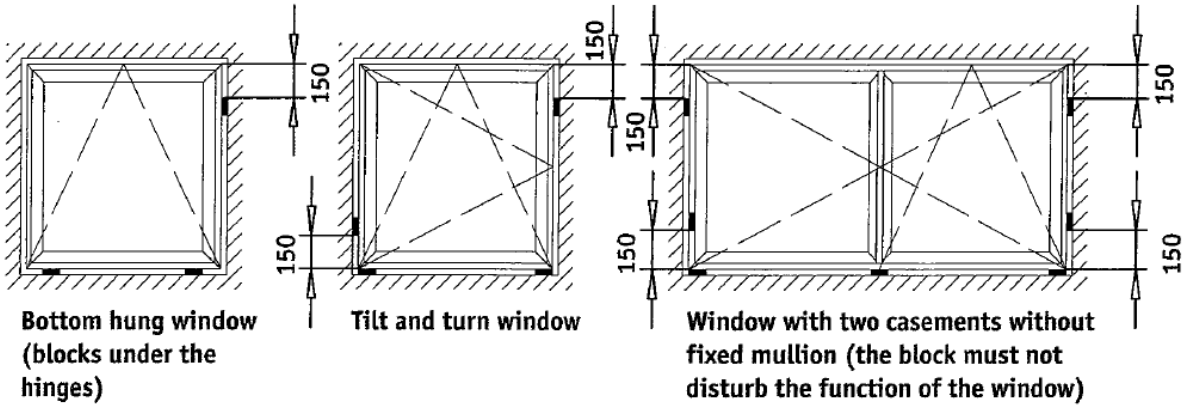
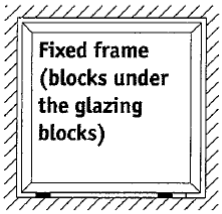
Placement of bearing blocks during installation of windows:
150 mm= 5 29/32"inch





Step 1

Place blocks

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Step 2
Place window on the blocks. Use shims and rubber hammer to hold window in place.

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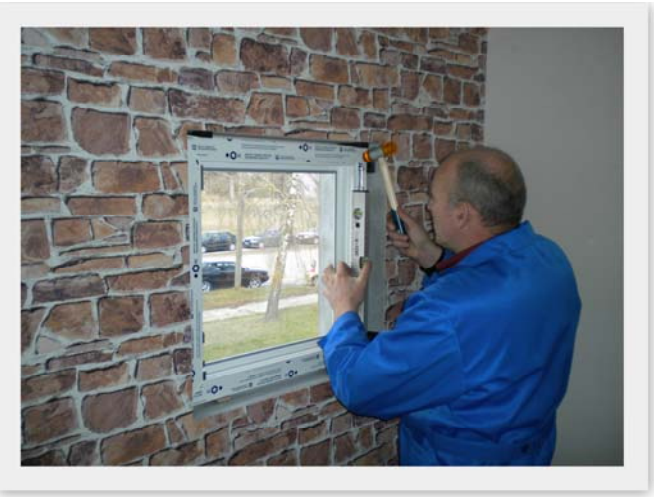
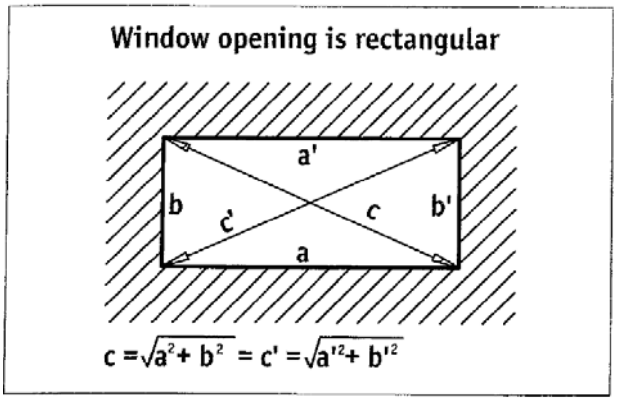
Step 3
Make sure window is level, plumb and rectangular.




Measurement of diagonals:



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Placement of fastening points:

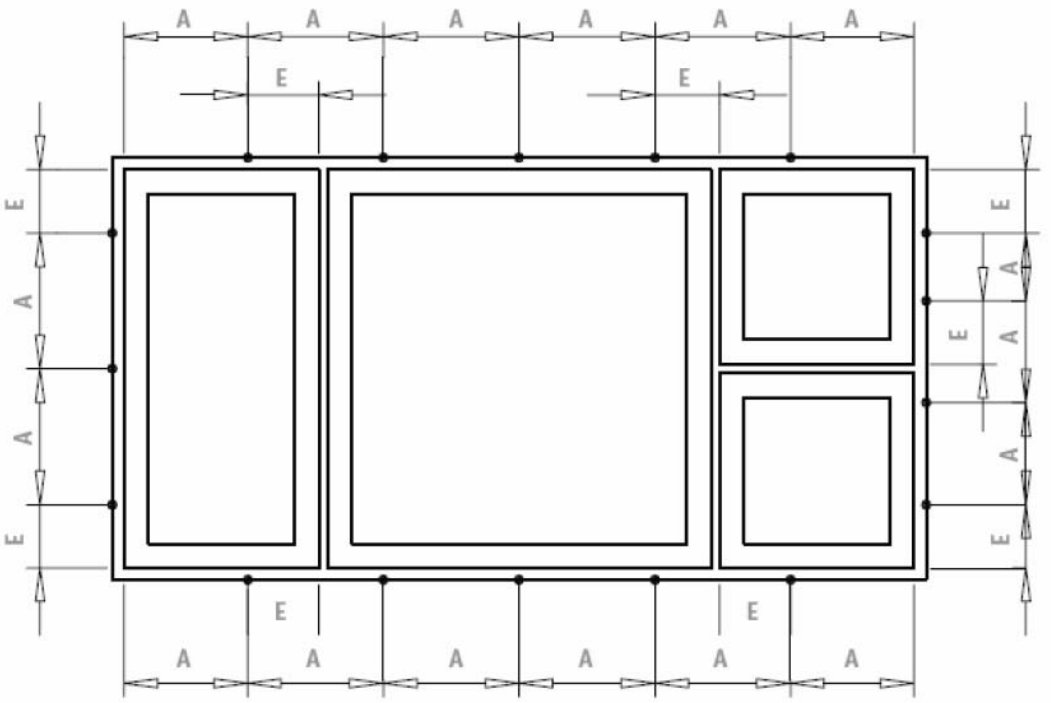
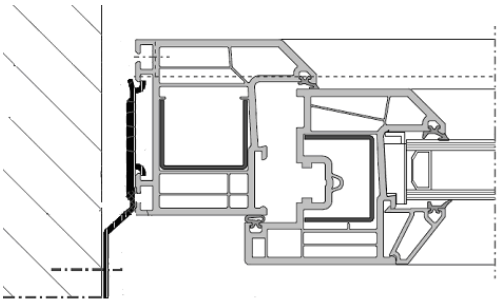


Fig. 1.
* - Fastening points
A – Distance between fastenings points shall not exceed 27 1/2” (700 mm)
E – Distance between window corner and fastener should be more than 5 7/8” (150mm) and shall not exceed 7 7/8” (200mm)

Usage of fastening parts

The product may be fastened in the rough opening by means of special mounting brackets that are hooked to the frame, or by mounting dowels/screws directly through the frame. Both mounting methods are acceptable.



It is very important not to deform the frame during the mounting of the product. In case of mounting by means of dowels, dowels located at the bottom of the frame shall be properly sealed in order to prevent water accumulation.

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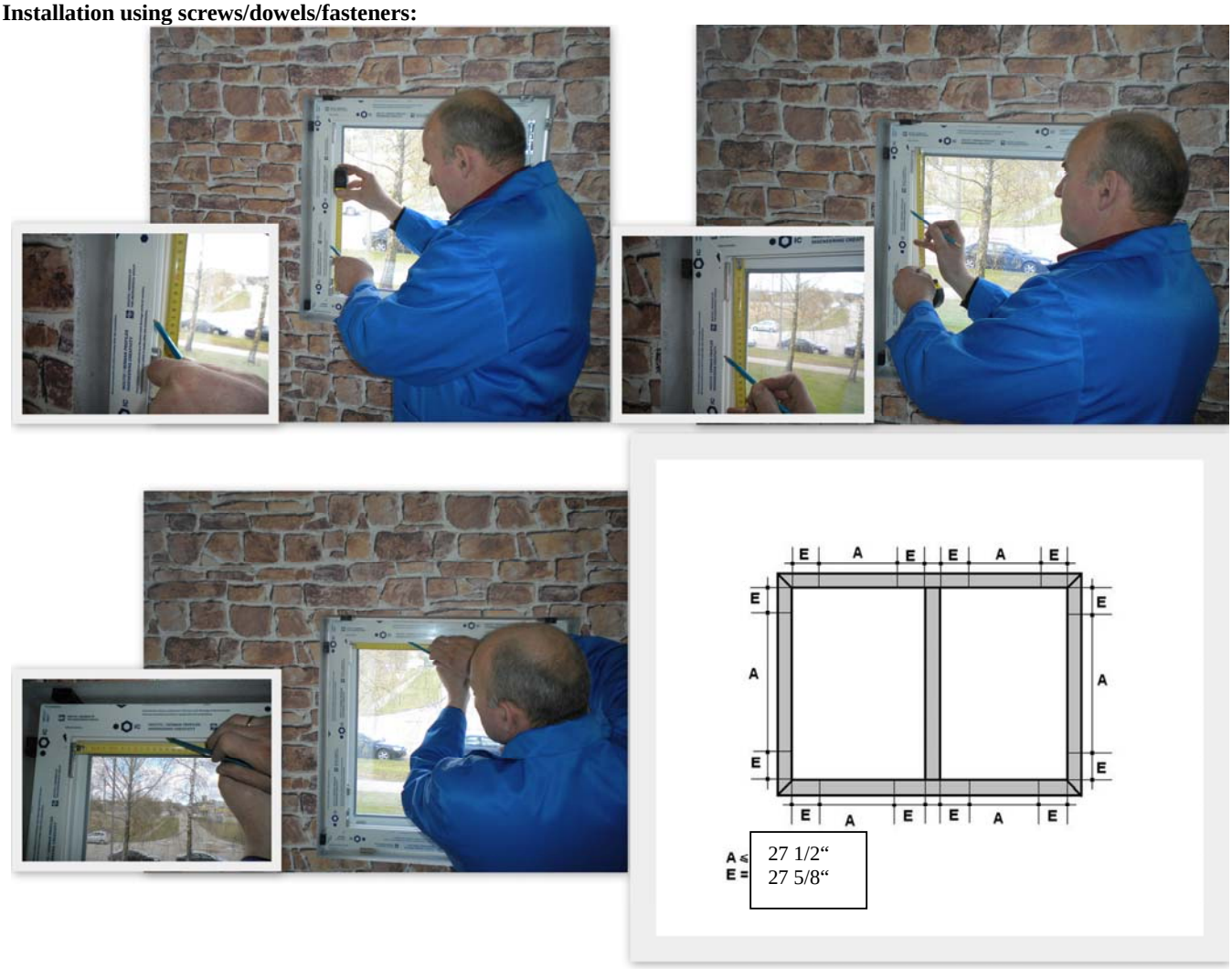
Step 4
Installation using screws/dowels/fasteners:



Mark fastener location.

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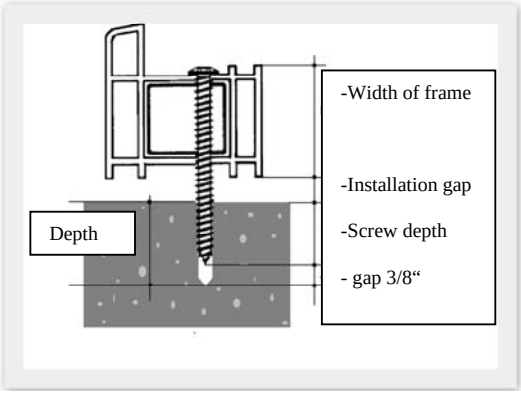
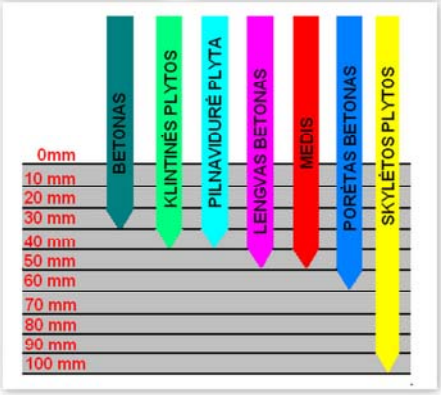
Step 5

Using Ø ¼“ drill bit pre-drill pilot holes.
Window frames are steel reinforced. Use appropriate drill bit for pilot holes.





Using Ø ¼“ drill bit pre-drill pilot holes.
Securing of fastening parts to the wall is very important.
Always follow recommendations to secure the product subject to the type of wall, where:
Concrete; 1 6/32” (30mm)
Solid brick; 1 18/32” (40mm)
Limestone brick; 1 18/32” (40mm)
Lightweight concrete; 2” (50mm)
Timber; 2” (50mm)
Hollow bricks; 2 12/32” (60mm)

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Step 6
Install appropriate fasteners. Do not over tighten.

Install screw covers.

Never force window handle! If excessive force is used hardware might become damaged and unrepairable.
If installation was performed correct window hardware should operate smoothly.
Always check window and hardware operation after securing the screws.
All windows come adjusted from the factory. After installation window and hardware has to operate smooth and easy.

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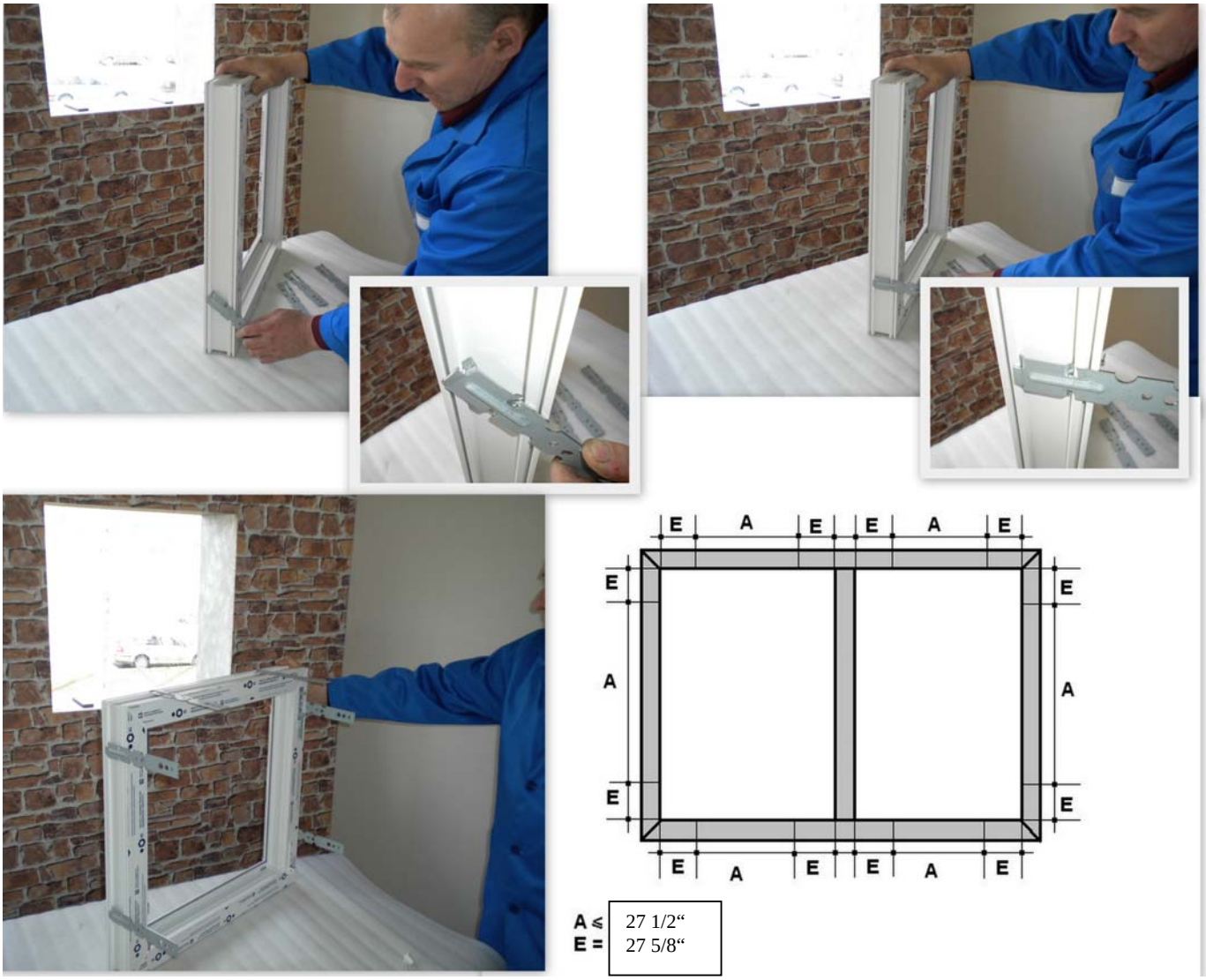
Installation using brackets

Attention:
Always use screws instead of brackets in following product installation:
Balcony door, Bi-fold door, Tilt/slide door, Lift/slide door, Entry.

Repeat steps 1 to 2
Step 3
Mount brackets on the window frame.



A ≤	27 1/2“
E =	27 5/8“

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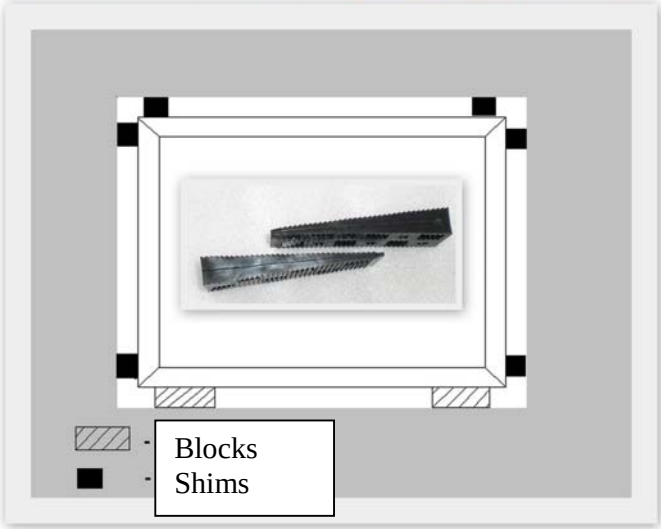
Step 4

Place window on the blocks. Use shims and rubber hammer to hold window in place.



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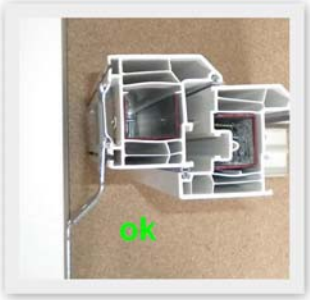
Step 5

Bend mounting brackets.



Bend mounting brackets.

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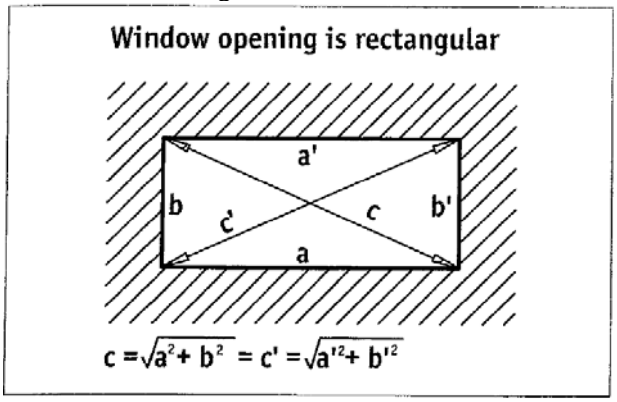
Step 6

Make sure window is level, plumb and rectangular.
Measurement of diagonals:



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Step 7

Using Ø ¼“ drill bit pre-drill pilot holes for brackets.
Securing of fastening parts to the wall is very important.
Always follow recommendations to secure the product subject to the type of wall, where:
Concrete; 1 6/32” (30mm)
Solid brick; 1 18/32” (40mm)
Limestone brick; 1 18/32” (40mm)
Lightweight concrete; 2” (50mm)
Timber; 2” (50mm)
Hollow bricks; 2 12/32” (60mm)

Always use appropriate fasteners depending on the wall material.

Never force window handle! If excessive force is used hardware might become damaged and unrepairable.
If installation was performed correct window hardware should operate smoothly.
Always check window and hardware operation after securing the screws.
All windows come adjusted from the factory. After installation window and hardware has to operate smooth and easy.

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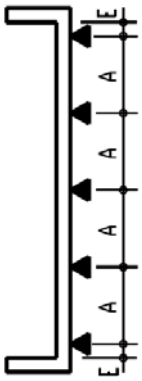
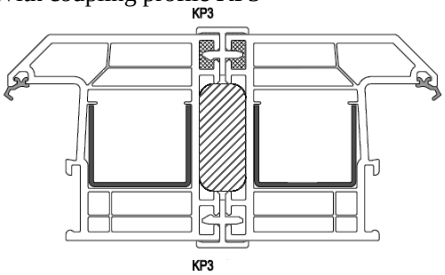
Attachment of coupling profiles (see complimentary guide):

General requirements:

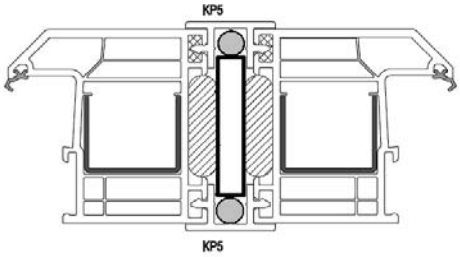
Careful sealing with silicone is necessary on the outside. The side with "tags" shall be placed first in order to prevent falling out. After attaching the second part both items shall be fastened with screws: E dimension 5 7/8" (150mm), A dimension not more than 27.5" (700mm)



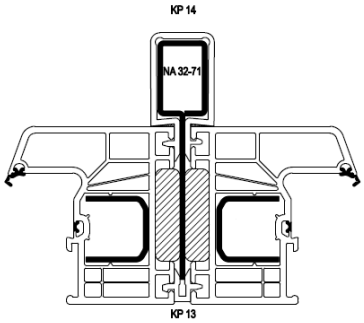
With coupling profile KP3



With coupling profile KP5



With coupling profile KP13 / KP 14



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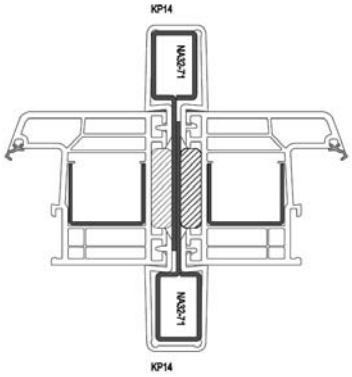
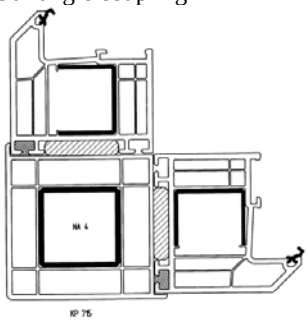
With coupling profile KP13 / KP 14

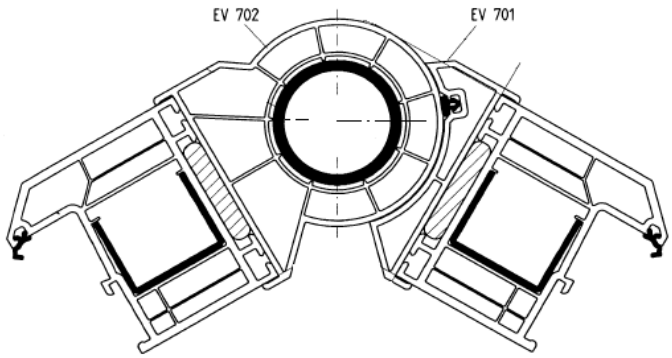


90° angle coupling



Non-fixed angle coupling

EV 701/EV 702



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Window sealing

General recommendations for cold climates (for different climate zones, different techniques might have to be used for best window performance):

Low expansion foam insulation can be used for this purpose. Air and moisture tight tapes shall be used on the inside frame to wall section to prevent air and water vapor infiltration in to the foam insulation. Moisture accumulation within the joint and loss of foam thermal value may be caused by failure to comply with the above rule. This causes impairment of insulating qualities of the joint, and damage beyond repair may be caused.

Examples of mistakes

The below picture (Fig.1) shows an example of window mounting currently applied practically. In this case no sealing is provided from the external side to protect from outside elements, nor from the inside – to protect the foam from water vapor emissions. Plaster/drywall layer do not stop water vapor, moving from the inside of building to the outside in winter conditions. The results of such mistakes may appear after a couple of seasons from mounting. As a result of moisture accumulation inside the joint, a trace of mould or fungus may be noticeable on the surface of window jamb.

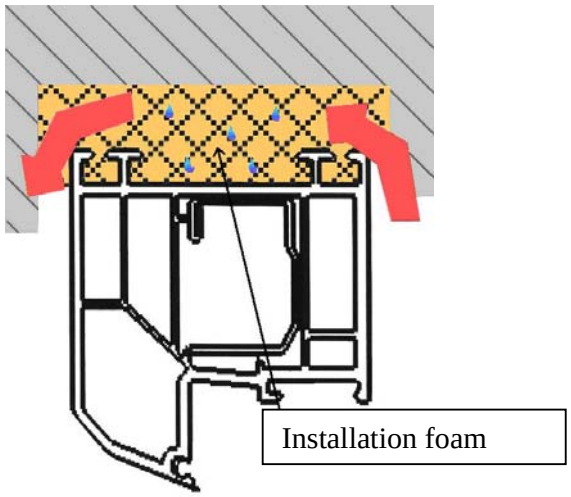
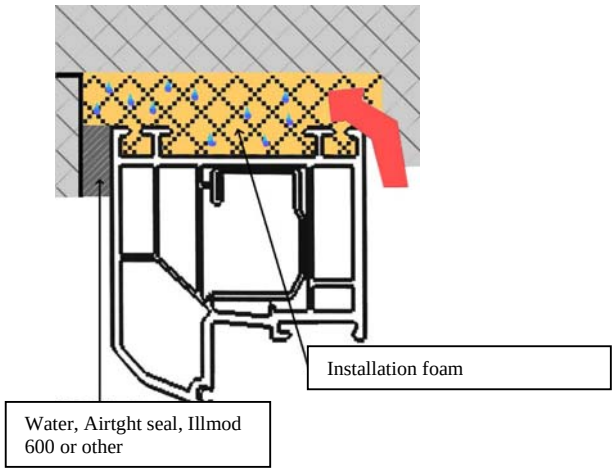


Fig.1 installation without application of vapor insulating tapes

The (Fig. 2) shows an external sealing but lacks internal sealing. The external sealing provides protection from the atmospheric effects, but water vapor from the inside of the building easily reaches the joint. Polyurethane foam is constantly moist, therefore, thermal insulation qualities thereof are reduced and in extreme cases the above mistake causes mechanical damage to the joint.



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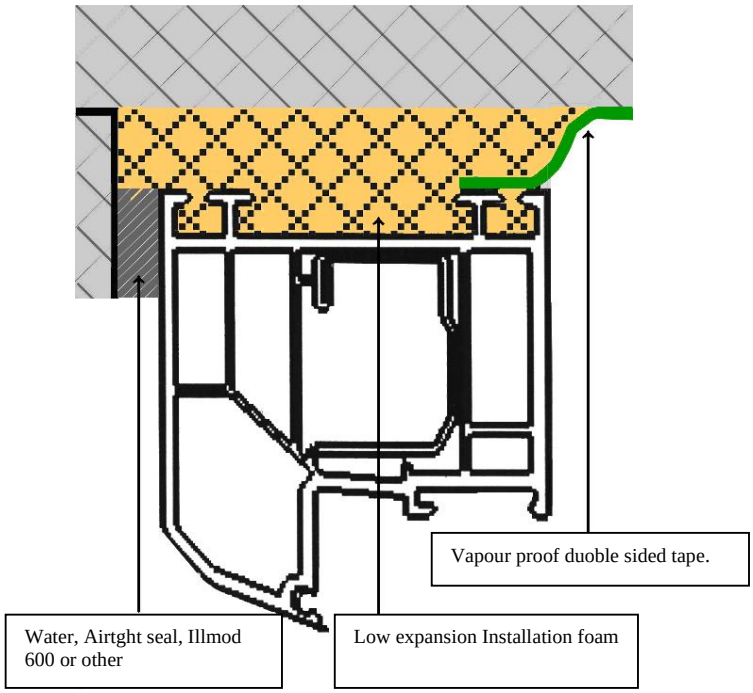
The third picture (Fig. 3) presents full sealing. Water vapor cannot get to the installation gap from the inside of building.. Polyurethane foam remains dry, good thermal insulation qualities remain, the joint is not mechanically damaged.



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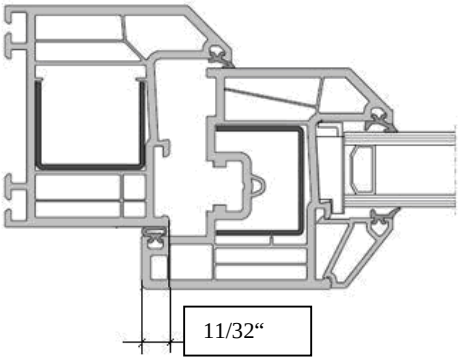
Adjustment of sash

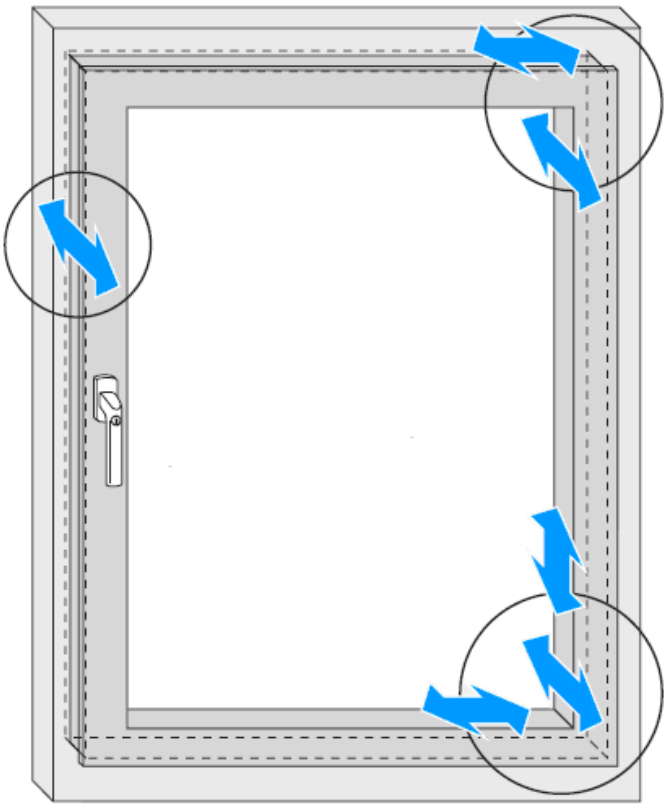
All buildings move. If movement is excessive windows or doors might need to be adjusted for proper operation.
General requirements:
Sash shall overlap the frame by 11/32” (9mm) for all products without any exceptions. Therefore, adjustment shall be aimed to the above.

Check for 11/32” (9mm) measurement:

- close the window sash and mark the position of window sash in respect of the frame in all four corners by a soft pencil;
- open the window sash and check whether 11/32” (9mm) distance is retained everywhere by means of a ruler.
- adjust if necessary



Adjustment of tilt/turn type Window



1mm=1/32”, 2mm= 5/64”

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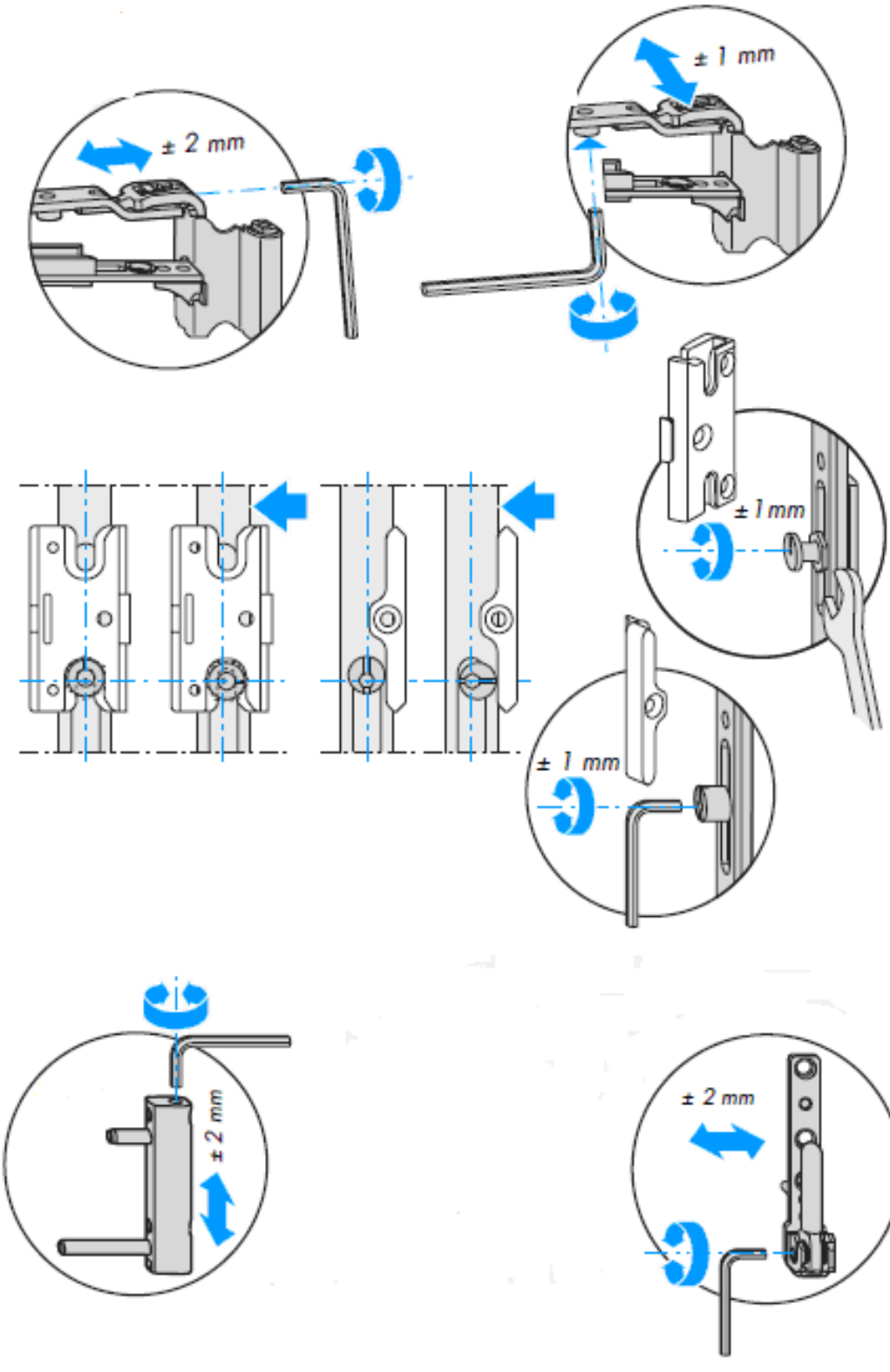

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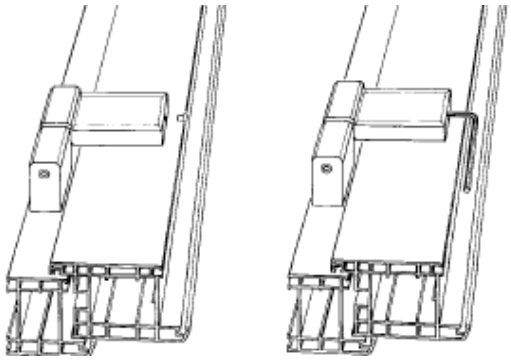
Windows shall be fitted so that water outlet is not blocked.
Cap shall be installed on the water outlet.

Adjustment of patio and entry doors

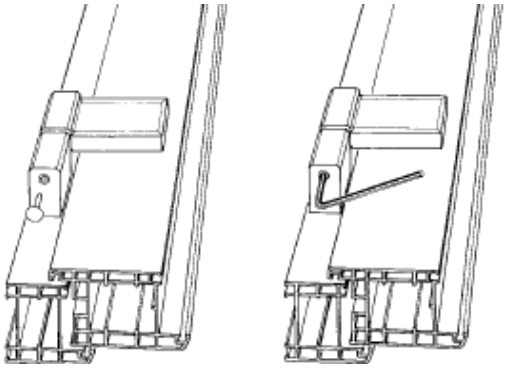
Horizontal adjustment:

- pull out the plastic stopper;
- use 5 mm hex key for adjustment . (1st turn corresponds 1mm shift)



Vertical adjustment:

- pull out the plastic stopper;
- reach the required height by screwing adjustment bolt with 5 mm key



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Mounting and adjustment of fold away (accordion) doors

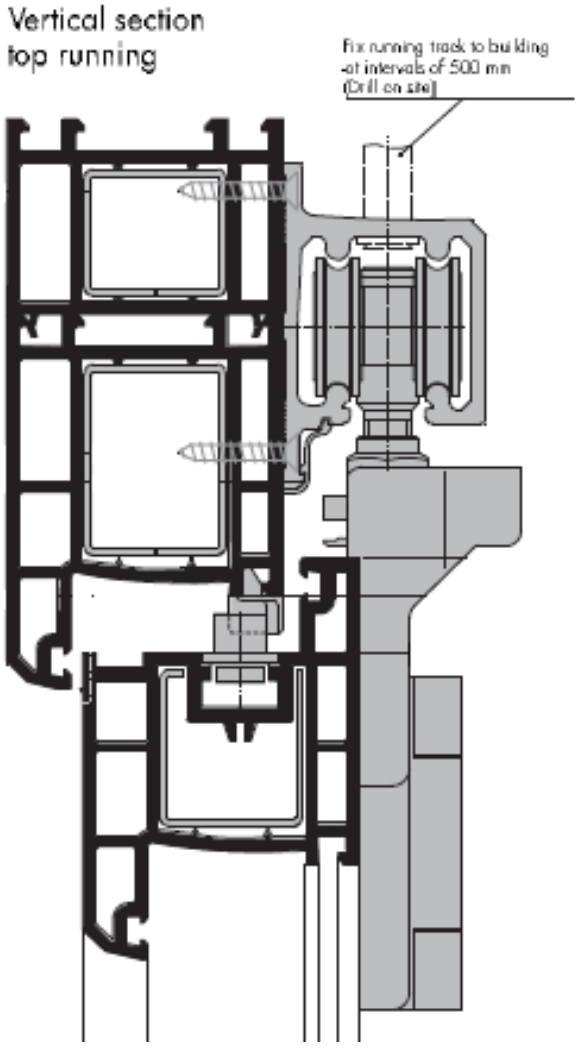
General requirements:

Disposition of fastening points and bearing blocks is the same as for mounting of windows.

See Figure 1.

Important:

The whole weight of fold away door is hanged on the upper rail, therefore, it is very important to ensure a secure fastening of the upper part of fold away (accordion) door in an absolutely horizontal position. In order to ensure stability, the upper rail shall be additionally fastened to the plat band every 19" (500mm). Holes shall be pre-drilled for mounting dowels.



Adjustment:

* Adjustment schemes provide cases where the bearing rail is installed at the bottom. Adjustment remains the same irrespective of rail mounting method.

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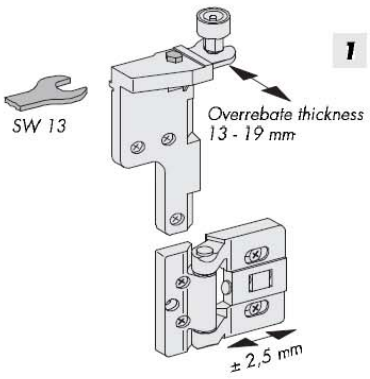
Adjustments

If required, the variety of adjustments listed below can be used.
For correct adjustment it is recommended that:

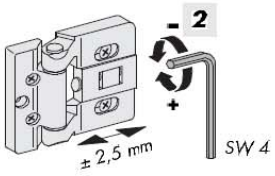
- first install the glass correctly
- the folding sliding elements are clamped horizontal and plumb or the frame is installed into the building



1

Sash presssure via the top hinge

A Loosen the lock nut SW13
B Firmly press the sash against the frame.
C Tighten the locking nut.

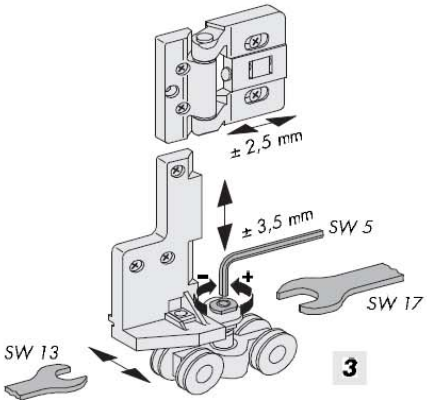


2

Positioning of the Sash hinges

Tip: Slacken sash hinges in order, adjust and re-tighten.

A Slacken both set screws.
B Adjust the gap with allen key SW 4 .
C Re-tighten setscrews.



3

Setting the height of Bogie wheels

A Slacken lock nut SW 17 on the bogie wheels.
B Adjust the height of the sash by using allen key SW 5 whilst holding the lock nut in place with spanner SW 17.
C Then re-tighten the lock nut keeping allen key SW5 firmly in place.

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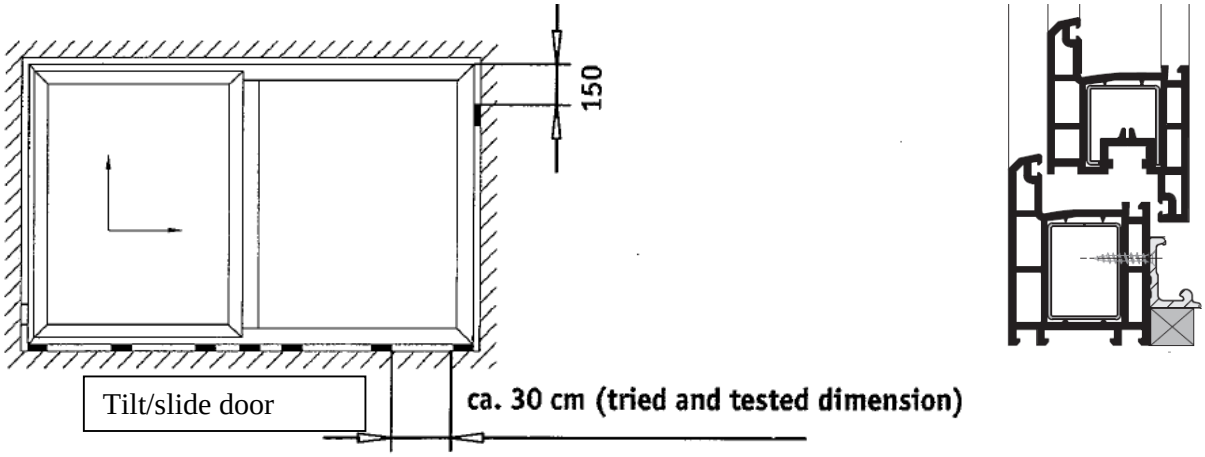
Mounting and adjustment of tilt/sliding doors

In case of the above type of doors the whole weight of moving door section falls to the bearing rail, therefore, it is very important to make sure the rail would not slide off when the door leaf moves. For this reason the bearing shall be placed within the distance not exceeding 300mm. The bearings shall be in perfect horizontal position.

150 mm= 5 29/32"inch
30cm =300mm=11 26/32"inch



Placement of fastening points is the same as in window installation.

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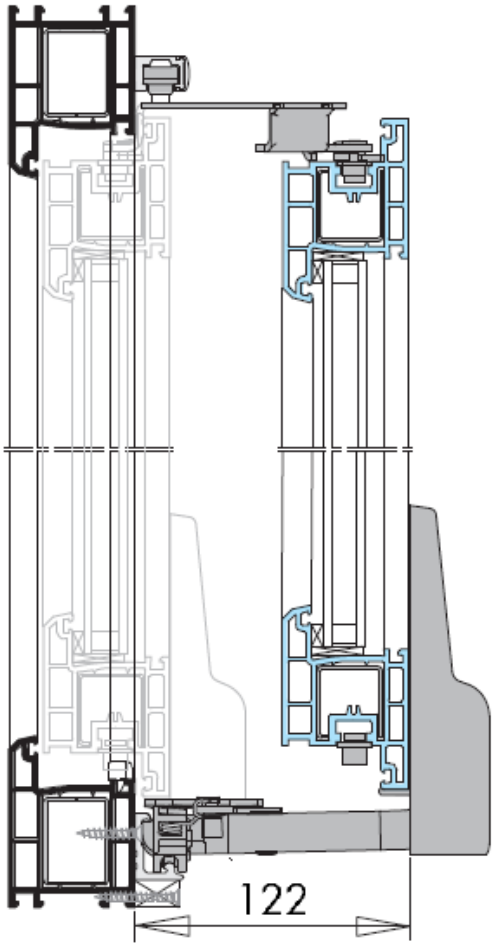

Important:

Please note that the door sliding part “moves in” when the door is opened. Make sure door has enough clearance to operate.

122mm=4 24/32” inch

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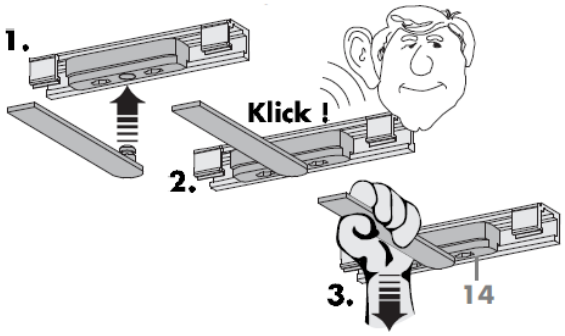
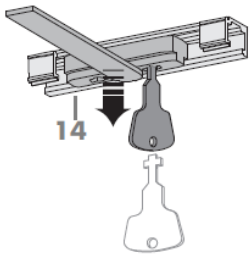
Adjustment of tilt/sliding doors

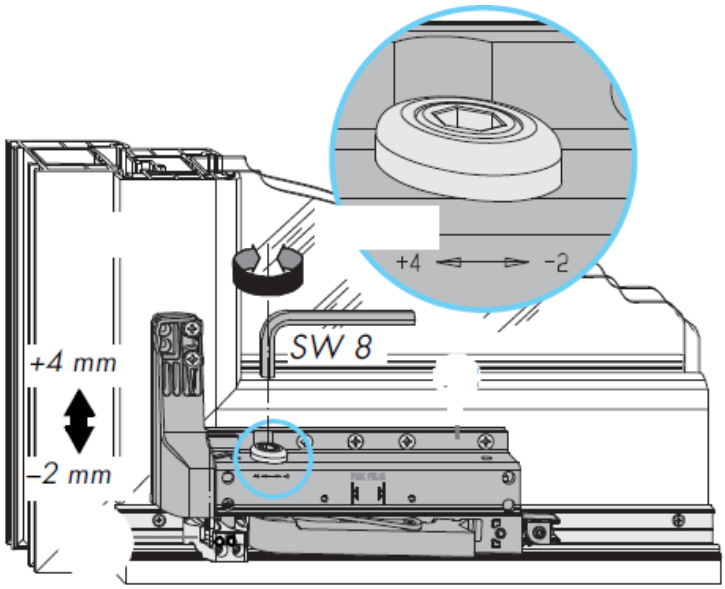
Hooking on and off door moving part



Aushängen der Scherenarme.



Adjustment of door



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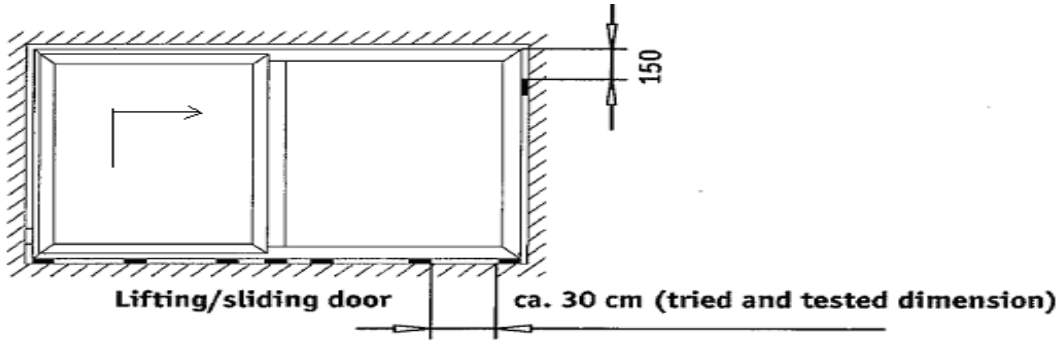
Mounting of lift/slide doors

In case of the above type of doors the whole weight of door leaf falls to the bearing rail, therefore, it is very important to make sure the rail would not slide off when the door leaf moves. For this reason the bearing shall be placed within the distance not exceeding 300mm. The bearings shall be ideally horizontal.

150 mm= 5 29/32"inch
30cm =300mm=11
26/32"inc



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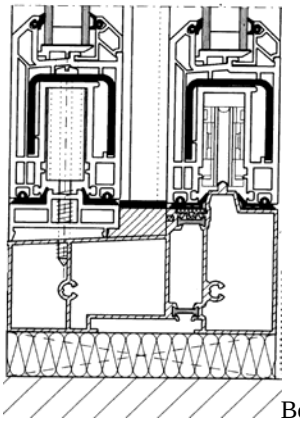
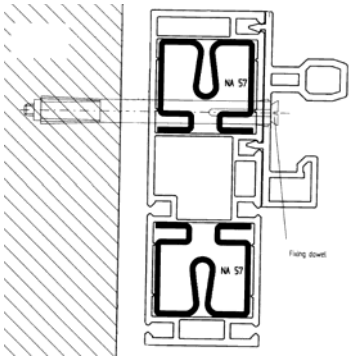
Fastening of lifting/sliding doors



Bottom



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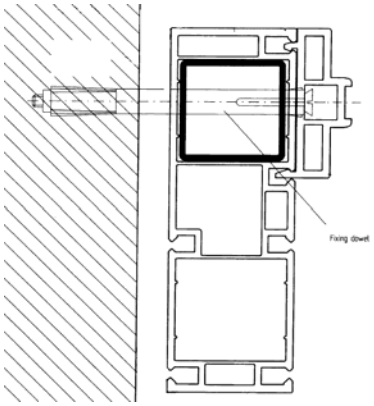
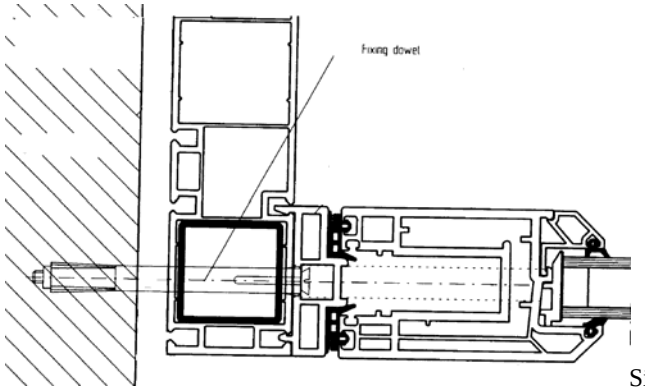


Side1



Side2

Intus Windows
probably **The most energy efficient windows and doors**

1042 Wisconsin Avenue, NW, 2nd Floor
Washington DC, 20007
Office:1-888-380-9940
Fax: 202-449-8637
Email: info@intusconsulting.com
Web: www.intuswindows.com

Glazing Removal and Installation









Please do not damage frame or glazing upon removal.

Intus Windows

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Web: www.intuswindows.com

Attention:
Always use proffesional glazing installers service for glazing replacement!

WOOD WITH ALUMINUM CLAD WINDOW AND DOOR LIMITED WARRANTY

This Limited Warranty applies to Intus Windows windows and patio doors purchased from an authorized Intus Windows dealer. This warranty extends only to the original purchaser of Intus Windows products. The warranty starts on the date of purchase of the home as new construction or the installation of Intus Windows windows and doors in the home as replacements ("start date") and remains effective as long as the original purchaser owns and resides in the home. In addition, if the original purchaser sells the home before ten (10) years has elapsed after the start date, Intus Windows will automatically extend full coverage under this warranty to the new owner(s) of the home and any subsequent owners, until the tenth (10th) anniversary of the start date upon registration by any such successor owner with Intus Windows by notifying Intus Windows at the address below within thirty days of such sale and the payment of $20 administrative transfer fee to Intus Windows (the original purchaser and any such transferees being referred to below as the "covered owner"). and extends to the owner of the structure in which the products are originally installed. This Limited Warranty is applicable only to product installed in the U.S.A.

SCREENS

Notwithstanding the above, Intus Windows will replace any Intus Windows windows or door screen frame and mesh that is defective in materials or workmanship at no charge to the original purchaser for a period of only one (1) year after start date.

GLASS COMPONENTS

Glass warranties apply to factory-installed glass or Intus Windows -supplied glass installed by Intus Windows -authorized service personnel. Clear insulating glass with stainless steel and warm edge spacers is warranted against seal failure resulting in visible obstruction through the glass for ten (10) years from the original date of purchase. Glass is warranted against stress cracks caused by manufacturing defects for ten (10) years from the original date of purchase. All other glass and glass features are provided with the same warranties, limitations, and exclusions Intus Windows receives from its supplier; contact Intus Windows for further details.

NON-GLASS COMPONENTS

Non-glass components are warranted to be free from manufacturing defects for ten (10) years from the original date of purchase. Hardware are warranted to be free from manufacturing defects for five (5) years, and anodized finishes and other specialty finishes are warranted to be free from manufacturing defects for ten (10) years, from the original date of purchase. Electric operators and other motorized accessories are provided with the same warranties, limitations, and exclusions Intus Windows receives from its supplier; contact Intus Windows for further details.

EXCLUSIVE REMEDY

If a covered defect appears during the term of the applicable warranty, Intus Windows will, at its option, repair or replace the product or component, or refund the price paid for the defective product or component. Removal, installation, finishing, refinishing, and disposal costs and services are not included. Intus Windows will endeavor to supply original replacement parts; however, replacement parts may differ from the original parts. Replacement parts, including upgrades, are warranted for the remainder of the original product warranty.

EXCLUSIONS

Damage, defects, or problems resulting from causes outside Intus Windows's control are excluded from coverage under the Limited Warranty. Such causes include, without limitation:

Installation, Maintenance, and Acts of God

- installation not in conformance with Intus Windows's installation instructions and applicable building codes
- improper or non-standard field finishing
- non-standard installation, such as non-vertical or sloped glazing, upside down, or out-of square
- installation or use in applications exceeding design standards
- field mulls; field finishes
- insulating glass installed above 5000 feet without capillary tubes or pressure relieve valves.
- installation or use near pools, saunas, hot tubs, or other high-humidity environments
- failure to follow Intus Windows's care and maintenance instructions
- failure to properly treat, seal, and maintain exposed wood
- use of brick wash, razor blades or other inappropriate cleaners or chemicals
- misuse, abuse, modification, alteration, accident, negligence
- shifting or settling of the structure in which the product is installed
- extreme weather events, extreme or unusual atmospheric conditions
- normal wear and tear;
- glass imperfections consistent with ASTM or other industry standards, which do not affect structural integrity
- war, insurrection, civil unrest, terrorism, or other Acts of God

Moisture Management
Products installed in wall systems that do not allow for proper moisture management, such as exterior insulation and finish systems (EIFS) or "synthetic stucco" without effective engineered drainage systems, are not covered under the Limited Warranty.

Thermal Efficiency
Intus Windows does not warrant the amount or percentage of argon or other inert gas present in insulating glass at any time after manufacture. Inert gas dissipates over time, and may be ineffective in products manufactured with capillary tubes. Thermal efficiencies vary with the application of the product. Intus Windows does not warrant a specific level of thermal efficiency will be maintained by inert gas, low emissivity coatings, or other product features.

Condensation
Condensation is not a product defect, but the result of excess humidity. Condensation, frost, or mold, mildew, or fungus on product surfaces is not covered by the Limited Warranty.

Corrosion
Finish failure or corrosion of aluminum cladding, anodized and other specialty finishes, hardware, or other components due to environmental conditions such as air pollutants, acid rain, salt, sand, chemicals, or other corrosive substances is not covered by the Limited Warranty. Corrosion, deterioration, or wear of aluminum cladding and hardware in products installed within one (1) mile of a seacoast is not covered, except as provided in Intus Windows's Limited Warranty Supplement for Products in Coastal Environments. Annodized and other specialty finishes and non-Coastal Hardware installed within one (1) mile of a seacoast are not warranted.

Screens
Screens are not designed to, and will not prevent falls.

DISCLAIMERS, LIMITATIONS, AND ADDITIONAL TERMS AND CONDITIONS

Disclaimers
This Limited Warranty is the only warranty, written or oral, express or implied, provided by Intus Windows. No dealer, employee, or agent of Intus Windows, nor any third party, may create or assume any other liability, obligation, or responsibility on behalf of Intus Windows. ALL IMPLIED WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. Any implied warranty which cannot be disclaimed under applicable law will be limited in duration to the shortest permissible term and, in any event, will not exceed the term of the applicable express limited warranty; the requirements for presenting any claim so affected will be as provided in this Limited Warranty. Any product or component not specifically subject to this Limited Warranty or another written Intus Windows product warranty is provided AS IS and without warranty. This Limited Warranty gives you specific legal rights and you may also have other rights, which may vary from state to state. THIS WARRANTY IS NOT A WARRANTY OF FUTURE PERFORMANCE OR A STATEMENT OF THE USEFUL LIFE OF ANY Intus Windows PRODUCT, BUT ONLY A WARRANTY TO REPAIR, REPLACE, OR REFUND.

Limitations
IN NO EVENT WILL Intus Windows BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES. IN NO EVENT WILL Intus Windows'S LIABILITY EXCEED THE PRICE PAID FOR THE AFFECTED PRODUCT OR COMPONENT. The limitations of warranty and liability set forth herein shall survive and apply, even if the exclusive remedy set forth in this Limited Warranty is found to have failed of its essential purpose.

Certifications and Ratings
Many standard Intus Windows products are labeled or rated by Europe Union certifying agencies. Certification is based on the performance of a single sample of the product at the time of manufacture. Many standard Intus Windows products are labeled with IFT Rosenheim ratings are based on a combination of computer simulations and physical testing of product samples. Certifications and ratings typically apply to single products only; however certain factory-mulled or combined product configurations may also be certified. Performance of individual products may vary and will change over time, depending upon the conditions of use. These certifications and ratings are not performance warranties. For details on Certification, go to http://www.ift-rosenheim.de/.

Suitability
Determining the suitability and compliance with local or other applicable building codes or standards, of all building components, including the use of any Intus Windows product, and the design and installation of any flashing or sealing system, is the responsibility of the buyer, user, architect, contractor, installer, and/or other construction professional. Intus Windows will not be liable for any problem or damage relating to inappropriate or faulty building design or construction, maintenance, installation, or selection of products. Windows and doors are only one element of a structure; Intus Windows does not warrant that third party certification of a building or project to any specific standard will be achieved through the use of any Intus Windows product.

No Waiver
Intus Windows may, in its discretion, extend benefits beyond what is covered under this Limited Warranty. Any such extension shall apply only to the specific instance in which it is granted, and shall not constitute a waiver of Intus Windows's right to strictly enforce the exclusions, disclaimers, and limitations set forth in this Limited Warranty in any or all other circumstances.

Warranty Claims

If you believe the Intus Windows products or any part thereof are defective in a manner covered by this warranty, you must submit a claim in writing (the "claim") to Intus Windows or the distributor, home improvement dealer or other business that sold you the Intus Windows products within ninety (90) days after any defect or other basis for the claim is discovered or should have been discovered. Claims submitted after such deadline shall not be covered by the warranty. Written claims should be directed to the warranty service center, 1042 Wisconsin ave,NW, FL2,Washington, DC,20007. In your written notice of the claim, you must provide a description of the Intus Windows product, purchase price of the Intus Windows product, and the date and location of purchase of the Intus Windows product. In addition, your claim should include a description of the nature of the problem, the date of installation of the Intus Windows products and reasonable evidence showing that you are covered by the warranty. Upon receipt of the claim by Intus Windows, Intus Windows will review the claim to determine if it is covered by this warranty. Inquiries should be directed to (888) 380-9940. Intus Windows may require you to supply pictures, ship a representative sample, postage/transportation prepaid, or request reasonable access for inspection. If the claim is covered by this warranty, Intus Windows will replace the defective part(s) or complete window unit(s) with new part(s) or new Intus Windows product unit(s) at no charge (except as otherwise provided herein) in accordance with the terms of this warranty. All replacement part(s) or complete window or door unit(s) will be shipped from Intus Windows's manufacturing facility. Postage/transportation charges are the responsibility of the covered owner. Any claims under this warranty are expressly limited, at the option of, to the (1) original cost of the Intus Windows product or (2) the cost of replacing or repairing the defective Intus Windows product or part of the Intus Windows product. The costs covered by this warranty do not include any labor or installation costs. The warranty period shall not be extended by the replacement of any Intus Windows products but any replacement Intus Windows products will continue to be covered during the remainder of the original applicable warranty period. Intus Windows reserves the right to change, alter or discontinue any of its products at its sole discretion. If any part, component or complete window or door unit is not available at the time of any claim by the covered owner under this warranty, Intus Windows reserves the right to substitute another product that it determines in its sole discretion is of substantially equal quality or value for the Intus Windows product involved in the warranty request.

PRODUCTS IN COASTAL ENVIRONMENTS LIMITED WARRANTY SUPPLEMENT

This Limited Warranty Supplement, in conjunction with the Intus Windows Limited Warranty, applies to Intus Windows brand products purchased from an authorized Intus Windows dealer, and installed within one (1) mile of a sea coast or other salt water source. THIS LIMITED WARRANTY SUPPLEMENT IS SUBJECT TO AND INCORPORATES THE TERMS, CONDITIONS AND LIMITATIONS SET FORTH IN THE INTUS WINDOWS LIMITED WARRANTY.
Intus Windows 's aluminum cladding finished, stainless steel hardware, hardware with physical vapor deposition , and other specifically-designated "coastal" hardware finishes (collectively "Coastal Hardware") are warranted to be free from manufacturing defects that result in abnormal corrosion or deterioration of the exterior cladding or finish for a period of 5 years from the original date of purchase. "Abnormal" corrosion means corrosion beyond what is normal for an ocean coastline environment. "Abnormal" deterioration means peeling, flaking, or blistering of the finish beyond what is normal for an ocean coastline environment. The environment within one mile of an ocean coastline or other salt water source can be extremely corrosive. Even with proper maintenance, it is normal for windows and doors installed in this environment to deteriorate more than windows and doors installed in other environments. Some corrosion and deterioration is considered normal wear in this environment. Non-Coastal Hardware and anodized or other specialty finishes are not recommended, and are not warranted in coastal environments.

EXCLUSIVE REMEDY

If a covered defect in the aluminum cladding appears during the five (5) years of the warranty term, Intus Windows will, at its option, repair the defect, replace the defective materials, or refund the price paid for the defective materials. If a covered Coastal Hardware defect appears during the term of the warranty, Intus Windows will, at its option, repair or replace the defective hardware, or refund the price paid for the defective hardware. Removal, installation, refinishing, and disposal costs and services are not included. Intus Windows will endeavor to supply original replacement parts; however, replacement parts may differ from the original parts. Replacement parts, including upgrades, are warranted for the remainder of the original product warranty.

LIMITATIONS

In addition to all terms, conditions, and limitations set forth in the Intus Windows Limited Warranty, the following limitations apply:

• Salt and other corrosive or abrasive materials must not be allowed to build up on the exterior surfaces or other exposed components of the product. Unless product-specific care instructions require more frequent cleaning, exterior surfaces and exposed components must be cleaned with a mild detergent soap and water at least every three (3) months (more frequently if necessary) to prevent this build-up. Lift and slide operational hardware must be cleaned and maintained in strict accordance with the written care instructions.

• Any breaches in the exterior finish, such as scratches, chips or abrasions can result in corrosion and must be repaired immediately.

IN NO EVENT WILL INTUS WINDOWS BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES. IN NO EVENT WILL INTUS WINDOWS LIABILITY EXCEED THE PRICE PAID FOR THE AFFECTED PRODUCT OR COMPONENT. The limitations of liability and disclaimers of warranty set forth herein shall survive and apply, even if the exclusive remedy is found to have failed of its essential purpose.

DISCLAIMER

This Limited Warranty supplement, together with the Intus Windows, is the only warranty, written or oral, express or implied, provided by Intus Windows . No dealer, employee, or agent of Intus Windows , nor any third party, may create or assume any other liability, obligation, or responsibility on behalf of Intus Windows . ALL IMPLIED WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. Any implied warranty which cannot be disclaimed under applicable law will be limited in duration to the shortest permissible term and, in any event, will not exceed the term of the applicable express limited warranty; the requirements for presenting any claim so affected will be as provided in the Intus Windows Limited Warranty. This Limited Warranty supplement gives you specific legal rights and you may also have other rights, which may vary from state to state. THIS LIMITED WARRANTY SUPPLEMENT IS NOT A WARRANTY OF FUTURE PERFORMANCE OR A STATEMENT OF THE USEFUL LIFE OF ANY INTUS WINDOWS PRODUCT, BUT ONLY A WARRANTY TO REPAIR, REPLACE, OR REFUND.

Intus Windows
1042 Wisconsin ave, NW, FL2,
Washington, DC, 20007
1-888-380-9940

Last Revision: January 01, 2012

Wood products maintenance and care

- **DO NOT use metal razor blades .**
- **DO NOT allow any sealants (including silicone) to contact the exterior glass surface. Sealants may cause damage to the exterior low-maintenance coating of the glass.**
- **DO NOT use abrasive cleaners on any glass surface, or on the exterior of Low-E glass.**
- **DO NOT apply any after-market films to glass. Thermal stress conditions resulting in glass damage may occur. The use of movable insulating materials such as window coverings, shutters and other shading devices may damage glass or vinyl. In addition, excessive condensation may result, causing deterioration of the window unit.**
- **Acid solutions used to wash masonry will damage glass, fasteners, hardware and metal flashing. Follow the acid solution manufacturer's instructions carefully. Protect and/or cover Intus products during cleaning process to prevent acid contact. If acid does come in contact with window unit, immediately wash all surfaces with clean water.**

Wood window care includes proper finishing and maintenance of wood and cleaning and caring for metal clad surfaces. Bi-annual inspections are sufficient for most areas; however, coastal areas require monthly inspections because of moisture and salt in the air.

EXPOSED WOOD SURFACES

Clean exposed wood surfaces with mild soap and water. For stubborn residue or mildew, consider lightly sanding and refinishing, or contact a paint professional for recommendations. Refinish cracks or voids immediately.

BRONZE CLADDING

Bronze clad products and components will naturally change color and appearance over time due to exposure to the environment. Depending upon the products' specific exposure, differences in appearance may occur in the same structure. Repair or replacement of products may also result in variations between original and replacement parts. Intus is not responsible for any variations in appearance of bronze parts. Wear cotton gloves during installation or servicing to avoid fingerprints on bronze surface. If fingerprints do occur and the following recommendations for cleaning do not remove them, call us for assistance.

Maintenance & Cleaning

To maintain an aged look, no maintenance is required except for occasional cleaning of surface debris with mild soap and water. For heavier cleaning, follow the same cleaning instructions for aluminum cladding. Do not use any solvents or cleaners that contain ammonia, salts or oxides.

Oxidation Removal

For a shiny, non-oxidized bronze appearance, try removing the oxidation with a baking soda/water solution. A nonabrasive paste cleaner may also work. Always test in an inconspicuous area first, and read the manufacturer's label for instructions.

ALUMINUM CLADDING

Aluminum cladding offers durability and excellent resistance against cracking, blistering, and flaking under normal use. When properly maintained, aluminum clad products will remain attractive for many years. Aluminum cladding usually does not require painting or finishing. Clad surfaces exposed to sunlight are subject to chalking which may cause color-fading. This is a natural process that occurs over time, even with proper maintenance. Certain chalking or fading and damage to exterior cladding from acid rain, salt air, or other corrosive elements may not be covered under the manufacturer's warranty. Moderate to Heavy Non Water-Soluble Cleaning Some solvents are acceptable for removing heavy soils (e.g. oil, grease, sealants, dried concrete stains, tar, rust and graffiti). See the following Solvent Recommendations. After using solvents, clean area with mild soap and water to remove traces of remaining solvent.

Note! Do not use solvent on painted surfaces other than metal cladding or damage may result.

Caution: Do not allow petroleum-based products to come in contact with hardware and weatherstrip. Do not use acetone and paint removers on coated aluminum clad surfaces. They may remove coatings.

These solvents may be used to clean non water-soluble debris from coated aluminum clad surfaces.

Use only in small, inconspicuous areas first.

Alcohols:

Try these least strong solvents first for non water-soluble debris.

- Denatured alcohol (ethanol)
- Isopropyl (rubbing alcohol)
- Methanol (wood alcohol)

Petroleum solvents and turpentine:
Especially helpful in removing grease, sealants, or some caulking compounds.
• VM&P naphtha
• Mineral spirits
• Kerosene
• Turpentine (wood or gum spirits)
Ketones, esters and lacquer thinner:
Use with extreme caution. Limit contact to one minute.
• Lacquer thinner
• Methyl ethyl ketone (MEK)
Chemical solutions:
Especially helpful in removing rust and masonry grout or concrete stains. Limit contact to five minutes. Thoroughly rinse with water. Acid solutions are corrosive. Mix one part to ten parts water.
• Sodium hypochlorite solution (laundry bleach)
• Acetic acid (vinegar) • Hydrochloric acid (muriatic acid)

Cleaning frame and glass

Most Intus tilt/turn windows can be washed from the inside. Simply open the window. Wash the sash from the inside, using caution to avoid accidental falls or mishaps. To remove dust, dirt, smoke, film, soot and salt spray use a mild detergent water solution and a soft cloth or brush. To remove heavy dirt or grime from glass, first wipe loose debris from the glass surface with a soft, dry cloth. Then apply a cleaning solution, such as mild soapy water, vinegar or a liquid window cleaner, and wipe in a circular motion. Remove cleaning solution with a squeegee or a clean, lint-free cloth. Do not use abrasive cleaners on the exterior Low-E glass. As a general practice, you should never clean glass in direct sunlight. To avoid damage to the glass, never use razor blades on glass surface.
To clean upvc exteriors, use a mild detergent and water solution and a soft cloth or brush. Abrasive cleaners or solutions containing corrosive solvents should not be used. For persistent dirt or grime, Mr. Clean® or Soft Scrub® brand cleansers or a mixture of water and alcohol or ammonia can be used. Casement and awning hinges need to be cleaned and lubricated occasionally to eliminate squeaking and binding. Hardware screws, especially hinge screws, should be periodically inspected and tightened if necessary. Wind buffeting the sash over time can loosen hardware fasteners. Remove grease or debris with a soft, dry cloth, then lubricate hinges and all other moving parts with a dry silicone spray. Lubricants or harsh abrasive cleaners are not recommended. Dry silicone spray may be purchased from your local hardware store.

Cleaning Grilles and Insect Screens

to remove dust, dirt, smoke, film, soot and salt spray from grilles, use a mild detergent water solution and a soft cloth or brush. To remove grease, oil or industrial solids, you may need to use stronger solutions such as Mr. Clean®, Soft Scrub® or rubbing alcohol. Glass surface should not come in contact with any abrasive materials. Conventional insect screens are best cleaned with a soft cloth or sponge.
“Mr. Clean” is a registered trademark of the Procter & Gamble Company.
“Soft Scrub” is a registered trademark of the Clorox Company.

Maintaining Intus Hardware

Your Intus hardware has been manufactured of high-quality, fine metal. Fine metal requires periodic attention to maintain its beauty and characteristics. Climate, location, and exposure to corrosive environments such as industrial areas, pesticides, herbicides, or salts can affect the hardware's beauty and characteristics.

- **DO NOT use or apply harsh chemicals, abrasives and/or cleaners. Product damage could occur.**
- **DO NOT refurbish hardware. Contact a professional hardware restorer for refurbishing.**

With the cost of everything on a rise, replacing windows and doors is the last thing on anybody's mind but, to keep your windows, doors and even conservatories in a good working order, it's important to lubricate the hinges and locks on occasions. Following these few simple steps can keep your windows and doors working, almost as good as new.

Pre-Step: Choosing the Right Lubricant

1. You can use either WD-40 or Silicon Spray, which are available in most supermarkets and DIY stores across the country.

Step One: Open the Window/Door/Conservatory

2. Opening enables you to get to the hinges and lock easily.
3. Note! If your window doesn't open, call a professional as lubricating the window will not help, if you can't get to the windows.

Step Two: Spraying the Locks, Hinges and Patio Door Wheels

4. Spraying these areas on your windows, doors and conservatories will help keep them in a good working order, as these are the areas that tend to fail first, if not treated.

Spraying a door lock

5. When spraying the handle, make sure you spray it in the open and closed (when the window is actually open) position, as it has the best impact.

Step Three: Test the Hinges and Locks

6. Open the windows, doors and conservatories several times to work the spray in. Once you're satisfied with the feel of it opening and closing, you can finally close and the process is complete.
7. Periodically lubricate all sliding window and door tracks and rollers. We recommend that you lubricate the hardware components every 6 months. In areas with high salt air, every 4 months is recommended.
8. Regularly check weatherstripping to ensure your patio doors (and windows) seal airtight.
9. Occasionally vacuum the tracks on all sliding patio doors and windows to remove any dirt or debris.

Lubricating window, door hardware.

Intus Windows

Window/Door Installation Manual

Tilt/turn Windows
Balcony doors
Patio doors
Accordion doors
Tilt/slide doors
Lift/slide doors

Installer and Builder Information

* Always provide a copy of these instructions for the current or future building owner.
* Plan sizing of rough opening and clearance from exterior finishing systems to allow for normal materials shrinkage or shifting (e.g. wood structure with brick veneer; allow adequate clearance at sill).
* Refer to the Technical Installation Requirements section for technical specifications regarding the installation of this product. These installation requirements as well as the details in this section must be followed to achieve the advertised design pressure (DP) rating of this product.

You Will Need to Supply

Safety glasses, Hearing protection
Tape measure, Sealant, flashing materials,
Level, Square, Hammer, Wood shims,
Weather resistive barrier.

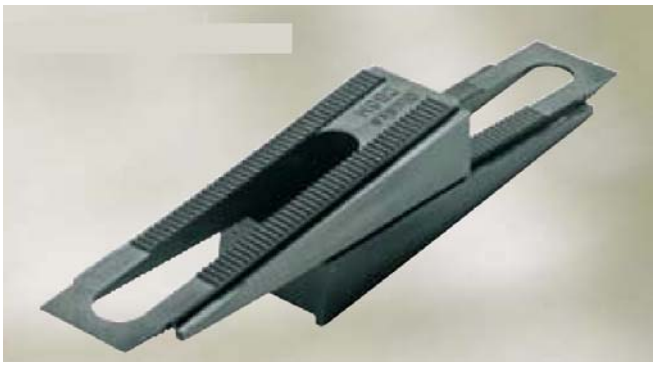
* It is the responsibility of the builder, installer and subcontractors to protect the interior and exterior of windows or doors from contact with harsh chemical washes, construction material contamination and moisture. Damage to glazing, hardware, weather strip and cladding/wood can occur. Protect with painters tape and/or protective sheathing as required. Follow all guidelines regarding material use, preparation, personal safety and disposal.

Warning
Always practice safety! Wear the appropriate eye, ear and hand protection, especially when working with power tools.

When installing a window not only installation horizontality and verticality must be evaluated but also the bias of the window. The window is usually leveled with shims or wood blocks, prepared at site by using a chisel for timber.. In case the window opens to the inside, it is recommended for the window to be tilted at an angle of several degrees to the inside, when the upper part is closer to the room.

Place the window

Level the lower part with wood blocks or shims



Secure brackets with screws to the frame

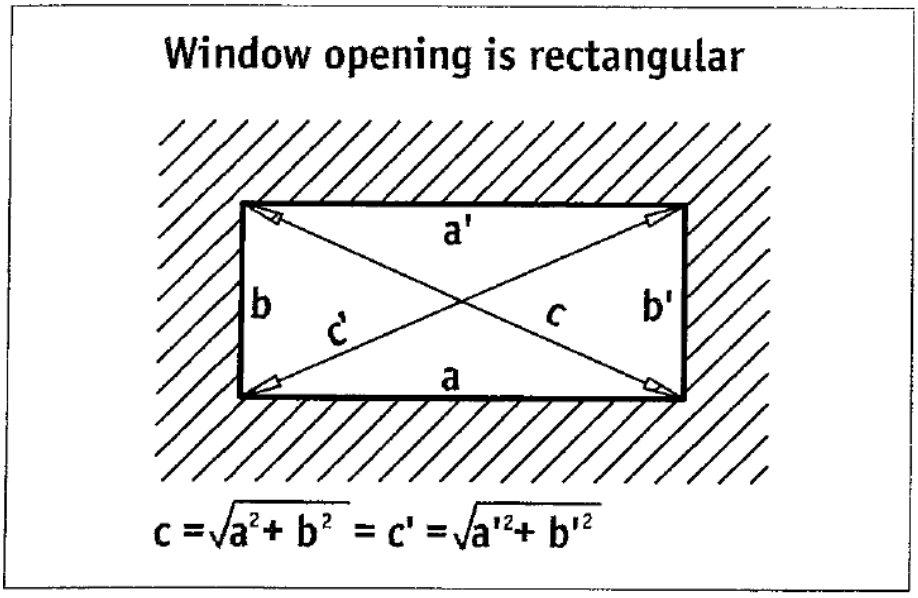
Insert wood blocks and brackets

Insert expansion prevention sticks

Fix window brackets and fill gaps with installation foam.

Some building codes require foam type insulation to form an infiltration seal. Use only low expansion type foam in combination with fiberglass insulation. Foam and foam application must conform to ASTM E2112-01, sec. 5.9.2. Follow all instructions and warnings from the foam manufacturer.

Measurement of diagonals



Requirements for the rough opening:

- No chips, hollows, grout deposits and other particles larger (deeper) than 6/32” (5 mm) shall be present at the edges and surfaces of external and internal reveals;

Surfaces contaminated with grease shall be degreased. Dry parts of surfaces shall be treated by means of binding substances.

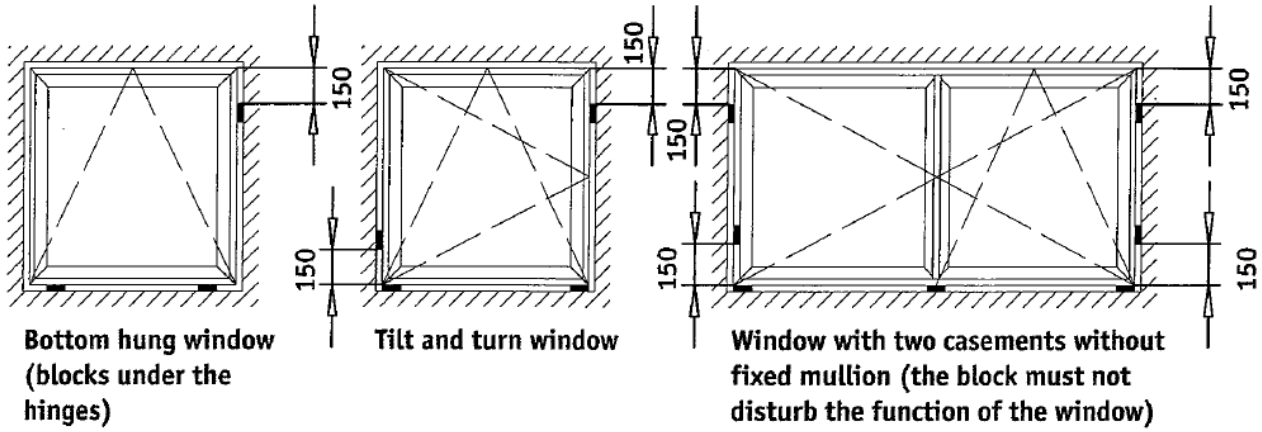
- Before using insulating materials, dust and mud shall be cleaned off of erection spaces, window holes and structural surfaces, and in winter – snow, ice, white frost shall be cleaned off, the surface shall be heated.

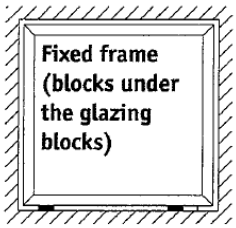
Rough opening shall have 3/8” to 5/8” installation gap on all sides.

Rough openings (RO) should be 1″ wider than the outside measurement of the frame and 1″ higher.

Placement of bearing blocks during installation of windows:

150 mm= 5 29/32”inch





Placement of fastening points:

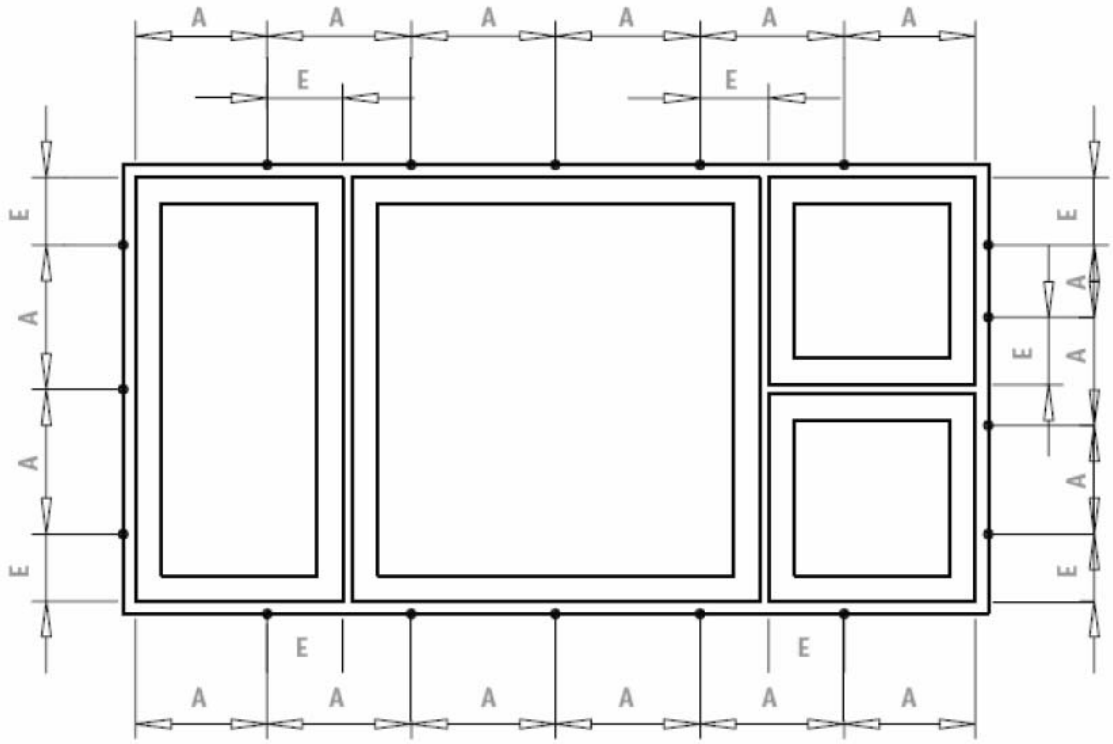


Fig. 1.

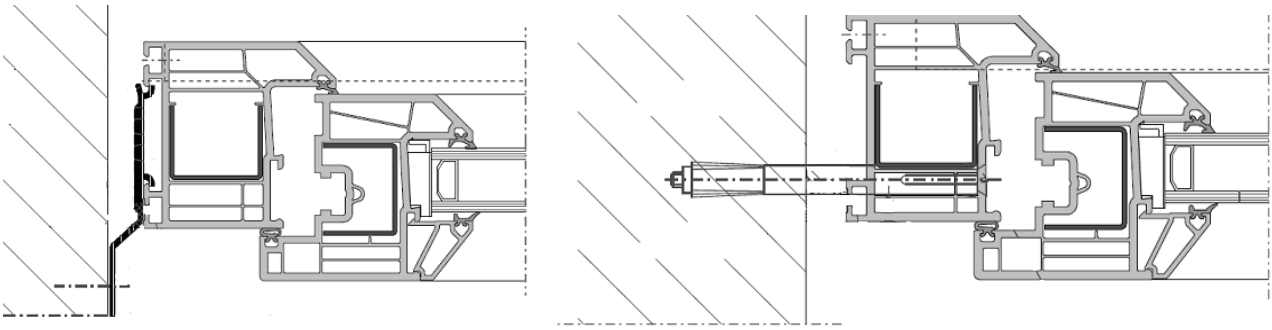
* - Fastening points

A – Distance between fastenings points shall not exceed 27 18/32” (700 mm)

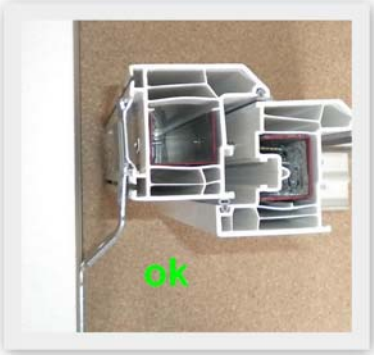
E – Distance between window corner and fastener should be more than 5 29/32” (150mm) and shall not exceed 7 28/32” (200mm)

Usage of fastening parts

The product may be fastened in the rough opening by means of special mounting brackets that are screwed to the frame, or by mounting dowels/screws directly through the frame. Both mounting methods are acceptable.



It is very important not to deform the frame during the mounting of the product. In case of mounting by means of dowels, dowels located at the bottom of the frame shall be properly sealed in order to prevent water accumulation.

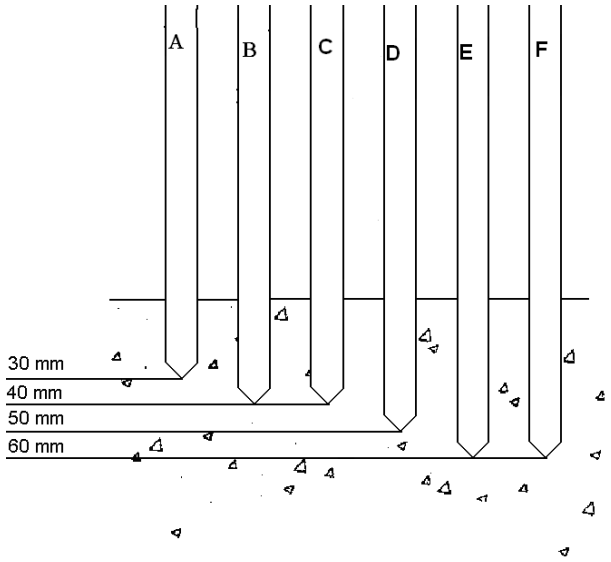


Installation of mounting bracket.

.

Jetting of fastening parts

Jetting of fastening parts to the wall is very important for secure fastening of the product subject to the type of wall, where:
A – Concrete, timber;
B, C – Solid and limestone bricks;
D – Pumice;
E – Lightweight concrete;
F – Hollow bricks
30mm= 1 6/32”
40mm= 1 18/32”
50mm= 2”
60mm= 2 12/32”

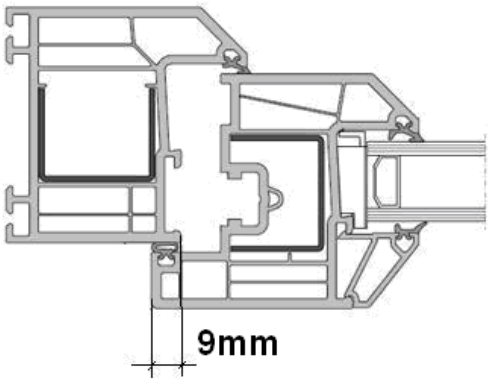


Adjustment of sash

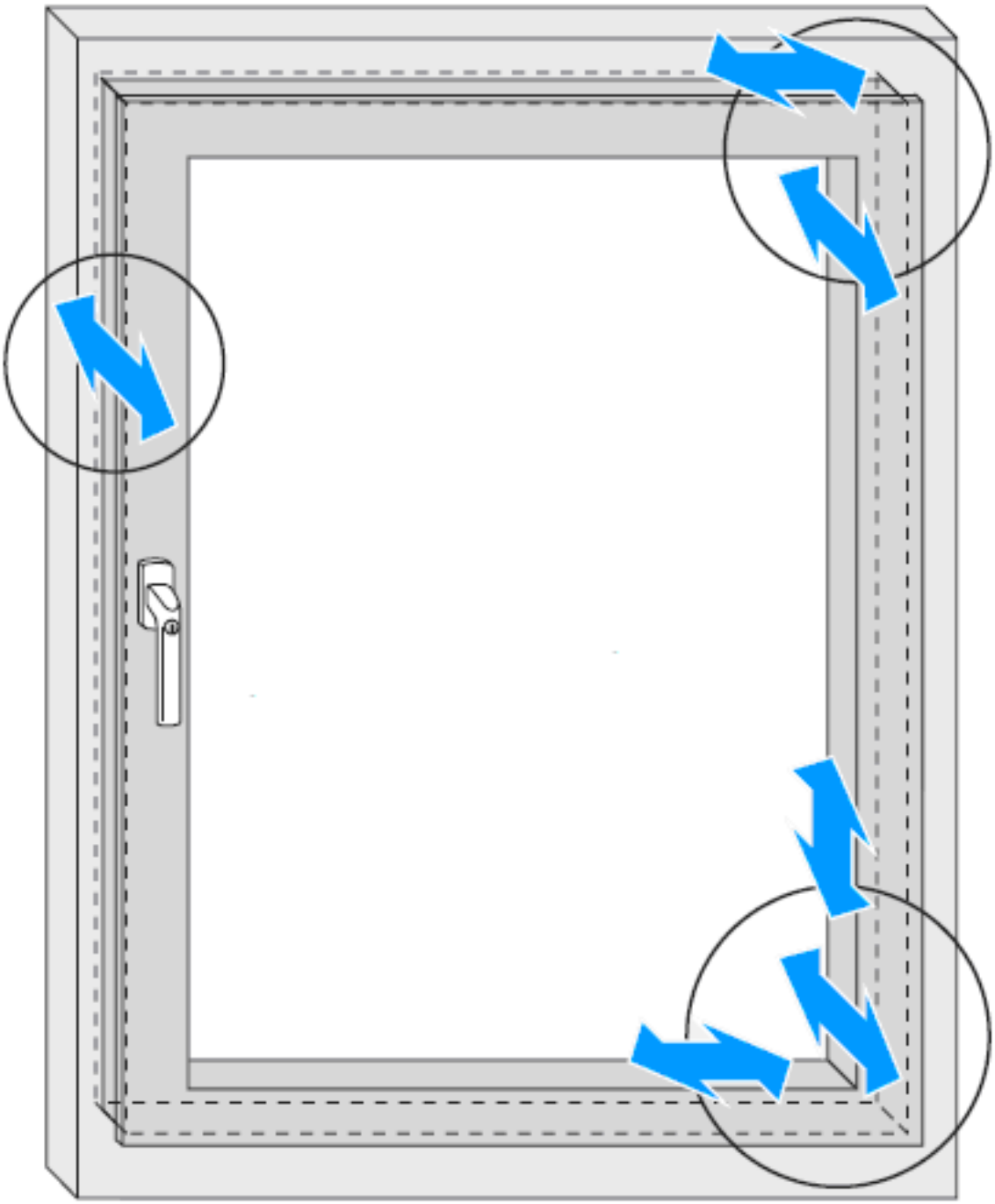
General requirements:
Sash shall overlap the frame by 11/32” (9mm) for all products without any exceptions. Therefore, adjustment shall be aimed to the above.

Check for 11/32” (9mm) measurement:

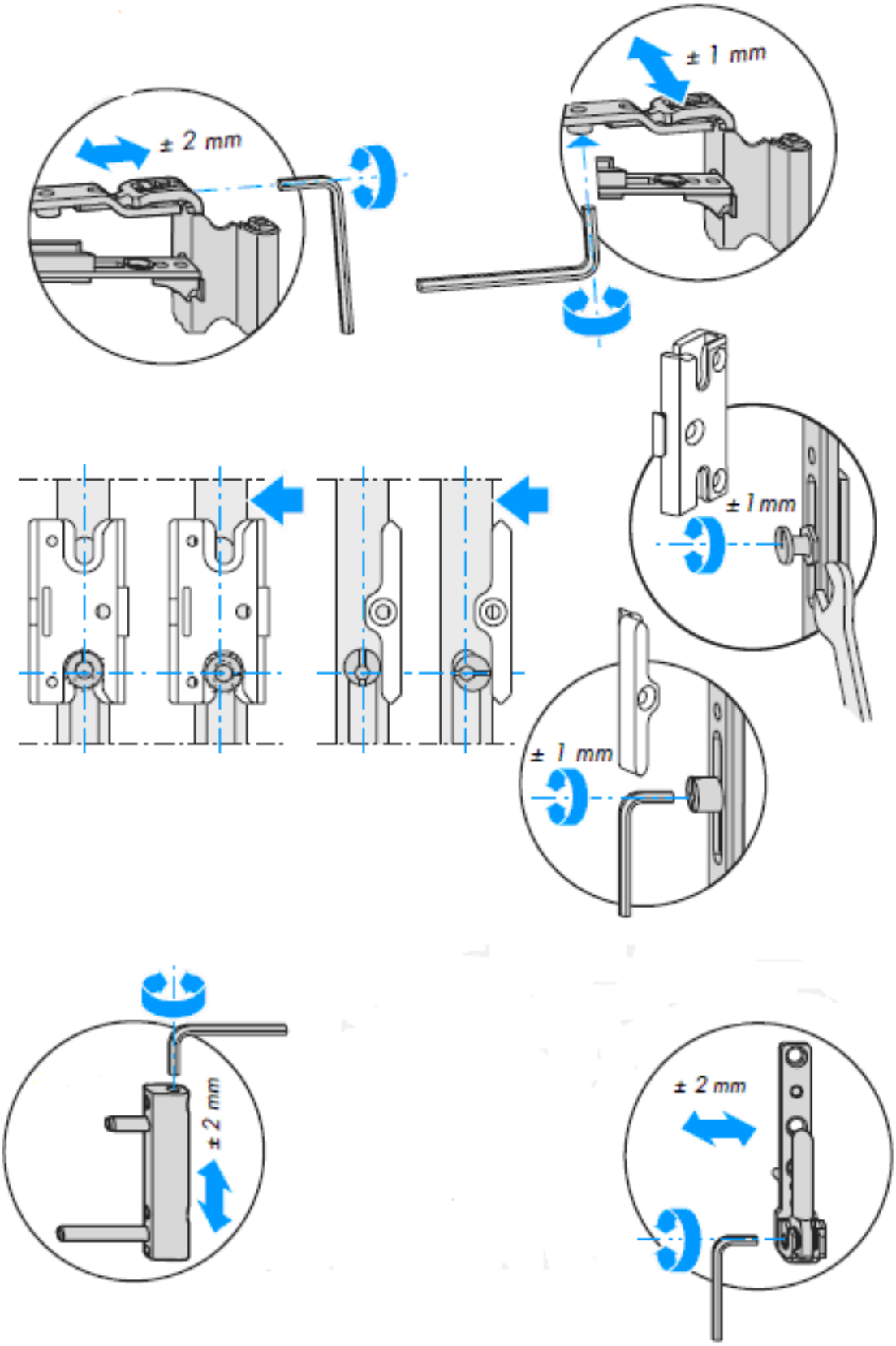
- close the window sash and mark the position of window sash in respect of the frame in all four corners by a soft pencil;
- open the window sash and check whether 11/32” (9mm) distance is retained everywhere by means of a ruler.
- adjust if necessary



Adjustment of tilt/turn type windows



1mm=1/32”, 2mm= 5/64”



Window Installation Gap sealing

General recommendations for cold climates (for different climate zones, different techniques might have to be used for best window performance):

Low expansion foam insulation can be used for this purpose. Air and moisture tight tapes shall be used on the inside frame to wall section to prevent air and water vapour infiltration in to the foam insulation. Moisture accumulation within the joint and loss of foam thermal value may be caused by failure to comply with the above rule. This causes impairment of insulating qualities of the joint, and damage beyond repair may be caused.

Examples of mistakes

The below picture (Fig.1) shows an example of window mounting currently applied practically. In this case no sealing is provided from the external side to protect from outside elements, nor from the inside – to protect the foam from water vapour emissions. Plaster/drywall layer do not stop water vapour, moving from the inside of building to the outside in winter conditions. The results of such mistakes may appear after a couple of seasons from mounting. As a result of moisture accumulation inside the joint, a trace of mould or fungus may be noticeable on the surface of window jamb.

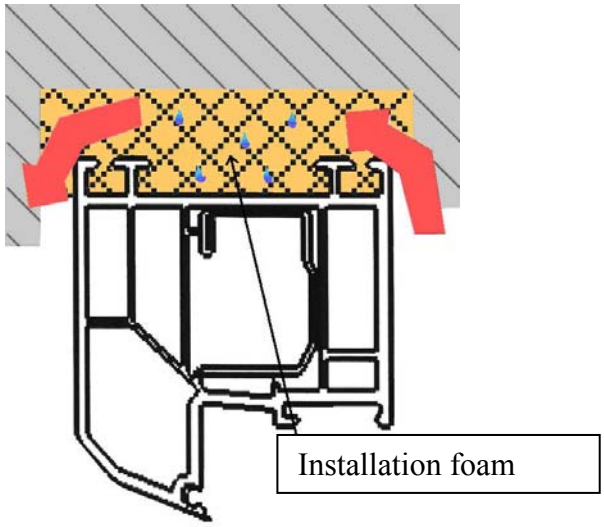
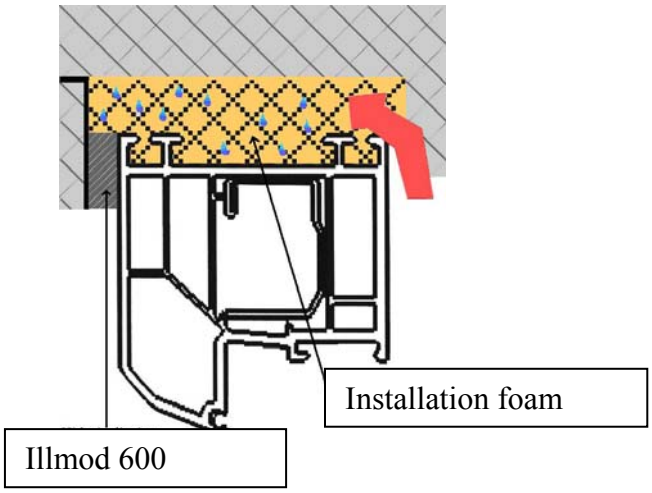
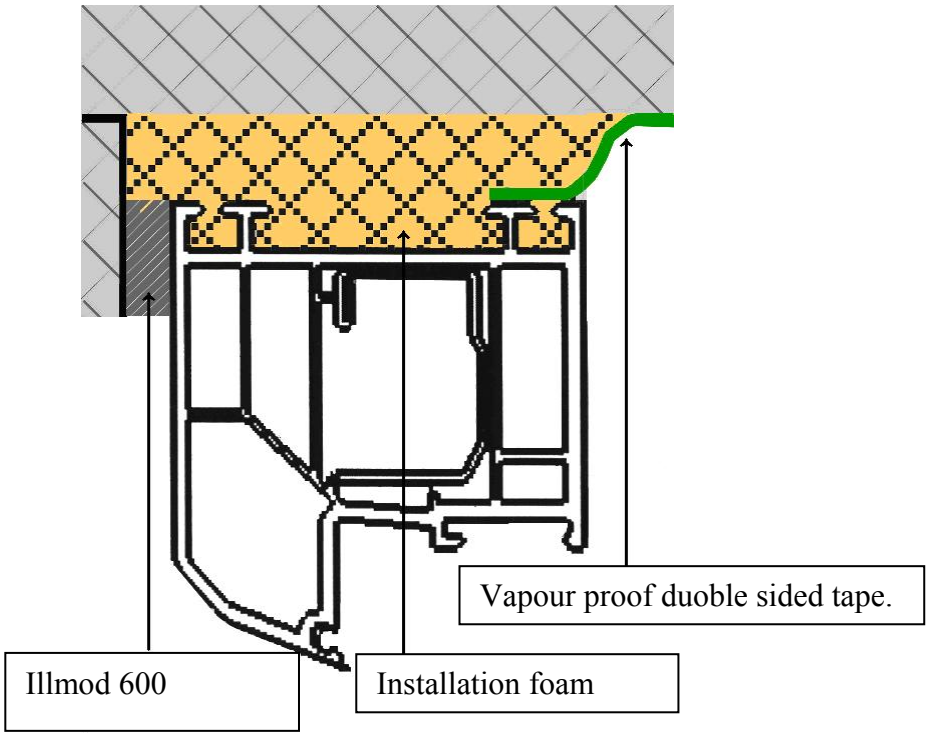


Fig.1 installation without application of vapour insulating tapes

The (Fig. 2) shows an external sealing but lacks internal sealing. The external sealing provides protection from the atmospheric effects, but water vapour from the inside of the building easily reaches the joint. Polyurethane foam is constantly moist, therefore, thermal insulation qualities thereof are reduced and in extreme cases the above mistake causes mechanical damage to the joint.



The third picture (Fig. 3) presents full sealing. Water vapour cannot get to the installation gap from the inside of building.. Polyurethane foam remains dry, good thermal insulation qualities remain, the joint is not mechanically damaged.



Please visit "Tremco" web site for installation details and recommendations:
http://www.tremcosealants.com/fileshare/pds/illmod600.pdf

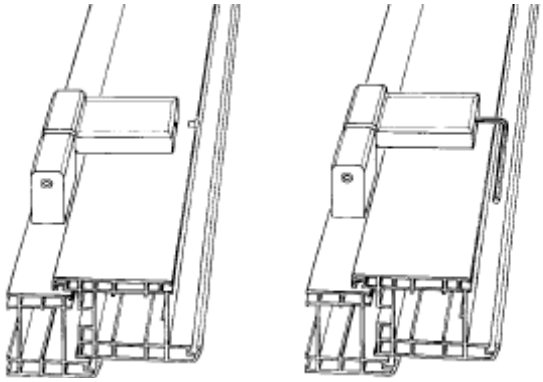
Glazing Removal and Installation

Attention:
Always use proffesional glazing installers service for glazing replacement!

Adjustment of patio and entry doors

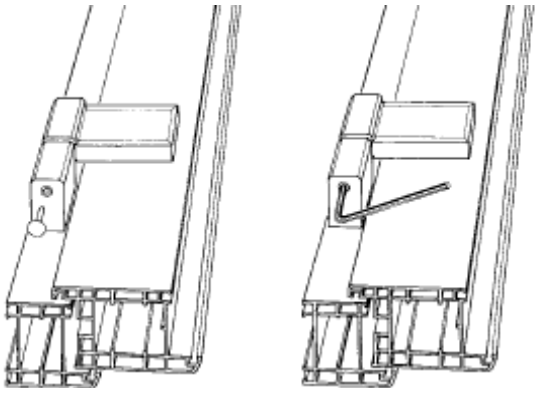
Horizontal adjustment:

- pull out the plastic stopper;
- reach the required measurement by screwing adjustment bolt by 5 mm key. (1st turn corresponds 1mm shift)



Vertical adjustment:

- pull out the plastic stopper;
- reach the required height by screwing adjustment bolt by 5 mm key



Mounting and adjustment of fold away (accordion) doors

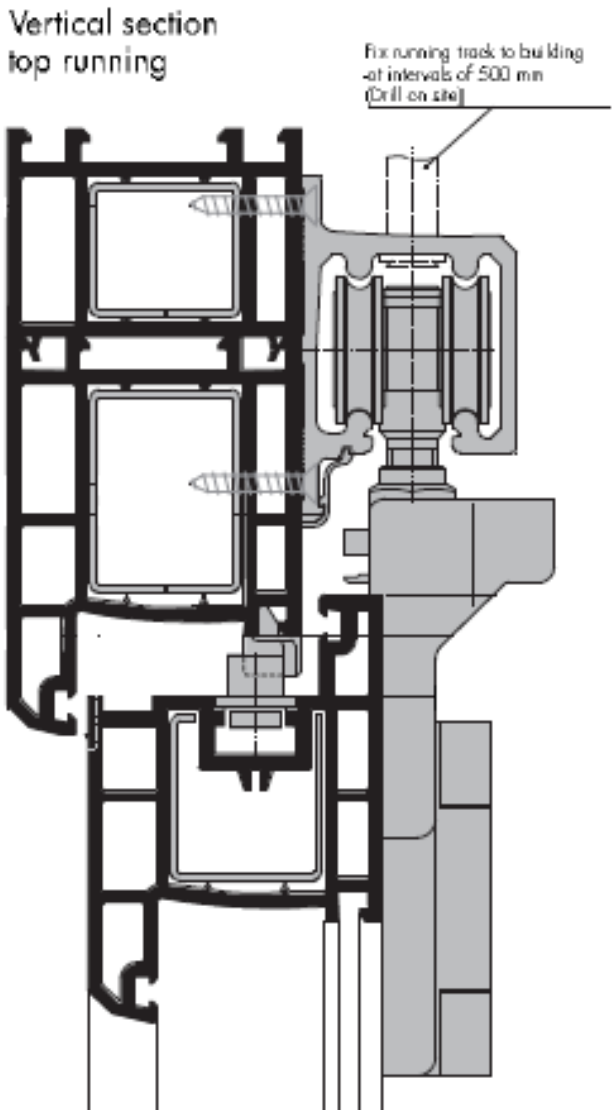
General requirements:

Disposition of fastening points and bearing blocks is the same as for mounting of windows.

See Figure 1.

Important:

The whole weight of fold away door is hanged on the upper rail, therefore, it is very important to ensure a secure fastening of the upper part of accordion door in an absolutely horizontal position. In order to ensure stability, the upper rail shall be additionally fastened to the platband every 19” (500mm). Holes shall be drilled for mounting dowels to be used for fastening.



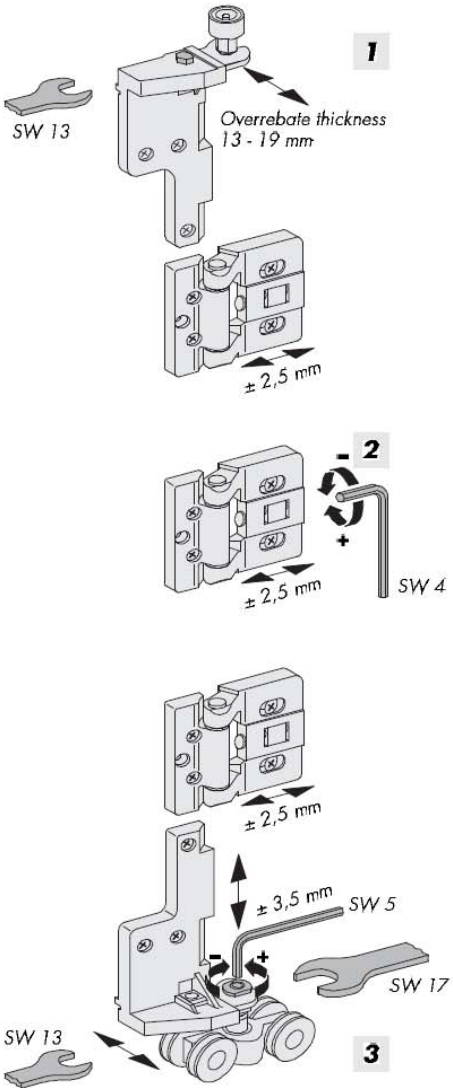
Adjustment:

* Adjustment schemes provide cases where the bearing rail is installed at the bottom. Adjustment remains the same irrespective of rail mounting method.

Adjustments

If required, the variety of adjustments listed below can be used.
For correct adjustment it is recommended that:

- first install the glass correctly
- the folding sliding elements are clamped horizontal and plumb or the frame is installed into the building



1

Sash presssure via the top hinge

- **A** Loosen the lock nut SW13
- **B** Firmly press the sash against the frame.
- **C** Tighten the locking nut.

2

Positioning of the Sash hinges

Tip: Slacken sash hinges in order, adjust and re-tighten.

- **A** Slacken both set screws.
- **B** Adjust the gap with allen key SW 4 .
- **C** Re-tighten setscrews.

3

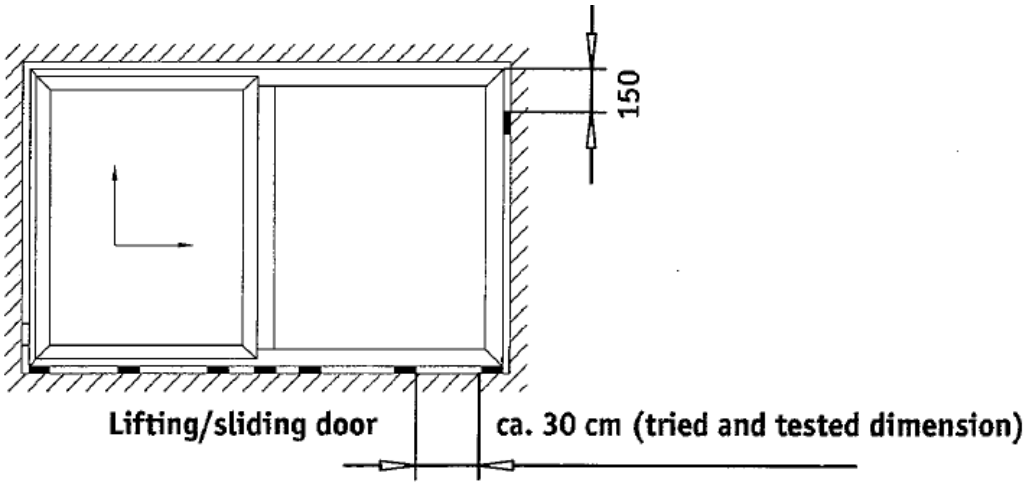
Setting the height of Bogie wheels

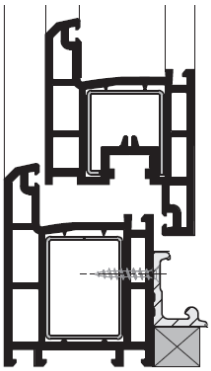
- **A** Slacken lock nut SW 17 on the bogie wheels.
- **B** Adjust the height of the sash by using allen key SW 5 whilst holding the lock nut in place with spanner SW 17.
- **C** Then re-tighten the lock nut keeping allen key SW5 firmly in place.

Mounting and adjustment of tilt/sliding doors

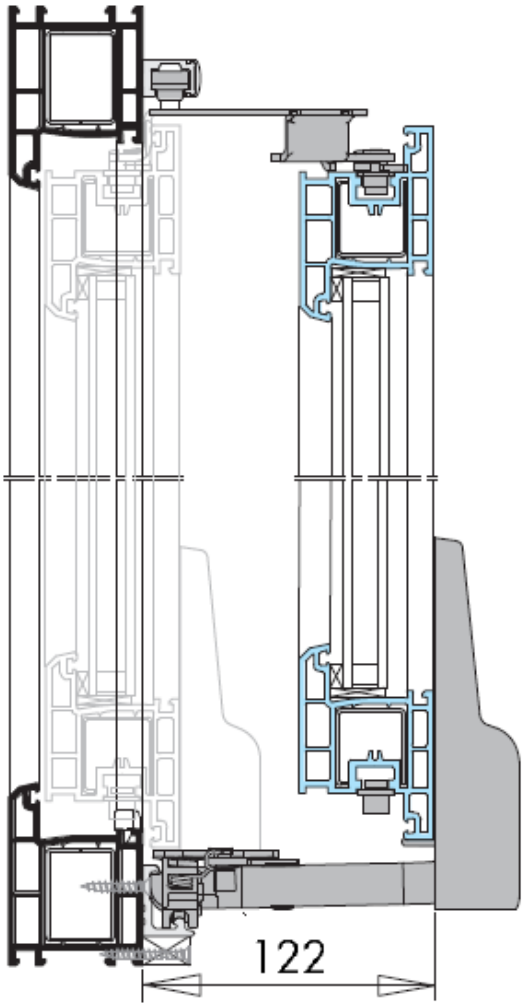
In case of the above type of doors the whole weight of moving door section falls to the bearing rail, therefore, it is very important to make sure the rail would not slide off when the door leaf moves. For this reason the bearing shall be placed within the distance not exceeding 300mm. The bearings shall be in perfect horizontal position.

150 mm= 5 29/32”inch
30cm =300mm=11 26/32”inch





Placement of fastening points is the same as for mounting of windows



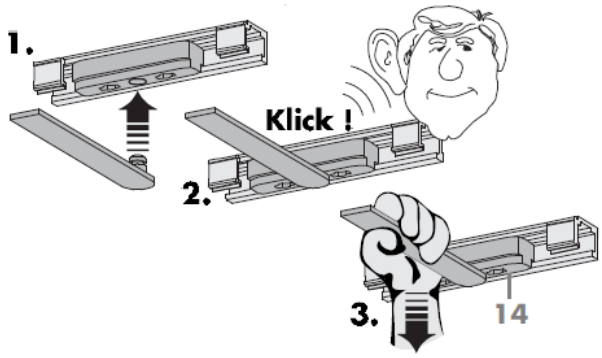
Important:

Please note that the door sliding part “rises” when the door is opened. Consider this when you will mount the door.

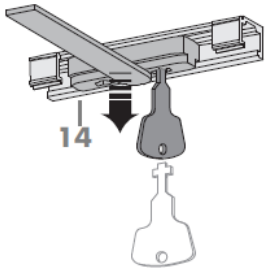
122mm=4 24/32” inch

Adjustment of tilt/sliding doors

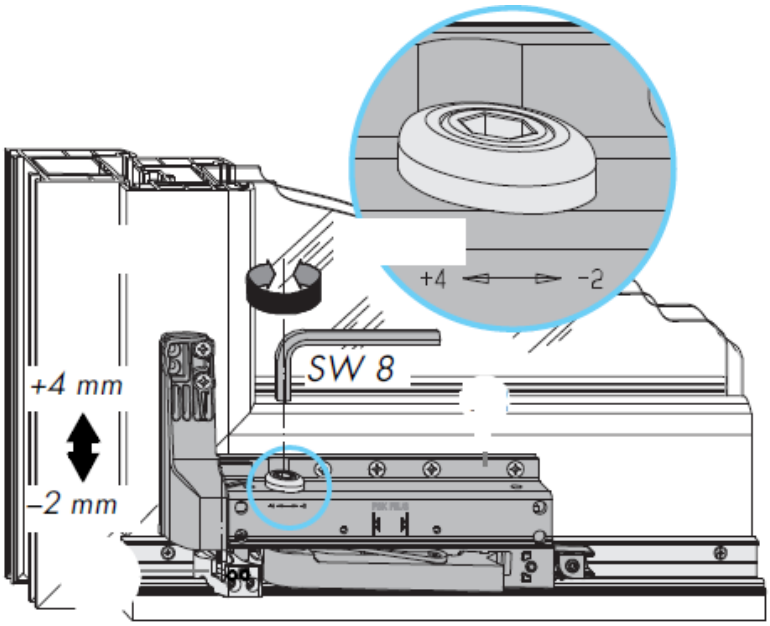
Hooking on and off door moving part



Aushängen der Scherenarme.



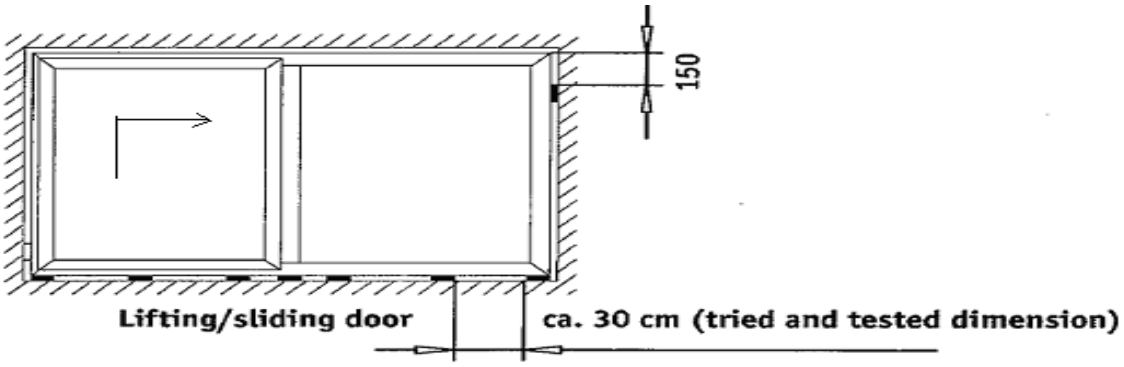
Adjustment of door



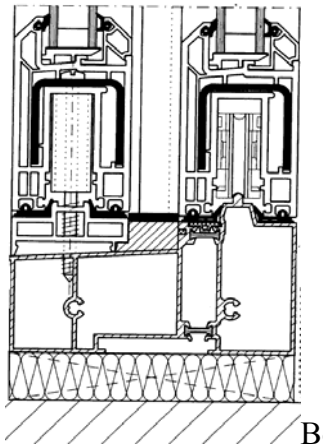
Mounting of lift/slide doors

In case of the above type of doors the whole weight of door leaf falls to the bearing rail, therefore, it is very important to make sure the rail would not slide off when the door leaf moves. For this reason the bearing shall be placed within the distance not exceeding 300mm. The bearings shall be ideally horizontal.

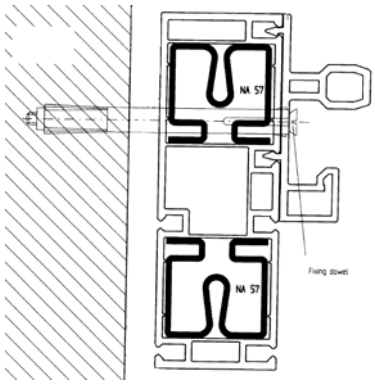
150 mm= 5 29/32”inch
30cm =300mm=11
26/32”inc



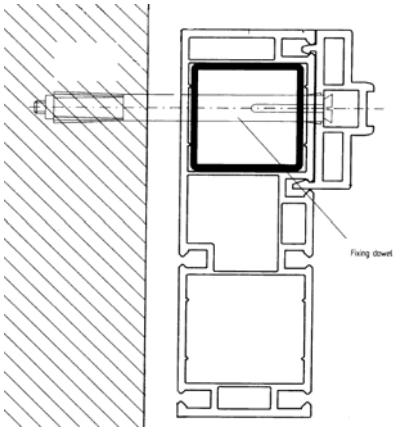
Fastening of lifting/sliding doors



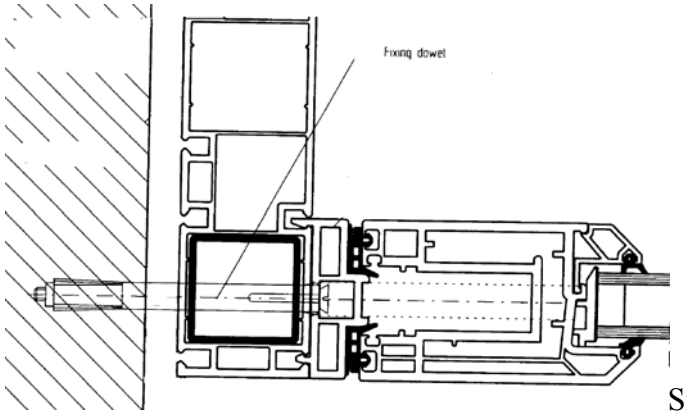
Bottom



Top



Side1



Side2

THERMORY®
Thermo-treated wood

Solid Hardwood Decking

What is Thermory® Decking?

An **ESTABLISHED** brand of hardwood decking produced from **AMERICAN** hardwoods, manufactured for consumers conscious of **DESIGN** and **FUNCTION** with **INNOVATIVE** and **PROVEN** technology, creating the **MOST STABLE** and **BEAUTIFUL** hardwood decking available.

What is the thermal process?

Heated to approximately 400 degrees
Utilizing only **HEAT** and **STEAM**
NO CHEMICALS
Equalized at 6% moisture content
Rearranges cell structure to reduce **MOVEMENT RELATED TO MOISTURE**

What kind of wood is Thermory Decking®?

Northern **AMERICAN ASH**
Harvested from well managed **SUSTAINABLE** forests

Is Themory® Decking reliable and established?

TORTURE TESTED (**80%** RH – **15%** RH)
STRENGTH TESTED (14,000 lbs/in2)
TWICE THE STRENGTH of Cedar
Over **30,000,000 SF** in use today
European technology for **15 YEARS**
CLASS 1 DURABILITY RATING, resistant to rot and decay for over 25 years
CONSISTENT SUPPLY of material year round

What widths and lengths are available?

.79 x 3-3/4" (7% WIDER THAN A STANDARD 1X4!)	8.9' - 12.8'
.79 x 5-7/8" (7% WIDER THAN A STANDARD 1X6!)	6.8' - 12.8'
1.02 x 3-1/2"	6.8' - 12.8'
1.02 x 5-3/4" (5% WIDER THAN A STANDARD 5/4 x 6!)	6.8' - 12.8'

↓ up to 2,800 lbs ↓

Clear, full usable lengths with end matching available (same price) – No Waste, less labor – end joints can be located anywhere—not just on the joists

THERMORY®
Thermo-treated wood

What are the benefits?

FUNCTION and **BEAUTY** with **UNMATCHED STABILITY**!

Plain sawn with beautiful cathedral grain.

CONVENTIONAL INSTALLATION, Thermory® is incredibly flat and stable and installed by face screwing or pre-grooved for hidden clip fastening systems.

Matching railings, siding and fence components available.

CLASS 1 DURABILITY rating, resistant to rot and decay for 25+ years!

Harvested from sustainable **AMERICAN** forests--not rain forests!

HALF THE WEIGHT of Ipe.

Easy on tooling, saw blades and drill bits.

Less thermal conductivity than Ipe or composites, **NO HOT FEET**!

Dust is **NOT TOXIC.**

GREEN thermal process using only heat and steam, **NO CHEMICALS.**

Proven **EXPERIENCE** and **ESTABLISHED** manufacturing using **EUROPEAN TECHNOLOGY.**

Ages gorgeously to a silver color, matching coastal homes or, maintain tropical tones with UV deck oils.

Thermory® USA has a fully functional manufacturing facility with planers, sanders, jointers, saws, CNC capabilities, molder, etc… so always ask “can we do this?”

Thermory® USA **Yard: 71 Market Street, Attica, NY 14011**

Buffalo, NY Office: 585-409-5930
Chicago, IL Office: 847-256-8828

THERMORY®
Thermo-treated wood

What is thermally modified hardwood flooring?

ONLY true solid hardwood flooring approved for use:
GLUED TO CONCRETE and **OVER RADIANT HEAT**

What is the process?

Heated to approximately 400 degrees
Utilizing only **HEAT** and **STEAM**
NO CHEMICALS
Equalized at 4% moisture content
Rearranges cell structure to **STOP MOISTURE MOVEMENT**

What kind of wood?

Northern **US DOMESTIC ASH**
Harvested from well managed US **SUSTAINABLE** forests

Is thermally modified hardwood flooring reliable?

TORUTURE TESTED here in the US prior to release (**80%** RH – **15%** RH)
European technology for **25 years**

What are the different colors?

Salsa – LIGHT
Tango – DARK (heated a little longer and a little hotter)
Easily accepts stains and dyes

What widths?

Tango: 3-1/2" 6" 7-1/2"
Salsa: 3-1/2" 5" 7-1/2"

How is it installed?

Conventional nailing
Glue directly to concrete
Conventional finishes

THERMORY®
Thermo-treated wood

Tips to remember when selling:

Functionality AND the beauty. We have a beautiful true solid hardwood floor with outstanding finish capabilities with UNMATCHED stability!

Thermally modified hardwood flooring is a great floor for any application, especially for coastal homes insignificant movement in width from winter to summer.

Insurance policy for moisture related issues in the future.

We are the only companies in the country offering warranty, tried and true, tested, thermally modified hardwood flooring line.

Many options with this one specie (Ash); 2 treatment levels, colors are limitless with stain and dye, random width, designs, boarders, hand scraped, brushed, oil finishes etc….

Out performs engineered, hands down!

Easy installation, Thermally modified hardwood is incredibly flat.

Ash is harder than Red Oak (Ash: 1360, Red Oak: 1320 on the jenka scale)

Attica Millwork, Inc. has a fully functional manufacturing facility with planers, sanders, jointers, saws, CNC capabilities, molder, etc… so always ask "can we do this?"

Thought: Why do consumers pay more for a Lincoln or a Cadillac? They are willing to pay for the better function, styling, performance reliability etc… Thermally modified hardwood flooring is simply a better floor by science.

ec1™

colorbody™ porcelain

NEXT™ by daltile®


NEXT™
by daltile®

ec1™

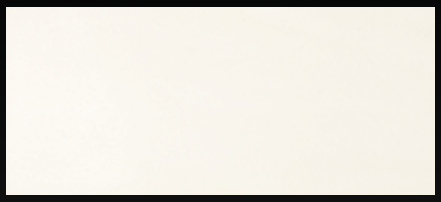
colorbody™ porcelain

Sleek, trendy colors and accents, multiple large format sizes, and choice of durable textured surfaces make EC1 a top choice for style and selection. This ColorBody Porcelain offers designers and architects an array of stylish options and is suitable for most exterior applications. EC1 is an eco-friendly product being produced using a high percentage of recycled materials.

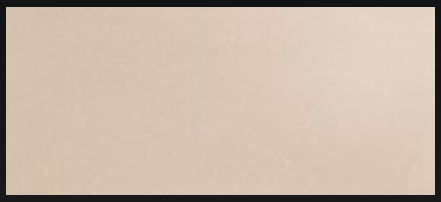
Photo features Barbican Unpolished 12 x 24 field tile on the floor and Barbican Textured in 12 x 24 with Barbican 6 x 24 decorative accent on the wall.

ec1™ colorbody™ porcelain

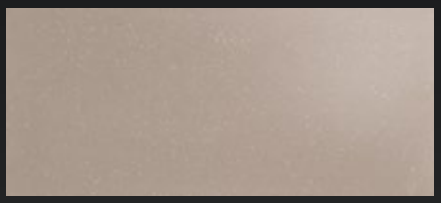
FIELD TILE



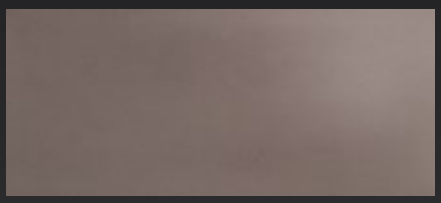
FARRINGDON J100



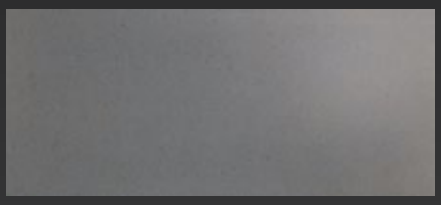
BANK J101



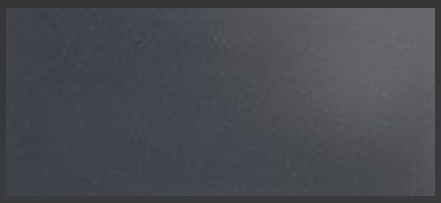
HOLBORN J102



DOCKS J103



CITY J104



BARBICAN J105

DECORATIVE ACCENTS

FARRINGDON J100 6 x 24 Random Linear Decorative Accent

BANK J101 6 x 24 Random Linear Decorative Accent

HOLBORN J102 6 x 24 Random Linear Decorative Accent

DOCKS J103 6 x 24 Random Linear Decorative Accent

CITY J104 6 x 24 Random Linear Decorative Accent

BARBICAN J105 6 x 24 Random Linear Decorative Accent

SURFACES

CLOSE-UP OF TILE

POLISHED Shown in Bank J101

CLOSE-UP OF TILE

HONED Shown in Bank J101

CLOSE-UP OF TILE

UNPOLISHED Shown in Bank J101

CLOSE-UP OF TILE

TEXTURED Shown in Bank J101

ec1™ colorbody™ porcelain

SIZES

			Sq. Ft. Per Carton	Pieces Per Carton
	24 x 48 Field Tile (Polished, Unpolished, Textured, Honed)	(24" x 48") (60.0 cm x 120.0 cm)	15.49	2
	24 x 24 Field Tile (Polished, Unpolished, Textured, Honed)	(24" x 24") (60.0 cm x 60.0 cm)	15.49	4
	12 x 24 Field Tile (Polished, Unpolished, Textured, Honed)	(12" x 24") (30.0 cm x 60.0 cm)	11.62	6
	4 x 24 Field Tile (Unpolished, Textured, Honed)	(4" x 24") (10.0 cm x 60.0 cm)	10.33	16
	6 x 24 Random Linear Accent	(6" x 24") (15.0 cm x 60.0 cm)	- -	6

TRIM

	Type	Number	Size	Pieces per carton
	Bullnose (Polished, Unpolished, Textured, Honed)	S-44F9	4 x 24	8
	Stair Tread (Polished, Unpolished, Textured, Honed)	S-6CF6	12 x 24	5

PRE CONSUMER RECYCLED MATERIALS

TRU-EDGE

EXTERIOR PRODUCT

CERTIFIED PORCELAIN TILE 0.5% or less water absorption

protected by design | daltile greenworks™ ENVIRONMENTAL LEADERSHIP THAT WORKS

Designed to help earn LEED™ Credits.

At Daltile, we help make it easier for you to earn points toward LEED™ certification so you don't have to compromise your design for any reason. We use recycled materials in many of our products and have multiple manufacturing facilities providing the potential to be within 500 miles of your projects. For detailed information, visit daltilegreenworks.com

APPLICATION

	INTERIOR			EXTERIOR	
	Residential	Light Commercial	Commercial	Residential	Commercial
Floors/Patios	✓	✓	✓*	✓*	✓**
Walls/Backsplashes	✓	✓	✓	✓	✓
Countertops	✓	✓	✓	✓	✓
Pool Decking	✓**	✓**	✓**	✓**	✓**
Pool Lining	✓	✓	✓	✓	✓

* Unpolished and Textured surfaces only

** Textured surface only

Textured Surface: Suitable for pool decks and patios in freezing and non-freezing climates when proper installation methods are followed.

Unpolished, Polished, & Honed: Suitable for exterior walls in freezing and non-freezing climates when proper installation methods are followed.

INSTALLATION

Thickness	Grout Joint Recommendation	Shade Variation
7/16" (11mm – Unpolished, Textured & Honed) 3/8" (10 mm – Polished)	1/8" (3/16" when rectangular sizes are used in a staggered brick-joint pattern, where the overlap does not exceed 33%)	Medium (V2)

TEST RESULTS (Unpolished and Textured Only)

	ASTM#	UNPOLISHED	POLISHED	HONED	TEXTURED
Water Absorption	C373	< 0.5%	< 0.5%	< 0.5%	< 0.5%
Breaking Strength	C648	> 400 lbs	> 400 lbs	> 400 lbs	> 400 lbs
Scratch Hardness	MOHS	7.0	7.0	7.0	7.0
Chemical Resistance	C650	Resistant	Resistant	Resistant	Resistant
Coefficient of Friction	C1028	Wet: ≥ 0.60 Dry: ≥ 0.70	Wet: ≥ 0.50 Dry: ≥ 0.60	Wet: ≥ 0.50 Dry: ≥ 0.60	Wet: ≥ 0.80 Dry: ≥ 0.80

NOTES

Special care should be taken when grouting with dark pigmented colors. A grout release is recommended to prevent finely powdered pigments from lodging in the pores of the tile surface.

Special care needs to be given when installing tiles 20" and larger. Please refer to www.daltile.com/LargeTiles for information.

SCAN QR CODE FOR PRODUCT INFORMATION.

Get a QR Code reader at ***get.daltile.com***

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7834 C.F. Hawn Freeway, Dallas, Texas 75217
1.800.933.TILE | DALTILE.COM

Material Safety Data Sheet

U.S. Department of Labor

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

Occupational Safety and Health Administration
from FORM 174, Sept. 1985 (Non-Mandatory Form)

Adapted

IDENTITY (As Used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
Floor Tile (Series - DB Yacht Club)	

Section I - Manufacturer & Distributor Information

Manufacturer's Name **Sanfi Ceramics (Xing Hui)**	Emergency Telephone Number **011-86 (0757)8396-9288**
Address *(Number, Street, City, State, Country and Postal Code)* **No. 1 Building A, Western District,**	Telephone Number For Information **011-86 (0757)8396-9288**
China Ceramics Industry HQ **Jihua Xi Road**	Date Prepared **3/12/2012**
Changcheng District, Foshan City	Signature Of Preparer (Optional)
Distributor's Name **Dal-Tile Company**	Distributor's Telephone Number **(800) 933-8453**

Section II - Hazard Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	CAS Number	Concentration (%)	OSHA PEL (mg/m3)	ACGIH TLV (mg/m3)	Other Limits Recommended
1 **Crystalline Silica (Quartz)**	**7631-86-9**	**< .5%**	**10/%SiO2 +2**	**0.05**	
2 **Amorphous Silica (fused)**	**60676-86-0**	**62-71**	**80/%SiO2**	**0.1**	

Section III - Physical/Chemical Characteristics

Boiling Point (Specify ^{o}F or ^{o}C)	**not applicable**	Specific Gravity *(H_2O = 1)*	**1.75 - 2.93**
Vapor Pressure (mm Hg.)	**not applicable**	Melting Point	**> 2000 ^{o}F**
Vapor Density (AIR = 1)	**not applicable**	Evaporation Rate *(Butyl Acetate = 1)*	**not applicable**
Solubility In Water **Insoluble**		Appearance And Odor **Brittle solid; color may vary and Odorless**	

Section IV - Fire and Explosion Hazard Data

Flash Point *(Include Method Used To Determine)*	Flammable Limits	LEL	UEL
not applicable		**not applicable**	**not applicable**
Extinguishing Media **None required. Non-flammable.**			
Special Fire Fighting Procedures **None required.**			
Unusual Fire And Explosion Hazards **None required.**			

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Section V - Reactivity Data

Unstable	**not applicable**	Conditions To Avoic **Avoid contact with acids (e.g., acetic, hydrofluoric, etc.)**
Stable	**Stable in current form.**	

Incompatibility*(Materials To Avoid)*

Avoid contact with acids (e.g., acetic, hydrofluoric, etc.)

Hazardous Decomposition Or Byproducts

Under normal conditions these products do not release hazardous materials after installation.

Hazardous Polymerization May Occu	**not applicable**	Conditions To Avoic **Not applicable**
Hazardous Polymerization Will Not Occu	**Will not occur**	

Section VI - Health Hazard Data

Route(s) Of Entry:	Inhalation **Yes**	Skin? **Yes**	Ingestion? **No**

Health Hazards (Acute and Chronic)

Acute - Excessive exposure to tile dust can cause eye, skin, and lung irritation from mechanical abrasion. Ingestion is not applicable for intact tile.

Chronic - Not applicable for intact tiles. Excessive exposure to tile dust can cause discomfort and mechanical irritation. Long term exposure to silica dusts can lead to silicosis.

Carcinogenicity - Respirable crystalline silica (quartz) is classified by International Agency for Research on Cancer (IARC) as a human carcinogen. Intact tile is not believed to be hazardous and limited potential of exposure exists for crystalline silica (quartz) during installation, disposal, and/or if damaged. Crystalline silica is described in ACGIH and NIOSH as being identified in other sources as a suspected human carcinogen; however, fused silica is reported only by ACGIH as a suspected human carcinogen.

Carcinogenicity:	NTP? **Yes**	IARC Monographs? **Yes**	OSHA Regulated? **Yes**

Signs And Symptoms Of Exposure

Excessive exposure to tile dust can cause eye, skin, and lung irritation from mechanical abrasion. Long term exposure to silca dusts can lead to silicosis.

Medical Conditions Generally Aggravated By Exposure

Existing lung disease my be aggravated after exposure to tile dusts.

Emergency And First Aid Procedures

Skin: Wash dust off any affected area with soap and water.

Inhalation: Remove the victim to fresh air if exposed to large amounts of tile cutting dust. Administer artificial respiration if breathing has stopped. Keep victim at rest. Call for prompt medical attention.

Ingestion: Not applicable for intact tiles.

*** Have emergency eyewash station available in area where tiles are cut.**

Section VII - Precautions for Safe Handling and Use

Steps To Be Taken In Case Material Is Released Or Spilled

Employ closed system and/or local exhaust ventilation. Use wet methods if needed to reduce generation of dust. Use respiratory protection in the absence of engineering controls.

Waste Disposal Method

Waste should be disposed of in a landfill certified to accept such materials in accordance with federal, state, and local regulations.

Precautions To Be Taken In Handling And Storing

Shelf life is unlimited. Do not store near acids. If tiles contact some acids, there is limited potential for leaching heavy metals.

Other Precautions

Broken tile could be sharp; therefore, appropriate gloves should be worn if working with broken product.

Section VIII - Control Measures

Respiratory Protection (Specify Type)

Use of a properly fitted NIOSH/MSHA approved particulate respirator is recommended when cutting tiles.

Ventilation:

Use adequate ventilation to keep exposure to dust below recommended exposure levels. Avoid inhaling dust. The highest probability of silica exposure occurs during dry cutting. Wet cutting methods are recommended.

Eye Protection:

Use dust-proof goggles or safety glasses with side shields. Contact lenses may absorb irritants. Do not wear contact lenses in work areas.

Skin Protection:

Cotton or leather work gloves should be worn when cutting this product to minimize skin exposure. Wash hands prior to eating drinking, or smoking, and at the end of the work shift, after cutting operations are conducted.

Other Protective Clothing or Equipment:

Note: Personal protection information listed above is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

Section VIIII - Regulatory Section

Title 22 Division 2, California Code of Regulation Chapter 3 (Proposition 65)

This product contains a chemical or chemicals known to the State of California to cause cancer and/or birth defects or other reproductive harm.

SARA Reporting

This tile contains < 0.1 percent by weight each of the following elements which are SARA 313 Recordable:
Antimony, Arsenic, Barium, Beryllium, Cadmium, Cobalt, Chromium, Mercury, Manganese, Nickel, Lead, Silver, Thallium, Vanadium, and Zinc.

Department of Transportation (DOT) Regulations

Tile is not regulated by DOT.

Toxic Substance Control Act (TSCA)

This product and/or its components have been introduced into U.S. commerce and is listed in the Toxic Substance Control Act (TSCA) Inventory of Chemicals in Commerce. Hence, it is subject to all applicable provisions and restrictions under TSCA 40 CFR Section 721 and 723.250.

Other information

National Fire Protection Act Hazard Rating:	**Health:**	**0**	**Fire:**	**0**	**Reactivity:**	**0**
Hazardous Material Information System Rating	**Health:**	**0**	**Fire:**	**0**	**Reactivity:**	**0**

Material Safety Data Sheet

U.S. Department of Labor

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

Occupational Safety and Health Administration
from FORM 174, Sept. 1985 (Non-Mandatory Form)

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China Ceramics Industry HQ **Jihua Xi Road**	Date Prepared **3/12/2012**
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Section III - Physical/Chemical Characteristics

Boiling Point (Specify ^{o}F or ^{o}C)	**not applicable**	Specific Gravity *(H_2O = 1)*	**1.75 - 2.93**
Vapor Pressure (mm Hg.)	**not applicable**	Melting Point	**> 2000 ^{o}F**
Vapor Density (AIR = 1)	**not applicable**	Evaporation Rate *(Butyl Acetate = 1)*	**not applicable**
Solubility In Water **Insoluble**		Appearance And Odor **Brittle solid; color may vary and Odorless**	

Section IV - Fire and Explosion Hazard Data

Flash Point *(Include Method Used To Determine)*	Flammable Limits	LEL	UEL
not applicable		**not applicable**	**not applicable**
Extinguishing Media **None required. Non-flammable.**			
Special Fire Fighting Procedures **None required.**			
Unusual Fire And Explosion Hazards **None required.**			

O+D15

Section V - Reactivity Data

Unstable	**not applicable**	Conditions To Avoic **Avoid contact with acids (e.g., acetic, hydrofluoric, etc.)**
Stable	**Stable in current form.**	

Incompatibility*(Materials To Avoid)*

Avoid contact with acids (e.g., acetic, hydrofluoric, etc.)

Hazardous Decomposition Or Byproducts

Under normal conditions these products do not release hazardous materials after installation.

Hazardous Polymerization May Occu	**not applicable**	Conditions To Avoic **Not applicable**
Hazardous Polymerization Will Not Occu	**Will not occur**	

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Route(s) Of Entry:	Inhalation **Yes**	Skin? **Yes**	Ingestion? **No**

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Acute - Excessive exposure to tile dust can cause eye, skin, and lung irritation from mechanical abrasion. Ingestion is not applicable for intact tile.

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Waste Disposal Method

Waste should be disposed of in a landfill certified to accept such materials in accordance with federal, state, and local regulations.

Precautions To Be Taken In Handling And Storing

Shelf life is unlimited. Do not store near acids. If tiles contact some acids, there is limited potential for leaching heavy metals.

Other Precautions

Broken tile could be sharp; therefore, appropriate gloves should be worn if working with broken product.

Section VIII - Control Measures

Respiratory Protection (Specify Type)

Use of a properly fitted NIOSH/MSHA approved particulate respirator is recommended when cutting tiles.

Ventilation:

Use adequate ventilation to keep exposure to dust below recommended exposure levels. Avoid inhaling dust. The highest probability of silica exposure occurs during dry cutting. Wet cutting methods are recommended.

Eye Protection:

Use dust-proof goggles or safety glasses with side shields. Contact lenses may absorb irritants. Do not wear contact lenses in work areas.

Skin Protection:

Cotton or leather work gloves should be worn when cutting this product to minimize skin exposure. Wash hands prior to eating drinking, or smoking, and at the end of the work shift, after cutting operations are conducted.

Other Protective Clothing or Equipment:

Note: Personal protection information listed above is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

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Hazardous Material Information System Rating	**Health:**	**0**	**Fire:**	**0**	**Reactivity:**	**0**

TILE ADHESIVES, MORTARS AND GROUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface Preparation Products: Backerboards, Self-Leveling Underlayments, Waterproofing and Anti-Fracture Membranes, Sound Reduction Mat Underlayments.

B. Setting Materials: Architecturally Engineered Mortar Systems, Thin-Set Mortars, Specialty Mortars, Ceramic Tile Adhesives.

C. Colored Tile Grouts – Sanded, Non-Sanded and Epoxy Grouts.

D. Tile and Stone Care and Maintenance Products.

1.2 RELATED SECTIONS

A. Section 03300 – Concrete substrate.

B. Section 07120 – Fluid applied waterproofing.

C. Section 07900 – Expansion and control joints.

D. Section 09200 – Scratch coat for ceramic wall tile.

E. Section 09250 – Gypsum Board System.

F. Section 09300 – Tile.

G. Section 10805 – Toilet accessories.

1.3 REFERENCES

A. ANSI A108.1 – Installation of Ceramic Tile Portland Cement Mortar.

B. ANSI A108.4 – Installation of Ceramic Tile with Organic Adhesives or Water-Cleanable Epoxy Adhesive.

C. ANSI A108.5 – Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.

D. ANSI A108.6 – Installation of Ceramic Tile with Chemical Resistant, Water-Cleanable, Tile Setting and Grouting Epoxy.

E. ANSI A108.8 – Installation of Ceramic Tile with Chemical Resistant Ruran Resin Mortar and Grout.

F. ANSI A108.9 – Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar and Grout.

G. ANSI A108.10 – Installation of Grout in Tile Work.

H. ANSI A108.11 – Installation of Cementitious Backer Units.

I. ANSI A108.12 – Installation of Ceramic Tile with EGP (Exterior Glued Plywood) Latex-Portland Cement Mortar.

I. ANSI A108.13 – Installation of Waterproof Membranes for Thin-Set Tile and Stone.

J. ANSI A108.14 – Installation of Paper-Faced glass mosaic tile.

K. ANSI A108.15 – Installation of Paper-Faced glass Mosaic Tile — Alternate Method.

L. ANSI A108.16 – Proposal for Installation of Paper-Faced, Back-Mounted, Edge-Mounted, or Clear Film Face-Mounted Glass Mosaic Tile.

M. ANSI A118.1 – Dry-Set Portland Cement Mortar.

N. ANSI A118.3 – Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy and Water-Cleanable Tile Setting Epoxy Adhesive.

O. ANSI A118.4 – Latex Portland Cement Mortar.

P. ANSI A118.6 – Ceramic Tile Grouts.

Q. ANSI A118.7 – Polymer Modified Cement Grout.

R. ANSI A118.9 – Cementitious Backer Units.

S. ANSI A118.10 – Waterproof Membranes for Thin-Set Tile and Stone.

T. ANSI A118.11 – EGP (Exterior Glued Plywood) latex-Portland cement mortar.

U. ANSI A118.12 – Crack Isolation Membranes.

V. ANSI A136.1 – Organic Adhesives, Type I Adhesive and Type II Adhesive.

W. TCA – Handbook for Ceramic Tile Installation.

X. U.S. Product Standard PS 1-83 for Construction and Industrial Plywood.

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. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products of this section with minimum ten years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Locate mock-ups on site in locations and size directed by Architect.
2. Finish areas designated by Architect.
3. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
4. Refinish mock-up area as required to produce acceptable work.
5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of work.
6. Obtain Architect's acceptance of mock-ups before start of final unit of work.

D. Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter and other causes.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 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.

B. Environmental: Install mortar, set and grout tile when surfaces and ambient temperature is minimum 50° F (10° C) and maximum 90° F (32° C). Consult with manufacturer for specific requirements.

C. Do not install mortar, set or grout tile exterior when inclement weather conditions are expected within 48 hours after work is completed unless properly protected.

D. Protection: Protect adjacent work surfaces during tile work. Close rooms or spaces to traffic of all types until mortar and grout has set.

E. Safety: Observe the manufacturer's safety instructions including those pertaining to ventilation.

1.8 WARRANTY

A. Products shall be provided with the manufacturers standard warranty as follows:

1. Installation Systems Limited Warranty:

a. _____.

1.9 EXTRA MATERIALS

A. Supply an amount equal to 3 percent of each size, color, and surface finish of tile specified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
Custom Building Products, 13001 Seal Beach Blvd., Seal Beach, CA 90740. ASD. Telephone Toll Free: 800-282-8786. Fax: 800-200-7765.
Web: www.custombuildingproducts.com.
Email: jackiel@cbpmail.net.

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MATERIALS

A. Anti-Fracture Membrane/Cleavage Membrane: Where indicated on the drawings, and elsewhere as required for isolating the installation from cracking due to minor substrate movement and normal structural deflections.

1. Custom Building Products RedGard® Waterproofing and Crack Prevention Membrane.
2. Custom Building Products SpiderWeb® Uncoupling Mat
3. Custom Building Products Crack Buster® Pro Crack Prevention Mat Underlayment.
4. Custom Building Products EasyMat® Tile & Stone Underlayment. For ASTM C 627 residential and light commercial use only.
5. Custom Building Products Peel & Stick Primer for self adhesive membrane.
6. Custom Building Products Custom® 9240 Waterproofing and Anti-Fracture Membrane.

B. Waterproofing and Anti-Fracture Membrane: Where indicated on the drawings, and elsewhere as required for thin-set tile installations complying with ANSI 118.10 for waterproof membranes.

1. Custom Building Products RedGard® Waterproofing and Crack Prevention Membrane.
2. Custom Building Products Custom® 9240 Waterproofing and Anti-Fracture Membrane.

C. Sound Control/Acoustical Underlayment: Where indicated on the drawings, and elsewhere as required to be load bearing, shock and vibration resistant.

1. Custom Building Products EasyMat® Tile & Stone Underlayment 3 mm, 5 mm or 12 mm thickness as engineered.
2. Custom Building Products EasyMat® Tile & Stone Underlayment peel and stick application 3 mm or 5 mm thickness as engineered.
3. Custom Building Products Peel & Stick Primer for self adhesive membrane.

D. Moisture Barrier System: Where indicated on the drawings and elsewhere as required for thin-set tile installations.

1. RedGard® Waterproofing and Crack Prevention Membrane. See moisture barrier installation instructions for RedGard®.

E. Self-Leveling Underlayment: Where indicated on the drawings, and elsewhere as required to provide a flat, level surface for direct receipt of tile and other floor coverings on dry, interior installations.

1. Custom Building Products LevelQuik® Rapid Setting Self-Leveling Underlayment for fills up to 1 inch (25 mm) thick.
2. Custom Building Products LevelQuik® Extended Setting Self-Leveling Underlayment for fills up to 1 inch (25 mm) thick.
3. Custom Building Products LevelLite® Self-Leveling Underlayment for fills up to 2 inches (51 mm) thick.
4. Custom Building Products LevelQuik® Latex Primer for surface preparation.

F. Mortar Bed Installations: Where indicated on the drawings, and elsewhere as required for mortar bed or brown coat as the substrate for tile work; work to conform to ANSI A108.1.

1. Custom Building Products CustomFloat™ Bedding Mortar mixed with 1/2 water and 1/2 Thin-Set Mortar Admix.

G. Cementitious Backer Units: ANSI A118.9 Where indicated on the drawings, and elsewhere as required for floors and walls, interior and/or exterior, wet areas, and dry as recommended substrate for tile, fire rated wall installations, heat shield with UL listing for floors and walls; installation to comply with ANSI A108.11 and manufacturer's installation instructions.

1. 1/2 inch (13 mm) WonderBoard® Backerboard (Exterior or Interior Floors, Walls, Ceilings, Countertops).
2. 1/4 inch (6 mm) WonderBoard® Backerboard (Exterior or Interior Floors and Countertops).

H. Cementitious Tile Adhesives:

1. ANSI A118.1: Where indicated on the drawings, and elsewhere as required for setting tile as specified by ANSI A108.5, Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar, over substrates prepared accordingly.
   a. Custom Building Products CustomBlend® Standard Thin-Set Mortar.
2. ANSI A118.4: Polymer-Enhanced Mortars:
   a. For Large Format Tile and Stone
      1) Custom Building Products ProLite® RS Rapid Setting Tile & Stone Mortar.
      2) Custom Building Products ProLite® Tile & Stone Mortar.
      3) Custom Building Products Marble, Granite & Travertine Premium Medium Bed Mortar.
      4) Custom Building Products Medium Bed Mortar.
      5) Custom Building Products Complete Contact™ Fortified Thin-Set Mortar.
      6) Custom Building Products Complete Contact RS Fortified Mortar.
   b. For Crack Prevention
      1) Custom Building Products MegaLite® Crack Prevention Mortar.
      2) Custom Building Products MegaLite® Rapid Setting Crack Prevention Mortar.
      3) Custom Building Products MegaFlex® Crack Prevention Mortar.
      4) Custom Building Products FlexBond® Crack Prevention Mortar.
   c. For maximum LEED credit
      1) Custom Building Products MegaLite® Crack Prevention Mortar.
      2) Custom Building Products MegaLite® Rapid Setting Crack Prevention Mortar.
      3) Custom Building Products ProLite® RS Rapid Setting Tile & Stone Mortar.
      4) Custom Building Products ProLite® Tile & Stone Mortar.
   d. For Rapid Setting Applications
      1) Custom Building Products MegaLite® Rapid Setting Crack Prevention Mortar.
      2) Custom Building Products ProLite® RS Rapid Setting Tile & Stone Mortar.
      3) Custom Building Products SpeedSet™ Fortified Thin-Set Mortar.
      4) Custom Building Products Complete Contact™ RS Fortified Mortar.

e. Standard Mortars

1) Custom Building Products VersaBond® Flex Fortified Thin-Set Mortar.

2) Custom Building Products VersaBond® Fortified Thin-Set Mortar.

3) Custom Building Products Porcelain Tile Fortified Thin-Set Mortar.

3. Latex Additives: Where specified, a latex additive is to be used as the mixing liquid, per manufacturer's direction, with certain pre-packaged, dry-set mortar mixes, to achieve a Latex Portland Cement Dry Set Mortar complying with ANSI A118.4.

a. Custom Building Products Thin-Set Mortar Admix.

I. Organic Tile Adhesives:

1. ANSI A136.1: Where indicated on the drawings, and elsewhere as required for setting tile as specified by ANSI A108.4, Organic Adhesives, over substrates prepared accordingly.

a. Custom Building Products OmniGrip® Maximum Strength Tile Adhesive (Type I).

b. Custom Building Products ReliaBond® Ceramic Tile Adhesive (Type I).

c. Custom Building Products ReliaBond® ES Extended Set Ceramic Tile Adhesive (Type I).

J. Epoxy Tile Adhesives:

1. ANSI A118.3: Where indicated on the drawings, and elsewhere as required for setting tile as specified by ANSI A108.6 Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy, over substrates prepared accordingly.

a. Custom Building Products EBM-Lite™ Epoxy Bonding Mortar — 100% Solids.

K. Grout: Where indicated on the drawings, and elsewhere as required for filling the joints between tiles.

1. Polymer-Modified Portland Cement Grout:

a. Custom Building Products Polyblend Sanded Tile Grout; ANSI A118.6, for joints 1/8 – 1/2 inch (3 –13 mm).

b. Custom Building Products Polyblend Non-Sanded Tile Grout; ANSI A118.6 or joints up to 1/8 inch (3 mm).

c. Custom Building Products Prism® SureColor® Tile Grout, ANSI A118.7 for joints 1/8 – 1/2 inch (3 –13 mm).

2. Dry-Set Grout:

a. Custom Building Products White Dry Tile Grout; ANSI A118.6, for joints up to 1/8 inch (3 mm). Note: Dry Tile Grout when gauged with Thin-Set Mortar Admix diluted with water 1:1 will yield a Latex Portland Cement Grout.

3. Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy; ANSI A118.3:

a. Custom Building Products 100% Solids Epoxy Grout. Available in all 48 Polyblend grout colors.

b. Custom Building Products CEG-Lite™ 100% Solids Commercial Epoxy Grout.

L. Elastomeric Joint Caulk: ANSI A108.01.3.7 Where indicated on the drawings, and elsewhere as required provide:

1. All joints between floors and walls and at joints between tile and dissimilar materials.

a. Commercial 100% Silicone Caulk – ideal for movement joints in traffic areas

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces, which are to receive tile.

B. Do not proceed with work until defects or conditions which would adversely affect quality, execution and permanence of finished tile work are corrected (ANSI A108.3).

C. 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.

C. Condition of surface to receive tile.

1. Assure that surfaces to receive tile are stable, flat, firm, dry, clean and free of oil, waxes and curing compounds.

2. Deflection of substrate not to exceed 1/360th of the span 1/2 inch (13 mm) in 15 feet (4.6 M) in accordance with ANSI A108.01–2.3. Allow for live and impact load as well as dead load weight of tile and setting bed.

3. Protect adjacent surfaces prior to beginning tile work.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Surface Preparation for Tile and Stone Work.

1. General:

a. All supporting surfaces shall be structurally sound, solid, stable, level, plumb, and true to a tolerance in plane of 1/4 inch (6 mm) in 10 feet 0 inch (3 M) for walls, 1/4 inch (6 mm) in 10 feet (3 M) for floors when specified for thin-set method. They shall be clean and free of dust, oil, grease paint, tar, wax, curing compound, primer, sealer, form release agent, laitance, loosely bonded topping, loose particles or any deleterious substance and debris which may prevent or reduce adhesion.

b. Mechanically sand and scarify the substrate to completely remove all paint, loosely bonded topping, loose particles and construction debris.

c. Neutralize any trace of strong acid or alkali.

d. All substrates shall be dry. The moisture content shall not exceed 50 percent.

e. Turn off all forced ventilation and radiant heating systems and protect work against drafts during installation and for a period of at least 72 hours after completion. Use indirect auxiliary heaters to maintain the temperatures in the area at the recommended workable level. Vent temporary heater to exterior to prevent damage to tile work from carbon dioxide build-up.

f. Presswood, particleboard, chipboard, masonite, gypsum floor patching compounds, asbestos board, Luan and similar dimensionally unstable materials are not acceptable substrates. Before work commences examine the areas to be covered and report any flaw or adverse condition in writing to the architect and to the general contractor. Do not proceed with work until surfaces and conditions comply with the requirements indicated in ANSI A108 specifications.

2. Concrete:

a. All concrete substrates shall be at least 28 days old, completely cured and free of hydrostatic conditions, and/or moisture problems.

b. New concrete surfaces for dry-set mortar, medium-bed mortar or thick-bed mortar installations shall be wood floated or broom finished. Concrete walls should be bush-hammered or heavily sandblasted.

c. On grade or below grade concrete slabs must be installed over an effective vapor barrier and be exempt from hydrostatic pressures.

d. Over excessively dry porous concrete, keep the concrete substrate continuously moist for at least 24 hours before work begins when using dry-set mortars or medium-bed mortars. Remove all excess water or standing water allowing the surface to become almost dry before installing the leveling coat, dry-set mortar or medium-bed dry-set mortar.

e. For minor repairs and smoothing up to 1/2 inch (13 mm), use Skim Coat & Patch Cement Underlayment or SpeedFinish™ Patching & Finishing Compound.

f. For leveling of large areas use LevelLite® Self-Leveling Underlayment for pours up to 2 inches (51 mm) thick, LevelQuik® Rapid Setting Self-Leveling Underlayment for pours up to 1 inch (25 mm) thick or Extended Setting Self-Leveling Underlayment for pours up to 1 inch (25 mm) thick.

g. CustomFloat™ Bedding Mortar mixed with water and Acrylic Mortar Admix to build-up or level a concrete substrate requiring a topping between 1/2 inch (13 mm) and 2 inch (50 mm) average thickness (see technical data sheet for details).

3. Plywood:

a. Plywood subfloor and underlayment must be Group 1, Exterior Glued Plywood, C.C. plugged type or better, conforming to A.P.A. classification and U.S. Product Standard PS 1-83.

b. Plywood substrates are acceptable only in dry areas and only on interior floor or countertop installations. Use exclusively new plywood.

c. Plywood is not an acceptable subfloor in heavy commercial and industrial installations.

d. Plywood shall be installed smooth face up. Offset joints of subfloor and underlayment.

e. When on joists 16 inches (406 mm) o.c.

f. Plywood subfloors shall consist of 2 layers each 5/8 inch (16 mm) thick, laid cross-grained and with 1/4 inch (6 mm) gaps between sheets. The plywood shall be screwed 6 inch (152 mm) o.c. around the perimeter and 8 inch (203 mm) o.c. throughout the body of the panel in each direction.

g. For light residential installations, an overlay of 1/2 inch (13 mm) thick Exterior Glued Plywood over a 1 inch (25 mm) nominal board subfloor is permissible. Maintain a 1/4 inch (6 mm) gap.

h. In all cases, the design of such floors shall not allow a deflection of more than 1/360th of the span under live and dead loads.

i. The adjacent edges of the plywood sheets shall not be more than 1/32 inch (.8 mm) above or below each other.

j. All wood subfloors shall be well vented from below.

4. Backerboard Units Installation of Floors, Decks or Countertops:

a. General Framing: All framing should comply with local building code requirements and be rigid with a maximum deflection or movement of 1/360 under all intended live (including wind and rain) and dead loads.

b. Subfloor Requirements: 5/8 inch (16 mm) Exterior Glued Plywood or OSB panels (PRP-108) should be securely glued or fastened to floor joists. Floor joists should be spaced a maximum of 16 inches (40.6 cm) o.c. 3/4 inch (19 mm) Exterior Glued Plywood or OSB subfloor framed with I-joists spaced a maximum of 19.2 inches o.c. (48.7 cm) is also acceptable. I-joists or truss systems spaced a maximum of 24 inches (61 cm) o.c. with a 3/4 inch (19 mm) Exterior Glued Plywood or OSB subfloor is acceptable when 1/2 inch (13 mm) WonderBoard® is used as the backerboard. When setting dimensional stone larger than 12 inches by 12 inches (30 cm by 30 cm) a 3/4 inch (19 mm) subfloor must be used for all installations. All plywood or OSB subfloor sheets must be gapped 1/8 inch (3 mm).

c. Using a 1/4 by 1/4 inch (6 by 6 mm) square-notched trowel, apply a Custom polymer-modified thin-set mortar to the subfloor or base.

d. Immediately place WonderBoard panels onto fresh mortar. Leave a 1/8 inch (3 mm) gap between boards at all joints and corners. Stagger the joints so they do not line up with underlying substrate joints.

e. Fasten panels every 6 to 8 inches (152 to 203 mm) on center throughout the field and within 1/2 inch to 2 inches (12.5 to 51 mm) from the edge using 1-1/4 inch (32 mm) concrete backerboard screws or 1-1/2 inch (38 mm) galvanized roofing nails.

f. Fill all corners and the joints between panels in all installations with polymer-modified thin-set mortar.

5. Wall and Ceiling Installation

a. Wall and Ceiling: Edges of backerboard parallel to framing should be continuously supported. Studs above a shower floor should be either notched or furred to accommodate the thickness of the waterproof membrane or shower pan. The surround opening for a tub or precast shower receptor should not be more than 1/4 inch (6 mm) longer than unit to be installed. The complete ceiling assembly allowable deflection should not exceed 1/360 of the span. Framing members in ceiling should not exceed 16 inches (40.6 cm) o.c.

b. Backerboard Installation: Fasten backerboard to studs every 6 to 8 inches (152 to 203 mm) on center throughout the panels and within 1/2 inch (12.5 mm) to 2 inches (51 mm) from panel edges using 1-1/4 inches (32 mm) concrete backerboard screws or 1-1/2 inches (38 mm) galvanized roofing nails. Leave a 1/8 inch (6 mm) gap at all joints and corners. Stagger board joints with those of adjacent rows.

1) Where open mesh wrapped edges meet, fill the gap completely with thin-set mortar.

2) On all other joints and corners, prefill the gap with thin-set mortar, then embed 2 inch wide (51 mm) alkali-resistant mesh tape and smooth.

6. Gypsum surfaces:

a. Gypsum dry wall panels and gypsum plaster walls shall be set with a polymer-modified thin-set mortar or mastic.

b. Gypsum-based floor patching compounds are not acceptable substrates to receive tiles.

7. Steel:

a. Steel substrates shall be rigid, solidly fixed, dry, well sanded and free of dust, oil, grease, primer and all deleterious substances, which may prevent or diminish the bond.

8. Tiling over old substrates:

a. Old cement terrazzo, ceramic tile paver, quarry tile, vinyl and vinyl composition floor coverings other than cushion vinyl shall be sound, solidly in place, flawless, stripped or sanded, clean, free of dust, wax, grease, sealers, soap residue and all other deleterious substances which may prevent or reduce the adhesion. For further details, see the TCA Handbook for Ceramic Tile Installation.

C. Install tile in accordance with appropriate ANSI A108 specifications and manufacturer's directions.

D. Expansion joints, control joints, insulation joints, etc., must be located in compliance with TCA EJ171 and filled with appropriate materials.

1. Joints must be carried through all layers of installation materials including tile, setting bed, mortar bed and reinforcing wire. Joints should be every 20 to 25 feet (6.1 to 7.3 M) in both directions for interior installations and 8 to 12 feet (2.4 to 3.6 M) in both directions for exterior installations. (Refer to TCA Handbook, EJ171 and ANSI AN-3.8 for details on placement, size and specifications of materials.) .

E. Install grout in accordance with Grout ANSI A108.10 specifications and manufacturer's directions.

F. Proper curing of grout entails periodically misting the installation with clean, cool water for a period of 72 hours.

G. Seal grout, stone and unglazed tile with a penetrating sealer such as TileLab® SurfaceGard® Sealer 48 – 72 hours after grout application.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before substantial completion.

Your Store:
North Charlotte, NC

You're shopping a store in:

Charlotte, NC
1100 Chancellor Park Dr.

We use your store location to provide current pricing and inventory. It'll also be the location for in-store pickups.

Kidde Pro Rechargeable Fire Extinguisher

Item #: 121326 | Model #: PRO210

Not Yet Rated

$37.98

Do you have a question about this product?

FREE
Store Pickup
Your order can be available for pickup in **Lowe's Of North Charlotte, NC** today.

Lowe's Truck Delivery
Your order will be ready for delivery to you from your selected store.

Parcel Shipping
Unavailable for This Order
Sent by carriers like UPS, FedEx, USPS, etc.

Kidde Pro Rechargeable Fire Extinguisher **$37.98**

Description

Pro Rechargeable Fire Extinguisher

- Pro 2A10BC multipurpose rechargeable fire extinguisher
- Pressure gauge allows for immediate pressure-status check
- UL-rated 2-A, 10-B:C
- Optional metal strap bracket part # 466400
- Durable aluminum cylinder
- Heavy-duty chrome-plated brass-valve assembly
- UL-approved wall hanger
- D.O.T. and Coast Guard (U.S.C.G.) approved when fitted with optional-mounting bracket
- Powder-coated cylinder for corrosion protection

Specifications

Extinguisher Type	Commercial/Residential	Operating Pressure	100
Size	4 lb net agent weight	Operating Range (Feet)	10.0
Rechargeable	Yes	Bracket Included	Yes
Heavy duty metal valves	Yes	Bracket Type	UL-approved wall hanger - painted metal
Color / Finish	Red	Useable Life	Rechargeable
Warranty	6-year limited	Cylinder Material	Aluminum
UL Safety Listing	Yes	Extinguishing Material	Monoammonium phosphate
CSA Safety Listing	No	Height (Inches)	13.5
ETL Safety Listing	No		

Your Store:
North Charlotte, NC

You're shopping a store in: Charlotte, NC
1100 Chancellor Park Dr.

We use your store location to provide current pricing and inventory. It'll also be the location for in-store pickups.

Kidde Fire Extinguisher Strap Bracket

Item #: 4691 | Model #: 420119

Be the first to

$5.97

Do you have a question about this product?

Parcel Shipping
Sent by carriers like UPS, FedEx, USPS, etc.

FREE
Store Pickup
Your order can be available for pickup as soon as today.

Lowe's Truck Delivery
Your order will be ready for delivery to you from your selected store.

Kidde Fire Extinguisher Strap Bracket **$5.97**

Description

Fire Extinguisher Strap Bracket

- Metal Retention strap bracket designed for use on Kidde 2A10BC rated (4 lb.) and 3A40BC rated (5 lb.) fire extinguishers. Sturdy corrosion-resistant coated bracket with aluminum straps and clasp
- Necessary for DOT approval and US Coast Guard approval of 2A10BC and 3A40BC rated fire extinguishers on marine vessels.
- For use with 4.5 in. diameter Kidde fire extinguishers
- Sturdy, durable design to endure the life of the extinguisher
- For 4lb & 5lb Fire Extinguishers

Specifications

Type	Bracket	Material	Powder-coat painted steel with aluminum retention straps

A-Series Hinges

Affordable quality, durable, competitively priced hinges. In stock and ready to ship.

- 3-Way Adjustable Cam
- Clip Mount
- Grade 2 and LGA Approved
- 80,000 cycle tested

Affordable quality is a rare find in today's atmosphere of rising prices and falling standards. Not so with Häfele's competitively priced A-Series hinges.

A-Series 110° Hinge Arm, Clip On, w/Cam Adjust

Full Overlay
Screw Mount: 311.60.500
Dowel Mount: 311.60.560

Half Overlay
Screw Mount: 311.60.501
Dowel Mount: 311.60.561

Inset
Screw Mount: 311.60.502
Dowel Mount: 311.60.562

A-Series Clip On, Mounting Plate w/Cam Adjust

0mm: 311.70.570 0mm w/Euro screws: 311.70.580
2mm: 311.70.572 2mm w/Euro screws: 311.70.582 4mm: 311.70.574 4mm w/Euro screws: 311.70.584

A-Series Clip On, Mounting Plate

0mm: 311.71.500 0mm w/Euro screws: 311.71.510
2mm: 311.71.502 2mm w/Euro screws: 311.71.512
4mm: 311.71.504 4mm w/Euro screws: 311.71.514

A-Series Clip On, Face Frame Mounting Plate

0mm: 311.72.530 3mm: 311.72.533

A-Series 110° Hinge Arm, Slide On

Full Overlay Screw Mount: 311.90.500 Dowel Mount: 311.90.560

Half Overlay Screw Mount: 311.90.501 Dowel Mount: 311.90.561

105723_Hefele American Co. A-Series Mounting Plate

Inset Screw Mount: 311.90.502 Dowel Mount: 311.90.562

A-Series Slide On, Mounting Plate

-2mm: 311.98.505 -2mm w/Euro screws: 311.98.515 0mm: 311.98.500 0mm w/Euro screws: 311.98.510 2mm: 311.98.502 2mm w/Euro screws: 311.98.512 4mm: 311.98.504 4mm w/Euro screws: 311.98.514

A-Series Slide On, Face Frame Mounting Plate

0mm: 311.98.590

Quick Specs

Appearance
Type : Built In
Style : Bottom Freezer
Size : Apartment
Door Style : One Door
French Door : No
Double Freezer Drawers : No
Counter-Depth : Yes
Glass Door : No
Undercounter : No
Hinge Side : Left
Reversible Doors : No
Door Finish : Smooth
Accepts Custom Panels : Yes
Door Color : Panel Ready
Cabinet Color : White

Dimensions
Width : 21 2/8"
Depth : 20 7/8"
Height : 69 5/8"

Capacity
Refrigerator Capacity : 6.64 cu. ft.
Freezer Capacity : 1.55 cu. ft.
Total Capacity : 9.53 cu. ft.

Refrigerator Features
Type of Shelves : Glass
Glass Shelves : Yes
Wire Shelves : No
Plastic Shelves : No
Stainless Steel Shelves : No
No. of Shelves : 4
Slide-out Shelves : Yes
Spill Safe Shelves : Yes
Cantilever Shelves : No
Split Shelves : No
No. of Door Bins : 4
Adjustable Door Bins : Yes
Gallon Door Storage : No
Water Dispenser : No
Dairy Center : Yes
Clear Deli Drawer : No
Child Lock : No
Door Lock : No
Wine Bottle Holder : Yes
Can Dispenser : No
Digital Temperature Control : No
Sabbath Mode : No

Freezer Features

Left Hinge Door Swing

Blomberg

Free Shipping

Blomberg BRFB0900L

24" Built-in Fully Integrated Bottom-Freezer Refrigerator with 4 Spill Proof Glass Shelves, Freezer Drawers, HygIONAntibacterial, Wine Rack and Requires Custom Panels: Left Hinge Door Swing

Your Price: $1,539.00
10% Off -$153.90
Today's Price: $1,385.10

Price Match Policy
Print
Share this item:

Qty: 1 Add to Cart

New Leaf SERVICEPRO SERVICE PLANS Essential consumer protection.
Includes in-home service, parts and labor. See Coverage Details

Options

Select	Right Hinge Door Swing	$1,295.10
Selected	**Left Hinge Door Swing**	$1,385.10

Description Energy Info Specifications Features Info & Guides Reviews

Specifications

Volume	
Total Gross Volume:	9.53 cu. ft.
Fresh Food Compartment Net Volume:	6.64 cu. ft.
Freezer Net Volume:	1.55 cu. ft.
Technical Features	
Type:	Built-in
Control System:	Mechanic
Cooling System:	Frost Free
Silence Level:	0 dBA
Reversible Door:	Yes
Temperature Rise Time:	0 hr
Number of Compressors:	1
Climate Class:	T
Fresh Food Compartment	
hygION Silver Coating:	Yes
hygAIR Ionizing Technology:	No
Inner Illumination:	Yes
Bottle Holder:	Yes
Defrost:	Automatic
Crispers:	2 Transparent

Defrost : Automatic
Ice Maker : No
Ice Dispenser : No
Quick Freeze : No
Glass Shelves : No
Wire Shelves : No
Plastic Shelves : No
Stainless Steel Shelves : No

Technical Details

Energy Star Rated : Yes
CEE Rating : Tier I
Star-K Certified : No
ADA Compliant : No
Approved for Commercial Use : No
Approved for Medical Use : No
Approved for Outdoor Use : No
Amps : 15
Voltage : 120 Volts

Shelves:	4 Adjustable, Spill Proof, Glass
Wine Rack:	Yes
Door Racks:	4
Egg Tray:	Yes
Freezer	
Freezer Compartments:	2 Drawers, 1 Flap
Ice Cube Tray:	Yes
Number of Transparent Crispers:	2
Defrost:	Automatic
Environmental Standards	
Energy Star:	Yes
RoHS Compliant:	Yes
Dimensions	
Width:	21 2/8"
Depth:	20 7/8"
Height:	69 5/8"

Lineup of Similar Blomberg Bottom Mount Counter Depth Refrigerators

Products 1-2 of 2

Items to Compare 

Blomberg
BRFB0900

1

$1,295.10

24" Built-in Fully Integrated Bottom-Freezer Refrigerator with 4 Spill Proof Glass Shelves, Freezer Drawers, HygION Antibacterial, Wine Rack and Requires Custom Panels: Right Hinge Door Swing

Blomberg
BRFB0900L

2

$1,385.10

24" Built-in Fully Integrated Bottom-Freezer Refrigerator with 4 Spill Proof Glass Shelves, Freezer Drawers, HygION Antibacterial, Wine Rack and Requires Custom Panels: Left Hinge Door Swing

& Kegerators, Ice Makers, Refrigeration Accessories

Dishwashers
Built In Dishwashers, Portable Dishwashers, Dishwasher Accessories

Air Conditioners
Room Air Conditioners, Mini Split Air Conditioners, Portable Air Conditioners, Air Quality

Vacuum Cleaner Accessories

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FRIGIDAIRE

Dishwashers

FFBD1821M S/W/B

18" Built-In

Product Dimensions

Height (Adjustable)	33-1/2" – 34-7/8"
Width	17-5/8"
Depth (Including Door)	23"

More Easy-To-Use Features

Ready-Select® Controls
Easily select options with the touch of a button.

Energy Saver
Eco-friendly cycle uses less energy without compromising cleaning performance.

Energy Saver Dry Option
No heat dry option.

Attractive Stainless Steel Exterior[1]

Low-Rinse Aid Indicator Light

Control Lock Option

China/Crystal Cycle
For a truly gentle cleaning action, the China/Crystal Cycle reduces wash pressure by 30% for a thorough cleaning of your most delicate stemware.

ENERGY STAR®
A.D.A. Compliant[2]

Available in:

Stainless (S) | White (W) | Black (B)

[1] Select model only.
[2] When properly installed, meets the appliance standards in the Americans with Disabilities Act and the Architectural Barriers Act Accessibility Guidelines as published by the United States Access Board on June 23, 2004, as amended August 5, 2005.

Signature Features

Stainless Steel Interior
Premium stainless steel interior for maximum durability.

Quiet Dishwasher
A quiet performance every time.

Multiple-Cycle Options
Features easy-to-use cleaning cycle options including China & Crystal and Heavy Wash.

Delay Start
Set your dishwasher to run on your schedule.

FRIGIDAIRE

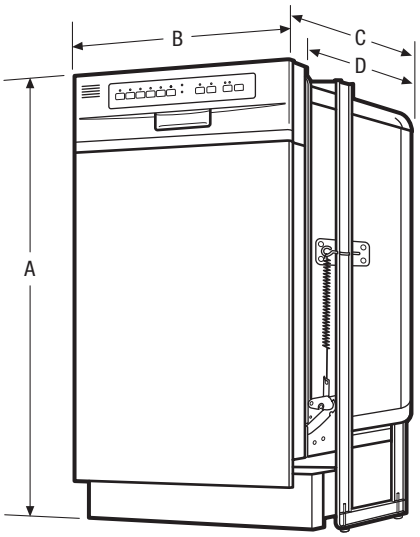
Dishwashers

FFBD1821M S/W/B **18" Built-In**

Features	
Control Design	Ready-Select®
Digital Display	
Door Latch	Pull Latch
Stay-Put Door Hinge Design	
Low Rinse-Aid Indicator Light	Yes
Interior Design	Standard
Interior Color	Stainless Steel
Wash System	Direct Feed
Wash Levels	4
Sound Package	UltraQuiet™ 3
Filter	Manual Clean
Filter Trap	Removable
Soft Food Disposer	
dB Level	55
Drying System	Static
Cycles	
Number of Cycles	6
Heavy	Yes
Normal	Yes
Light	Yes
Delicate	
Favorite	
China/Crystal	Yes
Rinse Only	
Energy Saver	Yes
Upper Rack Wash Only	
Cycle Indicator Light	
Control Lock	Yes
Options	
Heat/No Heat Dry	Yes
Hi-Temp Wash	
NSF® Certified Sanitize Rinse	
Delay Start	2 or 4 Hour
Rack System	
Rack Design/Rack Coating	Deluxe/Nylon
Upper Rack –	
Stemware/Champagne Glass Holders	
Fold-Down Tines	
Cup Shelves	
Lower Rack –	
Silverware Basket	Standard
Fold-Down Tines	
Small Items Cover	
Certifications	
ENERGY STAR®	Yes
A.D.A. Compliant[1]	Yes
Specifications	
Water Inlet Location	Left Bottom Front
Water Usage (Gallons)	3.96
Water Pressure (PSI)	20 – 120
Integral Air Gap on Supply	Yes
Leveling Legs	4
Power Supply Connection Location	Right Bottom Front
Voltage Rating	120V/60 Hz/15A
Connected Load (kW Rating) @ 120 Volts[2]	1.44
Amps @ 120 Volts	8.5
Shipping Weight (Approx.)	71 Lbs.

[1]When properly installed, meets the appliance standards in the Americans with Disabilities Act and the Architectural Barriers Act Accessibility Guidelines as published by the United States Access Board on June 23, 2004, as amended August 5, 2005.

[2]For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.



NOTE: For planning purposes only. Always consult local and national electric and plumbing codes. Refer to Product Installation Guide for detailed installation instructions on the web at frigidaire.com.

c UL us

Meets requirements of ASSE 1006

Product Dimensions	
A - Height (Adjustable)	33-1/2" – 34-7/8"
B - Width	17-5/8"
C - Depth (Including Door)	23"
D - Depth (To Tub Flange)	22-1/2"
Depth with Door Open 90°	46"

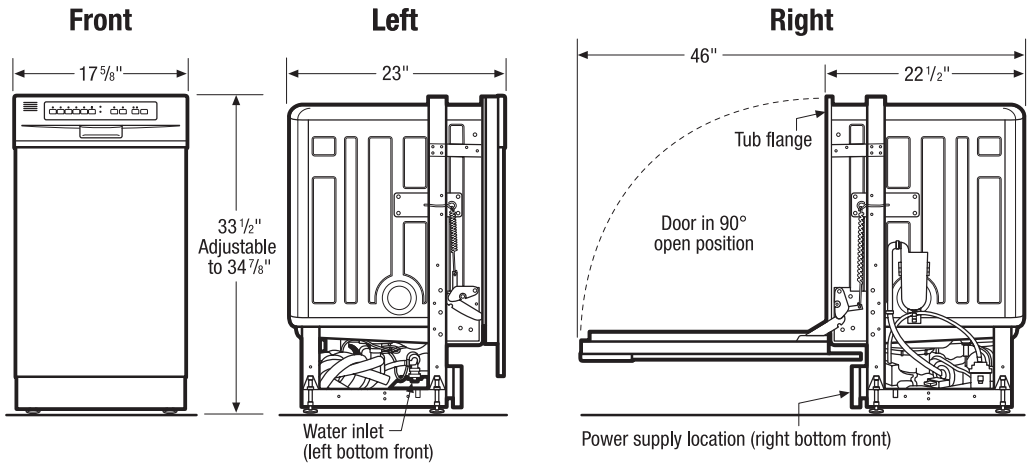
Cutout Dimensions	
Height (Min.)	32-1/2"
Height (Max.)	35-1/4"
Width (Min.-Max.)	17-5/8"–18"
Depth (Min.)	24"

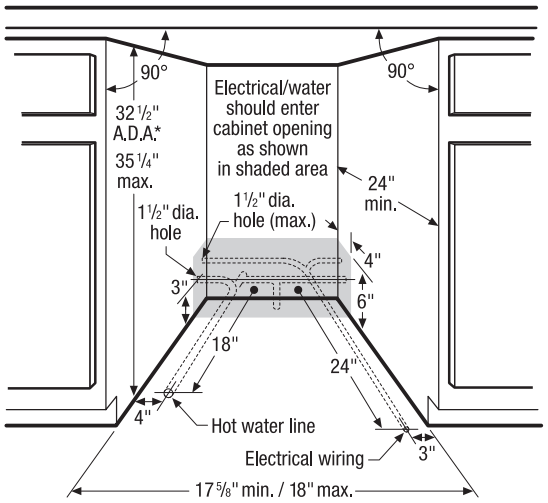
*Accessories information available on the web at **frigidaire.com***

FRIGIDAIRE

USA • 10200 David Taylor Drive • Charlotte, NC 28262 • 1-800-FRIGIDAIRE • **frigidaire.com**
CANADA • 5855 Terry Fox Way • Mississauga, ON L5V 3E4 • 1-800-265-8352 • **frigidaire.ca**

Specifications subject to change.





*A.D.A. installation, (32 1/2") beneath 34"- high countertop may be accomplished by adjusting toekick and leveling legs.

Dishwasher Specifications

- Product Shipping Weight (approx.) – 71 Lbs.
- Voltage Rating – 120V/60 Hz/15 Amps *(maximum 20 Amps if connected with disposer)*
- Connected Load (kW Rating) @ 120 Volts = 1.44 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120V = 8.5 Amps
- Always consult local and national electric & plumbing codes. Meets requirements of ASSE 1006—integral air gap on supply.
- Dishwasher enclosure requires that adjacent cabinets be square and plumb. Unit must be fully enclosed on top, sides and back; and not support any part of enclosure.
- For A.D.A. installation, (32 1/2") beneath 34"- high countertop may be accomplished by adjusting toekick and leveling legs.
- When installing unit adjacent to wall, cabinet or other obstruction that extends beyond front edge of unit, allow 2" minimum clearance between opened door and obstruction.
- Do not install unit beneath cooktop, damage will occur.
- Make sure location has required drain, water and electrical outlets to make proper connections.
- Air gap required if drain is connected to waste tee or disposer lower than 18" above floor. If no air gap required, minimum 32"-high drain loop must be used. Total drain hose length must not exceed 10' to drain outlet.
- Electrical and water supplies should enter enclosure on floor, or through rear or cabinet side walls, as shown in designated shaded area. Hot water line may pass through same hole as electrical cable and drain hose; or through additional 1-1/2" dia. hole designated to accommodate line.
- Water connection located on left side of dishwasher. Install hot water inlet line using no less than 3/8" O.D. copper and extend forward at least 18" from rear wall with hand shut-off valve accessible beneath sink.
- Water Pressure – Hot water line to dishwasher must provide between 20 and 120 pounds per square inch (psi).

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

Meets requirements of ASSE 1006

c UL us

FRIGIDAIRE

affinity

Front Load Dryer

FAQE7001L W

6 Dry Cycles
7.0 Cu. Ft. D.O.E. Electric

Optional SpaceWise® Pedestal Drawer Shown

Product Dimensions

Height	36"
Width	27"
Depth	30-5/16"

More Easy To Use Features

Express-Select® Controls
Easily select options with the touch of a button.

SilentDesign™
Designed for quiet operation.

Optional Pedestal Drawer

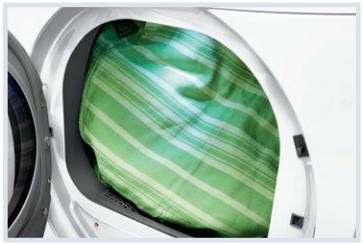
NSF® International Certification

Available in:

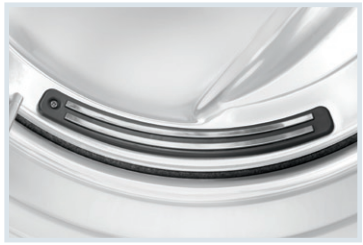
Classic White (W)

[1]Based on 7.0 cu. ft. capacity on 36" installation platform.

Signature Features



Ultra-Capacity Dryer
The largest in its class[1], so you do more laundry with less effort.



DrySense™ Technology
Dries your clothes more precisely, reducing wrinkles.

TimeWise® Technology
TimeWise® technology ensures wash time equals dry time — so you don't wait for clothes to dry.

One-Touch™ Wrinkle Release
This option features Wrinkle Release Technology that finishes by tumbling without heat, preventing wrinkles, so your clothes look great every time.

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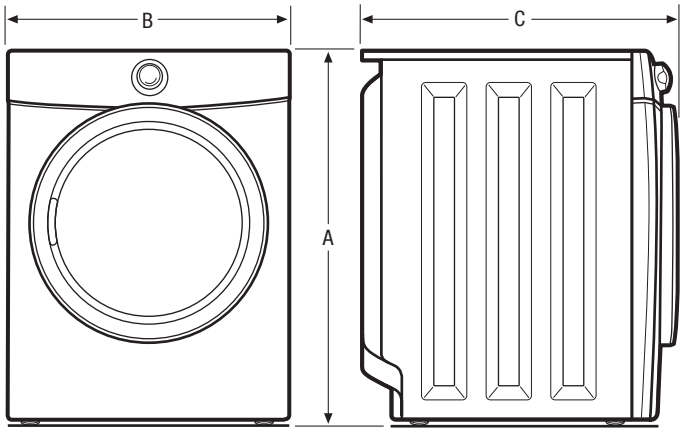
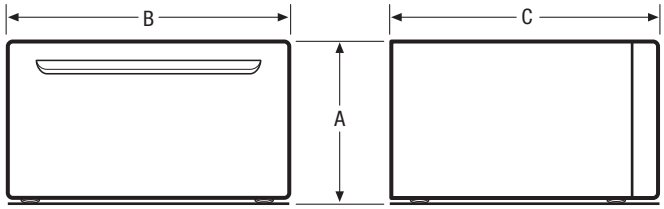
Front Load Dryer

FAQE7001L W **7.0 Cu. Ft. D.O.E. Electric**

Features	
Total Capacity D.O.E. (Cu. Ft.)	7.0
Controls	Express-Select®
Dryer Drum Interior	Painted Steel
Interior Light	Yes
Door Trim	Color-Coordinated
Ready Steam™	
DrySense™ Technology	Yes
Wrinkle Release Technology	Yes
TimeWise® Technology	Yes
Moisture Sensor	Yes
Time Remaining Indicator	Yes
Cycle Status Lights	Yes
Cycle Signal	Chime
Cycle Signal "On/Off"	Yes
Cycle Signal Volume Control	Yes
Control Lock	Yes
Start/Pause/Cancel Buttons	Yes
Energy Saver Option	
Delay Start	
Tumble Speed (RPM)	50
Reversible Door	Yes
Lint Screen	Yes
Sound Package	SilentDesign™
Adjustable Leveling Legs	Yes
Cycles	
Dry Cycles	6
Specialty Cycles	0
Options	
Temperature Selections	5
Dryness Level Selections	4
Timed Dry	30, 60, 90
Optional Accessories	
Dryer Stacking Kit	PN# STACKIT4X
15" Frigidaire Affinity® Pedestal Drawers	
Classic Red (R)	
Classic Blue (N)	
Classic Silver (A)	
Classic Black (B)	
Classic White (W)	(W) PN# CFPWD15W
Mobile Home Installation Kit	PN# 137067200
Drying Rack	PN# 137067300
Certifications	
NSF® Certified Sanitize	
Specifications	
Maximum Exhaust Duct Length[1] (Ft.)	64
Power Supply Connection Location	Right Bottom Rear
Voltage Rating	240V/60Hz/30A
Connected Load (kW Rating) @ 240 Volts	5.4
Amps @ 240 Volts	24
Heating Element @ 240 Volts (Watts)	4,500
Shipping Weight (Approx.)	140 Lbs.

[1]*Rigid metal duct preferred, semi-rigid optional and allow deductions for elbows and vents. Refer to Installation Guide on web for additional information.*





NOTE: For planning purposes only. Always consult local and national electric and plumbing codes. Refer to Product Installation Guide for detailed installation instructions on the web at frigidaire.com.

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Product Dimensions	
A - Height (Single)	36"
Height (Stacked)	71-1/2"
B - Width	27"
C - Depth	30-5/16"
Depth with Door Open 90°	51-7/16"
Pedestal Dimensions	
A - Height	15-1/4"
B - Width	27"
C - Depth	26-1/2"
Depth with Drawer Fully Extended	42-1/2"

Accessories information available on the web at ***frigidaire.com***

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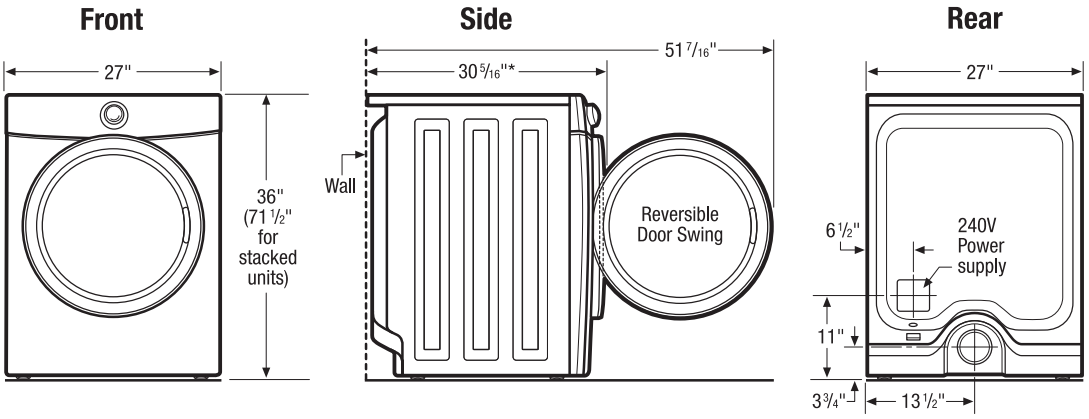
FAQE7001L 06/12

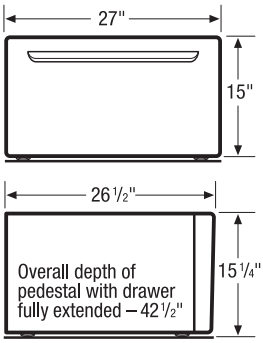
Specifications subject to change.

FRIGIDAIRE affinity.

Front Load Dryer

FAQE7001L W **7.0 Cu. Ft. D.O.E. Electric**



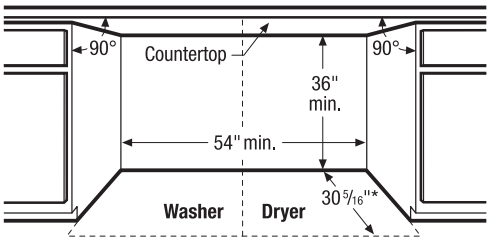


15" Drawer Pedestal Installation

Elevates dryer height to 51¼". For detailed pedestal installation, refer to instructions included with pedestal or on web. **Note:** Pedestal Installation requires modified utility hookup locations. For details, refer to Product Installation Guide on web.

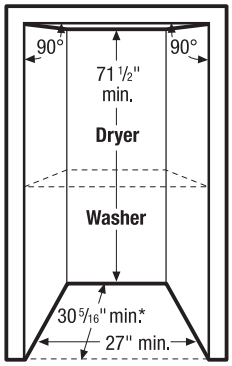
Built-In Installations

For built-in installations, NO minimum clearance required around sides or backs of units. For closet installation, allow additional 1" clearance between fronts of units and door. Location of plumbing, exhaust and utility hookups MUST be considered in built-in installations. For additional installation details, refer to Product Installation Guides on web.



Side-by-Side Units in Under-Counter Installation
Can be installed with standard countertop and/or cabinetry.

* To achieve minimal installation depth dimensions, dryer MUST be vented straight back. For installation with quick-turn 90° elbow, refer to Product Installation Guide on web for approximate clearances incurred with multi-directional exhausting options in freestanding, pedestal-mounted, or stacked installation.



Stacked Units in Recessed or Closet Installation
For detailed stacked installation, refer to instructions included with Stacking Kit or on web. **Note:** Stacked installation requires modified utility hookup locations for dryer. For details, refer to Product Installation Guide on web.

Front Load Dryer Specifications

- Product Shipping Weight (approx.) – 140 Lbs.
- An electrical supply with grounded three-prong receptacle is required.
- Voltage Rating – 240V/60 Hz/30 Amps
- Single phase 3- or 4-wire cable, 240 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line. *(Do not use same circuit as washer.)*
- Connected Load (kW Rating) @ 240 Volts = 5.4 kW
- Amps @ 240 Volts = 24 Amps
- Dryer MUST employ a 3-conductor NEMA 10-30 type SRDT or 4-conductor NEMA 14-30 type SRDT or ST (as required), rated at 240 volt AC minimum, 30 amp power supply cord marked for use with clothes dryers *(not supplied)*.
- Grounding through neutral link prohibited in specific applications and certain locales, requiring use of 4-wire system. *(For detailed electrical requirements, refer to Product Installation Guide on web.)*
- Always consult local and national electric codes.
- Can be installed alone, with or without optional 15" Drawer Pedestal, or stacked above matching Frigidaire® Affinity Washer, which requires installation of optional Dryer Stacking Kit. *(For installation details, refer to instructions included with optional pedestal or stacking kit or on web.)*
- Can be built in with matching Frigidaire® Affinity Washer in under-counter, recessed or closet installation. *(Refer to Built-In Installations on this page for cutout dimensions. For additional installation details, refer to Product Installation Guide on web.)*
- Closet installation requires vented door with 2 unobstructed louvered openings, minimum 60 sq. in. each, located 3" from top and bottom of door. Full-length 120 sq. in. opening also acceptable. Allow additional 1" clearance between fronts of units and closed door.
- Do NOT install in area exposed to dripping water or outdoor weather conditions; where gasoline or other flammables are kept or stored; or where dryer comes in contact with curtains, drapes or anything that will obstruct flow of combustion and ventilation air.
- For garage installation, dryer MUST be located minimum 18" above floor.
- Floor MUST be solid with 1" maximum slope. Do NOT install on carpeted surface.
- Dryer MUST exhaust to outside of building, NOT into any concealed space.
- Exhaust installation requires minimum 4"-diameter rigid or semi-rigid metal duct with approved, unobstructed vent hood having swing-out damper(s). If installing rigid metal duct (preferred), do not exceed MAXIMUM venting run length of 64 ft., allow deductions for elbows and vents. If installing semi-rigid metal duct, do not exceed MAXIMUM venting run length of 8 ft., always allow deductions for elbows and vents *(Refer to Product Installation Guide on web for additional information)*. Do NOT use flexible plastic or metal foil duct and use shortest run possible.
- Leveling legs supplied to level dryer properly and reduce excessive noise and vibration.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

Optional Accessories

- Dryer Stacking Kit – (PN# STACKIT4X).
- 15" Classic White Drawer Pedestal – (PN# CFPWD15W).
- Mobile Home Installation Kit – (PN# 137067200).
- Drying Rack – (PN# 137067300).

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Specifications subject to change.

FAQE7001L 06/12

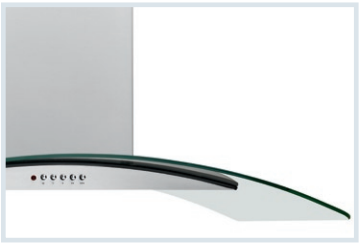
FRIGIDAIRE

Glass Canopy Island Hood

FHPC3660L S

36" Stainless Steel

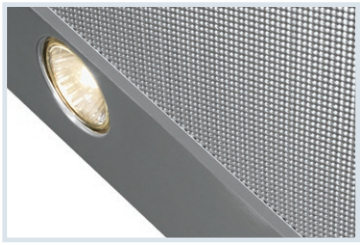
Signature Features



Glass Canopy Design
Glass and stainless steel construction is as attractive as it is functional.

Centrifugal Fan
Move air quietly and efficiently — up to 400 cu. ft. of air per minute.

Washable Filters
Dishwasher-safe for easy cleaning. The aluminum filter provides strength and durability not found in foam filters.



Halogen Lighting
Four halogen lights provide bright illumination of the cooktop surface on an island or peninsula application.

Features

Nominal Width	36"
Installation Type	Island/Peninsula Ceiling
Style	Stainless Steel/ Glass Canopy
Air Discharge	Vertical
Air Delivery (CFM)	400
Blower Type	Centrifugal
Controls	Electronic Push Button
Fan Speeds	3
Sound Level (dBA)	67.1
Quad Halogen Lights	Yes
Dishwasher-Safe Filter	Yes
Exhaust Duct	Convertible*
Duct Required	6" Round

Optional Accessories

Duct-Free Kit	PN# FHPRKT60LS
10' Flue Extension Kit	PN# FHP10X60LS

Specifications

Product Dimensions –	
Height (With One Cover) (With Flue Extension)	22-29/32" min. 30" min. 42" max
Width	35-11/32"
Depth	23-5/8"
Voltage Rating	120V/60Hz/15A
Amps @ 120 Volts	4.0
Connected Load (kW Rating) @120 Volts‡	0.52
Shipping Weight (Approx.)	88 Lbs.
Sones Rating	6.5

**Ventilation is convertible to be either ducted outside, or recirculated inside requiring no ducting. (Recirculated option requires use of optional Duct-Free Kit.)*

‡For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.

NOTE: Always consult local and national electric codes. Check local building codes for installation requirements, as they may vary per locale. Refer to Product Installation Guide for detailed installation instructions on the web at frigidaire.com.

Specifications subject to change.

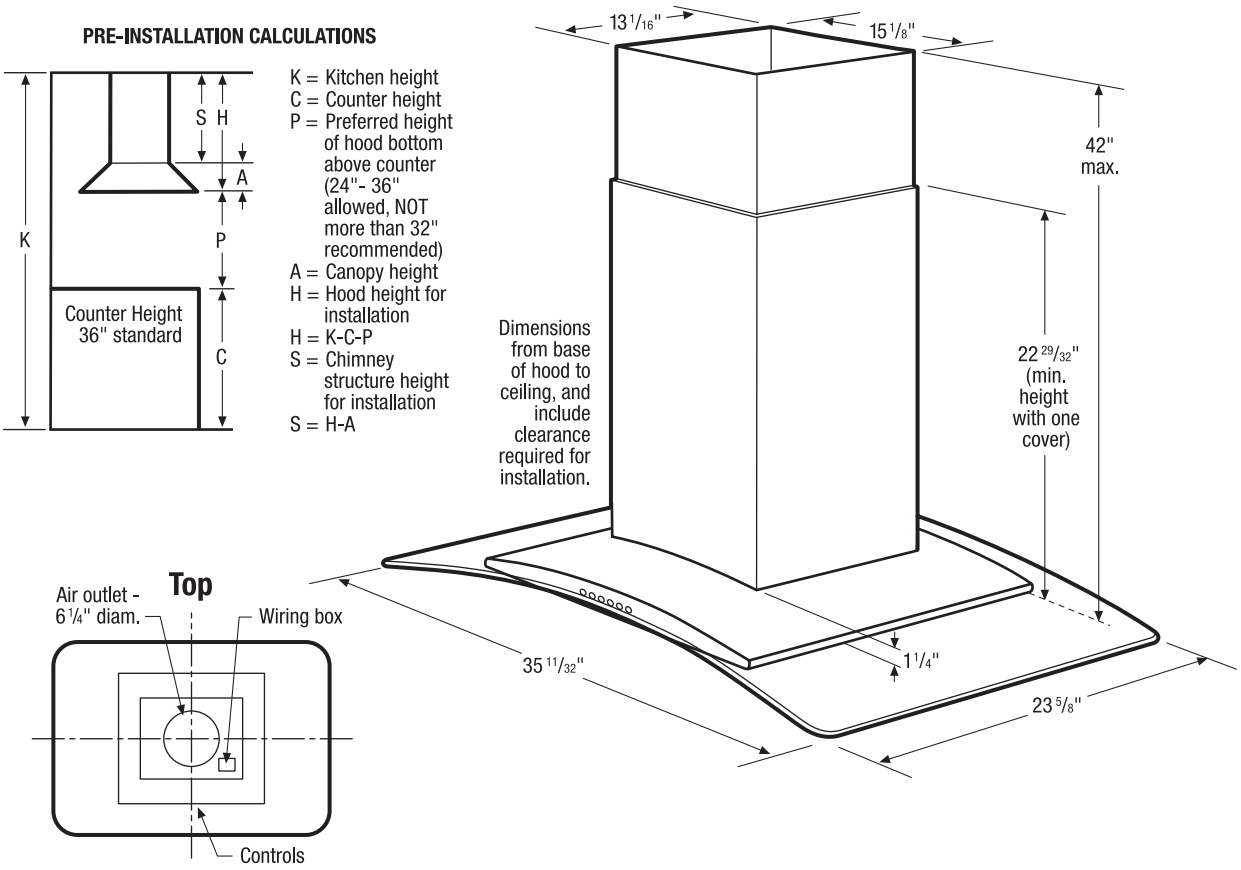
Available in:

Stainless (S)

FRIGIDAIRE

Glass Canopy Island Hood

FHPC3660L S **36" Stainless Steel**



Glass Canopy Island Hood Specifications

- Product Shipping Weight (approx.) – 88 Lbs.
- Island/Peninsula Ceiling-Mount Installation
- Ventilation system is preset to exhaust air outside. If outside ducting is not possible, optional Duct-Free Recirculation Kit (PN# FHPRKT60LS) is available to convert ventilation to allow air to recirculate inside. *(Refer to Ducted Option Specifications for outside ventilation.)*
- Sones Rating – 6.5
- Voltage Rating – 120V/60 Hz/15 Amps
- Connected Load (kW Rating) @ 120 Volts = 0.52 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 4 Amps
- Always consult local and national electric codes. Check local building codes for installation requirements, as they may vary per locale.
- Minimum installation height allowed from bottom of hood to standard 36"-high electric or gas cooking surface is 24" - 36". (NOT more than 32" recommended.) For detailed instructions regarding install heights in 8', 9' and 10' ceiling applications, refer to installation guide on web.
- To prepare mounting surface, adequate structure and support must be provided, capable of supporting 150 lbs.

Ducted Option Specifications

- For outside ventilation.
- Exhaust Duct Required – 6" round
- For most efficient airflow exhaust, use a straight run or as few elbows as possible.
- Use metallic flex ducting only to connect rigid duct directly to transitions *(if allowed by code)*.
- Thermal breaks such as short section of nonmetallic duct, should be used in areas of extreme cold.
- Cold weather installations should have additional backdraft damper installed.
- Refer to installation instructions on web for detailed exhaust duct preparation and converting vent blower system for recirculating inside.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

Pre-Installation Calculations

- Select hood preference height (P) that is comfortable for user *(24"- 36" minimum allowed, NOT more than 32" recommended)*.
- Calculate hood height (H) for installation (H = K-C-P).
- Confirm that (H) is within minimum to maximum range for hood. If not, adjust installation.
- Calculate chimney structure height (S). Use formulas, check dimensions of hood. Save calculation for use later in installation.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

Optional Accessories

- Duct-Free Recirculation Kit – (PN# FHPRKT60LS).
- 10' Flue Extension Kit – (PN# FHP10X60LS).

*Accessories information available on the web at **frigidaire.com***

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FHPC3660L 02/12

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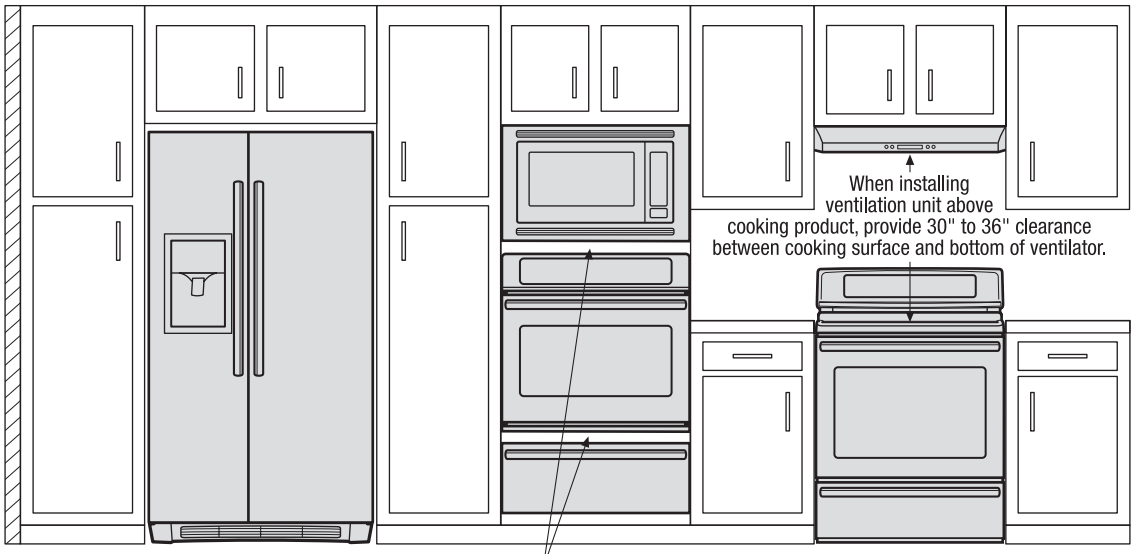
General Installation Guidelines

with Side-by-Side Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

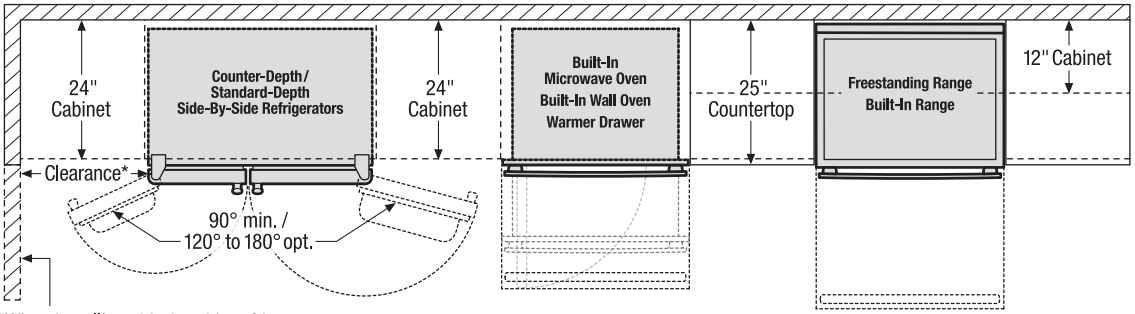
Front



When installing built-in cooking appliances in combination, 2"-high minimum visible gap between appliance faceplates required.

Clearance information for cooking appliances, provided in specific product's installation guide.

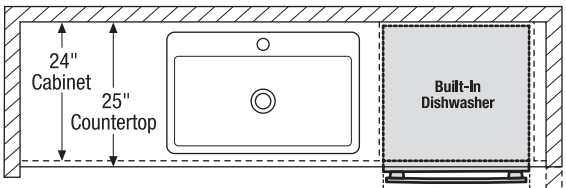
Top



*When installing side-by-side refrigerator adjacent to wall, cabinet or another appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 120° to 180° door swing, providing complete drawer/crisper access and removal. *(Absolute 4-1/2" minimum clearance will ONLY allow for 90° door swing which will provide limited drawer/crisper access with restricted removal.)*

When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

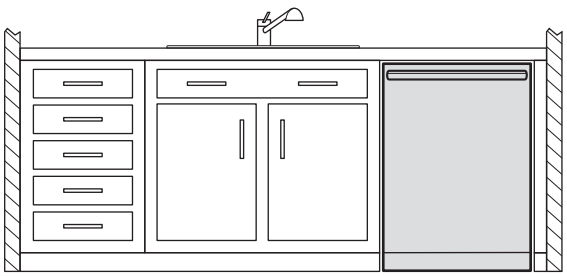
Top



When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

Front



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Specifications subject to change.

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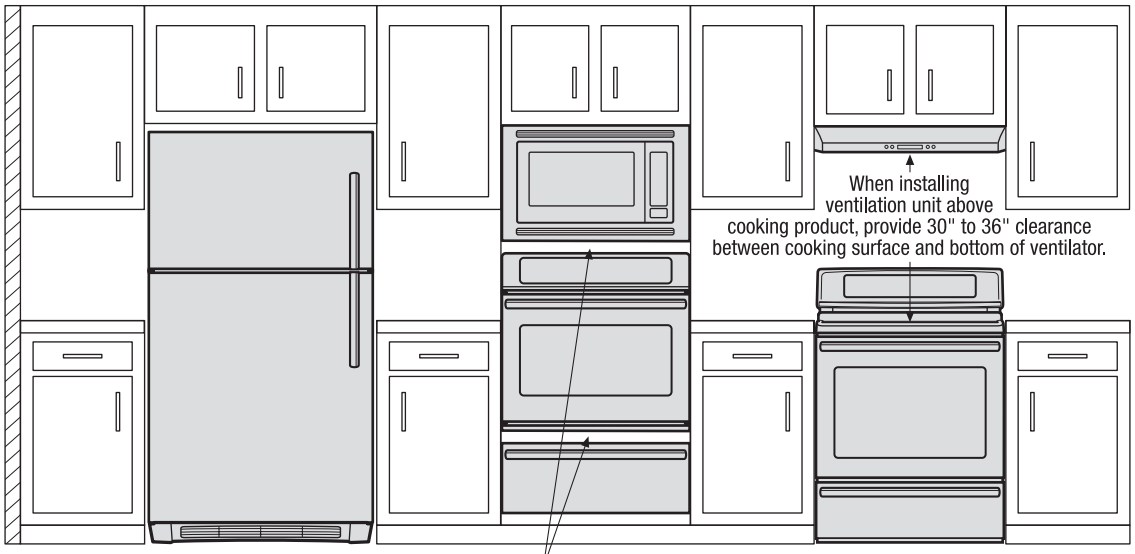
FRIGIDAIRE

General Installation Guidelines

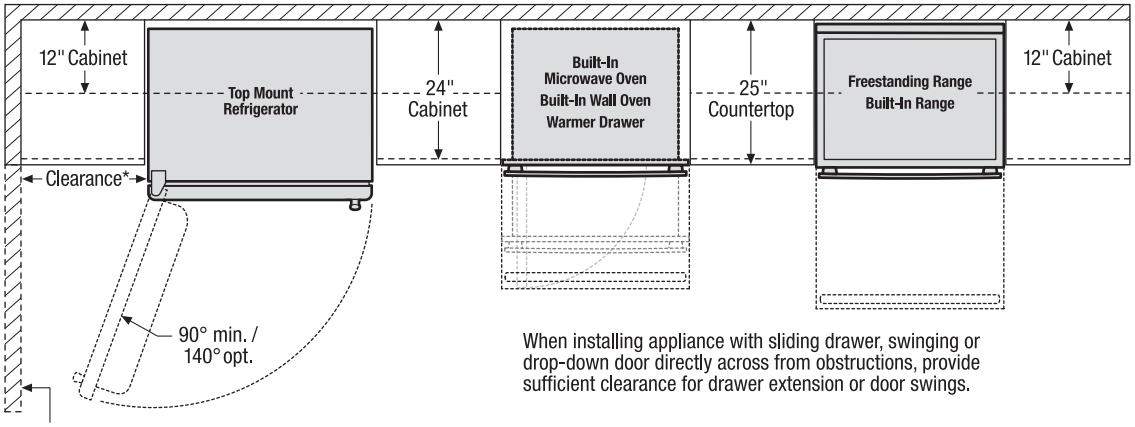
with Top Mount Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

Front



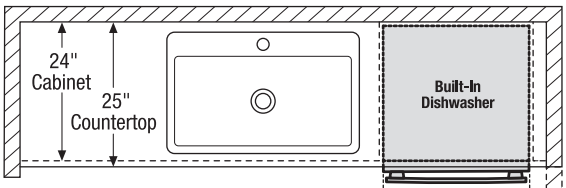
Top



When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

*When installing top mount refrigerator adjacent to wall, cabinet or other appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 140° door swing, providing complete crisper access and removal. *(Absolute 3" minimum clearance will ONLY allow for 90° door swing which will provide limited crisper access with restricted removal.)*

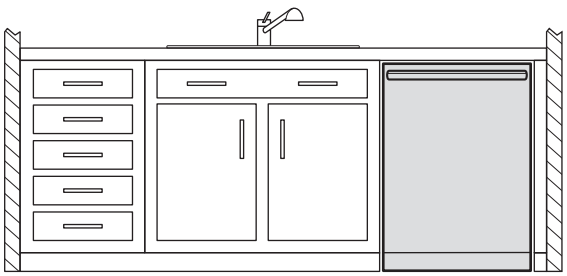
Top



When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

Front



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Specifications subject to change.

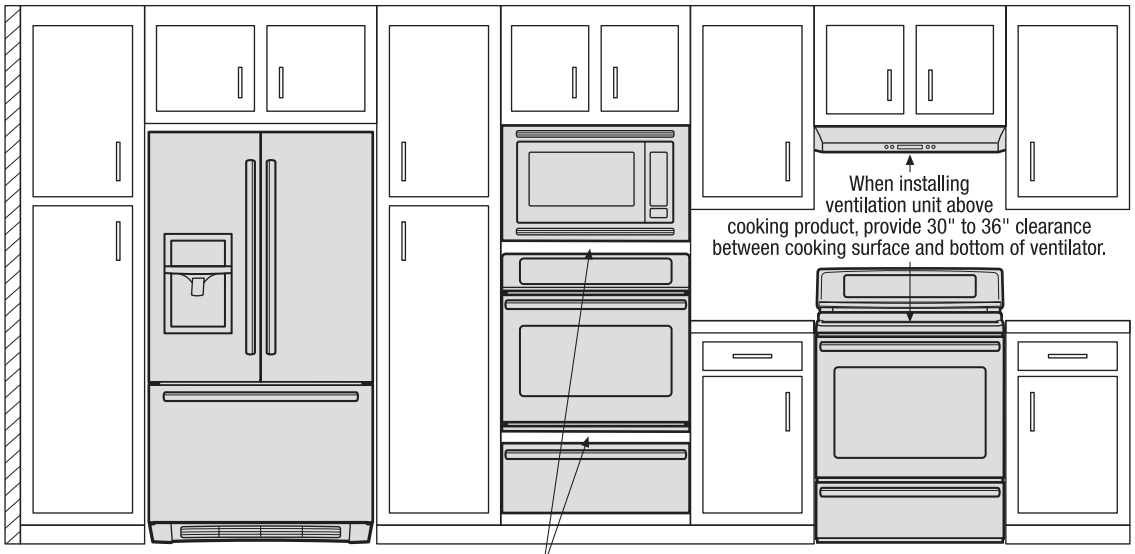
FRIGIDAIRE

General Installation Guidelines

with French Door Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

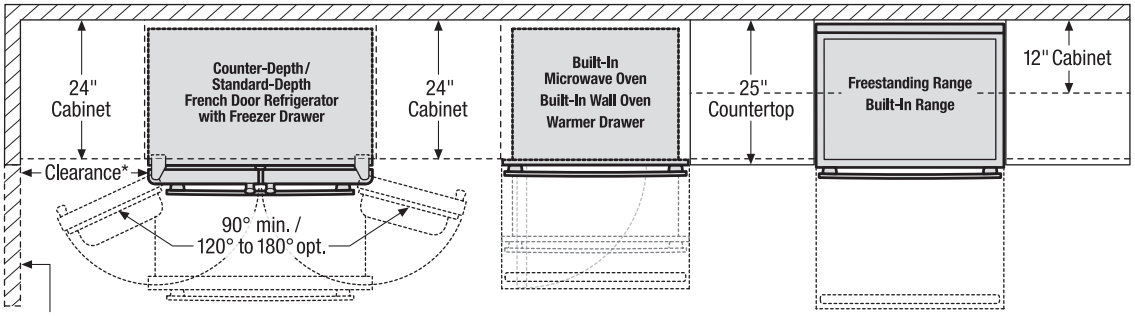
Front



When installing built-in cooking appliances in combination, 2"-high minimum visible gap between appliance faceplates required.

Clearance information for cooking appliances, provided in specific product's installation guide.

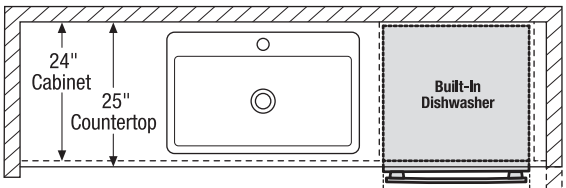
Top



*When installing French door refrigerator adjacent to wall, cabinet or another appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 120° to 180° door swing, providing complete drawer/crisper access and removal. *(Absolute 4-1/2" minimum clearance will ONLY allow for 90°door swing which will provide limited drawer/crisper access with restricted removal.)*

When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

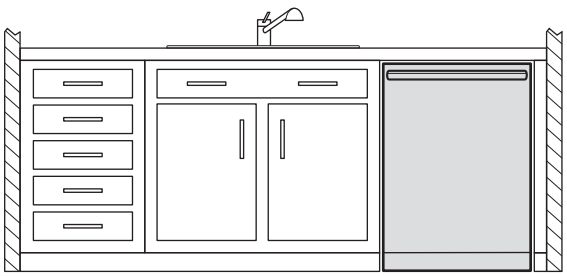
Top



When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

Front



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Specifications subject to change.

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FRIGIDAIRE GALLERY

Built-In Cooktop

FGIC3067M B

30" Induction

Signature Features

More Responsive
Cooking with induction is more responsive than gas or electric so you can easily go from simmer to boil.

Versatile Induction Elements
With up to five powerfully efficient induction elements, the Induction Cooktop offers the superior cooking flexibility. And the 10" induction element offers up to 3,400 watts of power, so you can bring water to a boil quickly.

Exceptional Temperature Control
Adjust heat with greater accuracy than on gas or electric cooktops especially at lower settings.

More Energy-Efficient
Cooking with induction is 70% more efficient than gas and 20% more efficient than electric.

Product Dimensions

Width	30-3/4"
Depth	21-1/2"
Height	4-3/8"

More Easy-To-Use Features

Cooktop Stays Cooler
With induction cooking, heat is transferred directly to the cookware, so the cooktop stays cooler to the touch—making it easier to clean.

Power Assist Function
Generates rapid heat for a faster boil.

Cooking Versatility
Gentle enough to melt chocolate and powerful enough to boil water, so it's great for entertaining or getting dinner on the table quickly.

Express-Select® Controls
Easily go from warm to boil.

Smoothtop Ceramic Glass Cooking Surface

Hot Surface Indicators

A.D.A. Compliant[1]

Available in:

Black (B)

Elements	Size	Watts
Right Front	10"	2,500/3,400
Right Rear	6"	1,450/2,000
Left Front	7"	1,800/2,600
Left Rear	8"	2,300/3,200

[1]When properly installed, meets the appliance standards in the Americans with Disabilities Act and the Architectural Barriers Act Accessibility Guidelines as published by the United States Access Board on June 23, 2004, as amended August 5, 2005.

FRIGIDAIRE GALLERY

Built-In Cooktop

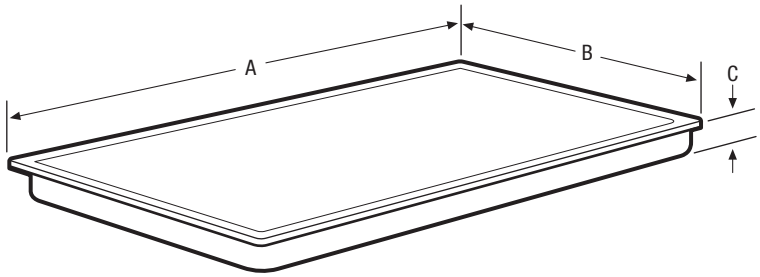
FGIC3067M B **30" Induction**

Features	
Controls	Express-Select®
Surface Type	Black Ceramic Glass
Right Front Element (Watts)	10" - 2,500/3,400
Right Rear Element (Watts)	6" - 1,450/2,000
Left Front Element (Watts)	7" - 1,800/2,600
Left Rear Element (Watts)	8" - 2,300/3,200
Hot Surface Indicators	Yes
Control Location	Center Front
Certifications	
A.D.A. Compliant[1]	Yes
Sabbath Mode (Star-K® Certified)	
Specifications	
Power Supply Connection Location	Right Rear
Voltage Rating	240V/208V/60Hz
Connected Load (kW Rating) @ 240/208 Volts[2]	8.4/7.3
Amps @ 240/208 Volts	35.1/35.0
Minimum Circuit Required (Amps)	40
Approved for Electric Single Wall Oven Combination Installation[3]	Yes
Shipping Weight (Approx.)	48 Lbs.

[1]When properly installed, meets the appliance standards in the Americans with Disabilities Act and the Architectural Barriers Act Accessibility Guidelines as published by the United States Access Board on June 23, 2004, as amended August 5, 2005.

[2]Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.

[3]Cooktops are approved for installation above any of our Electric Single Wall Ovens.



NOTE: For planning purposes only. Always consult local and national electric codes. Refer to Product Installation Guide for detailed installation instructions on the web at frigidaire.com.

Product Dimensions	
A - Width	30-3/4"
B - Depth	21-1/2"
C - Height	4-3/8"

Cutout Dimensions	
Width (Min.)/(Max.)	29-5/8"/29-3/4"
Depth (Min.)/(Max.)	20-3/8"/20-1/2"
Height	4-1/2"

Granite Countertop Installation Kit available.

*Accessories information available on the web at **frigidaire.com***

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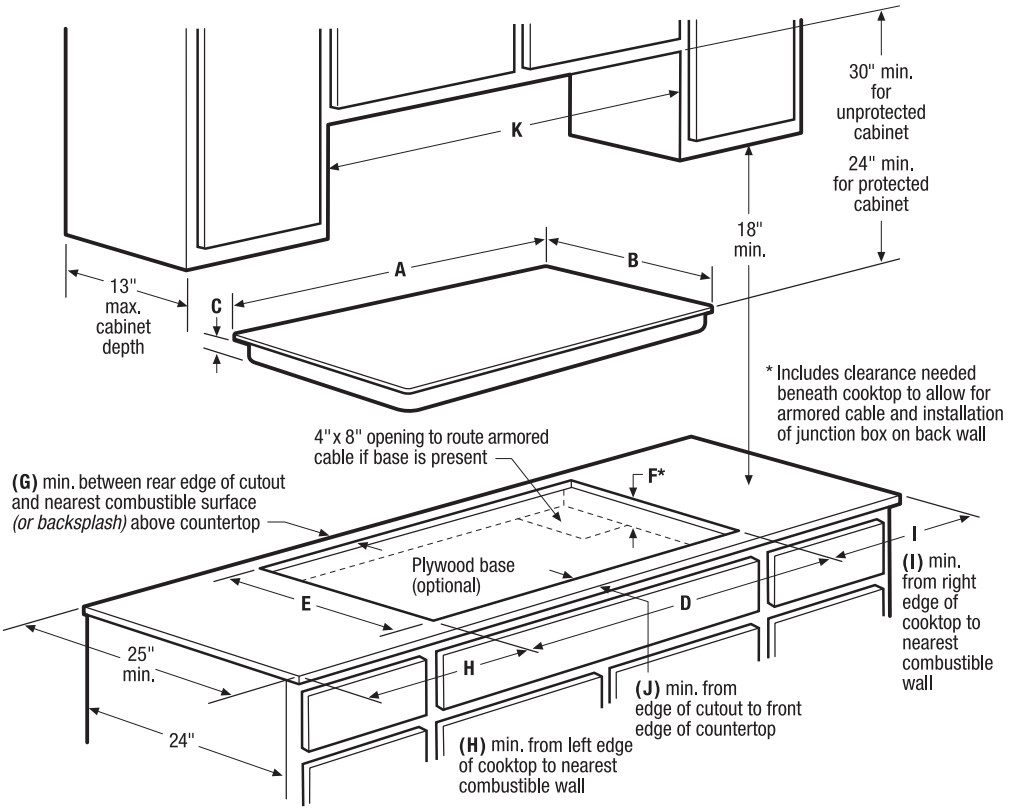
FGIC3067M 03/12

FRIGIDAIRE GALLERY

Built-In Cooktop

FGIC3067M B **30" Induction**



Product Dimensions			Required Clearances			
A - Width	**B - Depth**	**C - Height**	**G (min.)**	**H (min.)**	**I (min.)**	**J (min.)**
30-3/4"	21-1/2"	4-3/8"	1-1/2"	2"	2"	2-1/2"
Product Cutout Dimensions			**K - Cabinet Opening Width (min.)**		**Utility Connection Locations**	
D - Width (min. - max.)	**E - Depth (min. - max.)**	**F - Height (min.)***			**Power Supply**	
29-5/8" - 29-3/4"	20-3/8" - 20-1/2"	4-1/2"	30-3/4"		Right Rear	

Built-In Cooktop Specifications

- Product Shipping Weight (approx.) – 48 Lbs.
- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- Connected Load (kW Rating) @ 240/208 Volts = 8.4/7.3 kW
- Amps @ 240/208 Volts = 35.1/35.0 Amps
- Recommended Circuit Breaker – 40 Amps
- Always consult local and national electric codes.
- Cooktop cutout height includes clearance needed beneath cooktop to allow for armored cable and installation of junction box on back wall. Position center of junction box 10" inward from right side of cooktop cutout, and 12" down from underside of countertop.
- Overhead cabinetry should not exceed a 13" maximum depth.
- Absolute minimum horizontal distance between overhead cabinets installed to either side of appliance must be no less than 30-3/4".
- Allow 30" minimum clearance between top of cooktop platform and bottom of unprotected wood or metal overhead cabinet; or 24" minimum clearance when bottom of wood or metal overhead cabinet is protected by not less than 1/8" flame-retardant millboard covered with not less than No. 28 MSG sheet steel, 0.015" stainless steel, 0.024" aluminum or 0.020" copper.
- Allow 1-1/2" minimum clearance between rear edge of cutout and nearest combustible surface *(or backsplash)* above countertop.
- Allow 2" minimum required clearance from left edge of cooktop to nearest combustible wall and 2" minimum from right edge of cooktop to nearest combustible wall.
- Installation of drawer not recommended beneath cooktop.
- To reduce risk of fire when using overhead cabinetry, install range hood that projects horizontally a recommended minimum of 5" beyond bottom of cabinets.
- Electric Built-In Cooktop model FGIC3067M is approved to be used over any Frigidaire® Electric Single Wall Oven. *(Refer to Electric Cooktop Installation Over 30"/27" Electric Single Wall Oven Specifications page on web.)*
- Electric Built-In Cooktop model FGIC3067M is approved to be used in combination with Frigidaire® 30" Downdraft Vent E30DD75ESS or PL30DD50EC. *(Refer to model-specific Downdraft Vent product page on web for detailed countertop preparation specifications.)*

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

Optional Accessories

- Granite Countertop Installation Kit – (PN # 903061-9010).

Accessories information available on the web at ***frigidaire.com***

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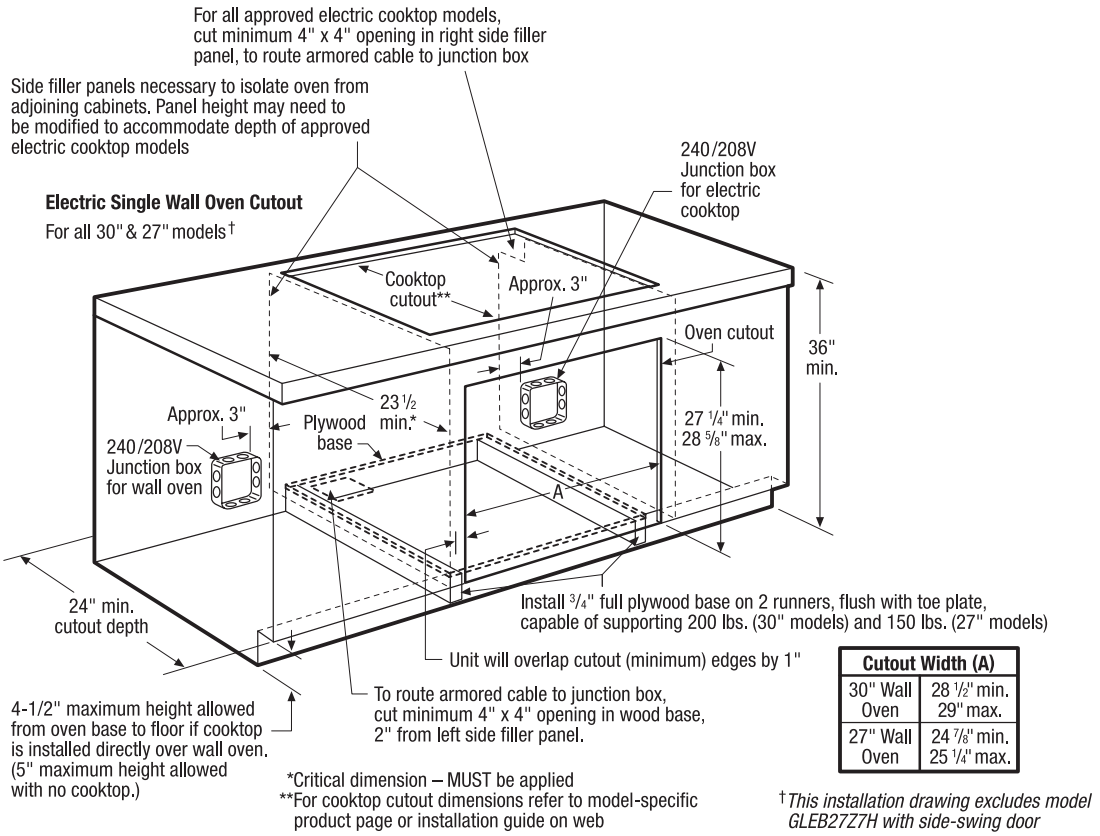
Electric Cooktop Installation Over 30"/27" Electric Single Wall Oven



Cutout Width (A)	
30" Wall Oven	28 1/2" min. 29" max.
27" Wall Oven	24 7/8" min. 25 1/4" max.

†*This installation drawing excludes model GLEB27Z7H with side-swing door*

30"/27" Electric Single Wall Oven Under-Counter Installation Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Always consult local and national electric codes.
- Minimum 21" clearance for oven door depth when open.
- Minimum 23-1/2" deep cutout dimension is critical for proper installation, to ensure that oven's faceplate will fit flush against cabinet front.
- Side filler panels necessary to isolate oven from adjoining cabinets.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs. (30" models) or 150 Lbs. (27" models). Install over two runners and flush with toe plate.
- Base must be level and cabinet front must be square.
- Allow 5" maximum height from oven base to floor, if NO cooktop is installed directly over wall oven.

Electric Cooktop Installation Over 30"/27" Electric Single Wall Oven Specifications

All Frigidaire® Electric Single Wall Ovens are approved to be used beneath any approved Frigidaire® Electric Cooktop. *(This installation page excludes approved wall oven model GLEB27Z7H. For model-specific installation details, refer to Electric Cooktop Installation Over 27" Electric Single Wall Oven GLEB27Z7H Specifications pages on web.)*

For detailed Electric Cooktop installation, refer to model-specific product page and installation guide on web.

- Side filler panel height may need to be modified to accommodate the depth of approved electric cooktop models.
- To route armored cable to junction box, cut minimum 4" x 4" opening in right side filler panel.
- Allow 4-1/2" maximum height from oven base to floor, if cooktop is installed directly over wall oven.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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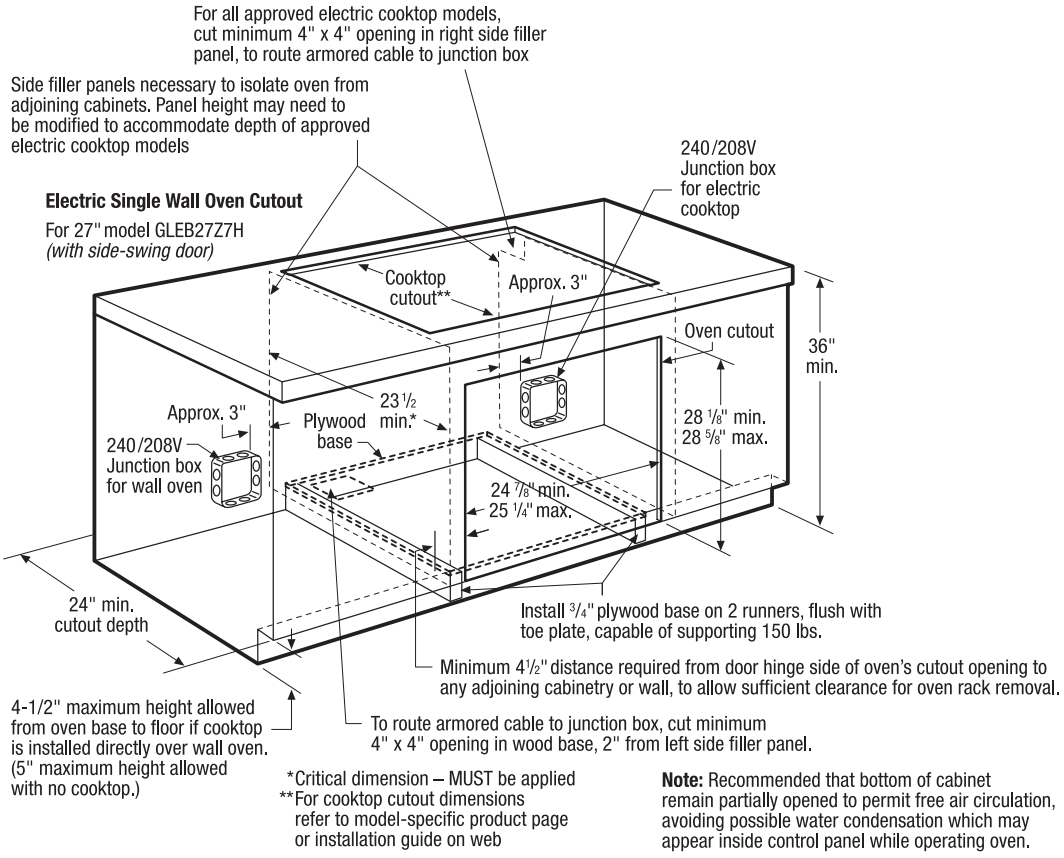
FRIGIDAIRE

Electric Cooktop Installation Over 27" Electric Single Wall Oven (GLEB27Z7H)



*Critical dimension – MUST be applied
**For cooktop cutout dimensions refer to model-specific product page or installation guide on web

Note: Recommended that bottom of cabinet remain partially opened to permit free air circulation, avoiding possible water condensation which may appear inside control panel while operating oven.

27" Electric Single Wall Oven (GLEB27Z7H) Under-Counter Installation Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Always consult local and national electric codes.
- Minimum 27-1/4" clearance for oven door depth when open.
- Minimum 23-1/2" deep cutout dimension is critical for proper installation, to ensure that oven's faceplate will fit flush against cabinet front.
- Minimum 4-1/2" distance required from door hinge side of oven's cutout opening to any adjoining cabinetry or wall, to allow sufficient clearance for oven rack removal.
- Side filler panels necessary to isolate oven from adjoining cabinets.
- Oven base of solid plywood or similar material required, capable of supporting 150 Lbs. Install over two runners and flush with toe plate.
- Base must be level and cabinet front must be square.
- Recommended that bottom of cabinet remain partially opened to permit free air circulation, avoiding possible water condensation which may appear inside control panel while operating oven.
- Allow 5" maximum height from oven base to floor, if NO cooktop is installed directly over wall oven.

Electric Cooktop Installation Over 27" Electric Single Wall Oven (GLEB27Z7H) Specifications

Frigidaire® Single Wall Oven model GLEB27Z7H is approved to be used beneath any approved Frigidaire® Electric Cooktop.

For detailed Electric Cooktop installation, refer to model-specific product page and installation guide on web.

- Side filler panel height may need to be modified to accommodate the depth of approved electric cooktop models.
- To route armored cable to junction box, cut minimum 4" x 4" opening in right side filler panel.
- Allow 4-1/2" maximum height from oven base to floor, if cooktop is installed directly over wall oven.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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FRIGIDAIRE GALLERY

Microwaves

FGMO205K F/W/B

24" Built-In

Product Dimensions

Height	13-3/8"
Width	24"
Depth	19-1/8"

More Easy-To-Use Features

Real Stainless Steel[1]
Real stainless steel with a protective coating that reduces fingerprints and smudges so it's easy to clean.

Sensor Cooking
Microwave automatically adjusts power levels and cooking times to perfectly cook a variety of items, effortlessly.

One-Touch Keep Warm Setting
Just one touch of a button keeps food warm until everything—and everyone—is ready.

One-Touch Add 30 Seconds

Built-In Trim Kit
Optional trim kit available in white, black or stainless trim in 27" or 30" diameter.

Available in:

Stainless (F) | White (W) | Black (B)

[1]Select models only.

Signature Features

Fits-More™ Microwave
Extra-large microwave provides 2.0 cubic feet of cooking space.

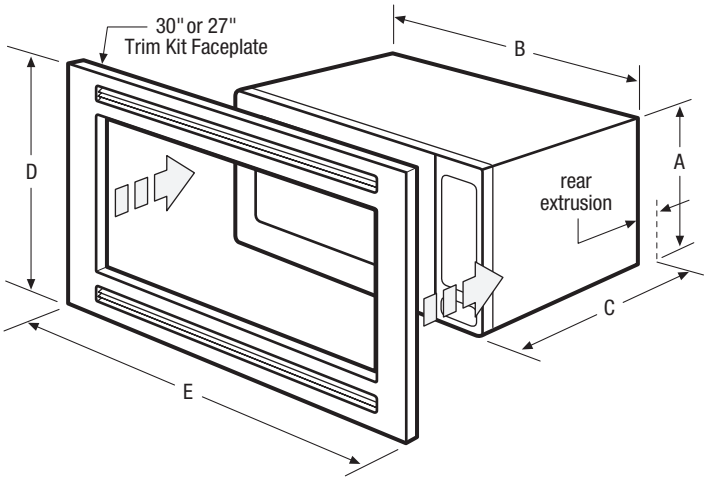
Effortless™ Reheat
Reheat almost anything with the touch of a button.

Over 30 Options
Versatile settings include: Chicken nuggets and snacks.

One-Touch Options
Our microwaves feature easy-to-use one-touch buttons so you can cook chicken nuggets, baked potatoes or popcorn with the touch of a button.

Features	
Control/Timing System	Express-Select®
Exterior Door Finish	Real Stainless Steel (F), Color-Coordinated (W/B)
Handle Design	Push Button
Microwave Capacity (Cu. Ft.)	2.0
Convection	
Watts (IEC-705 Test Procedure)	1,200
Interior Light	Yes
Interior Color	White
Turntable Diameter	16"
Turntable On/Off	
Control Lock	Yes
Clock	Yes
Touch Pad Buttons	28
Power Levels	High (1–10)
Accessory Metal Rack	
Microwave Control Options	
Popcorn Button	Yes
Chicken Nugget Button	Yes
Baked Potato Button	Yes
Sensor Reheat Button	Yes
Snack Button	Yes
Beverage	
Melt & Soften Options	4
Auto Reheat Options	3
Snack Menu Options	4
Auto Cook Options	3
Auto Defrost Options	6
Multi-Stage Cooking Option	
Keep Warm	Yes
Add-30-Seconds	Yes
Sensor Cooking Options	5
Vegetable Cook Sensor	Yes
Delay Start	Yes
User Preferences	Yes
Power Ratings	
Frequency (MHz)	2,450
Watts @ 120 Volts	1,700
Amps @ 120 Volts	14.3
Optional Accessories	
30" Stainless Steel Trim Kit	PN# MWTK30KF
30" White Trim Kit	PN# MWTK30KW
30" Black Trim Kit	PN# MWTK30KB
27" Stainless Steel Trim Kit	PN# MWTK27KF
27" White Trim Kit	PN# MWTK27KW
27" Black Trim Kit	PN# MWTK27KB
Specifications	
Oven Interior (HxWxD)	10-1/2" x 17-3/8" x 18-5/8"
Power Supply Connection Location	Right Top Rear
Voltage Rating	120V/60Hz/15 or 20A
Connected Load (kW Rating) @ 120 Volts[1]	1.7
Minimum Circuit Required (Amps)	15
Shipping Weight (Approx.)	46 Lbs.

[1]*For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.*

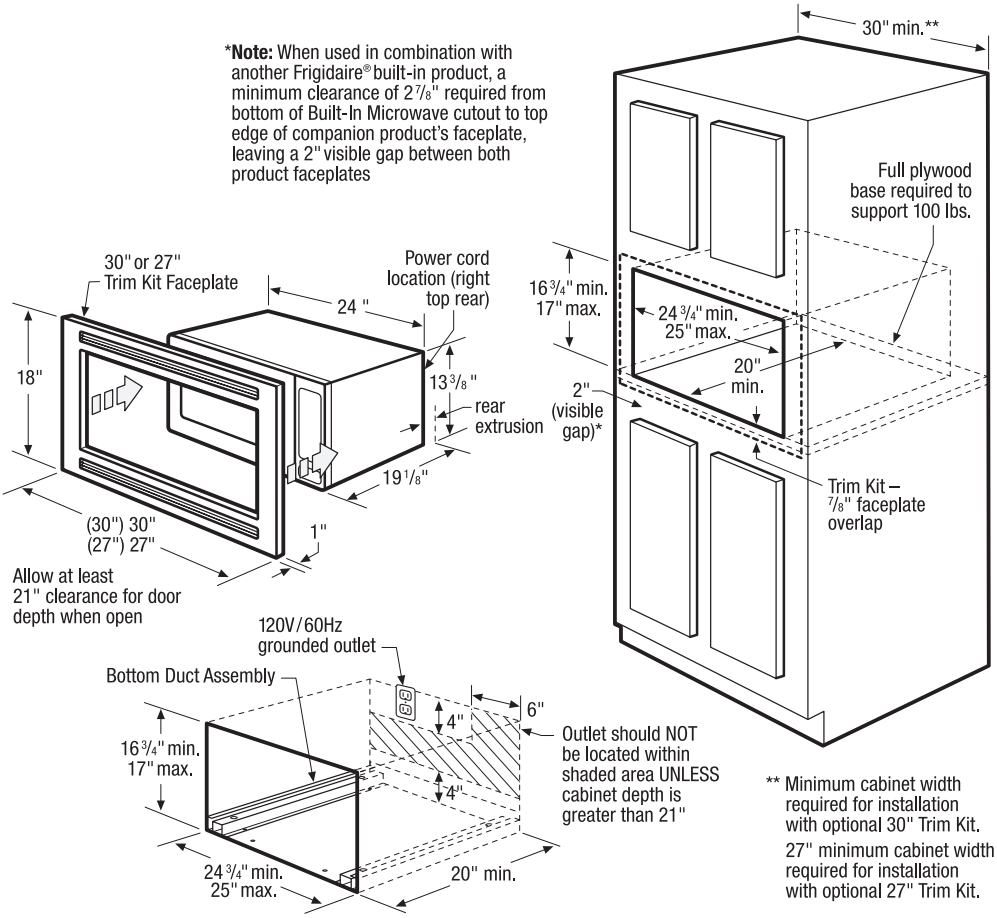


NOTE: For planning purposes only. Always consult local and national electric codes.
Refer to Product Installation Guide for detailed installation instructions on the web at frigidaire.com.

Product Dimensions	
A - Height	13-3/8"
B - Width	24"
C - Depth	19-1/8"
D - Height (Trim Kit Face Plate)	18"
E - Width (Trim Kit Face Plate)	30"/27"

Cutout Dimensions	
Height (Min.)	16-3/4"
Height (Max.)	17"
Width (Min.)	24-3/4"
Width (Max.)	25"
Depth (Min.)	20"

Accessories information available on the web at ***frigidaire.com***



Microwave Specifications

- Product Shipping Weight (Approx.) – 46 Lbs. *(not incl. Trim Kit)*
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.7 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 14.3 Amps
- Always consult local and national electric codes.
- Microwave can stand alone on countertop or be built in with optional 30" or 27" Trim Kit *(ordered by individual part number)* which includes Bottom Duct Assembly – shipped in separate box.
- Allow 21" minimum clearance for 90° door swing.
- Minimum 20" deep oven cutout dimension is critical for proper installation for oven and faceplate to fit flush against cabinet front.
- Consult local building code, in the event that cutout opening may be required to be enclosed with sides, ceiling and rear partition.
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Base must be level and front of cabinet square for proper operation.
- Grounded outlet should NOT be located in shaded area, as indicated, UNLESS cabinet depth is greater than 21".
- Can NOT be installed above any gas wall oven.
- Built-In Microwave is approved to be used in combination with any Frigidaire® Electric Single Wall Oven and/or Warmer Drawer. *(Refer to model-specific Combination Installation Specification pages on web.)*
- When used in combination with another Frigidaire® built-in product, a minimum clearance of 2-7/8" required from bottom of Built-In Microwave cutout to top edge of companion product's faceplate, leaving a 2" visible gap between both product faceplates.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions

Optional Accessories

- 30" Stainless Steel Trim Kit – (PN# MWTK30KF).
- 27" Stainless Steel Trim Kit – (PN# MWTK27KF).
- 30" White Trim Kit – (PN# MWTK30KW).
- 27" White Trim Kit – (PN# MWTK27KW).
- 30" Black Trim Kit – (PN# MWTK30KB).
- 27" Black Trim Kit – (PN# MWTK27KB).

*Accessories information available on the web at **frigidaire.com***

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Specifications subject to change.

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FRIGIDAIRE

30" Combination Installation

Built-In Microwave / Single Wall Oven

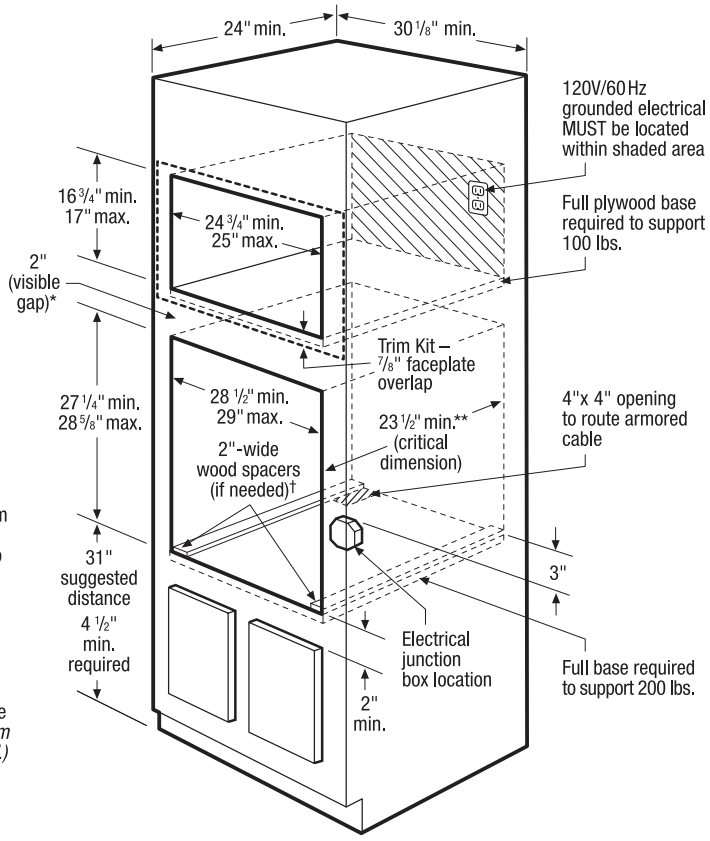
For detailed product dimensions and installation specifications, refer to model-specific product page and installation guide on web

30" Built-In Microwave Cutout

For Frigidaire® models with 30" Trim Kit:
FPMO209K
FGMO205K

30" Electric Single Wall Oven Cutout

For all 30" Frigidaire® models



* Minimum 2 7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

** Critical dimension – MUST be applied

† For cutout height greater than 28 1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Optional 3"-high bottom trim available for cutout height greater than 28 5/8".)*

30" Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-1/2" deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2" required distance from bottom of Wall Oven cutout to floor, 31" suggested.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21" clearance needed for Wall Oven door depth when open.

30" Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 30" Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.7 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 14.3 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

30" Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs.
- To adapt oven to fit cutout height greater than 28-1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Standard 1"- High Bottom Trim included.)*
- To adapt oven to fit cutout height greater than 28-5/8", optional 3"- High Bottom Trim available.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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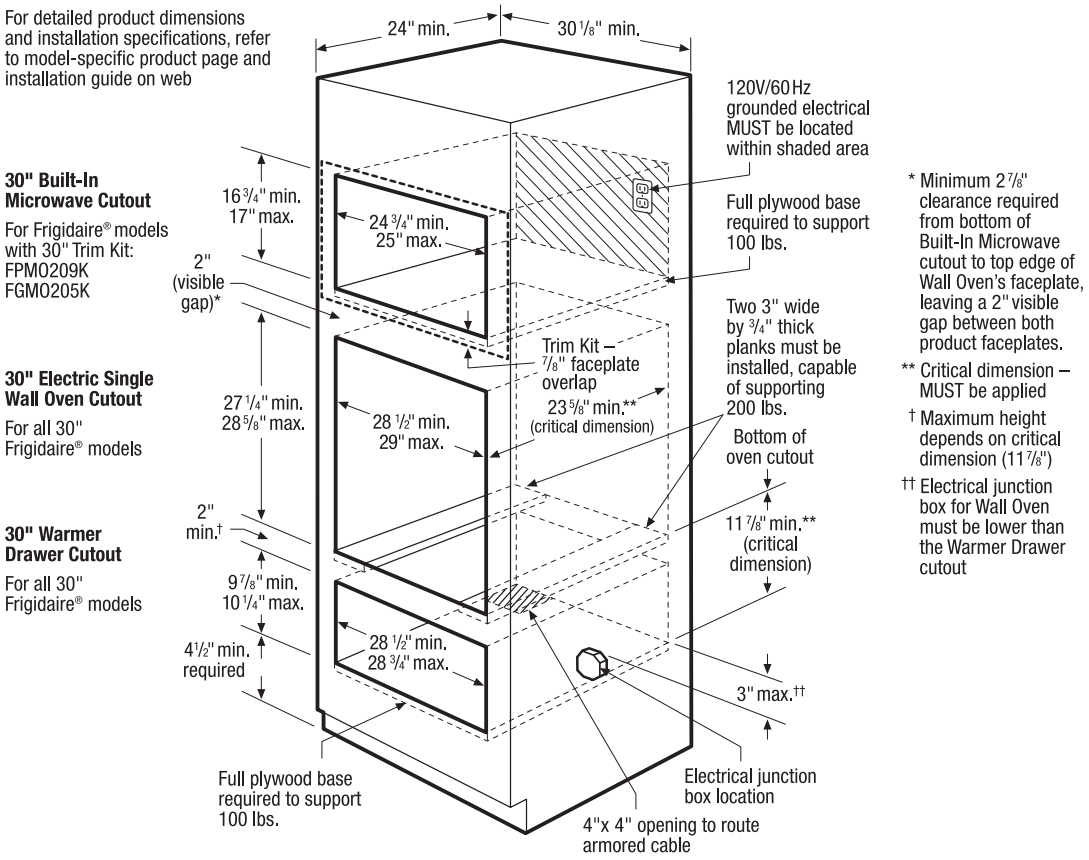
FRIGIDAIRE

30" Combination Installation

Built-In Microwave/Single Wall Oven/Warmer Drawer



30" Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-5/8" deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2" required distance from bottom of Warmer Drawer cutout to floor.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21" clearance needed for Wall Oven door depth when open.

30" Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 30" Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.7 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 14.3 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

30" Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- To support Wall Oven when using in combination with Warmer Drawer, two 3"-wide x 3/4"-thick planks must be installed as a base, capable of supporting 200 Lbs. Do NOT use full base, since planks are necessary to allow for proper air displacement.

30" Warmer Drawer Specifications

- Voltage Rating – 120V/450W/60 Hz/15 Amps
- Connected Load (kW Rating) @ 120 Volts = 0.5 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120V = 3.8 Amps
- Full base of solid plywood or similar material required, capable of supporting 100 Lbs.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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FRIGIDAIRE

27" Combination Installation

Built-In Microwave / Single Wall Oven

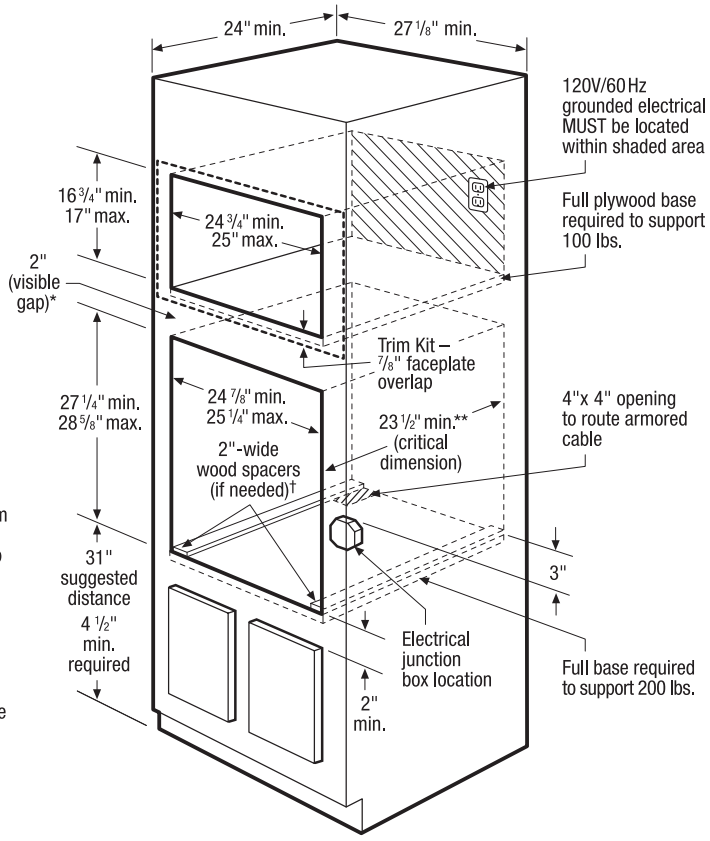
For detailed product dimensions and installation specifications, refer to model-specific product page and installation guide on web

27" Built-In Microwave Cutout

For Frigidaire® models with 27" Trim Kit:
FPMO209K
FGMO205K

27" Electric Single Wall Oven Cutout

For all 27" Frigidaire® models *(excluding model GLEB27Z7H)*



* Minimum 2 7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

** Critical dimension – MUST be applied

† For cutout height greater than 28 1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom.

27" Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-1/2" deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2" required distance from bottom of Wall Oven cutout to floor, 31" suggested.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21" clearance needed for Wall Oven door depth when open.

27" Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 27" Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.7 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 14.3 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

27" Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs.
- To adapt oven to fit cutout height greater than 28-1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Standard 1"- High Bottom Trim included.)*

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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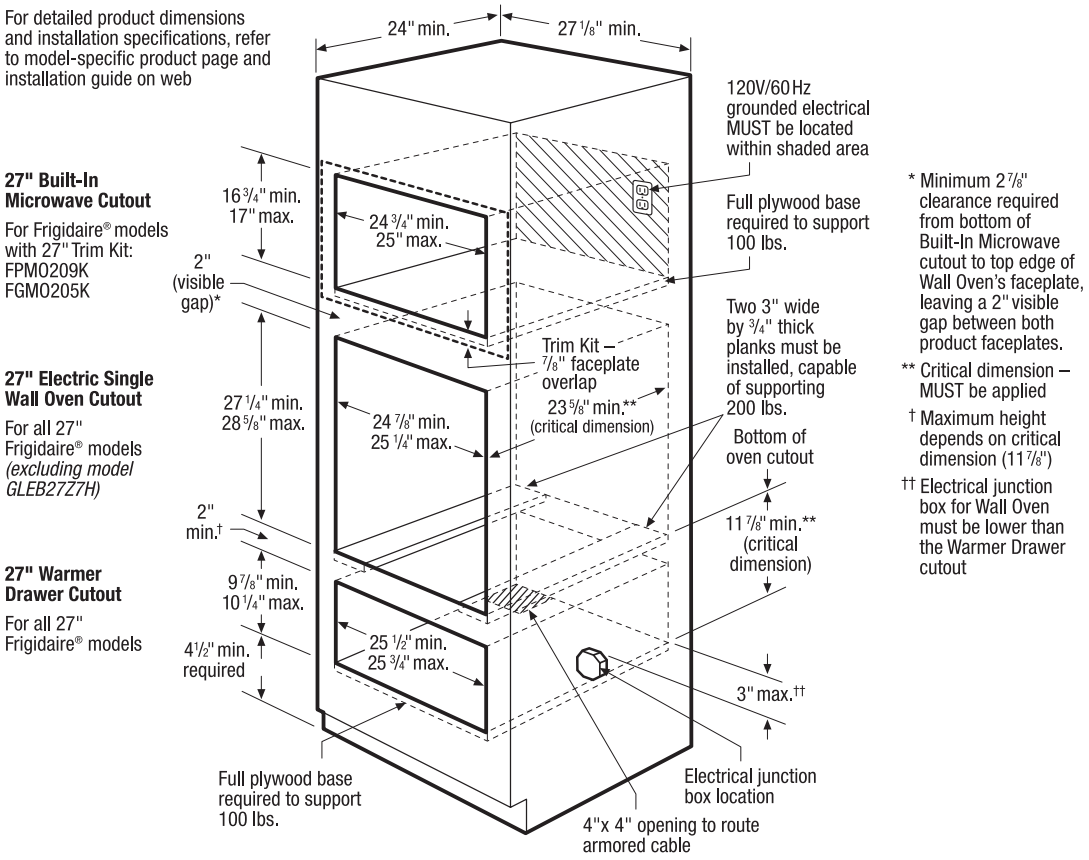
FRIGIDAIRE

27″ Combination Installation

Built-In Microwave/Single Wall Oven/Warmer Drawer



27″ Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-5/8″ deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2″ required distance from bottom of Warmer Drawer cutout to floor.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21″ clearance needed for Wall Oven door depth when open.

27″ Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 27″ Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.7 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 14.3 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8″ clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2″ visible gap between both product faceplates.

27″ Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- To support Wall Oven when using in combination with Warmer Drawer, two 3″-wide x 3/4″-thick planks must be installed as a base, capable of supporting 200 Lbs. Do NOT use full base, since planks are necessary to allow for proper air displacement.

27″ Warmer Drawer Specifications

- Voltage Rating – 120V/450W/60 Hz/15 Amps
- Connected Load (kW Rating) @ 120 Volts = 0.5 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120V = 3.8 Amps
- Full base of solid plywood or similar material required, capable of supporting 100 Lbs.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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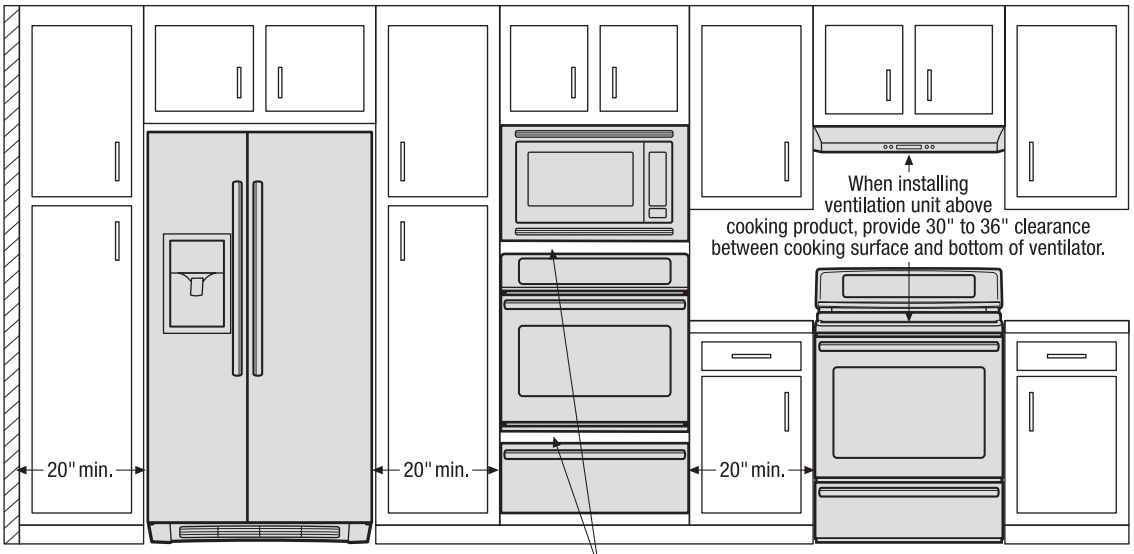
FRIGIDAIRE

General Installation Guidelines

with Side-by-Side Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

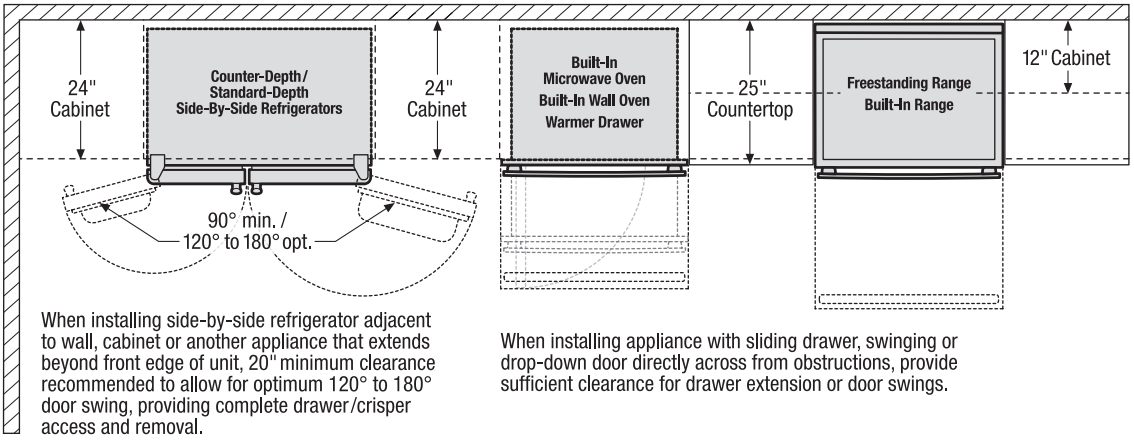
Front



When installing appliances adjacent to each other, 20" minimum distance between each appliance required.

When installing built-in cooking appliances in combination, 2" minimum visible gap between appliance faceplates required.

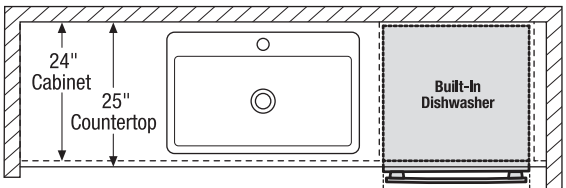
Top



When installing side-by-side refrigerator adjacent to wall, cabinet or another appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 120° to 180° door swing, providing complete drawer/crisper access and removal.

When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

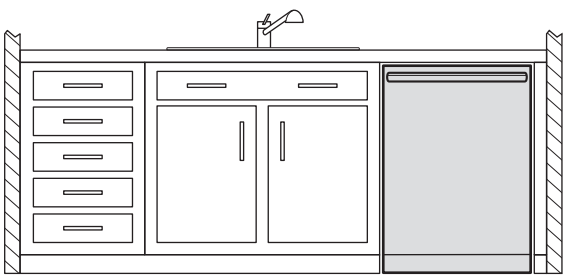
Top



When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

Front



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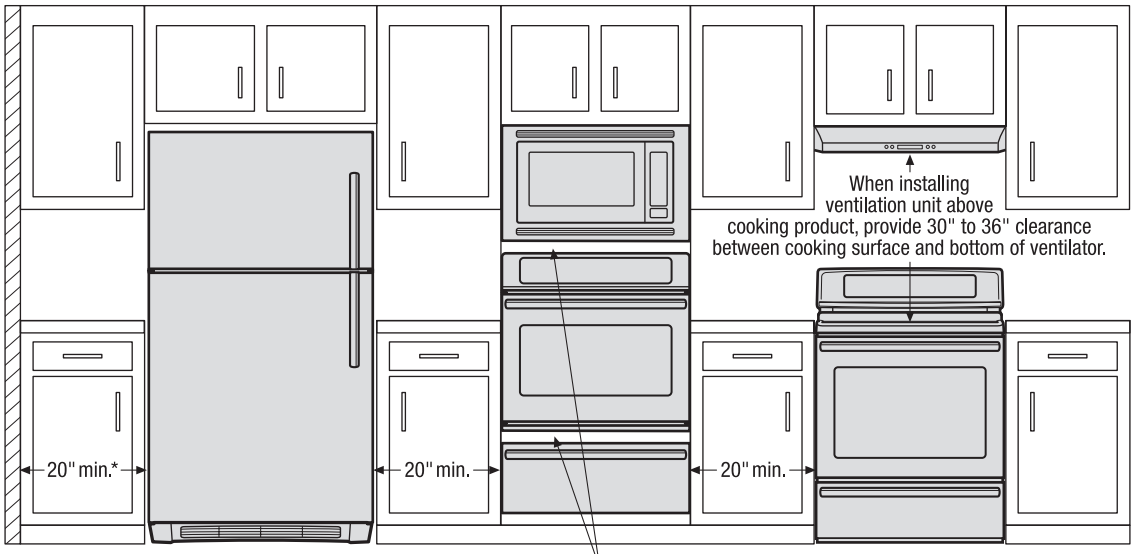
FRIGIDAIRE

General Installation Guidelines

with Top Mount Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

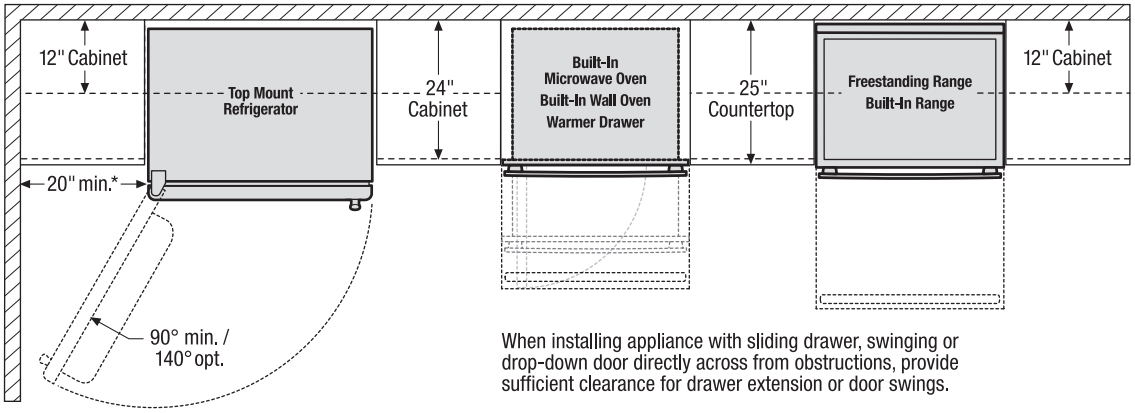
Front



When installing appliances adjacent to each other, 20" minimum distance between each appliance required.

When installing built-in cooking appliances in combination, 2" minimum visible gap between appliance faceplates required.

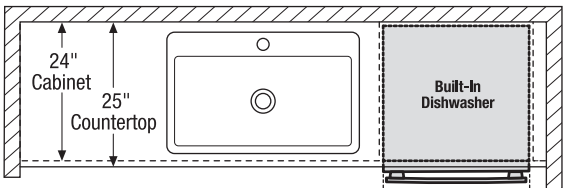
Top



When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

*When installing refrigerator adjacent to wall, cabinet or other appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 140° door swing, providing complete crisper access and removal. *(Absolute 3" minimum clearance will ONLY allow for 90° door swing which will provide limited crisper access with restricted removal.)*

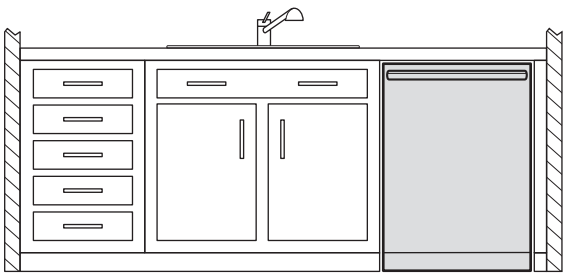
Top



When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

Front



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FRIGIDAIRE GALLERY

Single Wall Ovens

FGEW3045K F/W/B

30" Electric

Product Dimensions

Height	29"
Width	30"
Depth	24-1/2"

More Easy-To-Use Features

One-Touch Keep Warm Setting
Just one touch of a button keeps food warm until everything — and everyone — is ready.

Smudge-Proof Stainless Steel[2]
Protective coating reduces fingerprints and smudges so it's easy to clean.

Effortless™ Convection
Takes the guesswork out of convection cooking — our oven does the converting for you.

Even Baking Technology
Our latest technology ensures even baking every time.

Auto Oven Shut-Off
As an extra safety measure, the oven will automatically shut off after six hours.

Power Broil
Added power means you can broil food more evenly.

One-Touch Self Clean
Start the self-cleaning cycle with just the touch of a button.

Quick Clean
For a quick, light oven cleaning.

A.D.A. Compliant[3]

Sabbath Mode (Star-K® Certified)

Signature Features

Quick Preheat
Preheat in less than six minutes.[1]

True Convection
Multi-rack baking is faster and more even with True Convection.

Express-Select® Controls
Easily set cooking temperature or choose one-touch cooking options.

Chicken Nugget Button
Easily bake perfect chicken nuggets with the touch of a button.

Available in:

Stainless (F) | White (W) | Black (B)

[1]Based on single rack cooking performance, not set temperature, using Quick Preheat.

[2]Select models only.

[3]When properly installed, meets the appliance standards in the Americans with Disabilities Act and the Architectural Barriers Act Accessibility Guidelines as published by the United States Access Board on June 23, 2004, as amended August 5, 2005.

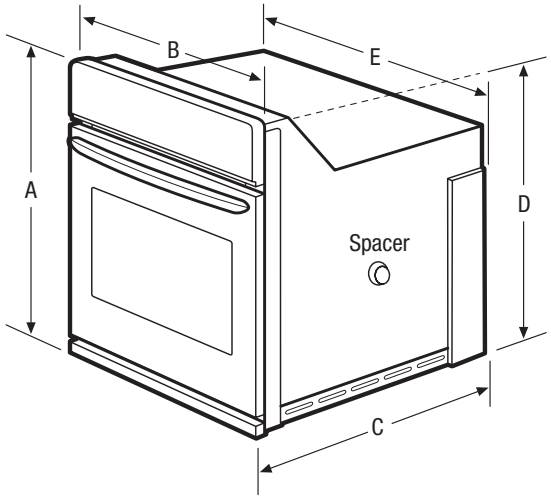
FRIGIDAIRE GALLERY

Single Wall Ovens

FGEW3045K F/W/B **30" Electric**

Features	
Oven Control/Timing System	Express-Select®
Window	Extra-Large
Exterior Door Finish	Smudge-Proof Stainless Steel (F), Color-Coordinated (W/B)
Handle Design	Stainless Steel (F), Color-Coordinated (W/B)
Oven Cleaning System	Self Clean
Oven Controls	
Bake/Broil	Yes/Variable (400 - 500 °F)
Effortless™ Convection Conversion	Yes
Convection Bake/Broil/Roast	Yes/No/No
Oven Preheat	Quick
My Favorite	
Chicken Nugget Button	Yes
Pizza Button	
Keep Warm	Yes
Add-a-Minute	
Delay Start	Yes
Self-Clean	Yes
Clean Option	Quick
Delay Clean	2, 3, 4 Hours
Kitchen Timer	Yes
Timed Cook Option	Yes
Control Lock	Yes
Auto Oven Shut-Off	Yes
Oven Lock-Out	Yes
Oven Features	
Capacity (Cu.Ft.)	4.2
Convection System	True Convection
Oven Light	1
Hidden Bake Element	Yes
Rack Configuration	2 Heavy Duty, 1 Offset Rack
Baking System	Even Baking Technology
Broiling System	Power Broil
Bake/Broil Element (Watts)	3,400/3,400
Optional Accessories	
3"-High Bottom Trim – Stainless Steel (F)/White (W)/Black (B)	(F) PN# 903114-910S (W) PN# 903114-9101 (B) PN# 903114-9100
Certifications	
A.D.A. Compliant[1]	Yes
Sabbath Mode (Star-K® Certified)	Yes
Specifications	
Oven Interior (H x W x D)	16-1/2" x 24-1/8" x 18-1/32"
Power Supply Connection Location	Left Bottom Rear
Voltage Rating	240V/208V/60Hz
Connected Load (kW Rating) @ 240/208 Volts	4.1/3.1
Amps @ 240/208 Volts	17.1/14.9
Minimum Circuit Required (Amps)	20
Approved for Under-Counter Installation	Yes
Shipping Weight (Approx.)	175 Lbs.

[1]*When properly installed, meets the appliance standards in the Americans with Disabilities Act and the Architectural Barriers Act Accessibility Guidelines as published by the United States Access Board on June 23, 2004, as amended August 5, 2005.*



NOTE: For planning purposes only. Always consult local and national electric codes. Refer to Product Installation Guide for detailed installation instructions on the web at frigidaire.com.

Product Dimensions	
A - Height	29"
B - Width	30"
C - Depth	24-1/2"
D - Height (Wrapper)	27-3/16"
E - Width (Wrapper)	28-1/4"
Depth with Door Open 90˚	44-1/2"

Cutout Dimensions	
Height (Min.)/(Max.)	27-1/4"/28-5/8"
Width (Min.)/(Max.)	28-1/2"/29"
Depth (Min.)	23-1/2"

*Accessories information available on the web at **frigidaire.com***

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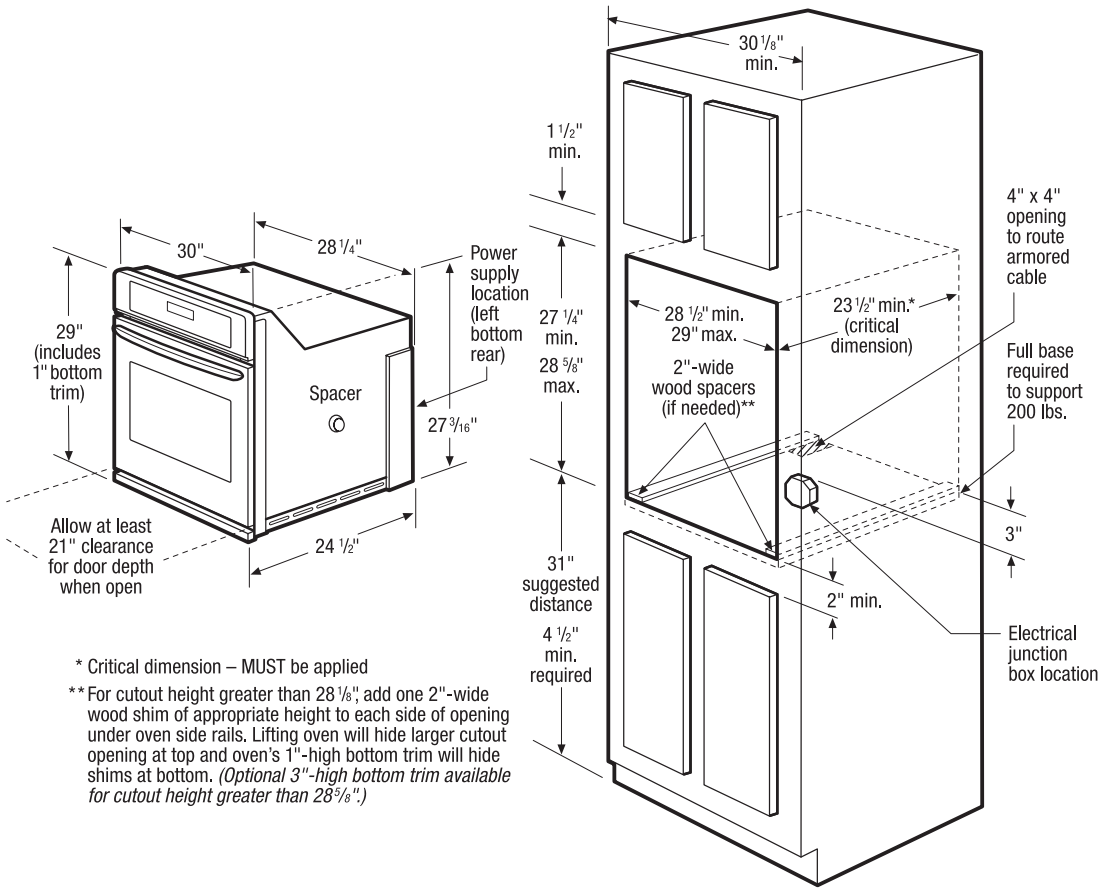
FGEW3045K 02/12

Specifications subject to change.

FRIGIDAIRE GALLERY

Single Wall Ovens

FGEW3045K F/W/B **30" Electric**



* Critical dimension – MUST be applied

** For cutout height greater than 28 1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Optional 3"-high bottom trim available for cutout height greater than 28 5/8".)*

Single Wall Oven Specifications

- Product Shipping Weight (approx.) – 175 Lbs.
- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- Connected Load (kW Rating) @ 240/208 Volts = 4.1/3.1kW
- Amps @ 240/208 Volts = 17.1/14.9 Amps
- Recommended Circuit Breaker – 20 Amps
- Always consult local and national electric codes.
- Minimum 21" clearance for oven door depth when open.
- Suggested distance from floor is 31". Minimum required distance is 4-1/2".
- Minimum 23-1/2" deep cutout dimension is critical for proper installation, to ensure that oven's faceplate will fit flush against cabinet front.
- To adapt oven to fit cutout height greater than 28-1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Standard 1"-High Bottom Trim included.)*
- To adapt oven to fit cutout height greater than 28-5/8", optional 3"-High Bottom Trim available.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs.
- Base must be level and cabinet front must be square.
- Single Wall Ovens are NOT approved to be used in stackable or side-by-side installation.
- Single Wall Ovens are approved to be used alone in under-counter installation or beneath any approved Frigidaire® gas or electric cooktop. *(Refer to Gas or Electric Cooktop Installation Over 30"/27" Electric Single Wall Oven Specifications pages on web.)*
- Single Wall Ovens are approved to be used in combination with any Frigidaire® Warmer Drawer. *(Refer to model-specific Warmer Drawer product page for Combination Installation Specifications.)*
- Single Wall Ovens are approved to be used in combination with any Frigidaire® Built-In Microwave Oven.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

Optional Accessories

- 3"-High Stainless Steel Bottom Trim – (PN# 903114-910S).
- 3"-High White Bottom Trim – (PN# 903114-9101).
- 3"-High Black Bottom Trim – (PN# 903114-9100).

*Accessories information available on the web at **frigidaire.com***

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Specifications subject to change.

FRIGIDAIRE

30" Combination Installation

Built-In Microwave / Single Wall Oven

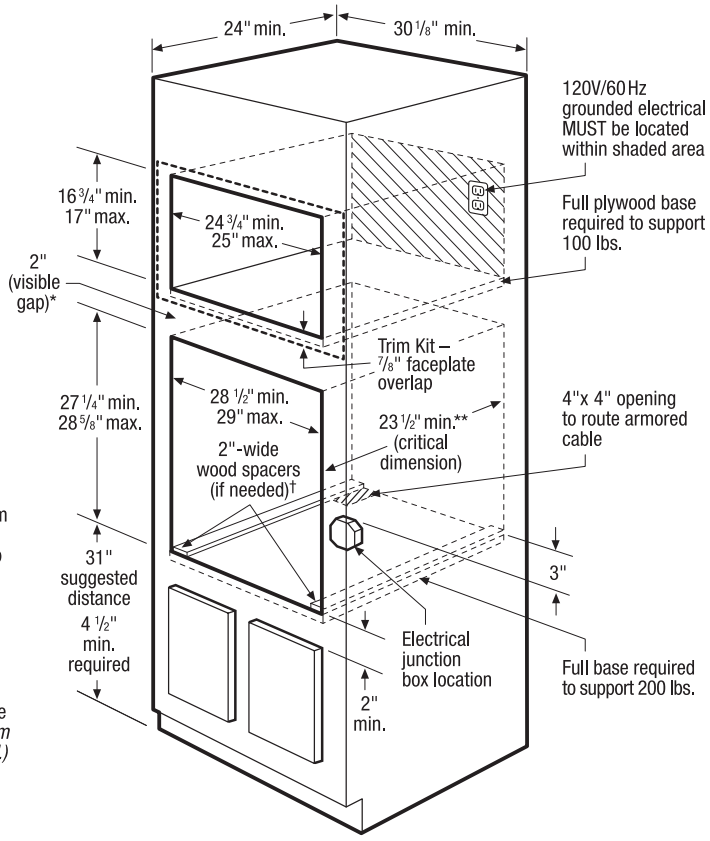
For detailed product dimensions and installation specifications, refer to model-specific product page and installation guide on web

30" Built-In Microwave Cutout

For Frigidaire® models with 30" Trim Kit:
FPMO209K
FGMO205K

30" Electric Single Wall Oven Cutout

For all 30" Frigidaire® models



* Minimum 2 7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

** Critical dimension – MUST be applied

† For cutout height greater than 28 1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Optional 3"-high bottom trim available for cutout height greater than 28 5/8".)*

30" Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-1/2" deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2" required distance from bottom of Wall Oven cutout to floor, 31" suggested.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21" clearance needed for Wall Oven door depth when open.

30" Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 30" Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.7 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 14.3 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

30" Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs.
- To adapt oven to fit cutout height greater than 28-1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Standard 1"- High Bottom Trim included.)*
- To adapt oven to fit cutout height greater than 28-5/8", optional 3"- High Bottom Trim available.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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Specifications subject to change.

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FRIGIDAIRE

30" Combination Installation

Built-In Microwave / Single Wall Oven

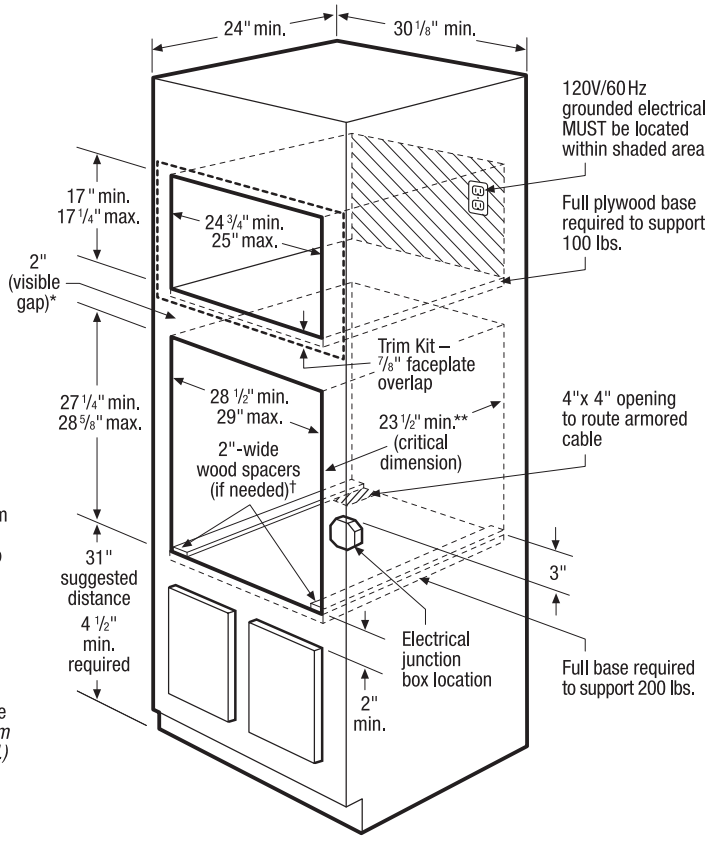
For detailed product dimensions and installation specifications, refer to model-specific product page and installation guide on web

30" Built-In Microwave Cutout

For Frigidaire® model with 30" Trim Kit: FFM01611L

30" Electric Single Wall Oven Cutout

For all 30" Frigidaire® models



* Minimum 2 7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

** Critical dimension – MUST be applied

† For cutout height greater than 28 1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Optional 3"-high bottom trim available for cutout height greater than 28 5/8".)*

30" Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-1/2" deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2" required distance from bottom of Wall Oven cutout to floor, 31" suggested.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21" clearance needed for Wall Oven door depth when open.

30" Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 30" Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.55 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 13 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

30" Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs.
- To adapt oven to fit cutout height greater than 28-1/8", add one 2"-wide wood shim of appropriate height to each side of opening under oven side rails. Lifting oven will hide larger cutout opening at top and oven's 1"-high bottom trim will hide shims at bottom. *(Standard 1"- High Bottom Trim included.)*
- To adapt oven to fit cutout height greater than 28-5/8", optional 3"- High Bottom Trim available.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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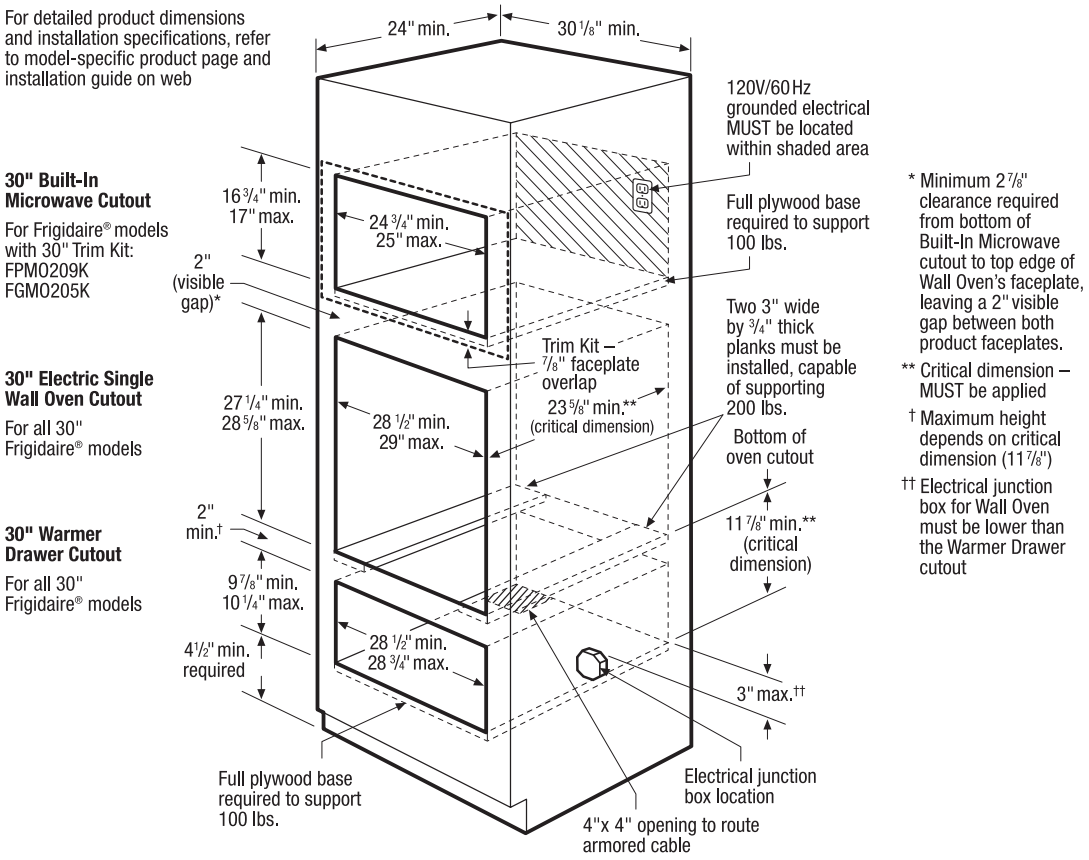
Specifications subject to change.

MOSS22_EW 30INST FR 02/12

FRIGIDAIRE

30" Combination Installation

Built-In Microwave/Single Wall Oven/Warmer Drawer



30" Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-5/8" deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2" required distance from bottom of Warmer Drawer cutout to floor.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21" clearance needed for Wall Oven door depth when open.

30" Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 30" Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.7 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 14.3 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

30" Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- To support Wall Oven when using in combination with Warmer Drawer, two 3"-wide x 3/4"-thick planks must be installed as a base, capable of supporting 200 Lbs. Do NOT use full base, since planks are necessary to allow for proper air displacement.

30" Warmer Drawer Specifications

- Voltage Rating – 120V/450W/60 Hz/15 Amps
- Connected Load (kW Rating) @ 120 Volts = 0.5 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120V = 3.8 Amps
- Full base of solid plywood or similar material required, capable of supporting 100 Lbs.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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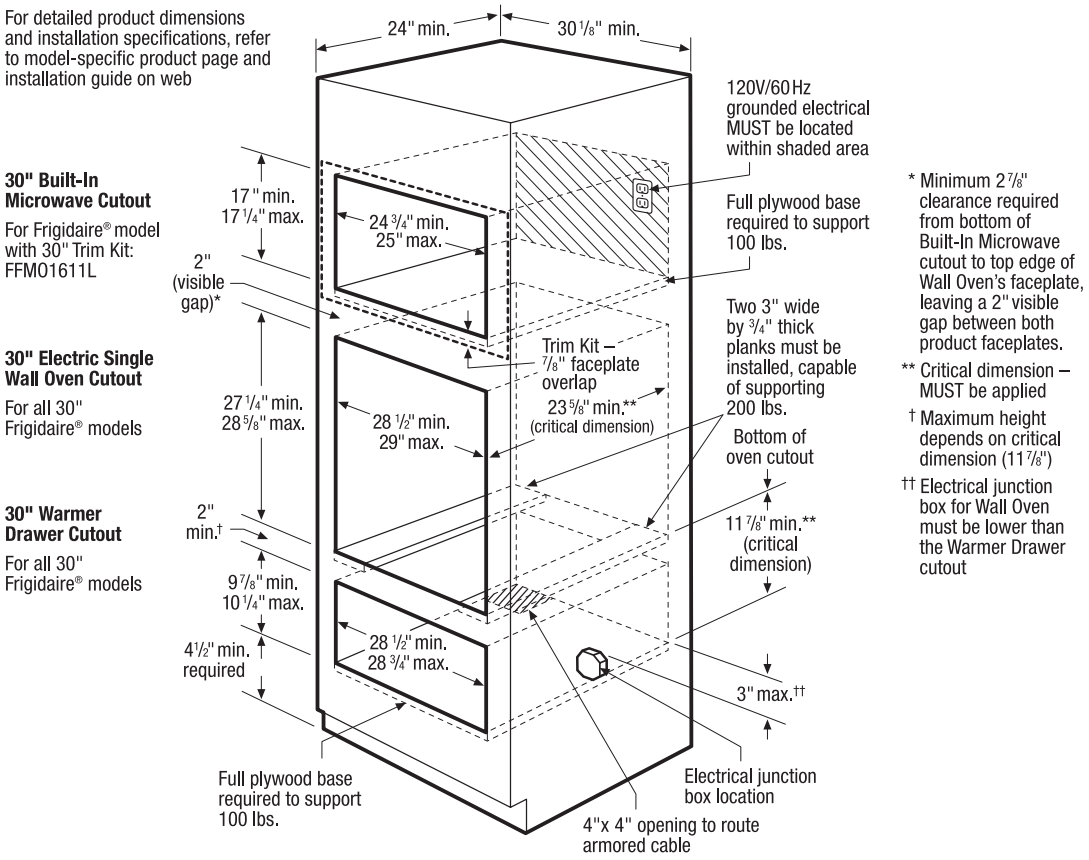
FRIGIDAIRE

30" Combination Installation

Built-In Microwave/Single Wall Oven/Warmer Drawer



30" Combination Installation Specifications

- Always consult local and national electric codes. *(Refer to product-specific electrical specifications on this page.)*
- Minimum 23-5/8" deep cutout dimension is critical for proper combination installation, to ensure that each built-in product's faceplate will fit flush against cabinet front.
- Bases must be level and cabinet front must be square.
- Minimum 4-1/2" required distance from bottom of Warmer Drawer cutout to floor.
- Respect critical dimensions as noted for proper installation of built-In products.
- Minimum 21" clearance needed for Wall Oven door depth when open.

30" Built-In Microwave Specifications

- For built-in installation, microwave MUST be installed with optional 30" Trim Kit which includes Bottom Duct Assembly – shipped in separate box, ordered by individual part number.
- Voltage Rating – 120V/60 Hz/15 or 20 Amps
- Connected Load (kW Rating) @ 120 Volts = 1.55 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120 Volts = 13 Amps
- Full oven base of solid plywood or similar material required, capable of supporting 100 Lbs.
- Minimum 2-7/8" clearance required from bottom of Built-In Microwave cutout to top edge of Wall Oven's faceplate, leaving a 2" visible gap between both product faceplates.

30" Electric Single Wall Oven Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- To support Wall Oven when using in combination with Warmer Drawer, two 3"-wide x 3/4"-thick planks must be installed as a base, capable of supporting 200 Lbs. Do NOT use full base, since planks are necessary to allow for proper air displacement.

30" Warmer Drawer Specifications

- Voltage Rating – 120V/450W/60 Hz/15 Amps
- Connected Load (kW Rating) @ 120 Volts = 0.5 kW (For use on adequately wired 120V, dedicated circuit having 2-wire service with a separate ground wire. Appliance must be grounded for safe operation.)
- Amps @ 120V = 3.8 Amps
- Full base of solid plywood or similar material required, capable of supporting 100 Lbs.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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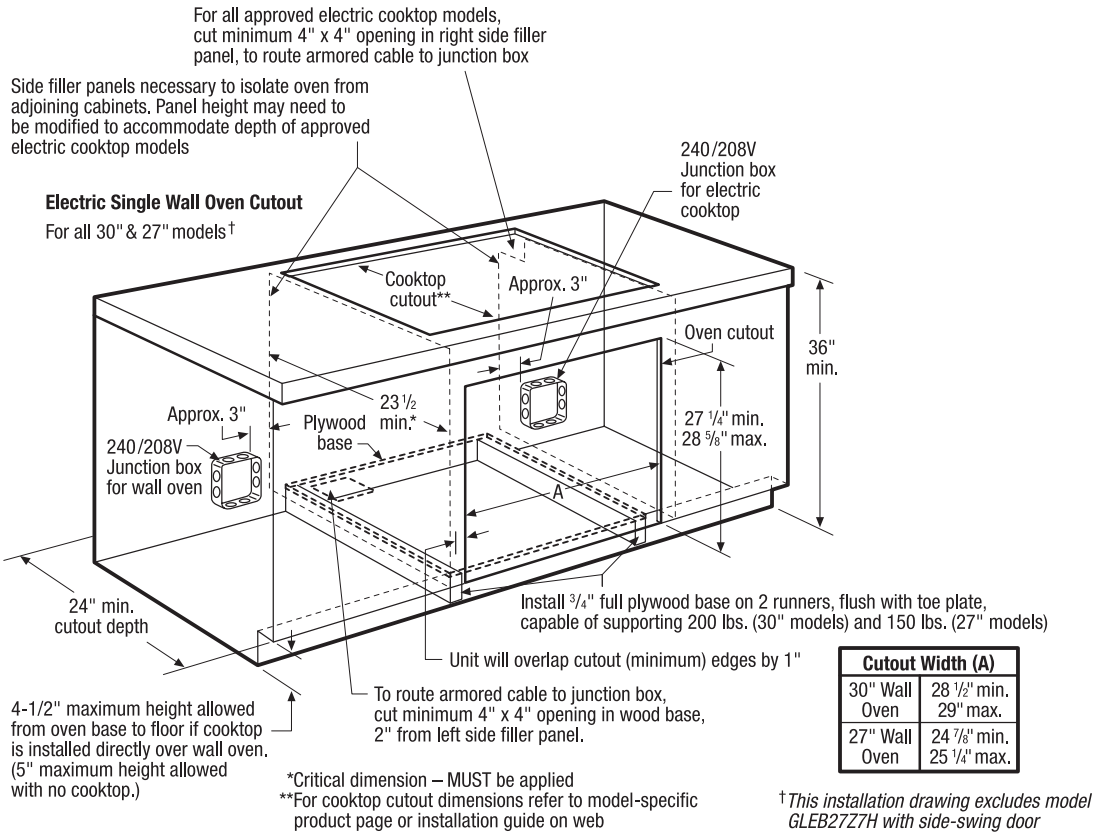
FRIGIDAIRE

Electric Cooktop Installation Over 30"/27" Electric Single Wall Oven



Cutout Width (A)	
30" Wall Oven	28 1/2" min. 29" max.
27" Wall Oven	24 7/8" min. 25 1/4" max.

†*This installation drawing excludes model GLEB27Z7H with side-swing door*

30"/27" Electric Single Wall Oven Under-Counter Installation Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Always consult local and national electric codes.
- Minimum 21" clearance for oven door depth when open.
- Minimum 23-1/2" deep cutout dimension is critical for proper installation, to ensure that oven's faceplate will fit flush against cabinet front.
- Side filler panels necessary to isolate oven from adjoining cabinets.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs. (30" models) or 150 Lbs. (27" models). Install over two runners and flush with toe plate.
- Base must be level and cabinet front must be square.
- Allow 5" maximum height from oven base to floor, if NO cooktop is installed directly over wall oven.

Electric Cooktop Installation Over 30"/27" Electric Single Wall Oven Specifications

All Frigidaire® Electric Single Wall Ovens are approved to be used beneath any approved Frigidaire® Electric Cooktop. *(This installation page excludes approved wall oven model GLEB27Z7H. For model-specific installation details, refer to Electric Cooktop Installation Over 27" Electric Single Wall Oven GLEB27Z7H Specifications pages on web.)*

For detailed Electric Cooktop installation, refer to model-specific product page and installation guide on web.

- Side filler panel height may need to be modified to accommodate the depth of approved electric cooktop models.
- To route armored cable to junction box, cut minimum 4" x 4" opening in right side filler panel.
- Allow 4-1/2" maximum height from oven base to floor, if cooktop is installed directly over wall oven.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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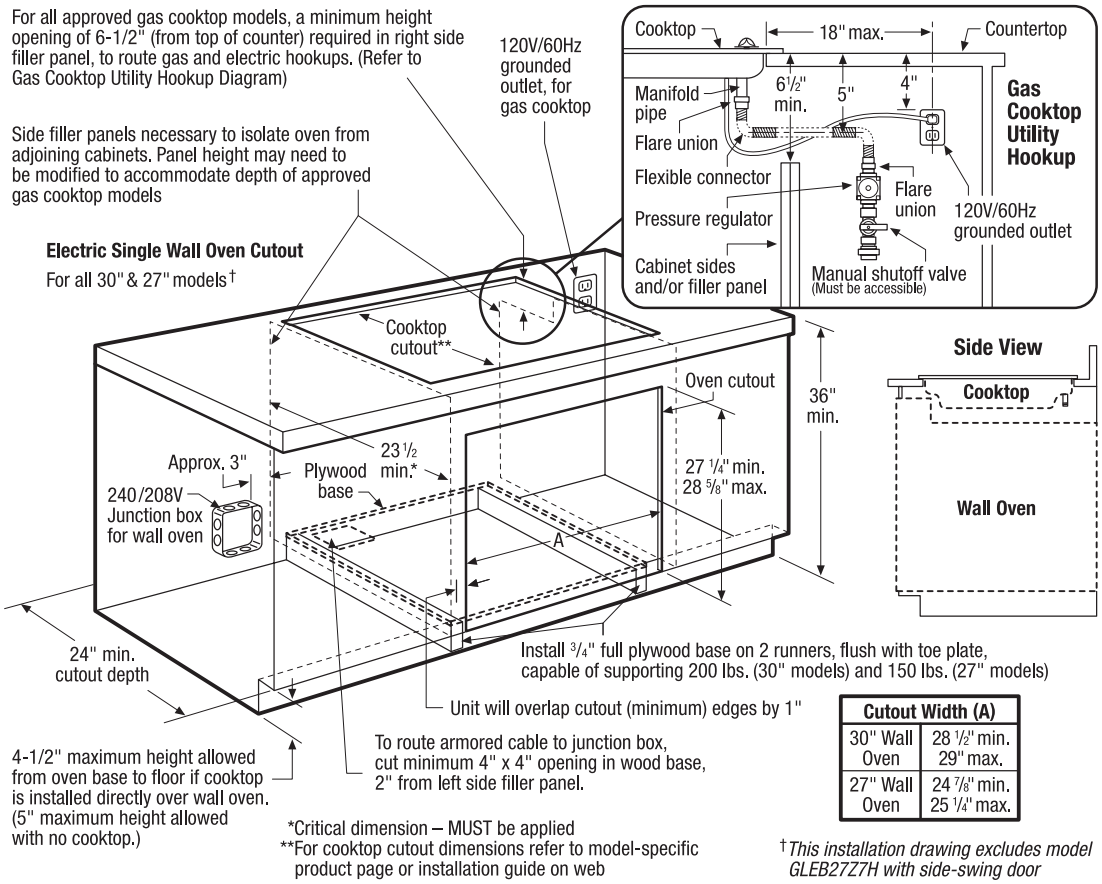
Gas Cooktop Installation Over 30"/27" Electric Single Wall Oven



Cutout Width (A)	
30" Wall Oven	28½" min. 29" max.
27" Wall Oven	24⅞" min. 25¼" max.

*Critical dimension – MUST be applied
**For cooktop cutout dimensions refer to model-specific product page or installation guide on web

†*This installation drawing excludes model GLEB27Z7H with side-swing door*

30"/27" Electric Single Wall Oven Under-Counter Installation Specifications

- Single phase 3- or 4-wire cable, 120/240 or 120/208 Volt, 60 Hertz AC only electrical supply with ground required on separate circuit fused on both sides of line.
- For detailed electrical requirements, refer to model-specific product page and installation guide on web.
- Always consult local and national electric codes.
- Minimum 21" clearance for oven door depth when open.
- Minimum 23-1/2" deep cutout dimension is critical for proper installation, to ensure that oven's faceplate will fit flush against cabinet front.
- Side filler panels necessary to isolate oven from adjoining cabinets.
- Full oven base of solid plywood or similar material required, capable of supporting 200 Lbs. (30" models) or 150 Lbs. (27" models). Install over two runners and flush with toe plate.
- Base must be level and cabinet front must be square.
- Allow 5" maximum height from oven base to floor, if NO cooktop is installed directly over wall oven.

Gas Cooktop Installation Over 30"/27" Electric Single Wall Oven Specifications

All Frigidaire® Electric Single Wall Ovens are approved to be used beneath any approved Frigidaire® Gas Cooktop. *(This installation page excludes approved wall oven model GLEB27Z7H. For model-specific installation details, refer to Gas Cooktop Installation Over 27" Electric Single Wall Oven GLEB27Z7H Specifications pages on web.)*

For detailed Gas Cooktop installation, refer to model-specific product page and installation guide on web.

- Side filler panel height may need to be modified to accommodate the depth of approved gas cooktop models.
- Minimum height opening of 6-1/2" *(from top of counter)* required in right side filler panel, to route gas and electric hookups.
- Allow 4-1/2" maximum height from oven base to floor, if cooktop is installed directly over wall oven.

Note: For planning purposes only. Refer to Product Installation Guide on the web at frigidaire.com for detailed instructions.

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Specifications subject to change.

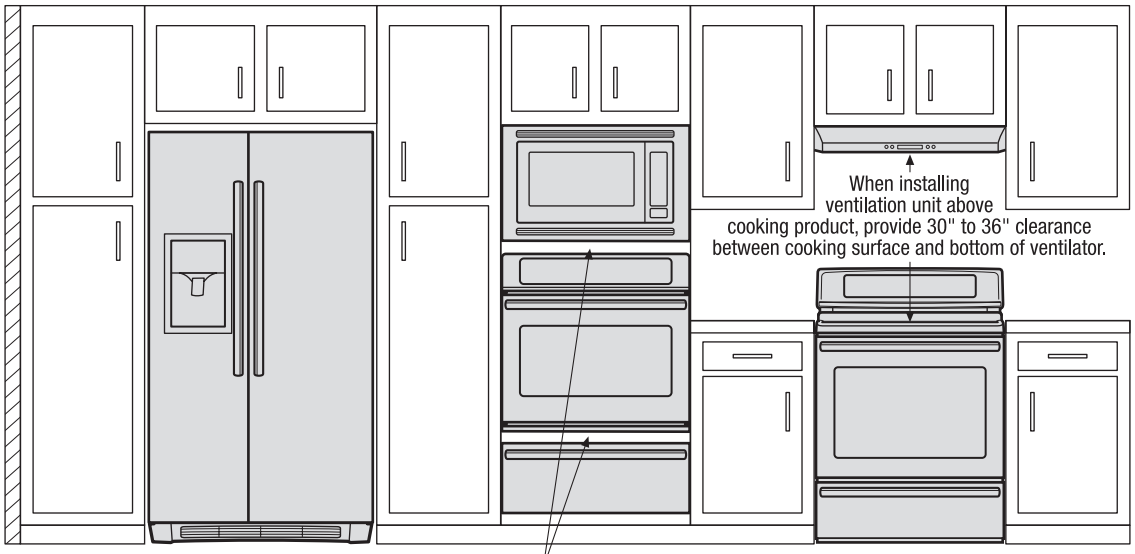
FRIGIDAIRE

General Installation Guidelines

with Side-by-Side Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

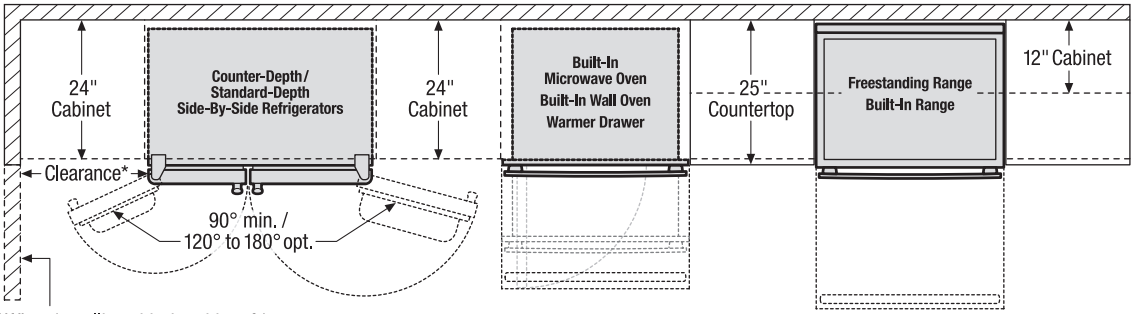
Front



When installing built-in cooking appliances in combination, 2"-high minimum visible gap between appliance faceplates required.

Clearance information for cooking appliances, provided in specific product's installation guide.

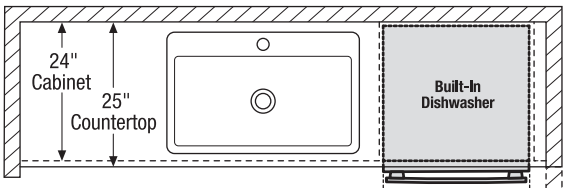
Top



*When installing side-by-side refrigerator adjacent to wall, cabinet or another appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 120° to 180° door swing, providing complete drawer/crisper access and removal. *(Absolute 4-1/2" minimum clearance will ONLY allow for 90° door swing which will provide limited drawer/crisper access with restricted removal.)*

When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

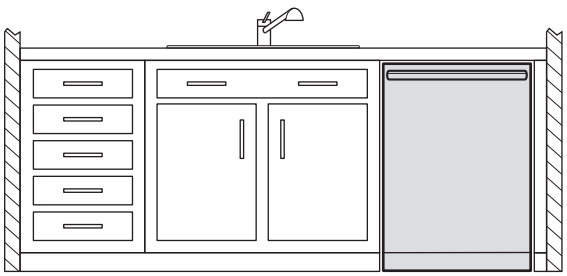
Top



When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

Front



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Specifications subject to change.

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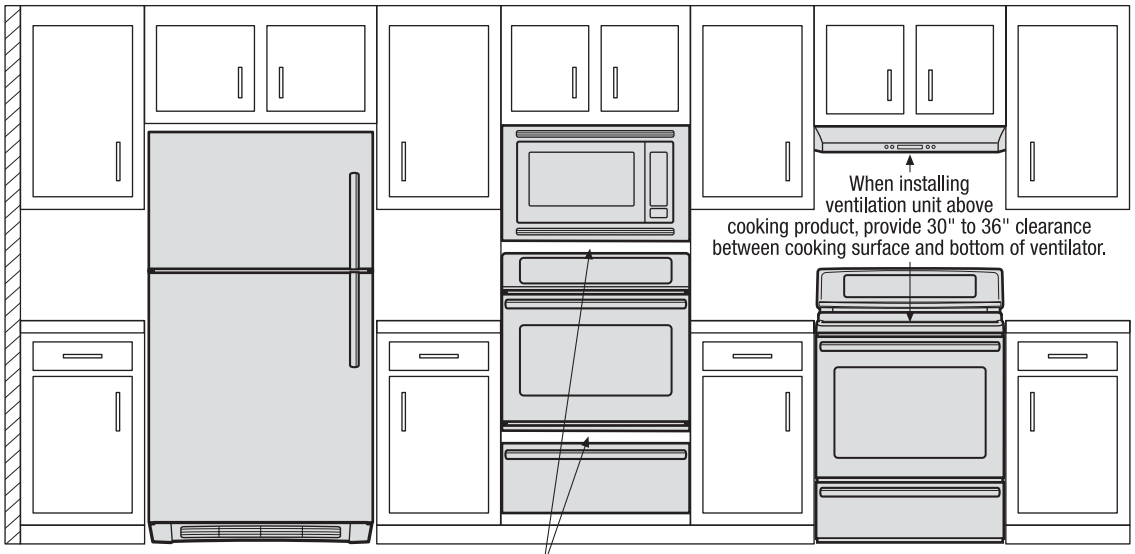
FRIGIDAIRE

General Installation Guidelines

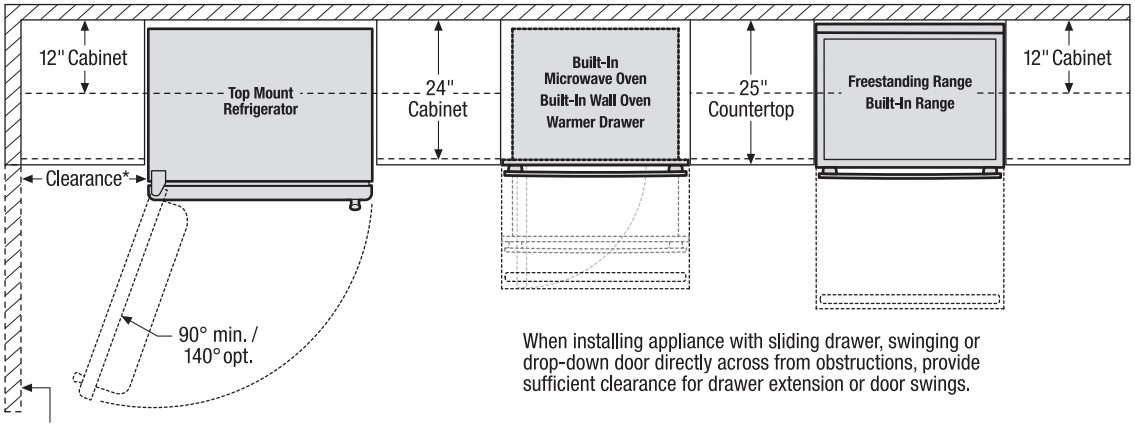
with Top Mount Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

Front



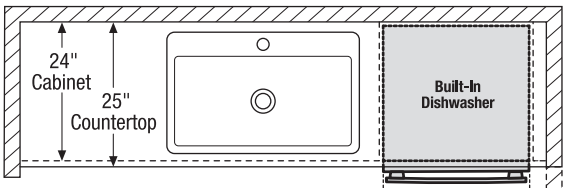
Top



When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

*When installing top mount refrigerator adjacent to wall, cabinet or other appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 140° door swing, providing complete crisper access and removal. *(Absolute 3" minimum clearance will ONLY allow for 90° door swing which will provide limited crisper access with restricted removal.)*

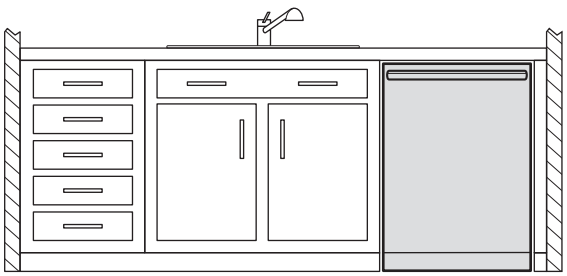
Top



When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

Front



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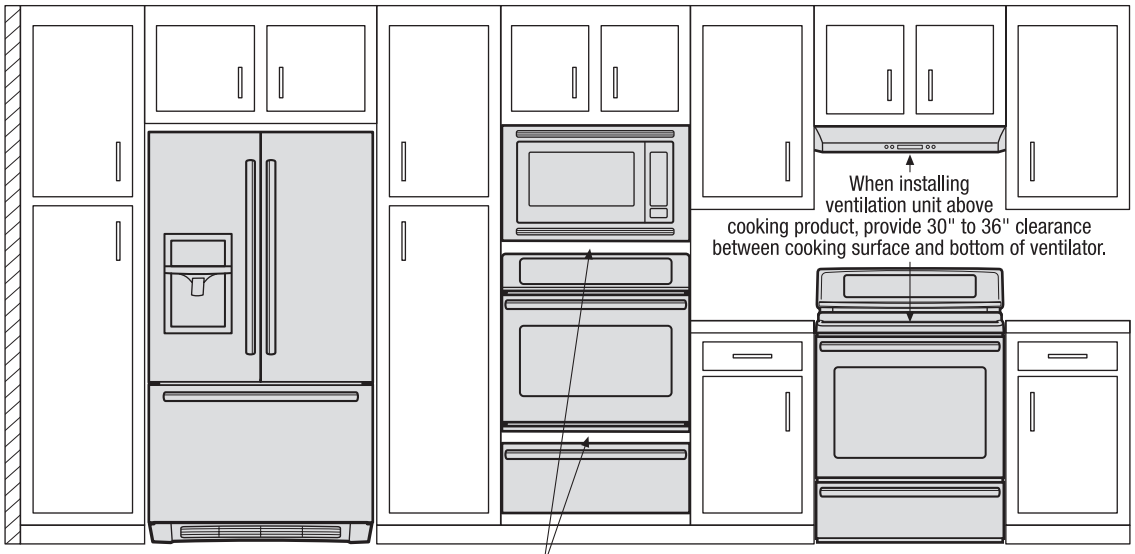
FRIGIDAIRE

General Installation Guidelines

with French Door Refrigerator

Use these dimensions and clearance instructions for planning purposes only. For detailed installation instructions, refer to installation guide, packed with product, or on the web at frigidaire.com.

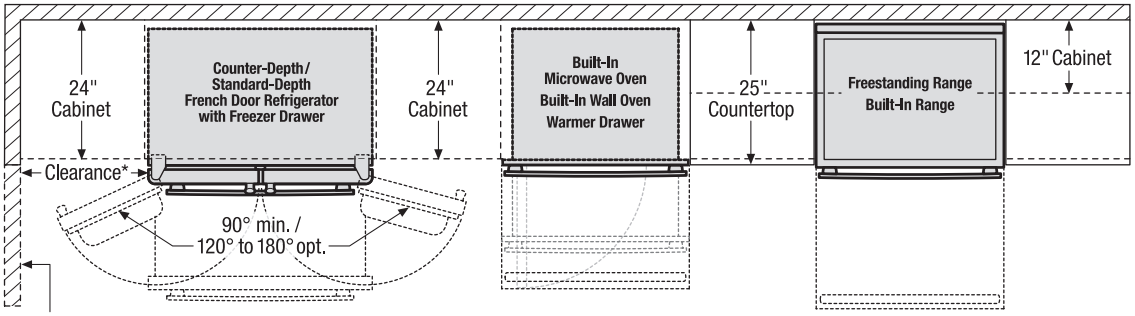
Front



When installing built-in cooking appliances in combination, 2"-high minimum visible gap between appliance faceplates required.

Clearance information for cooking appliances, provided in specific product's installation guide.

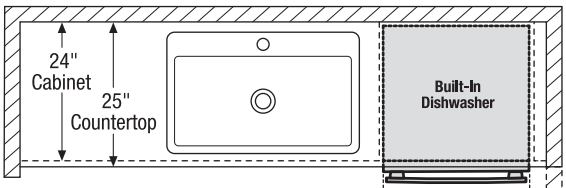
Top



*When installing French door refrigerator adjacent to wall, cabinet or another appliance that extends beyond front edge of unit, 20" minimum clearance recommended to allow for optimum 120° to 180° door swing, providing complete drawer/crisper access and removal. *(Absolute 4-1/2" minimum clearance will ONLY allow for 90°door swing which will provide limited drawer/crisper access with restricted removal.)*

When installing appliance with sliding drawer, swinging or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swings.

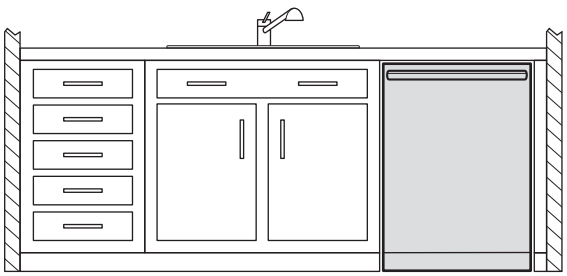
Top



When installing appliance with sliding drawer or drop-down door adjacent to wall, cabinet, or other obstruction that extends beyond front edge of appliance, allow 2" minimum clearance between drawer or door and obstruction.

When installing appliance with sliding drawer or drop-down door directly across from obstructions, provide sufficient clearance for drawer extension or door swing.

Front



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Specifications subject to change.

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PRINT

Frigidaire Affinity 3.7 Cu. Ft. Front Load Washer

MODEL: FAFW3921NW
27" W X 30-3/10" D X 36" H
MSRP: $899.00

Classic White

ENERGY GUIDE

Shown with Optional Pedestal.

Specifications

Specifications

General

Product Code: FAFW3921NW

Product Type: Front Load

Power Type: Electric

Installation Type: Free-Standing

UPC Code: 0-12505-38487-5

Color: Classic White

Options

Clean Washer: Yes, Key Combination

Delay Start (Hours): Yes

Energy Saver: Yes

Freshwater Rinse: Yes

Stain Clean: Yes

Controls

Control Lock: Yes

Cycle Status Lights: 4 - Door Lock / Sensing / Wash / Touch Pause to add a Garment

Time Remaining Indicator: Yes, LED Segment

Start/Pause/Cancel Function: Push 'Start/Pause' button to Start / Push 'Start/Pause' button

Certifications & Approvals

ENERGY STAR® Certified: Yes

ENERGY STAR® Most Efficient: Yes

NSF® Certified: Yes

Washer: Soil Level Selections

Heavy Soil: Yes

Light Soil: Yes

Normal Soil: Yes

Washer: Specifications

Bleach Dispenser: Yes

Detergent Dispenser: Yes

Drum Material: Stainless Steel

Fabric Softener Dispenser: Yes

Internal Water Heater: Yes

Maximum Spin Speed (RPM): 1,200

Stay Fresh Antimicrobial Seal: Yes

Stay Fresh Door Seal: Yes

Exterior Specifications

Cabinet Color: White

Washer: Cycles

Casual: Yes

Delicates: Yes

Hand Wash: Yes

Heavy: Yes

Normal: Yes

Quick Cycle: Yes - 25 minutes

Rinse & Spin: Yes

Temperature Settings

Automatic Temperature Control: Yes

Cold: Yes

Cold Water Clean: Yes

Hot: Yes

Sanitize: Yes

Warm: Yes

Exterior Dimensions

Depth: 30-3/10"

Depth (with Door 90° Open): 51-2/5"

Height: 36"

Width: 27"

to Pause / Push 'Cancel' button to Cancel

Electrical Specifications

Amps @ 120 Volts: 10.0

Connected Load (kW Rating) @ 120V: 1.10

Minimum Circuit Required (Amps): 15A

Power Supply Connection Location: Rear

Voltage Rating: 120V, 60Hz

Energy Data

CEE Tier Level: 3

kWh/year: 92

Modified Energy Factor: 3.35

Water Factor: 2.9

Water Usage/Year: 4183

Console Color: White

Door Lock Light: Yes

Door Style: Affinity

Knob, Button, Switch Color: Chrome

Lens Ring: White

Accessories

Drain Hose Extension Kit: Optional, order item no. 137098000

Dryer Stacking Kit: Optional, order item no. STACKIT4X

Mobile Home Installation Kit: Optional, order item no. 137067200

Pedestal: Optional, order item no. CFPWD15

General Specifications

Adjustable Leveling Legs: Yes

Product Weight (lbs): 235

[1]Based on a 15.8 lb. load as tested per DOE Protocol 10CFR430, subpart B, App. J, cl.3.1.

KOHLER®

Roughing-In

K-596, K-597
SIMPLICE®
PULL-DOWN KITCHEN SINK FAUCET

Product Information

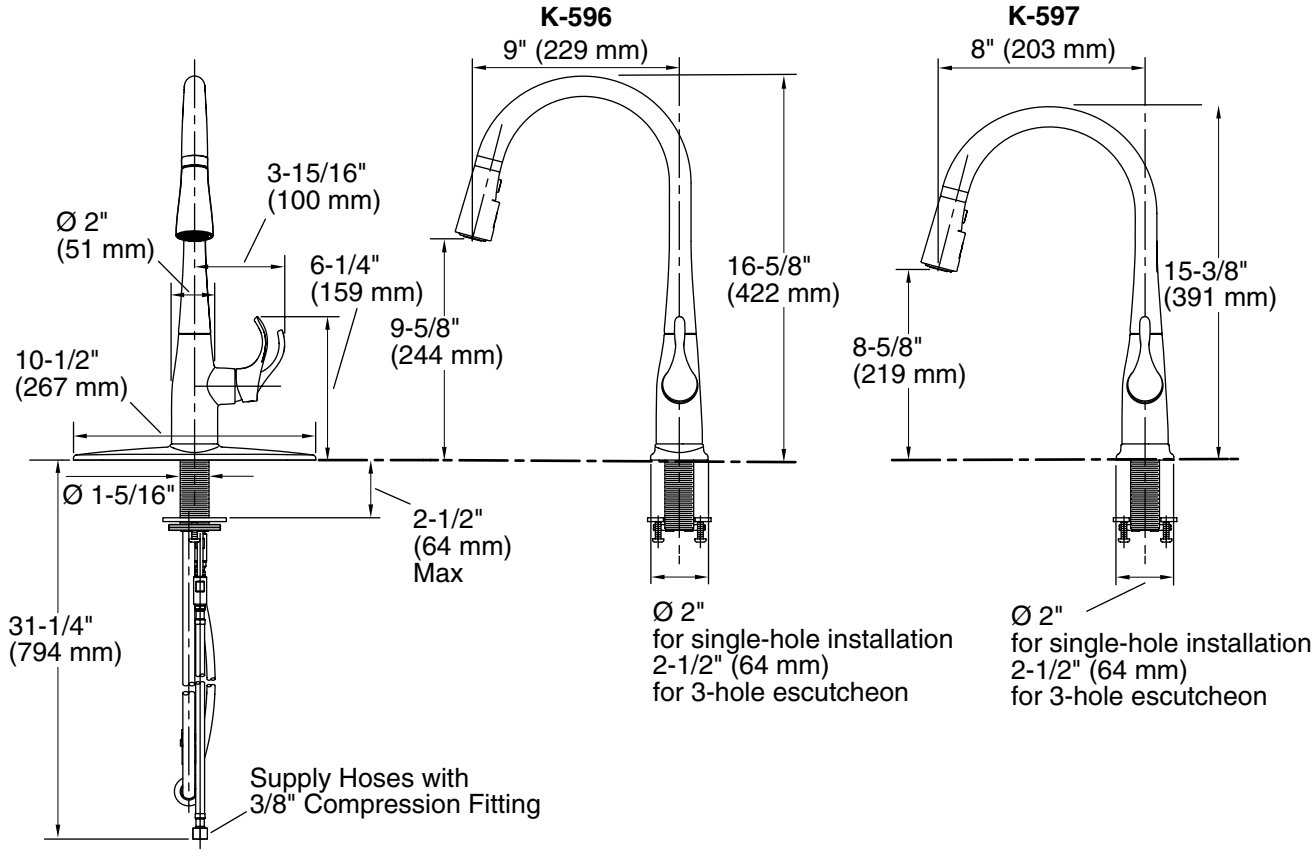
Applicable product:	
Pull-down kitchen sink faucet – 9″ (229 mm) swing spout reach	K-596
Pull-down kitchen sink faucet – 8″ (203 mm) swing spout reach	K-597
Lever handle is ADA, CSA B651, OBC compliant.	

Optional accessories:	
Deep roughing-in kit – provides an additional 2″ (51 mm) assembly depth	1012715
Low flow kit – reduces maximum flow to 1.5 gpm (5.7 L) at 60 psi (4.1 bar)	1167289
High flow kit – increases maximum flow to 2.2 gpm (8.3 L) at 60 psi (4.1 bar)	1167290

Installation Notes

Install this product according to the installation guide.

ADA, **CSA B651**, **OBC** compliant when installed to the specific requirements of these regulations.



KOHLER® FAUCETS

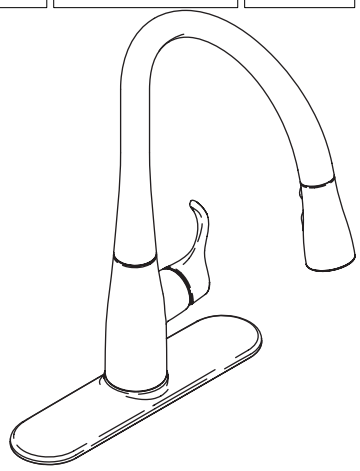
SIMPLICE®

PULL-DOWN KITCHEN SINK FAUCET

K-596

ALSO K-597

ADA | **CSA B651** | **OBC**



Features

- *Metal construction*
- *One-piece, self-contained ceramic disc valve allows both volume and temperature control*
- *Temperature memory allows faucet to be turned on and off at any temperature setting*
- *Touch control for stream-to-spray water flow*
- *Promotion™ technology with nylon hose and ball joint for easy operation*
- *Flexible connections for easy installation*
- *Three-function sprayhead with spray, aerated stream, and pause settings*
- *360° spout rotation*
- *For single-hole or three-hole installation when included 10-1/2″ (267 mm) escutcheon plate is used*
- *Meets CalGreen requirements for kitchen faucets*
- *1.8 gallons (6.8 L) per minute maximum flow rate at 60 psi (4.1 bar)*

Codes/Standards Applicable

Specified model meets or exceeds the following at date of manufacture:

- *ADA*
- *ICC/ANSI A117.1*
- *CSA B651*
- *OBC*
- *ASME A112.18.1/CSA B125.1*
- *NSF 61*
- *Energy Policy Act of 1992*
- *All applicable US Federal and State material regulations*

Colors/Finishes

- CP: Polished Chrome
- VS: Stainless Steel

Specified Model

Model	Description	Colors/Finishes	
K-596	Pull-down kitchen sink faucet – 9″ (229 mm) swing spout reach (shown)	❑ CP	❑ VS
K-597	Pull-down kitchen sink faucet – 8″ (203 mm) swing spout reach	❑ CP	❑ VS

Product Specification

The kitchen sink faucet shall be of metal construction with a one-piece, self-contained ceramic disc valve, which allows both volume and temperature control. Product shall feature temperature memory, allowing the faucet to be turned on and off at any temperature setting. Product shall feature a touch control for stream-to-spray water flow and Promotion technology with nylon hose and ball joint for easy operation. Product shall feature a 360° spout rotation and have flexible connections for easy installation. Product shall be available with a three-function sprayhead with spray, aerated stream, and pause settings. Product shall be for single-hole or three-hole installation when included 10-1/2″ (267 mm) escutcheon plate is used. Product shall be 1.8 gallon (6.8 L) per minute maximum flow rate. Product shall meet CalGreen requirements for kitchen faucets. Product shall be Kohler Model K-____-____.

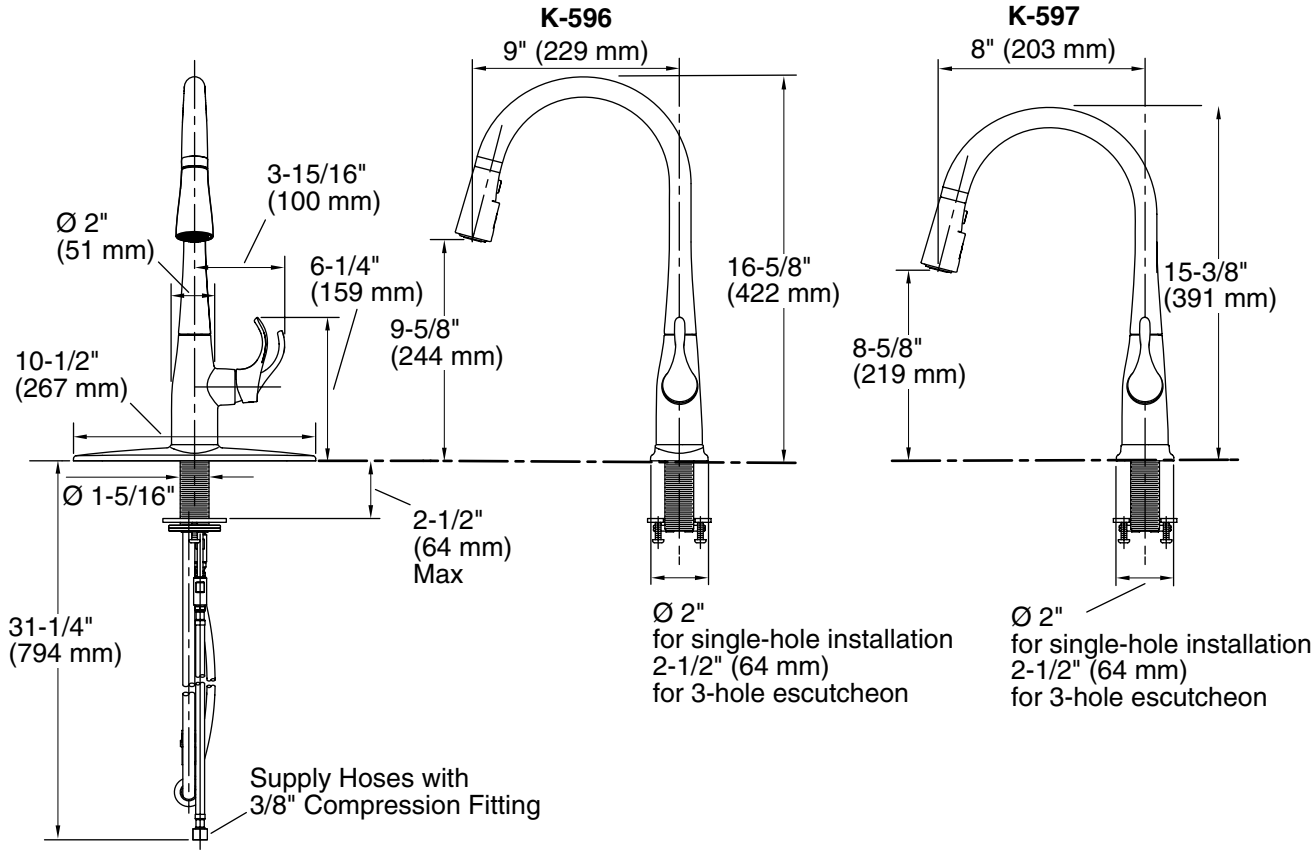
USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

Optional Accessories		
1012715	Deep roughing-in kit – provides an additional 2″ (51 mm) assembly depth	❑ NA
1167289	Low flow kit – reduces maximum flow to 1.5 gpm (5.7 L) at 60 psi (4.1 bar)	❑ NA
1167290	High flow kit – increases maximum flow to 2.2 gpm (8.3 L) at 60 psi (4.1 bar)	❑ NA

Installation Notes

Install this product according to the installation guide.

ADA, **CSA B651**, **OBC** compliant when installed to the specific requirements of these regulations.



Product Diagram

THE BOLD LOOK OF KOHLER®

KOHLER® FAUCETS

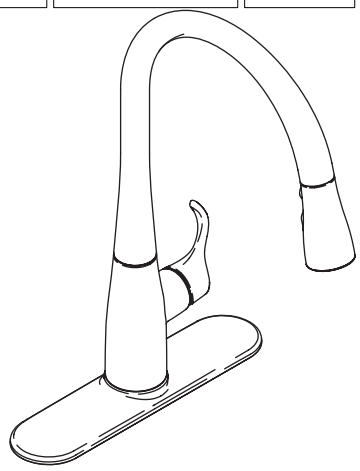
SIMPLICE®

PULL-DOWN KITCHEN SINK FAUCET

K-596

ALSO K-597

ADA | **CSA B651** | **OBC**



Features

- *Metal construction*
- *One-piece, self-contained ceramic disc valve allows both volume and temperature control*
- *Temperature memory allows faucet to be turned on and off at any temperature setting*
- *Touch control for stream-to-spray water flow*
- *Promotion™ technology with nylon hose and ball joint for easy operation*
- *Flexible connections for easy installation*
- *Three-function sprayhead with spray, aerated stream, and pause settings*
- *360° spout rotation*
- *For single-hole or three-hole installation when included 10-1/2″ (267 mm) escutcheon plate is used*
- *Meets CalGreen requirements for kitchen faucets*
- *1.8 gallons (6.8 L) per minute maximum flow rate at 60 psi (4.1 bar)*

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- *CSA B651*
- *OBC*
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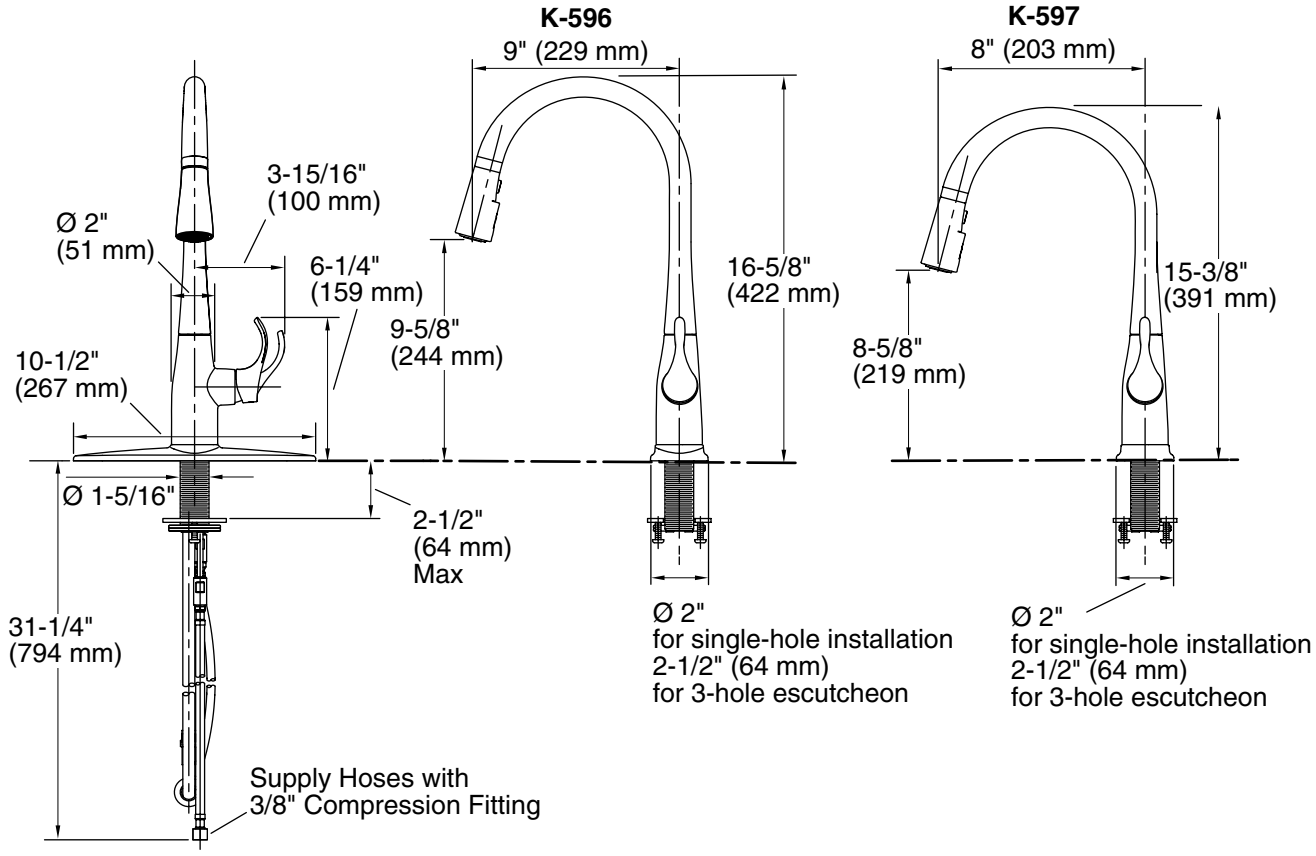


Product Diagram

THE BOLD LOOK OF KOHLER®

AMTROL INC.
Hydronic Technologies

THERM-X-TROL®

THERMAL EXPANSION ABSORBERS

The Best Solution for Controlling Thermal Expansion

As Seen On Ask This Old House

AMTROL INC.

THERM-X-TROL® Expansion Tanks

Table of Contents

What Is Thermal Expansion?

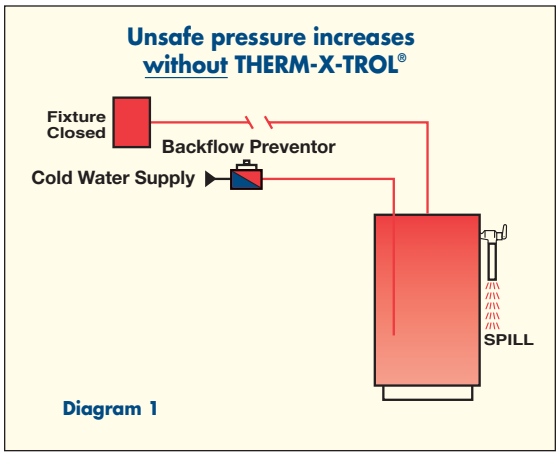
With modern plumbing codes mandating backflow prevention, thermal expansion can cause pressure buildup in domestic water systems. When demand is put upon a potable water system, hot water is drawn from the water heater. Cold water from the supply line enters the water heater to replenish it. The cold water is heated to replace the hot water used. With the installation of a backflow preventer, check valve or pressure reducing valve on the supply line, the water heater and the system piping form a closed plumbing system under pressure. As the water is heated, thermal expansion occurs. Pressure increases until the relief valve opens and the expanded water spills from the water heater. This spillage results in wasted energy and a potential safety hazard. (See Diagram 1)

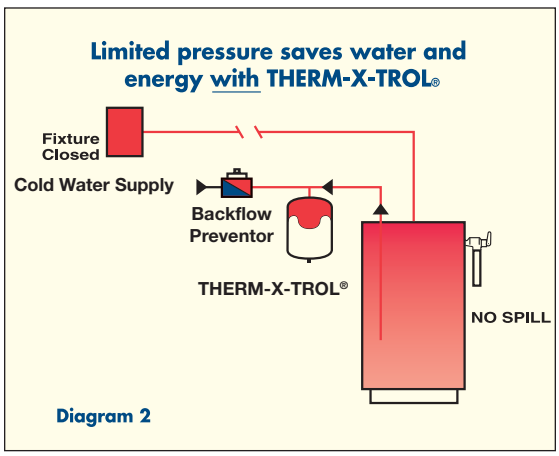
Closed Potable Hot Water System without THERM-X-TROL®

Backflow preventer, pressure reducing valve or other one-way device causes expanded (heated) water to build pressure causing the relief valve to open resulting in…

- Wasted energy
- Shortened water heater life
- Wasted municipal water and sewer dollars
- Potential safety hazard

The THERM-X-TROL® is designed to eliminate this problem by providing control of maximum pressures at a level below the relief valve setting. It also provides an additional space in the system to accommodate the increased volume of water created by thermal expansion, returning it to the system when hot water delivery is demanded. Maximum pressure is kept well below the relief valve setting by the THERM-X-TROL®, with its pre-charged air cushion that is separated from system water. The relief valve does not open, therefore spillage is eliminated (Diagram 2).





Closed Potable Hot Water System with THERM-X-TROL®

Expanded (heated) water is absorbed by THERM-X-TROL® which means…

- Water heater and fixtures are protected
- Eliminates energy and water waste, saving money
- No dangerous pressure build up in the system
- Relief valves will not open
- Potential safety hazard reduced

THERM-X-TROL®: The Market Leader

- #1 choice of Professional Installers
- Safest and most cost effective way to control Thermal Expansion
- Easy to install
- The innovator of Thermal Expansion Control in Closed Potable Hot Water Systems
- Broadest line of sizes and models
- Recognized Industry leader in Quality, Design, Manufacturing, Delivery and Service
- Extensive Network of Plumbing & Heating Distributors
- First to obtain NSF/ANSI 61, IAPMO, SBCCI & City of Los Angeles listings
- First to offer 5 year limited warranty

Product Features

High-grade connector

Deep Drawn Steel Domes for maximum strength & pressure rating

Rigid Polypropylene Liner for corrosion resistant reservoir

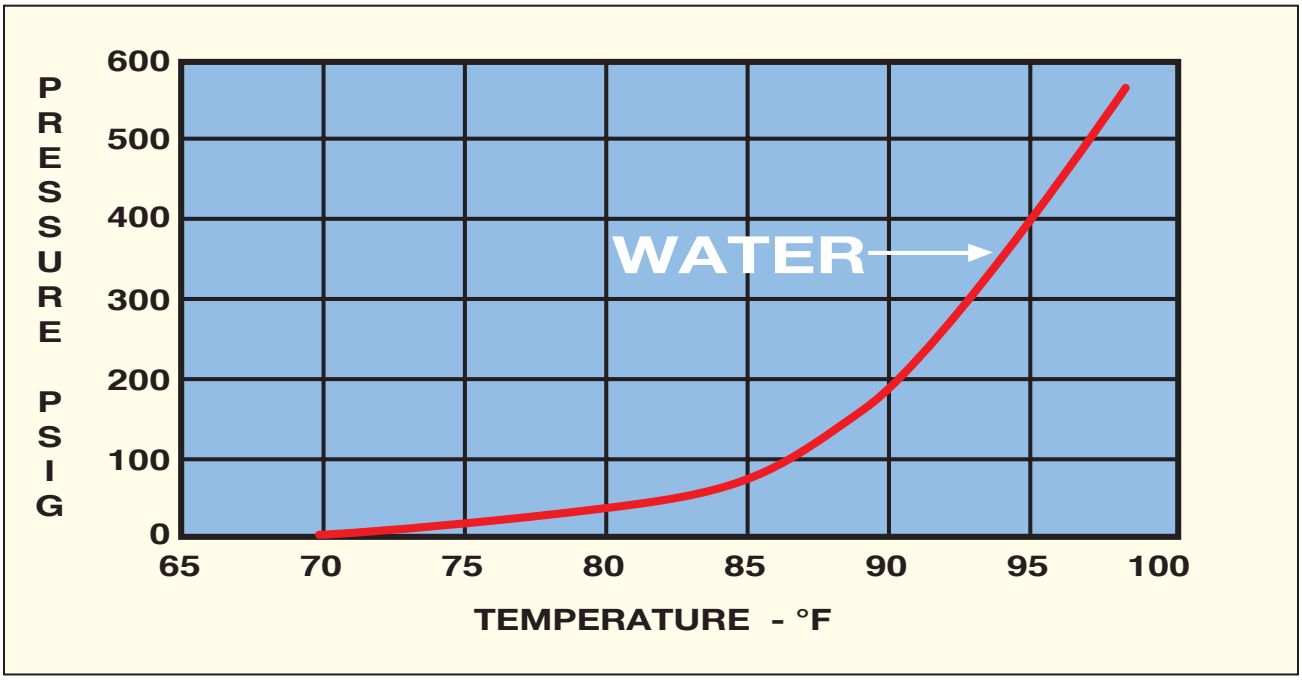
Butyl diaphragm for long life expectancy

Diaphragm Hoop Ring mechanically grooved for permanent air-tight seal

Welded Steel Construction

Welded Air Charge Fitting with protective plastic cap for corrosion resistance and maximum air-tight seal

Pressure Increase in Closed Piping System



Precise Sizing Procedure - For Special Applications

The procedure for sizing the Therm-X-Trol® for any application depends on four (4) vital pieces of information:

1. ASME or non-ASME requirement
2 Calculated thermally expanded water volume
3. Minimum water pressure experienced at the tank location
4. Maximum water pressure allowable at the tank location

The tank required for any application can be sized with the following equation:

Tv = Design Pressure Factor X expanded water

Where Tv is the total Thermal-X-Trol® volume required in gallons.

Example: A 240 gallon water heater with a 150°F aquastat setting is installed with a 125 psi maximum pressure requirement. For a static supply line pressure of 60 psi, what Therm-X-Trol® model is required for critical protection?

Critical Sizing AMTROL® Therm-X-Trol®
1. Total Water Heater Volume (Gallons)
2. Water Expansion Factor (Table I)
3. Calculate Expanded Water (Gallons) (Line 1 x Line 2)
4. Design Pressure Factor (Table II)
5. Therm-X-Trol Volume Required (Gallons) (Line 3 x Line 4)
6. Select Therm-X-Trol® Model (pg. 6 & 7)

Critical Sizing AMTROL® Therm-X-Trol®: *EXAMPLE*	
1. Total Water Heater Volume (Gallons)	240
2. Water Expansion Factor (Table I)	0.0179
3. Calculate Expanded Water (Gallons) (Line 1 x Line 2) = (240 x .0179)	4.3
4. Design Pressure Factor (Table II)	2.1
5. Therm-X-Trol Volume Required (Gallons) (Line 3 x Line 4) = (4.3 x 2.1)	9.0
6. Select Therm-X-Trol® Model (pg. 6 & 7)	ST-25V ST30V-C

Note: The Therm-X-Trol® air pressure should be equal to static line pressure.

For conditions not shown in table, use equation:

$$DPF = \frac{\text{Max. Allow. Pressure + 14.7}}{\text{Max. Allow. Pressure - Line Pressure}}$$

TABLE I Expansion Factor

Operating (Design) Temperature of Water Heater (Tank)	Expansion Factor* (Percentage of Water Volume Increase)	
100˚F	0.0062	0.6%
120˚F	0.0100	1.0%
130˚F	0.0124	1.2%
140˚F	0.0150	1.5%
150˚F	0.0179	1.8%
160˚F	0.0209	2.0%
170˚F	0.0242	2.4%
180˚F	0.0276	2.8%

** Based on the initial temperature of 40˚F*

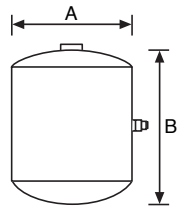
TABLE II Design Pressure Factor: DPF

Maximum Allowable Pressure	Line Pressure psi	Design Pressure Factor (DPF)
100	40	1.9
	50	2.3
	60	2.9
	70	3.8
	80	5.7
125	40	1.6
	50	1.9
	60	2.1
	70	2.5
	80	3.1
150	40	1.5
	50	1.6
	60	1.8
	70	2.1
	80	2.4

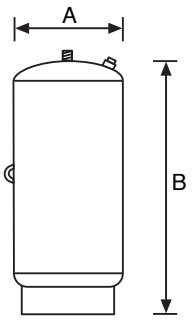
ASME THERM-X-TROL®

Code Applications

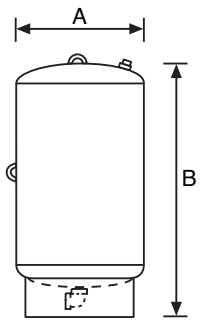
- Commercial Water Heaters
- Laundromats
- Hospitals and Nursing Homes
- Car Washes
- Dishwashers
- Plant Washrooms
- Hotels and Motels
- Restaurants
- Schools and Dormitories
- Other Applications as Required by Code



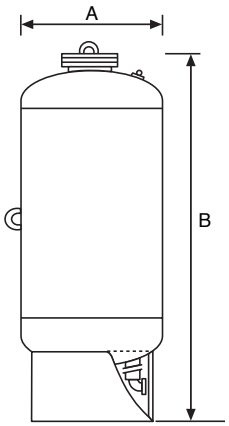
ST-5-C, ST-12-C



ST-20V-C to ST-70V-C



ST-80V-C to ST-210V-C



ST-447-C to ST-457-C

THERM-X-TROL® ASME Specifications

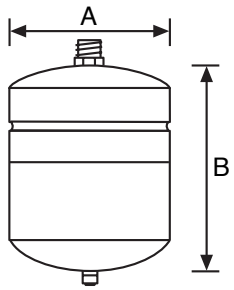
Model No.	Max. Working Pressure (PSIG)	Total Volume (Gals.)	Maximum Acceptance Factor	Diameter (A)	Height (B)	System Connection	Ship Weight (lbs)
ST-5-C	150	2.1	.42	10”	10 3/8”	3/4” NPT	21
ST-12-C	150	6.4	.50	12”	15 5/8”	3/4” NPT	26
ST-20V-C	150	8.0	.40	12”	19 1/2”	3/4” NPT	41
ST-30V-C	150	14.0	.64	16 1/4”	19 1/8”	3/4” NPT	84
ST-42V-C	150	17.5	.64	16 1/4”	24 1/4”	3/4” NPT	90
ST-60V-C	150	25.0	.45	16 1/4”	34”	3/4” NPT	96
ST-70V-C	150	34.0	.33	16 1/4”	45 3/4”	3/4” NPT	123
ST-80V-C	150	53.0	.64	24”	40 1/2”	1 1/4” NPT	229
ST-120V-C	150	66.0	.51	24”	47 3/4”	1 1/4” NPT	258
ST-180V-C	150	77.0	.44	24”	52 5/8”	1 1/4” NPT	288
ST-210V-C	150	90.0	.38	24”	60”	1 1/4” NPT	318
ST-447-C	125	53.0	.65	24”	45 1/4”	2” NPT	263
ST-448-C	125	80.0	.65	24”	59 1/8”	2” NPT	308
ST-449-C	125	106.0	.65	24”	73 1/8”	2” NPT	353
ST-450-C	125	132.0	.65	24”	86 5/8”	2” NPT	391
ST-451-C	125	158.0	.65	30”	73 1/4”	2” NPT	508
ST-452-C	125	211.0	.65	30”	91”	2” NPT	760
ST-453-C	125	264.0	.65	36”	85 5/8”	3” NPT	810
ST-454-C	125	317.0	.65	36”	98”	3” NPT	914
ST-455-C	125	370.0	.65	36”	110 3/8”	3” NPT	1,018
ST-456-C	125	422.0	.65	48”	81 7/8”	3” NPT	1,655
ST-457-C	125	528.0	.65	48”	97 1/4”	3” NPT	1,925

Maximum Allowable Working Temperature: ST-5-C through ST-210V-C: 200°F; ST-447-C through ST-457-C: 240°F Standard Factory Precharge: 55 PSIG.

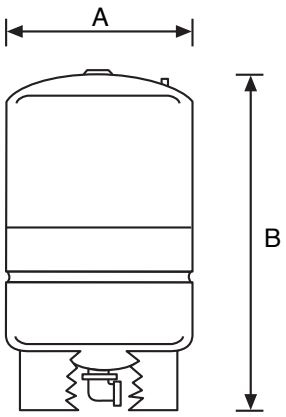
Non-ASME THERM-X-TROL®

General Usage

- Residential Water Heaters
- Office Buildings
- Apartment Buildings
- Dormitories
- Elderly Housing
- Extended Care Facilities
- Condominiums/Multiple Residential
- Food Service
- Laundromats
- Hospitals
- Other General-Use Hot Water Systems



ST-5, ST-8, ST-12



ST-25V through ST-210V

THERM-X-TROL® Non-ASME Specifications

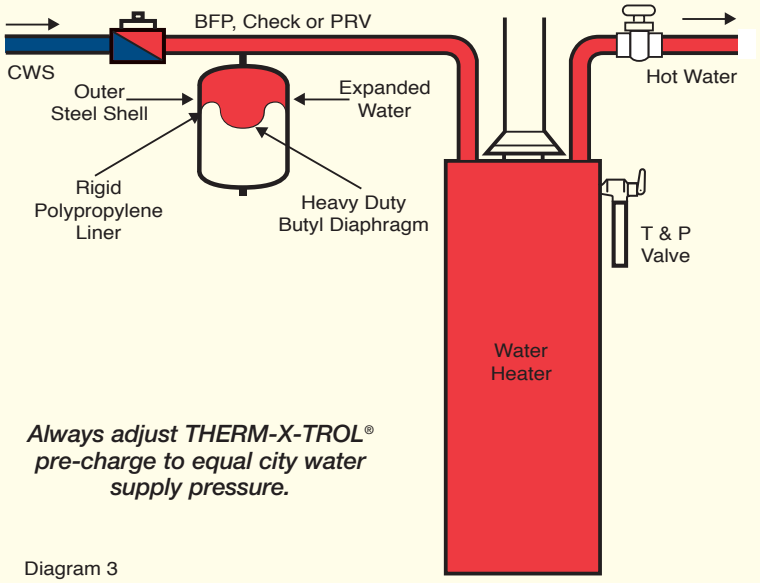
Model No.	Total Volume (Gals.)	Maximum Acceptance Factor	Diameter (A)	Height (B)	System Connection	Ship Weight (lbs)
ST-5	2.0	.45	8”	12 5/8”	3/4” NPT	5
ST-8	3.2	.45	9”	15”	3/4” NPT	7
ST-12	4.4	.55	11”	15”	3/4” NPT	9
ST-25V	10.3	1.0	15 3/8”	19 1/4”	3/4” NPT	23
ST-30V	14.0	.81	15 3/8”	23 7/8”	3/4” NPT	25
ST-42V	20.0	.57	15 3/8”	31 5/8”	3/4” NPT	33
ST-60V	34.0	.35	22”	29 5/8”	1 1/4” NPT	61
ST-80V	44.0	.77	22”	36”	1 1/4” NPT	69
ST-180V	62.0	.55	22”	46 3/4”	1 1/4” NPT	92
ST-200V	81.0	.41	22”	56 3/8”	1 1/4” NPT	103
ST-210V	86.0	.54	26”	47 1/4”	1 1/4” NPT	123
ST-451	158.0	.65	73 1/4”	30”	2” NPT	508
ST-452	211.0	.65	91”	30”	2” NPT	760
ST-453	264.0	.65	85 5/8”	36”	3” NPT	810
ST-454	317.0	.65	98”	36”	3” NPT	914
ST-455	370.0	.65	110 3/8”	36”	3” NPT	1,018
ST-456	422.0	.65	81 7/8”	48”	3” NPT	1,655
ST-457	528.0	.65	97 1/4”	48”	3” NPT	1,925

Maximum Working Pressure: 150 PSI. All Models listed by NSF 61 (excluding ST-451 – ST-457); Maximum Allowable Working Temperature: ST-5 through ST-210V: 200°F; ST-451 through ST-457: 240°F; Standard Factory Precharge: 40 PSIG (ST-5 – ST-210V); 55 PSIG (ST-451 – ST-457)

THERM-X-TROL®

THERM-X-TROL®

The THERM-X-TROL® from AMTROL is designed to protect domestic water heaters from the effects of thermal expansion. Installation is easy; just tee it into the cold water inlet (before the water heater) as shown in Diagram 3.



Always adjust THERM-X-TROL® pre-charge to equal city water supply pressure.

Diagram 3

If your Plumbing Code requires a Backflow Preventer,Check Valve or Pressure Reducing Valve... You Need a THERM-X-TROL® on Every Job!

THERM-X-TROL® Quick-Sizing Chart

Sizing Charts are based on 40°F incoming water temperature and a 150 psi T & P safety relief valve.

Water Heater* Size (gals.)	Static Supply Pressure (psi)**		
	40	60	80
40	ST-5	ST-5	ST-5
50	ST-5	ST-5	ST-5
60	ST-5	ST-5	ST-8
80	ST-8	ST-8	ST-12
120	ST-12	ST-12	ST-25V

Max. Temp. Setting 140°F

Water Heater* Size (gals.)	Static Supply Pressure (psi)**		
	40	60	80
40	ST-5	ST-5	ST-5
50	ST-5	ST-5	ST-8
60	ST-8	ST-8	ST-8
80	ST-8	ST-8	ST-12
120	ST-12	ST-12	ST-25V

Max. Temp. Setting 150°F

Water Heater* Size (gals.)	Static Supply Pressure (psi)**		
	40	60	80
40	ST-8	ST-8	ST-8
50	ST-8	ST-8	ST-12
60	ST-8	ST-12	ST-25V
80	ST-12	ST-25V	ST-25V
120	ST-25V	ST-25V	ST-25V

Max. Temp. Setting 180°F

* For multiple heater, use the total volume of the heaters plus any storage tanks.

** Therm-X-Trol Precharge must be set to equal Static Supply Pressure prior to installation.

AMTROL INC.

w w w . a m t r o l . c o m

Corporate Headquarters

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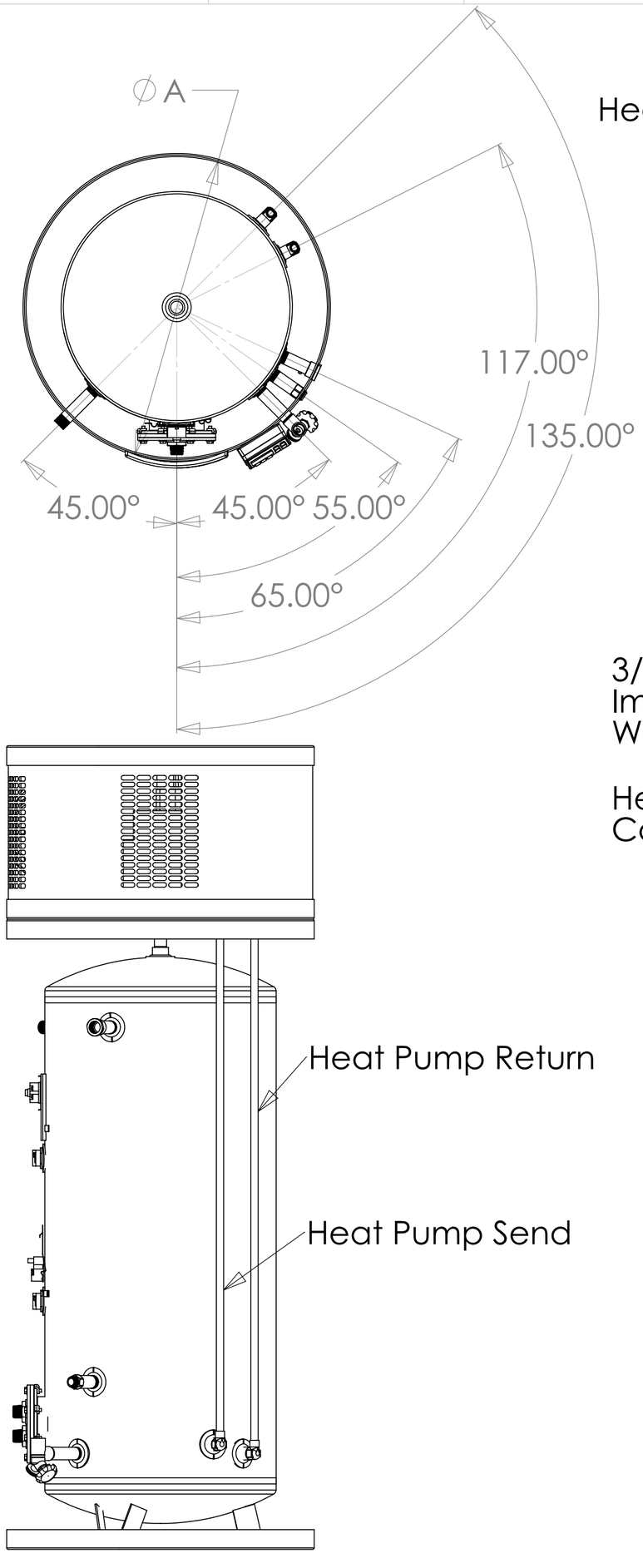
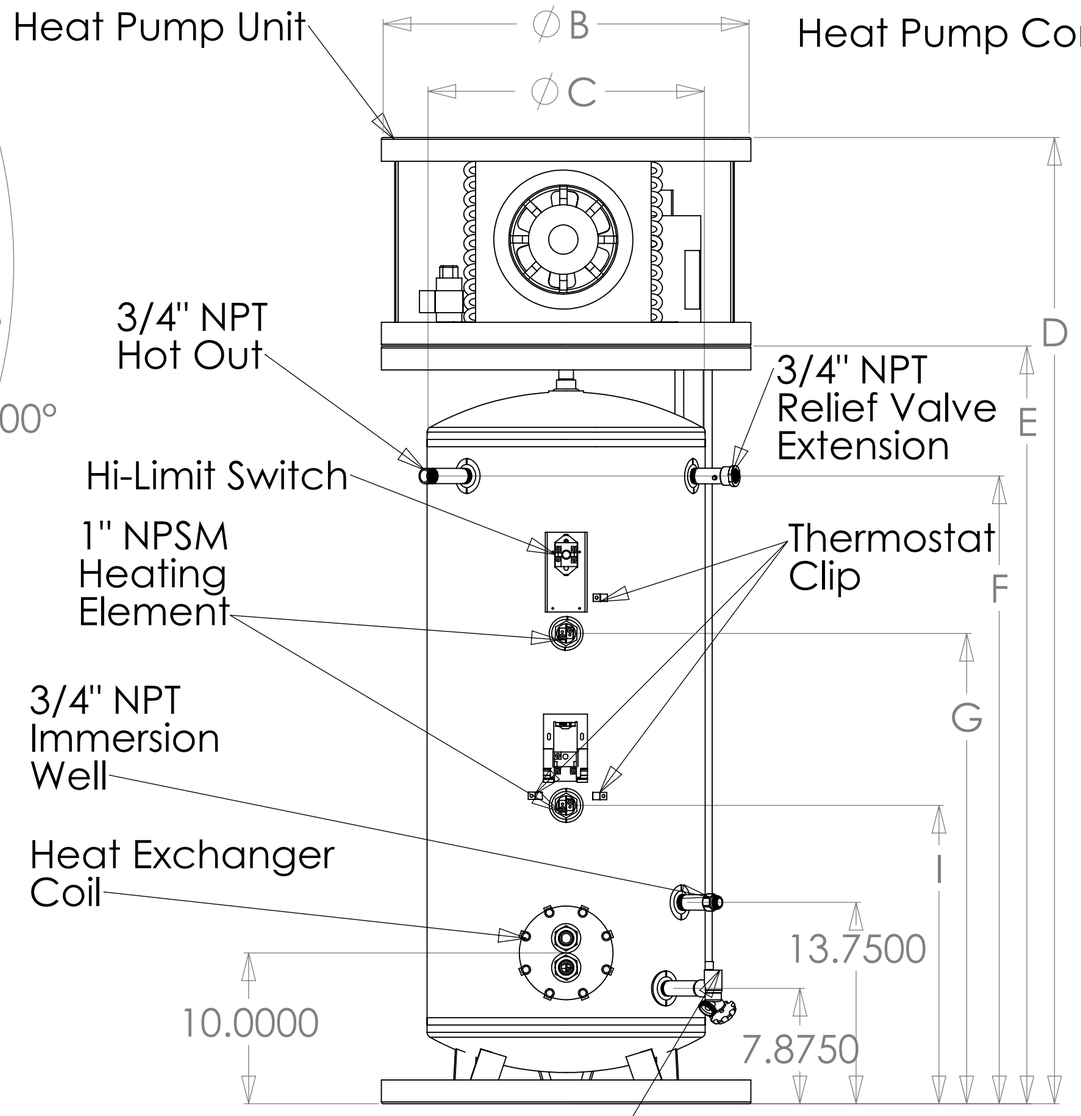
Telephone: 401-884-6300 • Fax: 401-884-5276

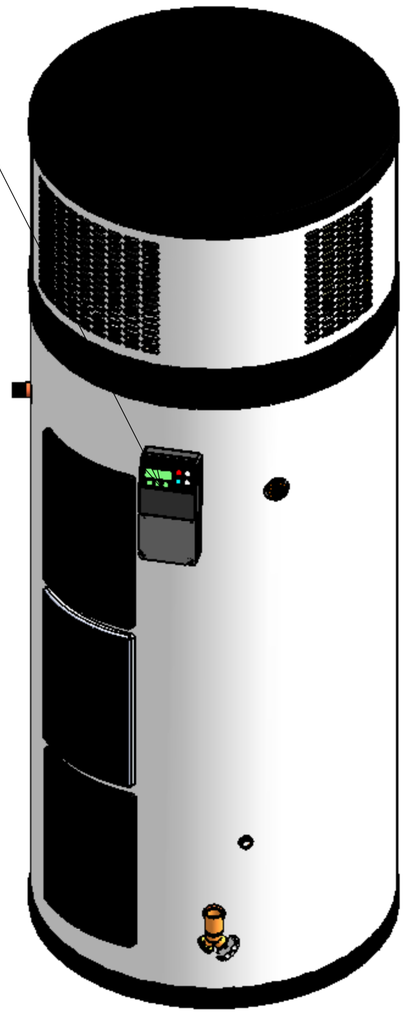
AMTROL Canada, Ltd.
275 Shoemaker Street, Kitchener, Ontario N2E 3B3
Telephone: 519-478-1138 • Fax: 519-748-4231

NSF/ANSI 61

MC# 4090 (06/09)







Tank Size	A	B	C	D	E	F	G	I
40UC	28	28	22	49	34.75	25.375	20.125	N/A
50	25	25	19	66	51.75	42.875	32.125	N/A
65	28	28	22	63	48.5	39.375	32.125	N/A
80	28	28	22	73.5	59	49.875	40.625	N/A
120	30	28	24	84	69.5	60.375	47.875	28.75

NEXT ASSY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	EP	
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

Vaughn Manufacturing

TITLE:
Tank Assembly SRHPT

SIZE C | DWG. NO. | REV

SCALE: 1:12

Quiet, Reliable Inline Circulators for Heating/Cooling & Pumping Systems

- Maintenance-free
- Easily handles dirty water conditions
- Rugged, compact design
- 25% more efficient than competition
- Close-coupled dry motor

LOW LEAD CONTENT†

Series PL™

A SUPERIOR ALTERNATIVE TO WET ROTOR PUMPS

A-142D

Bell & Gossett
a xylem brand

SERIES PL™

A Superior Alternative to Wet Rotor Pumps

Description

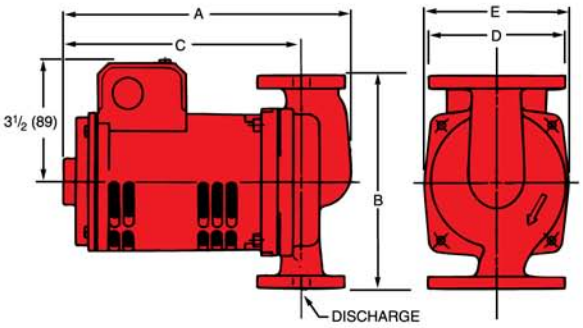
The Series PL™ close coupled booster pumps are specifically designed for quiet operation in hydronic, radiant and geothermal heating and cooling systems. These inline permanently lubricated pumps are available in cast iron or lead-free† bronze body construction.

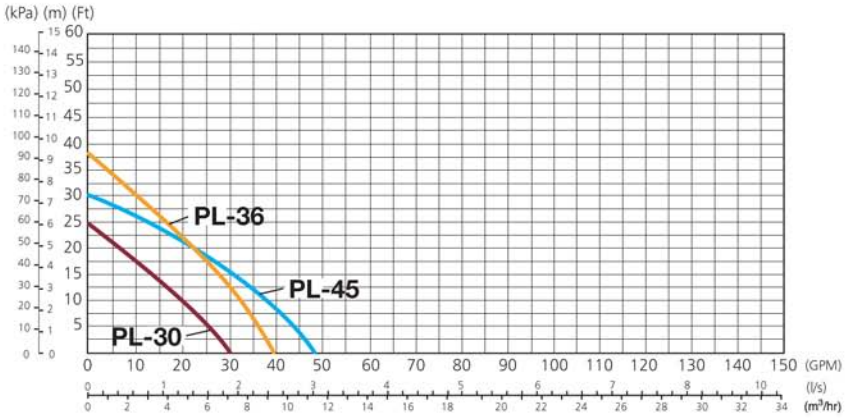
Operating Data

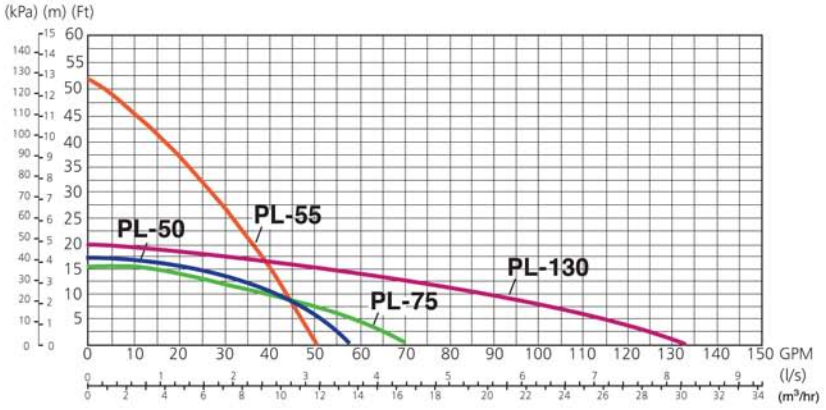
Maximum working pressure . . . . . .150 psi (10 bar)
Maximum operating temperature . . . . . 225°F (107°C)

Materials of Construction

Pump Body . . . . . Cast Iron or Lead-Free† Bronze
Face Plate . . . . . Stainless Steel
Impeller . . . . . 30% Glass Filled Noryl®
PL-55 & PL-130. . . Glass Filled PPS
Shaft . . . . . Solid High-Strength Alloy Steel
Seal System . . . . . Carbon/Silicon Carbide
Bearings . . . . . XL11™ Permanently Lubricated Sealed Precision Bearings
Motor Type . . . . . ODP







Dimension & Weights

Cast Iron		Lead-Free† Bronze		Flange Size	Motor Characteristics*				Dimensions in inches (mm) @ 60 Hz (Open Drip-Proof)					Approx. Shipg. Wt. lbs. (Kg)
Model No.	Part No.	Model No.	Part No.	Inches - NPT	HP	ø	Voltage	RPM	A	B	C	D	E	
PL-30	1BL012	PL-30B	1BL013LF	3/4 1 & 1 1/4 1 1/2	1/12	1	115	2650	8 5/8 (219)	6 3/8 (162)	7 1/8 (181)	4 3/16 (106)	4 3/8 (111)	11.6 (5.3)
PL-36	1BL001	PL-36B	1BL003LF	3/4 1 & 1 1/4 1 1/2	1/6			3300	8 5/8 (219)	6 3/8 (162)	7 1/8 (181)	4 3/16 (106)	4 3/8 (111)	13.1 (6.0)
PL-45	1BL002	PL-45B	1BL004LF	1 1 1/4 & 1 1/2	1/6			3300	9 1/8 (232)	8 1/2 (216)	7 1/4 (184)	4 5/8 (117)	4 3/8 (111)	14.5 (6.6)
PL-50	1BL016	PL-50B	1BL017LF	1 1 1/4 & 1 1/2	1/6			3300	9 1/8 (232)	8 1/2 (216)	7 1/4 (184)	4 5/8 (117)	4 3/8 (111)	14.5 (6.6)
PL-55	1BL032	PL-55B	1BL068LF 1BL069LF	3/4 1 & 1 1/4 1 1/2	2/5			3250	9 9/16 (243)	6 3/8 (162)	7 15/16 (202)	4 3/16 (106)	4 3/4 (121)	13.1 (6.0)
PL-75	1BL034	PL-75B	1BL035LF	2	1/6			3400	915/16 (252)	8 1/2 (216)	7 3/8 (187)	5 3/16 (132)	4 5/8 (117)	18.5 (8.4)
PL-130	1BL063	PL-130B	1BL065LF	2	2/5			3200	10 3/4 (273)	8 1/2 (216)	8 1/4 (210)	5 3/16 (132)	5 1/8 (130)	22 (10)

* 230/60/1 motors available upon request. Models PL-75 and PL-130 have a four bolt hole flange connection, all others have two bolt hole flange connectors.
Dimensions are approximate and subject to changes. Contact factory for certified dimensions.

† Contains less than 0.25% lead content by weight on wetted surfaces.

xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue
Morton Grove, Illinois 60053
Phone: (847) 966-3700
Fax: (847) 965-8379
www.xyleminc.com/brands/bellgossett

JAMES M PLEASANTS CO RO

February 12, 2013

Proposal No: CR13-02-12 01
Item No: ITEM 001
Job:

Series: e-SV Size: 1SV QTY: 1 Stage No: 3

Operating conditions

SERVICE	
LIQUID	
CAPACITY	7.0 gpm
HEAD	70.0 (ft)

Performance at 3500 RPM

PUBLISHED EFFY	48.4% (CDS)
RATED EFFY	48.4%
RATED POWER	0.30 hp (Run out 0.3 hp)
NPSHR	2.9 ft
DISCHARGE PRESSURE	34.0 psi g (35.9 psi g @ Shut off) Based on 0.0 psi g Suc.press
PERF. CURVE	1SV-3600-0
SHUT OFF HEAD	82.9 ft

Quoted Features

CONSTRUCTION	CI-304
MECHANICAL SEAL	Carbon/Silicon Carbide/Viton

Driver : Electric motor Manufacturer : Factory Choice

FURNISHED BY	Pump Mfg	MOUNTED BY	Pump Mfg
RATING	0.50 hp (0.4 KW)	ENCLOSURE	TEFC
PHASE/FREQ/VOLTS	1/60 Hz/115/208-230	SPEED	3600 RPM
INSULATION/SF		FRAME	56C
MOTOR PART NO	V04722		

Program Version 1.39.0.0

Submittal Data

Multi-Stage Pumps

MODEL : 1SV3GA3J20

Hydraulic Data					Motor Data	e-SV Vertical Model	Qty.
Maximum Flow	Flow at Duty Point	Maximum TDH	TDH at Duty Point	NPSHR	Voltage/Phase/Enclosure		
12.3 gpm	7.0 gpm	82.9 ft	70.0 ft	2.9 ft	115/208-230V 1 PH TEFC	1SV3GA3J20	1

Submittal Prepared for: JAMES M PLEASANTS CO RO
Job:
Proposal No: CR13-02-12 01
Engineer:
Contractor:
Item No: ITEM 001
Submittal Prepared by: Chad Roberts
Company:
Date: February 12, 2013
Submittal Date: February 12, 2013
Approved by:

Engineering Data

Pump Code: 1SV3GA3J20
Pump Size: 1SV
Stage No: 3
Pump Horsepower at Rating Point: 0.30 hp
Pump Shut Off Head: 82.9 ft
Efficiency: 48.4 %
Motor Speed: 3600
System Input Power: 1 / 115/208-230 V
Motor Rated Horsepower: 0.50 hp
Max.Frequency: 60Hz
Frame Size: 56C
Motor Part No: V04722
Discharge Size: 1.25 in
Impeller Construction: CI-304
Impeller Type: Radial Impeller
Shaft Seal: Carbon/Silicon Carbide/Viton

Standard Equipment / Capability:

PUMP

The e-SV pump is a non-self priming vertical multistage pump coupled to a standard motor.The liquid end, located between the upper cover and the pump casing, is held in place bytie rods. The pump casing is available with different configurations and connection types.

- Delivery: up to 700.0 gpm/ Head: up to 1200. ft
- Temperature of pumped liquid: -20.0 deg F to 250.0 deg F standard version
- Direction of rotation: clockwise looking at the pump from the top down (marked with an arrow on the adapter and on the coupling).

MOTOR

- Standard NEMA 56C Frame motor totally enclosed fan cooled
- 3600 RPM nominal
- Single phase version,2 pole: 115/208-230 V,60Hz,0.50 hp
- G-Cast Iron/304SS AISI Round Flange with 500.0 psi g MAWP
- Reduced axial thrusts enable the use of standard NEMA TC motors that are easily found in the market
- Seal housing chamber designed to prevent the accumulation of air in the critical area next to the mechanical seal
- Mechanical seal according to EN 12756 (ex DIN 24960) and ISO 3069
- Versions with ANSI flanges that can be coupled to ANSI counter-flanges
- Threaded oval counter-flanges made of stainless steel are standard supply for the T versions
- Easy maintenance. No special tools required for assembly or disassembly
- Standard version for temperatures ranging from: 0 deg F to 250 deg F (optional to 300 deg F)

Unit Dimensions

Multi-Stage Pumps

MODEL : 1SV3GA3J20

Hydraulic Data					Motor Data	e-SV Vertical Model	Qty.
Maximum Flow	Flow at Duty Point	Maximum TDH	TDH at Duty Point	NPSHR	Voltage/Phase/Enclosure		
12.3 gpm	7.0 gpm	82.9 ft	70.0 ft	2.9 ft	115/208-230V 1 PH TEFC	1SV3GA3J20	1

Submittal Prepared for: JAMES M PLEASANTS CO RO
Job:
Proposal No: CR13-02-12 01
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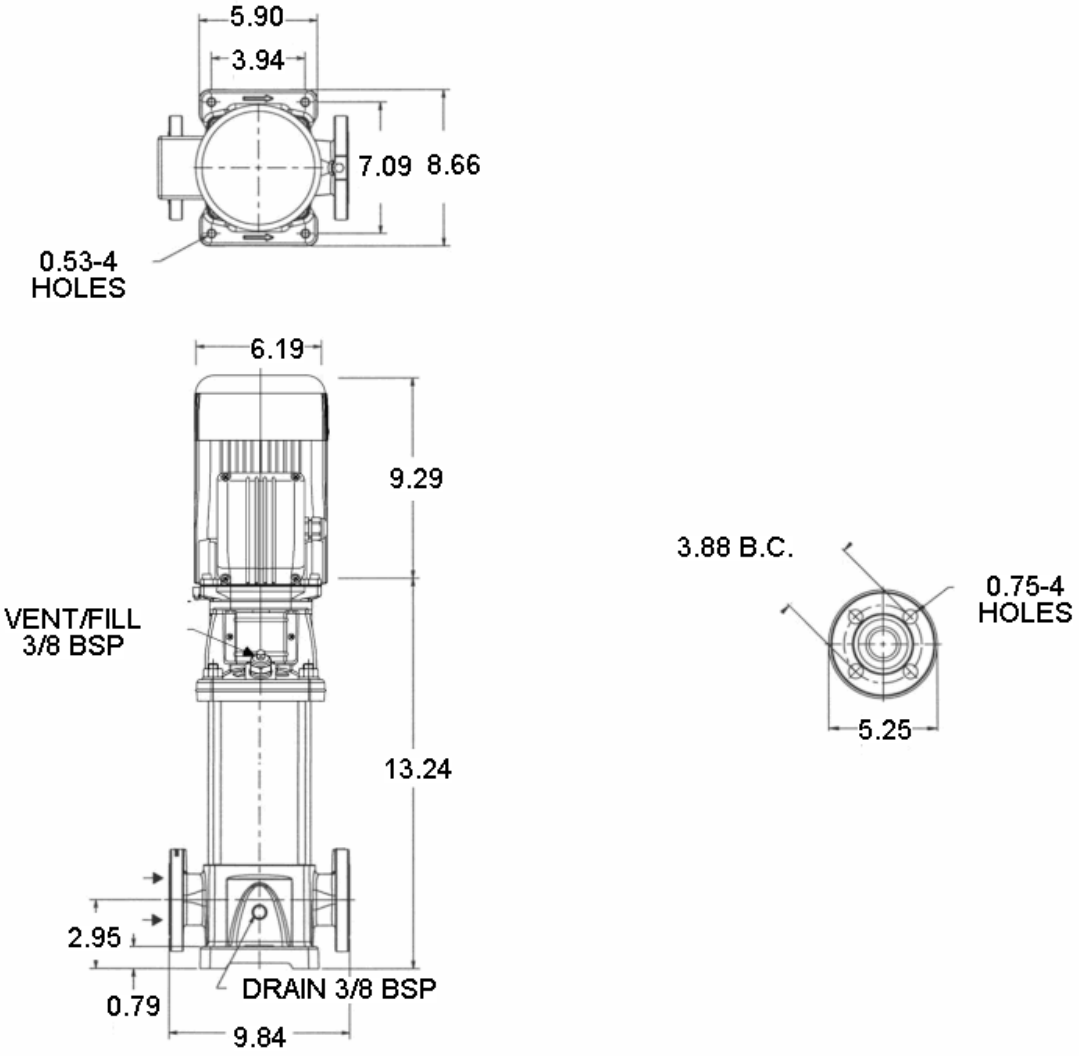

• Dimensions are subject to change. Not to be used for construction purposes unless certified

Performance Data

Multi-Stage Pumps

MODEL: 1SV3GA3J20

Hydraulic Data					Motor Data	e-SV Vertical Model	Qty.
Maximum Flow	Flow at Duty Point	Maximum TDH	TDH at Duty Point	NPSHR	Voltage/Phase/Enclosure		
12.3 gpm	7.0 gpm	82.9 ft	70.0 ft	2.9 ft	115/208-230V 1 PH TEFC	1SV3GA3J20	1

Submittal Prepared for: JAMES M PLEASANTS CO RO
Job:
Proposal No: CR13-02-12 01

Engineer:
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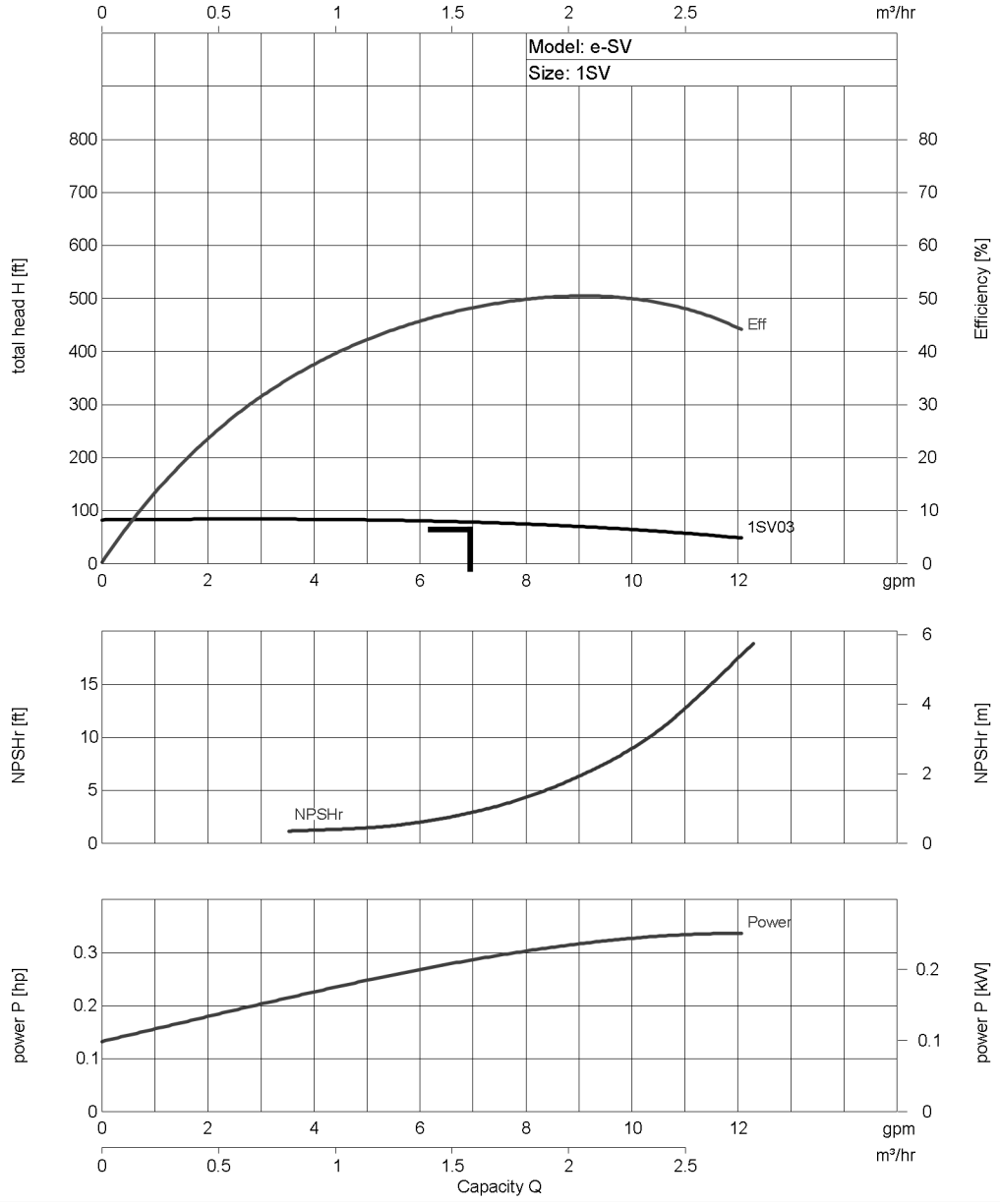

Performance Data

Multi-Stage Pumps

MODEL: 1SV3GA3J20

Hydraulic Data					Motor Data	e-SV Vertical Model	Qty.
Maximum Flow	Flow at Duty Point	Maximum TDH	TDH at Duty Point	NPSHR	Voltage/Phase/Enclosure		
12.3 gpm	7.0 gpm	82.9 ft	70.0 ft	2.9 ft	115/208-230V 1 PH TEFC	1SV3GA3J20	1

Submittal Prepared for: JAMES M PLEASANTS CO RO
Job:
Proposal No: CR13-02-12 01

Engineer:
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Submittal Prepared by: Chad Roberts
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Date: February 12, 2013

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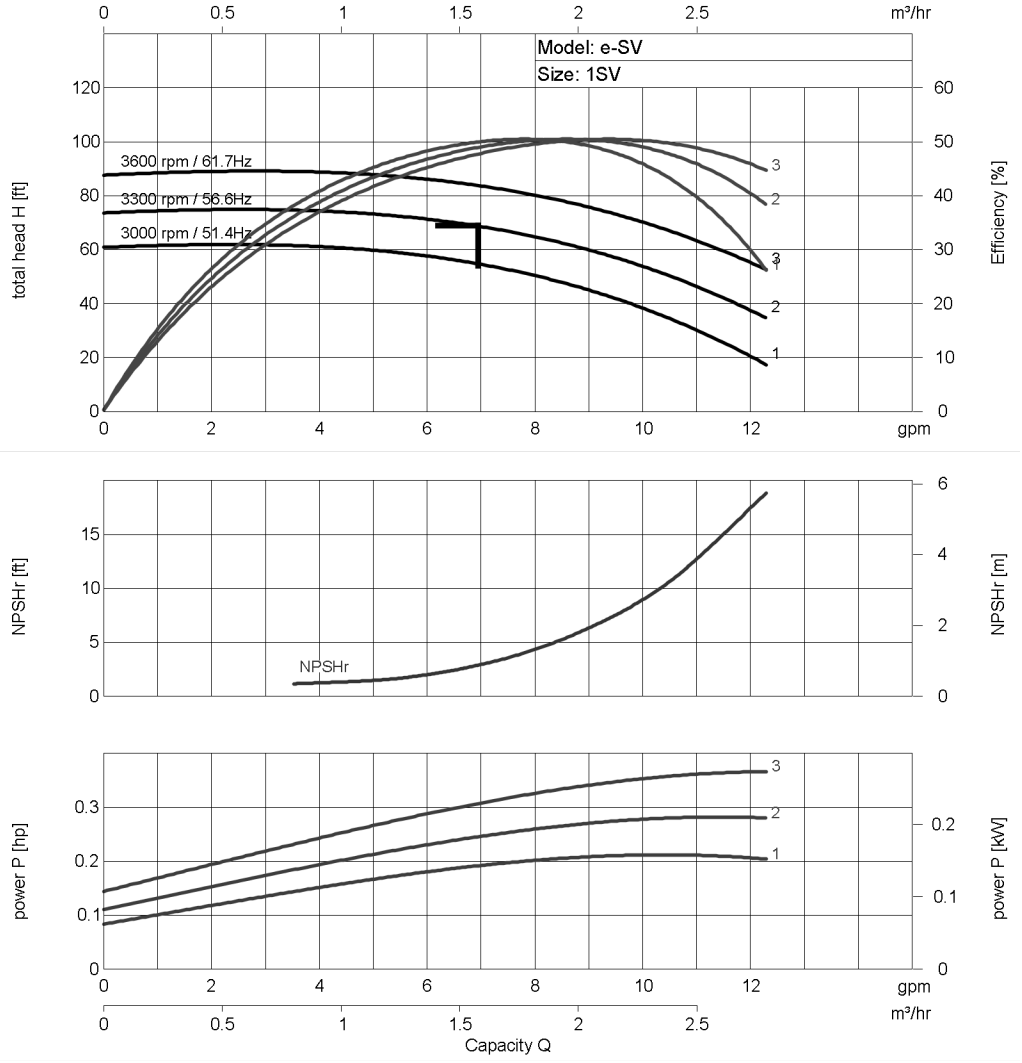
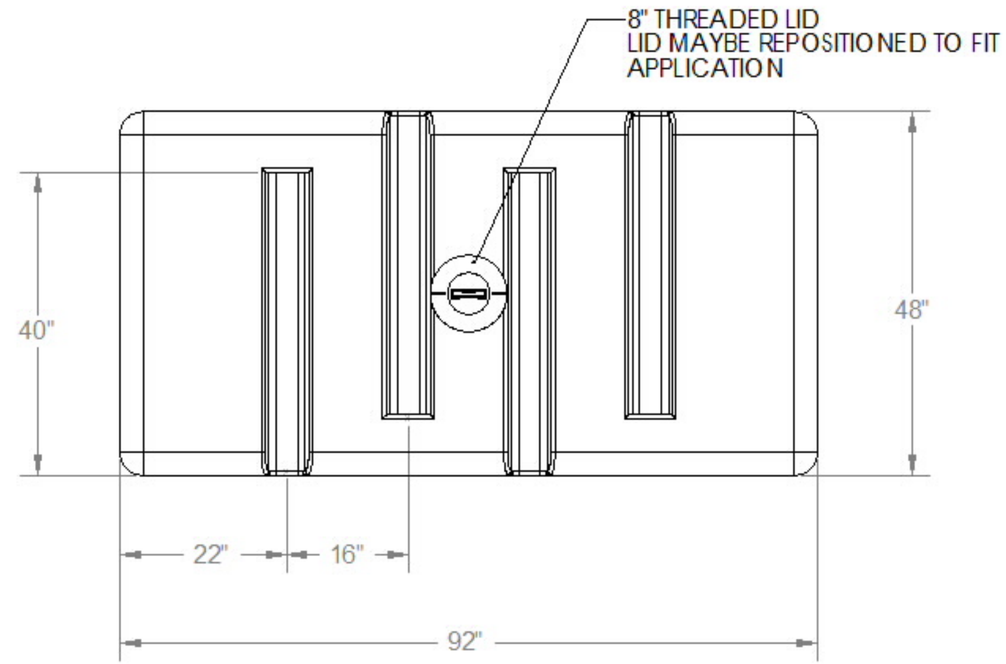
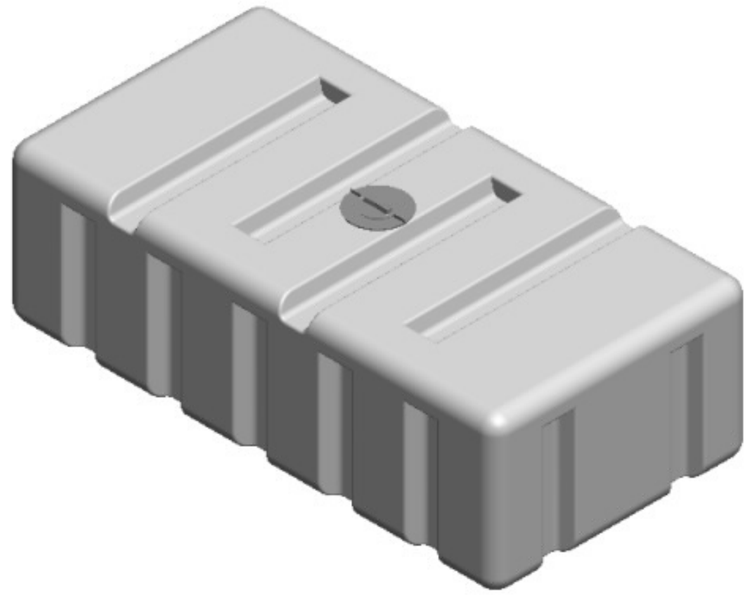
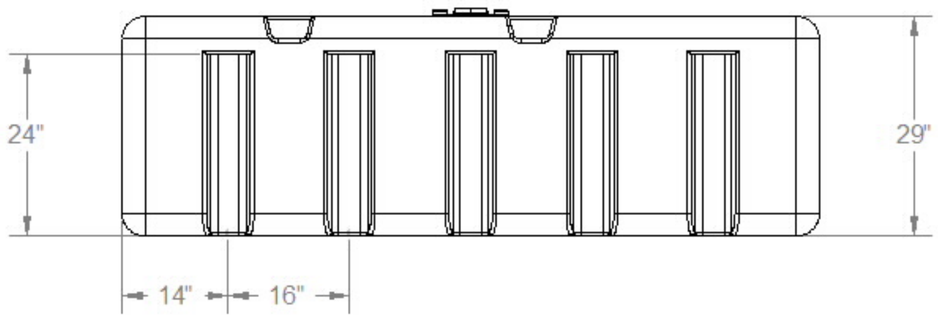
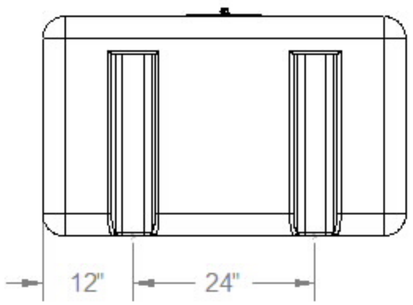










NOTES:

1. MATERIAL: POLYETHYLENE
2. CAPACITY: 500 GALLONS
3. WEIGHT: 185 LBS.

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	EBW	9-25-09
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

GOTO PLASTICS

TITLE:
500 GALLON RECTANGULAR TANK

SIZE	DWG. NO.	REV
B	500 RT	

SCALE: 1:20 WEIGHT: SHEET 1 OF 1

WELL-X-TROL® Professional by AMTROL®

As Seen On

Ask This Old House

WELL-X-TROL® Professional Pre-Pressurized **Water System Tanks**

Well-X-Trol® Professional revolutionized the industry

Well-X-Trol® redefined the industry in 1963 with the first pre-pressurized diaphragm well tank; featuring innovation elements like a sealed air charge and corrosion-proof water reservoir. With proven performance for nearly five decades, Well-X-Trol Professional remains the industry's most trusted brand, continuing to deliver unparalleled reliability. Well-X-Trol Professional offers unique design features that provide consistent performance while promoting pump longevity and reduced energy use.

Features and Benefits

Exclusive butyl diaphragm, along with the 100% corrosion-proof virgin polypropylene liner, are secured by a positive hoop ring seal for added strength and reliability. This totally integrated system outperforms other types of water chamber designs. The plated steel air valve is welded rather than threaded to prevent loss of air pressure. The finest quality, custom mill steel is used in the deep drawn dome for extra strength while keeping tank weight to a minimum.

More choices mean more flexibility

Well-X-Trol Professional offers more options and sizes than any other well tank manufacturer, including both vertical and horizontal designs, and sizes ranging from 2 gallons to 119 gallons so you can configure a system that's right for any application.

First in Industry Safety Standards

Well-X-Trol Professional tanks were the first to meet all industry standards for quality and safety. The butyl diaphragm in all models meets EPA requirements for potable water as defined in the Safe Drinking Water Act of 1986. All parts, including the polypropylene liner, butyl diaphragm, and stainless acceptance fittings are listed by NSF® International Standard 61.

Advanced design features continue to set industry standards

- Welded air valve is permanently attached rather than mechanically threaded to prevent loss of air pressure and to minimize stress on the well's pump system. It also carries a tamper-evident warning label.
- Deep-drawn steel domes offer twice the strength of rolled steel while minimizing weight.
- Unique positive hoop ring seal secures diaphragm and liner for added strength and reliability.
- Heavy duty butyl diaphragm is the thickest in the industry and features seamless construction for uniform strength and flexibility. It conforms exactly to the shell configuration without stretching, creasing, or forming bubbles or corners that could trap water or sediment. Butyl is the best known elastomer to prevent air loss.
- Heavy duty butyl diaphragm is extremely resistant to bacterial growth and meets FDA requirements for potable water supply.
- Polypropylene liner provides a 100% corrosion resistant, non-metallic rigid water reservoir that is listed by NSF® International Standard 61.
- Stainless-steel system connection withstands aggressive water.
- Exclusive welding process eliminates interior rough spots and sharp edges that can damage the diaphragm and liner.
- Each finished tank is pressure tested for safety.
- Each finished tank is pre-pressurized to the most common pump cut-in pressure.
- Exterior appliance-like finish looks attractive while protecting the tank from the elements.

Dome


Hoop


Diaphragm


Liner


Dome

Stainless-steel System Connection


Stand

esp (Effective System Protection): maximum system output with minimal pump starts

The ESP sizing procedure covers modern residential water-use habits, increased off-peak demands and the general increase in water use that have occurred over the past twenty-five years.

ESP sizing is designed to reduce pump wear and tear, and reduce energy consumption by keeping pump starts to a minimum.

Choose the amount of protection you need.

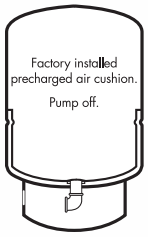
ESP I: Tank selection is based on approximately one minute minimum pump running time. This is recommended for pumps up to 3/4 H.P.

ESP II: Tank selection is based on approximately two minute minimum pump running time. This is recommended for 3/4 H.P. or larger pumps.

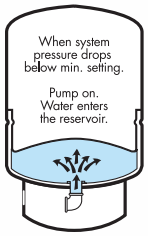
ESP Sizing Table

PUMP DISCHARGE RATE GPM (Approx.)	PRESSURE SWITCH OPERATING RANGE - PSIG					
	ESP I			ESP II		
	20/40	30/50	40/60	20/40	30/50	40/60
5	WX-202	WX-202	WX-202	WX-203	WX-205	WX-205
7	WX-202	WX-202XL	WX-203	WX-205	WX-250	WX-251
10	WX-203	WX-205	WX-205	WX-251	WX-251	WX-255
12	WX-205	WX-250	WX-250	WX-251	WX-255	WX-255
15	WX-250	WX-250	WX-251	WX-255	WX-302	WX-350
20	WX-251	WX-251	WX-255	WX-350	WX-350	(2) WX-255
25	WX-251	WX-255	WX-302	(2) WX-251	(2) WX-255	(2) WX-302
30	WX-255	WX-302	WX-350	(2) WX-255	(2) WX-302	(2) WX-350
35	WX-302	WX-350	WX-350	(2) WX-302	(2) WX-350	(2) WX-350
40	WX-350	WX-350	(2) WX-255	(2) WX-350	(2) WX-350	(3) WX-302

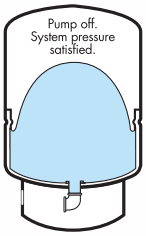
Well-X-Trol® Professional
tank operation
time tested design



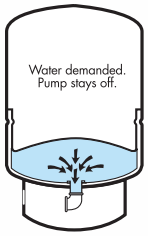
Well-X-Trol Professional has a sealed in air chamber that is pre-pressurized before it leaves our factory. Air and water do not mix.



When the pump starts, water enters the Well-X-Trol Professional. Only usable water is stored.



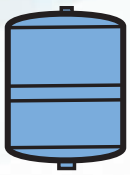
When the pressure in the chamber reaches cut-out pressure, the pump stops. The Well-X-Trol Professional is filled.



When water is demanded, pressure in the air chamber forces water into the system. Since Well-X-Trol Professional consistently delivers the maximum usable water, minimum pump starts are assured.

Well-X-Trol® Professional residential models

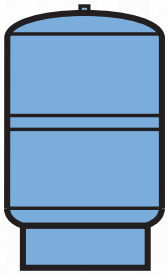
In-Line Models



Model No.	Dimensions Diameter (ins)	Dimensions Height (ins)	Total Volume (gals)	Max. Accept. Factor	System Drawdown 20/40 (gals)	System Drawdown 30/50 (gals)	System Drawdown 40/60 (gals)	Shipping Wt. (Vol.) lbs (cu ft)
WX-101	8	12 5/8	2.0	0.45	.8	.7	.6	5 (0.6)
WX-102	11	15	4.4	0.55	1.8	1.5	1.3	9 (1.2)
WX-103	11	22 1/4	7.6	0.42	3.1	2.6	2.2	15 (1.8)
WX-104	15 3/8	17 3/4	10.3	1.00	4.1	3.5	3.0	20 (2.6)
WX-200	15 3/8	22	14.0	0.81	5.6	4.8	4.1	22 (3.3)

Precharge Pressure for WX-101 & WX-102 is 18 PSIG and Sys. Conn. is 3/4" NPTM.
Precharge Pressure for WX-103 is 28 PSIG and Sys. Conn. is 3/4" NPTM.
Precharge Pressure for WX-104 and WX-200 is 38 PSIG and Sys. Conn. is 1" NPTM.
Maximum Working Pressure is 125 PSIG and Maximum Working Temperature is 200° F.
WX-101 and WX-102 models available with Ultra TUF-KOTE™ exterior coating option.

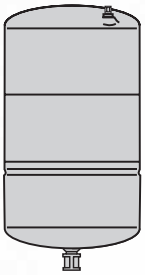
Stand Models



Model No.	Dimensions Diameter (ins)	Dimensions Height (ins)	Total Volume (gals)	Max. Accept. Factor	System Drawdown 20/40 (gals)	System Drawdown 30/50 (gals)	System Drawdown 40/60 (gals)	Shipping Wt. (Vol.) lbs (cu ft)
WX-104-S	15 3/8	19 1/4	10.3	1.00	4.1	3.5	3.0	23
WX-201	15 3/8	25 1/8	14.0	0.81	5.6	4.8	4.1	25
WX-202	15 3/8	31 5/8	20.0	0.57	8.0	6.8	5.9	33
WX-202XL	15 3/8	38 1/4	26.0	0.44	10.5	8.8	7.6	36
WX-203	15 3/8	46 1/2	32.0	0.35	—-	10.9	9.4	43
WX-205	22	29 5/8	34.0	1.00	13.7	11.6	10.0	61
WX-250	22	36	44.0	0.77	17.7	15.0	12.9	69
WX-251	22	46 3/4	62.0	0.55	24.9	21.1	18.2	92
WX-255	22	56 3/8	81.0	0.41	32.6	27.5	23.8	103
WX-252	22	62 1/4	86.0	0.39	34.6	29.2	25.3	114
WX-302	26	47 1/4	86.0	0.54	34.6	29.2	25.3	123
WX-350	26	61 7/8	119.0	0.39	43.6	40.5	35	166

Precharge Pressure for WX-104-S thru WX-203 is 38 PSIG and Sys. Conn. is 1" NPTF.
Precharge Pressure for WX-205 thru WX-350 is 38 PSIG and Sys. Conn. is 1 1/4" NPTF.
Maximum Working Temperature is 200° F. Maximum Working Pressure for all models except WX-252 is 125 PSIG.
Maximum Working Pressure for WX-252 is100 PSIG.
All models available with Ultra TUF-KOTE™ except WX-104-S, WX-201, and WX-252.
All models except, WX-104S, WX-201, WX-252 are available with Pro-Access.

Underground Models



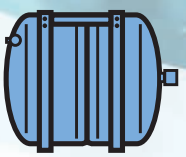
Model No.	Dimensions Diameter (ins)	Dimensions Height (ins)	Total Volume (gals)	Max. Accept. Factor	System Drawdown 20/40 (gals)	System Drawdown 30/50 (gals)	System Drawdown 40/60 (gals)	Shipping Wt. (Vol.) lbs (cu ft)
WX-200-UG	15 3/8	22	14.0	0.81	5.6	4.8	4.1	22
WX-202-UG	15 3/8	30	20.0	0.57	8.0	6.8	5.9	30 (4.9)
WX-250-UG	22	33 3/8	44.0	0.77	17.7	15.0	13.0	60 (9.8)
WX-251-UG	22	44 1/8	62.0	0.55	24.9	21.1	15.3	83 (13.9)

Precharge Pressure for WX-202-UG is 38 PSIG and Sys. Conn. is 1" NPTF Coupling.
Precharge Pressure for WX-205-UG and WX-251-UG is 38 PSIG and Sys. Conn. is 1 1/4" NPTF Coupling.
Maximum Working Pressure is 125 PSIG and Maximum Working Temperature is 200° F.

Well-X-Trol® Professional specialty residential models

Pump Stand Models

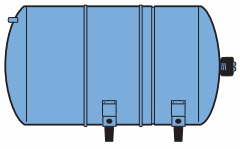
Model No.	Height (ins)	Dimensions Width (ins)	Length (ins)	Total Volume (gals)	Max. Accept. Factor	System Drawdown 20/40 (gals)	30/50 (gals)	40/60 (gals)	Shipping Wt. (Vol.) lbs (cu ft)
WX-105-PS	11	10 9/16	18 1/4	5.3	0.80	2.1	1.8	1.6	13 (1.5)
WX-200-PS	16	15 3/8	20 7/8	14.0	0.81	5.6	4.8	4.1	29 (4.0)
WX-102-PS*	12 1/2	9 1/4	14 1/4	4.4	0.55	1.8	1.5	1.3	13 (1.4)



Precharge Pressure is 18 PSIG and Sys. Conn. is 3/4" NPTM Fitting for 102-PS and 105-PS; and 1" NPTF Coupling for 200-PS.
Precharge Pressure for WX-200-PS is 28 PSIG.
Maximum Working Pressure is 125 PSIG and Maximum Working Temperature is 200° F.
*WX-102-PS includes Universal VFD Mounting Bracket.

Space Saver Model

Model No.	Height (ins)	Dimensions Width (ins)	Length (ins)	Total Volume (gals)	Max. Accept. Factor	System Drawdown 20/40 (gals)	30/50 (gals)	40/60 (gals)	Shipping Wt. (Vol.) lbs (cu ft)
WX-202-H	28 5/8	15 3/8	15 1/4	20.0	0.57	8.0	6.8	5.9	33 (4.9)



Precharge Pressure is 38 PSIG. System connection is 1" NPTF (straight coupling connection).
Maximum Working Pressure is 125 PSIG. Maximum Working Temperature is 200° F.

Specialty Options

Ultra TUF-KOTE™

A new improved paint finish available only on WELL-X-TROL tanks. This new paint has been re-formulated for outdoor applications where acids, salts and moisture can harm regular paint. It is crack proof and impermeable to moisture.

PRO Access®

PRO Access® Stainless Steel System Connection piped through the stand is available on most WELL-X-TROL models. Indicate PRO Access when ordering.

WELL-X-TROL® Professional by AMTROL®

Well Above The Rest™

New for 2009, AMTROL is proud to introduce the Well Above The Rest™ Program. Not all well tanks are created equal, and we're ready to demonstrate the value, features, and benefits that have proven Well-X-Trol® as the most trusted well tank for generations.

To learn more about the Well Above The Rest Program, contact your local representative or visit **www.amtrol.com/wellabovetherest.htm** to learn more.

NSF/ANSI 61

AMTROL INC.

Corporate Headquarters
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MC 4380 4/09
US English

Specialty Products
Qwik Jon® Ultima 204

Features & Benefits

Product Specifications

Technical Data

Dimensional Data Drawings

Literature/Documents

Product Specifications

Horsepower: 1/2 HP

Hertz: 60 Hz

Discharge Size: 1"

Impeller Type: Non-clogging vortex impeller

Cord Length: 9 ft (3m)

Cord Type: UL listed, 3-wire neoprene cord and plug

Motor Protection: thermal overload

The Qwik Jon® Ultima can be installed either freestanding or behind a wall with the 2" MPT or 1-1/2" internal slip side inlets.

 site map

"Quality Pumps Since 1939"

Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

ZOELLER® PUMP CO.

MAIL TO: P.O. BOX 16347 • Louisville, KY 40256-0347
SHIP TO: 3649 Cane Run Road • Louisville, KY 40211-1961
(502) 778-2731 • 1 (800) 928-PUMP • FAX (502) 774-3624

SECTION: 2.10.050
FM0592
0809
Supersedes
0306

visit our web site:
www.zoeller.com

81 Thermoplastic - 1/3 HP
82 Cast Iron - 1/3 HP
84 Cast Iron - 1/2 HP

(For Pump Prefix Identification see News & Views 0052)

"OLD FAITHFUL"

DEWATERING AND SUMP PEDESTAL PUMP

Model 82 Pictured

Product may not be exactly as shown.

COMPARE THESE FEATURES:

Motor: Metal enclosed, 115V split phase motor, permanently lubricated, thermal overload protected. 1725 RPM.
Impeller: Non-clogging impeller design. Constructed of engineered thermoplastic.
Pump Housing & Base: Heavy duty thermoplastic or cast iron construction.
Strainer: Top intake strainer is part of pump housing. Passes lint. No strainer to deteriorate, replace or to periodically clean.
Discharge: Model 81 - 1¼" FPT
Model 82 & 84 - 1-½" FPT.
Column: 81, 82 & 84 Series feature high impact PVC (1½" OD).
Shaft: Noncorrosive shaft.
Switch: Reliable positive displacement switch.
Float: Chemically resistant polyethylene.
Float Rod: Plated steel rod.
Guide: Nylon
Bearings: Permanently lubricated upper sleeve bearing. Durable lower bronze bushing.
Cord: 7½ foot UL Listed 3-wire cord & plug.
Cycle: Adjustable 12" cycle, factory set at 9". Max. "ON" - 16" Min. "OFF" - 4"
Temperature Rating: 130°F. - 54°C.
Specs:

Model	81	82	84
Amps	4.0	5.7	7.3
Ship Wt.(lbs)	15	19	22.5
Max. Width (in.)	9.55	9.55	9.55
Max. Height (in.)	31.25	31.75	32.5

Minimum pit size recommended - 18" x 22"

TOTAL DYNAMIC HEAD/FLOW
PER MINUTE DEWATERING

MODEL		81		82		84	
Feet	Meters	Gal.	Liters	Gal.	Liters	Gal.	Liters
5	1.5	50	189	52	197	59	223
10	3.0	36	136	41	155	51	193
15	4.6	10	38	12	45	38	144
20	6.1	--	--	--	--	17	64
Shut-off Head:		16 ft.(4.9m)		17 ft.(5m)		24 ft.(7.3m)	

014569

NOTE: This unit is designed for indoor applications where the motor is mounted above the pit cover and protected from water, water spray, and high humidity. Pump is not intended for use with flammable liquids.

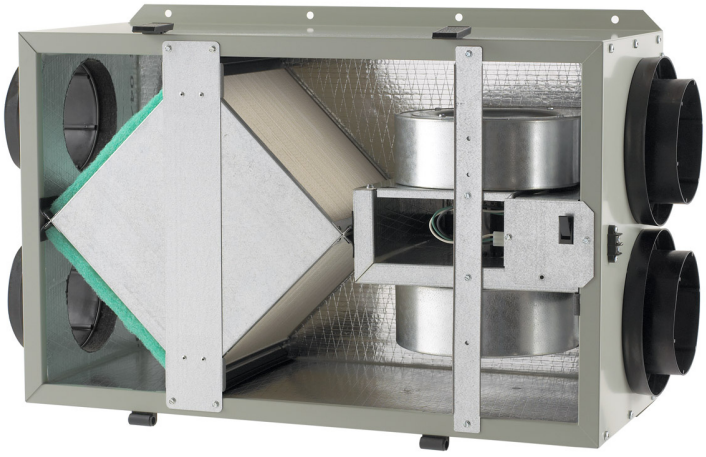
Tested to UL Standard UL778 & Certified to CSA Standard C22.2 No. 108

FEATURES AVAILABLE:
115V Automatic
1/3 HP or 1/2 HP

TRANE®

FreshEffects™ Energy Recovery Ventilator

TERVR100A9P00A
TERVR200A9P00A
TERVR300A9P00A



PUB. NO. 22-1776-04

General Features

General Features
Energy Recovery Ventilator (ERV)

Product Description
Packaged static plate enthalpic-energy recovery ventilator. Energy transfer core is constructed of static plates in a cross flow arrangement with no moving parts. The unit is capable of operating in summer and winter conditions without generating condensate. No condensate drain pan or drain line is required. The ERV ships with cleanable polyester air filters in the exhaust and fresh air streams to protect the energy transfer core.

Product Certification
ERV models are listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers and are certified by the Home Ventilating Institute (HVI) per CSA 439. Both a heating and cooling test are run to demonstrate year round energy recovery.

Energy Transfer
ERV's are capable of transferring both heat and moisture between airstreams. Moisture transfer is achieved by direct water vapor transfer from one air stream to the other.

Passive Frost Control
The energy transfer core performs without condensing or frosting under normal operating conditions (defined as outside temperatures above -10F and inside relative humidity below 40%). Occasional extreme conditions will not affect the usual function or performance of the element. A condensate drain is not required.

Continuous Ventilation
FreshEffects™ ERV's have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters or defrost cycles under normal operating conditions.

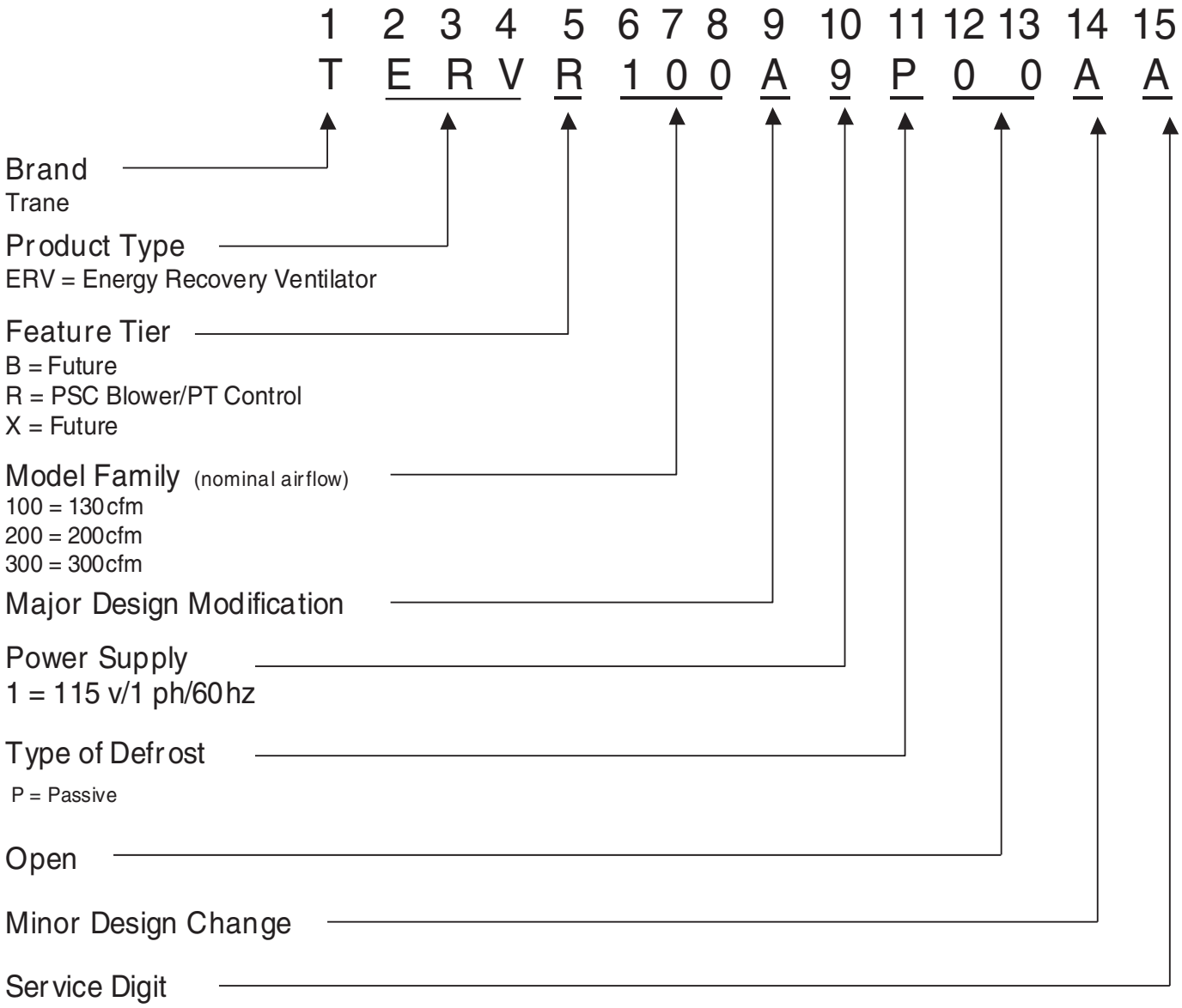
Positive Airstream Separation
Water vapor transfer is achieved through molecular transport by hydroscopic resin and shall not be achieved by "porous plate" mechanisms. Exhaust and fresh air travel in separate passages at all times, and airstreams do not mix.

Laminar Flow
Airflow through the energy transfer core is laminar, avoiding deposit of particulates on the interior of the energy exchange plate material.

Pub. No. 22-1776-04

Contents

ERV Model Nomenclature



Pub. No. 22-1776-04

Features and Benefits

Features and Benefits

Features:

- FreshEffects™ ERV technology for all seasons and climates
- Static plate energy transfer core for efficient transfer of heat and moisture
- Passive defrost does not require condensate drain and provides lower installed cost and improves reliability
- Multi position mounting for installation flexibility
- FreshEffects™ ERV airflow design does not require installation of balancing dampers reducing installation and start up time
- Percent Timer (PT) control included with ERV for simple, automatic operation
- Optional push button control accessory provides manual override at point of use
- Cam action latches and hinged access doors provide quick access for maintenance and service.
- Heavy gauge, powder painted steel cabinet provides durability and matches the system appearance
- Permanently lubricated motor bearings for long life
- Standard 34" power cord with ground plug for easy installation
- Double duct collars (6” & 8”)for connection of flexible or rigid ductwork for TERVR100 and 200
- 8” round compatible duct connection for TERVR300
- Cabinet wall and doors have 1" cleanable, foil face, high density board insulation, with 1/4” foam insulation on access panel for thermal and sound insulation
- ERV cabinet / door color: Polyslate Gray/ Tarpaulin Gray
- 5 year limited warranty on parts
- 10 year limited warranty on energy transfer core
- **Optional 5 and 10 year extended warranties**

OPTIONAL ACCESSORIES

Point of Use Push Button Control for use with ERV models 100, 200, 300 ..... TCONTV10APBC0A [ ]
Filters - 2 per pack, for use with ERV model 100 ..... BAYFLT10A1010A [ ]
Filters - 2 per pack, for use with ERV model 200 & 300 ..... BAYFLT20A1020A [ ]
6 inch White Vinyl Ventilation Hood ..... BAYWHT10AVENTA [ ]
6 inch Brown Vinyl Ventilation Hood ..... BAYBRN10AVENTA [ ]
8 inch Galvenized Ventilation Hood ..... BAYGLV10AVENTA [ ]

General Data

MODEL	TERVR100A9P00A	TERVR200A9P00A	TERVR300A9P00A
RATINGS ①	See Note ①	See Note ①	See Note ①
AIRFLOW RANGE (cfm)	50-130	100-210	150-320
BLOWER ASSEMBLY			
Diameter x Width	6.32" x 2.01"	6.75" x 1.89"	7.67" x 1.89"
No. Blower Wheels Used	2	2	2
Speeds ②	1	1	1
No. Motors — H.P.	1 - 0.09	1 - 0.09	1 - 0.25
Nominal Motor Speed (R.P.M.)	1750	1750	1550
POWER CONNECTIONS			
Volts/Ph/Hz	120/1/60	120/1/60	120/1/60
Ampacity (in Amps)	15	15	15
Fuse Size - Max (Amps)	15	15	15
F.L. Amps	1.3	1.5	3.3
FILTER			
Filter Furnished?	Yes	Yes	Yes
Type Recommended	Cleanable Polyester	Cleanable Polyester	Cleanable Polyester
No.-Size-Thickness	2 - 10.5" x 10.5"	2 - 10.5" x 21.75"	2 - 10.5" x 21.75"
Defrost	Passive	Passive	Passive
Duct Connections	See Note ②	See Note ②	8" oval connection for flex or rigid
Heat Exchanger	See Note ③	See Note ③	See Note ③
Insulation - Thermal/Sound	See Note ④	See Note ④	See Note ④
DIMENSIONS	H x W x D	H x W x D	H x W x D
Crated (In.)	21-1/2 x 32 x 17-1/2	21-1/2 x 32 x 28-1/2	21-1/2 x 32 x 28-1/2
Uncrated (In.) (Not including duct collars)	20-1/8 x 28-3/4 x 13	20-1/8 x 28-3/4 x 23-7/8	20-1/8 x 28-3/4 x 23-7/8
WEIGHT			
Shipping (Lbs.) / Net (Lbs) Including collars)	65 / 58	91 / 78	95 / 82

① Certified HVI 2100 PER CSA 439 and listed under UL standard UL 1812.

② Insulating double collars with 6" and 8" round connections for flex or rigid duct.

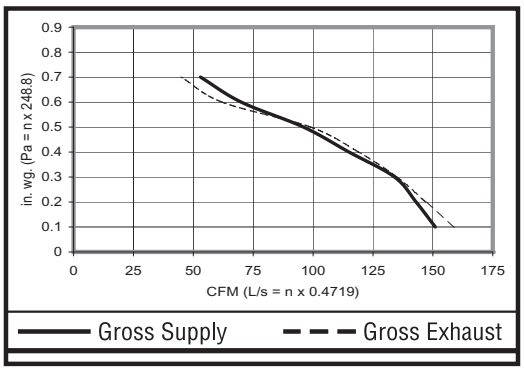
③ Cross flow - fixed plate enthalpic energy transfer core. Transfers heat and moisture.

④ Cabinet - 1" cleanable foil face fiberglass high density board insulation. Access door - 1/4" foam insulation over 1" fiberglass board insulation.

Pub. No. 22-1776-04

Performance Data

*ERVR100 - Ventilation Performance							
Ext. Static Pressure		Net Supply Airflow		Gross Airflow			
				Supply		Exhaust	
Pa	in. wg	L/S	CFM	L/S	CFM	L/S	CFM
25	0.1	77	165	79	168	79	168
50	0.2	72	153	73	156	73	156
75	0.3	64	137	66	140	66	140
100	0.4	59	126	61	129	61	129
125	0.5	49	104	50	106	50	106
150	0.6	37	79	38	81	38	81

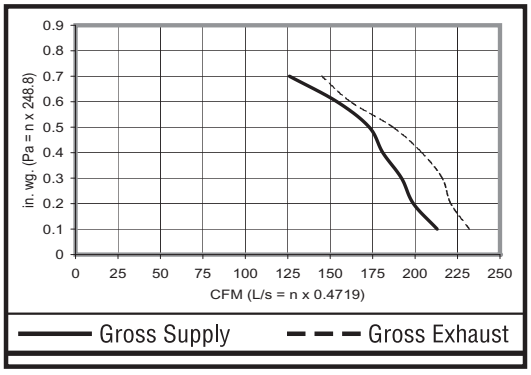


Electrical Requirements Volts 120 Amps 1.3

Exhaust Air Transfer Ratio = 2% @ 0.2 in. wg (50 PA) and 2% @ 0.4 in. wg (100 PA)

*ERVR100 - Energy Performance							
Supply Temperature		Net Airflow		Average Power Watts	Sensible Recovery Efficiency %	Apparent Sensible Effectiveness %	Net Moisture Transfer %
C°	F°	L/S	CFM				
Heating							
0°	32°	61	130	102	71	77	53
Cooling					Total Recovery Efficiency %		
35°	95°	61	130	102	48		

*ERVR200 - Ventilation Performance							
Ext. Static Pressure		Net Supply Airflow		Gross Airflow			
				Supply		Exhaust	
Pa	in. wg	L/S	CFM	L/S	CFM	L/S	CFM
25	0.1	97	207	100	213	109	232
50	0.2	90	192	93	199	104	221
75	0.3	88	186	90	192	101	216
100	0.4	83	176	85	181	96	204
125	0.5	79	168	81	173	88	187
150	0.6	70	149	72	154	76	162
175	0.7	57	122	59	126	68	145



Electrical Requirements Volts 120 Amps 1.5

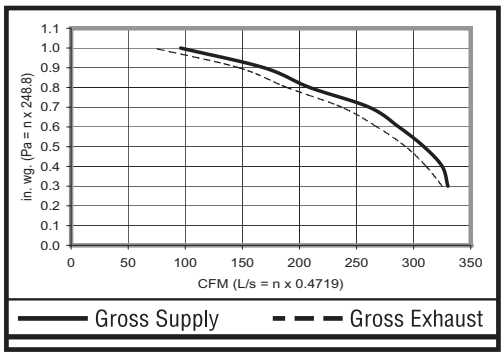
Exhaust Air Transfer Ratio = 3% @ 0.2 in. wg (50 PA) and 3% @ 0.4 in. wg (100 PA)

*ERVR200 - Energy Performance							
Supply Temperature		Net Airflow		Average Power Watts	Sensible Recovery Efficiency %	Apparent Sensible Effectiveness %	Net Moisture Transfer %
C°	F°	L/S	CFM				
Heating							
0°	32°	85	181	157	78	85	62
Cooling					Total Recovery Efficiency %		
35°	95°	85	180	155	52		

*May be "A" or "T"

Performance Data

*ERVR300 - Ventilation Performance							
Ext. Static Pressure		Net Supply Airflow		Gross Airflow			
				Supply		Exhaust	
Pa	in. wg	L/S	CFM	L/S	CFM	L/S	CFM
100	0.4	147	311	150	317	143	303
125	0.5	139	295	142	301	133	283
150	0.6	131	277	133	282	125	265
175	0.7	121	256	123	261	108	230
200	0.8	101	215	103	219	94	198
225	0.9	90	191	92	195	74	156
250	1.0	80	170	82	174	47	99



Electrical Requirements Volts 120 Amps 3.3
Exhaust Air Transfer Ratio = 3% @ 0.4 in. wg (50 PA)

*ERVR300 - Energy Performance							
Supply Temperature		Net Airflow		Average Power Watts	Sensible Recovery Efficiency %	Apparent Sensible Effectiveness %	Net Moisture Transfer %
C°	F°	L/S	CFM				
Heating							
0°	32°	139	297	315	67	74	54
Cooling					Total Recovery Efficiency %		
35°	95°	138	294	313	46		

*May be "A" or "T"

* Refer to HVI Directory (Home Ventilation Institute) for definitions of column headings

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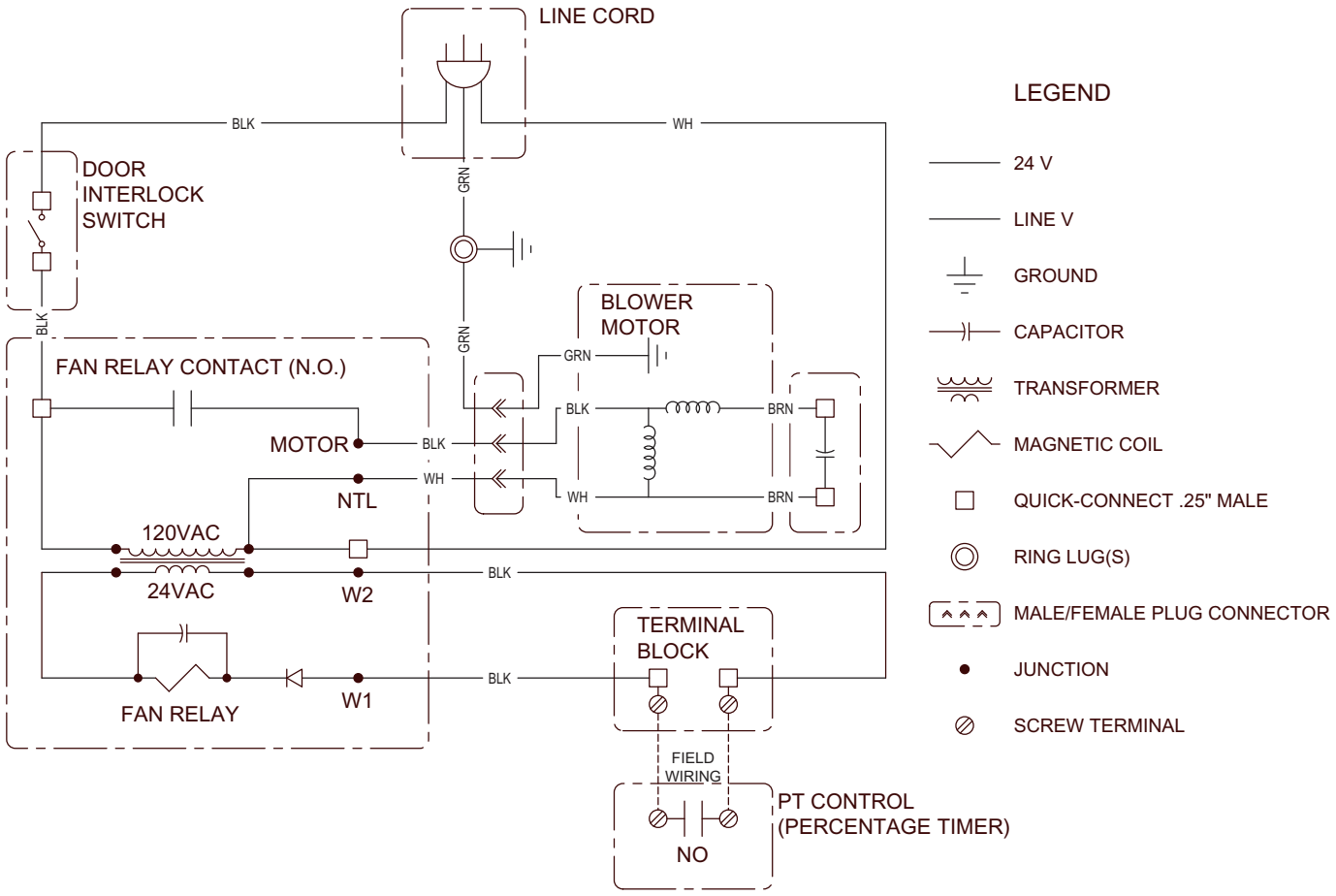
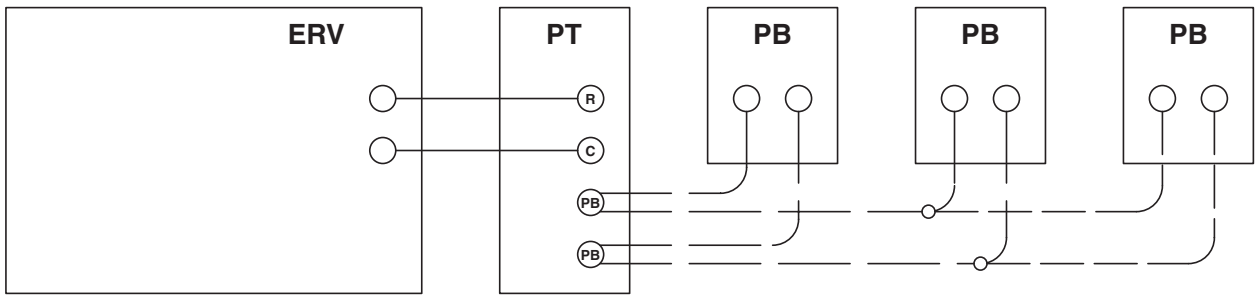
Electrical Data



Optional PB Controls

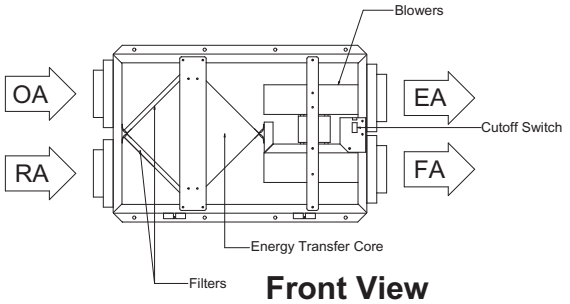


(2) PB controls can be directly connected to the PT control

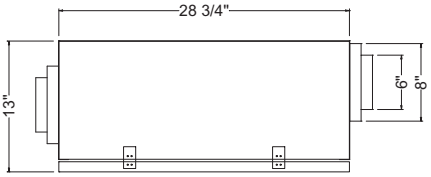
Up to (6) PB controls, wired in parallel, may be used.

Dimensions

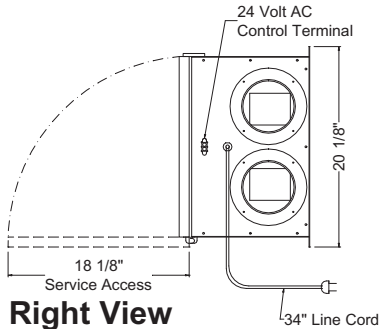
TERVR100A9P00A



Front View

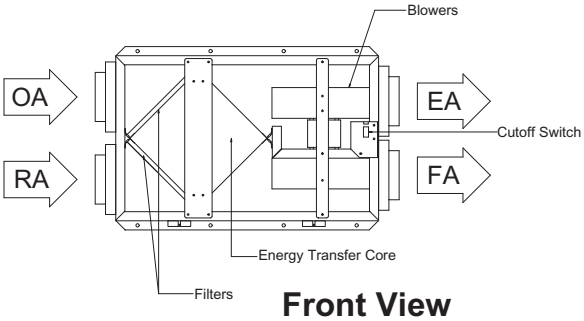


Top View

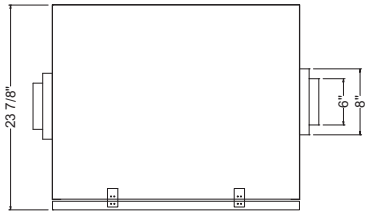


Right View

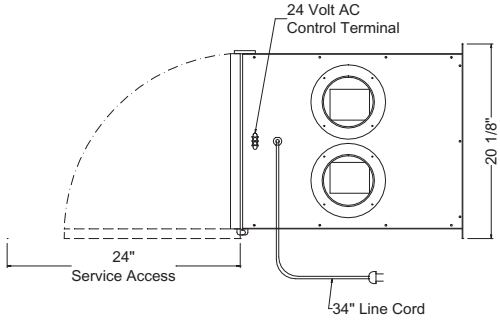
TERVR200A9P00A



Front View

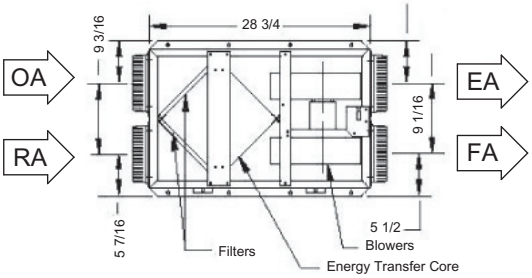


Top View

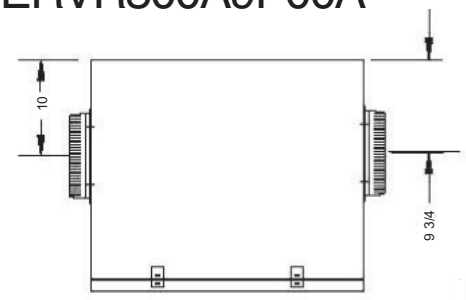


Right View

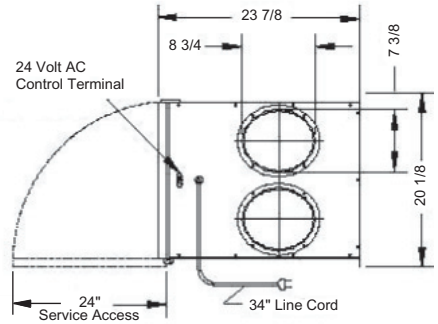
TERVR300A9P00A



Front View



Top View



Right View

Pub. No. 22-1776-04

Notes

TRANE®

Trane
6200 Troup Highway
Tyler, TX 75707
www.trane.com

Notes to the installer:

EXTENSION CORDS are not recommended due to the possibility of water getting on the connection or stress on the cord. A permanent outlet is recommended 7 feet or less from the unit itself. When absolutely necessary the following extension cords may be used:

- 16 GAUGE: 0-100 feet long for tool loads up to 10 amps
- 14 GAUGE: 0-50 feet long for tool loads between 10 and 15 amps
- 12 GAUGE: 50-100 feet long for tool loads between 10 and 15 amps

DEFROST SWITCH: Opens at 19°. The defrost control will run the compressor for 45 minutes and the unit will continue to dehumidify. Then the fan runs for 15 minutes with the compressor off until the unit warms up to 50°.

OPTIONAL CONDENSATE PUMP AND A SAFETY SWITCH: The condensate pump does have a safety switch (3.3 amps) however it cannot handle the load our unit would put on it . The entire load cannot be switched through the safety switch. A relay can be used to cut the power off to the unit or the outlet itself.

- EXTERNAL WIRING: Use a relay switch in conjunction with a piggy-back plug. This will cut the power off to the unit or the outlet itself. This is the easiest because no internal wiring is necessary.
- INTERNAL WIRING: Second option is to use relay cutting into A/C cord (turns whole unit off) or dehumidistat (still fan operation w/o compressor operation)—negative, owner may not know the unit ceased operating.

RUNNING FLEX DUCT: More than 25-50 feet of duct will decrease the efficiency of the unit by 10% or more. Minimize turns as much as possible. Also, can increase duct size or size of dehumidifier.

CHANGE FILTER every 6-12 months. MERV 14 filter every 2-3 years. Filters may be vacuumed in between. A dirty filter reduces unit efficiency.

DAMPER DOESN'T OPEN: If the damper doesn't open it could be a bad damper or bad transformer. Hook damper across secondary of transformer and plug in damper. Damper should open. If it doesn't open there is a bad damper or transformer.

REFRIGERANT CONNECTIONS: All dehumidifiers have a service valve on the refrigeration system to allow technicians to check the charges with gauges, if necessary.

HIGH TEMPERATURE OPERATION: Use of a thermostat is recommended in attic applications that exceed 100°. WW Grainger has an adjustable thermostat that plugs into the 115V outlet. The dehumidifier plugs into the thermostat that is set for 100° F and during the hottest part of the day the thermostat will stop the dehumidifier from running.

VIBRATION NOISE: If there is vibration in the cabinet of the dehumidifier, remove the cover and check the compressor/tubing for contact with the case. Most of our units have a shipping support band on the compressor. This should be removed. Adjusting the compressor bolts to maximize the flexing of the compressor will reduce vibration transfer.

4026208

Do you know the relative humidity levels in your home?

The Humidity Alert™ was designed to discriminate between occasional periods of high humidity and the prolonged periods that create a risk of unhealthy biological activity. It's a simple, inexpensive device that monitors temperature and relative humidity conditions and records data that is known to contribute to **wood rot, mold growth, musty odors and increased pest activity.**

Easy to use:

1. Place the meter in the desired space.
2. Collect the necessary humidity data.

4023660

Ultra-Aire Digital Controller

You will enjoy the comfort that comes with precise regulation of your indoor environment with our new **DEH 3000 Digital Control**. This control will allow you the ability to monitor and control relative humidity levels in your home. The DEH 3000 is designed to accommodate your personal comfort level.

This unit replaces the DEH 2000 Digital Control. To be used with Ultra-Aire Whole House Ventilating Dehumidifiers.

Powerful, compact, energy efficient, whole house dehumidification.

Ultra·Aire™ 65H

ENERGY STAR 4027170

Introducing the most compact whole house ventilating dehumidifier anywhere.

WHOLE HOUSE VENTILATING DEHUMIDIFICATION

To avoid the problems caused by moisture, and create a comfortable environment, a dehumidifier is necessary to maintain relative humidity between 45-50% throughout the home. Only supplemental dehumidification provides indoor humidity control regardless of air conditioner operation or outside moisture conditions.

The highly efficient and compact Ultra-Aire 65H utilizes refrigeration and internal air circulation to cool the incoming air stream below its dew point. After helping to cool the incoming air, the processed air is reheated by passing through the condenser coil. The heat removed by the evaporator coil is returned to the air stream, resulting in warm, filtered dry air returning to your home.

The Ultra-Aire 65H is controlled by a variety of 24 volt remote wired controls, suitable to various applications.

FRESH AIR VENTILATION

Optional fresh outdoor air may be ducted to the unit via a “T” to the inlet duct. This provides fresh air to dilute pollutants and maintain a normal oxygen content in the air. The amount of fresh air ventilation can be regulated by a variety of dampers and controls.

AIR FILTRATION

The Ultra-Aire 65H includes air filtration to improve indoor air quality. A MERV-11 media filter is standard.

65H

Specifications and Installation

Part Number:	4027170
Blower:	190 CFM @ 0.0" WG
Power:	680 Watts @ 80°F and 60% RH
Supply Voltage:	110-120 VAC – 1phase – 60 Hz
Current Draw:	5.50 Amps
Energy Factor:	1.95 L/kWh
Operating Temp.:	Between 40°F and 95°F Max
Sized for:	Up to 1600 Sq. Ft. - Typical
Miniumum Performance at 80°F and 60% RH	
Water Removal:	65 pints/day
Efficiency:	4.1 Pints/kWh
Air Filter:	MERV-11
Efficiency:	Standard 65% Efficient ASHRAE Dust Spot Test
Size:	9" x 11" x 1"
Power Cord:	9', 110-120 VAC, Ground
Drain Connection:	3/4" Threaded MPT
Drain Hose:	5/8" ID x 8'

Dimensions	**Unit**	**Shipping**
Width:	21"	27"
Height:	12"	17"
Depth:	12"	17"
Weight:	55 lbs	59 lbs

OPTIONAL ACCESSORIES

4027158	MERV 11 Filter
4027422	MERV 11 4-Pack
4027427	MERV 11 12-Pack
4028085	Pump Kit
4028111	Hang Kit
4028074	Duct Kit
4023647	8" Gravity Damper
4020646	8" Butterfly Damper
4027415	8" Flex Duct
4020177	8" Flex Duct (Insulated)
4027430	Register Head 8"
4020126	Register Grill (White)

INSTALLATION MATERIALS

Control Options	**Part Number**
Humidity / Fan Control	4024155
Ventilation Timer / Humidity / Fan Control	4024125
DEH 3000 - Digital Control	4026570
Ducting Options	
6", 2 wire 24 volt Electric Air Damper	4023672
8" Gravity Damper	4023647
8" Butterfly Damper	4020646
8" Flex Duct	4027415
8" Flex Duct (insulated)	4020177
Duct Tape (Not Provided)	N/A
Large Cable Ties (Not Provided)	N/A
Insulated 6" Air Duct (Flex) - 25 ft.	4020128
Insulated 10" Air Duct (Flex) - 25 ft.	4022126

Plumbing - Not Provided By Therma-Stor
3/4" PVC Pipe
3/4" PVC Threaded Nipple
3/4" PVC Elbow
PVC Primer and Glue

Electrical - Not Provided By Therma-Stor
12-2 Non-Metallic Sheeted NM-B (Romex) Wire
20 AMP 120 Volt Single Pole Breaker
20 AMP 120 Volt Rated (3) Prong Outlet
Thermostat Wire (5Conductor, 18 AWG)
Wire Staples
Outlet Cover
Outlet Box

Preferred installation is to draw air from a separate intake duct located in the central part of the home. Duct the outlet air into the supply duct for distribution throughout the home. A backdraft damper prevents air from the supply duct from being pushed backward through the Ultra-Aire 65H when central (A/C) fan is on and the Ultra-Aire fan is off.

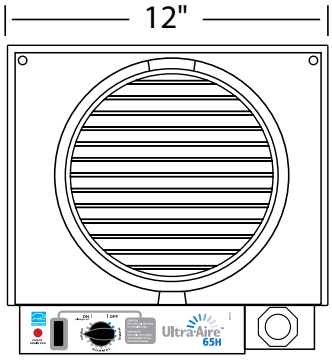
Therma-Stor does not recommend drawing air from the return ducting system and discharging into the supply for two reasons:

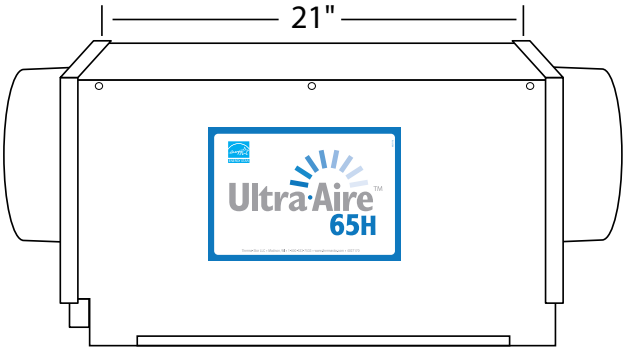
Central Fan On: The Ultra-Aire 65H is pulling against a negative pressure (intake side) and discharging against a positive pressure (outlet side), which results in lower airflow and reduced capacity.

Central Fan Off: Discharge air may counter-flow from the supply duct directly to the return duct and not be distributed throughout the home effectively.

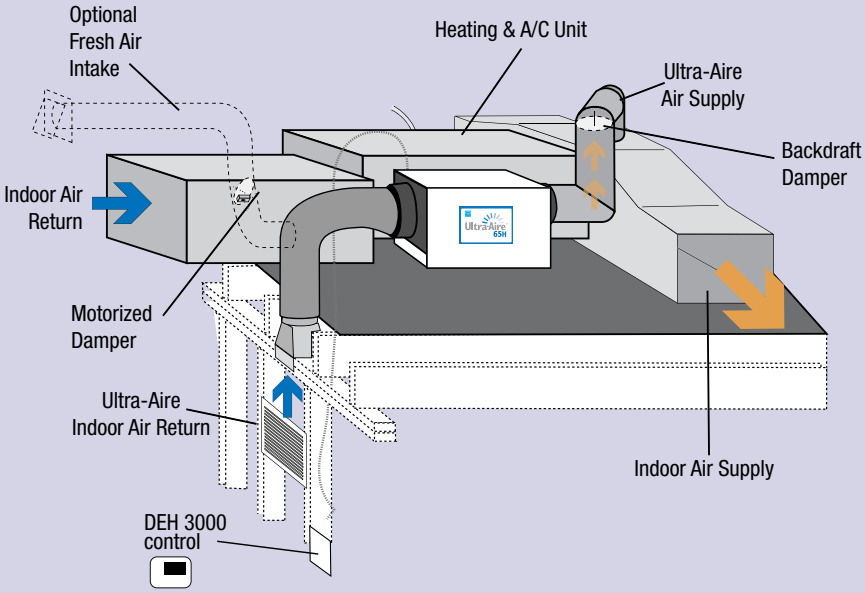
Ultra-Aire 65H

Ultra·Aire™ 65H



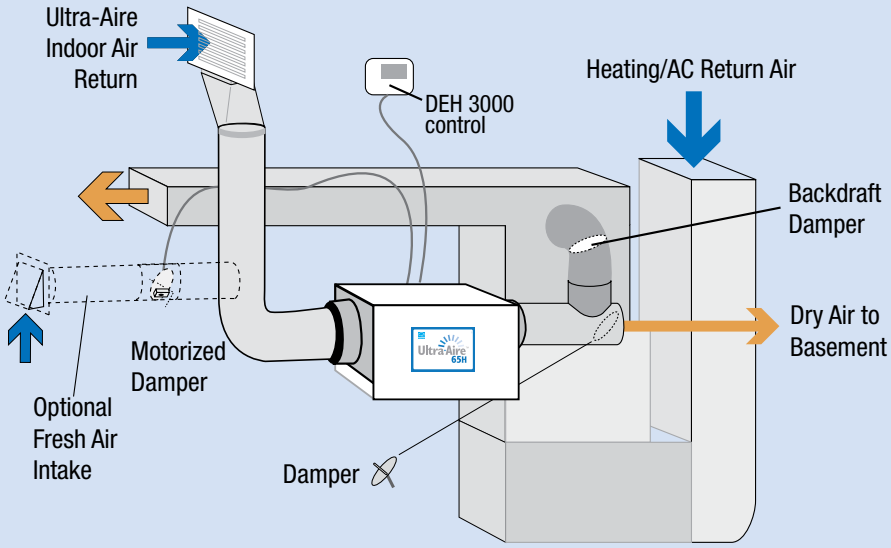


installation



ULTRA-AIRE 65H ATTIC INSTALLATION

1. Indoor air return should come from an open area of the first or second floor.
2. The Ultra-Aire supply should be ducted into the forced air system past the air conditioning coil. The duct connection should be perpendicular to the air flow.
3. The optional six inch fresh air intake should be located at least six feet away from any exhaust ports, such as, dryer, range hood, or combustion device exhaust. Intake location must be consistent with local codes.
4. If placed over a finished area, use of a secondary drip pan is recommended.
5. A section of flex duct or vibration absorbing duct should be located between the connections of the Ultra-Aire ductwork and the forced air system ductwork.
6. The backdraft damper prevents counter-flow of the A/C supply air through the Ultra-Aire 65H.



ULTRA-AIRE 65H BASEMENT OR CRAWLSPACE INSTALLATION

1. Indoor air return should come from an open area of the first or second floor.
2. The Ultra-Aire supply should be ducted into the forced air system supply beyond the air conditioning coil. The duct connection should be perpendicular to the air flow.
3. An optional ten inch tee fitting with an adjustable blade damper on the straight run may be attached at the Ultra-Aire supply. This allows for increased air flow to the basement/crawlspace during the summer months.
4. The optional six inch fresh air intake should be located at least six feet away from any exhaust ports, such as, dryer, range hood, or combustion device exhaust. Intake location must be consistent with local codes.
5. A section of flex duct or vibration absorbing duct should be located between the connections of the Ultra-Aire ductwork and the forced air system ductwork.
6. The backdraft damper prevents counter-flow of the A/C supply air through the Ultra-Aire 65H.

Installer's Manual

Split System (R-410A)

16~22 SEER Inverter System

9,000 to 36,000 BTU/Hr

R-410A, 60Hz

Single Split	Indoor Unit	Outdoor Unit
Heat pump	4MXW8-A	4TXK8-A

September 2012

MS-SVN23A-EN

Warnings and Cautions

Warnings and Cautions. Notice that warnings and cautions appear at appropriate intervals throughout this manual. Warnings are provided to alert installing contractors to potential hazards that could result in personal injury or death, while cautions are designed to alert personnel to conditions that could result in equipment damage.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

Attention: Warnings and Cautions appear at appropriate sections throughout this literature. Read these carefully.

⚠**WARNING**: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠**CAUTION**: Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE: Indicates a situation that could result in equipment or property-damage only accidents.

⚠WARNING

This equipment is to be serviced by professionally trained personnel ONLY. Under NO circumstances should an unqualified person service it. This equipment contains refrigerant under PRESSURE and operates at HIGH VOLTAGE. Improperly installed, adjusted or altered equipment by an unqualified person poses safety hazards including FIRE, ELECTROCUTION, or EXPLOSION, which could result in death or serious injury.

⚠WARNING

Electrocution and Fire Hazards with Improperly Installed and Grounded Field Wiring!

Improperly installed and grounded field wiring poses FIRE & ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in the National Electrical Codes (NEC) and your local/state electrical codes. All field wiring MUST be performed by qualified personnel.
Failure to follow these requirements could result in death or serious injury.

Preface

⚠WARNING

R410A Refrigerant under Higher Pressure than R22!

The units described in this manual use R410A refrigerant which operates at 50 to 70% higher pressures than R-22. Use only R-410A approved service equipment. Refrigerant cylinders are painted with "pink" color to indicate the type of refrigerant and may contain a "dip" tube to allow for charging of liquid refrigerant into the system. For specific handling concerns with R-410A, please contact your local sales office.

Failure to use R-410A approved service equipment could result in standard equipment exploding under R-410A higher pressure which could result in death or serious injury.

NOTICE

Use PVE Oil with R-410A Mini-Split Units!

All R-410A mini-splits use a PVE oil (Polyvinyl Ether Oil) that readily absorbs moisture from the atmosphere. To limit this "hygroscopic" action, the system should remain sealed whenever possible. If a system has been open to the atmosphere for more than 4 hours, the compressor oil must be replaced. Never break a vacuum with air and always change the driers when opening the system for component replacement. For specific handling concerns with PVE oil, contact your local sales office.

USE ONLY THE FACTORY RECOMMENDED - DAFNE HERMETIC OIL FV50S - for servicing these units.

Important!

Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Advocates the responsible handling of all refrigerants—including industry replacements for CFCs such as HCFCs and HFCs.

Responsible Refrigerant Practices

The manufacturer believes that responsible refrigerant practices are important to the environment our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified. The Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

Contents

General Information

This Installation Manual is given as a guide to good practices in the installation and operation of a wall mounted split system models 4MYW8 and 4TYK8 ; 4MXW8 and 4TXK8. However it does not contain all the service procedures for this unit, as these procedures must be performed by a qualified service technician, through the maintenance contract with a reputable service company.

Read these operation Instructions completely before installing the unit.

Reception

On arrival, inspect the unit before signing the delivery note. Specify any damage of the unit on the delivery note, and send a registered letter of protest to the last carrier of the goods within 72 hours of delivery. Notify your supplier at the same time.

The unit should be totally inspected within 7 days of delivery. If any concealed damage is discovered, send a registered letter of protest to the carrier within 7 days of delivery and notify the local supplier.

About the Unit

These units are assembled, pressure tested, dehydrated, charged and run tested before shipment. This manual contains informations related to 4MYW8 and 4TYK8; 4MXW8 and 4TXK8 .

Refrigerant

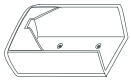
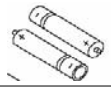
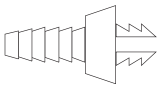
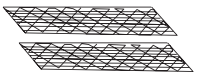
The refrigerant provided by the manufacturer comply with all the requirements for our units. When using a recycled or reprocessed refrigerant, we recommend its qualities be as good as those of a new refrigerant. It is necessary to have the refrigerant tested by a qualified laboratory. Failure to do so could void the warranty.

Important

These instructions do not cover all variations in systems, nor do they provide for every possible contingency to be met in connection with installation. Should further information be desired or should particular problems arise which are not covered sufficiently in this manual, the matter should be referred to your local sales office.

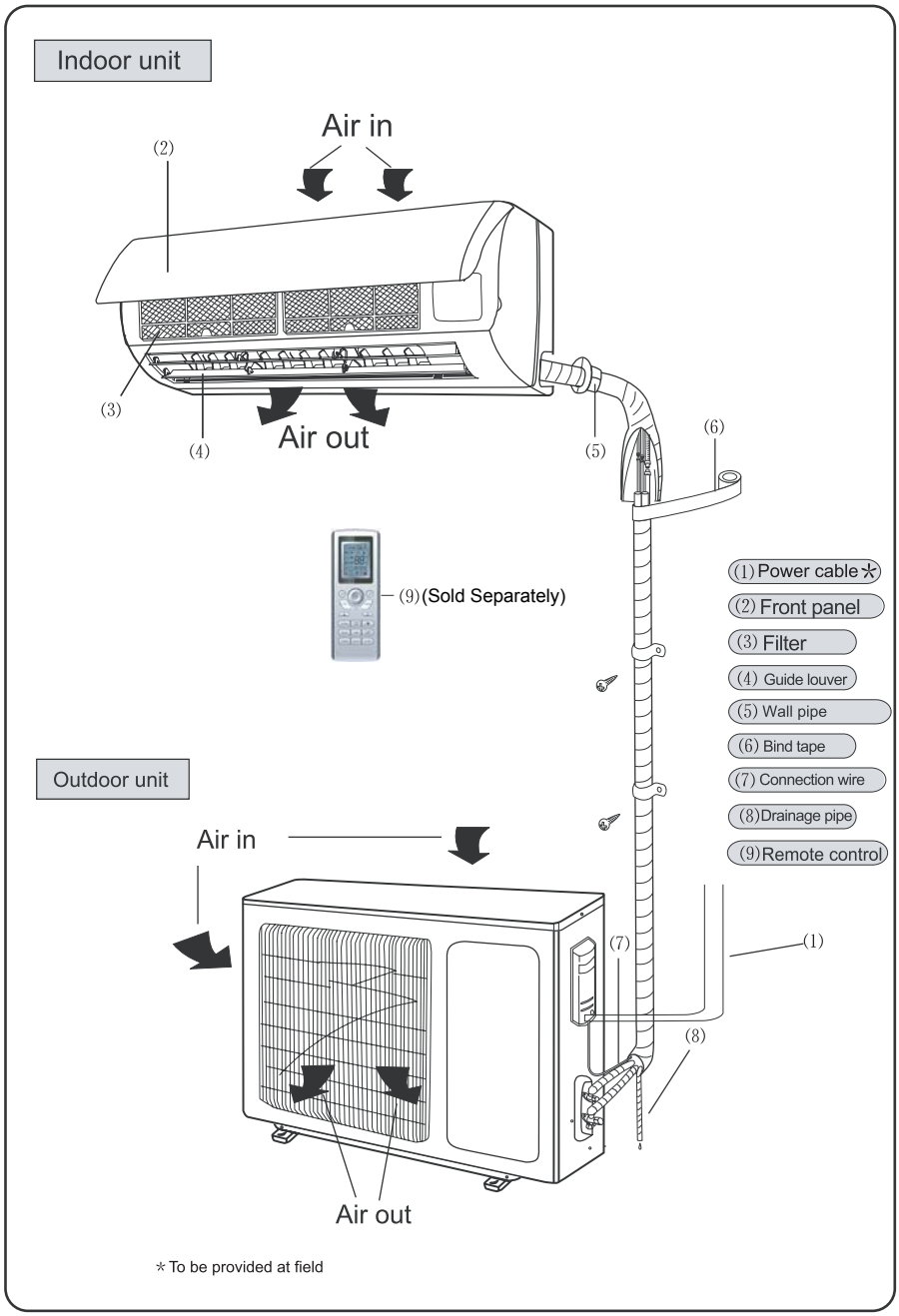
Accessories

Table 1. Parts list

No.	Part Name	Diagram	Qty	Specification	Memo
1	Mounting plate		1		
2	Wireless remote controller		1		Sold Separately
3	Remote controller holder		1		
4	Battery		2	AAA,1.5V	
5	Tapping screw		10	ST4.2 X 25	For mounting plate
6	Drain hose		1	L = 6 ft.	
7	Thermal insulation		1		
8	Drain kit		1		Heat pump type only
9	Drain hole cover		3		Heat pump type only
10	Active air filters		2		One active carbon filter One catechin filter
11	Air filter		2		Washable plastic filters

Typical Installation

Names and functions of each part



Installation location

Indoor Unit

⚠WARNING

Adequate Support!

Wall structure must be adequate to support the weight of the unit. Failure to ensure adequate structural support could result in unit falling from its location which could result in death, serious injury, or equipement or property-only damage.

1. Avoid locating the indoor unit where the return and/or supply air may be obstructed
2. Select a location where it is easy to drain the condensing water and connect to the outdoor unit;
3. Keep the indoor unit far away from heat sources, vapor and flammable gas;
4. Be sure that the installation of the indoor unit conforms to the installation dimension diagram;
5. Be sure to leave enough space to allow access for routine maintenance; clearance between the indoor unit and the floor should be more than 7 feet.
6. Install in a location where the unit is more than 3 feet away from other electric appliances such as television, audio devices etc.;
7. Select location where air filters can be easily removed

Outdoor unit

⚠WARNING

Adequate Support!

Wall structure must be adequate to support the weight of the unit. Failure to ensure adequate structural support could result in unit falling from its location which could result in death, serious injury, or equipement or property-only damage.

1. Select a location from which noise and air discharge by unit will not annoy neighbors.
2. Select a location where there is sufficient ventilation.
3. Make sure the air inlet and outlet are not blocked by any obstacles.
4. Select a location capable of supporting the weight and vibration of the outdoor unit, and where installation work can be carried out safely.
5. Select a location away from flammable gas or gas leaks.
6. Make sure that the installation of the outdoor unit conforms to the installation dimension diagram.
7. Locate the outdoor unit away from any bedroom windows.

NOTICE

Installing the unit in one of the following locations could result in unit malfunction:

- Places where oil (machine oil) is used
- Seaside/places with high level of salt in the air.
- Places with high level of sulfur gas such as areas with hot springs.
- Places where high-frequency waves are generated by radio equipment, welders and medical equipment.
- Other unusual places where unit operation may be altered.

Installation

Indoor Unit Installation

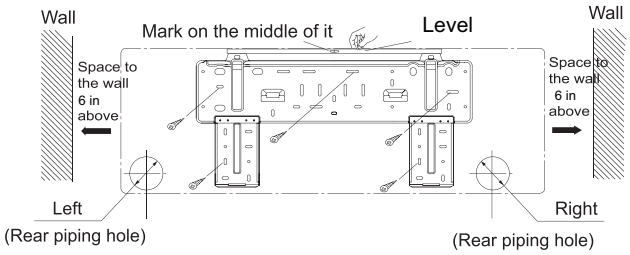
⚠WARNING

Hazardous Service Procedures!

The maintenance and troubleshooting procedures recommended in this section of the manual could result in exposure to electrical, mechanical or other potential safety hazards. Always refer to the safety warnings provided throughout this manual concerning these procedures. When possible, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks. Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.

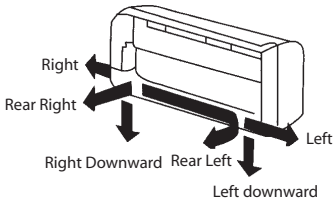
Mounting Location

1. Always mount the rear panel horizontally.
2. Fix the rear panel on the selected location
3. Be sure that the rear panel has been fixed firmly enough to withstand the weight 140 lbs, furthermore, the weight should be evenly shared by each screw.

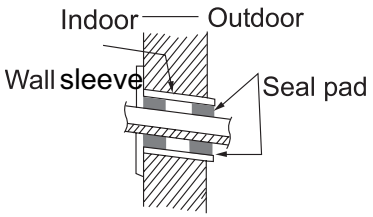


Drilling a hole in the wall to install the piping

The piping can be connected in six different locations on the unit, as shown on figure below:



1. Drill a 2 1/2 inch diameter hole in the wall at a slight downward angle toward the outdoor side in such a way that the end of the pipe outside is 1/4 inch lower than the inside.
2. Insert a sleeve into the hole to prevent the connection piping and wiring from being damaged when passing through the hole.



NOTICE

When a wall sleeve is not used, it is then necessary to drill a straight hole in the wall. If the hole is not straight and uniform, this could result in water leaking from condensation, resulting in property damage.

NOTICE

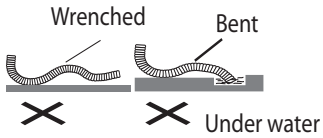
If a wall sleeve is not mounted in the wall, the wiring between the indoor unit and the outdoor unit can possibly be damaged resulting in electrical current loss in the ground wiring.

Installing the water drain pipe

NOTICE

Do not wrench or bend the drain hose and make sure the ends of the drain pipe are not under water. Failure to do so could result in leakage.

1. To ensure proper water drainage, the drain hose should be placed at a downward slant.
2. The water drain pipe must be insulated throughout the house.



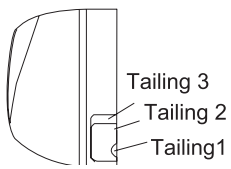
Installing the unit

Note: *The piping can be lead out from right, right rear, left, left rear.*

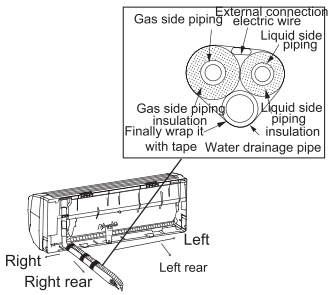
1. When routing the piping and wiring from the left or right side of indoor unit, cut off the tailings from the chassis in necessary.

   (1).Cut off the tailings 1 when routing the wiring only;

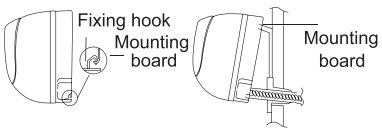
   (2).Cut off the tailings 1 and tailings 2 when routing both the wiring and piping.(or 1,2,3)



2. Take out the piping from body case, wrap the piping electric wire, water pipe with tape and put them through the piping hole.

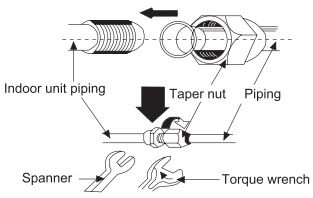


3. Hang the mounting slots of the indoor unit on the upper tabs of the rear panel and check if it is firm enough.



Installing the connection pipe

1. Align the center of the piping flare with the relevant valve.



2. Screw in the flare nut by hand and then tighten the nut with spanner and torque wrench refer to the following.

Table 2. Tightening Torque Table

Hex nut Diameter	Tightening torque (lbf-inch)
6mm - 1/4"	133-177
9.5mm - 3/8"	274-310
12mm - 1/2"	443-487
16mm - 5/8"	531-575

Note: First, connect the connection pipe to indoor unit, then to outdoor unit; pay attention to the piping bending, do not damage the connection pipe; to avoid leakage, do not over tighten the joint nut

Recommended wire size

Models which power supplied from ODU to IDU (In this IOM are specific to all 60Hz models)

Wire type	Wire size
Power supply wire	AWG12
Wires between IDU and ODU	AWG14

Note: Always refer to unit ID tag for additional information on Minimum Circuit Ampacity (MCA) and Maximum Overload Protection (MOP).

⚠WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

1. Open the front panel of the indoor unit by lifting upward.
2. Unscrew and remove the cover plate.
3. Pull the power connection cable through the back of the indoor unit.
4. Firmly attach the power connection cables to the terminal block in the indoor unit, making certain to observe the proper terminal connections as shown on the unit wiring diagram.
5. Reattach the cover plate with the proper screws.
6. The electric wire must be tighten with the wire clip. And for the heat pump unit, the signal control wire must be connected to the terminal board with the wire clip.

Installing Outdoor Unit

Wiring

⚠WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

1. Disassemble handle of right side plate or front side plate of outdoor unit.
2. Take off wire clamp, connect and attach power wiring cord to terminal block. Wiring should match that of the indoor unit.
3. Attach the power wiring cord with wire clamp, for cooling and heating unit, then use the wire clamp to attach the signal control wire, then connect the corresponding connector.
4. Ensure if wire has been attached well.
5. Install handle or front side plate.

Note: Incorrect wiring may cause system damage or malfunction

Note: After attaching the cable, make certain there is adequate space between the connection and the strain relief

Vacuum Pump and Leak Inspection

⚠WARNING

Hazard of Explosion!

Never use an open flame to detect gas leaks. Explosive conditions may occur. Use a leak test solution or other approved methods for leak testing. Failure to follow recommended safe leak test procedures could result in death or serious injury or equipment or property-only-damage.

⚠WARNING

Hazard of Explosion!

Use only dry nitrogen with a pressure regulator for pressurizing unit. Do not use acetylene, oxygen or compressed air or mixtures containing them for pressure testing. Do not use mixtures of a hydrogen containing refrigerant and air above atmospheric pressure for pressure testing as they may become flammable and could result in an explosion. Refrigerant, when used as a trace gas should only be mixed with dry nitrogen for pressurizing units. Failure to follow these recommendations could result in death or serious injury or equipment or property damage.

After the installation of refrigerant lines to both the outdoor and indoor units are completed, the flare connections must be checked for leaks. Pressurize through the service valve ports, the indoor unit and field refrigerant lines with dry nitrogen to 150 psi. Use soap bubbles or other leak-checking methods to see that all flares are leak-free! If not, release pressure; then repair!

SYSTEM EVACUATION

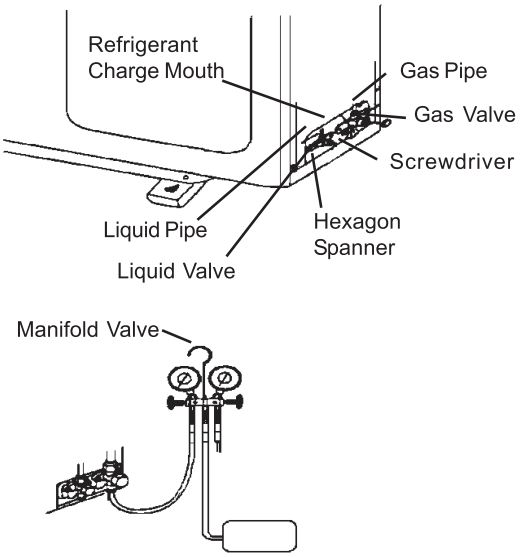
Note: *Since the oudoor unit has a refrigerant charge, the gas and liquid line valves must remain closed.*

1. Upon completion of leak check, evacuate the refrigerant lines and indoor coil before opening the gas and liquid line valves.
2. Attach appropriate hoses from manifold gauge to gas and liquid line pressure taps.
3. Attach center hose of manifold gauges to vacuum pump.
4. Evacuate until the micron gauge reads no higher than 350 microns.
5. Close off valve to vacuum pump and observe the micron gauge. If gauge pressure rises above 500 microns in one (1) minute, then evacuation is incomplete or system has a leak.
6. If vacuum gauge does not rise above 500 microns in one (1) minute, the evacuation should be complete.
7. Blank off vacuum pump and micron gauge, close valves on manifold gauge set.

Note: *DO NOT VENT REFRIGERANT INTO THE ATMOSPHERE.*

8. The liquid line shut-off valve can now be opened. Remove shut-off-valve cap. Fully insert hex wrench into the stem and backout counterclockwise open.

Figure 1. Vacuum Pump and Leak inspection



Gauges must be R410A rated

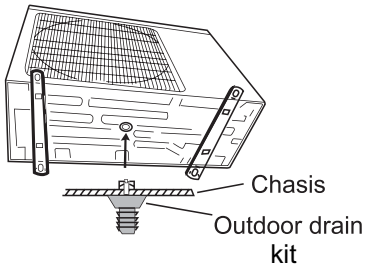
9. The gas valve can now be opened. Open the gas valve by removing the shut-off valve cap and turning the valve stem 1/4 turn counterclockwise using 1/4" Open End or Adjustable wrench.
10. The gas valve is now open for refrigerant flow. If refrigerant lines are longer than twenty five ft it will be necessary to adjust system refrigerant charge upon completion of installation.

Outdoor condensation drainage (Heat pump type only)

When the unit is heating, the condensing water and defrosting water can be drained out reliably through the drain hose.

Installation:

Install the outdoor drain kit in a hole 1 inch on the base plate, and joint the drain hose to the kit, so that the wastewater formed in the outdoor unit can be drained out to the proper place.
In applications where the system may be operating in heating mode during ambient conditions near or below freezing. consider wrapping the drain line with heat tape or equivalent to prevent the drain line from freezing during defrost operation.



Operating Functions

Operation of remote controller

Temperature parameters

- Room set temperature (T set)
- Room ambient temperature (T amb)

Fundamental functions

After powered on, no matter when the compressor is started, the time interval between two startups cannot be less than 3 minutes.

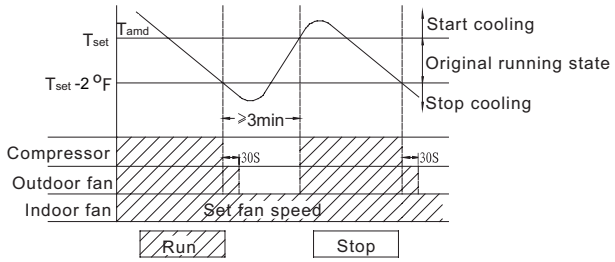
COOL mode

The condition and process of cooling

- If T amb is equal or greater than T set, COOL mode will act, the compressor and outdoor fan will run, and the indoor fan will run at the set speed.
- If T amb is equal or less than T set -2 °F, the compressor will stop, the outdoor fan will delay 30 seconds to stop, and the indoor fan will run at the set speed.
- If T set -2 °F< T amb < Tset, the unit will keep running in the previous mode.

In this mode, the reversal valve will not be powered on and the temperature setting range is 61°F ~ 86°F

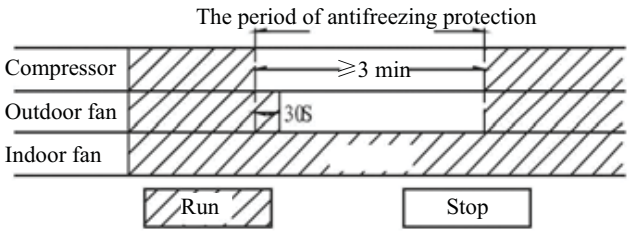
The unit will adjust the running frequency of the compressor automatically according to the change of ambient temperature.



Protection function

- Antifreezing protection

  Under cooling and drying mode, after the compressor run about 10 mins, when the pipe temp.of the evaporator is to low, the compressor will stop, the outdoor fan will stop after 30s, under cooling mode the indoor fan and swing motor will keep running in the original mode, under drying mode the indoor fan will run at low fan speed, the swing motor will run in the original mode. When antifreezing protection is eliminated and the compressor has stopped for 3 minutes, the unit will resume running in the original mode.



Overcurrent protection

If total current is high, the compressor will run in limited or dropped frequency. When total current goes on rising over the stated value, the compressor will stop, the outdoor fan will delay 30 seconds to stop.

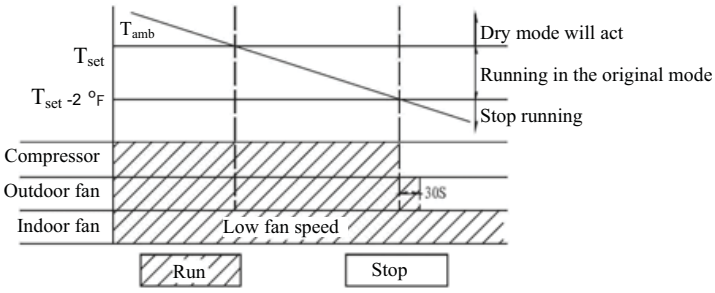
DRY mode

The condition and process of drying

- If T amb > T set, DRY mode will act, the indoor fan, outdoor fan and compressor will run, and indoor fan will run at low speed.
- If T set -2 °F< T amb < T set t he unit will keep running in the original mode.
- If T amb < T set -2 °F the compressor will stop running, the outdoor fan will delay 30 seconds to stop and the indoor fan will run at low speed.

In this mode, the reversal valve will not be powered on and the temperature setting range is 61°F~86 °F.

The unit will adjust the running frequency of the compressor automatically according to the change of ambient temperature.



Protection

Protection is the same with that in COOL mode.

HEAT mode

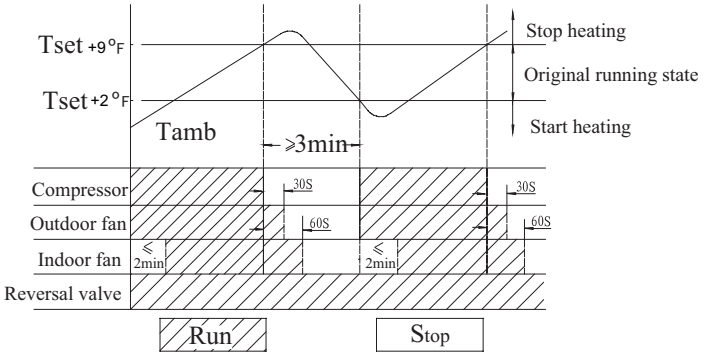
The condition and process of heating

- If T amb is equal or less than T set +2 °F HEAT mode will act, the compressor, outdoor fan and 4-way valve will run simultaneously, the indoor fan will delay at most for 2min to run.
- If T set +2 °F < T amb < T set +9 °F, the unit will keep running in the original mode.
- If T amb > T set +9°F, the compressor will stop, the outdoor fan will delay 30 sec to stop and the indoor fan will blow for 60 sec at the original speed and then stop.

In this mode, the temperature setting range is 61°F~86°F.

The air conditioner will adjust the running frequency of the compressor automatically according to the change of ambient temperature.

When the unit is turned off in HEAT mode, or switched to other mode from HEAT mode, the four-way valve will be powered off 2min later after the compressor stops.



The condition and process of defrosting

When frost is detected in the condenser, the system will enter into defrosting state. When defrosting starts, the compressor and indoor fan will stop, and the outdoor fan and four-way valve will delay 30 seconds to stop. The compressor will start again after 30 seconds and when the compressor has run for 8mins, the compressor will stop.

After 30 seconds the four-way valve opens and after another 60 seconds, the compressor and outdoor fan resume running. The indoor fan will delay 2 minutes to run at the latest and temperature on the display panel shows H1.

Under heating mode,when the compressor is stopped by malfunction, the indoor fan will blow at low fan speed for 60s and then stop.

Protection

- Overcurrent protection

  If total current is high, the compressor will run in limited or dropped frequency. When total current go on rising over the stated value, the compressor will stop, the outdoor fan will delay 30 seconds to stop.

FAN mode

In this mode, the indoor fan will run the fan in High, Med, Low and Auto mode. The compressor, outdoor fan and four-way valve will stop.

In this mode, the temperature setting range is 61 F~86 F.

The unit will adjust the running frequency of the compressor automatically according to the change of ambient temperature.

AUTO mode

In this mode, the system selects COOL, HEAT and FAN mode automatically according to the change of ambient temperature. The protection function is the same with that of COOL/HEAT mode.

The unit will adjust the running frequency of the compressor automatically according to the change of ambient temperature.

Other control

ON / OFF

Each time the On/Off button of the remote controller is pressed, the On/Off state will switch once.

MODE selection

Press the MODE button on the remote controller to select and display the following modes: AUTO, COOL, DRY, FAN, and HEAT.

TEMP. setting button

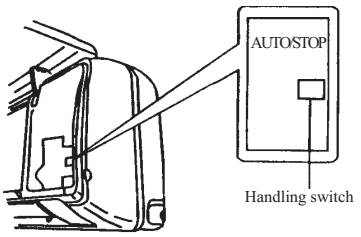
Each time TEMP + or TEMP - button is pressed, the set temperature will be increased or decreased by 2°F.

Adjustingrange is 61°F~86°F . In AUTO mode, this button does not function.

AUTO key

When the unit stops, press AUTO key, the unit will run under AUTO mode and the swing motor starts.

When the unit is running, press AUTO key, the unit will be stopped.



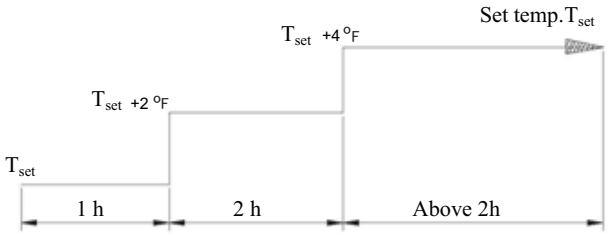
increased by another 1°C af

Timer control

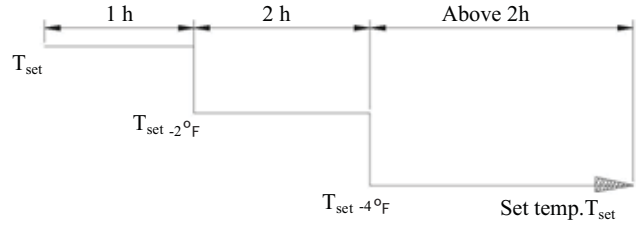
The unit is turned on or off according to the timer set by the remote controller.

Sleep control

When the air conditioner is in COOL or DRY mode, after Sleep mode has been set properly, the preset Tset will be increased by+2°F after the sleep program has run for 1 hour, and Tset will be increased by another +2 °F after 2 hours. Tset has been increased by +4 °F total in two hours. Then the unit will run at this set temperature and at the set speed.



When the air conditioner is in HEAT mode, after Sleep mode has been set properly, the preset Tset will be decreased by +2 °F after the sleep program has run for 1 hour, and Tset will be decreased by another +2 °F after 2 hours. Tset has been increased by +4 °F totally in two hours. Then the unit will run at this set temperature and at the set speed.



In AUTO or FAN mode, the setting temp. will not change.

Indoor fan control

Use the remote controller to set the indoor fan running at HIGH, MED or LOW speed. At this time the fan will run at high, medium or low speed. It can also be set to AUTO and the indoor fan will select fan speed(HIGH, MED or LOW) automatically according to ambient temperature.

There are at least 3 mins and 30s delay for fan speed shift.

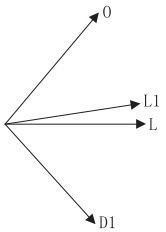
Power supply for outdoor unit

The power supply for outdoor unit is turned on in AUTO, COOL, HEAT and DRY mode under turn-on state.

The power supply for outdoor unit will delay 3 minutes to turn off under turn-off state or in the FAN mode under turn-on state.

Swing control

Use the SWING button of the wireless remote control to control SWING On and Off. Swing will only act when indoor fan is running. After power on, the swing motor turns back to 0 position and closes the air outlet vent; if it does not preset swing, after the unit is turned on, it will turn to the max. air outlet D1 position; then turn back to L position under COOL mode.Under HEAT mode, the guide louver stays at D1; when in swinging state, it will swing between L1 and D1 position. When the unit is turned off, it will turn back to 0 position.



Buzzer control

When the unit is power on or receives remote control signal or the auto key be pressed, the buzzer will give out a beep.

Power-off memory function

Contents of memory: Mode; Swing; Set fan speed, Set temperature, Timing etc.

Under turn-on state, when power off and power on, the power supply for outdoor unit will be turn on after 3 mins.

Under turn-off state, when power off and power on, the power supply for outdoor unit will be turn on immediately.

Delay Protection of Compressor

Under COOL; DRY; HEAT mode, before each time the compressor starts, there will be 3 mins delay.

Common protection function in each mode

Overload protection

Ttube: at cooling,it detects the temp. of outdoor heat exchanger,at heating,it detects the temp. of indoor heat exchanger.

When Ttube is detected high, the compressor will run in limited frequency. When Ttube goes on rising over the stated value, the compressor will stop; under AUTO HEAT or HEAT mode, indoor fan will blow 60s at low fan speed and then stop; under other mode, the indoor fan will run at set speed.

Compressor discharge temperature protection

When discharge temperature is too high over the stated value, the compressor will stop, and When discharge temp. resume normal and the compressor has stopped for 3 minutes, the unit will resume its original operating status.

Communication malfunction

When not receiving correct signal for 3 minutes, the unit has communication malfunction and the outdoor unit stops, it is the same as normal stop when meeting the set temp.

Module protection

When module is in protection, the compressor will stop, after the compressor has stopped for 3 minutes, it will resume to running. During module protection period, the indoor unit displays malfunction and the whole unit stops.

Connection Pipe

Connection Pipe	Heat pump		4MXW8509A1	4MXW8512A1	4MXW8518A1	4MXW8524A1	4MXW8536A1
			4TXK8509A1	4TXK8512A1	4TXK8518A1	4TXK8524A1	4TXK8536A1
	Refrigerant Charge(oz)		45.8	45.8	49.3	56.4	91.7
	Length(ft)		24.6	24.6	24.6	24.6	24.6
	Gas additional charge(oz/ft)		0.2	0.2	0.2	0.6	0.6
	Outer Diameter	Liquid Pipe(inch)	1/4	1/4	1/4	1/4	1/4
		Gas Pipe(inch)	3/8	3/8	1/2	5/8	5/8
	Max Distance	Height(ft)	65	65	65	65	65
		Length(ft)	100	100	130	130	130

Wiring Diagrams

⚠WARNING

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

⚠WARNING

Improperly installed and grounded field wiring poses FIRE & ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in the National Electrical Codes (NEC) and your local/state electrical codes. All field wiring MUST be performed by qualified personnel.
Failure to follow these requirements could result in death or serious injury.

Figure 1. 4MXW8509A1 4MXW8512A1 4MXW8518A1 (Heat pump indoor units)

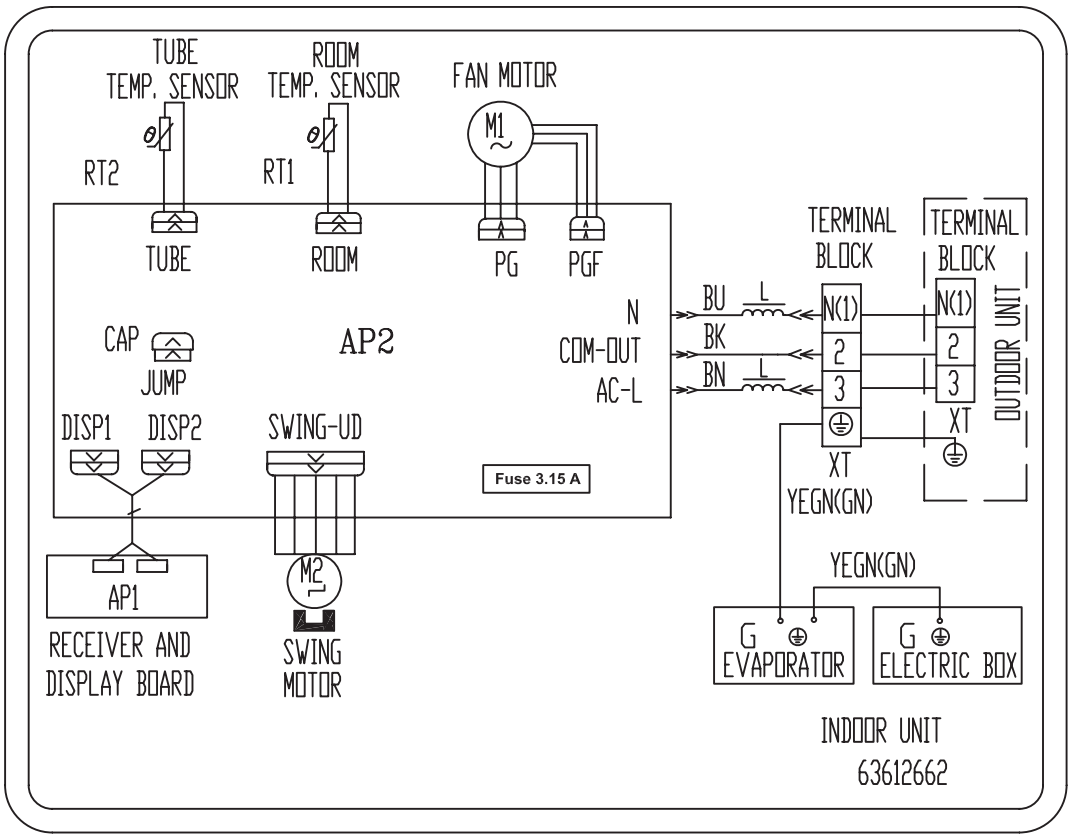


Figure 2. 4MXW8524A1 (Heat pump indoor units)

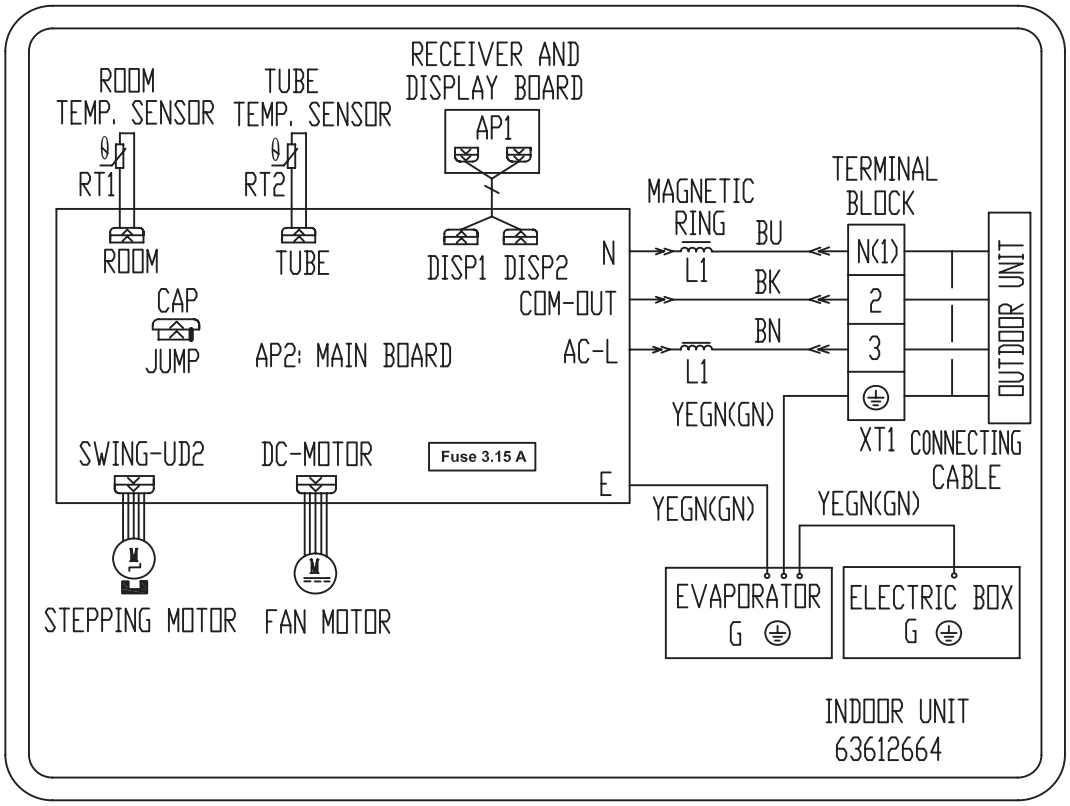


Figure 3. 4MXW8536A1 (Heat pump indoor units)

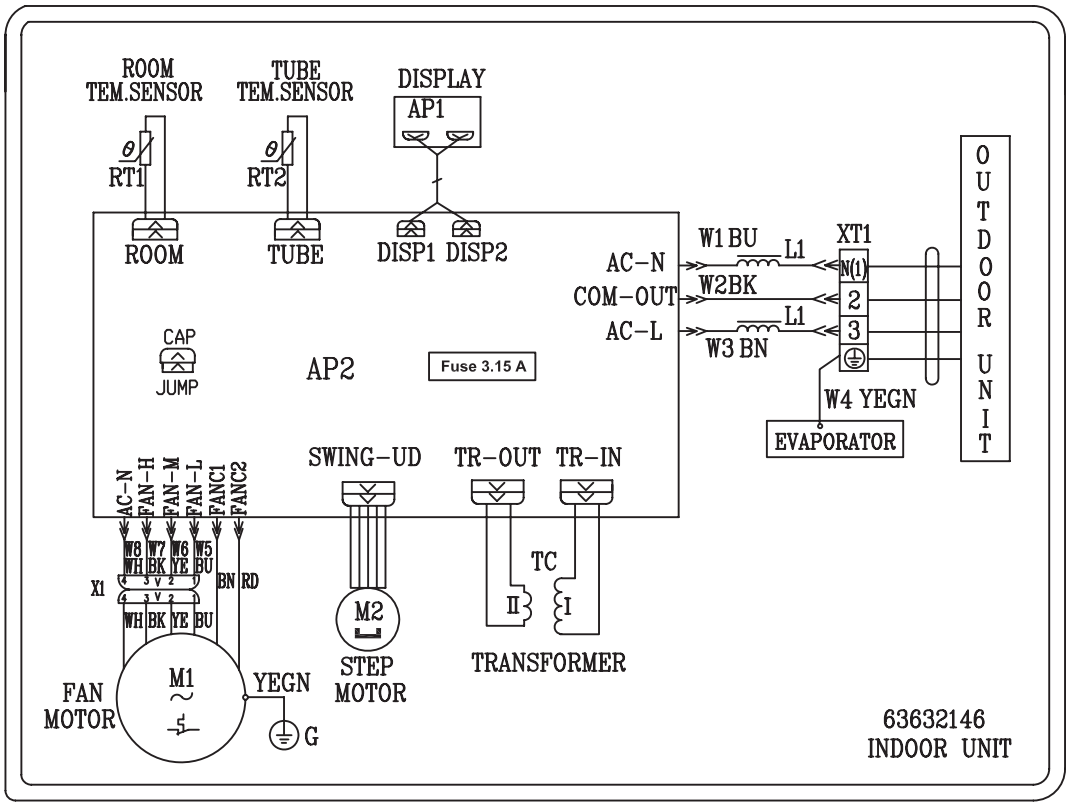


Figure 4. 4TXK8509A1 4TXK8512A1 (Heat pump outdoor units)

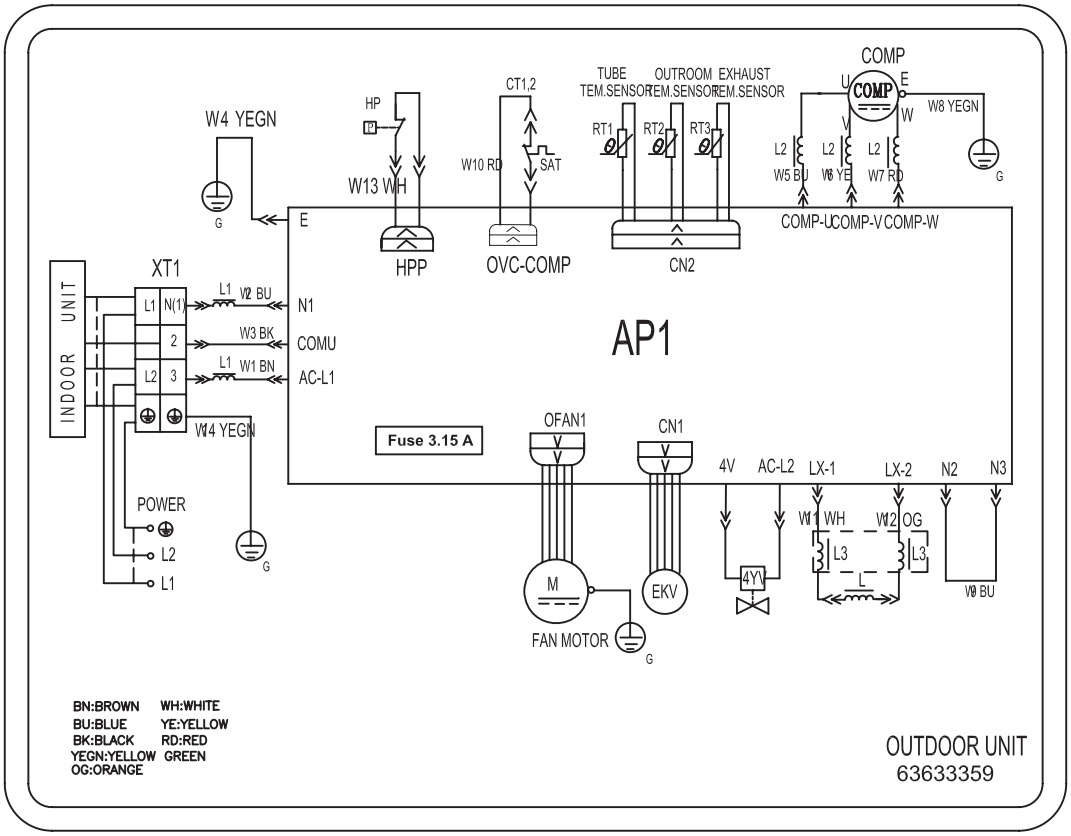


Figure 5. 4TXK8518A1 (Heat pump outdoor units)

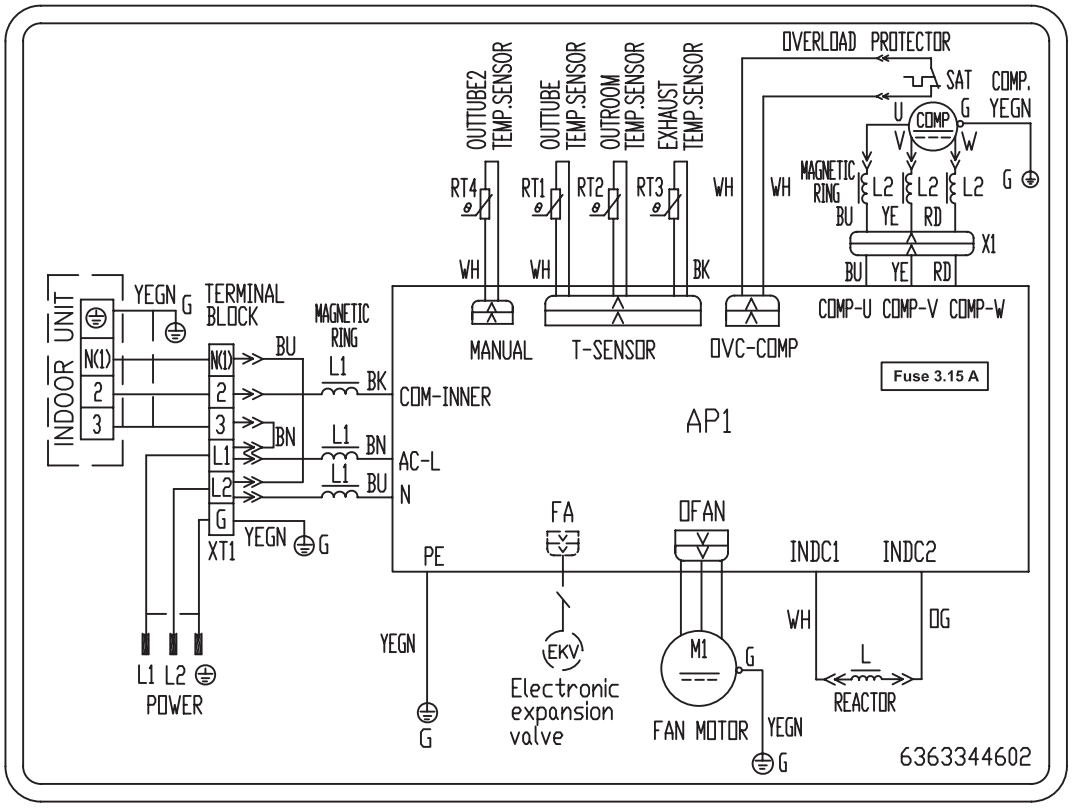


Figure 6. 4TXK8524A1 (Heat pump outdoor units)

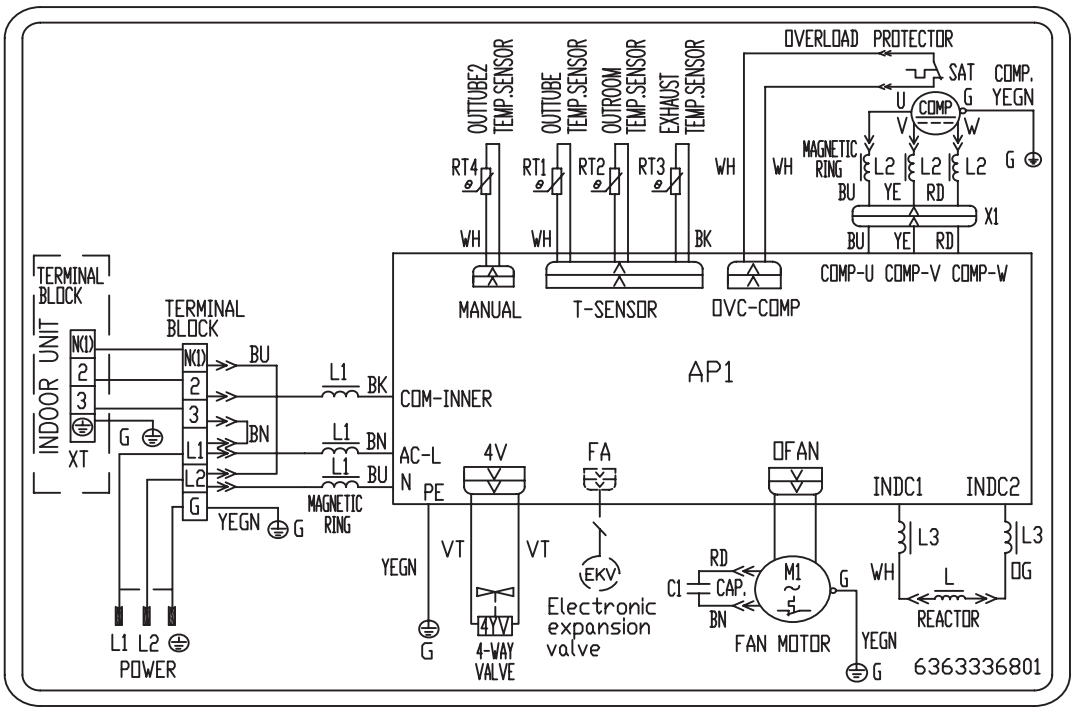
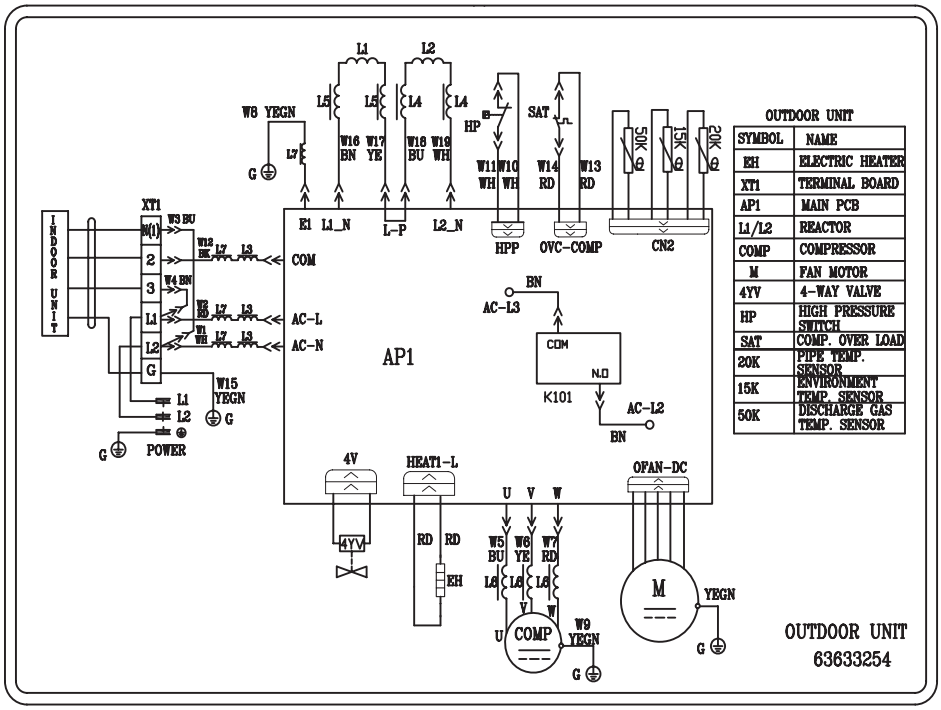


Figure 7. 4TXK8536A1(Heat pump outdoor unit)



CONFORMS TO
UL STD. 1995
CERTIFIED TO
CSA STD. C22.2
N0. 236

Literature Order Number MS-SVN23A-EN
Date September 2012
Supersedes New

The manufacturer has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice.

66129912205

PDQ-O LED

24V DC Strip Lighting

Wet Location / Outdoor

PDQ-H-O High Output
PDQ-S-O Standard Output

LEDs

- **High-output**
  Warm White: 2,800°K ±100°K,
  CRI 70, 225 lm per foot
  Natural White: 4,100°K ±100°K,
  CRI 65, 235 lm per foot
- **Standard-output**
  Warm White: 2,800°K ±100°K,
  CRI 70, 125 lm per foot
  Natural White: 4,100°K ±100°K,
  CRI 65, 135 lm per foot

System

- 24VDC system, onboard constant-current driver:
  High-output – 3.65W per foot
  Standard-output – 2.30W per foot
- Dimmable with magnetic low-voltage (MLV) dimmer
- 20' max. run length
- Ultra-compact strip
- Available in 5' and 20' lengths
- 5' power feeds included with 5' lengths; 10' power feeds included with 20' lengths
- Field-cuttable with convenient markings every 4 inches
- Stainless steel mounting clips available
- UL/C-UL Listed for wet location (IP67)

24VDC, High-output LEDs

☐ PDQ24-H-O-20-WW	Warm White High-output LED (2,800°K ±100K), CRI 70	20'
☐ PDQ24-H-O-20-NW	Natural White High-output LED (4,100°K ±100K), CRI 65	20'
☐ PDQ24-H-O-5-WW	Warm White High-output LED (2,800°K ±100K), CRI 70	5'
☐ PDQ24-H-O-5-NW	Natural White High-output LED (4,100°K ±100K), CRI 65	5'

24VDC, Standard-output LEDs

☐ PDQ24-S-O-20-WW	Warm White Standard-output LED (2,800°K ±100K), CRI 70	20'
☐ PDQ24-S-O-20-NW	Natural White Standard-output LED (4,100°K ±100K), CRI 65	20'
☐ PDQ24-S-O-5-WW	Warm White Standard-output LED (2,800°K ±100K), CRI 70	5'
☐ PDQ24-S-O-5-NW	Natural White Standard-output LED (4,100°K ±100K), CRI 65	5'

Project _____

Fixture Type _____

Location _____

Contact _____

Phone _____

CSL CREATIVE SYSTEMS LIGHTING®
A Division of Troy-CSL Lighting, Inc.
14508 Nelson Avenue City of Industry CA 91744 Tel: 626.336.4511 Fax: 626.330.4266 www.csllighting.com

PDQ-O LED
Accessories

System

- 24VDC system, onboard constant-current driver:
  High-output – 3.65W per foot
  Standard-output – 2.30W per foot
- Dimmable with magnetic low-voltage (MLV) dimmer
- 20' max. run length
- Ultra-compact strip
- Available in 5' and 20' lengths
- 5' power feeds included with 5' lengths; 10' power feeds included with 20' lengths
- Field-cuttable with convenient markings every 4 inches
- Stainless steel mounting clips available
- UL/C-UL Listed for wet location (IP67)

PDQ LED Outdoor Dimmable LED Drivers

	24VDC					
☐	D-133	20W Mag	24V	E.I. magnetic	5" x 2¼" x 2"	4 lbs
☐	D-134	40W Mag	24V	E.I. magnetic	5" x 2¼" x 2"	4 lbs
☐	D-135	60W Mag	24V	E.I. magnetic	6" x 2⅝" x 2¼"	4 lbs
☐	D-136	100W Mag	24V	E.I. magnetic	6" x 2⅝" x 2¼"	5 lbs
☐	D-137	150W Mag	24V	E.I. magnetic	7½" x 3" x 3"	7 lbs

Stainless Steel Mounting Clip

☐	PDQ-OD-SS-CLIP	Stainless steel mounting clip

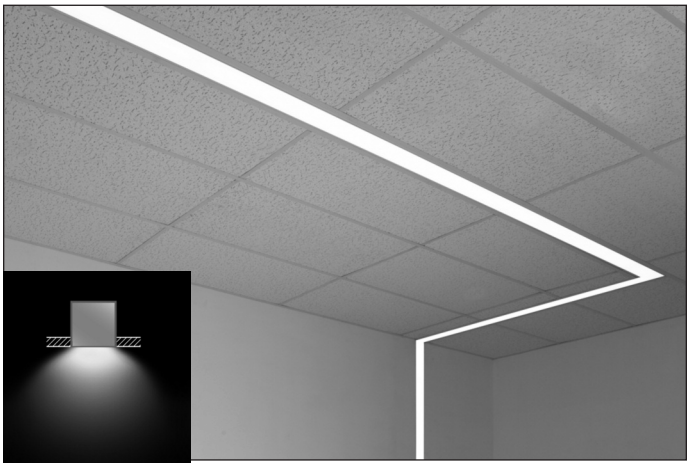
CSL CREATIVE® SYSTEMS LIGHTING
A Division of Troy-CSL Lighting, Inc.
14508 Nelson Avenue City of Industry CA 91744 Tel: 626.336.4511 Fax: 626.330.4266 www.csllighting.com

LED

BUY AMERICAN ACT OF 2009 COMPLIANT

FINELITE

High Performance 4” Aperture (HP-4) - Recessed



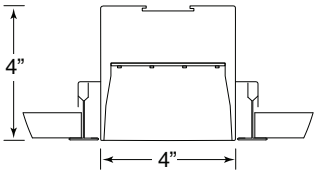
INDUSTRY BEST 10 YEAR WARRANTY HP-4-LED

LED lighting facts® A Program of the U.S. DOE

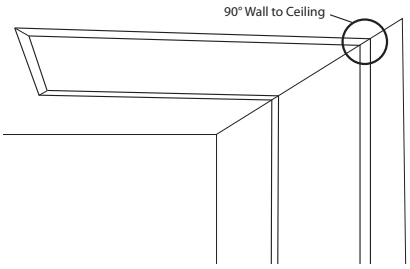
Date	
Project	
Type	
Comments	

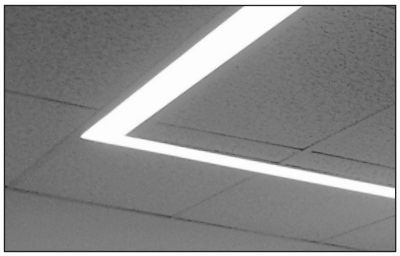
DESCRIPTION

High Performance 4” aperture recessed (HP-4 R) is a patent pending linear LED luminaire for offices, schools, retail and healthcare facilities. HP-4 R is the first recessed linear LED luminaire to feature On-Grid™ mounting for standard lengths, making installation quick and easy. Advanced optical designs and mid-powered LEDs deliver an efficient, long-lasting luminaire free of glare and socket shadows for continuous lighting applications. HP-4 R accommodates grid and drywall ceilings. 90º corners are available for ceiling and wall-to-ceiling applications. HP-4 R is RoHS compliant.



Flush Diffuser





DIMENSIONS & LIGHT ENGINE:

A glare-free experience is attained with mid-powered LEDs properly distributed and paired with a precise diffuser to eliminate pixilation.

MITERED ANGLES:

Illuminated 90º corners and wall-to-ceiling configuration are seamless without socket shadows. Custom angles are available. Contact factory.

SEAMLESS ILLUMINATION:

The optical design features seamless lenses up to 12’ in length and eliminates socket shadows at joints and corners.

ORDERING GUIDE

Sample Number: HP-4 R - 32’ - S0 - 3500K - 120V - SC - C1

HP-4 R

Finelite **Series HP-4 R**
Size (4’, 8’, 12’ multiples standard)
Light Engine (SO - Standard Output, HO - High Output)
LED Color Temperature (3000K, 3500K, 4000K)
Voltage (120, 277V)
Circuiting (SC-Single Circuit, MC-Multi-Circuit)
Mounting (C1-1" T-Bar, C2-9/16" T-Bar, C3-Screw Slot, C3F-Flush Screw Slot, VF-Visible Flange, C2T-9/16" Tegular, SF-Spackle Flange, TZ6-Tech Zone 6”)

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LED

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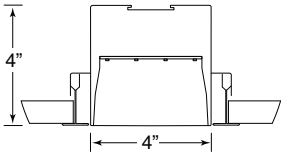
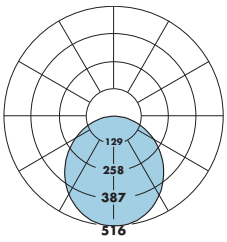
FINELITE

High Performance 4” Aperture (HP-4) - Recessed

PHOTOMETRY

Standard Output
Efficacy (Lumen per watt): 79.9
Total luminaire output: 1447 Lumens/ 18 Watts
CRI: 83
R9: 10
CCT: 4000K
ITL LM79 Report 74686

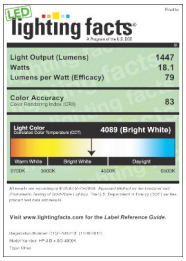




— Refer to www.finelite.com for additional photometry and product information.

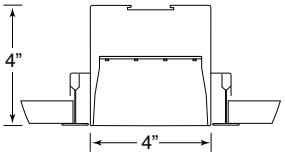
CANDLEPOWER SUMMARY

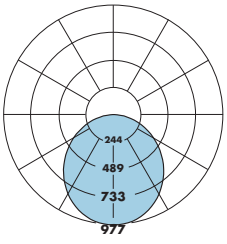
	0.0	22.5	45	67.5	90	Flux
0	514	514	514	514	514	
5	514	511	511	511	513	49
15	493	492	492	491	492	139
25	453	492	492	491	492	139
35	397	397	395	395	394	247
45	331	330	328	328	326	254
55	255	256	256	255	251	228
65	179	179	180	178	174	177
75	103	103	104	102	99	109
85	33	33	34	34	33	37
90	0	2	4	5	6	



PHOTOMETRY

High Output
Efficacy (Lumen per watt): 74.6
Total luminaire output: 2754 Lumens/ 37 Watts
CRI: 83
R9: 10
CCT: 4000K
ITL LM79 Report 74687

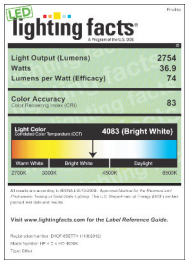




— Refer to www.finelite.com for additional photometry and product information.

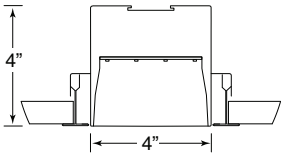
CANDLEPOWER SUMMARY

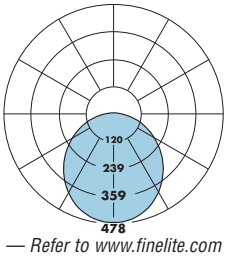
	0.0	22.5	45	67.5	90	Flux
0	973	973	973	973	973	
5	974	969	968	969	972	92
15	936	932	931	932	934	263
25	860	859	855	856	858	395
35	754	755	750	751	751	470
45	628	629	625	625	623	483
55	487	489	488	486	481	435
65	341	342	343	340	334	337
75	199	198	198	194	190	208
85	65	64	64	63	61	70
90	0	4	6	8	8	



PHOTOMETRY

Standard Output
Efficacy (Lumen per watt): 74
Total luminaire output: 1348 Lumens/ 18 Watts
CRI: 84
R9: 14
CCT: 3500K
ITL LM79 Report 74684

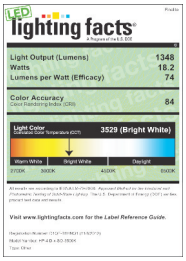




— Refer to www.finelite.com for additional photometry and product information.

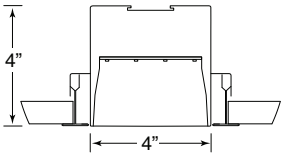
CANDLEPOWER SUMMARY

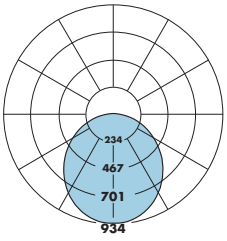
	0.0	22.5	45	67.5	90	Flux
0	476	476	476	476	476	
5	476	474	473	473	475	45
15	457	456	455	455	456	129
25	420	422	418	418	419	193
35	368	369	367	367	367	230
45	308	307	306	306	304	236
55	238	239	238	238	235	213
65	167	167	168	166	163	165
75	97	97	97	96	94	102
85	32	31	32	32	32	35
90	0	2	4	5	6	



PHOTOMETRY

High Output
Efficacy (Lumen per watt): 70.5
Total luminaire output: 2622 Lumens/ 37 Watts
CRI: 84
R9: 16
CCT: 3500K
ITL LM79 Report 74685

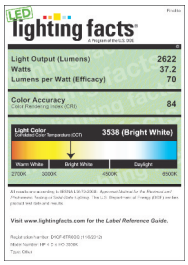




— Refer to www.finelite.com for additional photometry and product information.

CANDLEPOWER SUMMARY

	0.0	22.5	45	67.5	90	Flux
0	930	930	930	930	930	
5	930	926	925	925	928	88
15	893	890	889	890	891	251
25	820	821	816	816	817	377
35	719	719	714	715	714	448
45	598	598	595	595	592	460
55	463	464	463	462	456	413
65	325	325	326	323	317	320
75	188	188	189	186	181	198
85	61	61	62	62	60	67
90	0	2	5	6	7	



Consult www.finelite.com for 3000K photometric reports.

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Due to continuing product improvements, Finelite reserves the right to change specifications without notice. Please visit www.finelite.com for most current data.

LED

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FINELITE

High Performance 4” Aperture (HP-4) - Recessed

SPECIFICATIONS

CONSTRUCTION: Precision cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring standard. Housing is powder coated.

ENDCAPS: Flat endcap at each end of run adds 0.05” to overall length.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors are finished in 96 LG high reflectance matte white powder coat paint.

DIFFUSER: Frost white snap-in lens, 73% transmissive, 99% diffusion.

LIGHT ENGINE: Available in two lumen packages - High Output and Standard Output. High Output (HO): 4ft 3500K delivers 2622 lumens at 37.2 watts. Standard Output (SO): 4ft LED 3500K delivers 1348 lumens at 18.2 watts. High Output (HO): 4ft 4000K delivers 2754 lumens at 36.9 watts. Standard Output (SO): 4ft LED 4000K delivers 1447 lumens at 18.1 watts. Light engine is made up of high performance mid-powered LEDs and is designed to distribute heat properly to maximize the life of the LED.

LED COLOR TEMPERATURE: Available in 3000K, 3500K, and 4000K. CRI: 87 (3000K-HO), 87 (3000K-SO), 84 (3500K-HO), 84 (3500K-SO), 83 (4000K-HO), 83 (4000K-SO). R9: 33 (3000K-HO), 34 (3000K-SO), 16 (3500K-HO), 14 (3500K-SO), 10 (4000K-HO), 10 (4000K-SO).

DRIVER: High performance LED driver. Driver is fully accessible from below the ceiling. *120/277v. Power Factor = 95.6%-HO, 86.2%-SO (3000K), 97.5%-HO, 97.8%-SO (3500K), 97.6%-HO, 97.9%-SO (4000K). Total harmonic distortion (THD) <20%. Input current: 3000K HO=0.325A, SO=0.172A. 3500K HO=0.317A, SO=0.155A. 4000K HO=0.315A, SO=0.154A. *Driver is wired for dimming or non-dimming. Dimming is compatible with 0-10v controls with a range of 100-10%.

ELECTRICAL: 120 or 277V prewired. Fixture and electrical components are UL/C-UL listed and fixture will bear UL/C-UL labels. Optional Adders: emergency circuits, emergency battery packs. Optional: Chicago Plenum Available. Contact factory.

MOUNTING: Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to ceiling grid from above. Tie-in T-Bar brackets. Connect luminaire to T-Bar for securing to structure. Consult local code for appropriate tie-wire recommendations.

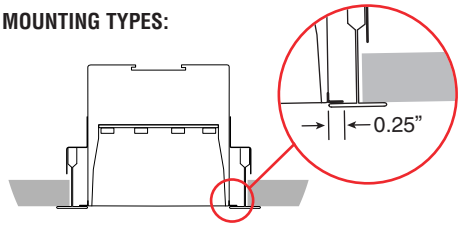
FEED: Standard with (5) 18 gauge wires. 14 gauge wires used when fixture current exceeds 5amps. Optional 6’ flex conduit whips available.

LENGTHS: Standard 4’, 8’, and 12’ section lengths can be combined to make longer runs. Contact factory for lengths in increments of 1’ or down to the inch.

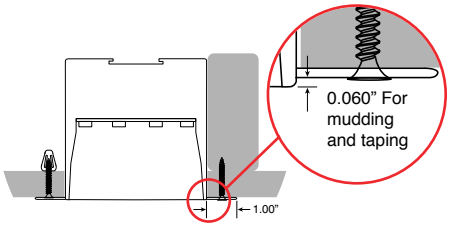
WEIGHT: Fixture weight = 2.5 lb/ft.

WARRANTY: HP-4 R comes standard with a 10-year warranty on all components.

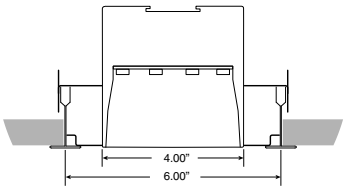
MOUNTING TYPES:



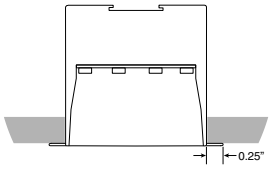
1” T-Bar (C1) & 9/16” T-Bar (C2)



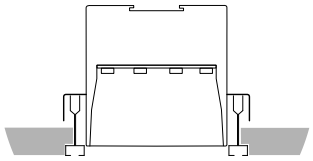
Spackle Flange (SF)



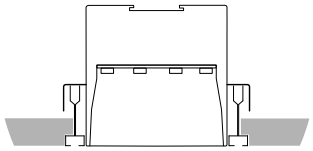
Tech Zone (TZ6)



Visible Flange (VF)

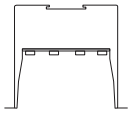


Standard Screw Slot (C3)



Standard Screw Slot (C3F)

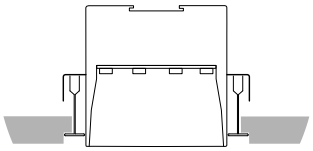
Housing With Extruded Flange (V1)



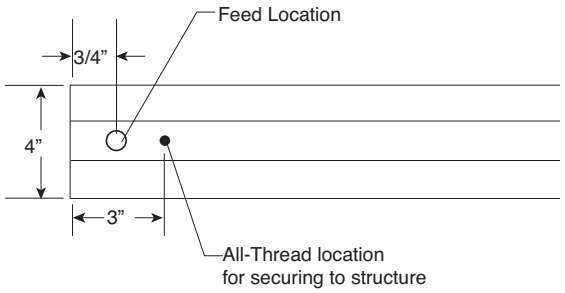
Ceiling Options
C1, C2, C3, VF

Housing Without Extruded Flange (V2)
Ceiling Hardware Attached

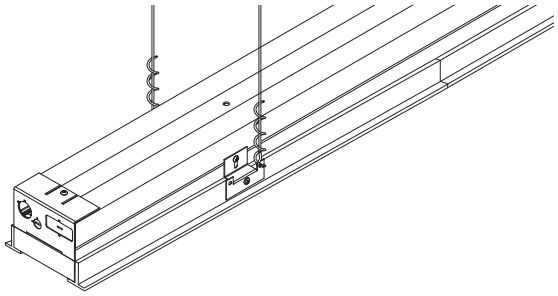
Ceiling Options
C2T, C3F, SF, TZ6



9/16” Tegular (C2T)



SHEET ROCK INSTALLATION:
Flex conduit is secured to top of fixture. Support to structure using All-Thread. All-Thread support holes are located on each end of the fixture.



T-BAR INSTALLATION:
HP-4 R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the fixture to T-Bar and provide support to structure location.

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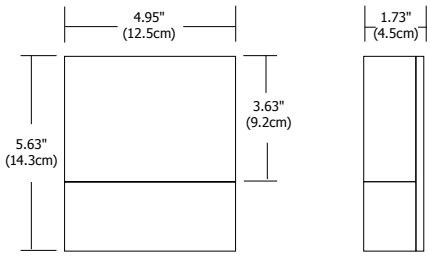
Due to continuing product improvements, Finelite reserves the right to change specifications without notice. Please visit www.finelite.com for most current data.

 Form CTK0075.01/13

TV LED - INDOOR/ OUTDOOR

REV.12.13.11



Description:
The geometric TV **LED** wall sconce provides intense light with warm white **LED**s. Available with satin aluminum or white base, fixture features crystal diffuser. IP 65 rated for indoor and outdoor applications. ADA compliant. Fixture includes 5 year warranty.

Finish:
Satin Aluminum or White

Lamp Specification:
6.7 Total Watts (LED and power supply), 12VAC **LED**, 2878K, 86CRI, 323 lumens, 48 lumens per watt; 70% lumen maintenance based on 50,000 hours of operation

Power Supply:
4x1W 700mA driver
Not dimmable

Dimming:
Not dimmable

Weight:
4 lb (1.80 kg)

	Type	Lamp	Finish
TV –	**W** –	**L1** –	**SA**
	W Wall	**L1** LED	**SA** Satin Aluminum **WH** White

PROJECT:

FIXTURE TYPE:

DATE:

1718 W. Fullerton Ave. Chicago, IL 60614 P: 773.770.1195 F: 773.935.5613 www.edgelighting.com

Edge LIGHTING

SISTEMALUX

SPECIFICATION SHEET

LOFT
WALL

S.667___-120-___
LED COLOR / FINISH

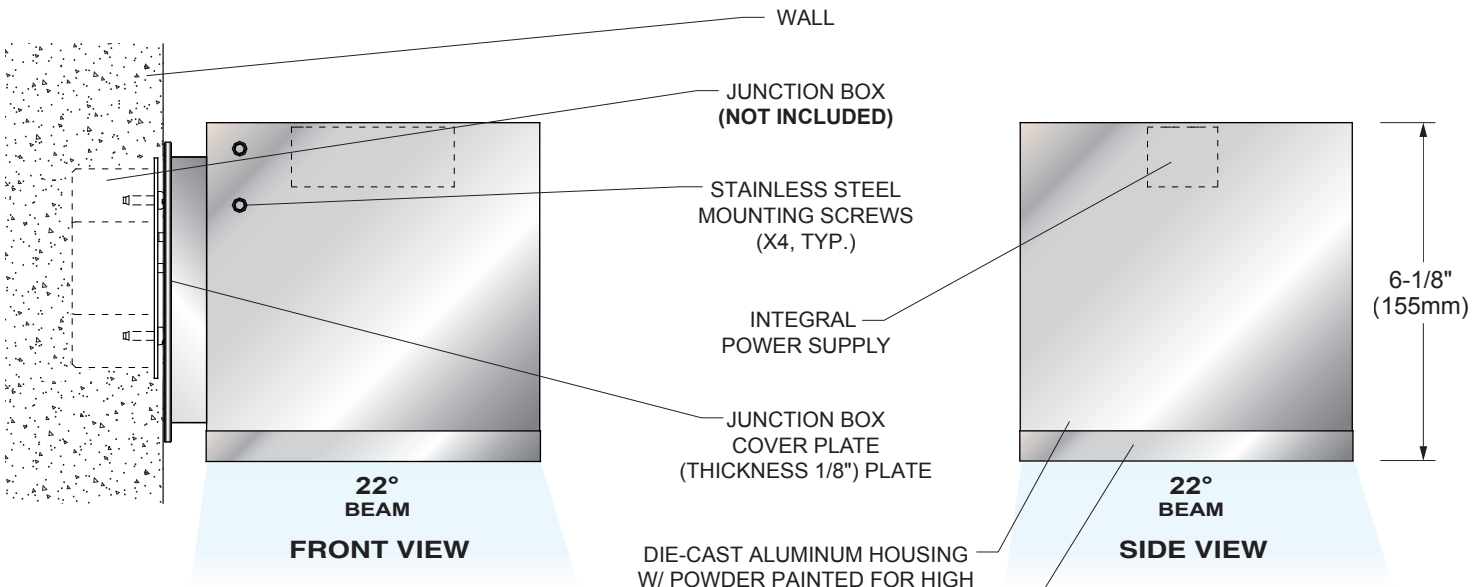
LAMPING: 10W ACCENT LED, **(SEE LED COLOR)**

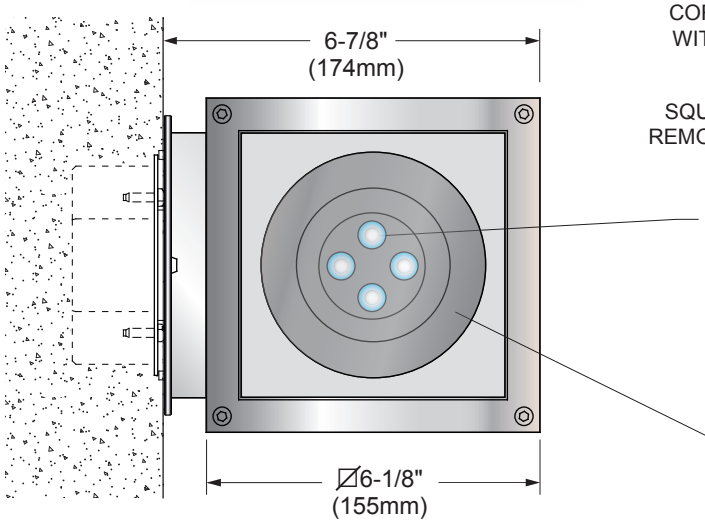
PROJECT NAME: _____

TYPE: _____ **QTY:** _____

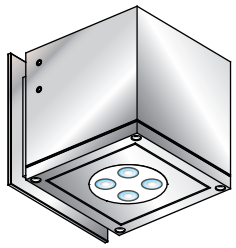
LAST UPDATE: JULY 18, 2012

The LOFT WALL is an outdoor wall application projecting a 22° downlight beam. This die-cast aluminum housing is powder painted for high corrosion resistance. Simple clean cut lines for various applications.





BOTTOM VIEW



ISOMETRIC VIEW

IP 65 | **IK 06**

PLEASE CONTACT FACTORY FOR BLUE, RED GREEN OR AMBER LED COLOR OPTION

ACCESSORIES (TO BE ORDERED SEPARATELY)

- ◯ **S.6604** - 30° INCLINED BRACKET
- ◯ **S.6639** - ELLIPSOIDAL BEAM LENS
- ◯ **S.6605** - EXTENSIVE BEAM LENS

LED COLOR

- ◯ **S.6678** - 10W ACCENT COOL WHITE LED, 6000K
- ◯ **S.6678W** - 10W ACCENT WARM WHITE LED, 3200K

VOLTAGE ✔ 120V

FINISH ◯ 01 - WHITE ◯ 14 - ALUMINUM GREY

c UL us

5455 de Gaspé
suite 100, Montréal (Québec)
Canada H2T 3B3
P.: 514.523.1339 F.: 514.525.6107

SISTEMALUX GROUP

LOFT
WALL

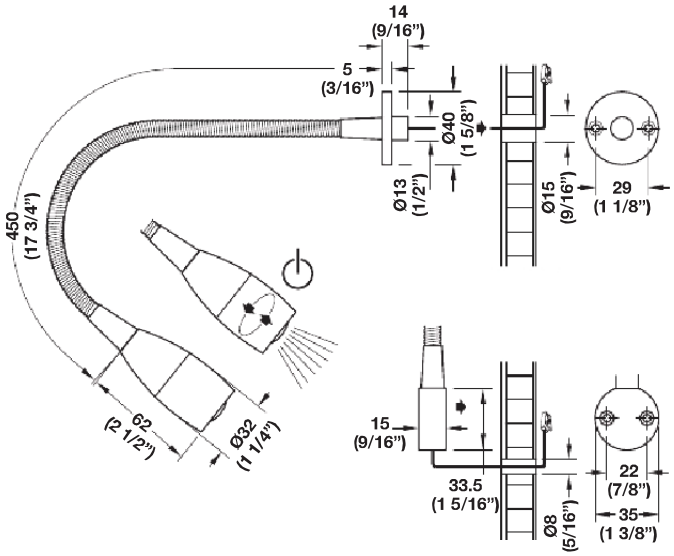
Loox LED 2018

Flexible Light

12 V System

Recess Mounted

Surface Mounted



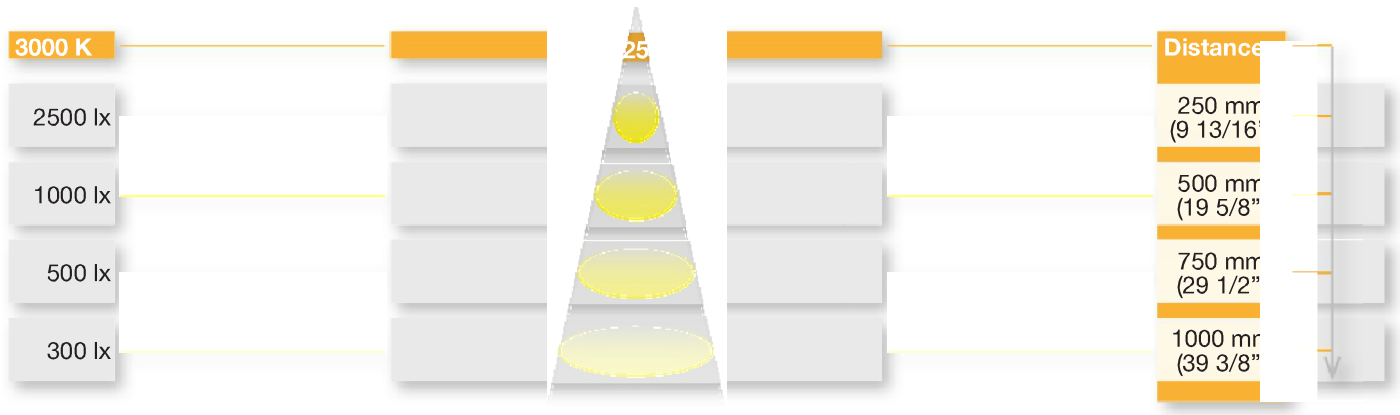
- Reading light
- Flexible spotlight in the bookshelf or storage area
- Easy to position
- Glass lens provides a pleasant, uniform cone of light
- Integrated switch – simply rotate the head of the light for on/off

Supplied with: Mounting accessories
Accessories: Driver - page **21**
Note: Cannot be dimmed

Light Color: 3000 (warm white)
Diameter: 32 mm (1 1/4")
Length: 450 mm (17 3/4")
Wattage: 2
Number of LEDs: 1
Lumen: 70
Lumen per watt: 48
Color rendering index (CRI): 93
Cable length: 2 m (78 3/4")
Material/Finish: Steel, silver

Mounting	Item No.	SRP
Surface	833.74.100	$48.00
Recess	833.74.110	$48.00

Packing: 1 pc.

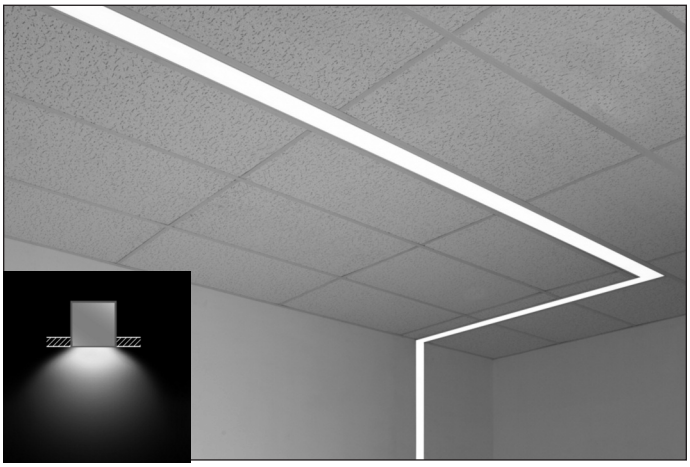


LED

BUY AMERICAN ACT OF 2009 COMPLIANT

FINELITE

High Performance 4” Aperture (HP-4) - Recessed



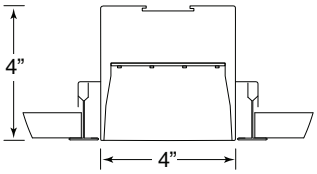
INDUSTRY BEST 10 YEAR WARRANTY HP-4-LED

LED lighting facts® A Program of the U.S. DOE

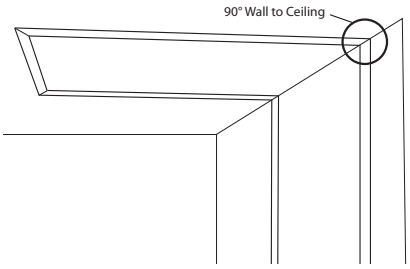
Date	
Project	
Type	
Comments	

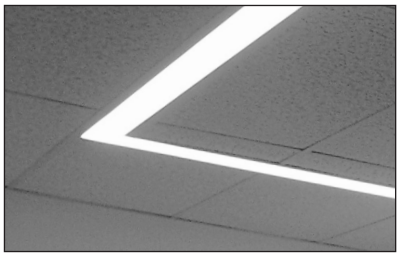
DESCRIPTION

High Performance 4” aperture recessed (HP-4 R) is a patent pending linear LED luminaire for offices, schools, retail and healthcare facilities. HP-4 R is the first recessed linear LED luminaire to feature On-Grid™ mounting for standard lengths, making installation quick and easy. Advanced optical designs and mid-powered LEDs deliver an efficient, long-lasting luminaire free of glare and socket shadows for continuous lighting applications. HP-4 R accommodates grid and drywall ceilings. 90º corners are available for ceiling and wall-to-ceiling applications. HP-4 R is RoHS compliant.



Flush Diffuser





DIMENSIONS & LIGHT ENGINE:

A glare-free experience is attained with mid-powered LEDs properly distributed and paired with a precise diffuser to eliminate pixilation.

MITERED ANGLES:

Illuminated 90º corners and wall-to-ceiling configuration are seamless without socket shadows. Custom angles are available. Contact factory.

SEAMLESS ILLUMINATION:

The optical design features seamless lenses up to 12’ in length and eliminates socket shadows at joints and corners.

ORDERING GUIDE

Sample Number: HP-4 R - 32’ - S0 - 3500K - 120V - SC - C1

HP-4 R

Finelite **Series HP-4 R**
Size (4’, 8’, 12’ multiples standard)
Light Engine (SO - Standard Output, HO - High Output)
LED Color Temperature (3000K, 3500K, 4000K)
Voltage (120, 277V)
Circuiting (SC-Single Circuit, MC-Multi-Circuit)
Mounting (C1-1" T-Bar, C2-9/16" T-Bar, C3-Screw Slot, C3F-Flush Screw Slot, VF-Visible Flange, C2T-9/16" Tegular, SF-Spackle Flange, TZ6-Tech Zone 6”)

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LED

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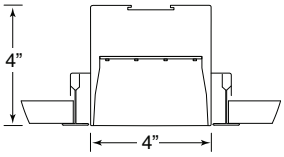
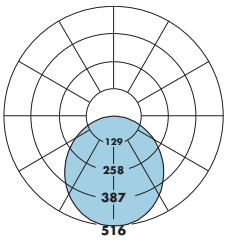
FINELITE

High Performance 4” Aperture (HP-4) - Recessed

PHOTOMETRY

Standard Output
Efficacy (Lumen per watt): 79.9
Total luminaire output: 1447 Lumens/ 18 Watts
CRI: 83
R9: 10
CCT: 4000K
ITL LM79 Report 74686

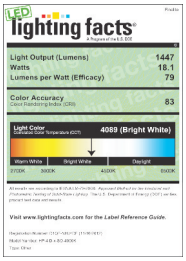




— Refer to www.finelite.com for additional photometry and product information.

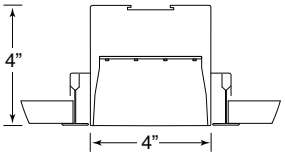
CANDLEPOWER SUMMARY

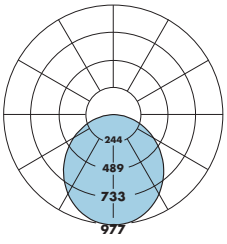
	0.0	22.5	45	67.5	90	Flux
0	514	514	514	514	514	
5	514	511	511	511	513	49
15	493	492	492	491	492	139
25	453	492	492	491	492	139
35	397	397	395	395	394	247
45	331	330	328	328	326	254
55	255	256	256	255	251	228
65	179	179	180	178	174	177
75	103	103	104	102	99	109
85	33	33	34	34	33	37
90	0	2	4	5	6	



PHOTOMETRY

High Output
Efficacy (Lumen per watt): 74.6
Total luminaire output: 2754 Lumens/ 37 Watts
CRI: 83
R9: 10
CCT: 4000K
ITL LM79 Report 74687

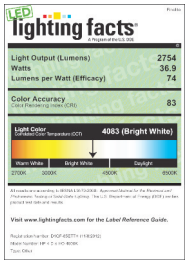




— Refer to www.finelite.com for additional photometry and product information.

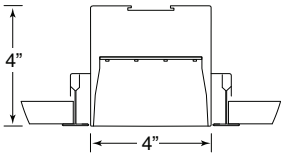
CANDLEPOWER SUMMARY

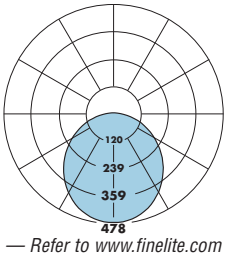
	0.0	22.5	45	67.5	90	Flux
0	973	973	973	973	973	
5	974	969	968	969	972	92
15	936	932	931	932	934	263
25	860	859	855	856	858	395
35	754	755	750	751	751	470
45	628	629	625	625	623	483
55	487	489	488	486	481	435
65	341	342	343	340	334	337
75	199	198	198	194	190	208
85	65	64	64	63	61	70
90	0	4	6	8	8	



PHOTOMETRY

Standard Output
Efficacy (Lumen per watt): 74
Total luminaire output: 1348 Lumens/ 18 Watts
CRI: 84
R9: 14
CCT: 3500K
ITL LM79 Report 74684

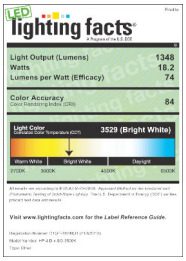




— Refer to www.finelite.com for additional photometry and product information.

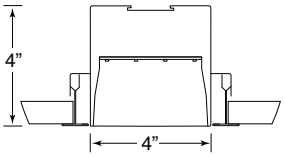
CANDLEPOWER SUMMARY

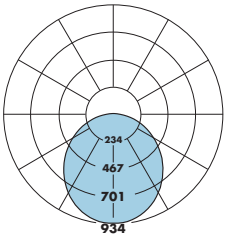
	0.0	22.5	45	67.5	90	Flux
0	476	476	476	476	476	
5	476	474	473	473	475	45
15	457	456	455	455	456	129
25	420	422	418	418	419	193
35	368	369	367	367	367	230
45	308	307	306	306	304	236
55	238	239	238	238	235	213
65	167	167	168	166	163	165
75	97	97	97	96	94	102
85	32	31	32	32	32	35
90	0	2	4	5	6	



PHOTOMETRY

High Output
Efficacy (Lumen per watt): 70.5
Total luminaire output: 2622 Lumens/ 37 Watts
CRI: 84
R9: 16
CCT: 3500K
ITL LM79 Report 74685

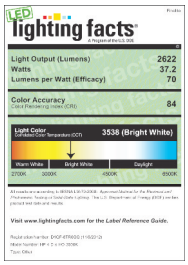




— Refer to www.finelite.com for additional photometry and product information.

CANDLEPOWER SUMMARY

	0.0	22.5	45	67.5	90	Flux
0	930	930	930	930	930	
5	930	926	925	925	928	88
15	893	890	889	890	891	251
25	820	821	816	816	817	377
35	719	719	714	715	714	448
45	598	598	595	595	592	460
55	463	464	463	462	456	413
65	325	325	326	323	317	320
75	188	188	189	186	181	198
85	61	61	62	62	60	67
90	0	2	5	6	7	



Consult www.finelite.com for 3000K photometric reports.

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LED

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FINELITE

High Performance 4” Aperture (HP-4) - Recessed

SPECIFICATIONS

CONSTRUCTION: Precision cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring standard. Housing is powder coated.

ENDCAPS: Flat endcap at each end of run adds 0.05” to overall length.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors are finished in 96 LG high reflectance matte white powder coat paint.

DIFFUSER: Frost white snap-in lens, 73% transmissive, 99% diffusion.

LIGHT ENGINE: Available in two lumen packages - High Output and Standard Output. High Output (HO): 4ft 3500K delivers 2622 lumens at 37.2 watts. Standard Output (SO): 4ft LED 3500K delivers 1348 lumens at 18.2 watts. High Output (HO): 4ft 4000K delivers 2754 lumens at 36.9 watts. Standard Output (SO): 4ft LED 4000K delivers 1447 lumens at 18.1 watts. Light engine is made up of high performance mid-powered LEDs and is designed to distribute heat properly to maximize the life of the LED.

LED COLOR TEMPERATURE: Available in 3000K, 3500K, and 4000K. CRI: 87 (3000K-HO), 87 (3000K-SO), 84 (3500K-HO), 84 (3500K-SO), 83 (4000K-HO), 83 (4000K-SO). R9: 33 (3000K-HO), 34 (3000K-SO), 16 (3500K-HO), 14 (3500K-SO), 10 (4000K-HO), 10 (4000K-SO).

DRIVER: High performance LED driver. Driver is fully accessible from below the ceiling. *120/277v. Power Factor = 95.6%-HO, 86.2%-SO (3000K), 97.5%-HO, 97.8%-SO (3500K), 97.6%-HO, 97.9%-SO (4000K). Total harmonic distortion (THD) <20%. Input current: 3000K HO=0.325A, SO=0.172A. 3500K HO=0.317A, SO=0.155A. 4000K HO=0.315A, SO=0.154A. *Driver is wired for dimming or non-dimming. Dimming is compatible with 0-10v controls with a range of 100-10%.

ELECTRICAL: 120 or 277V prewired. Fixture and electrical components are UL/C-UL listed and fixture will bear UL/C-UL labels. Optional Adders: emergency circuits, emergency battery packs. Optional: Chicago Plenum Available. Contact factory.

MOUNTING: Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to ceiling grid from above. Tie-in T-Bar brackets. Connect luminaire to T-Bar for securing to structure. Consult local code for appropriate tie-wire recommendations.

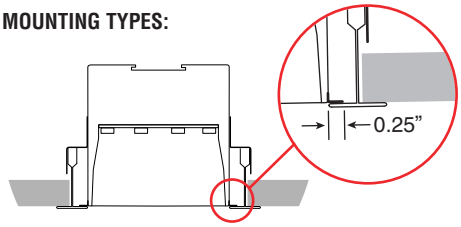
FEED: Standard with (5) 18 gauge wires. 14 gauge wires used when fixture current exceeds 5amps. Optional 6’ flex conduit whips available.

LENGTHS: Standard 4’, 8’, and 12’ section lengths can be combined to make longer runs. Contact factory for lengths in increments of 1’ or down to the inch.

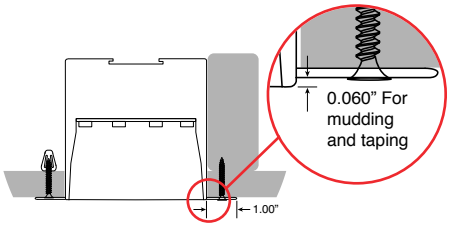
WEIGHT: Fixture weight = 2.5 lb/ft.

WARRANTY: HP-4 R comes standard with a 10-year warranty on all components.

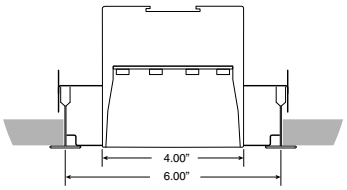
MOUNTING TYPES:



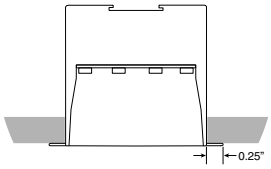
1” T-Bar (C1) & 9/16” T-Bar (C2)



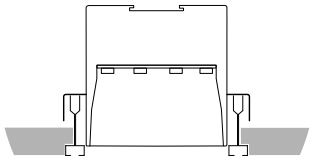
Spackle Flange (SF)



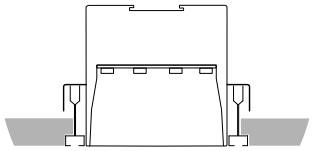
Tech Zone (TZ6)



Visible Flange (VF)

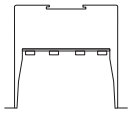


Standard Screw Slot (C3)



Standard Screw Slot (C3F)

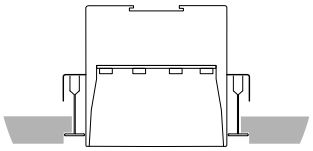
Housing With Extruded Flange (V1)



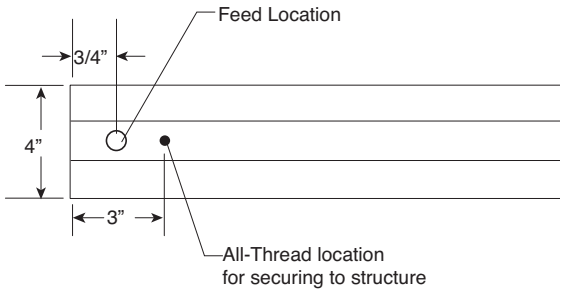
Ceiling Options
C1, C2, C3, VF

Housing Without Extruded Flange (V2)
Ceiling Hardware Attached

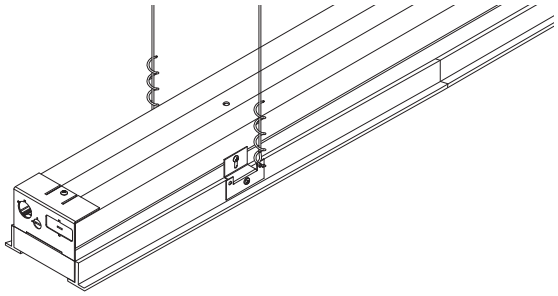
Ceiling Options
C2T, C3F, SF, TZ6



9/16” Tegular (C2T)



SHEET ROCK INSTALLATION:
Flex conduit is secured to top of fixture. Support to structure using All-Thread. All-Thread support holes are located on each end of the fixture.



T-BAR INSTALLATION:
HP-4 R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the fixture to T-Bar and provide support to structure location.

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Due to continuing product improvements, Finelite reserves the right to change specifications without notice. Please visit www.finelite.com for most current data.

 Form CTK0075.01/13

6" LED Downlight

LC6LED

120 or 277V

0-10V Dimming Option

DATE: TYPE:

FIRM NAME:

PROJECT:

LiteFrame®

Ceiling Cutout: 6¼"
Maximum Ceiling Thickness 1¼"
For conversion to millimeters, multiply inches by 25.4
Not to Scale

APPLICATIONS:

LiteFrame Commercial (LC6LED) is a 6" commercial grade LED downlight with available outputs between 900-1600 lumens. This is suitable to replace most CFL downlighting applications, while realizing substantial energy and maintenance savings. Rated for a minimum of 50,000 hours life (70% lumen maintenance) with ambient plenum temperatures up to 35°C (LED5), 28°C (LED6), 25°C (LED7). Free Air Flow around fixture is required for optimal life performance.

HOUSING:

One-piece 22 gauge non-corrosive steel platform. Pre-wired J-box with snap-on cover for easy access. Snap-in connection from driver compartment allows easy installation of light engine/trim assembly and can be upgraded to accommodate technology improvements. Approved for 8 (4 in/4 out) No. 12 AWG conductors rated for 90°C through wiring.

REFLECTOR:

High purity aluminum, Alzak, iridescence suppressed, semi-diffuse reflector. Self-trim standard. Painted white self-trim (WT) available as option.

LED LIGHT ENGINE:

The LC6LED uses either 36, 54, 72 low power Nichia LED's, specifically mixed to provide a minimum of 80 CRI with 3 SCDM color consistency. The use of multiple low power LED's allows for optimal thermal management by effectively spreading the heat over a larger area and eliminating hot spots on the LED's. A diffuse, yet highly transmissive lens obscures the view of the LED's and creates a smooth, even look from below. The light engine is available in multiple Kelvin temperatures and the system is designed to provide optimal life and lumen maintenance (50,000 hours at 70% lumen maintenance). The reflector/light engine assembly is mechanically retained to the housing.

LED DRIVER:

The LC6LED utilizes a 25 watt constant current Thomas Research Products LED driver. This same driver is capable of running all three different lumen outputs, resulting in a reduction of housing sku's and simplified specification. The driver is UL8750 and Class II compliant.

DIMMING:

A 0-10V dimming option is available (DM), providing flicker-free dimming down to 10%. See list of compatible dimmers on page (3). For the sizing of the control circuit, the dimming circuit may require up to 1.2mA of sink current.

INSTALLATION:

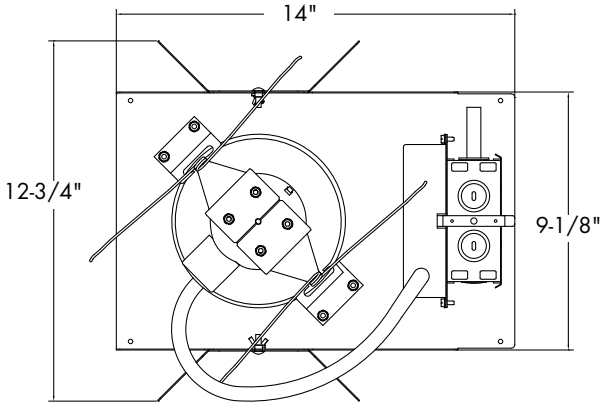
Light commercial bar hangers included. Universal adjustable mounting brackets also accept ½" EMT conduit or 1½" or ¾" lathing channel (by others) or Prescolite 24" bar hangers (B24 or B6).

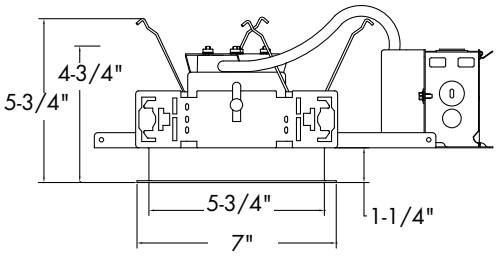
CERTIFICATIONS:

CSA certified to US and Canadian safety standards. Suitable for wet locations.

WARRANTY:

5 year warranty. See www.prescolite.com for details.





6LCLED 5 & 6

***See page 4 for 6LCLED 7 line art**

Order housing, reflector, and accessories separately

CATALOG NUMBER: EXAMPLE: LC6LED120DM - 6LCLED535K8WT

HOUSING	VOLTAGE	HOUSING OPTIONS	–	TRIM APERTURE	OUTPUT	KELVIN	CRI	REFLECTOR FINISH	REFLECTOR COLOR	REFLECTOR OPTIONS	–	ACCESSORIES
❑ **LC6LED** 6" LED Housing	❑ **120** 120V ❑ **277** 277V	❑ **Blank** No Dimming ❑ **DM** 0-10V dimming to 10% ❑ **WIH** Wi-Hubb Enabled		❑ **6LCLED** 6" Open Reflector/ Light Engine Assembly,	❑ **5** Nominal 1000 Delivered Lumens ❑ **6** Nominal 1400 Lumens Delivered ❑ **7** Nominal 1600 Lumens Delivered	❑ **27K** 2700 Kelvin ❑ **30K** 3000 Kelvin ❑ **35K** 3500 Kelvin ❑ **40K** 4000 Kelvin	❑ **8** 80+ CRI	❑ **Blank** Clear Alzak, Semi-Diffuse	❑ **WH**[1] White Paint	❑ **WT** White Trim		❑ **B24** Set of two(2) 24" bar hangers for T-bar ceilings ❑ **B6** Set of two (2) bar hangers for ceiling joist up to 24" centers ❑ **LG1S**[2] Dual-Lite100VA Surface Wall Mount LiteGear Emergency Lighting Inverter ❑ **LG1R**[2] Dual-Lite100VA Recessed Wall Mount LiteGear Emergency Lighting Inverter ❑ **LG1T**[2] Dual-Lite100VA Recessed Ceiling T-Grid LiteGear Emergency Lighting Inverter ❑ **LG2S**[2] Dual-Lite 250 VA Surface Wall Mount LiteGear Emergency Lighting Inverter ❑ **SCA6D_** Sloped ceiling adapter (see note on page 4)

[1] Requires WT option
[2] See LC6LED and LiteGear Compatibility on page 3

prescolite
A Division of Hubbell Lighting, Inc.

PHOTOMETRIC DATA

LiteFrame - 6" LF6LED Downlight

DRIVER DATA	6LCLED5xxx	6LCLED6xxx	6LCLED7xxx
Input Voltage	120-277V	120-277V	120-277V
Input Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Input Current	0.143 (120v)	0.200 (120v)	0.148 (120v)
	0.062 (277v)	0.087 (277v)	0.108 (277v)
Input Power	17.1W	24.0W	29.8W
Constant Current Output	700mA	700mA	700mA
Power Factor	≥0.90	≥0.90	≥0.90
THD	<25%	<20%	<20%
EMI Filtering	FCC 47CFR	FCC 47CFR	FCC 47CFR
	Part 15, Class A	Part 15, Class A	Part 15, Class A
Operating Temperature	-30°C to +35°C	-30°C to +28°C	-30°C to +25°C
Dimming	0-10V	0-10V	0-10V

Over-voltage, over-current, short-circuit protected

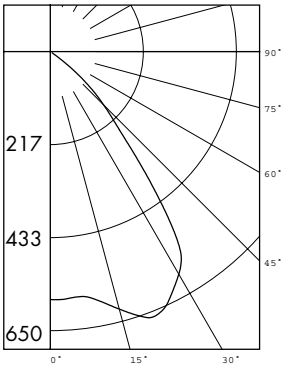
Lumen Multiplier Table

Photometrics for the LC6LED are published below at a nominal 3500 Kelvin temperature. This table may be used to approximate the lumen values at different Kelvin temperatures. Power consumption would stay the same.

5000 Kelvin	1.14
4000 Kelvin	1.03
3500 Kelvin	1.00
3000 Kelvin	1.00
2700 Kelvin	0.91

LC6LED120 6LCLED535K8

LED Light Engine: 3500K, 80+ CRI
System Wattage: 17.1W
Fixture Delivered Lumens: 925
Fixture Efficacy: 54.0
Spacing Criteria: 1.3



ZONAL LUMEN SUMMARY

ZONE	LUMENS
0-60	920.4
0-90	925.1
90-180	0.0
0-180	925.1

LUMINANCE DATA IN CANDELA/ SQ. METER

Angle in Vertical	Average - 0°
45°	12691
55°	873
65°	326
75°	164
85°	62

CANDELA DISTRIBUTION

DEG	CANDELA
0	560
5	552
15	593
25	621
35	444
45	161
55	10
65	2
75	1
85	0
90	0

COEFFICIENTS OF UTILIZATION Zonal Cavity Method

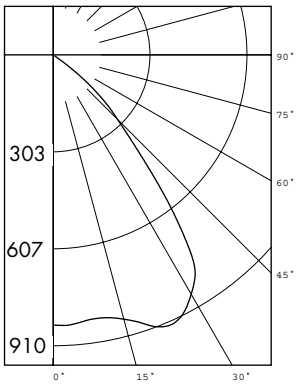
Room Cavity Ratio	% Effective Ceiling Cavity Reflectance: 80%				70%				50%				30%			10%
	20% Effective Floor Cavity Reflectance															
	% Wall Reflectance															
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10
1	113	110	107	105	110	108	105	103	104	102	100	100	98	97	96	95	94
2	106	101	96	93	104	99	95	92	96	93	90	93	90	88	90	88	86
3	100	93	87	83	98	91	86	82	89	84	81	86	83	80	84	81	78
4	94	86	79	75	92	84	79	74	82	77	73	80	76	72	78	75	72
5	88	79	72	68	87	78	72	67	76	71	67	74	70	66	73	69	65
6	83	73	66	62	82	72	66	61	71	65	61	69	64	60	68	63	60
7	78	68	61	56	77	67	61	56	66	60	56	64	59	55	63	59	55
8	74	63	56	52	72	62	56	51	61	55	51	60	55	51	59	54	51
9	69	59	52	47	68	58	52	47	57	51	47	56	51	47	55	50	47
10	66	55	48	44	64	54	48	44	53	48	44	53	47	43	52	47	43

LC6LED120 6LCLED535K8 Test No. 1,911

Test No. TUV JI1211251-1-LM79
Tested at 25°C Ambient in accordance to IESNA LM-79-2008

LC6LED120 6LCLED635K8

LED Light Engine: 3500K, 80+ CRI
System Wattage: 24.0W
Fixture Delivered Lumens: 1375
Fixture Efficacy: 57.3
Spacing Criteria: 1.3



ZONAL LUMEN SUMMARY

ZONE	LUMENS
0-60	1369.3
0-90	1375.2
90-180	0.0
0-180	1375.2

LUMINANCE DATA IN CANDELA/ SQ. METER

Angle in Vertical	Average - 0°
45°	19982
55°	1447
65°	541
75°	244
85°	89

CANDELA DISTRIBUTION

DEG	CANDELA
0	836
5	824
15	847
25	869
35	649
45	249
55	16
65	4
75	1
85	0
90	0

COEFFICIENTS OF UTILIZATION Zonal Cavity Method

Room Cavity Ratio	% Effective Ceiling Cavity Reflectance: 80%				70%				50%				30%			10%
	20% Effective Floor Cavity Reflectance															
	% Wall Reflectance															
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10
1	113	110	107	105	110	108	105	103	103	102	100	100	98	97	96	95	94
2	106	101	96	92	104	99	95	91	96	92	89	93	90	87	90	88	86
3	100	93	87	83	98	91	86	82	89	84	81	86	82	79	84	81	78
4	94	85	79	74	92	84	78	74	82	77	73	80	75	72	78	74	71
5	88	79	72	67	86	78	71	67	76	70	66	74	69	65	72	68	65
6	83	73	66	61	81	72	65	61	70	64	60	69	64	60	67	63	59
7	78	67	60	56	76	66	60	55	65	59	55	64	59	55	63	58	54
8	73	62	56	51	72	62	55	51	61	55	50	59	54	50	58	54	50
9	69	58	51	47	68	57	51	47	56	51	46	55	50	46	55	50	46
10	65	54	47	43	64	54	47	43	53	47	43	52	47	43	51	46	43

LC6LED120 6LCLED535K8 Test No. 1,911

Test No TUV JI1211251-2-LM79
Tested at 25°C Ambient in accordance to IESNA LM-79-2008

prescolite

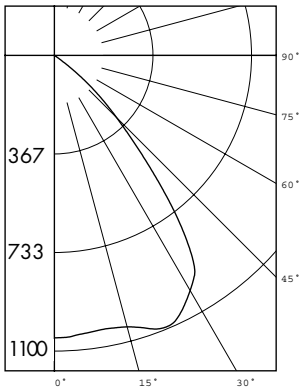
Web: **www.prescolite.com** • Tech Support: **(888) 777-4832**
701 Millennium Boulevard • Greenville, SC 29607 U.S.A. • Phone (864) 678-1000

HUBBELL®
Hubbell Lighting, Inc.

PHOTOMETRIC DATA

LiteFrame - 6" LF6LED Downlight

LC6LED120 6LCLED735K8
LED Light Engine: 3500K, 80+ CRI
System Wattage: 29.8W
Fixture Delivered Lumens: 1598
Fixture Efficacy: 53.6
Spacing Criteria: 1.3



Test No. TUV JI1211251-3-LM79
Tested at 25°C Ambient in accordance to IESNA LM-79-2008

CANDELA DISTRIBUTION

DEG	CANDELA
0	1003
5	996
15	998
25	1020
35	822
45	314
55	25
65	5
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

ZONE	LUMENS
0-60	1590.1
0-90	1597.6
90-180	0
0-180	1597.6

LUMINANCE DATA IN CANDELA/ SQ. METER

Angle in Vertical	Average - 0°
45°	22934
55°	1376
65°	538
75°	272
85°	75

COEFFICIENTS OF UTILIZATION Zonal Cavity Method

Room Cavity Ratio	% Effective Ceiling Cavity Reflectance: 80%				70%				50%			30%			10%		
	20% Effective Floor Cavity Reflectance																
	% Wall Reflectance																
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10
1	113	110	107	105	110	108	105	103	103	101	100	100	98	97	96	95	94
2	106	101	96	93	104	99	95	91	96	92	89	93	90	88	90	88	86
3	100	93	87	83	98	91	86	82	89	84	81	86	82	79	84	81	78
4	94	85	79	74	92	84	78	74	82	77	73	80	76	72	78	74	71
5	88	79	72	67	86	78	72	67	76	70	66	74	69	66	73	68	65
6	83	73	66	61	81	72	66	61	70	65	60	69	64	60	67	63	60
7	78	67	61	56	76	67	60	56	65	59	55	64	59	55	63	58	55
8	73	63	56	51	72	62	55	51	61	55	51	60	54	50	59	54	50
9	69	58	52	47	68	58	51	47	57	51	47	56	50	47	55	50	46
10	65	54	48	43	64	54	48	43	53	47	43	52	47	43	51	46	43

LC6LED120 6LCLED735K8 Test No. 1,912

DIMMING COMPATIBILITY TABLE

Control Manufacturer	Wallbox Dimmer	Power Booster Available
Douglas Lighting Controls	WPC 5721	
Entertainment Technology	Tap Glide TG600FAM120 (120V) Tap Glide Heatsink TGH1500fam120 (120V) Oasis DA2000FAMU (120/277V)	
Honeywell, Inc.	EL731A1019 and EL7315A1009	EL7305A1010
HUNT Dimming	Preset Slide: PS-010-IV-120V and PS-010-WH-120V Preset Slide: PS-010-3W-IV-120V and PS-010-3W-WH-120V Preset Slide: PS-010-IV-277V and PS-010-WH-277V Preset Slide: PS-010-3W-IV-277V and PS-010-3W-WH-277V Preset Slide, controls FD-010: PS-1FC-010-IV- and PS-IFC-010-32-WH-120/277V Preset Slide, controls FD-010: PS-IFC-010-32-IV- and PS-IFC-010-3W-WH-120/277V Remoted mounted unit: FD-010120V and FD-010-277V	
Lehigh Electric Products Co.	Solitaire	PBX
Leviton Lighting Controls Div.	Leviton Centura Fluorescent Control System IllumaTechTM IP7 Series	CN100 PE300
Lutron Electronics Co., Inc.	Visit www.lutron.com/advance for the latest control information and selection	
PDM Electrical products	WPC-5721	
Starfield Controls	TR61 with DALI Interface port	RT03 DALInet Router
The Watt Stopper, Inc.	LS-4 used with LCD-101 and LCD-103	

Central Inverters

For fixture full light output in back-up mode, Prescolite and Dual-lite have jointly tested the LiteFrame Commercial LED with the 100 (LG1) and 250 (LG2) VA LiteGear inverters. For more information on LiteGear go to http://www.dual-lite.com/resources/litegear_luminaire_loading_chart/

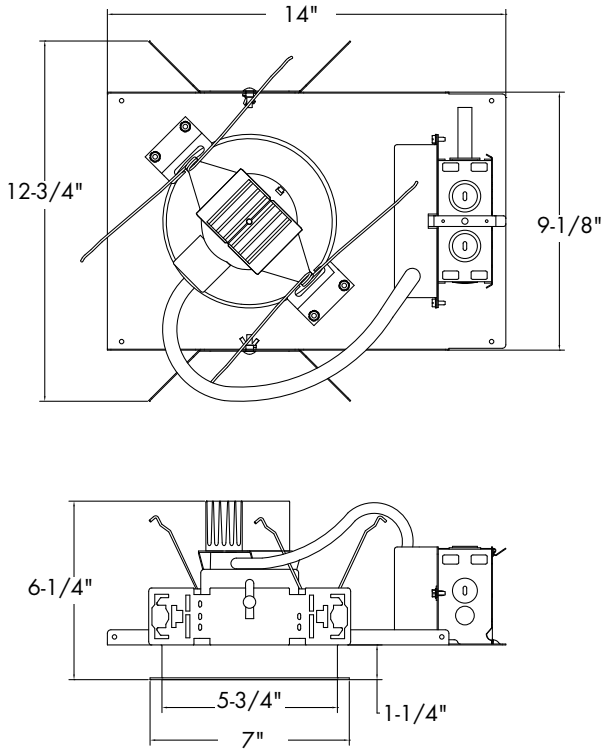
wiHUBB®

Fixture comes with a pre-installed In-Fixture Module (1 relay, 0-10V) compatible with the HBA wiHUBB system. Actual dimming requires the selection of 0-10V dimming ballast as well. Consult factory for compatibility with EM fixtures.

prescolite
Web: **www.prescolite.com** • Tech Support: **(888) 777-4832**
701 Millennium Boulevard • Greenville, SC 29607 U.S.A. • Phone (864) 678-1000

HUBBELL®
Hubbell Lighting, Inc.

PHOTOMETRIC DATA



6LCLED 7

SCA6D

When ordering a sloped ceiling adapter, specify the degree of slope in 5° increments, maximum of 35°. For a more precise degree or wet ceiling applications, please contact factory. Sloped ceiling adapter and housing must be installed at the same time.

SISTEMALUX

SPECIFICATION SHEET

MICRO TITAN LED 12" **#1078-** ____ MODEL

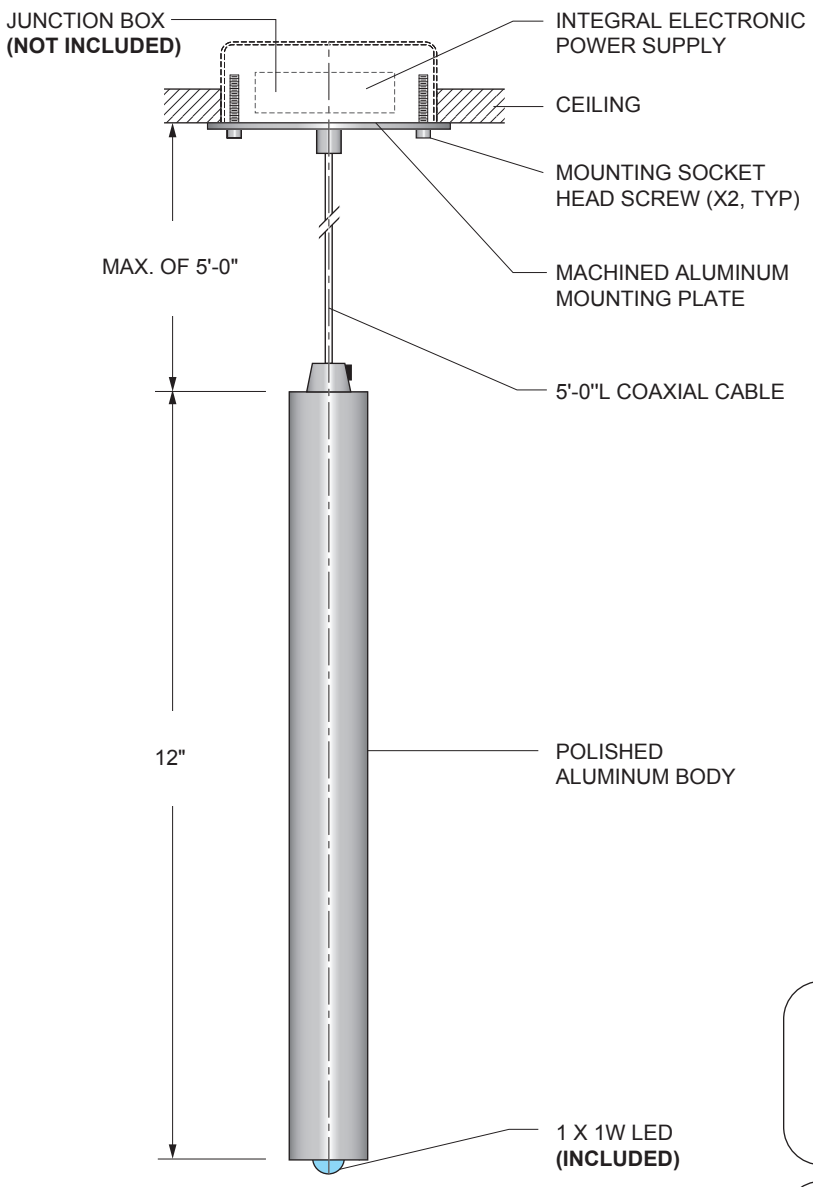
Micro Titan LED is made with a 12" inch aluminium extrusion, suspended by a 5'-0"L cable. It uses a 1 watt LED.

LAMPING: 1 X 1W LED (120V ONLY) **(SEE MODEL)**

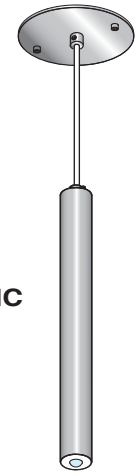
PROJECT NAME: _____

TYPE: _____ **QTY:** _____

LAST UPDATE: MAY 18, 2012



FRONT VIEW



ISOMETRIC VIEW

MODEL

- ◯ 00-WHITE 5500°K
- ◯ 01-WARM WHITE 3000°K
- ◯ 04-YELLOW
- ◯ 05-RED
- ◯ 06-GREEN
- ◯ 09-BLUE

VOLTAGE ☑ 120 V

METAL FINISH ☑ 11 - ALUMINIUM

5455 de Gaspé
suite 100, Montréal (Québec)
Canada H2T 3B3
P.: 514.523.1339 F.: 514.525.6107

MICRO TITAN LED 12"

LITHONIA LIGHTING®

Catalog Number	
Notes	Type

FEATURES & SPECIFICATIONS

Indoor General Purpose

Rayzer™ Modular LED Lighting System

INTENDED USE
Provides task or accent lighting in commercial, retail, hospitality and residential applications. Ideal for use under and over cabinets, display cases, task lighting, office lighting, coves and utility/work areas.

ATTRIBUTES
Durable aluminum construction in a low-profile design. Can be plugged in or direct-wired (splice box and 24" connector cord required for direct-wiring). Link up to 10' of modular system to one transformer (sold separately). Fixtures can be linked end-to-end with the end row connector (sold separately). All fixtures include a 18" linking cord. 3", 24" and 121" connector cords may also be purchased separately.

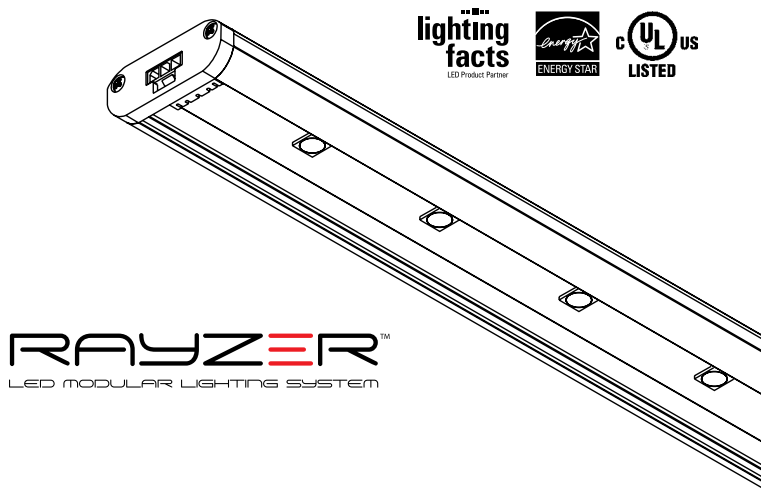
LEDs have a 50,000 hour L70 rated life. Provides warm color temperature, 3,000K with CRI 85, and even illumination.

Dimmable when used with the optional step dimmer.

All mounting hardware included. Mounting clips allow for quick & easy installation flush or at 30º. All configurations tested to IES LM79 standards.

LISTING
CUL listed to US and Canadian safety standards. ENERGY STAR® qualified.

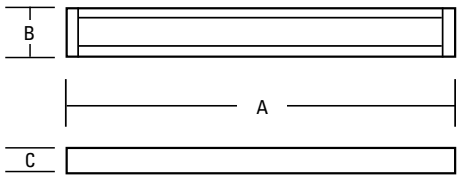
WARRANTY
Guaranteed for three years against mechanical defects in manufacture.



DIMENSIONS

All dimensions are in inches (centimeters)

Nominal Size	Model No.	Number of Lamps	(A) Length Inches (cm)	(B) Width Inches (cm)	(C) Height Inches (cm)
9"	RAZ9	3	9-1/4" (23.49)	1-1/4" (3.18)	1/2" (1.27)
12"	RAZ12	4	12-1/4" (31.11)	1-1/4" (3.18)	1/2" (1.27)
18"	RAZ18	6	18-1/4" (46.35)	1-1/4" (3.18)	1/2" (1.27)
24"	RAZ24	8	24-1/4" (46.35)	1-1/4" (3.18)	1/2" (1.27)



ORDERING INFORMATION

Example: **RAZ18**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line.
Order accessories as separate catalog numbers.

Model Number

RAZ9	9" length - 3 LEDs
RAZ12	12" length - 4 LEDs
RAZ18	18" length - 6 LEDs
RAZ24	24" length - 8 LEDs

Options

(Consult factory)

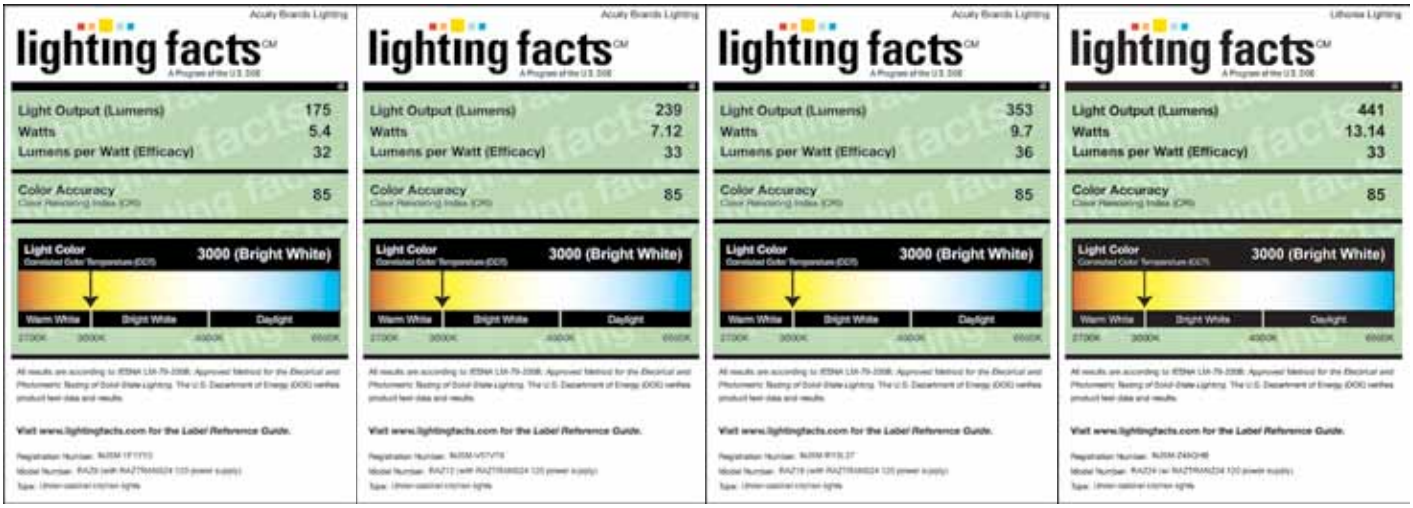
Accessories/Replacement Parts

RAZTRANS24 120	24v transformer - 120v power source
RAZTRANS24 MVOLT	24v transformer - Multi-Volt power source
RAZDIM	Step dimmer with remote touch pad
RAZ CC121	121" Linking cord (fixture to fixture)
RAZ CC24	24" linking cord (fixture to fixture)
RAZ CC3	3" linking cord (fixture to fixture)
RAZLVCC	Low voltage linking cord (cord to cord)
RAZ ERC	End row connector
RAZ PHD	Power hub distributor
RAZ INLS26	In-line power switch
UCD JB	Splice box - white (required for direct wire)
UCD JB BL	Splice box - black (required for direct wire)
UC ERC24 R12	24" connector cord - white (required for direct wire)
UC ERC24 BL	24" connector cord - black (required for direct wire)

PHOTOMETRICS

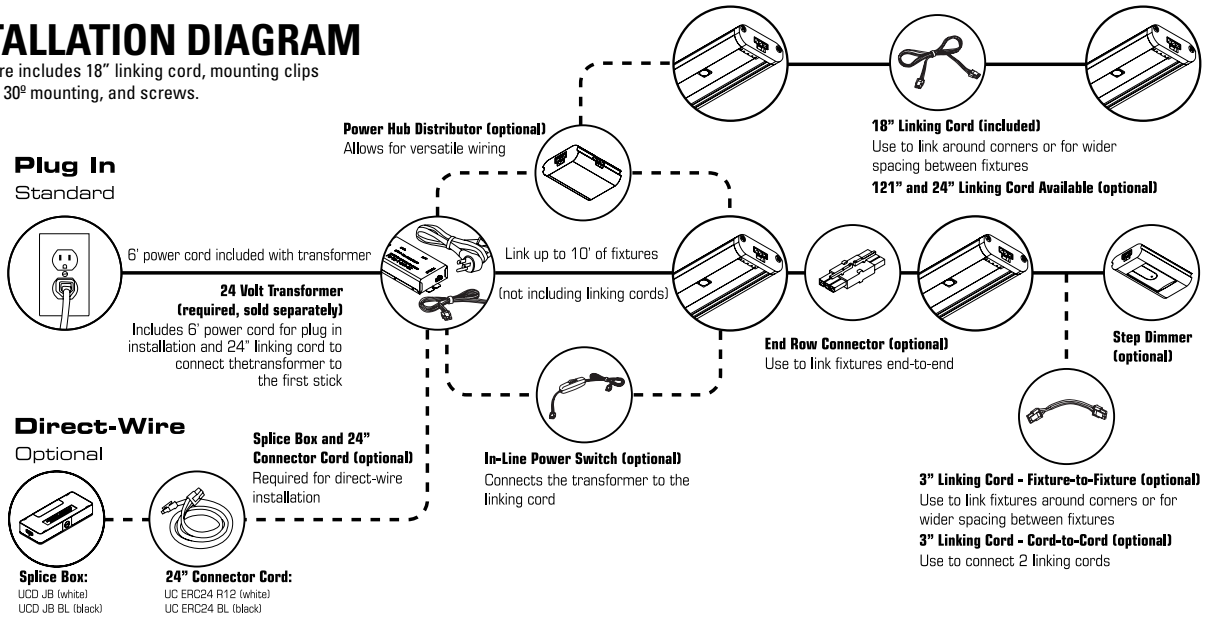
Full photometric data report available within 2 weeks from request. Consult factory.

9″ **12″** **18″** **24″**



INSTALLATION DIAGRAM

Note: Fixture includes 18″ linking cord, mounting clips for flush or 30º mounting, and screws.



LITHONIA LIGHTING®
An AcuityBrands Company

Lithonia Lighting
Consumer Products Group
One Lithonia Way, Conyers, GA 30012
Phone: 800-748-5070 Fax: 770-860-3903
In Canada: 160 Avenue Labrosse, Point-Claire, P.Q., H9R 1A1
www.lightahome.com

Sheet #: RAZC

Lumens.com LIGHT + LIVING

877.445.4486
Mon-Fri 6 to 6 Pacific | Sat 7 to 5 Pacific

Arc Floor Lamp by George Kovacs

See All Products From George Kovacs

Get far-reaching style with the George Kovacs Arc Floor Lamp. Features a large globe-shaped metal shade at the end of an overarching metal column, all of which is sturdily balanced by a heavy coordinating marble base. Comes in a cool-toned option of Chrome with a White marble base, or a warmer version in Dorian Bronze with a Brown marble base. For the matching table lamp, see Arc P043 Table Lamp.

Compare at: ~~$540.00~~
Our Price: **$360.00**
You Save 33%

Shipping: **$125.00**
Why is there a shipping charge?

Item # as Selected: ----
Manufacturer ID: ----

Options

1. Select Finish:


enlarge
Chrome


enlarge
Dorian Bronze

Finish

Price: Item #

Details

Get far-reaching style with the George Kovacs Arc Floor Lamp. Features a large globe-shaped metal shade at the end of an overarching metal column, all of which is sturdily balanced by a heavy coordinating marble base. Comes in a cool-toned option of Chrome with a White marble base, or a warmer version in Dorian Bronze with a Brown marble base. For the matching table lamp, see Arc P043 Table Lamp.

The creative and often humorous mid-century modern aesthetic of George Kovacs (1926-2007) made a lasting impression on contemporary lighting. The extraordinary George Kovacs lighting collection, which also includes pieces by Alecia Wesner, Karim Rashid and other mid-century

modern lighting designers, is now part of the Minka Group.

The George Kovacs Arc Floor Lamp is available with the following:

Details:

- Metal shade
- Marble base
- On/off floor switch
- Energy efficient
- UL Listed

Options:

- **Finish:** Chrome with White Marble Base, or Dorian Bronze with Brown Marble Base.

Lighting:
One 13 Watt 120 Volt Medium Base Compact Fluorescent lamp (included). Or use with this recommended Incandescent bulb: one 150 Watt 120 Volt Type E26 Medium Base Incandescent lamp (not included).

Shipping:
This item usually ships in 48 hours.

Dimensions:
Fixture: Height Adjustable from 72 In. to 86 In., Depth 64 In.
Base: Diameter 15 In.

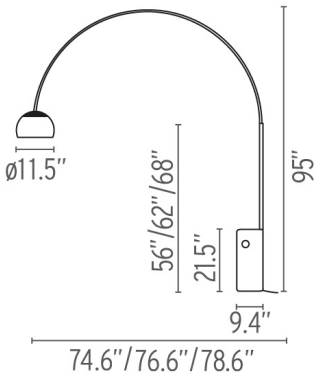
ARCO - Specification Sheet

by Achille and Pier Giacomo Castiglioni,1962

Mounting	
Lamp (Bulb) Description	100W A-21 Medium Silvered Bulb Incandescent
Environment	Indoor
Finish	N/S
Technical and Product Description	ARCO floor lamp providing direct and indirect light. Marble base supports a spun aluminum reflector via a curved stainless steel adjustable stem.

FU030000 Stainless

Dimensions



Electrical

Emergency	Without
Switching	Foot switch on power cord

Physical

Supply	Power cord
Cord length (inches)	N/S
Construction material	Aluminum, Marble, Stainless steel

Certifications

Lamping (Bulbs)

100W A-21 Medium Silvered Bulb Incandescent

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — Sharing many popular Z Series elements, this solid-state strip offers long maintenance-free life, several color temperatures, lumen outputs and lengths. Ideal for new construction and retrofit applications in both T5 and T8 lengths. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, cove and display applications.

CONSTRUCTION — Compact-design channel and cover are formed from code-gauge, cold-rolled steel. Improved easy "snap 'n' lock" end plates allow for quick attachment.

Finish: High-gloss, baked white enamel (standard). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance. Finish options include galvanized (GALV), matte black (MB) and smoke gray (SKGY).

OPTICS — LEDs provide 83 CRI at 3000K, 3500K or 4000K.

Lumen output ranges from 1400 to 4600 lumens. Beam angle is 110 FWHM (full width at half maximum).

Replaceable clear and diffuse lenses (up to 10%) offer ingress protection from debris.

ELECTRICAL — Utilizes high-brightness LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Internal pluggable wiring harness prevents wiring errors. Electronic LED driver is rated for 75 input watts maximum, multi-volt input and 0-10V dimming standard.

In 30°C (86°F) ambient environments, L70 is predicted to be greater than 100,000 hours; L86 is predicted to be 60,000 hours. Luminaire should be installed in applications where ambient temperatures do not exceed 30°C (86°F). Ambient temperatures that exceed 30°C (86°F) will result in reduced life and will void warranty.

INSTALLATION — Tool-less channel cover for easy installation.

Fixture may be surface, pendant or stem mounted. Three-point aligner locks in place for easy continuous row mounting.

LISTINGS — CSA Certified to US and Canadian safety standards. Damp location listed between -25°C (-13°F) and 30°C (86°F).

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Specifications subject to change without notice.

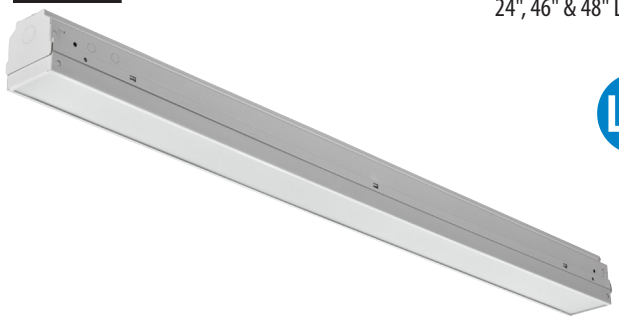
Actual performance may differ as a result of end-user environment and application.

Z SERIES

Lensed LED Striplight

ZL2

24", 46" & 48" Lengths



LED

CONFIGURATIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.

WIDTH	DEPTH	LENGTH	LUMENS	WATTAGE	COMPARABLE FLUORESCENT
3-3/8 (8.6)	3-1/4 (8.3)	46 (116.8) or 48 (121.9)	4600	75	2-lamp 32W T8 or 2-lamp 28W T5
		46 (116.8) or 48 (121.9)	2300	32	1-lamp 32W T8 or 1-lamp 28W T5
		24 (61.0)	2600	39	2-lamp 17W T8 or 2-lamp 15W T5
		24 (61.0)	1400	21	1-lamp 17W T8 or 1-lamp 15W T5

All dimensions are inches (centimeters) unless otherwise indicated.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**

Example: ZL2 L46 2300L LP840

ZL2									
Series		**Length**		**Lumens**		**Voltage**		**Lamp**	
ZL2	Lensed LED striplight	**L46**	46"	**2300L**	2300 lumens[1]	**(blank)**	MVOLT	**LP840**	83 CRI, 4000K
		L48	48"	4600L	4600 lumens[1]			LP830	83 CRI, 3000K
		L24	24"	2600L	2600 lumen[2]			LP835	83 CRI, 3500K
				1400L	1400 lumens[2]				

Diffuser		Options		Finish	
(blank)	Medium diffuse	BSL722	Emergency battery pack[4,5]	**(blank)**	White
CL	Clear[3]	PLR	Plug-in wiring[7]	GALV	Galvanized
		BDP	Ballast disconnect plug	MB	Matte black
				SKGY	Smoke gray

Accessories: *Order as separate catalog number.*

ZACVH	Aircraft cable with hook	ZACF144	Aircraft cable with feed, 144"
ZAC72	Aircraft cable, 72"	CMRB-50	Aisle motion sensor[6]
ZACF72	Aircraft cable with feed, 72"	CMRB-6	360° motion sensor[6]
ZAC120	Aircraft cable, 120"	SFR7KIT	360° motion sensor[6]
ZACF120	Aircraft cable with feed, 120"	HC36	Hanger chain, 36"
ZAC144	Aircraft cable, 144"	ZSPRG	For 15/16" T-grid only

Replacement Lens

LZL2 XX MDIF	Medium-diffuse lens. Specify length 24, 46 or 48[8]
LZL2 XX CL	Clear-diffuse lens. Specify length 24, 46 or 48[8]

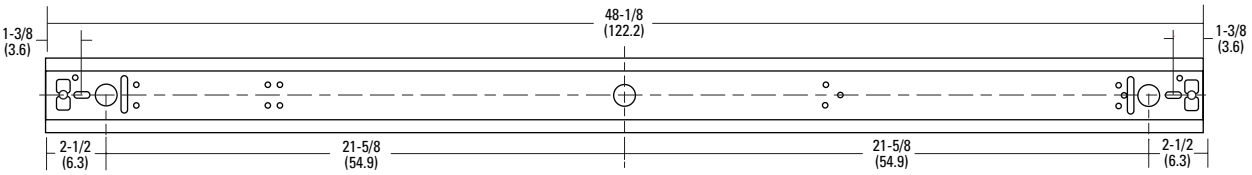
Notes

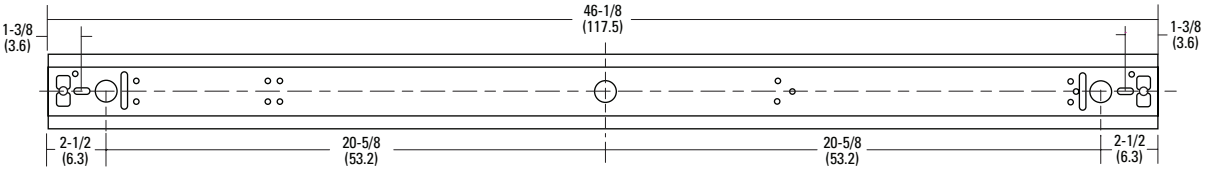
1. Available with 46" and 48" only.
2. Available with 24" only.
3. Clear lens yields an additional 10% light.
4. Specify voltage; 120 or 277.
5. Output is 1400 lumens.
6. Field installed only.
7. See ordering information on page 2
8. XX denotes length.

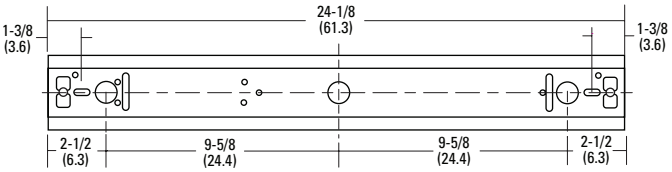
DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.

Specifications subject to change without notice.

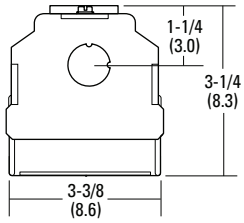






KO SIZE = 7/8 (22) Dia

SLOT SIZE = 1/2 (12.7) X 1/8 (4.0)



PHOTOMETRICS

Please see www.lithonia.com.

PRODUCT INFORMATION

Advanced plug-in system with three-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and PLR33 (3-circuit) crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA Certified systems available with up to 2 circuits. G ground required.

Note: Specifications subject to change without notice.

Wiring

PLR

Advaned 3-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits			Ground	
PLR	(blank)	Not required for 22 or 33	Circuits to which ballast is connected		C Blue wire[1]	(blank)	No ground in PLR
PLR22	1	Black	(blank)	Not required for 22 or 33	AB Outboard lamps to black, inboard to red	G	Ground. Maximum 2 circuits
PLR33	2	Black and red	A	Black wire	AC Outboard lamps to black, inboard to blue		
	3	Black, red and blue[1]	B	Red wire			

ADDITIONAL INFORMATION For additional product information, visit www.lithonia.com.

Typical Applications

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits, 2-circuit (PLR 22) and 3-circuit (PLR 33)
- Multiple circuit with night-lights located along row as desired

TYPICAL APPLICATIONS										
PLR 3 C (All PLR22)	PLR 3 C	PLR 3 C	PLR 3 C	PLR 2 B	PLR 2 B	PLR 2 B	PLR 2 B	PLR 1	PLR 1	PLR 1
Circuit A	Circuit B	Circuit A	Circuit B	Circuit A	Circuit B	Circuit A	Circuit B	Circuit A	Circuit B	Circuit A
(All PLR33)										
Circuit A	Circuit B	Circuit C	Circuit A	Circuit B	Circuit C	Circuit A	Circuit B	Circuit C	Circuit A	Circuit B
PLR 3 A	PLR 3 A	PLR 3 A	PLR 3 C	PLR 3 B	PLR 3 B	PLR 3 B	PLR 3 C	PLR 3 A	PLR 3 A	PLR 3 A

Notes

1 Ground not available.

INDUSTRIAL: One Lithonia Way Conyers, GA 30012 Phone: 800-315-4963 Fax: 770-981-8191 www.lithonia.com

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — For wall or ceiling mounting, vertical or horizontal. The WL combines digital LED lighting and controls technologies with high-performance optical design to offer the most advanced wall-mount luminaire for general ambient lighting applications. High-efficacy light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable.

CONSTRUCTION — Housing is roll formed from code-gauge steel.

Impact modified linear-faceted refractor with light diffusing film. Refractor is retained in die cast ends providing secure installation and easy maintenance.

Decorative die-cast end caps provide added durability.

Finish: All metal parts are post-painted in white polyester powder coat for smooth, finished edges and uniform light distribution.

OPTICS — High impact acrylic diffuser with light diffusing film. Optically engineered for superior light distribution and maximum efficacy.

Crescent-shape linear faceted refractor system obscures and integrates individual LED images and uniformly washes fixture surface with light.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. WL is rated to deliver L80 performance for 50,000 hours.

Optional nLight™ embedded controls continuously monitor system performance and allow for constant lumen management / compensation function.

Lumen Management: Unique lumen management system (option N80) provides onboard intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing energy waste created by the traditional practice of over-lighting.

LED AccuDrive ™ driver delivers full-range dimming from 0-10V control signal.

Integral occupancy control: Sensor Switch nES 7 or nES PDT 7 integrated occupancy sensor allows luminaire to power off or dim to 10% to 50% output when space is unoccupied. Fixture designed to fail on.

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion (e.g. corridors, stairwells). Additionally, an optional integrated photocell enables daylight harvesting control as well.

For rooms like restrooms and private offices or any space with obstructions, the nES PDT 7 dual technology sensor is recommended.

Driver disconnect provided where required to comply with US and Canadian codes.

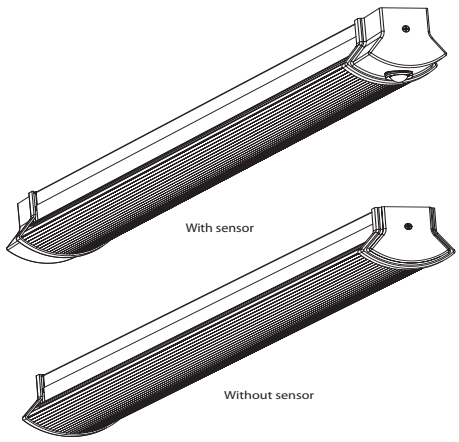
Maintenance: LED boards include plug-in connectors for easy replacement or servicing.

LISTINGS — CSA certified to meet U.S. and Canadian standards.

Patents pending.

W SERIES

Wall bracket & Surface Mount LED



WL

2', 4'

LED

nLIGHT ENABLED

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Specifications subject to change without notice.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: WL4 25L D24 LP835 NX

Series		Lumens[1]	Voltage		Wattage		Color temperature		Lumen management	
WL2	2' wall-mount LED	12L[2]	(blank)	MVOLT (120 - 277V)	D13	13W[7]	LP830	82 CRI, 3000 kelvin[8,9]	NX	Less nLight
WL4	4' wall-mount LED	18L[3]	347	347V[6]	D20	20W[7]	LP835	82 CRI, 3500 kelvin	N80	nLight with 80% (L80) lumen management
		25L[4]			D24	24W[7]	LP840	82 CRI, 4000 kelvin	N80EMG	nLight with 80% (L80) lumen management for use with generator supply EM power
		41L[5]			D43	43W[7]	LP850	82 CRI, 5000 kelvin[8,9]	N100	nLight with 100% (L100) lumen management
									N100EMG	nLight with 100% (L100) lumen management for use with generator supply EM power

Occupancy control[10]		Standby mode[12]		Options		Finish[14]	
NES7	Sensor Switch nES 7 PIR integral occupancy sensor[11]	(blank)	Fixture turns off when unoccupied	EL14L	LED Emergency battery pack (nominal 1400 lumens); see Life Safety section[13]	(blank)	White
NESPDT7	Sensor Switch nES PDT 7 dual technology integral occupancy control[11]	DIM10	Fixture dims to 10% when unoccupied	SC	Surface conduit end cap provisions		
NES7ADCX	Sensor Switch nES 7 ADCX PIR integral occupancy sensor with automatic dimmng control[11]	DIM50	Fixture dims to 50% when unoccupied				

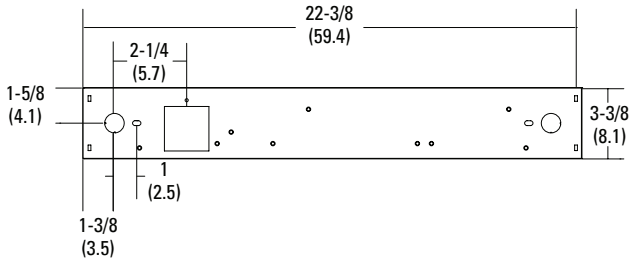
Notes

1 Approximate lumen output.
2 For use with WL2 only, requires D13 driver.
3 For use with WL2 only, requires D20 driver.
4 For use with WL4 only, requires D24 driver.
5 For use with WL4 only, requires D43 driver.
6 Not available for use with WL2.
7 Actual wattage may differ by +/- 5% when operating between 120-277V +/- 10%.
8 Extended lead time.
9 Not available with 41L.
10 See integral occupancy control section in header.
11 Requires N80 or N100.
12 Requires occupancy control.
13 Not available with WL2; not available with 347V.
14 For additional paint finishes refer to Architectural Colors.

WL Wall Bracket & Surface Mount LED

MOUNTING DATA

For unit installation; surface ceiling or wall mounting.



DIMENSIONS

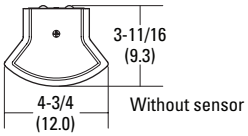
All dimensions are inches (centimeters) unless otherwise noted.

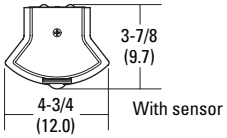
Specifications

Length: with sensor - 25-7/8 (65.7)
50-15/16 (129.40)
without sensor - 23-3/8 (59.4)
46-13/16 (118.90)

Height: with sensor - 3-11/16 (9.3)
without sensor - 3-7/8 (9.7)

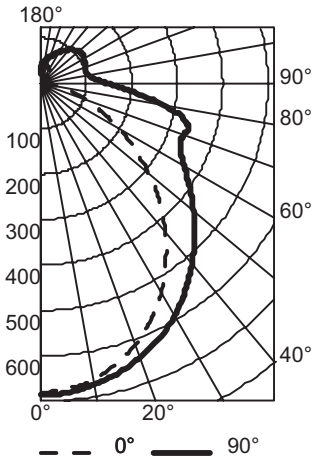
Width: 4-3/4 (12.1)





PHOTOMETRICS

WL4 25L D24 LP835, 2505 delivered lumens, test no. LTL21295, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	684	684
5°	675	683
15°	640	660
25°	574	618
35°	480	555
45°	369	479
55°	253	400
65°	147	339
75°	66	331
85°	16	198
90	5	147

Coefficients of Utilization

pf	20%								
pc	80%			70%			50%		
pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR 0	115	115	115	110	110	110	102	102	102
1	103	98	93	94	89	85	86	83	79
2	93	84	77	81	74	69	75	69	64
3	85	74	65	71	63	57	65	59	54
4	77	65	56	63	54	48	58	51	45
5	71	58	49	56	47	41	52	45	39
6	66	52	43	50	42	36	47	40	34
7	61	47	38	46	37	32	43	35	30
8	57	43	35	42	34	28	39	32	27
9	53	39	31	38	31	25	36	29	24
10	49	36	29	35	28	23	33	27	22

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	525	20.9	20.9
0° - 40°	852	34.0	34.0
0° - 60°	1483	59.2	59.2
0° - 90°	2072	82.7	82.7
90° - 120°	227	9.1	9.1
90° - 130°	297	11.9	11.9
90° - 150°	392	15.6	15.6
90° - 180°	432	17.3	17.3
0° - 180°	2505	100.0	100.0

LED Energy Comparison to T5/T8

System	Lamp type	Ballast factor	Input watts	Watts saved by using LED
LED-N100	LED	1	24	--
LED-N80[1]	LED	1	19	--
One-lamp T8	F32T8	0.88	28	3
One-lamp T5	F28T5	1	32	7

Note

1 With nlight 80% lumen management input watts start at 19 and gradually increasing to 24 at 50,000 hrs.

Total Lumens with Control Options

Lumen package	Control option							
	N100		N80		Dim50		Dim10	
	Wattage	Lumens	Wattage	Lumens	Wattage	Lumens	Wattage	Lumens
12L	13	1200	10	1044	6.5	470	1.3	38
18L	20	1800	16	1566	10	810	2.0	126
25L	24	2500	19	2175	12	1125	2.4	175
41L	43	4100	34	3567	22	1845	4.3	330

LITHONIA LIGHTING®
An AcuityBrands Company

WL-LED

LED: One Lithonia Way Conyers, GA 30012 Phone: 800.858.7763 Fax: 770-929-8789 www.lithonia.com

Rev.11/19/12

Product Number: 78907

Order Abbreviation: LED12A19/DIM/O/827

General Description: LED 12Watt A19 Omni directional lamp, 2700K, 80 CRI

Product Information

Abbrev. With Packaging Info.	LED12A19DIMO827 6/CS 1/SKU
Average Rated Life (hr)	25000
Base	E26
Bulb	A19
Color Temperature/CCT (K)	2700
Color Rendering Index (CRI)	80
Nominal Voltage (V)	120.00
Nominal Wattage (W)	12.00
Abbrev. With Packaging Info.	LED12A19DIMO827 6/CS 1/SKU
Language Strategy	ENGLISH/FRENCH/SPANISH
Ordering Abbreviation	LED12A19/DIM/O/827
UPC Code	UPC046135789076
Lamp Finish	Frosted

Quality – Reliability – Performance
Bosch Solar Module c-Si M 60 NA42117

Invented for life
Solar modules from Bosch Solar Energy

BOSCH

Bosch's 60-cell monocrystalline modules include the following benefits

Focus on quality: A reliable and durable design developed from the ability to control and monitor the manufacturing process from raw materials to module production.

German-engineered reliability: Positive power sorting, proven US and German components, structured front glass and a robust anodized frame are combined to produce required energy now and for the future.

Performance: The Bosch Gen IV solar cell and proprietary Light Harvesting String cell interconnection system promote higher module output and energy yield.

Long-term bankability: With over 125 years of history, Bosch's module testing goes beyond international standards, backed by a 10-year product warranty and 25-year performance guarantee.

Quality
Certified UL 1703 and CEC registered

Product features
Performance sorting –0/+4.99 Wp
Temperature coefficient P_{mpp} –0.44 % K

Value chain
Crystal – Wafer – Cell – Module

Components
Structured frontglass, MC4 connectors, Light Harvesting String, Bosch Solar Gen IV cell "Made in Germany"

Warranty
10 years product and
25 years performance guarantee
(90 % up to 10 years, 80 % up to 25 years)

Power classes
245–255 Wp

Bosch Solar Module c-Si M 60 | NA42117

Length [x]	Width [y]	Frame height [z]	Weight	Junction box	Plug connector type	Cable [l negative] [l positive]	Front glass surface
65.35 in 1660.0	38.98 in 990.0	1.97 in 50.0	46.30 lb 21.0	Spelsberg	MC4	–31.50 in (–800) +47.24 in (+1200)	Structured

If not stated differently, x, y, l in mm, ±2; z in mm, ±0.3; weight in kg ±0.5

Crystalline solar module	
Performance classes	**245 Wp, 250 Wp, 255 Wp**
Performance sorting	–0/+4.99 Wp
Structure	**Glass-foil laminate** ▶ Anodized aluminum frame ▶ Junction box (IP 65) with 3 bypass diodes ▶ Weather-resistant back sheet (white)
Cells	**60x monocrystalline solar cells** in 156 mm x 156 mm format
Mechanical load	**5400 Pa superimposed load, 2400 Pa suction load,** in accordance with IEC 61215 (extended test)

Electrical characteristics for STC[1]:

Designation	Pmpp [Wp]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	Reverse-current load capacity [A]
255 Wp	255	30.51	8.36	38.00	8.92	17
250 Wp	250	30.31	8.25	37.90	8.82	17
245 Wp	245	30.11	8.14	37.80	8.72	17

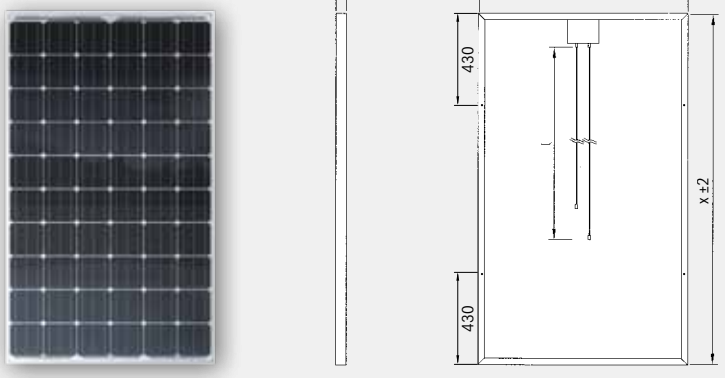
Reduction in module efficiency with decrease in irradiation level from 1000 W/m² to 200 W/m² (at 25 °C): –0.32% (absolute); measuring tolerance Pmpp ±3%

Electrical characteristics for NOCT[1]:

Designation	Pmpp [W]	Vmpp [V]	Voc [V]	Isc [A]
255 Wp	185	27.54	34.92	7.19
250 Wp	182	27.36	34.82	7.11
245 Wp	178	27.19	34.73	7.03

NOCT: Normal Operation Cell Temperature 48.4 °C: Irradiation level 800 W/m², AM 1.5, temperature 20 °C, wind speed 1 m/s, electrical open circuit operation

Dimensions[2]:



Specifications in mm

Notes on assembly:

- ▶ See installation and operating manual at: www.bosch-solarenergy.com/products
- ▶ Module may be mounted in portrait or landscape orientation
- ▶ System voltage max. 600 V
- ▶ Operating temperature range –40 to 85 °C

Weak light performance:

Intensity [W/m²]	Vmpp [%]	Impp [%]
800	0.0	–20
600	0.0	–40
400	–0.18	–60
200	–2.36	–80
100	–5.45	–90

The electrical data applies for 25 °C and AM 1.5.

Thermal characteristics:

Temperature coefficient	TK [%/K]
Pmpp	–0.44
Uoc	–0.31
Isc	0.031

[1] Electrical parameters are typical mean values from historical production data. No guarantee is made for the accuracy of this data for future production batches.

[2] Drawings are not to scale. For detailed dimensions and tolerances, see above.

Bosch Solar Energy Corporation
2988 Campus Dr. Suite 100
San Mateo, CA 94403
USA
Phone: +1 650 356 3100
Fax: +1 650 525 0830
sales.se@us.bosch.com
www.bosch-solarenergy.com

Version: 10/2012

power-one®
Renewable Energy Solutions

AURORA®

PVI-3.0-TL
PVI-3.6-TL
PVI-4.2-TL

GENERAL SPECIFICATIONS
OUTDOOR MODELS

The most common residential inverter is the ideal size for an average-sized family home. This family of single-phase string inverter complements the typical number of rooftop solar panels, allowing home-owners to get the most efficient energy harvesting for the size of the property. This rugged outdoor inverter has been designed as a completely sealed unit to withstand the harshest environmental conditions.

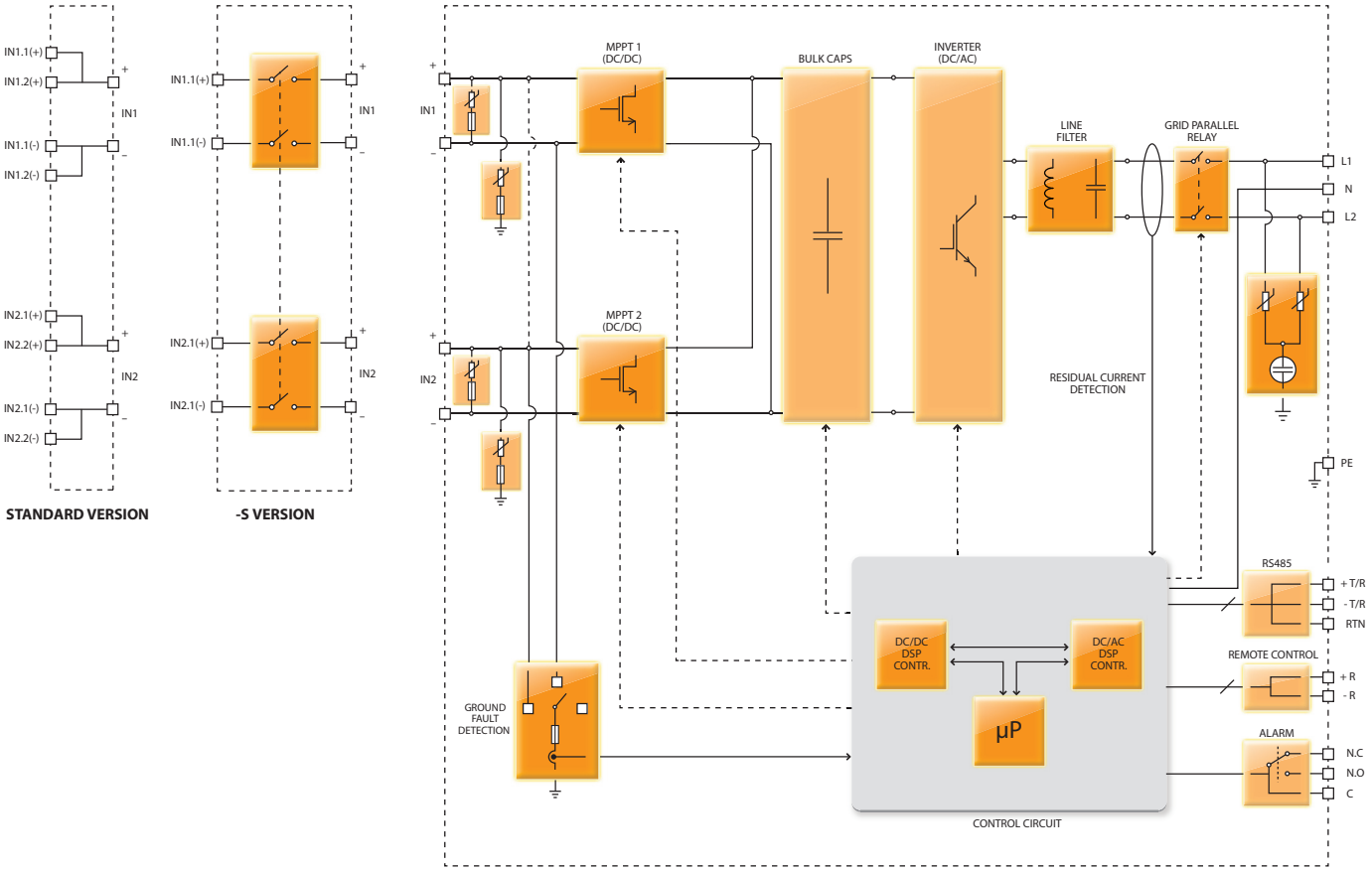
One of the key benefits of the Uno family of single-phase inverters is the dual input section to process two strings with independent MPPT especially useful for rooftop installations with two different orientations (ie East and West). The high speed MPPT offers real-time power tracking and improved energy harvesting.

The transformerless operation gives the highest efficiency of up to 97.0%. The wide input voltage range makes the inverter suitable to low power installations with reduced string size.

Features

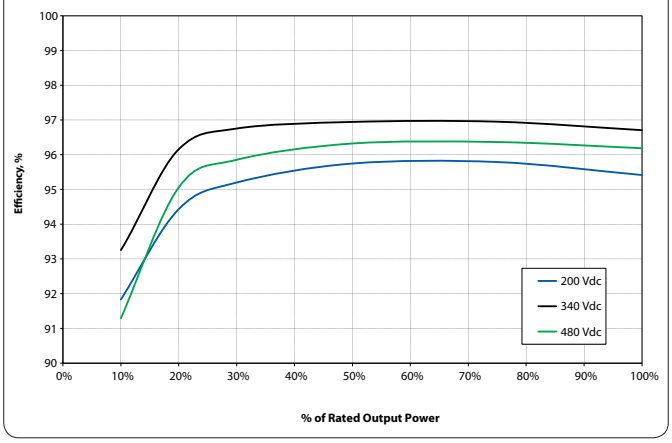
- Each inverter is set on specific grid codes which can be selected in the field
- Single phase output
- Dual input sections with independent MPPT, allows optimal energy harvesting from two sub-arrays oriented in different directions
- Wide input range
- High speed and precise MPPT algorithm for real time power tracking and improved energy harvesting
- Flat efficiency curves ensure high efficiency at all output levels ensuring consistent and stable performance across the entire input voltage and output power range
- Outdoor enclosure for unrestricted use under any environmental conditions
- Integrated DC disconnect switch in compliance with international Standards (-S Version)
- RS-485 communication interface (for connection to laptop or datalogger)
- Compatible with PVI-RADIOMODULE for wireless communication with Aurora PVI-DESKTOP

BLOCK DIAGRAM OF PVI-3.0-OUTD, PVI-3.6-OUTD AND PVI-4.2-OUTD FOR NORTH AMERICA

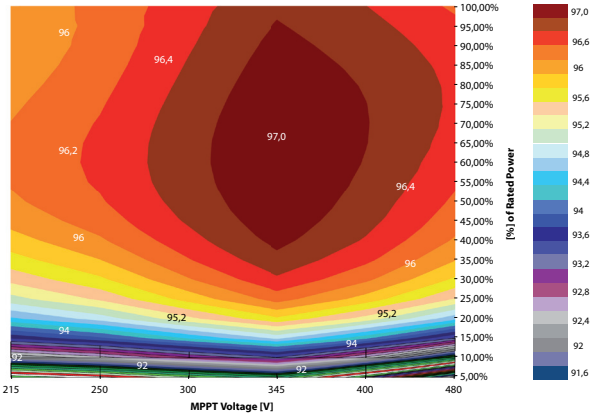


Block Diagram and Efficiency Curves

PVI-4.2-OUTD-US



PVI-4.2-OUTD-US



TECHNICAL DATA	VALUES	PVI-3.0-OUTD-US			PVI-3.6-OUTD-US			PVI-4.2-OUTD-US		
Nominal Output Power	W	3000			3600			4200		
Maximum Output Power	W	3000	3300**	3300**	3600	4000**	4000**	4200	4600**	4600**
Rated Grid AC Voltage	V	208	240	277	208	240	277	208	240	277
Input Side (DC)										
Number of Independent MPPT Channels		2			2			2		
Maximum Usable Power for Each Channel	W	2000			3000			3000		
Absolute Maximum Voltage (Vmax)	V	600			600			600		
Start-Up Voltage (Vstart)	V	200 (adj. 120-350)			200 (adj. 120-350)			200 (adj. 120-350)		
Full Power MPPT Voltage Range	V	160-530			120-530			140-530		
Operating MPPT Voltage Range	V	0.7xVstart-580			0.7xVstart-580			0.7xVstart-580		
Maximum Current (Idcmax) for both MPPT in Parallel	A	20			32			32		
Maximum Usable Current per Channel	A	10			16			16		
Maximum Short Circuit Current Limit per Channel	A	12.5			20			20		
Number of Wire Landing Terminals Per Channel		2 Pairs (1 on -S version)			2 Pairs (1 on -S version)			2 Pairs (1 on -S version)		
Array Wiring Termination		Terminal block, Pressure Clamp, AWG10-AWG4								
Output Side (AC)										
Grid Connection Type		1Ø/2W	Split-Ø/3W	1Ø/2W	1Ø/2W	Split-Ø/3W	1Ø/2W	1Ø/2W	Split-Ø/3W	1Ø/2W
Adjustable Voltage Range (Vmin-Vmax)	V	183-228	211-264	244-304	183-228	211-264	244-304	183-228	211-264	244-304
Grid Frequency	Hz	60			60			60		
Adjustable Grid Frequency Range	Hz	57-60.5			57-60.5			57-60.5		
Maximum Current (Iacmax)	A_{RMS}	14.5	14.5	12	17.2	16	16	20	20	20
Power Factor		> 0.995			> 0.995			> 0.995		
Total Harmonic Distortion At Rated Power	%	< 2			< 2			< 2		
Grid Wiring Termination Type		Terminal block, Pressure Clamp, AWG10-AWG4								
Protection Devices										
Input										
Reverse Polarity Protection		Yes			Yes			Yes		
Over-Voltage Protection Type		Varistor, 2 for each channel			Varistor, 2 for each channel			Varistor, 2 for each channel		
PV Array Ground Fault Detection		Pre start-up Riso and dynamic GFDI (Requires Floating Arrays)								
Output										
Anti-Islanding Protection		Meets UL 1741/IEE1547 requirements			Meets UL 1741/IEE1547 requirements			Meets UL 1741/IEE1547 requirements		
Over-Voltage Protection Type		Varistor, 2 (L_1 - L_2 / L_1 - G)			Varistor, 2 (L_1 - L_2 / L_1 - G)			Varistor, 2 (L_1 - L_2 / L_1 - G)		
Maximum AC OCPD Rating	A	20	20	15	25	20	20	25	25	25
Efficiency										
Maximum Efficiency	%	96.9			97			97		
CEC Efficiency	%	96			96			96		
Operating Performance										
Stand-by Consumption	W_{RMS}	< 8			< 8			< 8		
Night time consumption	W_{RMS}	< 0.6			< 0.6			< 0.6		
Communication										
User-Interface		16 characters x 2 lines LCD display								
Remote Monitoring (1xRS485 incl.)		AURORA-UNIVERSAL (opt.)								
Wired Local Monitoring (1xRS485 incl.)		PVI-USB-RS485_232 (opt.), PVI-DESKTOP (opt.)								
Wireless Local Monitoring		PVI-DESKTOP (opt.) with PVI-RADIOMODULE (opt.)								
Environmental										
Ambient Air Operating Temperature Range	°F (°C)	-13 to +140 (-25 to +60) with derating above 131 (55)			-13 to +140 (-25 to +60) with derating above 131 (55)			-13 to +140 (-25 to +60) with derating above 113 (45)		
Ambient Air Storage Temperature Range	°F (°C)	-40 to 176 (-40 to +80)			-40 to 176 (-40 to +80)			-40 to 176 (-40 to +80)		
Relative Humidity	% RH	0-100 condensing			0-100 condensing			0-100 condensing		
Acoustic Noise Emission Level	db (A) @1m	< 50			< 50			< 50		
Maximum Operating Altitude without Derating	ft(m)	6560 (2000)			6560 (2000)			6560 (2000)		
Mechanical Specifications										
Enclosure rating		NEMA 4X			NEMA 4X			NEMA 4X		
Cooling		Natural Convection			Natural Convection			Natural Convection		
Dimensions (H x W x D)	in (mm)	33.8 x 12.8 x 8.7 (859 x 325 x 222) -S Version								
Weight	lb/(kg)	< 47.3 (21.3) -S version			< 47.3 (21.3) -S version			< 47.3 (21.3) -S version		
Mounting System		Wall bracket			Wall bracket			Wall bracket		
Conduit Connections* **		Trade size KOs: (2ea x 1/2") and (2ea x 1-1/4", 3 places side, front, rear)			Trade size KOs: (2ea x 1/2") and (2ea x 1-1/4", 3 places side, front, rear)			Trade size KOs: (2ea x 1/2") and (2ea x 1-1/4", 3 places side, front, rear)		
DC Switch Rating (Per Contact)	A/V	25 / 600			25 / 600			25 / 600		
Safety										
Isolation Level		Transformerless (Floating Array)			Transformerless (Floating Array)			Transformerless (Floating Array)		
Safety and EMC Standard		UL 1741, CSA - C22.2 N. 107.1-01			UL 1741, CSA - C22.2 N. 107.1-01			UL 1741, CSA - C22.2 N. 107.1-01		
Safety Approval		$_{c}CSA_{us}$			$_{c}CSA_{us}$			$_{c}CSA_{us}$		
Warranty										
Standard Warranty	years	10			10			10		
Extended Warranty	years	15 & 20			15 & 20			15 & 20		
Available Models										
Standard - Without DC Switch and Wiring Box		PVI-3.0-OUTD-US			PVI-3.6-OUTD-US			PVI-4.2-OUTD-US		
With DC Switch and Wiring Box		PVI-3.0-OUTD-S-US			PVI-3.6-OUTD-S-US			PVI-4.2-OUTD-S-US		

*All data is subject to change without notice

** Capability enabled at nominal AC voltage and with sufficient DC power available

*** When equipped with optional DC Switch and Wiring Box

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Power-One Renewable Energy Worldwide Sales Offices

Country	Name/Region	Telephone	Email
Australia	Asia Pacific	+61 2 9735 3111	sales.australia@power-one.com
China (Shenzhen)	Asia Pacific	+86 755 2988 5888	sales.china@power-one.com
China (Shanghai)	Asia Pacific	+86 21 5505 6907	sales.china@power-one.com
India	Asia Pacific	+65 6896 3363	sales.india@power-one.com
Singapore	Asia Pacific	+65 6896 3363	sales.singapore@power-one.com
Belgium / The Netherlands / Luxembourg	Europe	+32 2 206 0338	sales.belgium@power-one.com
France	Europe	+33 (0) 141 796 140	sales.france@power-one.com
Germany	Europe	+49 7641 955 2020	sales.germany@power-one.com
Italy	Europe	00 800 00287672 Opt. n°5	sales.italy@power-one.com
Spain	Europe	+34 91 879 88 54	sales.spain@power-one.com
United Kingdom	Europe	+44 1903 823 323	sales.UK@power-one.com
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Canada	North America	+1 877 261-1374	sales.canada@power-one.com
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USA Central	North America	+1 877 261-1374	sales.usacentral@power-one.com
USA West	North America	+1 877 261-1374	sales.usawest@power-one.com

power-one®
Renewable Energy Solutions

AURORA®

PVI-5000-TL
PVI-6000-TL

GENERAL SPECIFICATIONS
OUTDOOR MODELS

Designed for residential and small commercial PV installations, this inverter fills a specific niche in the Aurora product line to cater for those installations producing between 5kW and 20kW.

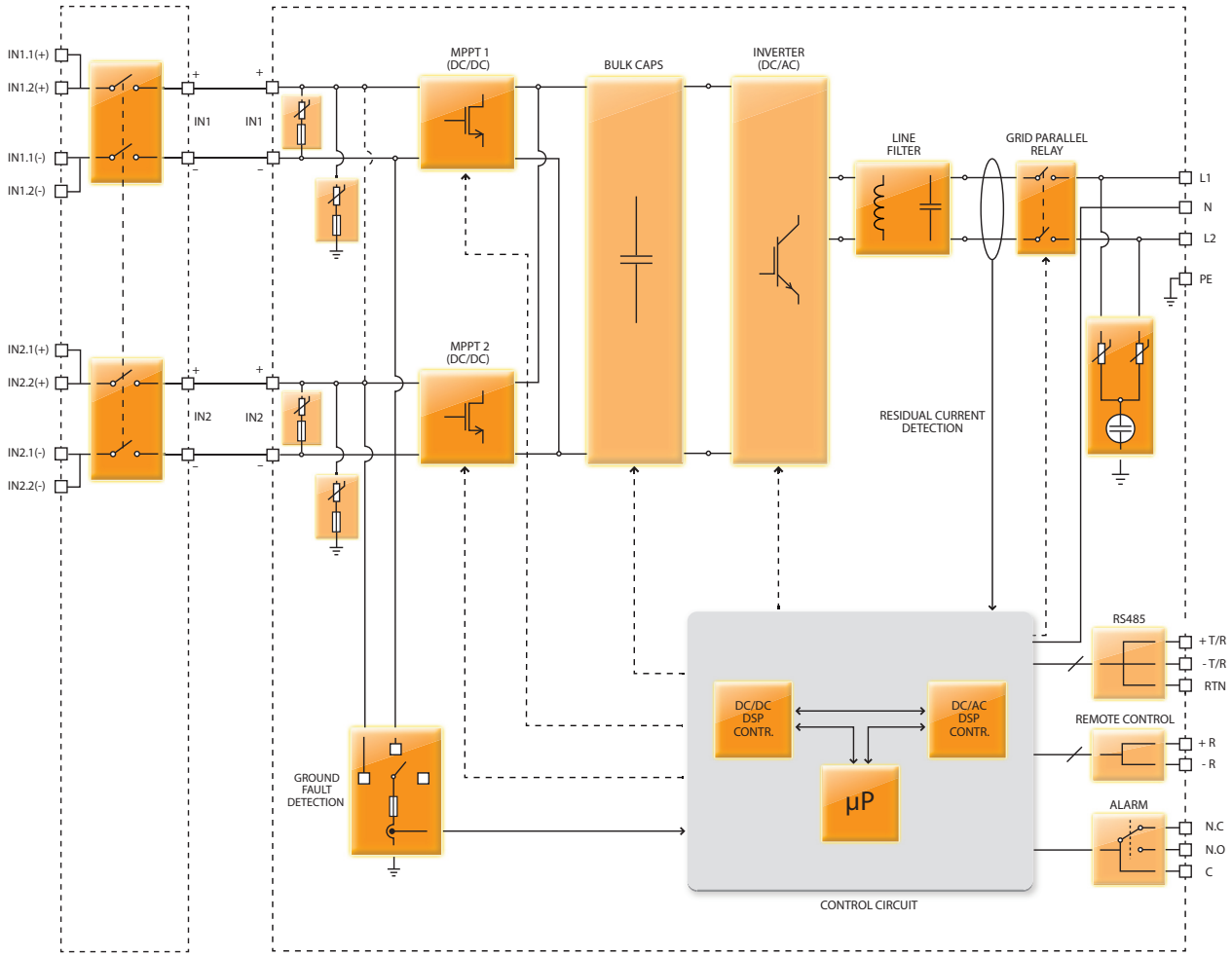
This inverter has all the usual Aurora benefits, including dual input section to process two strings with independent MPPT, high speed and precise MPPT algorithm for real-time power tracking and energy harvesting, as well as transformerless operation for high performance efficiencies of up to 97.1%.

The wide input voltage range makes the inverter suitable to low power installations with reduced string size. This outdoor inverter has been designed as a completely sealed unit to withstand the harshest environmental conditions.

Features

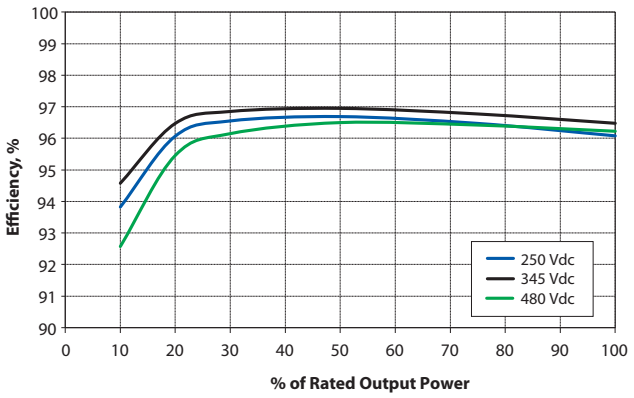
- Each inverter is set on specific grid codes which can be selected in the field
- Single phase output
- Dual input sections with independent MPPT, allows optimal energy harvesting from two sub-arrays oriented in different directions
- Wide input range
- High speed and precise MPPT algorithm for real time power tracking and improved energy harvesting
- Flat efficiency curves ensure high efficiency at all output levels ensuring consistent and stable performance across the entire input voltage and output power range
- Outdoor enclosure for unrestricted use under any environmental conditions
- RS-485 communication interface (for connection to laptop or datalogger)
- Compatible with PVI-RADIOMODULE for wireless communication with Aurora PVI-DESKTOP

BLOCK DIAGRAM OF PVI-5000-OUTD AND PVI-6000-OUTD FOR NORTH AMERICA

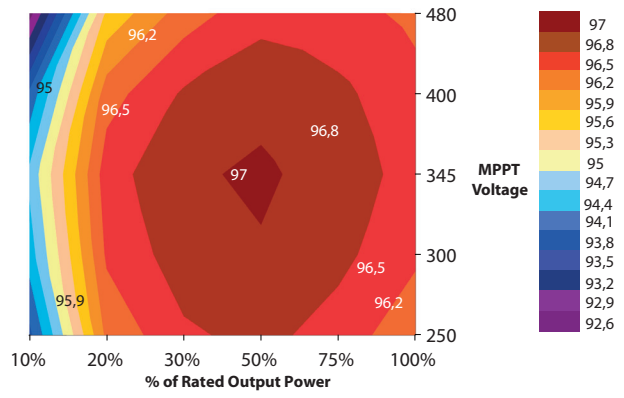


Block Diagram and Efficiency Curves

PVI-5000/6000-OUTD-US



PVI-5000/6000-OUTD-US



TECHNICAL DATA	VALUES	PVI-5000-OUTD-US			PVI-6000-OUTD-US		
Nominal Output Power	W	5000			6000		
Maximum Output Power	W	5000			6000		
Rated Grid AC Voltage	V	208	240	277	208	240	277
Input Side (DC)							
Number of Independent MPPT Channels		2			2		
Maximum Usable Power for Each Channel	W	4000			4000		
Absolute Maximum Voltage (Vmax)	V	600			600		
Start- Up Voltage (Vstart)	V	200 (adj. 120-350)			200 (adj. 120-350)		
Full Power MPPT Voltage Range	V	200-530			200-530		
Operating MPPT Voltage Range	V	0.7xVstart-580			0.7xVstart-580		
Maximum Current (Idcmax) for both MPPT in Parallel	A	36			36		
Maximum Usable Current per Channel	A	18			18		
Maximum Short Circuit Current Limit per Channel	A	22			22		
Number of Wire Landing Terminals Per Channel		2 Pairs			2 Pairs		
Array Wiring Termination		Terminal block, Pressure Clamp, AWG8-AWG4					
Output Side (AC)							
Grid Connection Type		1Ø/2W	Split-Ø/3W	1Ø/2W	1Ø/2W	Split-Ø/3W	1Ø/2W
AdjustableVoltage Range (Vmin-Vmax)	V	183-228	211-264	244-304	183-228	211-264	244-304
Grid Frequency	Hz	60			60		
Adjustable Grid Frequency Range	Hz	57-60.5			57-60.5		
Maximum Current (Iacmax)	A_{RMS}	27	23	20	30	28	24
Power Factor		> 0.995			> 0.995		
Total Harmonic Distortion At Rated Power	%	< 2			< 2		
Contributory Fault Current**	A_{pk}/A_{RMS}	36.25/25.63	36.5/25.81	31.75/22.45	36.25/25.63	36.5/25.81	31.75/22.45
Grid Wiring Termination Type		Terminal block, Pressure Clamp, AWG8 - AWG4					
Protection Devices							
Input							
Reverse Polarity Protection		Yes			Yes		
Over-Voltage Protection Type		Varistor, 2 for each channel			Varistor, 2 for each channel		
PV Array Ground Fault Detection		Pre start-up Riso and dynamic GFDI (Requires Floating Arrays)			Pre start-up Riso and dynamic GFDI (Requires Floating Arrays)		
Output							
Anti-Islanding Protection		Meets UL 1741/IEE1547 requirements			Meets UL 1741/IEE1547 requirements		
Over-Voltage Protection Type		Varistor, 2 (L_1 - L_2 / L_1 - G)			Varistor, 2 (L_1 - L_2 / L_1 - G)		
Maximum AC OCPD Rating	A	35	30	25	40	35	30
Efficiency							
Maximum Efficiency	%	97.1			97.1		
CEC Efficiency	%	96	96.5	96.5	96	96.5	96.5
Operating Performance							
Stand-by Consumption	W_{RMS}	< 8			< 8		
Night time consumption	W_{RMS}	< 0.6			< 0.6		
Communication							
User-Interface		16 characters x 2 lines LCD display					
Remote Monitoring (1xRS485 incl.)		AURORA-UNIVERSAL (opt.)					
Wired Local Monitoring (1xRS485 incl.)		PVI-USB-RS485_232 (opt.), PVI-DESKTOP (opt.)					
Wireless Local Monitoring		PVI-DESKTOP (opt.) with PVI-RADIOMODULE (opt.)					
Environmental							
Ambient Air Operating Temperature Range	°F (°C)	-13 to +140 (-25 to +60)			-13 to +140 (-25 to +60) with derating above 122 (50)		
Ambient Air Storage Temperature Range	°F (°C)	-40 to 176 (-40 to +80)			-40 to 176 (-40 to +80)		
Relative Humidity	% RH	0-100 condensing			0-100 condensing		
Acoustic Noise Emission Level	db (A) @1m	< 50			< 50		
Maximum Operating Altitude without Derating	ft(m)	6560 (2000)			6560 (2000)		
Mechanical Specifications							
Enclosure rating		NEMA 4X			NEMA 4X		
Cooling		Natural Convection			Natural Convection		
Dimensions (H x W x D)	in (mm)	41.4 x 12.8 x 8.6 (1052 x 325 x 218)					
Weight	lb (kg)	< 59.5 (27.0)			< 59.5 (27.0)		
Shipping Weight	lb (kg)	< 78 (35.4)			< 78 (35.4)		
Mounting System		Wall bracket			Wall bracket		
Conduit Connections		Trade Size Kos: (2ea x 1/2") and (2ea x 1-1/4", 3 places side, front, rear)			Trade Size Kos: (2ea x 1/2") and (2ea x 1-1/4", 3 places side, front, rear)		
DC Switch Rating-(Per Contact)	A/V	25 / 600			25 / 600		
Safety							
Isolation Level		Transformerless (Floating Array)			Transformerless (Floating Array)		
Safety and EMC Standard		UL 1741, CSA - C22.2 N. 107.1-01			UL 1741, CSA - C22.2 N. 107.1-01		
Safety Approval		$_cCSA_{us}$			$_cCSA_{us}$		
Warranty							
Standard Warranty	years	10			10		
Extended Warranty	years	15 & 20			15 & 20		
Available Models							
Standard - With DC Switch - Floating Array		PVI-5000-OUTD-US			PVI-6000-OUTD-US		

*All data is subject to change without notice

** Inverter can apply that much current - Breaker will open

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USA West	North America	+1 877 261-1374	sales.usawest@power-one.com

Aspen LED • 12V LED-16

flood & accent

Construction: Body, cap and knuckle machined from 6061 - T6 ALUMINUM. Lens cut from heat strengthened borosilicate glass for superior clarity and strength.

LED Unit:
3022-3027: Winscape proprietary replaceable LED unit using three (3) High Output LEDs and an integral low voltage (11V-14V) AC / DC LED driver and a Field replacable optic. Available in three (3) beam spreads; 10˚ Spot, 25˚ Narrow Flood, and 40˚ Flood. Available as STANDARD in "ANSI BIN" 3000K and 5000K color temperatures. Also available in "ANSI BIN" 2700K, 3500K, & 4000K by Special Order. Units have near constant light output when supplied with 11VAC - 14VAC to combat voltage drop. Dimmable using standard LOW VOLTAGE MAGNETIC dimming switch / systems.

Input Voltage (VAC*)	Total Current (Amps)	Wattage
8.0	0.165	1.32
9.0	0.358	3.23
10.0	0.448	4.48
11.0	0.463	5.10
12.0	0.471	5.65
12.5	0.476	5.95
13.0	0.487	6.34
14.0	0.499	6.99

* Contact factory for Current and Wattage rating for VDC.

Finishes: Available in 12 standard TGIC polyester powder coat finishes. Custom powder coat finishes available (contact factory for more information).

Features: Field replaceable lens. Tapered "Sure Lock" knuckle seat for infinite aiming and unparalleled locking ability. Any combination of up to 3 lens accessories/color filter/shielding can be specified in any cap style and are held securely by a removable stainless steel clip ring.

General: This fixture requires a low voltage MAGNETIC transformer to function properly. Magnetic transformer must be purchased separately (see Accessories section on our website). Mounting must be specified separately (see Accessories section on our website). Available with 350˚ rotational knuckle.

MOUNTING OPTIONS:

GROUND MOUNT | WALL MOUNT | TREE MOUNT | SURFACE MOUNT

NOTE: See Accessories on our website for mounting options.

ETL Listed:
Wet Location - Indoor/Outdoor
Conforms to UL Standard 1598

1. **ASLED** — SERIES
   - **ASLED** = ASPEN LED

2. **3023** — LIGHT SOURCE
   - **Warm White, 3000K (ANSI BIN)****
   - **3022** = 6W/10˚SP/3K WW LED16
   - **3023** = 6W/25˚NFL/3K WW LED16
   - **3024** = 6W/40˚FL/3K WW LED16
   - **Cool White, 5000K (ANSI BIN)****
   - **3025** = 6W/10˚SP/5K CW LED16
   - **3026** = 6W/25˚NFL/5K CW LED16
   - **3027** = 6W/40˚FL/5K CW LED16

** See page 2 for complete luminaire performance data.

3. **12V** — VOLTAGE
   - **12V** = 12 VOLT

4. ACCESSORY LENS
   - **L0** = NONE
   - **L1** = PRISMATIC
   - **L2** = LINEAR
   - **L3** = SOFTENING
   - **L4** = WATERSHED™

5. FINISH
   - **BKS** = BLACK SMOOTH
   - **BKT** = BLACK TEXTURED
   - **BRS** = BRONZE SMOOTH
   - **BRT** = BRONZE TEXTURED
   - **WHS** = WHITE SMOOTH
   - **WHT** = WHITE TEXTURED
   - **SIS** = SILVER SMOOTH
   - **IVS** = IVORY SMOOTH
   - **CHS** = CHROME SMOOTH
   - **NBS** = NATURAL BRONZE SMOOTH
   - **VET** = VERDE TEXTURED
   - **SAT** = SAND TEXTURED
   - **CPF** = CUSTOM FINISH

6. COLOR FILTER
   - **F0** = NONE
   - **FM** = MERCURY VAPOR
   - **FR** = RED
   - **FRD** = RED DICHROIC
   - **FP** = PINK
   - **FA** = AMBER
   - **FG** = GREEN
   - **FGD** = GREEN DICHROIC
   - **FLB** = LIGHT BLUE
   - **FMB** = MEDIUM BLUE
   - **FMBD** = MEDIUM BLUE DICHROIC

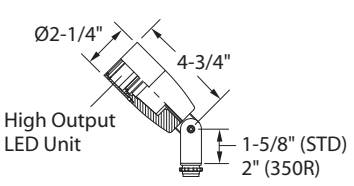
7. SHIELDING
   - **SH0** = NONE
   - **SH6** = HONEYCOMB LOUVER

8. CAP STYLE
   - **C1** = SHORT FLUSH
   - **C2** = LENS RECESSED
   - **C3** = 45˚ CUTOFF
   - **C4** = LONG FLUSH
   - **C5** = 45˚ SCALLOPED

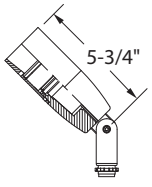
9. SPECIAL
   - **STD** = STANDARD
   - **MOD** = MODIFIED
   - **350R** = 2 PIECE 350˚ ROTATION KNUCKLE

Modification Descriptions: (if needed)

Note: Winona Lighting reserves the right to make design revisions without prior notice.



CAP C1



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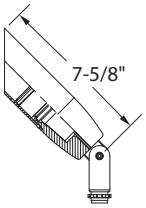

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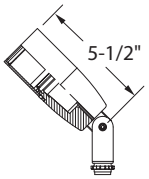

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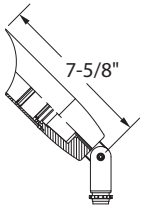
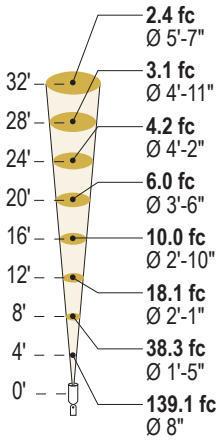
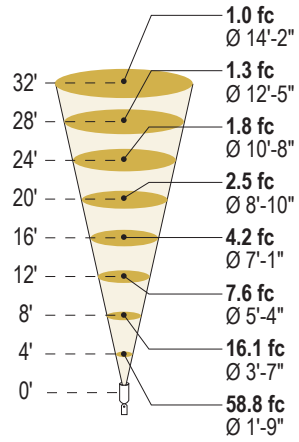


CAP C5

PHOTOMETRY • LED-16



#3022
6W/10°SP/3K WW LED16



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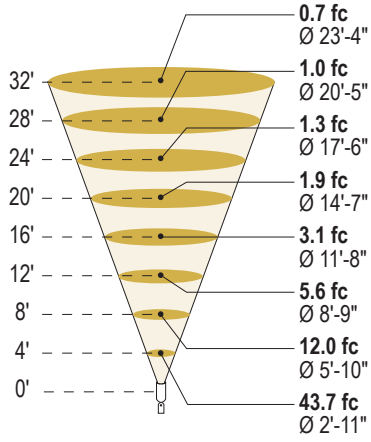
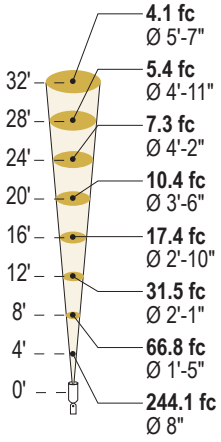
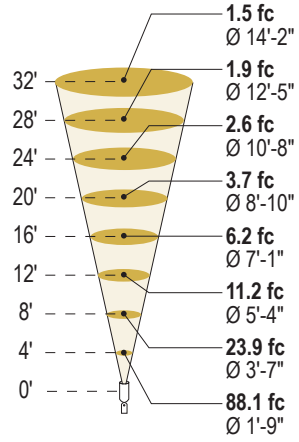
6W/25°NFL/3K WW LED16



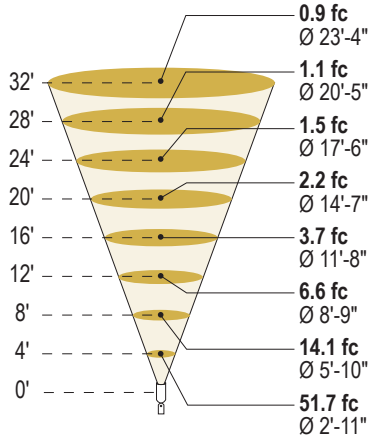
#3024
6W/40°FL/3K WW LED16



#3025
6W/10°SP/5K CW LED16



#3026
6W/25°NFL/5K CW LED16



#3027
6W/40°FL/5K CW LED16

Luminaire Performance Data

Lamp Code	Description	Volts* (Vac)	Watts* (W)	Beam Spread*	Center Beam Candlepower* (cd)	Rated Life** (Hr)	CCT* (°K)	CRI* (Ra)	Luminous Flux* (LU)	Efficacy* (LU/W)
3022	6W/10°SP/3K WW LED16	12	5.8	10°	2,400	> 60,000	3040	> 83	220	38
3023	6W/25°NF/3K WW LED16	12	5.8	25°	1,000	> 60,000	3040	> 83	215	37
3024	6W/40°FL/3K WW LED16	12	5.8	40°	750	> 60,000	3040	> 83	210	36
3025	6W/10°SP/5K CW LED16	12	5.8	10°	4,200	> 60,000	5200	> 65	320	55
3026	6W/25°NF/5K CW LED16	12	5.8	25°	1,500	> 60,000	5200	> 65	300	51
3027	6W/40°FL/5K CW LED16	12	5.8	40°	890	> 60,000	5200	> 65	260	44

* All values are nominal, based on IES LM-79-08 & Photometric test data. Values may vary due to manufacturing tolerances, options selected and ambient conditions (temperature, voltage, orientation, etc…) during use.

** Rated Life based on diode manufacturer IES LM-80 test data, TM-21 projection to 70% of Initial Lumens (L70).

All information is subject to change without prior notice.
All dimensions are nominal.

LIGHTING FACTS

LM-79 & Photometric Test Data

The below are LM-79 test results using an AspenLED series luminaire; PN: ASLED-Lamp Code-12V-L0-BKS-F0-SH0-C1-STD

Lamp Code	Description	Volts* (Vac)	Watts* (W)	Center Beam Candlepower** (cd)	CCT* (°K)	CRI* (Ra)	Luminous Flux* (LU)	Efficacy* (LU/W)
3022	6W/10°SP/3K WW LED16	11.9	5.2	2,433	3012.3	85.3	213.7	41.10
3022	6W/10°SP/3K WW LED16	14.1	7.2	N/A	3015.0	85.0	246.6	34.25
3023	6W/25°SP/3K WW LED16	12.1	5.7	1,019	3064.4	83.4	215.0	37.85
3024	6W/40°SP/3K WW LED16	12.0	5.7	757	3041.5	84.3	218.8	38.39
3025	6W/10°SP/5K CW LED16	12.0	5.7	4,252	5220.8	67.0	318.5	55.88
3025	6W/10°SP/5K CW LED16	14.1	7.4	N/A	5207.0	67.4	344.8	46.59
3026	6W/25°SP/5K CW LED16	12.0	5.8	1,531	5207.9	67.4	299.5	51.46
3027	6W/40°SP/5K CW LED16	12.1	5.7	896	5194.8	66.8	271.9	47.53

* Information from IES LM-79-08 test results (LTL22353S, LTL22392S, LTL22352S, LTL22351S, LTL22350S, LTL22393S, LTL22349S, LTL22348S).
** Information from Photometric test results (LTL22353, LTL22352, LTL22351, LTL22350, LTL22349, LTL22348).

LIGHTING FACTS - Coming Soon
LM-79-08 tests have been submitted to Lighting Facts and are awaiting approval.

Date: _____ Type: _____

Firm Name: _____

Project: _____

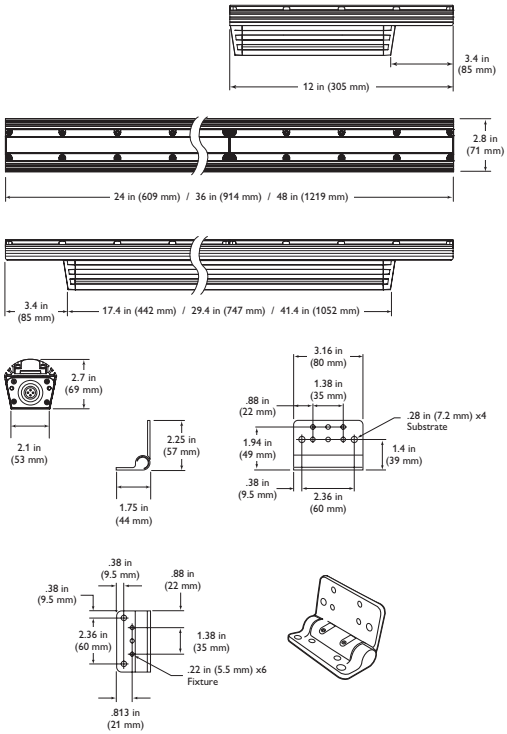
eW Graze Powercore

2700 K, 30° x 60° beam angle

Linear exterior LED wall grazing fixture with solid white light

eW Graze Powercore Powercore linear LED lighting fixtures are ideal for surface grazing and wall-washing applications that require high-quality white light. Featuring Powercore technology, eW Graze Powercore processes power directly from line voltage, eliminating the need for external power supplies. Fixtures are available in seven color temperatures, ranging from a warm 2700 K to a cool 6500 K, including standard color temperatures of 2700 K and 4000 K. eW Graze Powercore offers superior illumination quality and dramatic energy savings for new installations and retrofit upgrades. A space-efficient, low-profile aluminum housing and flexible mounting options allow discreet placement within a wide range of compact architectural details.

- Tailor light output to specific applications — eW Graze Powercore is available in standard 1 ft and 4 ft exterior-rated housings, and standard 10° x 60° and 30° x 60° beam angles.
- High-performance illumination and beam quality — Superior beam quality offers striation-free saturation as close as 6 in (152 mm) from fixture placement with no visible light scalloping between fixtures.
- Supports new applications for white light— Long useful source life (50,000 hours at 70% lumen maintenance) significantly reduces or eliminates maintenance problems, allowing the use of white lighting in spaces where lamp maintenance may be limited or unfeasible.
- Universal power input range — eW Graze Powercore accepts line voltage input of 100, 120, 220 – 240, and 277 VAC.
- Versatile installation options — Constant torque locking hinges offer simple position control from various angles without special tools. The low-profile extruded aluminum housing accommodates installation within architectural niches of many different shapes and sizes.
- Support for installations requiring conduit to fixtures — eW Graze Powercore Conduit fixtures have flying leads and threaded openings for 1/2 in NPT conduit to support installations in North America where conduit is required.



- Wide range of custom configurations — Additional fixture lengths, beam angles, and color temperatures up to 6500 K are available as custom configurations. See the eW Graze Powercore Ordering Information specification sheet for complete details.
- "Cool lighting" functionality — eW Graze Powercore fixtures do not heat illuminated surfaces, discharge infrared radiation, or emit ultraviolet light.
- Dimming capability — Patented DIMand technology offers smooth dimming capability with selected commercially available reverse-phase ELV-type dimmers.

For detailed product information, please refer to the eW Graze Powercore Product Guide at www.philipscolorkinetics.com/ls/essentialwhite/ewgraze/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	1 ft (305 mm)	4 ft (1.2 m)
Output	Lumens†	422	1688
	Efficacy (lm / W)	31.3	
	CRI	83	
	Mixing Distance	6 in (152 mm) to uniform beam saturation	
	Lumen Maintenance‡	100,000+ hours L_{70} @ 25° C 50,000 hours L_{70} @ 50° C	
Electrical	Input Voltage	100 / 120 / 220 – 240 / 277 VAC, 50 / 60 Hz	
	Power Consumption	15 W maximum at full output, steady state	60 W maximum at full output, steady state
Control	Dimming	Compatible with selected commercially available reverse-phase ELV-type dimmers§	
Physical	Dimensions *(Height x Width x Depth)*	2.7 x 12 x 2.8 in (69 x 305 x 71 mm)	2.7 x 48 x 2.8 in (69 x 1219 x 71 mm)
	Weight	2.7 lb (1.2 kg)	10.8 lb (4.9 kg)
	Housing	Extruded anodized aluminum, cool gray hinge color	
	Lens	Clear polycarbonate	
	Fixture Connectors	Integral male / female waterproof connectors	
	Humidity	0 – 95%, non-condensing	
	Temperature Ranges	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup -40° – 176° F (-40° – 80° C) Storage	
	Fixture Run Lengths	To calculate fixture run lengths and total power consumption for your specific installation, download the Configuration Calculator from www.philipscolorkinetics.com/support/install_tool/	
Certification and Safety	Certification	UL / cUL, FCC Class B (120 VAC), CE, C-Tick, CCC	
	Environment	Dry / Damp / Wet Location, IP66	

* Color temperatures conform to nominal CCTs as defined in ANSI Chromaticity Standard C78.377A.

† Lumen measurement complies with IES LM-79-08 testing procedures.

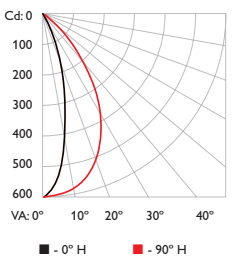
‡ L_{70} = 70% lumen maintenance (when light output drops below 70% of initial output). Ambient luminaire temperatures specified. Lumen maintenance calculations are based on lifetime prediction graphs supplied by LED source manufacturers. Calculations for white-light LED fixtures are based on measurements that comply with IES LM-80-08 testing procedures. Refer to www.philipscolorkinetics.com/support/appnotes/ for more information.

§ See www.philipscolorkinetics.com/support/appnotes/notes/ for specific details.

Photometrics

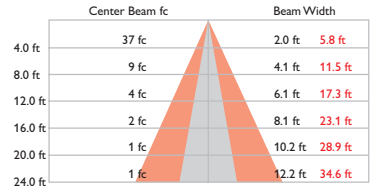
2700 K, 1 ft, 30° x 60° beam angle

Polar Candela Distribution



	0.0	22.5	45.0	67.5	90.0
0	594	594	594	594	594
5	549	555	569	583	588
15	276	304	386	494	547
25	85	103	176	338	456
35	35	40	67	182	310
45	20	22	31	78	156
55	12	13	18	34	61
65	6	7	10	16	23
75	3	3	4	6	8
85	1	1	1	1	1
90	1	0	0	0	0

Illuminance at Distance



24.4 ft (7.4 m)
1 fc maximum distance

■ Vert. Spread: 28.6°
■ Horiz. Spread: 71.6°

Lumens	422
Efficacy	31.3 lm / W

For lux multiply fc by 10.7

OPTIBIN® CK TECHNOLOGY | POWERCORE® CK TECHNOLOGY | DIMAND® CK TECHNOLOGY

Fixtures

See the eW Graze Powercore Ordering Specification Sheet for a complete list of standard and custom configurations.

Fixture	Length	Item Number	Philips 12NC
eW Graze Powercore, 2700 K, 30° x 60° Beam Angle 100 VAC	1 ft (305 mm)	523-000030-28	910503700304
	4 ft (1.2 m)	523-000030-30	910503700306
eW Graze Powercore, 2700 K, 30° x 60° Beam Angle 120 VAC	1 ft (305 mm)	523-000030-04	910503700280
	4 ft (1.2 m)	523-000030-06	910503700282
eW Graze Powercore, 2700 K, 30° x 60° Beam Angle 220 – 240 VAC	1 ft (305 mm)	523-000030-20	910503700296
	4 ft (1.2 m)	523-000030-22	910503700298
eW Graze Powercore, 2700 K, 30° x 60° Beam Angle 277 VAC	1 ft (305 mm)	523-000030-12	910503700288
	4 ft (1.2 m)	523-000030-14	910503700290
eW Graze Powercore, 2700 K, 30° x 60° Beam Angle Conduit / 120 VAC	1 ft (305 mm)	523-000061-09	910503701855
	4 ft (1.2 m)	523-000061-54	910503701901
eW Graze Powercore, 2700 K, 30° x 60° Beam Angle Conduit / 277 VAC	1 ft (305 mm)	523-000062-09	910503701521
	4 ft (1.2 m)	523-000062-54	910503701566

Use Item Number when ordering in North America.

Accessories

Item	Type	Size	Item Number	Philips 12NC
Leader Cable	UL / cUL	50 ft (15.2 m)	108-000041-00	910503700320
	CE		108-000041-01	910503700320
Jumper Cable	UL / cUL	End-to-End	108-000039-00	910503700314
		1 ft (305 mm)	108-000039-01	910503700315
		5 ft (1.5 m)	108-000039-02	910503700316
	CE	End-to-End	108-000040-00	910503700317
		1 ft (305 mm)	108-000040-01	910503700318
		5 ft (1.5 m)	108-000040-02	910503700319
Glare Shield		1 ft (305 mm)	120-000081-00	910503700745
		2 ft (610 mm)	120-000081-01	910503700746
		3 ft (914 mm)	120-000081-02	910503700747
		4 ft (1.2 m)	120-000081-03	910503700748
Additional Terminators		Quantity 10	120-000074-00	910503700580
Additional Hinge		Quantity 1	120-000098-00	910503700772

Use Item Number when ordering in North America.

Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.philipscolorkinetics.com

DAS-000009-03 R08 07-12

LITHONIA LIGHTING®

Catalog Number	
Notes	Type

FEATURES & SPECIFICATIONS

Indoor General Purpose

Rayzer™ Modular LED Lighting System

INTENDED USE
Provides task or accent lighting in commercial, retail, hospitality and residential applications. Ideal for use under and over cabinets, display cases, task lighting, office lighting, coves and utility/work areas.

ATTRIBUTES
Durable aluminum construction in a low-profile design. Can be plugged in or direct-wired (splice box and 24" connector cord required for direct-wiring). Link up to 10' of modular system to one transformer (sold separately). Fixtures can be linked end-to-end with the end row connector (sold separately). All fixtures include a 18" linking cord. 3", 24" and 121" connector cords may also be purchased separately.

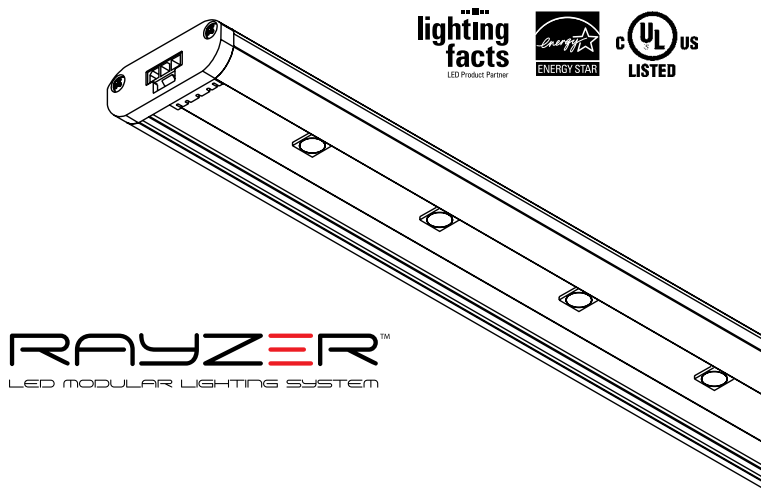
LEDs have a 50,000 hour L70 rated life. Provides warm color temperature, 3,000K with CRI 85, and even illumination.

Dimmable when used with the optional step dimmer.

All mounting hardware included. Mounting clips allow for quick & easy installation flush or at 30º. All configurations tested to IES LM79 standards.

LISTING
CUL listed to US and Canadian safety standards. ENERGY STAR® qualified.

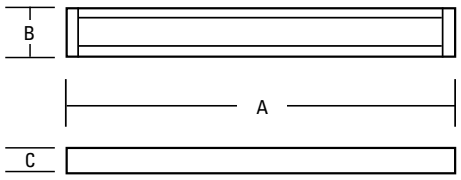
WARRANTY
Guaranteed for three years against mechanical defects in manufacture.



DIMENSIONS

All dimensions are in inches (centimeters)

Nominal Size	Model No.	Number of Lamps	(A) Length Inches (cm)	(B) Width Inches (cm)	(C) Height Inches (cm)
9"	RAZ9	3	9-1/4" (23.49)	1-1/4" (3.18)	1/2" (1.27)
12"	RAZ12	4	12-1/4" (31.11)	1-1/4" (3.18)	1/2" (1.27)
18"	RAZ18	6	18-1/4" (46.35)	1-1/4" (3.18)	1/2" (1.27)
24"	RAZ24	8	24-1/4" (46.35)	1-1/4" (3.18)	1/2" (1.27)



ORDERING INFORMATION

Example: **RAZ18**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line.
Order accessories as separate catalog numbers.

Model Number

RAZ9	9" length - 3 LEDs
RAZ12	12" length - 4 LEDs
RAZ18	18" length - 6 LEDs
RAZ24	24" length - 8 LEDs

Options

(Consult factory)

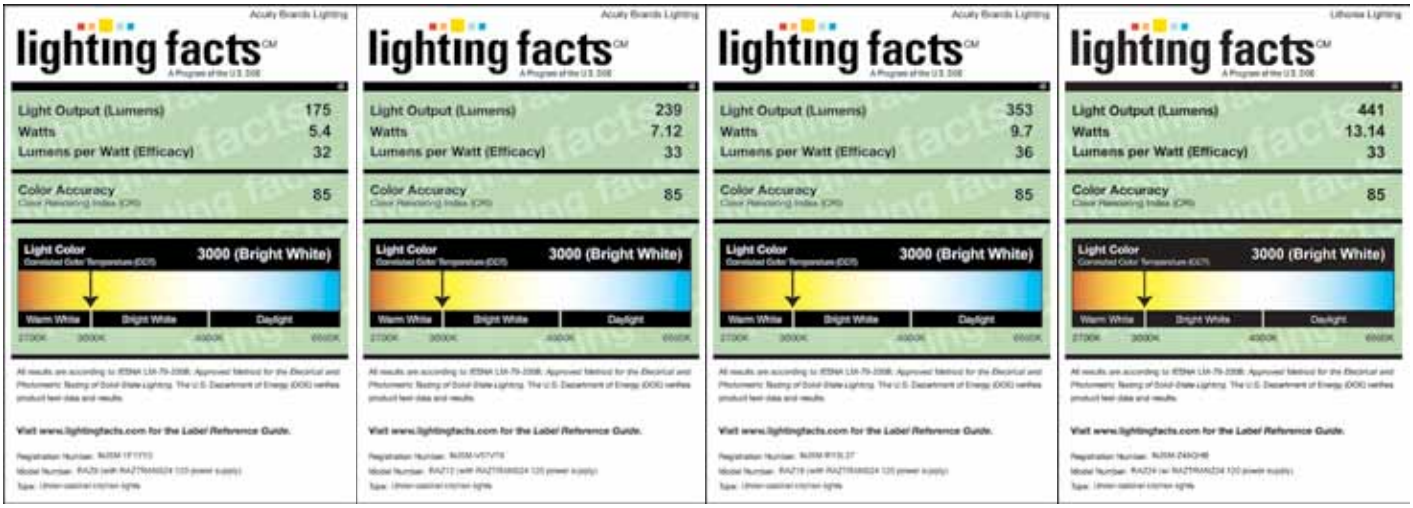
Accessories/Replacement Parts

RAZTRANS24 120	24v transformer - 120v power source
RAZTRANS24 MVOLT	24v transformer - Multi-Volt power source
RAZDIM	Step dimmer with remote touch pad
RAZ CC121	121" Linking cord (fixture to fixture)
RAZ CC24	24" linking cord (fixture to fixture)
RAZ CC3	3" linking cord (fixture to fixture)
RAZLVCC	Low voltage linking cord (cord to cord)
RAZ ERC	End row connector
RAZ PHD	Power hub distributor
RAZ INLS26	In-line power switch
UCD JB	Splice box - white (required for direct wire)
UCD JB BL	Splice box - black (required for direct wire)
UC ERC24 R12	24" connector cord - white (required for direct wire)
UC ERC24 BL	24" connector cord - black (required for direct wire)

PHOTOMETRICS

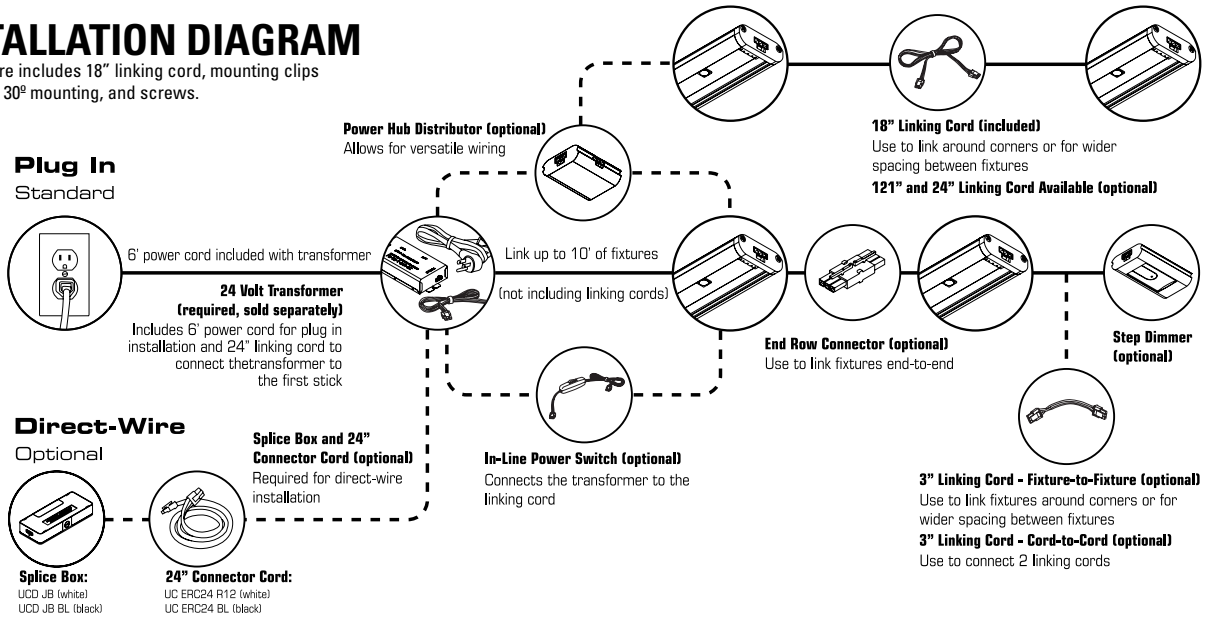
Full photometric data report available within 2 weeks from request. Consult factory.

9″ **12″** **18″** **24″**



INSTALLATION DIAGRAM

Note: Fixture includes 18″ linking cord, mounting clips for flush or 30º mounting, and screws.



LITHONIA LIGHTING®
An AcuityBrands Company

Lithonia Lighting
Consumer Products Group
One Lithonia Way, Conyers, GA 30012
Phone: 800-748-5070 Fax: 770-860-3903
In Canada: 160 Avenue Labrosse, Point-Claire, P.Q., H9R 1A1
www.lightahome.com

Sheet #: RAZC

CRS 6LEDQR

Quick Release 3W LED Gravity-Fit Pendants

Catalog No. _____

Type _____

Project _____

Specifications/Features

Fixture

3W LED light source provides an energy efficient lighting solution.

Cool (6000K) or Warm (3000K) white LED color temperatures.

Four lengths are available and field adjustable for custom lengths.

Must be used with one of the mounting options listed below. Choose from line voltage track, line voltage flexible track or mono-point mounting options (details on following page).

Compatible with Gravity-Fit Rock Cottage Glass and Orchard Field Glass shades (sold separately).

Lamp/Electrical

(1) 3W Cool (6000K) or Warm (3000K) white LED

Driver

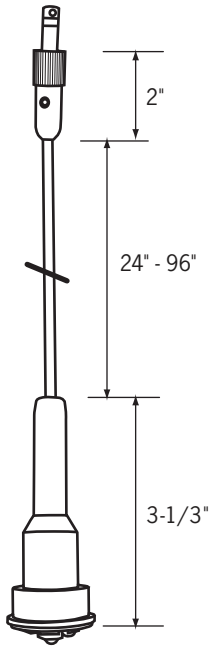
Input: 100-240VAC , 0.18A
Output: 700mA constant current

Warranty

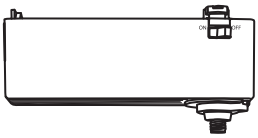
This fixture is covered by Con-Tech's full five (5) year replacement guarantee after date of purchase.
Driver is covered by manufacturer's two (2) year warranty.

Labels/Usage

CSA Certified to UL Standards. Suitable for dry locations.

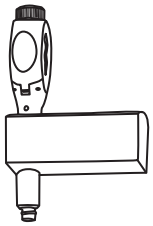


Mounting Options



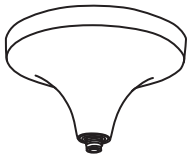
Line Voltage Track Adapter
Connect 3W LED Quick Release pendant to standard line voltage track. LED Driver included. 5-1/4"L x 1-11/16"H. Black, white and silver finish only.

CRS-LVTQRD-(B,P,S)



Odyssey Line Voltage Flexible Track Adapter
Connect 3W LED Quick Release pendant to Odyssey line voltage flexible track. LED Driver included. 3-1/4"L x 5"H.

CRS-ODYQRD-(AB,B,P,S)



Decorative Ceiling Canopy
Connect 3W LED Quick Release pendant to ceiling. Mounts to NEC approved 4" round or octagon junction box with minimum depth of 1-1/2". LED Driver included. 2-1/2" H, 4-3/8"Dia.

CRS-DQRCD-(AB,B,P,S)

Thin Ceiling Canopy
Connect 3W LED Quick Release pendant to ceiling. Mounts to NEC approved 4" round or octagon junction box with minimum depth of 1-1/2". LED Driver included. 1/4" H, 4-3/8"Dia.

CRS-TQRCD-(AB,B,P,S)

Ceiling Canopy
Connect 3W LED Quick Release pendant to ceiling. LED Driver included. 1-5/16" H, 4-3/8"Dia.

CRS-QRCD-(AB,B,P,S)

Ordering Information

Example Order: CRS7246LEDQRW – S CRS-QRCD – S

Fixture	LED Temperature	Finish	Mounting Option*	Finish
CRS7246LEDQR	C	– S	CRS-QRCD	– S

CRS7246LEDQR - 2' Pendant
CRS7486LEDQR - 4' Pendant
CRS7726LEDQR - 6' Pendant
CRS7966LEDQR - 8' Pendant

C - 6000K Cool White
W - 3000K Warm White

AB - Antique Bronze
B - Black
P - White
S - Silver

CRS-LVTQRD - Line Voltage Track Adapter
CRS-ODYQRD - Odyssey Line Voltage Flexible Track Adapter
CRS-DQRCD - Decorative Ceiling Canopy
CRS-TQRCD - Thin Ceiling Canopy
CRS-QRCD - Ceiling Canopy

AB - Antique Bronze
B - Black
P - White
S - Silver

*All moutning options include LED Driver

CRS 6LEDQR

Quick Release 3W LED Gravity-Fit Pendants

Catalog No. _____

Type _____

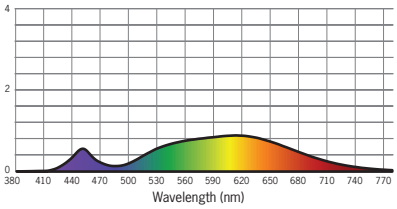
Project _____

Photometrics

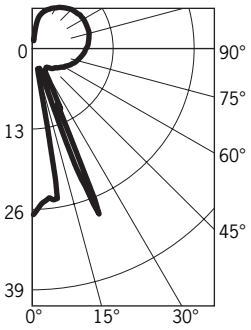
CRS7246LEDQRC, MLA106-W

Designed for 50,000 Hour Lamp Life*; LM-79 Test No. 67380

Light Output (Fixture Delivered Lumens): 98
Total Watts@120V: 4
Lumens Per Watt: 27
Color Rendering Index (CRI)[1]: 73
Color Temperature (CCT)[2]: 5681K Cool White
Spectral Power Distribution Chart[3]



Candela Curve



Candlepower Summary

FROM 0	CANDELA	LUMENS
0	27	
5	25	2
15	4	2
25	7	5
35	4	3
45	5	4
55	6	5
65	7	7
75	8	8
85	8	9
95	9	10

Intensity Distribution

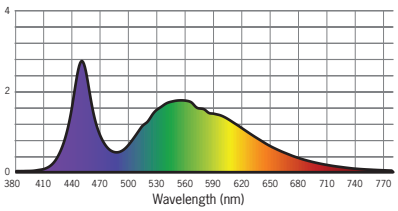
DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
1'	27.0	0.4
2'	6.8	0.7
3'	3.0	1.1
4'	1.7	1.4
5'	1.1	1.8
6'	0.8	2.1

Beam Distribution: 21°

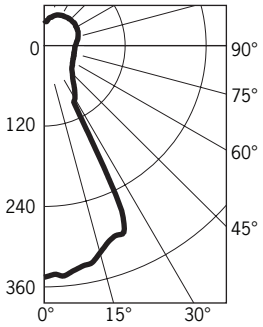
CRS7246LEDQRC, OFG201

Designed for 50,000 Hour Lamp Life*; LM-79 Test No. 67435

Light Output (Fixture Delivered Lumens): 104
Total Watts@120V: 4
Lumens Per Watt: 27
Color Rendering Index (CRI)[1]: 75
Color Temperature (CCT)[2]: 5728K Cool White
Spectral Power Distribution Chart[3]



Candela Curve



Candlepower Summary

FROM 0	CANDELA	LUMENS
0	43	
5	43	4
15	40	11
25	34	12
35	10	6
45	7	6
55	6	6
65	6	6
75	6	6
85	6	6
95	6	7

Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
1'	43.2	1.0
2'	10.8	1.9
3'	4.8	2.9
4'	2.7	3.8
5'	1.7	4.8
6'	1.2	5.7

Beam Distribution: 54°

6" LED Downlight

LC6LED

120 or 277V

0-10V Dimming Option

DATE: TYPE:

FIRM NAME:

PROJECT:

LiteFrame®

Ceiling Cutout: 6¼"
Maximum Ceiling Thickness 1¼"
For conversion to millimeters, multiply inches by 25.4
Not to Scale

APPLICATIONS:

LiteFrame Commercial (LC6LED) is a 6" commercial grade LED downlight with available outputs between 900-1600 lumens. This is suitable to replace most CFL downlighting applications, while realizing substantial energy and maintenance savings. Rated for a minimum of 50,000 hours life (70% lumen maintenance) with ambient plenum temperatures up to 35°C (LED5), 28°C (LED6), 25°C (LED7). Free Air Flow around fixture is required for optimal life performance.

HOUSING:

One-piece 22 gauge non-corrosive steel platform. Pre-wired J-box with snap-on cover for easy access. Snap-in connection from driver compartment allows easy installation of light engine/trim assembly and can be upgraded to accommodate technology improvements. Approved for 8 (4 in/4 out) No. 12 AWG conductors rated for 90°C through wiring.

REFLECTOR:

High purity aluminum, Alzak, iridescence suppressed, semi-diffuse reflector. Self-trim standard. Painted white self-trim (WT) available as option.

LED LIGHT ENGINE:

The LC6LED uses either 36, 54, 72 low power Nichia LED's, specifically mixed to provide a minimum of 80 CRI with 3 SCDM color consistency. The use of multiple low power LED's allows for optimal thermal management by effectively spreading the heat over a larger area and eliminating hot spots on the LED's. A diffuse, yet highly transmissive lens obscures the view of the LED's and creates a smooth, even look from below. The light engine is available in multiple Kelvin temperatures and the system is designed to provide optimal life and lumen maintenance (50,000 hours at 70% lumen maintenance). The reflector/light engine assembly is mechanically retained to the housing.

LED DRIVER:

The LC6LED utilizes a 25 watt constant current Thomas Research Products LED driver. This same driver is capable of running all three different lumen outputs, resulting in a reduction of housing sku's and simplified specification. The driver is UL8750 and Class II compliant.

DIMMING:

A 0-10V dimming option is available (DM), providing flicker-free dimming down to 10%. See list of compatible dimmers on page (3). For the sizing of the control circuit, the dimming circuit may require up to 1.2mA of sink current.

INSTALLATION:

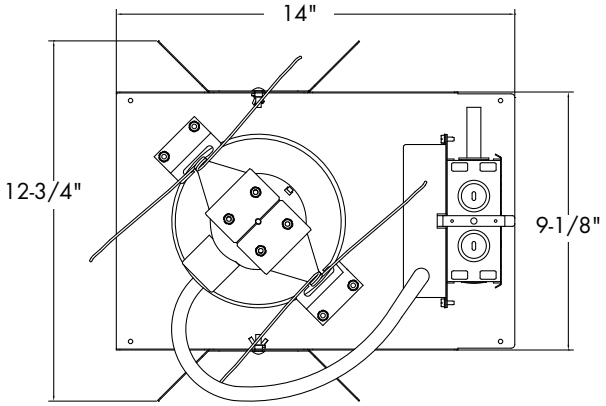
Light commercial bar hangers included. Universal adjustable mounting brackets also accept ½" EMT conduit or 1½" or ¾" lathing channel (by others) or Prescolite 24" bar hangers (B24 or B6).

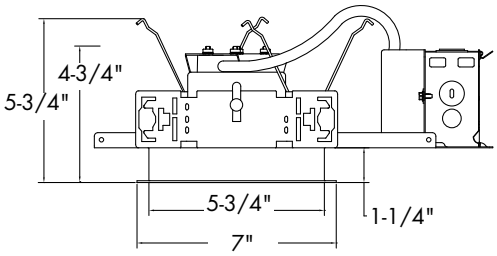
CERTIFICATIONS:

CSA certified to US and Canadian safety standards. Suitable for wet locations.

WARRANTY:

5 year warranty. See www.prescolite.com for details.





6LCLED 5 & 6

***See page 4 for 6LCLED 7 line art**

Order housing, reflector, and accessories separately

CATALOG NUMBER: EXAMPLE: LC6LED120DM - 6LCLED535K8WT

HOUSING	VOLTAGE	HOUSING OPTIONS	–	TRIM APERTURE	OUTPUT	KELVIN	CRI	REFLECTOR FINISH	REFLECTOR COLOR	REFLECTOR OPTIONS	–	ACCESSORIES
❑ **LC6LED** 6" LED Housing	❑ **120** 120V ❑ **277** 277V	❑ **Blank** No Dimming ❑ **DM** 0-10V dimming to 10% ❑ **WIH** Wi-Hubb Enabled		❑ **6LCLED** 6" Open Reflector/ Light Engine Assembly,	❑ **5** Nominal 1000 Delivered Lumens ❑ **6** Nominal 1400 Lumens Delivered ❑ **7** Nominal 1600 Lumens Delivered	❑ **27K** 2700 Kelvin ❑ **30K** 3000 Kelvin ❑ **35K** 3500 Kelvin ❑ **40K** 4000 Kelvin	❑ **8** 80+ CRI	❑ **Blank** Clear Alzak, Semi-Diffuse	❑ **WH**[1] White Paint	❑ **WT** White Trim		❑ **B24** Set of two(2) 24" bar hangers for T-bar ceilings ❑ **B6** Set of two (2) bar hangers for ceiling joist up to 24" centers ❑ **LG1S**[2] Dual-Lite100VA Surface Wall Mount LiteGear Emergency Lighting Inverter ❑ **LG1R**[2] Dual-Lite100VA Recessed Wall Mount LiteGear Emergency Lighting Inverter ❑ **LG1T**[2] Dual-Lite100VA Recessed Ceiling T-Grid LiteGear Emergency Lighting Inverter ❑ **LG2S**[2] Dual-Lite 250 VA Surface Wall Mount LiteGear Emergency Lighting Inverter ❑ **SCA6D_** Sloped ceiling adapter (see note on page 4)

[1] Requires WT option
[2] See LC6LED and LiteGear Compatibility on page 3

prescolite
A Division of Hubbell Lighting, Inc.

PHOTOMETRIC DATA

LiteFrame - 6" LF6LED Downlight

DRIVER DATA	6LCLED5xxx	6LCLED6xxx	6LCLED7xxx
Input Voltage	120-277V	120-277V	120-277V
Input Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Input Current	0.143 (120v)	0.200 (120v)	0.148 (120v)
	0.062 (277v)	0.087 (277v)	0.108 (277v)
Input Power	17.1W	24.0W	29.8W
Constant Current Output	700mA	700mA	700mA
Power Factor	≥0.90	≥0.90	≥0.90
THD	<25%	<20%	<20%
EMI Filtering	FCC 47CFR	FCC 47CFR	FCC 47CFR
	Part 15, Class A	Part 15, Class A	Part 15, Class A
Operating Temperature	-30°C to +35°C	-30°C to +28°C	-30°C to +25°C
Dimming	0-10V	0-10V	0-10V

Over-voltage, over-current, short-circuit protected

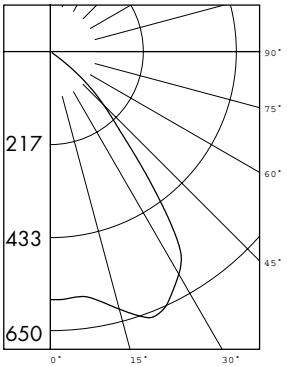
Lumen Multiplier Table

Photometrics for the LC6LED are published below at a nominal 3500 Kelvin temperature. This table may be used to approximate the lumen values at different Kelvin temperatures. Power consumption would stay the same.

5000 Kelvin	1.14
4000 Kelvin	1.03
3500 Kelvin	1.00
3000 Kelvin	1.00
2700 Kelvin	0.91

LC6LED120 6LCLED535K8

LED Light Engine: 3500K, 80+ CRI
System Wattage: 17.1W
Fixture Delivered Lumens: 925
Fixture Efficacy: 54.0
Spacing Criteria: 1.3



ZONAL LUMEN SUMMARY

ZONE	LUMENS
0-60	920.4
0-90	925.1
90-180	0.0
0-180	925.1

LUMINANCE DATA IN CANDELA/ SQ. METER

Angle in Vertical	Average - 0°
45°	12691
55°	873
65°	326
75°	164
85°	62

CANDELA DISTRIBUTION

DEG	CANDELA
0	560
5	552
15	593
25	621
35	444
45	161
55	10
65	2
75	1
85	0
90	0

COEFFICIENTS OF UTILIZATION Zonal Cavity Method

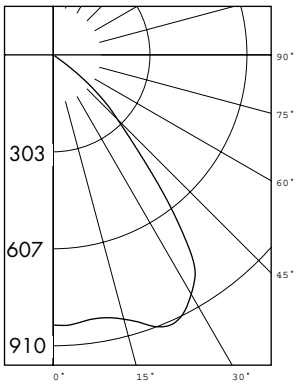
Room Cavity Ratio	% Effective Ceiling Cavity Reflectance: 80%				70%				50%				30%			10%
	20% Effective Floor Cavity Reflectance															
	% Wall Reflectance															
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10
1	113	110	107	105	110	108	105	103	104	102	100	100	98	97	96	95	94
2	106	101	96	93	104	99	95	92	96	93	90	93	90	88	90	88	86
3	100	93	87	83	98	91	86	82	89	84	81	86	83	80	84	81	78
4	94	86	79	75	92	84	79	74	82	77	73	80	76	72	78	75	72
5	88	79	72	68	87	78	72	67	76	71	67	74	70	66	73	69	65
6	83	73	66	62	82	72	66	61	71	65	61	69	64	60	68	63	60
7	78	68	61	56	77	67	61	56	66	60	56	64	59	55	63	59	55
8	74	63	56	52	72	62	56	51	61	55	51	60	55	51	59	54	51
9	69	59	52	47	68	58	52	47	57	51	47	56	51	47	55	50	47
10	66	55	48	44	64	54	48	44	53	48	44	53	47	43	52	47	43

LC6LED120 6LCLED535K8 Test No. 1,911

Test No. TUV JI1211251-1-LM79
Tested at 25°C Ambient in accordance to IESNA LM-79-2008

LC6LED120 6LCLED635K8

LED Light Engine: 3500K, 80+ CRI
System Wattage: 24.0W
Fixture Delivered Lumens: 1375
Fixture Efficacy: 57.3
Spacing Criteria: 1.3



ZONAL LUMEN SUMMARY

ZONE	LUMENS
0-60	1369.3
0-90	1375.2
90-180	0.0
0-180	1375.2

LUMINANCE DATA IN CANDELA/ SQ. METER

Angle in Vertical	Average - 0°
45°	19982
55°	1447
65°	541
75°	244
85°	89

CANDELA DISTRIBUTION

DEG	CANDELA
0	836
5	824
15	847
25	869
35	649
45	249
55	16
65	4
75	1
85	0
90	0

COEFFICIENTS OF UTILIZATION Zonal Cavity Method

Room Cavity Ratio	% Effective Ceiling Cavity Reflectance: 80%				70%				50%				30%			10%
	20% Effective Floor Cavity Reflectance															
	% Wall Reflectance															
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10
1	113	110	107	105	110	108	105	103	103	102	100	100	98	97	96	95	94
2	106	101	96	92	104	99	95	91	96	92	89	93	90	87	90	88	86
3	100	93	87	83	98	91	86	82	89	84	81	86	82	79	84	81	78
4	94	85	79	74	92	84	78	74	82	77	73	80	75	72	78	74	71
5	88	79	72	67	86	78	71	67	76	70	66	74	69	65	72	68	65
6	83	73	66	61	81	72	65	61	70	64	60	69	64	60	67	63	59
7	78	67	60	56	76	66	60	55	65	59	55	64	59	55	63	58	54
8	73	62	56	51	72	62	55	51	61	55	50	59	54	50	58	54	50
9	69	58	51	47	68	57	51	47	56	51	46	55	50	46	55	50	46
10	65	54	47	43	64	54	47	43	53	47	43	52	47	43	51	46	43

LC6LED120 6LCLED535K8 Test No. 1,911

Test No TUV JI1211251-2-LM79
Tested at 25°C Ambient in accordance to IESNA LM-79-2008

prescolite

Web: **www.prescolite.com** • Tech Support: **(888) 777-4832**
701 Millennium Boulevard • Greenville, SC 29607 U.S.A. • Phone (864) 678-1000

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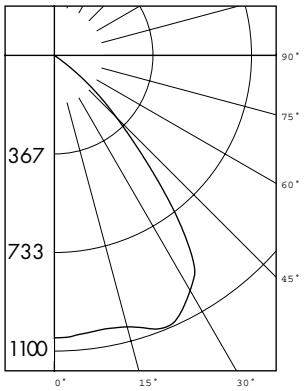
Hubbell Lighting, Inc.

PHOTOMETRIC DATA

LiteFrame - 6" LF6LED Downlight

LC6LED120 6LCLED735K8
LED Light Engine: 3500K, 80+ CRI
System Wattage: 29.8W
Fixture Delivered Lumens: 1598
Fixture Efficacy: 53.6
Spacing Criteria: 1.3



Test No. TUV JI1211251-3-LM79
Tested at 25°C Ambient in accordance to IESNA LM-79-2008

CANDELA DISTRIBUTION

DEG	CANDELA
0	1003
5	996
15	998
25	1020
35	822
45	314
55	25
65	5
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

ZONE	LUMENS
0-60	1590.1
0-90	1597.6
90-180	0
0-180	1597.6

LUMINANCE DATA IN CANDELA/ SQ. METER

Angle in Vertical	Average - 0°
45°	22934
55°	1376
65°	538
75°	272
85°	75

COEFFICIENTS OF UTILIZATION Zonal Cavity Method

Room Cavity Ratio	% Effective Ceiling Cavity Reflectance: 80%				70%				50%			30%			10%		
	20% Effective Floor Cavity Reflectance																
	% Wall Reflectance																
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10
1	113	110	107	105	110	108	105	103	103	101	100	100	98	97	96	95	94
2	106	101	96	93	104	99	95	91	96	92	89	93	90	88	90	88	86
3	100	93	87	83	98	91	86	82	89	84	81	86	82	79	84	81	78
4	94	85	79	74	92	84	78	74	82	77	73	80	76	72	78	74	71
5	88	79	72	67	86	78	72	67	76	70	66	74	69	66	73	68	65
6	83	73	66	61	81	72	66	61	70	65	60	69	64	60	67	63	60
7	78	67	61	56	76	67	60	56	65	59	55	64	59	55	63	58	55
8	73	63	56	51	72	62	55	51	61	55	51	60	54	50	59	54	50
9	69	58	52	47	68	58	51	47	57	51	47	56	50	47	55	50	46
10	65	54	48	43	64	54	48	43	53	47	43	52	47	43	51	46	43

LC6LED120 6LCLED735K8 Test No. 1,912

DIMMING COMPATIBILITY TABLE

Control Manufacturer	Wallbox Dimmer	Power Booster Available
Douglas Lighting Controls	WPC 5721	
Entertainment Technology	Tap Glide TG600FAM120 (120V) Tap Glide Heatsink TGH1500fam120 (120V) Oasis DA2000FAMU (120/277V)	
Honeywell, Inc.	EL731A1019 and EL7315A1009	EL7305A1010
HUNT Dimming	Preset Slide: PS-010-IV-120V and PS-010-WH-120V Preset Slide: PS-010-3W-IV-120V and PS-010-3W-WH-120V Preset Slide: PS-010-IV-277V and PS-010-WH-277V Preset Slide: PS-010-3W-IV-277V and PS-010-3W-WH-277V Preset Slide, controls FD-010: PS-1FC-010-IV- and PS-IFC-010-32-WH-120/277V Preset Slide, controls FD-010: PS-IFC-010-32-IV- and PS-IFC-010-3W-WH-120/277V Remoted mounted unit: FD-010120V and FD-010-277V	
Lehigh Electric Products Co.	Solitaire	PBX
Leviton Lighting Controls Div.	Leviton Centura Fluorescent Control System IllumaTechTM IP7 Series	CN100 PE300
Lutron Electronics Co., Inc.	Visit www.lutron.com/advance for the latest control information and selection	
PDM Electrical products	WPC-5721	
Starfield Controls	TR61 with DALI Interface port	RT03 DALInet Router
The Watt Stopper, Inc.	LS-4 used with LCD-101 and LCD-103	

Central Inverters

For fixture full light output in back-up mode, Prescolite and Dual-lite have jointly tested the LiteFrame Commercial LED with the 100 (LG1) and 250 (LG2) VA LiteGear inverters. For more information on LiteGear go to http://www.dual-lite.com/resources/litegear_luminaire_loading_chart/

wiHUBB®

Fixture comes with a pre-installed In-Fixture Module (1 relay, 0-10V) compatible with the HBA wiHUBB system. Actual dimming requires the selection of 0-10V dimming ballast as well. Consult factory for compatibility with EM fixtures.

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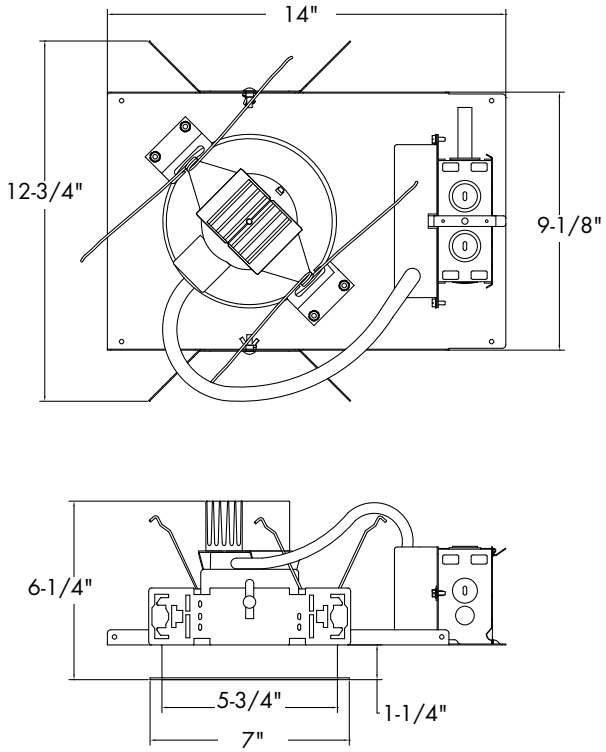
HUBBELL®
Hubbell Lighting, Inc.

PHOTOMETRIC DATA



6LCLED 7

SCA6D

When ordering a sloped ceiling adapter, specify the degree of slope in 5° increments, maximum of 35°. For a more precise degree or wet ceiling applications, please contact factory. Sloped ceiling adapter and housing must be installed at the same time.

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — For wall or ceiling mounting, vertical or horizontal. The WL combines digital LED lighting and controls technologies with high-performance optical design to offer the most advanced wall-mount luminaire for general ambient lighting applications. High-efficacy light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable.

CONSTRUCTION — Housing is roll formed from code-gauge steel.

Impact modified linear-faceted refractor with light diffusing film. Refractor is retained in die cast ends providing secure installation and easy maintenance.

Decorative die-cast end caps provide added durability.

Finish: All metal parts are post-painted in white polyester powder coat for smooth, finished edges and uniform light distribution.

OPTICS — High impact acrylic diffuser with light diffusing film. Optically engineered for superior light distribution and maximum efficacy.

Crescent-shape linear faceted refractor system obscures and integrates individual LED images and uniformly washes fixture surface with light.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. WL is rated to deliver L80 performance for 50,000 hours.

Optional nLight™ embedded controls continuously monitor system performance and allow for constant lumen management / compensation function.

Lumen Management: Unique lumen management system (option N80) provides onboard intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing energy waste created by the traditional practice of over-lighting.

LED AccuDrive ™ driver delivers full-range dimming from 0-10V control signal.

Integral occupancy control: Sensor Switch nES 7 or nES PDT 7 integrated occupancy sensor allows luminaire to power off or dim to 10% to 50% output when space is unoccupied. Fixture designed to fail on.

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion (e.g. corridors, stairwells). Additionally, an optional integrated photocell enables daylight harvesting control as well.

For rooms like restrooms and private offices or any space with obstructions, the nES PDT 7 dual technology sensor is recommended.

Driver disconnect provided where required to comply with US and Canadian codes.

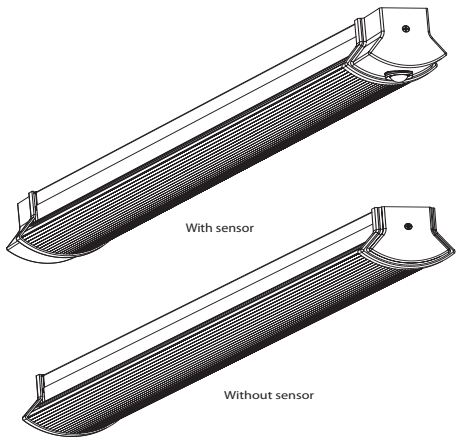
Maintenance: LED boards include plug-in connectors for easy replacement or servicing.

LISTINGS — CSA certified to meet U.S. and Canadian standards.

Patents pending.

W SERIES

Wall bracket & Surface Mount LED



WL

2', 4'

LED

nLIGHT ENABLED

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Specifications subject to change without notice.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: WL4 25L D24 LP835 NX

Series		Lumens[1]	Voltage		Wattage		Color temperature		Lumen management	
WL2	2' wall-mount LED	12L[2]	(blank)	MVOLT (120 - 277V)	D13	13W[7]	LP830	82 CRI, 3000 kelvin[8,9]	NX	Less nLight
WL4	4' wall-mount LED	18L[3]	347	347V[6]	D20	20W[7]	LP835	82 CRI, 3500 kelvin	N80	nLight with 80% (L80) lumen management
		25L[4]			D24	24W[7]	LP840	82 CRI, 4000 kelvin	N80EMG	nLight with 80% (L80) lumen management for use with generator supply EM power
		41L[5]			D43	43W[7]	LP850	82 CRI, 5000 kelvin[8,9]	N100	nLight with 100% (L100) lumen management
									N100EMG	nLight with 100% (L100) lumen management for use with generator supply EM power

Occupancy control[10]		Standby mode[12]		Options		Finish[14]	
NES7	Sensor Switch nES 7 PIR integral occupancy sensor[11]	(blank)	Fixture turns off when unoccupied	EL14L	LED Emergency battery pack (nominal 1400 lumens); see Life Safety section[13]	(blank)	White
NESPDT7	Sensor Switch nES PDT 7 dual technology integral occupancy control[11]	DIM10	Fixture dims to 10% when unoccupied	SC	Surface conduit end cap provisions		
NES7ADCX	Sensor Switch nES 7 ADCX PIR integral occupancy sensor with automatic dimmng control[11]	DIM50	Fixture dims to 50% when unoccupied				

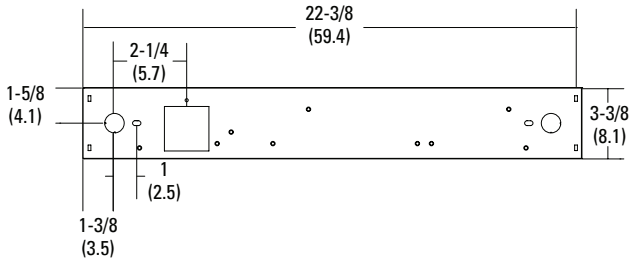
Notes

1 Approximate lumen output.
2 For use with WL2 only, requires D13 driver.
3 For use with WL2 only, requires D20 driver.
4 For use with WL4 only, requires D24 driver.
5 For use with WL4 only, requires D43 driver.
6 Not available for use with WL2.
7 Actual wattage may differ by +/- 5% when operating between 120-277V +/- 10%.
8 Extended lead time.
9 Not available with 41L.
10 See integral occupancy control section in header.
11 Requires N80 or N100.
12 Requires occupancy control.
13 Not available with WL2; not available with 347V.
14 For additional paint finishes refer to Architectural Colors.

WL Wall Bracket & Surface Mount LED

MOUNTING DATA

For unit installation; surface ceiling or wall mounting.



DIMENSIONS

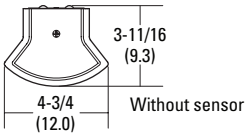
All dimensions are inches (centimeters) unless otherwise noted.

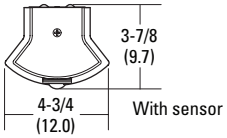
Specifications

Length: with sensor - 25-7/8 (65.7)
50-15/16 (129.40)
without sensor - 23-3/8 (59.4)
46-13/16 (118.90)

Height: with sensor - 3-11/16 (9.3)
without sensor - 3-7/8 (9.7)

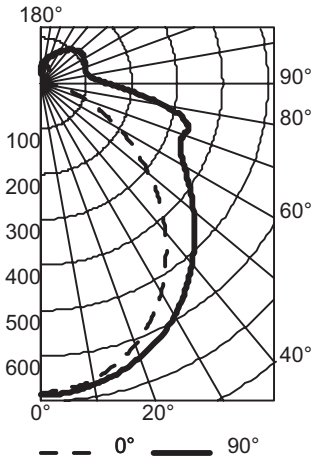
Width: 4-3/4 (12.1)





PHOTOMETRICS

WL4 25L D24 LP835, 2505 delivered lumens, test no. LTL21295, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	684	684
5°	675	683
15°	640	660
25°	574	618
35°	480	555
45°	369	479
55°	253	400
65°	147	339
75°	66	331
85°	16	198
90	5	147

Coefficients of Utilization

pf	20%								
pc	80%			70%			50%		
pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR 0	115	115	115	110	110	110	102	102	102
1	103	98	93	94	89	85	86	83	79
2	93	84	77	81	74	69	75	69	64
3	85	74	65	71	63	57	65	59	54
4	77	65	56	63	54	48	58	51	45
5	71	58	49	56	47	41	52	45	39
6	66	52	43	50	42	36	47	40	34
7	61	47	38	46	37	32	43	35	30
8	57	43	35	42	34	28	39	32	27
9	53	39	31	38	31	25	36	29	24
10	49	36	29	35	28	23	33	27	22

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	525	20.9	20.9
0° - 40°	852	34.0	34.0
0° - 60°	1483	59.2	59.2
0° - 90°	2072	82.7	82.7
90° - 120°	227	9.1	9.1
90° - 130°	297	11.9	11.9
90° - 150°	392	15.6	15.6
90° - 180°	432	17.3	17.3
0° - 180°	2505	100.0	100.0

LED Energy Comparison to T5/T8

System	Lamp type	Ballast factor	Input watts	Watts saved by using LED
LED-N100	LED	1	24	--
LED-N80[1]	LED	1	19	--
One-lamp T8	F32T8	0.88	28	3
One-lamp T5	F28T5	1	32	7

Note

1 With nlight 80% lumen management input watts start at 19 and gradually increasing to 24 at 50,000 hrs.

Total Lumens with Control Options

Lumen package	Control option							
	N100		N80		Dim50		Dim10	
	Wattage	Lumens	Wattage	Lumens	Wattage	Lumens	Wattage	Lumens
12L	13	1200	10	1044	6.5	470	1.3	38
18L	20	1800	16	1566	10	810	2.0	126
25L	24	2500	19	2175	12	1125	2.4	175
41L	43	4100	34	3567	22	1845	4.3	330

LITHONIA LIGHTING®
An AcuityBrands Company

WL-LED

LED: One Lithonia Way Conyers, GA 30012 Phone: 800.858.7763 Fax: 770-929-8789 www.lithonia.com

Rev.11/19/12

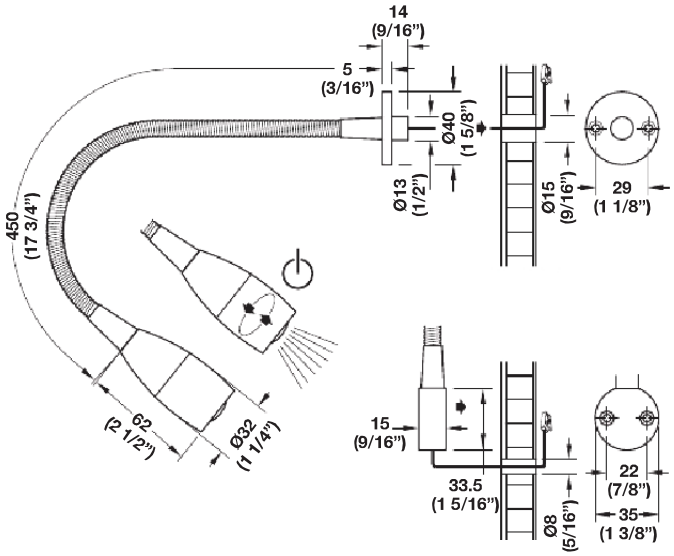
Loox LED 2018

Flexible Light

12 V System

Recess Mounted

Surface Mounted



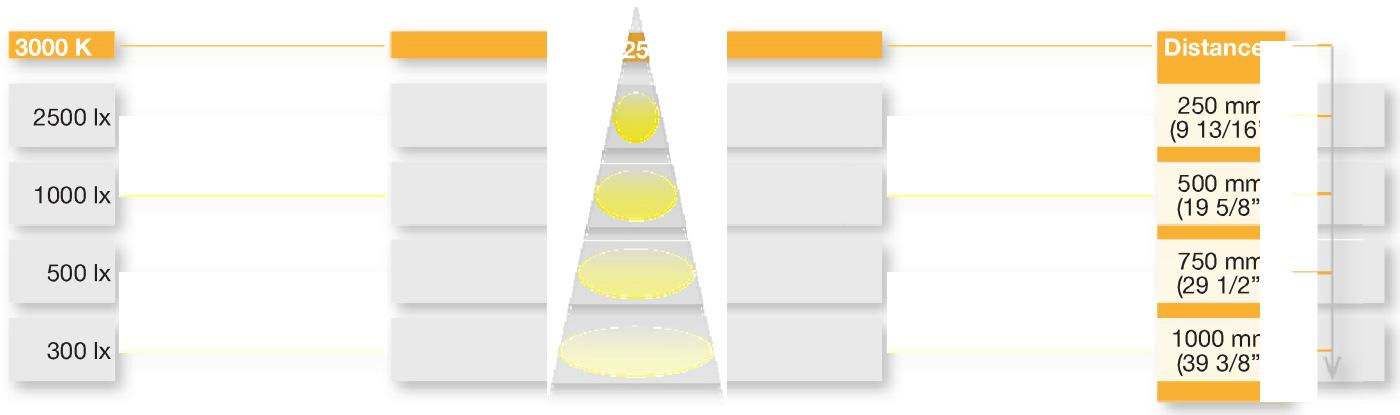
- Reading light
- Flexible spotlight in the bookshelf or storage area
- Easy to position
- Glass lens provides a pleasant, uniform cone of light
- Integrated switch – simply rotate the head of the light for on/off

Supplied with: Mounting accessories
Accessories: Driver - page **21**
Note: Cannot be dimmed

Light Color: 3000 (warm white)
Diameter: 32 mm (1 1/4")
Length: 450 mm (17 3/4")
Wattage: 2
Number of LEDs: 1
Lumen: 70
Lumen per watt: 48
Color rendering index (CRI): 93
Cable length: 2 m (78 3/4")
Material/Finish: Steel, silver

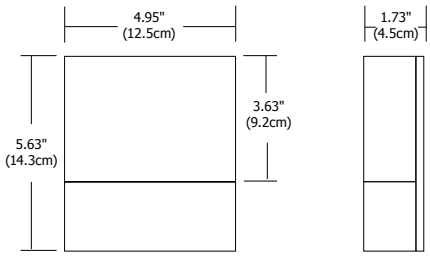
Mounting	Item No.	SRP
Surface	833.74.100	$48.00
Recess	833.74.110	$48.00

Packing: 1 pc.



TV LED - INDOOR/ OUTDOOR

REV.12.13.11



Description:
The geometric TV **LED** wall sconce provides intense light with warm white **LED**s. Available with satin aluminum or white base, fixture features crystal diffuser. IP 65 rated for indoor and outdoor applications. ADA compliant. Fixture includes 5 year warranty.

Finish:
Satin Aluminum or White

Lamp Specification:
6.7 Total Watts (LED and power supply), 12VAC **LED**, 2878K, 86CRI, 323 lumens, 48 lumens per watt; 70% lumen maintenance based on 50,000 hours of operation

Power Supply:
4x1W 700mA driver
Not dimmable

Dimming:
Not dimmable

Weight:
4 lb (1.80 kg)

	Type	Lamp	Finish
TV –	**W** –	**L1** –	**SA**
	W Wall	**L1** LED	**SA** Satin Aluminum **WH** White

PROJECT:

FIXTURE TYPE:

DATE:

1718 W. Fullerton Ave. Chicago, IL 60614 P: 773.770.1195 F: 773.935.5613 www.edgelighting.com

Edge LIGHTING

KOHLER FAUCETS

PURIST®

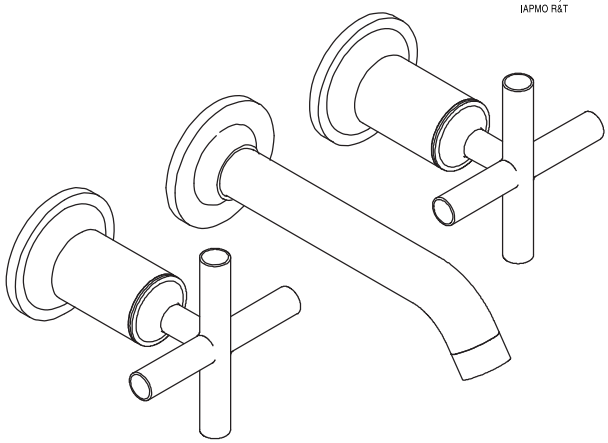
WALL-MOUNT BATHROOM SINK FAUCET TRIM
K-T14413
ALSO K-T14415, K-T14417

ADA

WaterSense Meets EPA Criteria
Certified by IAPMO R&T

Features

- *Brass construction*
- *Dual control wall-mounted*
- *Cross or lever handles*
- *Stationary spout*
- *Less drain*
- *6-1/4″ (159 mm), 8-1/4″ (210 mm), or 10-1/4″ (260 mm) 35° spout from wall to center of drain*
- *1.5 gallons (5.7 liters) per minute maximum flow rate*



Codes/Standards Applicable

Specified model meets or exceeds the following at date of manufacture:

- *ADA*
- *ASME A112.18.1/CSA B125.1*
- *ICC/ANSI A117.1*
- *NSF 61*
- *All applicable US Federal and State material regulations*
- *EPA WaterSense®*

Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes
- NA: None applicable

Specified Model

Model	Description	Cross		Lever	
		ADA		ADA	
K-T14413-3	Wall-mount bathroom sink faucet trim – 6-1/4″ (159 mm)	❑ CP	❑ Other __		
K-T14413-4	Wall-mount bathroom sink faucet trim – 6-1/4″ (159 mm)			❑ CP	❑ Other __
K-T14415-3	Wall-mount bathroom sink faucet trim – 8-1/4″ (210 mm)	❑ CP	❑ Other __		
K-T14415-4	Wall-mount bathroom sink faucet trim – 8-1/4″ (210 mm)			❑ CP	❑ Other __
K-T14417-3	Wall-mount bathroom sink faucet trim – 10-1/4″ (260 mm)	❑ CP	❑ Other __		
K-T14417-4	Wall-mount bathroom sink faucet trim – 10-1/4″ (260 mm)			❑ CP	❑ Other __

Product Specification

The wall-mount bathroom sink faucet trim shall be of brass construction. Product shall have a maximum flow rate of 1.5 gallons (5.7 liters) per minute. Product shall be dual control wall-mounted. Product shall be available with a 6-1/4″ (159 mm), 8-1/4″ (210 mm), or 10-1/4″ (260 mm) 35° spout from the wall to center of the drain. Product shall be available with cross or lever handles. Product shall feature a stationary spout. Product shall be less drain. Faucet shall be Kohler Model K-T_____-_____ -_____ with required K-410-K-NA valve.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

Required Accessories		
K-410-K	Wall-mount valve	❑ NA

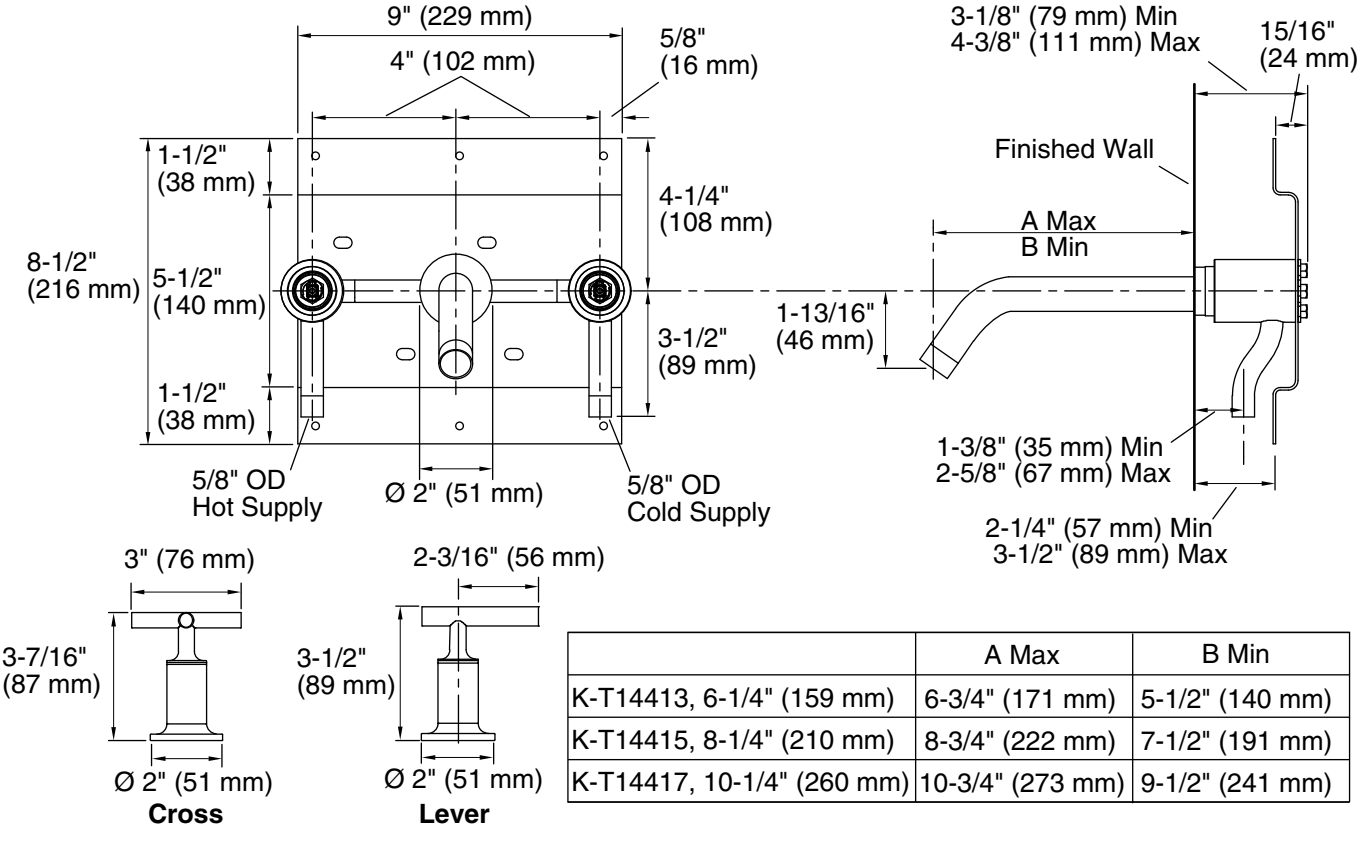
Optional Accessories				
K-7114	Pop-up bathroom sink drain		❑ CP	❑ Other____
K-7124	Touch-activated bathroom sink drain		❑ CP	❑ Other____
K-7127	Bathroom sink drain with non-removable metal stopper		❑ CP	❑ Other____
K-7129	Bathroom sink grid drain		❑ CP	❑ Other____
_____	Additional flow options are available (refer to the Kohler Price Book)	❑ NA		

Installation Notes

Install this product according to the installation guide.

The distance between the bottom of spout and top of the fixture rim must not be less than 1-1/2″ (38 mm) and not greater than 6″ (152 mm).

Three 1-1/2″ (38 mm) diameter cutout holes required for spout and handles.



	A Max	B Min
K-T14413, 6-1/4" (159 mm)	6-3/4" (171 mm)	5-1/2" (140 mm)
K-T14415, 8-1/4" (210 mm)	8-3/4" (222 mm)	7-1/2" (191 mm)
K-T14417, 10-1/4" (260 mm)	10-3/4" (273 mm)	9-1/2" (241 mm)

Product Diagram

THE BOLD LOOK OF KOHLER®

KOHLER FAUCETS

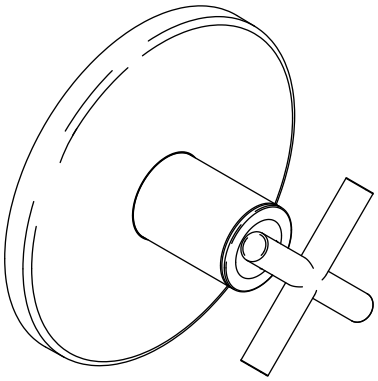
PURIST®

Features

- *Brass construction*
- *Available with cross or lever handles*
- *Front seal plate assembly*
- *Handle assembly*
- *Complements Purist® Suite*

THERMOSTATIC TRIM SET
K-T14488
ALSO K-T14489, K-T14490, K-T14491

ADA



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ADA*
- *ASME A112.18.1/CSA B125.1*
- *ICC/ANSI A117.1*

Not sure if this is correct, whatever is chosen make sure it is a LEVER HANDLE option

Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Accessories:

- NA: None applicable

Specified Model

For complete faucet, both faucet trim and valving must be specified.

Model	Description	Colors/Finishes	
K-T14488-3	Thermostatic valve trim, cross handle	❑ CP	❑ Other ____
K-T14488-4	Thermostatic valve trim, lever handle	☒ CP	❑ Other ____
K-T14489-4	Stacked thermostatic valve trim. lever handle **only**	❑ CP	❑ Other ____
K-T14490-3	Volume control trim, cross handle	❑ CP	❑ Other ____
K-T14490-4	Volume control trim, lever handle	❑ CP	❑ Other ____
K-T14491-3	Transfer valve trim, cross handle	❑ CP	❑ Other ____
K-T14491-4	Transfer valve trim, lever handle	❑ CP	❑ Other ____

Required Accessories *(continued on page 2)*

K-2972-KS (replaces K-679-KS)	1/2″ Thermostatic valve	❑ NA
K-2973-KS (replaces K-680-KS)	1/2″ Stacked thermostatic valve	❑ NA
K-2974-K (replaces K-681-K)	1/2″ Volume control	❑ NA
K-2975-KS (replaces K-669-KS)	3/4″ Thermostatic valve	❑ NA

Product Specification

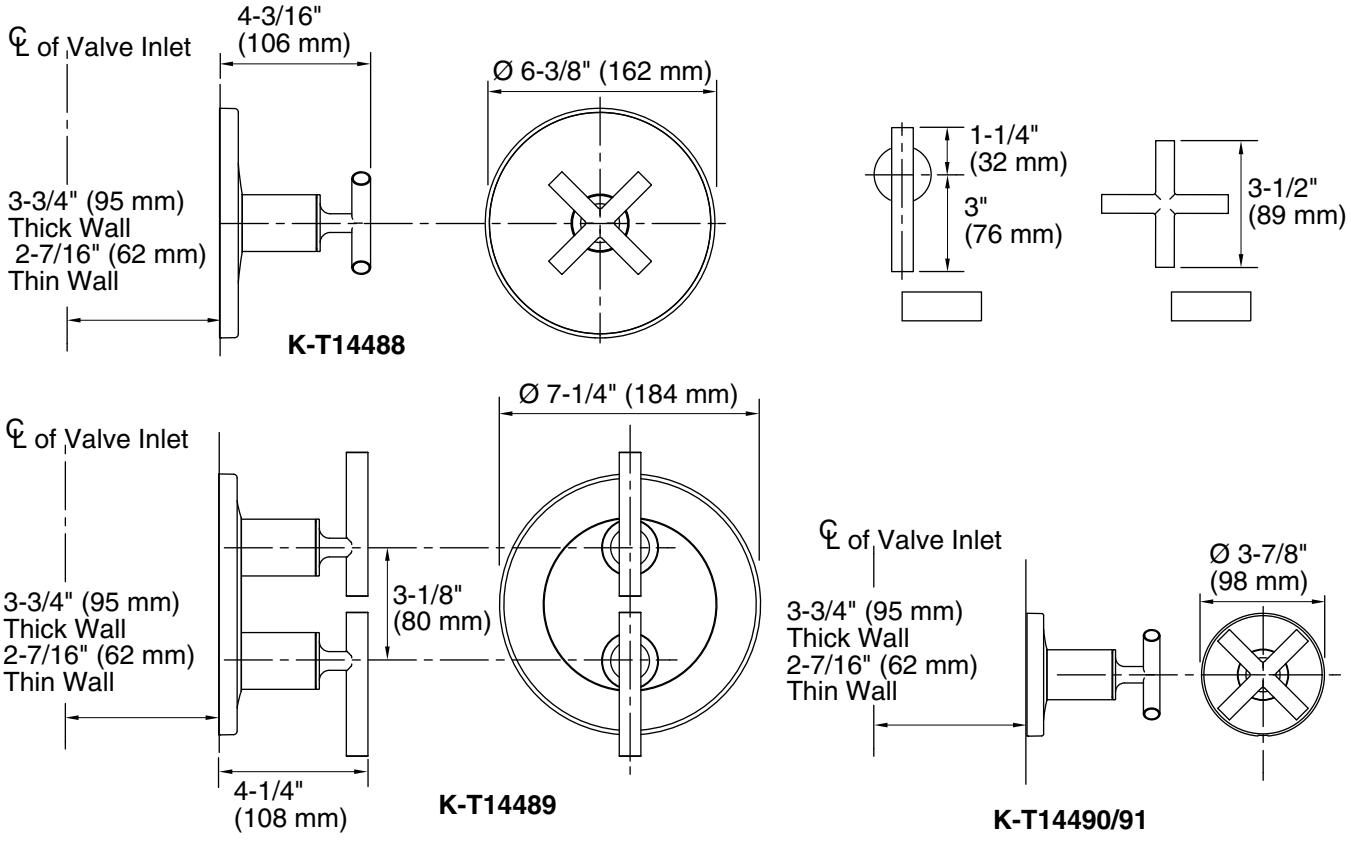
Thermostatic trim set shall be of brass construction. Trim shall include front seal plate assembly and handle assembly. Product shall be available with cross or lever handles. Thermostatic trim set shall complement the Purist® Suite. Ttrim shall be Kohler Model K-T____-____-____ and thermostatic valving shall be K-____-__-NA.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

Required Accessories (Cont.)		
K-2976-KS (replaces K-670-KS)	3/4″ Stacked thermostatic valve	❑ NA
K-2977-K (replaces K-671-K)	3/4″ Volume control	❑ NA
K-728-K	3/4″ Transfer valve	❑ NA
K-737-K	3/4″ Diverter valve	❑ NA

Installation Notes

Install this product according to the installation guide.



Product Diagram

THE BOLD LOOK OF KOHLER®

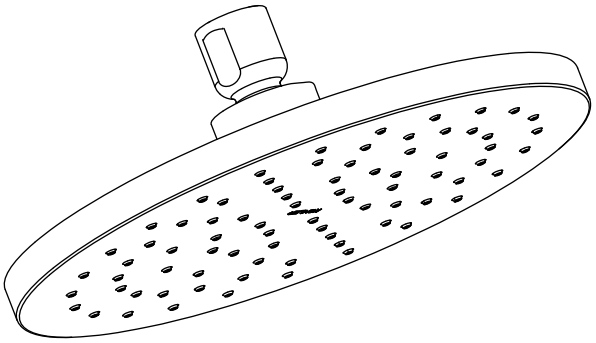
KOHLER FAUCETS

CONTEMPORARY ROUND

RAIN SHOWERHEAD
K-13688
ALSO K-13689, K-13690, K-13691

Features

- *Single-function Rain showerhead*
- *MasterClean™ spray nozzles prohibit mineral buildup for easy cleaning*
- *Katalyst™ Spray Technology with air induction ball joint (patent pending)*
- *Optimized sprayface for maximum performance*
- *Solid brass construction*
- *2.5 gallon (9.5 L) per minute flow rate*
- *1/2″ - 14 NPT connection*



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ASME A112.18.1/CSA B125.1*
- *Energy Policy Act of 1992*

Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Accessories

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Size	Nozzles	Colors/Finishes	
K-13688	Rain showerhead	8″ (203 mm)	78	❑ CP	❑ Other___
→ K-13689	Rain showerhead	10″ (254 mm)	78	☒ CP	❑ Other___
K-13690	Rain showerhead	12″ (305 mm)	102	❑ CP	❑ Other___
K-13691	Rain showerhead	14″ (356 mm)	126	❑ CP	❑ Other___

Optional Accessories			
K-7392	12″ (305 mm) straight ceiling-mount shower arm and flange	❑ CP	❑ Other____
→ K-7394	6″ (152 mm) straight ceiling-mount shower arm and flange	☒ CP	❑ Other____
K-7396	3″ (76 mm) straight ceiling-mount shower arm and flange	❑ CP	❑ Other____
K-10124	Right-angle shower arm and flange	❑ CP	❑ Other____

Product Specification

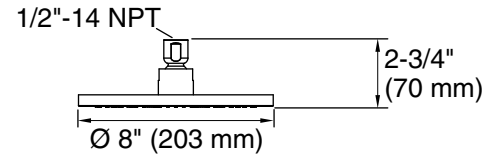
The single function rain showerhead shall be made of solid brass construction with MasterClean™ spray nozzles to prohibit mineral build up for easy cleaning. Showerhead shall have Katalyst™ spray technology with air induction ball joint (patent pending) and optimized spray face for maximum performance. Showerhead shall have a flow rate of 2.5 gallons (9.5 L) per minute. Showerhead shall have a 1/2″-14 NPT connection. Showerhead shall be Kohler Model K-13688-____, K-13689-____, K-13690-____ or K-13691-____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

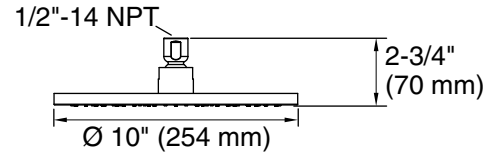
CONTEMPORARY ROUND

Installation Notes

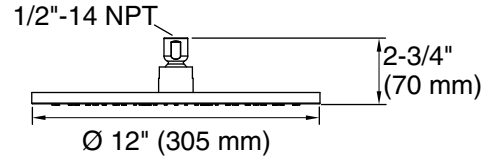
Install this product according to the installation guide.



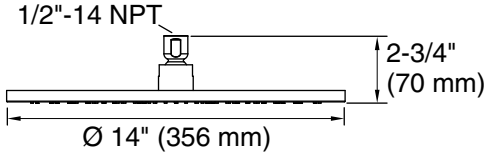
K-13688



K-13689



K-13690



K-13691

Product Diagram

THE BOLD LOOK OF KOHLER®

KOHLER®

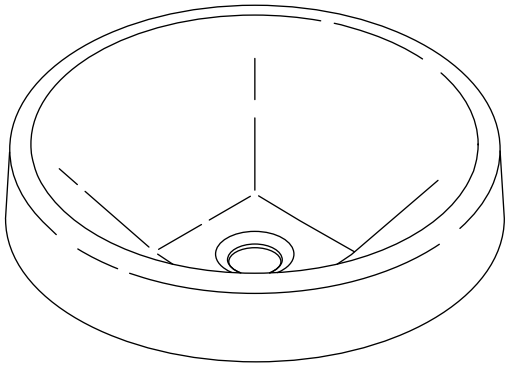
INSCRIBE™

WADING POOL® BATHROOM SINK
K-2388

ADA

Features

- *KOHLER cast iron*
- *Drop-in*
- *Without overflow*
- *Less faucet hole*
- *Countertop installation*
- *16-1/2″ (419 mm) diameter*



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ADA*
- *ICC/ANSI A117.1*
- *ASME A112.19.1/CSA B45.2*

Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

Accessories:

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Colors/Finishes	
K-2388	Wading Pool bathroom sink	☒ 0	❑ Other_____

Recommended Accessories			
K-9018	Adjustable P-trap with extension	❑ CP	❑ Other_____
K-7124	Pop-up bathroom sink drain	❑ CP	❑ Other_____

Product Specification

The drop-in cast iron bathroom sink shall be 16-1/2″ (419 mm) in diameter. Bathroom sink shall be without overflow and less faucet hole. Bathroom sink shall be countertop installation. Bathroom sink shall be Kohler Model K-2388-_____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

INSCRIBE™

Technical Information

Fixture*:	
Basin area	Ø 14-3/4″ (375 mm)
Water depth	4-9/16″ (116 mm)
Drain hole	Ø 1-3/4″ (44 mm)
* Approximate measurements for comparison only.	

Included component:	
Cut-out template	1091072-7

Installation Notes

Install this product according to the installation guide.

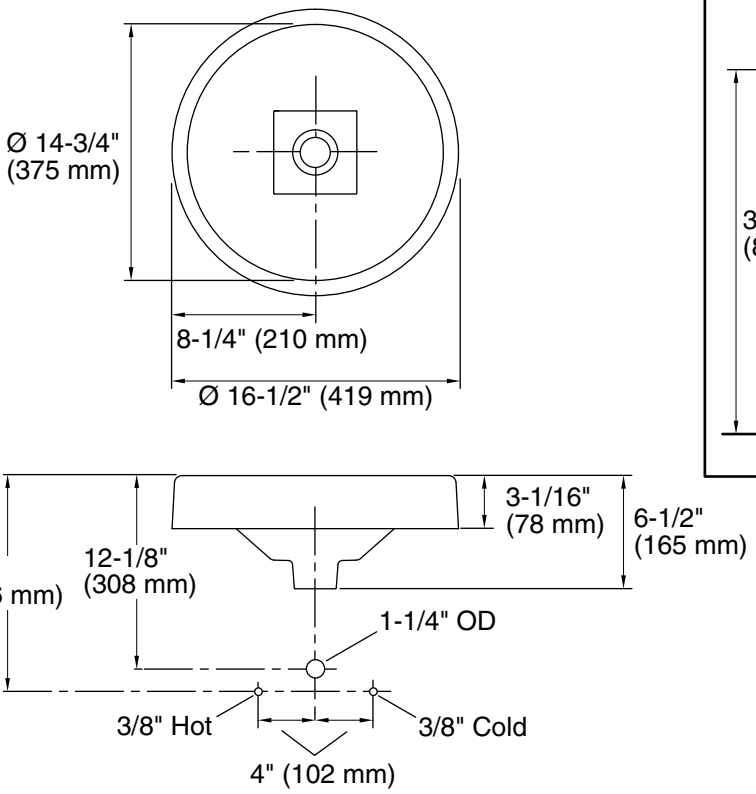
Product does not have overflow.

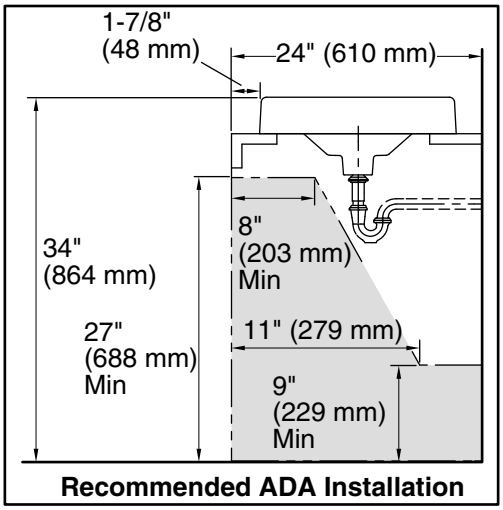
NOTICE: The countertop manufacturer or cutter **must** use the cut-out template provided with the product, or a current cut-out template provided by the Kohler Co. (call 1-800-4KOHLER). Kohler Co. is not responsible for errors when the incorrect cut-out template is used.

The spout must be a minimum of 5″ (127 mm) long for adequate clearance into the bathroom sink when installed with the centerline, as shown.

The spout must be tall enough to clear the 3-1/16″ (78 mm) rim height and provide a 1″ (25 mm) air gap per ASME A112.1.2.

Will comply with **ADA** when installed per section 606 Lavatories of the Act.





Recommended ADA Installation

Product Diagram

THE BOLD LOOK OF KOHLER®

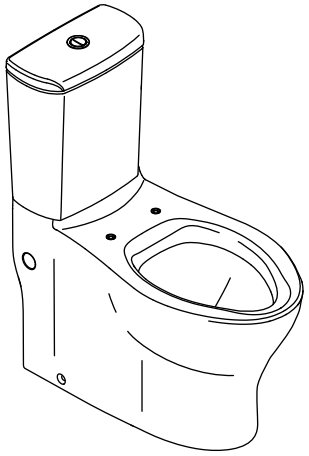
KOHLER®

PERSUADE® CIRC

DUAL FLUSH TOILET
K-3753

Features

- *Vitreous china*
- *Elongated bowl*
- *Dual Flush flushing system*
- *Includes polished chrome push buttons*
- *Two-bolt installation system*
- *Supply line included*
- *12″ (305 mm) rough-in*
- *1.6 gpf (6 lpf) or 1.0 gpf (3.8 lpf)*
- *2″ (51 mm) glazed trapway*
- *4-1/2″ (114 mm) x 5-3/4″ (146 mm) water area*
- *28-5/8″ (727 mm) x 14-3/16″ (360 mm) x 33-3/4″ (857 mm)*



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ASME A112.19.2/CSA B45.1*
- *ASME A112.19.14*
- *EPA WaterSense®*

Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

Accessories

- 0: White
- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Colors/Finishes	
K-3753	Dual flush toilet – center push button	☒ 0	❑ Other_____

Recommended Accessories				
K-4774	Brevia™ elongated toilet seat	☒ 0		❑ Other_____
K-4650	Lustra™ open-front toilet seat	❑ 0		❑ Other_____
K-7659	3/8″ NPT angle stop **OR**		❑ CP	❑ Other_____
K-7660	1/2″ NPT angle stop **OR**		❑ CP	❑ Other_____

Product Specification

Elongated bowl toilet shall be made of vitreous china. Toilet shall be 28-5/8″ (727 mm) in length, 14-3/16″ (360 mm) in width, and 33-3/4″ (857 mm) in height with a 4-1/2″ (114 mm) x 5-3/4″ (146 mm) water area. Toilet shall be two-bolt installation and 12″ (305 mm) rough-in. Toilet shall have 1.6 gpf (6 lpf) or 1.0 gpf (3.8 lpf) flow rate with Dual Flush flushing system. Toilet shall have 2″ (51 mm) glazed trapway. Toilet shall include polished chrome push buttons and a supply line. Toilet shall be Kohler Model K-3753-___.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

PERSUADE® CIRC

Recommended Accessories (cont.)			
K-7668	3/8″ NPT straight stop **OR**	❑ CP	❑ Other_____
K-7678	1/2″ NPT straight stop	❑ CP	❑ Other_____

Technical Information

Fixture:	
Configuration	Two-piece, elongated
Water per flush	1.6 gpf (6 lpf) or 1.0 gpf (3.8 lpf)
Passageway	2″ (51 mm)
Water area	4-1/2″ (114 mm) x 5-3/4″ (146 mm)
Water depth from rim	8-1/2″ (216 mm)
Seat post hole centers	5-1/2″ (140 mm)

Included components:	
Bowl	K-4353
Tank	K-4442
Tank cover	1101883
Push buttons	1072961

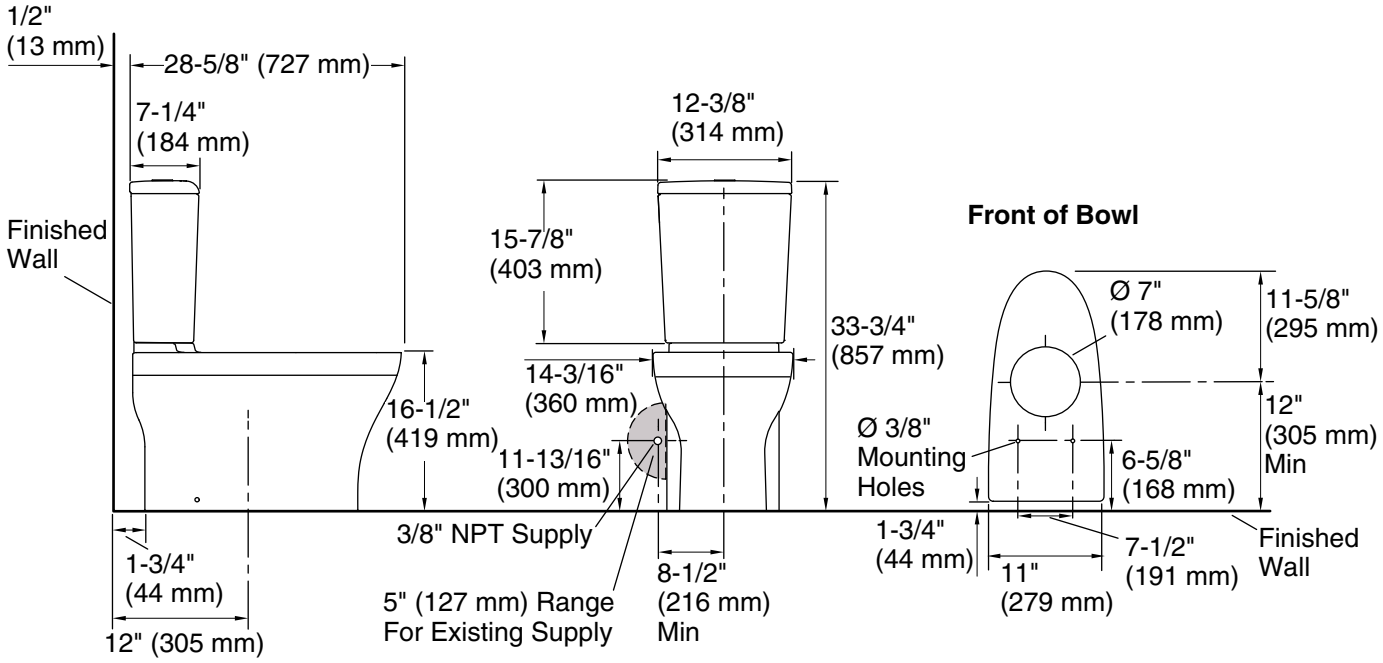
Installation Notes

IMPORTANT! The rough-in must be 12″ (305 mm) or more from the base of the wall or baseboard. Install or relocate the supply and outlet as necessary to conform to rough-in dimensions.

If this toilet is installed to new construction, install a new supply stop following the dimensions in the diagram.

In installations with the supply stop installed, the existing supply stop may need to be relocated if it is less than 8-1/2″ (216 mm) from the centerline of the toilet. Dry fit the toilet to confirm if the supply stop needs to be relocated.

The supplied hose will extend roughly 6″ (152 mm) from the toilet. If the supplied hose does not reach the supply stop, a longer supply hose may be used.



Product Diagram

THE BOLD LOOK OF KOHLER®

KOHLER®

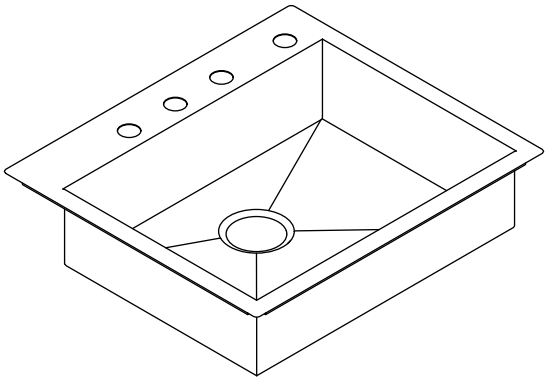
VAULT™

TOP-MOUNT/UNDER-MOUNT KITCHEN SINK
K-3894

ADA

Features

- *18-gauge stainless steel*
- *Top-mount or under-mount*
- *Includes installation hardware*
- *Small single bowl*
- *25″ (635 mm) x 22″ (559 mm)*



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ADA*
- *ICC/ANSI A117.1*
- *ASME A112.19.3/CSA B45.4*

Colors/Finishes

- NA: None applicable

Accessories

- CP: Polished Chrome
- ST: Stainless Steel
- NA: None applicable
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Colors/Finishes
K-3894-4	Top-mount/under-mount kitchen sink – 4-hole	☒ NA

Optional Accessories					
K-6645	Bottom bowl rack		❑ ST		
K-8801	Duostrainer® sink strainer			☒ CP	❑ Other_____
1131881	Hardware kit for countertops with a 2-1/2″ (64 mm) thickness or less	☒ NA			

Product Specification

The top-mount or under-mount kitchen sink shall be made of 18-gauge stainless steel. Sink shall include installation hardware. Sink shall have a small single bowl. The sink shall be 25″ (635 mm) in length, 22″ (559 mm) in width. Sink shall be Kohler Model K-3894-_____-_____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

VAULT™

Technical Information

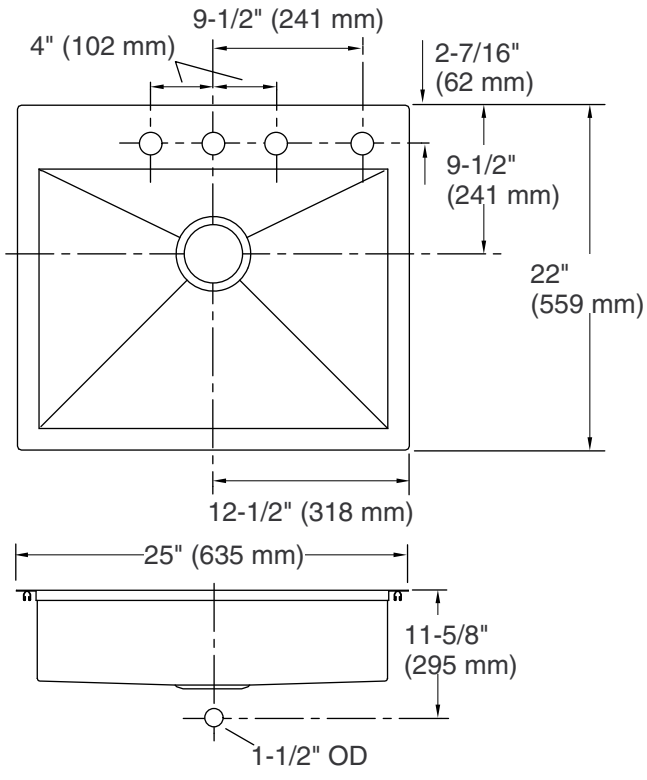
Fixture*:	
Bowl area	22-1/4″ (565 mm) x 16-9/16″ (421 mm)
Water depth	6″ (152 mm)
Drain hole	Ø 3-5/8″ (92 mm)
* Approximate measurements for comparison only.	

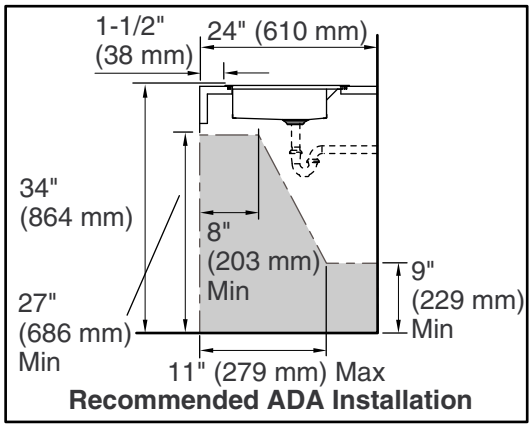
Included components:	
Hardware kit – self-rimming	1130570
Cut-out template	1130822

Installation Notes

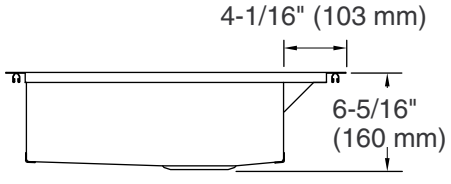
Install this product according to the installation guide.

For under-mount installation, counter top thickness can not be greater than 1″ (25 mm) for **ADA** compliance.





Recommended ADA Installation



Product Diagram

THE BOLD LOOK OF KOHLER®

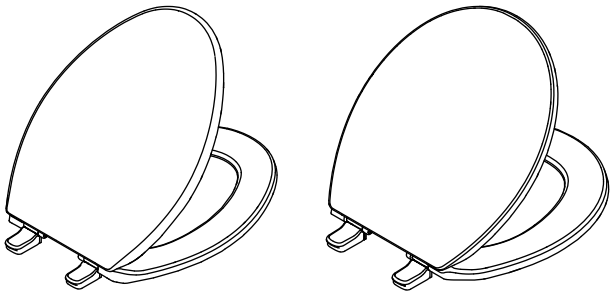
KOHLER®

BREVIA® Q2 ADVANTAGE™

TOILET SEAT
K-4774
ALSO K-4775

Features

- *Quick-Release™ hinge caps snap open and seat pulls forward for removal*
- *Quick-Attach™ stainless steel fastener allows for top-mount screwdriver only install*
- *Solid polypropylene plastic*
- *Closed-front*
- *Contoured seat for user comfort*



K-4774 **K-4775**

Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ANSI Z124.5*

Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Colors/Finishes	
K-4774	Toilet seat – elongated closed-front	❑ 0	❑ Other_____
K-4775	Toilet seat – round closed-front	❑ 0	❑ Other_____

Product Specification

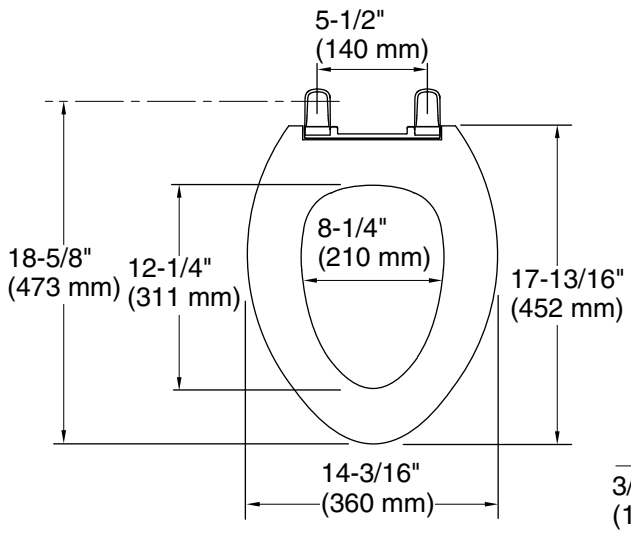
The toilet seat shall be made of solid polypropylene plastic. Toilet seat shall be available with closed-front. Toilet seat shall have contoured seat for user comfort. Toilet seat shall have Quick-Release™ hinge caps snap open and seat pulls forward for removal. Toilet seat shall have shall have Quick-Attach™ stainless steel fastener, which allows for top-mount screwdriver only install. Toilet seat shall be Kohler Model K-_____-_____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

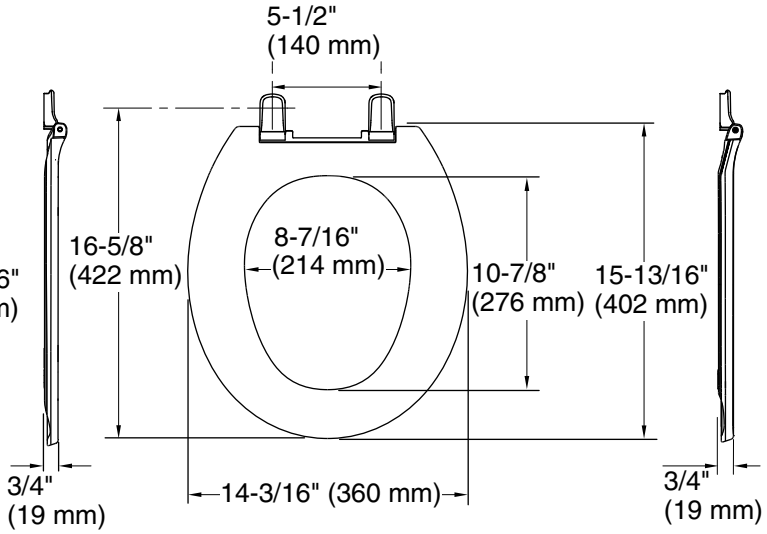
BREVIA® Q2 ADVANTAGE™

Installation Notes

Install this product according to the installation guide.



K-4774



K-4775

Product Diagram

THE BOLD LOOK OF KOHLER®

KOHLER FAUCETS

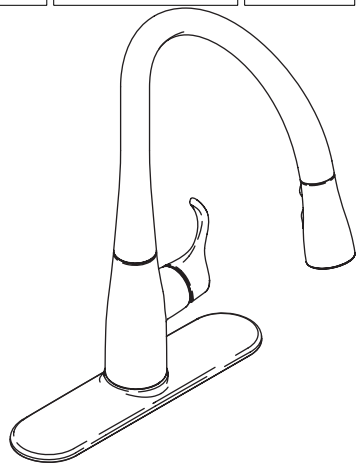
SIMPLICE®

PULL-DOWN KITCHEN SINK FAUCET

K-596

ALSO K-597

ADA	CSA B651	OBC



Features

- *Metal construction*
- *One-piece, self-contained ceramic disc valve allows both volume and temperature control*
- *Temperature memory allows faucet to be turned on and off at any temperature setting*
- *Touch control for stream-to-spray water flow*
- *Promotion™ technology with nylon hose and ball joint for easy operation*
- *Flexible connections for easy installation*
- *Three-function sprayhead with spray, aerated stream, and pause settings*
- *360° spout rotation*
- *For single-hole or three-hole installation when included 10-1/2″ (267 mm) escutcheon plate is used*
- *Meets CalGreen requirements for kitchen faucets*
- *1.8 gallons (6.8 L) per minute maximum flow rate at 60 psi (4.1 bar)*

Codes/Standards Applicable

Specified model meets or exceeds the following at date of manufacture:

- *ADA*
- *ICC/ANSI A117.1*
- *CSA B651*
- *OBC*
- *ASME A112.18.1/CSA B125.1*
- *NSF 61*
- *Energy Policy Act of 1992*
- *All applicable US Federal and State material regulations*

Colors/Finishes

- CP: Polished Chrome
- VS: Stainless Steel

Specified Model

Model	Description	Colors/Finishes	
K-596	Pull-down kitchen sink faucet – 9″ (229 mm) swing spout reach (shown)	☒ CP	❑ VS
K-597	Pull-down kitchen sink faucet – 8″ (203 mm) swing spout reach	❑ CP	❑ VS

Product Specification

The kitchen sink faucet shall be of metal construction with a one-piece, self-contained ceramic disc valve, which allows both volume and temperature control. Product shall feature temperature memory, allowing the faucet to be turned on and off at any temperature setting. Product shall feature a touch control for stream-to-spray water flow and Promotion technology with nylon hose and ball joint for easy operation. Product shall feature a 360° spout rotation and have flexible connections for easy installation. Product shall be available with a three-function sprayhead with spray, aerated stream, and pause settings. Product shall be for single-hole or three-hole installation when included 10-1/2″ (267 mm) escutcheon plate is used. Product shall be 1.8 gallon (6.8 L) per minute maximum flow rate. Product shall meet CalGreen requirements for kitchen faucets. Product shall be Kohler Model K-____-____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

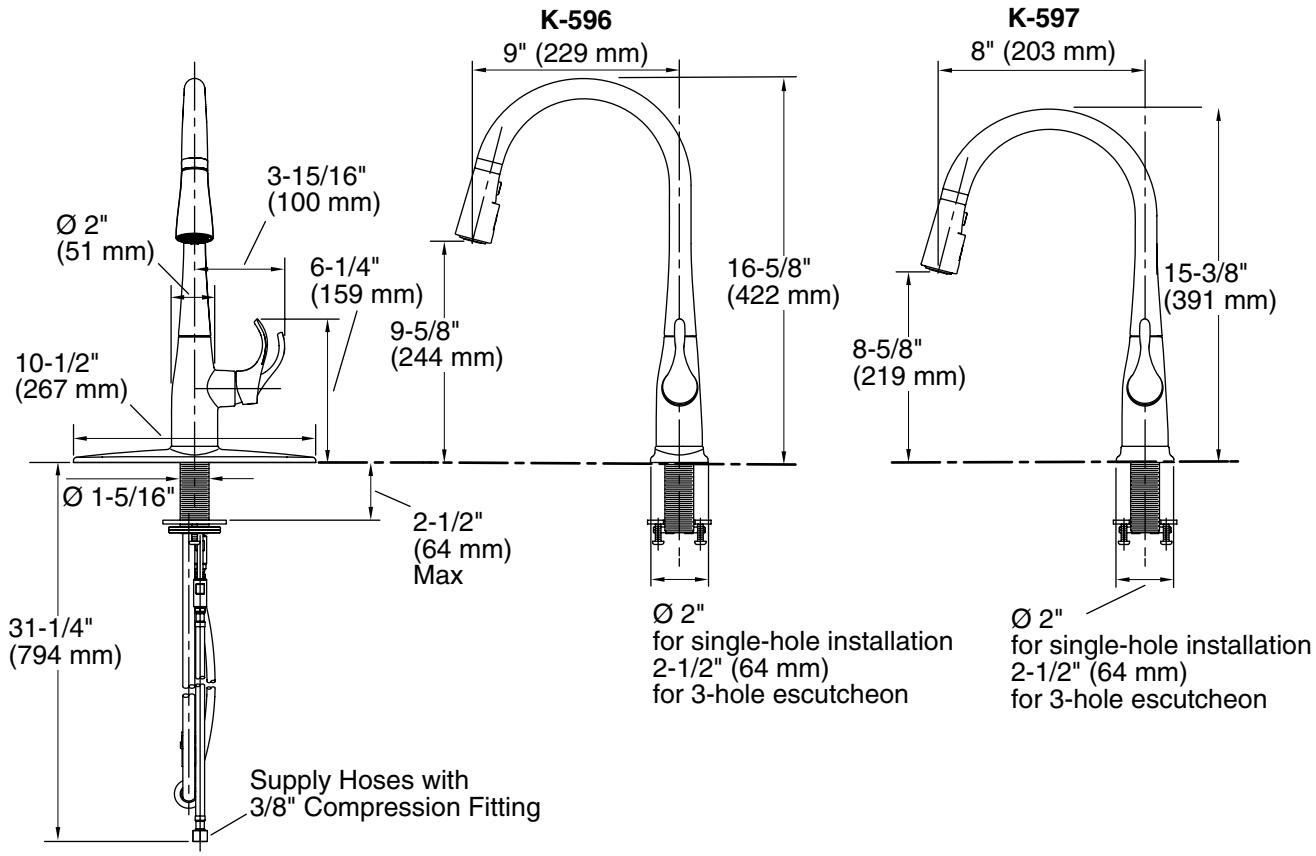
SIMPLICE®

Optional Accessories		
1012715	Deep roughing-in kit – provides an additional 2″ (51 mm) assembly depth	❑ NA
1167289	Low flow kit – reduces maximum flow to 1.5 gpm (5.7 L) at 60 psi (4.1 bar)	☒ NA
1167290	High flow kit – increases maximum flow to 2.2 gpm (8.3 L) at 60 psi (4.1 bar)	❑ NA

Installation Notes

Install this product according to the installation guide.

ADA, **CSA B651**, **OBC** compliant when installed to the specific requirements of these regulations.

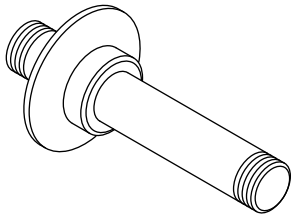


Product Diagram

THE BOLD LOOK OF KOHLER®

KOHLER FAUCETS

SHOWER ARM
K-7392
ALSO K-7394, K-7396



Features

- *Brass construction*
- *1/2″ NPT connections*
- *Ceiling-mount*
- *Includes flange*
- *3″ (76 mm) or 6″ (152 mm) or 12″ (305 mm) straight shower arm*

Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ASME A112.18.1/CSA B125.1*

Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Color/Finish	
K-7392	12″ (305 mm) shower arm	❑ CP	❑ Other_____
K-7394	6″ (152 mm) shower arm	☒ CP	❑ Other_____
K-7396	3″ (76 mm) shower arm	❑ CP	❑ Other_____

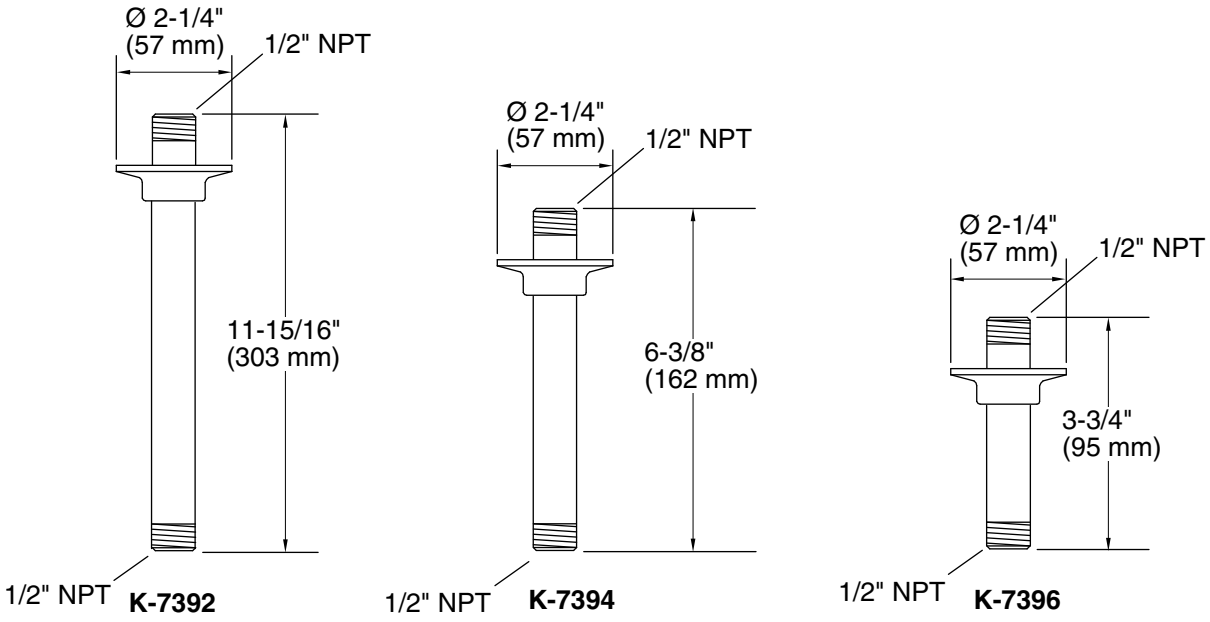
Product Specification

The ceiling-mount shower arm and flange shall be of brass construction. Shower arm shall have a 3″ (76 mm) or 6″ (152 mm) or 12″ (305 mm) straight shower arm. Shower arm shall have a 1/2″ NPT connection at both ends. Shower arm shall be Kohler Model K-7392-____ or K-7394-____ or K-7396-____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

Installation Notes

Install this product according to the installation guide.



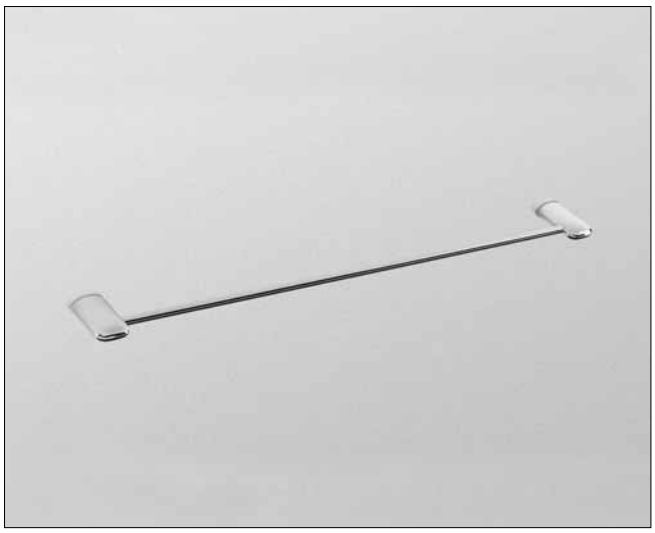
Product Diagram

THE BOLD LOOK OF KOHLER®

TOTO®

Y_416 Series

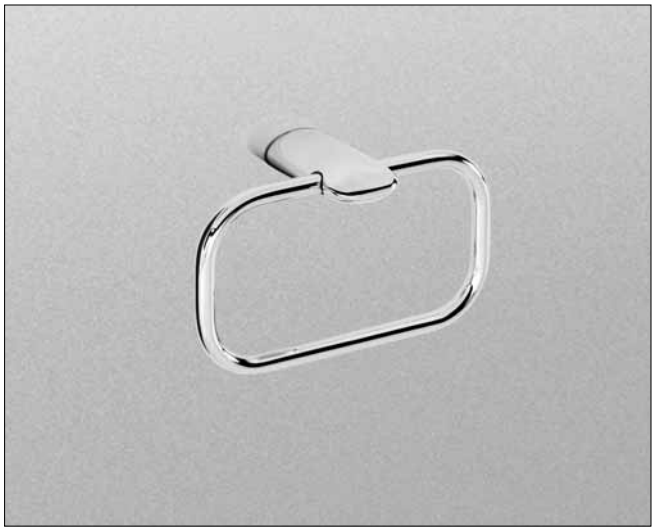
Aquia® Bath Accessories



YB416 - Towel Bar 24"

YP416 - Paper Holder

YH416 - Robe Hook



YR416 - Towel Ring

FEATURES

- Solid metal construction
- Mounting hardware for both drywall & tile included

COLORS/FINISHES

- #CP Polished Chrome
- #BN Brushed Nickel
- #PN Polished Nickel

MODELS

- YB416 - Towel Bar 24"
- YH416 - Robe Hook
- YP416 - Paper Holder
- YR416 - Towel Ring

PRODUCT SPECIFICATION

Product shall have a solid metal construction and include installation hardware. Product shall be TOTO Model Y_416#____.

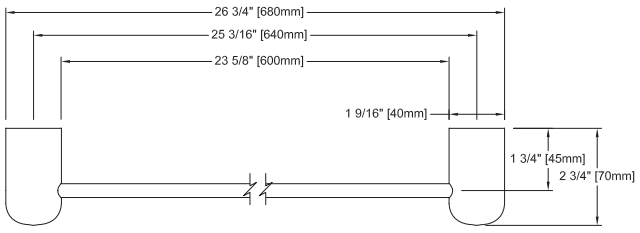
Y_416 Series

Aquia® Bath Accessories

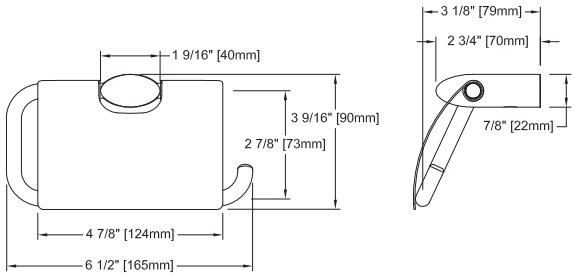
SPECIFICATIONS

- Warranty — Lifetime Limited Warranty (Residential Use) One Year (Commercial Use)
- Material — Metal

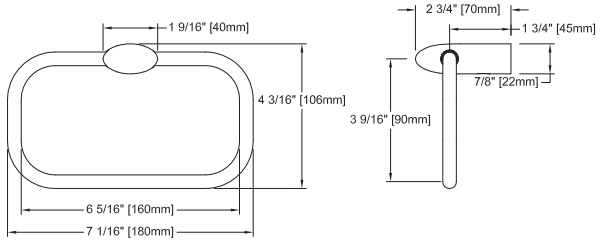
Product Number	Shipping Weight	Shipping Dimensions
YB416	2.1 lbs.	28-1/2"L x 4-1/4"W x 3-3/8"H
YP416	1.7 lbs.	8-1/2"L x 6-1/2"W x 4-1/2"H
YR416	1.2 lbs.	9"L x 7-1/2"W x 3-1/4"H
YH416	0.6 lbs.	7"L x 6"W x 2"H



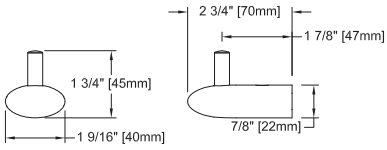
YB416#___



YP416#___



YR416#___



YH416#___