



CLEMSON UNIVERSITY

# INDIGO PINE

Clemson University's Solar Decathlon project brings together an active team of students and faculty from architecture, engineering, and social sciences to collaborate on the design, construction, and promotion of a prototypical, three bedroom, 1,000 sq ft, low environmental impact, net zero, solar house that is cost effective in today's market and comfortable under South Carolina's climate. We are focused on stitching together innovative building methods, southern personality, and local products into a home for a southern family.

U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2015

CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON)

INDIGO PINE WEST

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AS-BUILT PROJECT MANUAL

8/17/2015



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## Summary of Changes

### NOVEMBER 18, 2014 REVISIONS

#### Structural Calculations

Revised to include Design Narrative and planned structural tests.

#### Detailed Water Budget

Revised to include additional sprinkler head.

#### Summary of Reconfigurable Features

Section content removed.

#### Energy Analysis from E-Quest

Section removed.

#### Quantity Takeoff of Competition Prototype House

Revised to match changes to Construction Specifications.

#### Construction Specifications

The following sections were added or updated to match current design:

- 06 10 00 ROUGH CARPENTRY
- 06 16 00 SHEATHING
- 06 41 00 ARCHITECTURE WOOD CASEWORK
- 08 14 00 WOOD DOORS
- 08 53 PLASTIC WINDOWS
- 09 50 00 CEILINGS
- 09 60 00 FLOORING
- 21 11 00 FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING
- 22 07 00 PLUMBING INSULATION
- 22 11 16 DOMESTIC WATER PIPING
- 22 11 23 DOMESTIC WATER PACKAGED BOOSTER PUMPS
- 22 12 19 FACILITY GROUND-MOUNTED, POTABLE-WATER STORAGE TANKS
- 22 13 00 FACILITY SANITARY SEWORAGE AND VENT PIPING
- 22 41 RESIDENTIAL PLUMBING FIXTURES
- 26 51 00 INTERIOR LIGHTING



## FEBRUARY 12, 2015 REVISIONS

### Rules Compliance Checklist

Updated and revised to match current design.

### Structural Calculations

Updated and revised to include results of completed structural tests.

### Quantity Takeoff of Competition Prototype House

Revised to match changes to Construction Specifications.

### Construction Specifications

The following sections were added or updated to match current design:

- 03 71 00 MASS CONCRETE FOR RAFT FOUNDATIONS
- 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY
- 05 05 23 METAL FASTENINGS
- 05 10 00 STRUCTURAL METAL FRAMING
- 06 10 00 ROUGH CARPENTRY
- 06 16 00 SHEATHING
- 06 41 00 ARCHITECTURE WOOD CASEWORK
- 07 13 00 SHEET WATERPROOFING
- 07 21 00 THERMAL INSULATION
- 07 41 13 ALUMINUM ROOF PANELS
- 07 42 00 WALL PANELS
- 07 71 23 MANUFACTURED GUTTERS AND DOWNSPOUTS
- 08 14 00 WOOD DOORS
- 08 53 00 PLASTIC WINDOWS
- 08 71 00 DOOR HARDWARE
- 09 50 00 CEILINGS
- 09 60 00 FLOORING
- 09 65 13 RESILIENT BASE
- 09 70 00 WALL FINISHES
- 11 11 36 VEHICLE CHARGING EQUIPMENT
- 11 30 00 RESIDENTIAL EQUIPMENT
- 12 32 23 CASEWORK HARDWARE
- 12 36 00 COUNTERTOPS
- 21 13 00 FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING
- 22 07 00 PLUMBING INSULATION
- 22 11 16 DOMESTIC WATER PIPING
- 22 11 23 DOMESTIC WATER PACKAGED BOOSTER PUMPS
- 22 12 19 FACILITY GROUND-MOUNTED, POTABLE-WATER STORAGE TANKS



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22 13 00 FACILITY SANITARY SEWORAGE  
22 33 00 ELECTRIC DOMESTIC WATE HEATERS  
22 41 00 RESIDENTIAL PLUMBING FIXTURES  
23 31 13 METAL DUCTS AND CASINGS  
23 37 13 DIFFUSERS, REGISTERS, AND GRILLES  
23 72 00 AIR-TO-AIR ENERGY RECOVERY EQUIPMENT  
23 81 26 SPLIT-SYSTEM HEAT PUMPS  
26 24 16 PANELBOARDS  
26 27 26 WIRING DEVICES  
26 31 00 PHOTOVOLTAIC COLLECTORS  
26 51 00 INTERIOR LIGHTING  
26 56 00 EXTERIOR LIGHTING  
32 93 00 PLANTS  
32 97 00 PLANTERS  
48 19 16 ELECTRICAL POWER GENERATION INVERTERS

The following sections were removed:

05 54 00 METAL FLOOR PLATES  
07 91 16 JOINT GASKETS  
12 21 00 WINDOW BLINDS  
22 13 53 FACILITY SEPTIC TANKS  
32 91 13 SOIL PREPARATION  
48 16 00 GEOTHERMAL ENERGY ELECTRICAL POWER GENERATION EQUIPMENT

### **Appendix A: Structural Calculations**

Section added to include detailed structural analysis.



**MARCH 25, 2015**

### **Rules Compliance Checklist**

Updated and revised to match current design.

### **Quantity Takeoff of Competition Prototype House**

Revised to match changes to Construction Specifications.

### **Construction Specifications**

The following sections were added or updated to match current design:

- 01 42 00 REFERENCES
- 01 50 00 TEMPORARY FACILITIES AND CONTROLS
- 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
- 03 31 00 STRUCTURAL CONCRETE
- 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY
- 05 45 16 ELECTRICAL METAL SUPPORTS
- 07 13 13 FELT ROOF UNDERLAYMENT
- 07 21 00 THERMAL INSULATION
- 07 25 00 WEATHER BARRIERS
- 07 42 00 WALL PANELS
- 08 14 23 OUT-SWING ENTRY DOORS
- 08 53 13 VINYL DOUBLE-HUNG WINDOWS
- 08 71 00 DOOR HARDWARE
- 09 60 00 FLOORING
- 09 65 13 RESILIENT BASE
- 09 72 00 WALL COVERINGS
- 09 74 13 WOOD WALL COVERING AND FASTENING
- 10 28 00 TOILET, BATH AND LAUNDRY ACCESSORIES
- 22 12 19 FACILITY GROUND-MOUNTED, POTABLE-WATER STORAGE TANKS
- 22 33 00 ELECTRIC DOMESTIC WATE HEATERS
- 23 07 13 DUCT INSULATION
- 23 31 13 METAL DUCTS AND CASINGS
- 23 33 43 FLEXIBLE CONNECTORS
- 26 24 16 PANELBOARDS
- 26 27 26 WIRING DEVICES
- 26 31 00 PHOTOVOLTAIC COLLECTORS
- 26 51 00 INTERIOR LIGHTING
- 26 56 00 EXTERIOR LIGHTING
- 28 31 43 SMOKE DETECTION SENSORS
- 48 19 16 ELECTRICAL POWER GENERATION INVERTERS

The following sections were removed:



## CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

05 05 23 METAL FASTENINGS

05 10 00 STRUCTURAL METAL FRAMING

DIVISION 13 – SPECIAL CONSTRUCTION

DIVISION 14 – CONVEYING EQUIPMENT

DIVISION 31 – EARTHWORK

DIVISION 33 – UTILITIES

DIVISION 40 – PROCESS INTERCONNECTIONS

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

### **Appendix B: CNC-Milling Documentation**

Section added to include detailed information pertaining to CNC labor cost.





**AUGUST 17, 2015**

### **Rules Compliance Checklist**

Updated and revised to match current design.

### **Structural Calculations**

Updated and revised to include results of completed structural tests.

### **Quantity Takeoff of Competition Prototype House**

Revised to match changes to Construction Specifications.

### **Energy Analysis Results & Discussion**

Added to include engineering energy analysis data.

### **Construction Specifications**

The following sections were added or updated to match current design:

- 01 10 00 SUMMARY
- 01 40 00 QUALITY REQUIREMENTS
- 05 45 16 ELECTRICAL METAL SUPPORTS
- 06 10 00 ROUGH CARPENTRY
- 06 16 00 SHEATHING
- 06 41 00 ARCHITECTURE WOOD CASEWORK
- 06 74 13 FIBERGLASS REINFORCED GRATINGS
- 07 13 13 FELT ROOFING UNDERLAYMENT
- 07 42 00 WALL PANELS
- 07 92 00 JOINT SEALANTS
- 09 70 00 WALL FINISHES
- 09 74 13 WOOD WALL COVERING AND FASTENING
- 09 91 00 PAINTING
- 21 13 00 FIRE SUPPRESSION SPRINKLER SYSTEM
- 22 41 00 RESIDENTIAL PLUMBING FIXTURES
- 23 09 13 INSTRUMENTATION & CONTROL DEVICES FOR HVAC
- 23 31 13 METAL DUCTS AND CASINGS
- 23 37 13 DIFFUSERS, REGISTERS, AND GRILLES
- 26 51 00 INTERIOR LIGHTING
- 26 56 00 EXTERIOR LIGHTING
- 32 93 00 PLANTS
- 32 97 00 PLANTERS

The following sections were removed:

- DIVISION 2 EXISTING CONDITIONS
- 07 25 00 WEATHER BARRIERS



## CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

07 71 23 MANUFACTURED GUTTERS AND DOWNSPOUTS  
DIVISION 10 SPECIALTIES  
10 28 00 TOILET, BATH AND LAUNDRY ACCESSORIES  
22 11 23 DOMESTIC WATER PACKAGED BOOSTER PUMPS  
DIVISION 27 COMMUNICATIONS

Of note, all construction specifications have been updated to include a quality assurance section, noting the type of labor required to perform the work and all necessary qualifications. See section 01 40 00 QUALITY REQUIREMENTS for more information regarding the labor division requirements for construction of Indigo Pine.

### **Appendix B: Sprinkler System Calculations**

Moved from Detailed Water Budget to manual Appendix to allow clear reference.

### **Appendix C: CNC-Milling Documentation**

Updated to reflect the current cost of CNC-milling structural units of home.

### **Appendix D: CNC Part Data**

Added to supplement information regarding CNC-milled parts of home.

### **Appendix E: On-Site Labor Division**

Added to supplement quality requirements found various specification sections.

### **Appendix F: Manufacturer's Specifications**

Added to supplement information found in the construction specifications.



## Rules Compliance Checklist

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	O-Series
Rule 4-2	Construction Equipment	Specifications for heavy machinery	Div. 01 50 00
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S-102
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	G-Series
Rule 4-5	Generators	Specifications for generators (including sound rating)	N/A
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	F-Series P-Series
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	Div. 21 00 00 Div. 22 00 00 Div. 23 00 00
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	S-102 S-202
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot	S-102 S-202
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	G-Series A-Series
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	S-Series "Structural Testing" Section Appendix A
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



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Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	N/A
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-105
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	N/A
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	N/A
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	Div. 26 31 00 Div. 48 19 16
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	N/A
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	N/A
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	Pg. 50
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-series
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	Div. 26 00 00 Div. 48 19 16
Rule 8-5	Village Grid	One-line electrical diagram	E-101
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-201
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	G-105 A-102
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-112
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	P-102
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. PDT or between 8 a.m. and 4 p.m. solar time on October 1	P-102



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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	O-Series
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	N/A
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	N/A
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	N/A
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	N/A
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	N/A
Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	O-Series
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	Div. 22 12 19
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	O-Series
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	Div. 22 12 19
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-105



## Structural Testing

### Structural Narrative and Quality / Durability Assurance Plan

#### Project Overview: The Sim[PLY] Framing System and The Indigo Pine Application

The Indigo Pine house is framed with the Sim[PLY] structural framing system developed by Clemson University. The Sim[PLY] system utilizes CNC-cut plywood components in lieu of traditional dimension lumber. The prefabricated nature of this system maximizes quality control, while minimizing on-site construction time by relegating all measuring and cutting to the factory. The use of CNC processing also allows for various forms of customization including MEP integration, component labeling, and mortise and tenon-type connections, among others.

The framing components of the Sim[PLY] system are cut from standard 4ft x 8ft sheets of 23/32"-thick plywood sheathing, an industrial product that is highly standardized. In particular, the Sim[PLY] system utilizes SFI-certified Douglas Fir-Larch plywood supplied by Plum Creek. The regularity of structural plywood, like the Douglas Fir-Larch, stems from its engineered physical properties and the quality-control standards governing its manufacture. With respect to traditional graded lumber, plywood offers enhanced dimensional stability because of the alternating grain direction of its layers. Wood tends to shrink or swell primarily in its radial and tangential grain directions, while it is stable in its longitudinal direction. The alternation of grain direction in plywood serves to balance and minimize shrinkage, swelling, and warping. Structural plywood is also inherently devoid of the knots and other inconsistencies that can adversely affect dimension lumber. This is because of the care taken in the manufacturing process to avoid the alignment of knots from one ply to the next, meaning that any knots present in the final product are only one ply deep at any given point.

In working with plywood it is critical that any mechanical fasteners be oriented to pass through the face of the plywood rather than the edge so as to avoid splitting and tear-out. For this reason, the Sim[PLY] system utilizes plywood flanges on all studs, joists, and rafters. These flanges are oriented perpendicularly to the webs and allow for the reliable fastening of exterior sheathing and interior finish materials. Thus, all structural sheathing is fastened through the face of the plywood flanges rather than through the edge of plywood webs.

Sim[PLY] flanges are pre-routed with mortises to accept the pre-routed tenons of the Sim[PLY] webs. Shear forces are transferred from the sheathing to the flanges via traditional fasteners and from the flanges to the webs via the mortise and tenon connections. In the case of the Indigo Pine house, Zip System sheathing by Huber is utilized for all sheathing applications. The size and frequency of screws used to fasten the Zip System sheathing was cross-checked with results from physical single-fastener shear tests. Likewise, the shear capacity of the flange-to-web mortise and tenon connections were tested. The final size and spacing of the tenons was cross-checked with the results from these tests to



ensure adequacy. Safety factors of 0.8 ( $\lambda$ ) and 0.75 ( $\phi_v$ ) were together applied in determining the final required size and spacing for single fasteners. These factors are consistent with the factors prescribed for through-thickness shear in the National Design Specification for Wood Construction (NDS). The efficacy of the connections and their spacings were also confirmed through physical racking tests of entire shear wall assemblies.

The flanges are prevented from withdrawing from the webs by stainless steel tension ties that bind these elements together. Each steel tie has a reported tensile capacity of 150 pounds. This capacity was also tested directly through single-fastener tensile tests. The results of these tests determined the minimal required spacing of the steel ties. A safety factor of 1/3 (33% of ultimate load) was applied in determining the final tensile capacity and minimal spacing. If, in testing, the combination of steel ties and mortise and tenon joints were found to be insufficient for the withdrawal and shear loads expected at the studs, then a structural adhesive would have been added between the flanges and webs to strengthen their connection. However, test results confirmed the adequacy of the connection without adhesives.

The Indigo Pine application of the Sim[PLY] system is designed to mimic a 24" on-center, double-stud, "advanced" platform framing scenario. The roof framing utilizes Sim[PLY] rafters, which consist of spliced double-layered webs. The longer of the rafter lengths (13 ft) was subjected to physical testing to confirm bending strength. The floor framing utilizes Sim[PLY] joists. These joists sit atop an innovative exposed Geothermal System consisting of stacked CMU block. This CMU base is anchored to the ground and grouted at key locations around the perimeter in order to form a rigid foundation capable of withstanding lateral design loads. The structural framing of the house is affixed to the CMU base using hold-downs equivalent to Simpson HL73. The Indigo Pine Porch is structurally independent of the Sim[PLY] framing used to construct the house. The porch is framed using traditional framing techniques and calculations detailed in Appendix A of this structural report.

All reasonable caution and care will be taken in the shipping and storage of the Sim[PLY] framing materials utilized in the Indigo Pine house. The framing elements will be CNC-cut prior to being packaged and shipped to Irvine, California. After arriving on site, the framing elements will be covered and protected from the elements either in shipping pods or with water-proof wraps until the time of construction. As is the case with plywood sheathing, the Sim[PLY] framing elements are capable of the limited exposure that accompanies construction. However, once the integrated weather barrier of the Zip System sheathing is sealed, all framing elements will be fully protected against moisture, just as traditional framing would be.

## Structural Calculations and Testing

Extensive structural testing of the Indigo Pine / Sim[PLY] framing system has been conducted at Clemson University. Testing was performed by Michael Stoner and overseen by Dr. Weichi Pang and Professor Dustin Albright. All testing was performed at the University's WISER (Wind and



Structural Engineering Research) facility. A detailed description of the selected structural tests and protocols is included in the following pages.

Supporting structural calculations were reviewed by the Indigo Pine engineer of record, Ty Monks, P.E., LEED AP, who is licensed in both California and South Carolina. Mr. Monks is Vice President and Managing Principal at Nishkian Monks, PLLC in Bozeman, Montana. He is a member of the American Society of Civil Engineers, American Council of Engineering Companies, International Code Council, and the Green Building Certification Institute.





## Structural Loads

### General

Occupancy Category: II (ASCE 7-10 Table 1-1)

### Construction Loads

Construction Live Load: 20psf

### Transportation Loads

There will be no Transportation Loads. The project will be constructed of manageable pre-cut components that shall be assembled on site.

### Design Loads

The live loads listed here are taken from the Solar Decathlon competition guidelines. The dead loads are calculated in Table 1 using the published weights of the construction materials utilized in the Indigo Pine house. The Wind and Seismic loads come from the competition guidelines and reflect the wind and seismic design loads associated with Irvine, California, the 2015 competition site. The values for these loads are calculated using ASCE 7-10.

#### Indigo Pine Porch Loads:

Live Load: 100psf

Dead Load: 15psf (See Table 1 for detailed calculations.)

#### Indigo Pine Floor Loads:

Live Load: 50psf

Dead Load: 10psf (See Table 1 for detailed calculations.)

#### Indigo Pine Roof Loads:

Live Load: 20psf

Dead Load: 14psf (See Table 1 for detailed calculations.)



Indigo Pine Wind Loads:

85mph (38.0m/s) (3-second gust), exposure category C

Indigo Pine Seismic Loads:

IRC Seismic Design Category (SDC) D2 See IRC Section R301.2.2

DEAD LOADS	Uniform Load (psf)
<b>Porch</b>	
Self-Weight of Framing (Conservative Estimate)	15
<b>Total Porch Dead Load</b>	<b>15</b>
<b>Floor</b>	
Subflooring (HUBER Zip Panel - 7/16")	1.5
Finished Plywood Flooring	2.2
Floor Joist Self Weight	2
<b>Total Floor Dead Load Subtotal (Conservative Rounding Estimate)</b>	<b>10</b>
<b>Roof</b>	
Sheathing (HUBER Zip Panel - 5/8")	1.5
30 lb Roofing Felt	0.14
PBR Metal Roof	0.8
Photovoltaic Panels (30 at 41lb)	2.33
PV Panel Frame (30 at 20lb)	0.4
Roof Joist Self Weight	3
MEP	3
Interior Sheathing	1.5
<b>Total Roof Dead Load Subtotal</b>	<b>14</b>

Table 1: Dead Load Calculations for Indigo Pine



### Roof Rafter Forces:

The maximum shear and moment forces are listed below for the rafters. These calculations were based on uniform loading conditions, a rafter spacing of 2 feet, and Sim[PLY]-supported span lengths of 10 and 13 feet.

10 ft span: Maximum Moment = 1220 lb-ft  
Maximum Shear = 488 lb

13 ft span: Maximum Moment = 2062 lb-ft  
Maximum Shear = 635 lb

### Wind Forces:

The wind loads calculations are derived for two distinct wind speed calculations: the competition wind speed (85 mph), and an expected wind speed for coastal South Carolina (135 mph). The values of shear are reported as both the value of applied shear force at the top of the wall assembly and as the maximum shear in the wall considering openings. Uplifts on the roof members are determined using the worst case scenario for a single roof rafter. The out-of-plane wall pressures are determined using the maximum negative pressures.

All calculations are based on LRFD design according to ASCE 7-10 with detailed calculations shown in Appendix A.

85 mph winds (CA): Maximum Shear in Wall = 187 plf (openings considered; West Wall)

Maximum Shear applied to wall (North/South Walls) = 121.9 plf

Maximum Shear applied to wall (East/West Walls) = 68.5 plf

Maximum Uplift on Rafters = 37.8 plf

Maximum Out-of-Plane Pressure = 26.8 psf

135 mph winds (SC): Maximum Shear in Wall = 295 plf (openings considered; West Wall)

Maximum Shear applied to wall (North/South Walls) = 192.5 plf

Maximum Shear applied to wall (East/West Walls) = 114.1 plf

Maximum Uplift on Rafters = 56.8 plf

Maximum Out-of-Plane Pressure = 37.7 psf (East/West Walls)



### Seismic Forces:

The seismic forces are calculated using the Equivalent Lateral Force System (ELF) along with associated gravity accelerations provided by the United States Geological Survey (USGS). The values for the gravity accelerations in Irvine, CA were determined according to the following USGS report:

User-Specified Input

Report Title Solar Decathlon Data UTC

Building Code Reference Document 2012 International Building Code (which utilizes USGS hazard data available in 2008)

Site Coordinates 33.6672°N, 117.71974°W

Site Soil Classification Site Class D – “Stiff Soil”

Risk Category I/II/III

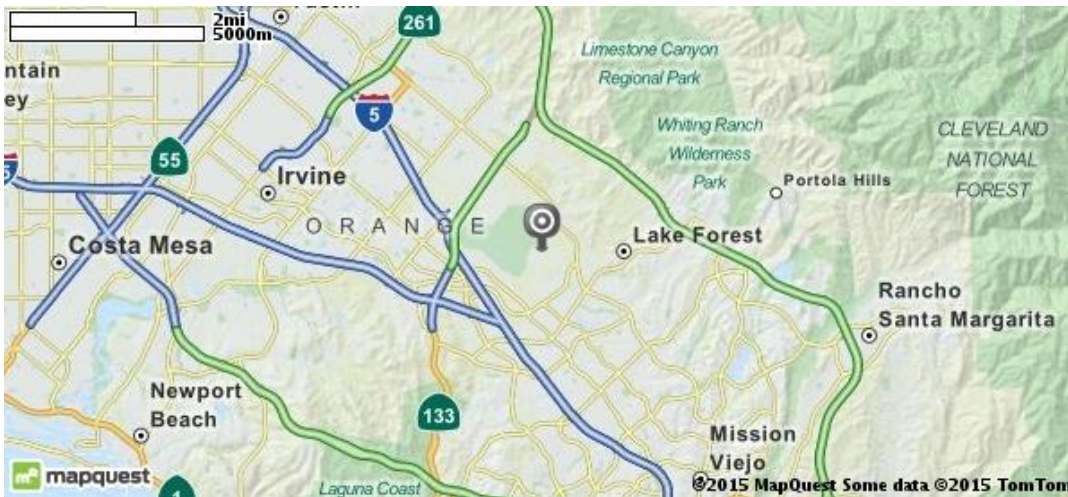


Figure 1: Seismic Design Map



**USGS-Provided Output:**

$$S_s = 1.485 \text{ g} S_{MS} = 1.485 \text{ g} S_{DS} = 0.990 \text{ g}$$

$$S_1 = 0.552 \text{ g} S_{M1} = 0.827 \text{ g} S_{D1} = 0.552 \text{ g}$$

The given data from the USGS report was used to determine the relevant loads and properties of the system. The important values are shown below:

Approximate Fundamental Period:	0.161 sec
Seismic Weight:	19.4 kips
Diaphragm Shear (East/West shaking):	147 plf
Diaphragm Shear (North/South shaking):	195 plf
Anchorage Force:	27.4 plf

The values for the loads shown above are a summary of the expected loads on the structure. For a complete set of calculations refer to Appendix A: Structural Calculations.



## Reference Strength Data for Plywood

The following design strength values are projections derived from the National Design Specification for Wood Construction (NDS), and based on the specific grade and dimensions of the plywood sheathing for the Sim[PLY] framing system in the Indigo Pine House. Because there is no precedent in the NDS on 7-ply plywood, the structural values for 5-ply wood will be used. These projected material strengths were also confirmed, in part, through physical testing of specific connections and assemblies, as described later in this document.

**Product:** *Douglas Fir-Larch 7-ply*

**Thickness:** 23/32" (7-ply)

**Span Rating:** 48/24

### Factored Planar Shear Resistance:

$\lambda\phi_v V_s \times C_G = 0.588 \text{ kips/ft} \times 1.4 = 0.823 \text{ kips/ft}$  (where  $C_G$  is the Grade and Construction factor for 5-ply plywood)

### Factored Through-Thickness Shear Resistance:

$\lambda\phi_v V_t \times C_G = 0.130 \text{ kips/ft} \times 2.0 = 0.260 \text{ kips/ft} = 21.667 \text{ \#/in.}$  (where  $C_G$  is the Grade and Construction factor for 5-ply plywood)

### Factored Compression Resistance:

$\lambda\phi_c P \times C_G = 8.294 \text{ kips/ft} \times 1.5 = 12.441 \text{ kips/ft} = 12,441.000 \text{ \#/ft}$  (where  $C_G$  is the Grade and Construction factor for 5-ply plywood)

### Unfactored Axial Stiffness:

$EA \times C_G = 5,000 \text{ kips/ft} \times 1.0 = 5,000 \text{ kips/ft}$  (where  $C_G$  is the Grade and Construction factor for 5-ply plywood)



## Structural Tests and Results

Key structural elements and assemblies from the Indigo Pine / Sim[PLY] framing system were subjected to targeted load testing in order to quantify and confirm their physical strength and resiliency. Testing included both gravity and lateral load scenarios.

The tested elements and assemblies are described in detail in the following pages. The specific test protocols and objectives are also listed, including the numbers of test specimens. In each case, all of the tested materials and their key dimensions matched those utilized in the Indigo Pine house. It should be noted that additional long-duration, cyclic, and fatigue-type testing are planned for the Sim[PLY] framing system, but are outside the boundaries of the Solar Decathlon Competition and therefore not addressed in this report.

As a point of reference, the typical Sim[PLY] stud and sheathing assembly is illustrated below in Figures 2 and 3.

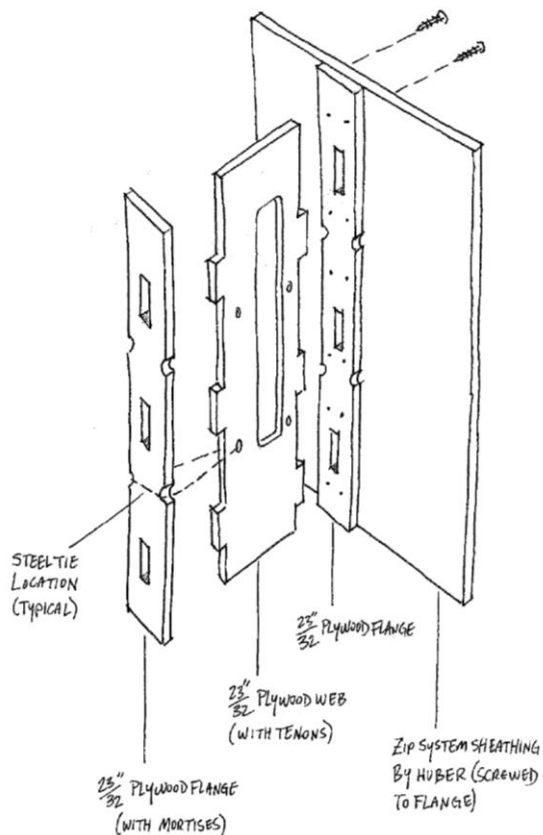


Figure 2: Sim[PLY] System Stud



Figure 3: Sim[PLY] Stud Detail



## Structural Test 1: Shear Capacity of Flange-to-Web Connection

The Indigo Pine house utilizes built-up plywood studs spaced at 2ft on center. These studs (illustrated in Figure 2) feature plywood flanges attached to a plywood web. Shear loads are transferred from flange to web through mortise and tenon connections, and the flange is prevented from withdrawing due to the inclusion of stainless steel ties, which secure it to the web. The effective shear strength of the mortise and tenon connection was measured directly through load testing. The test was modeled after the single-fastener shear test described in **ASTM D1761-12: Standard Test Methods for Mechanical Fasteners in Wood**, and was performed on five separate specimens. The minimum required size and spacing of the mortise and tenon shear connections was established through these tests. Safety factors of 0.8 ( $\lambda$ ) and 0.75 ( $\phi_v$ ) were together applied in determining the final size and spacing. These factors are consistent with the factors prescribed for through-thickness shear in the National Design Specification for Wood Construction (NDS).

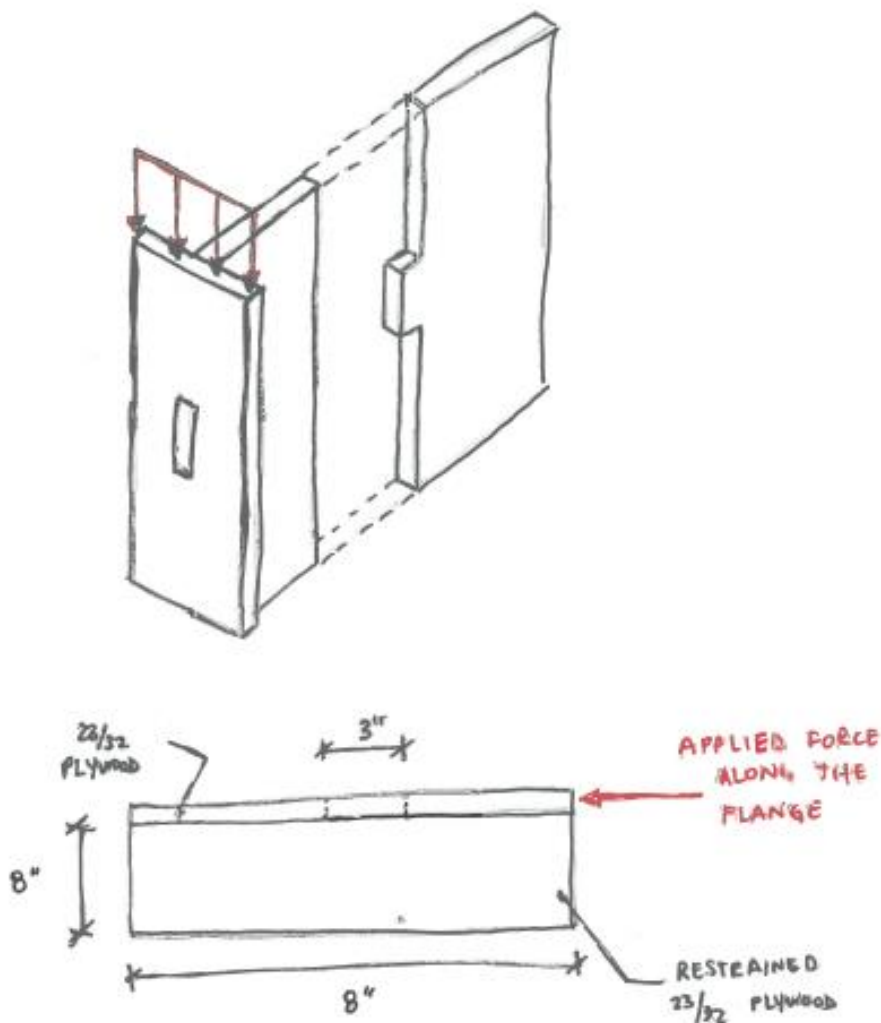


Figure 4: Flange-To-Web Connection Detail





## Structural Test 1 Results: Shear Capacity of Flange-to-Web Connection

The mortise and tenon joint was tested using Douglas Fir-Larch as outlined in Structural Test 1. Figure 5 shows the test setup. The results of the five individual tests are summarized below:

Test Number	Average
Maximum Force (lbs)	1021
Displacement at Failure (in)	0.40

Table 2: Summarized Mortise and Tenon Results



Figure 5: Shear Tab Test Setup

Using these test values and the designated factors of safety, the number of required shear tabs given the expected lateral loads were determined. In order to determine these requirements, assumptions were made about the load path of the lateral load travelling through the sheathing and into the plywood studs. The shear tabs were considered to take all of the shear load that was applied by the roof diaphragm. In this instance it was also assumed that each tab shared this shear load equally throughout the height of the wall when in fact the load is more concentrated on the exterior shear tabs. Based on these assumptions, the following information was determined with detailed calculations in Appendix A:

Maximum Applied Shear: 10.55 kips

Factored Capacity of Shear Tab: 613 lbs

Number of Shear Tabs/Wall: 17.21

Shear Tabs Required per Square Foot: North: 0.0304, South: 0.0345, East: 0.0425 West: 0.0425



## Structural Test 2: Shear Capacity of Sheathing-to-Flange Fasteners

Having established the effective shear strength of the mortise and tenon connection in Structural Test 1, the shear strength of the sheathing-to-flange fasteners were tested in Structural Test 2. This test was modeled after the single-fastener shear test described in **ASTM D1761-12: Standard Test Methods for Mechanical Fasteners in Wood**, and was performed on five separate specimens. The purpose of this test was to combine its data with data gathered in Structural Test 5 .

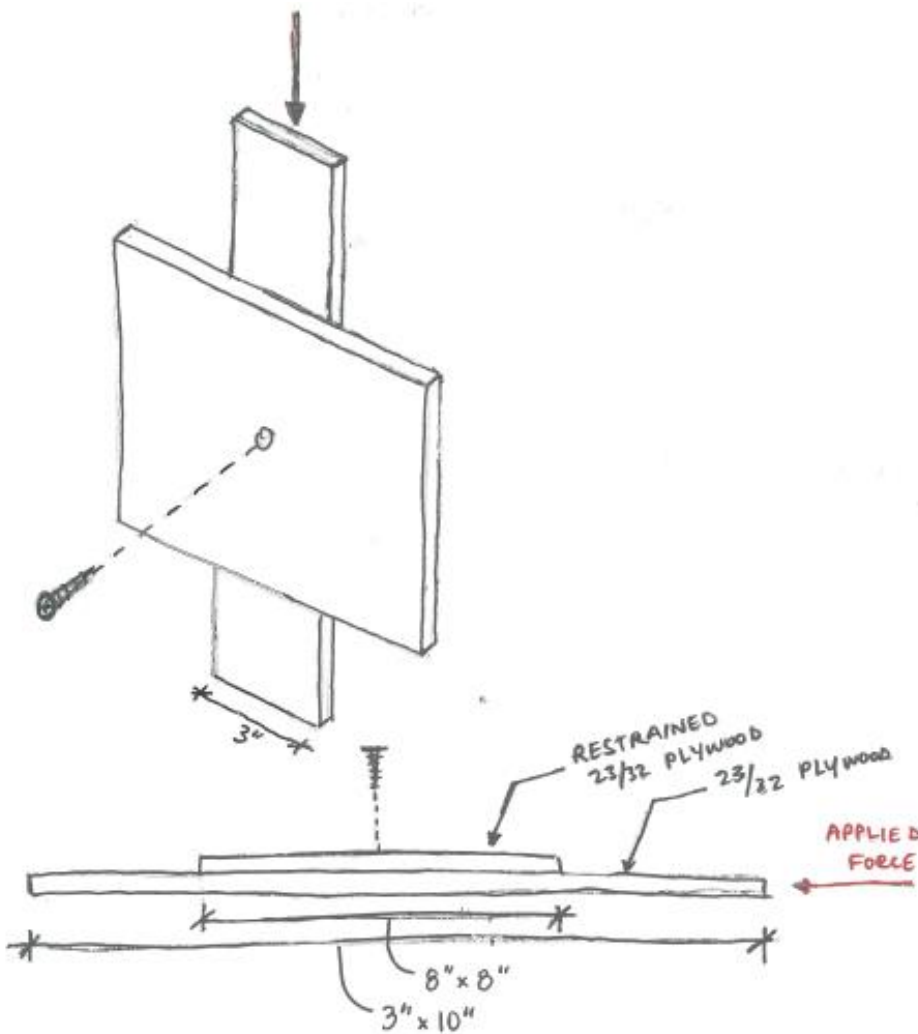


Figure 6: Sheathing-to-Flange Connection Test Detail



## Structural Test 2 Results: Shear Capacity of Sheathing-to-Flange Fasteners

The shear capacity of the sheathing-to-flange fasteners was tested using Douglas Fir-Larch plywood and a 1 5/8" exterior wood screw. These values were used to help determine the theoretical shear capacity of the wall assembly as well as the withdrawal capacity of the sheathing in negative pressure wind conditions. Figure 7 shows a setup of the test. The summary of the results of the shear fastener test is included below with detailed test values shown in Appendix A:

Test Number	Average
Maximum Force (lbs)	332.27
Displacement at Failure (in)	0.50

Table 3: Summarized Shear Fastener Results



Figure 7: Screw Shear Test Setup

The results of the screw shear capacity test prove that these fasteners are adequate in taking the expected shear loads in the wall assembly. Drawing also from the data gathered in Structural Test 5, the spacing of these screws in the wall assembly was conservatively set to 3" on all exterior edges and 6" on interior studs.



### Structural Test 3: Tensile Withdrawal of Stud Flange

The Indigo Pine house utilizes built-up plywood studs spaced at 2ft on center. These studs (illustrated in Figure 2 above) feature plywood flanges attached to a plywood web. Shear loads are transferred from flange to web through mortise and tenon connections, and the flange is prevented from withdrawing due to the inclusion of stainless steel ties, which secure it to the web. All such ties are fastened using a tie-gun tool, which is designed to reach a prescribed tension prior to releasing the tie, thereby insuring uniformity and quality-control during construction. The reported tensile strength of the steel ties is 150 pounds. The effective tensile strength in the context of the flange-to-web connection was measured directly through load tests applied to the stud flanges. Deflection was also measured in order to evaluate the combined effect of localized wood crushing and elongation of the ties. The test is modeled after the single-fastener withdrawal test described in **ASTM D1761-12: Standard Test Methods for Mechanical Fasteners in Wood**, and was performed on five separate specimens. A safety factor of 1/3 (33% of ultimate load) was applied in determining the final tensile capacity and required spacing. This factor of safety is consistent with industry standards for cable ties.

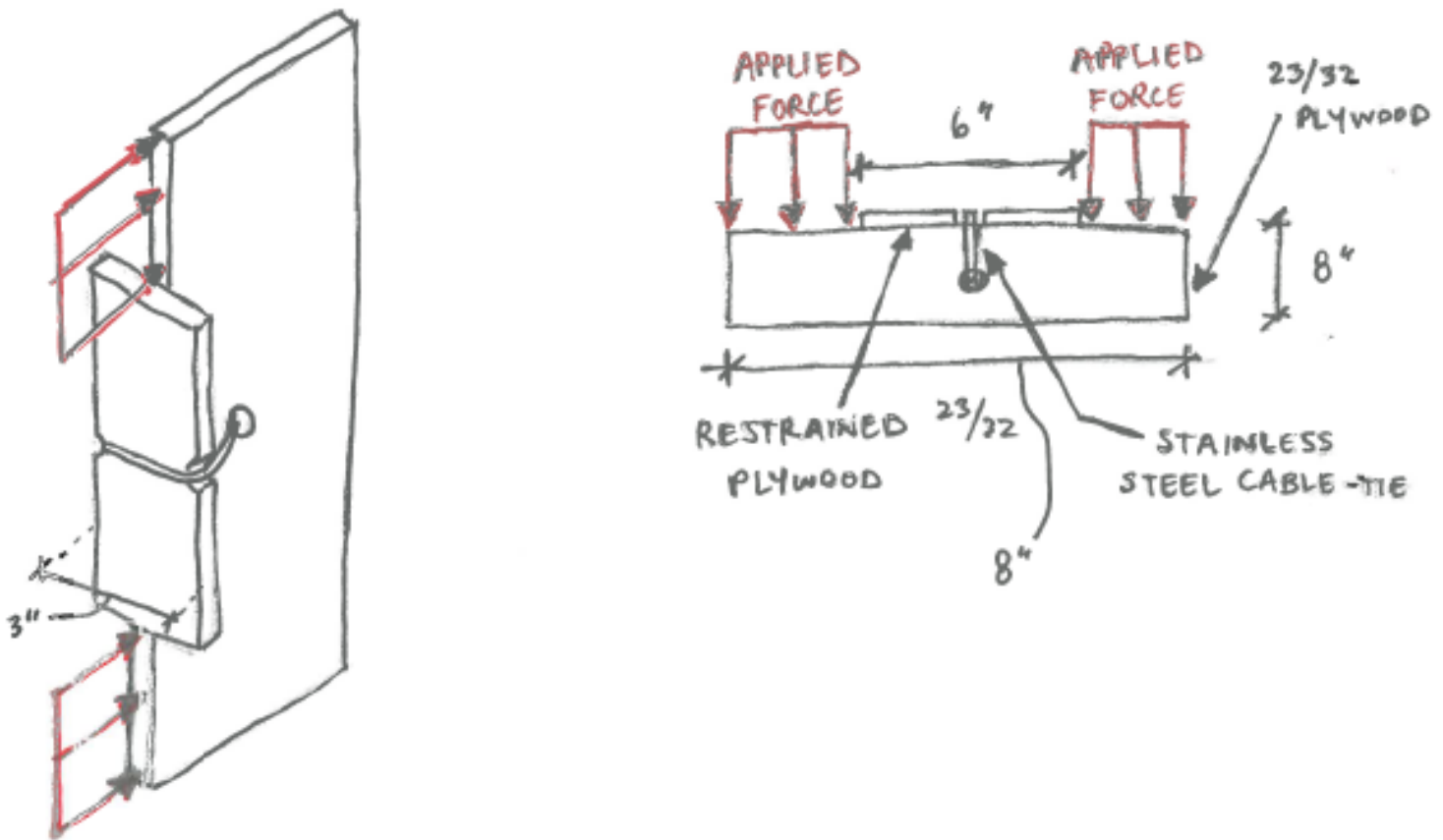


Figure 8: Cable Tie Detail



### Structural Test 3 Results: Tensile Withdrawal of Stud Flange

Figure 9 shows a setup of the cable tie test setup. The cable-tie connection was tested using Douglas Fir-Larch plywood and yielded the following results:

Test Number	Average
Maximum Force (lbs)	268.35
Displacement at Failure (in)	0.35

Table 4: Summarized Cable-Tie Test Results



Figure 9: Cable Tie Test Setup

Using these experimental values, along with the designated factor of safety and the expected negative wind pressures for 85 mph and 135 mph, the minimum number of cable ties was determined. For each case, the minimum required number of cable ties was determined for the ultimate values. These values are summarized below and are detailed in Appendix A:

	Gross Area (sf)	85 mph	135 mph
NORTH WALL	566.2	29.91	44.98
SOUTH WALL	499.3	26.38	39.66
EAST WALL	404.5	21.37	32.13
WEST WALL	404.5	21.37	32.13
ROOF	972.2	71.90	108.04

Table 5: Cable-Tie Requirements



### Structural Test 4: Withdrawal Capacity of Sheathing-to-Flange Fasteners

Having established the effective tensile strength of the cable tie connection in Structural Test 3, the withdrawal capacity of the sheathing-to-flange fasteners was tested in Structural Test 4. The test followed the single-fastener withdrawal test described in **ASTM D1761-12: Standard Test Methods for Mechanical Fasteners in Wood**, and was performed on five separate specimens. A safety factor of 1/6 (16.67% of ultimate load) was applied in determining the working withdrawal strength of the screws. This safety factor is consistent with recommendations outlined for plywood under long-term load duration by the American Panel Association (APA).

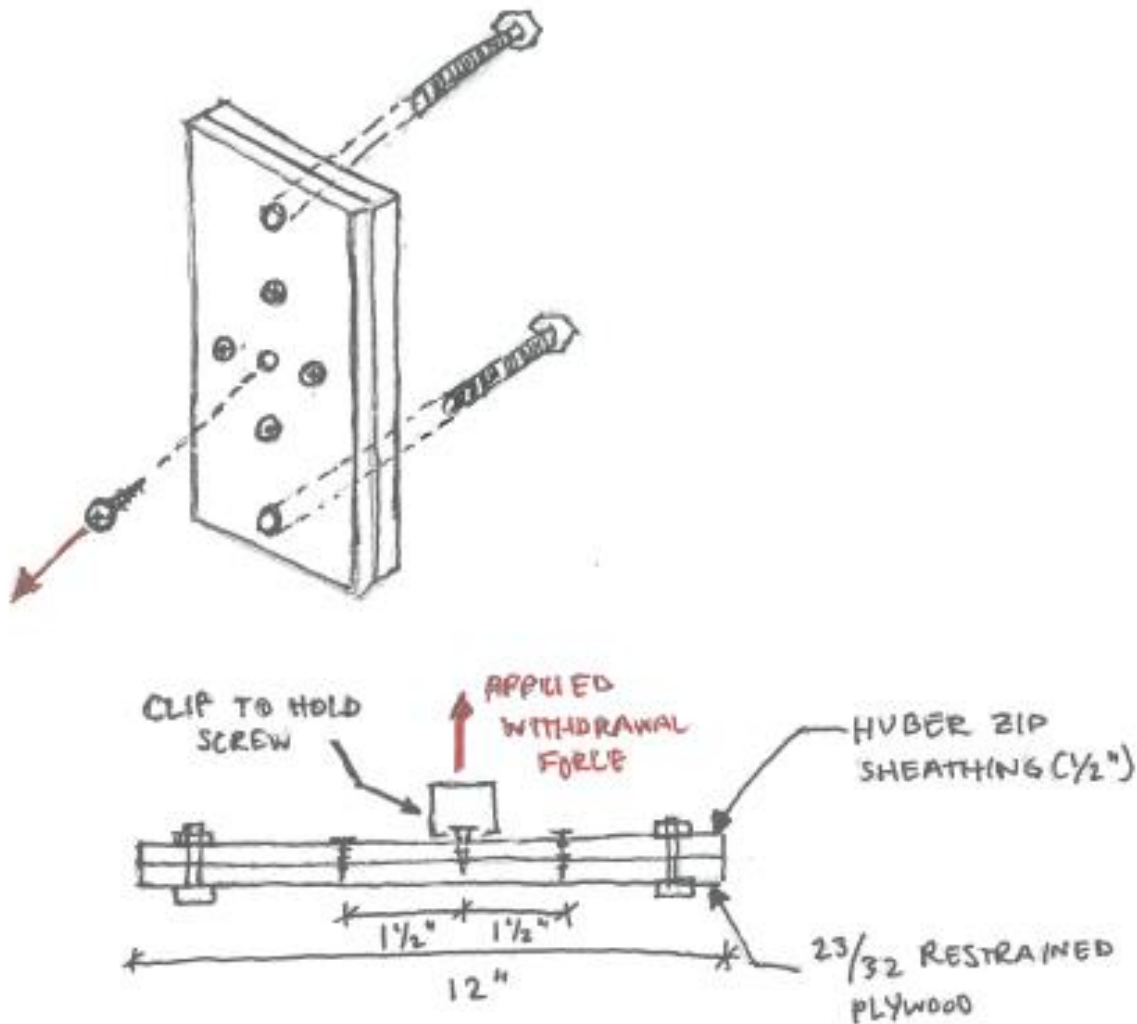


Figure 10: Withdrawal Capacity of Sheathing-to-Flange Fasteners



### Structural Test 4 Results: Withdrawal Capacity of Sheathing-to-Flange Fasteners

Figure 11 shows the setup of the screw withdrawal test. The withdrawal capacity of a 1 5/8" exterior wood screw into Huber Zip Sheathing and 23/32 Douglas Fir-Larch plywood was tested and yielded the following results:

Test Number	Average
Maximum Force (lbs)	397.62
Displacement at Failure (in)	0.09

Table 6: Summarized Screw Withdrawal Results



Figure 11: Screw Withdrawal Test Setup

The designated safety factors were applied and the maximum negative pressures were considered for each wall and the roof. The minimum number of required screws was determined and is shown below, as well as detailed in Appendix A.

	Gross Area (sf)	85 mph	135 mph
NORTH WALL	566.2	115.34	173.44
SOUTH WALL	499.3	101.71	152.95
EAST WALL	404.5	82.40	123.91
WEST WALL	404.5	82.40	123.91
ROOF	972.2	277.27	416.64

Table 7: Exterior Screw Requirements



## Structural Test 5: Wall Assembly in Shear

The Sim[PLY] shear wall assembly shown below in Figure 12 was subjected to a lateral racking load. The test followed **ASTM E564-06: Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings**, and was performed on two separate assembly specimens, as recommended by the test standard. A typical section of wall was tested in order to represent the walls in the Indigo Pine home that resist the expected lateral forces. The tested wall section was 8 feet long by 8 feet tall in accordance with ASTM testing standards. The numbers in the figure below represent the points on the wall at which displacements were measured.

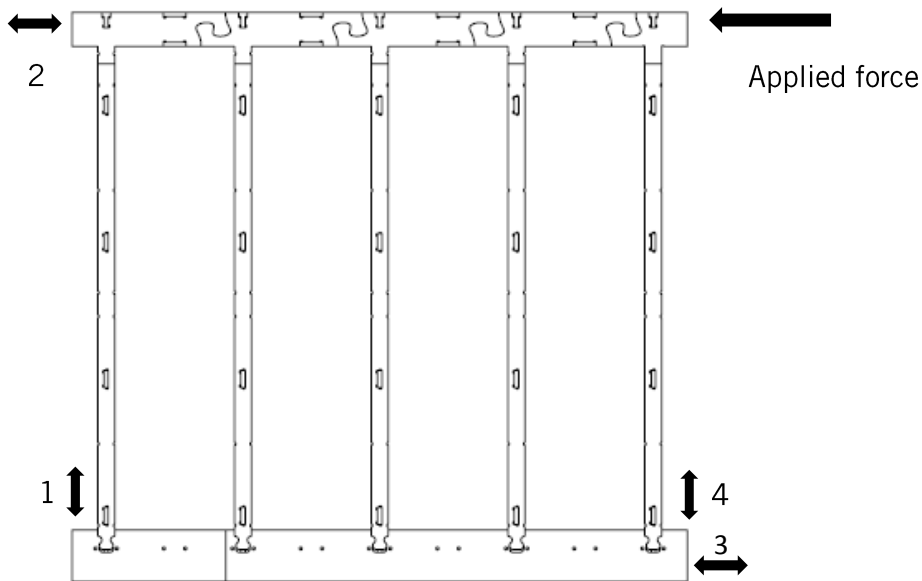


Figure 12: Sim[PLY] Shear Wall Test Assembly





## Structural Test 5 Results: Wall Assembly in Shear

### Wall Setup

The first Sim[PLY] Shear Wall Test using 7-ply Douglas Fir-Larch wood from Plum Creek was performed on Friday, June 26, 2015. The second test of the wall assembly system took place on July 15, 2015. These tests aimed to determine the shear capacity a typical section of the wall assembly. The wall's sheathed dimensions were 8 feet long by 8 feet tall. Figure 13 shows an image of the testing frame itself. Figure 14 shows the setup with the wall assembly loaded into place.



Figure 14: Shear Wall Testing Frame



Figure 13: Wall Loaded into Shear Wall Testing Frame

The wall was anchored to a deep wide-flange member at the base of the setup using (3) L4x4x3/8 angles. These angles bolted through the Sim[PLY] rim joists and into the angle using (2) 5/8" diameter bolts. The angles were then bolted to the frame through a 2x10 base plate using (2) 5/8" diameter bolts. Figure 15 shows the angles that served as the connection between the wall and the base plate.



Figure 15: Angle Connection Wall to Frame

Along with the horizontal hold down angles, vertical hold down systems were employed to assure the wall resisted uplift forces caused by the resolution of the shear forces. In the first shear wall test,  $\frac{3}{4}$ " inch rods were used as the hold down mechanism. Figure 16 shows this connection that acts as a vertical anchor for the wall system. In the second test an alternative hold down was employed. It was a USP HD5A connector, and it bolted through the web of the stud with a backer instead of bearing on the plywood flooring. Figure 17 shows the USP hold down as the vertical anchor for the wall system.



Figure 17:  $\frac{3}{4}$ " Vertical Hold Downs Rods

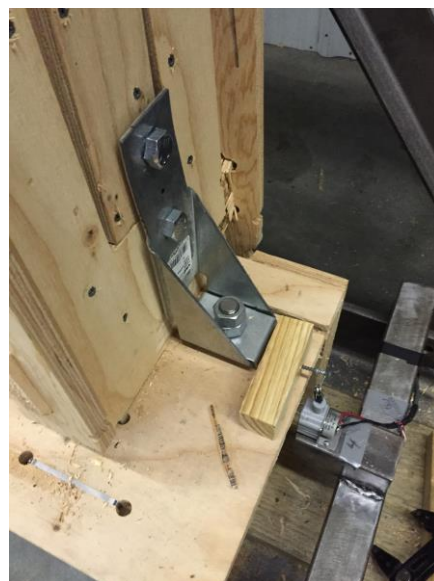


Figure 16: USP HD5A Vertical Hold Down



The wall assembly was secured at the top to a spreader bar. This steel HSS tube served to transfer the applied load to the header of the wall assembly, to which it was connected using three 5/8" threaded rods. Figure 18 shows the entire wall assembly highlighting the HSS spreader bar and its attachment to the wall assembly.



Figure 18: Wall Assembly and HSS Attachment

The wall assembly was constructed using 15/32 Huber ZIP Sheathing on one side. This was in accordance with the exterior sheathing selected for the Indigo Pine house. The attachment pattern utilized a 3 inch spacing on all screws around the perimeter of the sheet and a 6 inch spacing on all "field" screws in the interior of the sheet. This spacing was selected as a conservative attachment pattern in order to maximize the capacity of the sheathing.



## Testing Procedure

Structural Test 5 was conducted using the ASTM E564 Standard for testing wood stud walls in shear. Reasonable adjustments were made to accommodate the differences in the test wall and a typical wood frame wall. The loading procedure for ASTM E564 dictates a specific loading pattern. Table 8 displays the load steps in the loading procedure of the test wall. In addition, a 6-inch maximum displacement stop was put in place in order assure safety of the test frame. Each load increase and decrease was applied at a uniform rate of 400 lbs/min.

Step Number	Load (lbs)	Rate/Duration
1	400	5 min
2	0	5 min
3	1333	5 min
4	0	5 min
5	2667	5 min
6	0	5 min
7	80% Ultimate	--

Table 8: Loading procedure

The displacement characteristics of the test were recorded at four points in the wall system. The horizontal movement was recorded at both the top of the wall at the load application point and the bottom of the wall opposite the load application. In addition the compression of the wall and the uplift were measured on the corners of the wall. Table 9 describes the function of each of the LVDTs and Figure 12 (above) shows their position on the test wall.

LVDT	Function
1	Compression in wall opposite load
2	Racking displacement
3	Sliding of wall apparatus
4	Tension in wall near load

Table 9: LVDT Number and Function



## Test Results and Analysis

### Results

The test results for the shear wall assembly include output of the four LVDTs as well as the actuator force and displacement. After the LVDT voltage outputs were calibrated and corrected to read any displacements resulting from the test setup itself, they were used to create a corrected output for the actual displacement of the wall under load. Load displacement curves were then created to show the response of the shear wall. Figures 19 and 20 shows the curves for actuator displacements and the LVDT displacements of walls 1 and 2 respectively.

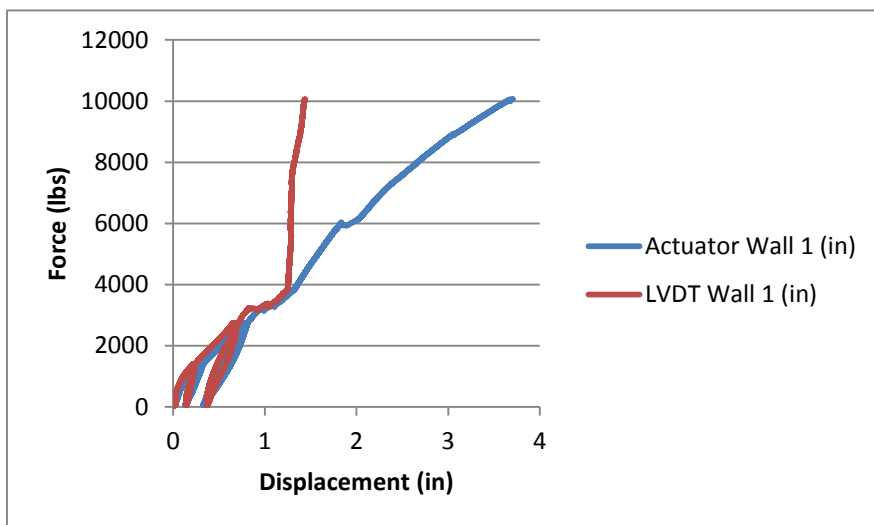


Figure 20: Load Displacement Curve for Wall 1

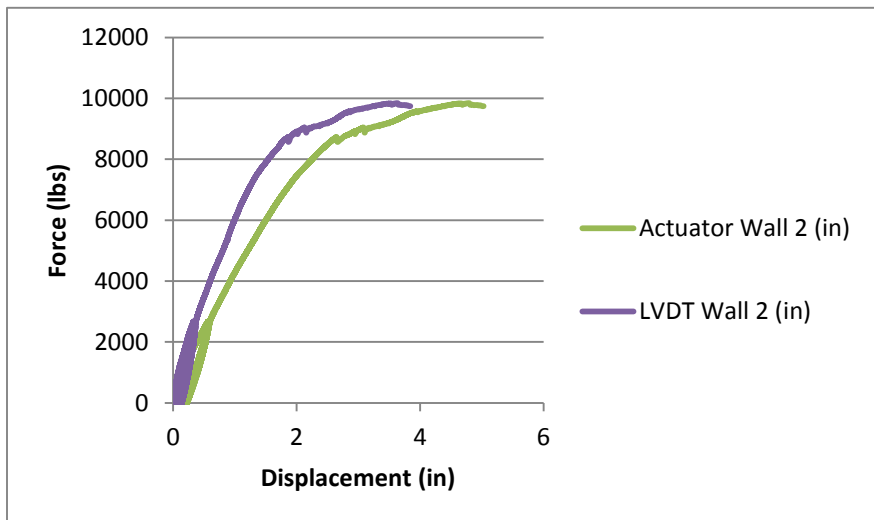
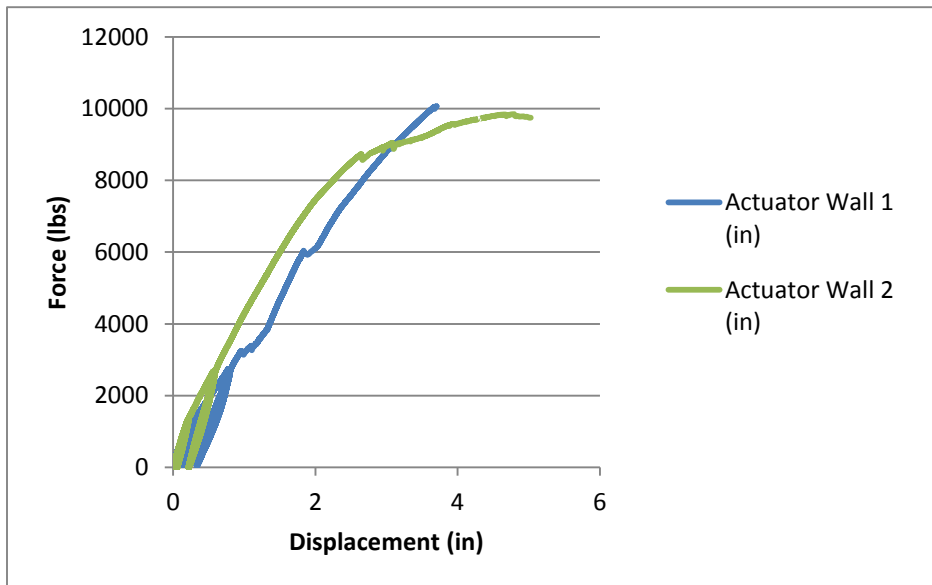


Figure 19: Load Displacement Curve for Wall 2



There are several values to note in the load displacement curves that are shown, the first of which is the ultimate load of the wall assembly. In the case of the first wall, this ultimate value was the maximum value that was allowed by the test frame apparatus. The 10,000 lb limit of the test frame is to assure that no permanent damage is done to either the apparatus or the connectors. It is likely, given the ultimate load for wall assembly 2 of 9,844 lbs (1,230.5 plf), that wall assembly 1 was very close to failure. These values were then adjusted by a conservative safety factor of 1/3 and strength reduction value of 0.8, which are consistent with typical wood-frame testing. Using these reductions, the final factored strength for the walls was 333 plf and 328 plf respectively. These values were then compared with the service level loads calculated using ASCE 7-10.

The second important value for Structural Test 5 is the initial stiffness. A recognized procedure for determining this initial stiffness suggests the load at 0.2 inches of displacement be used as the basis for determining the force per length of wall. This capacity would be compared to the service level loads for Irvine, CA. For wall assembly 1, this load value at 0.2 inches of displacement was 128.3 plf. For wall assembly 2, it was 188 plf. Figure 21 shows a comparison as it represents the actuator displacements of both tests.



**Figure 21:** Load Displacement Curves for Wall Assemblies 1 and 2 (Actuator Displacements)



## Analysis of Failure

The differences in the critical values associated with wall assemblies 1 and 2 are largely due to the difference in hold-down. The failure mode for wall 1 was a combination of excessive lateral displacements and excessive uplift. The eventual pressure at the hold-down resulted in a bearing failure of the sill plate. Figure 22 shows this failure in wall assembly 1. Because the plywood sill failed, larger displacements ultimately occurred up until the point that the 10,000 lb test limit was reached and the test was stopped. Figure 23, on the other hand, shows the failure mode in wall assembly 2. In this case, there was a tensile failure in the outermost stud. This was the stud at which the USP hold-down had been applied. It is apparent that the hold-down solution of wall 2 served to provide a higher stiffness and to concentrate the uplift load into the stud itself. Thus, the initial stiffness for wall 2 was greater and the wall's ultimate failure occurred more suddenly.

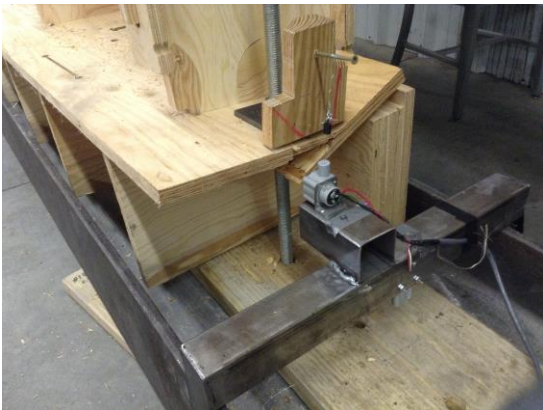


Figure 22: Bearing failure in hold downs of Wall 1

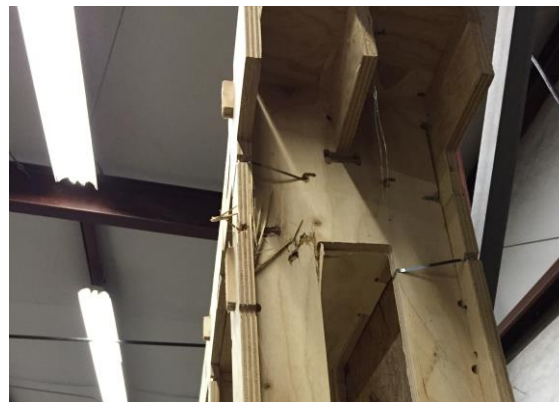


Figure 23: Tensile failure of studs in Wall 2

It is important to understand what the difference in failure modes between the tests actually demonstrates. The observable concentration of uplift force into the studs of wall 2 does not indicate that the studs are suspect in tension, but rather that effective stiffness was achieved and that the studs are rightly doing their part to transfer the shear forces. It is also reasonable to conclude that the larger deflections in wall 1 were due to the insufficient hold-down scenario rather than the sheathing and its screw pattern, which did not change between tests. Thus, the screw pattern for the sheathing was verified as sufficient, while the added stiffness of wall 2 established a preference for a “thru-stud” hold-down solution.

Moving forward, the factored ultimate loads attained through testing were averaged and compared with the minimum required resistance, as calculated in Appendix A. The average factored test strength of



330 plf is greater than the required value of 307 plf, with a margin of 7%. Thus, the Sim[PLY] shear wall passes the strength test.

The service level criterion, characterized by the load at 0.2 inches of displacement, was calculated to be 184 plf. Wall assembly 2 successfully met this deflection criterion, but wall assembly 1 did not. That being said, this failure is an issue of serviceability only. Because the wall is more than sufficient in strength design, it is certain that under a design level earthquake, the wall will not fail. If anything, these results indicate that if hold-downs like those used in wall assembly 1 are used, higher initial deflections and possible damages to non-structural materials could occur (i.e. finishes, veneers). However, using “thru-stud” hold-downs like those used in wall assembly 2 would assure the success of the wall under both strength and serviceability criteria.





## Structural Test 6: Rafter Flexure

The Indigo Pine house utilizes built-up plywood rafters spaced at 2ft on center. The rafters consist of a double-layer plywood web, which is screwed together at pre-defined locations, and single layer plywood flanges. The web contains an offset splice joint in order to accommodate spans greater than 8ft. The longest rafter span is 13ft. The 13ft rafter specimens illustrated in Figure XX below were tested according to the edge-wise flexure test outlined in **ASTM D4761-13 Standard Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Material**. The test was performed on three separate specimens. Safety factors of 0.8 ( $\lambda$ ) and 0.85 ( $\phi_b$ ) were together applied in evaluating the flexural strength of the rafters. These factors are consistent with the factors prescribed by the National Design Specification for Wood Construction (NDS) for flexure in wood-based materials.

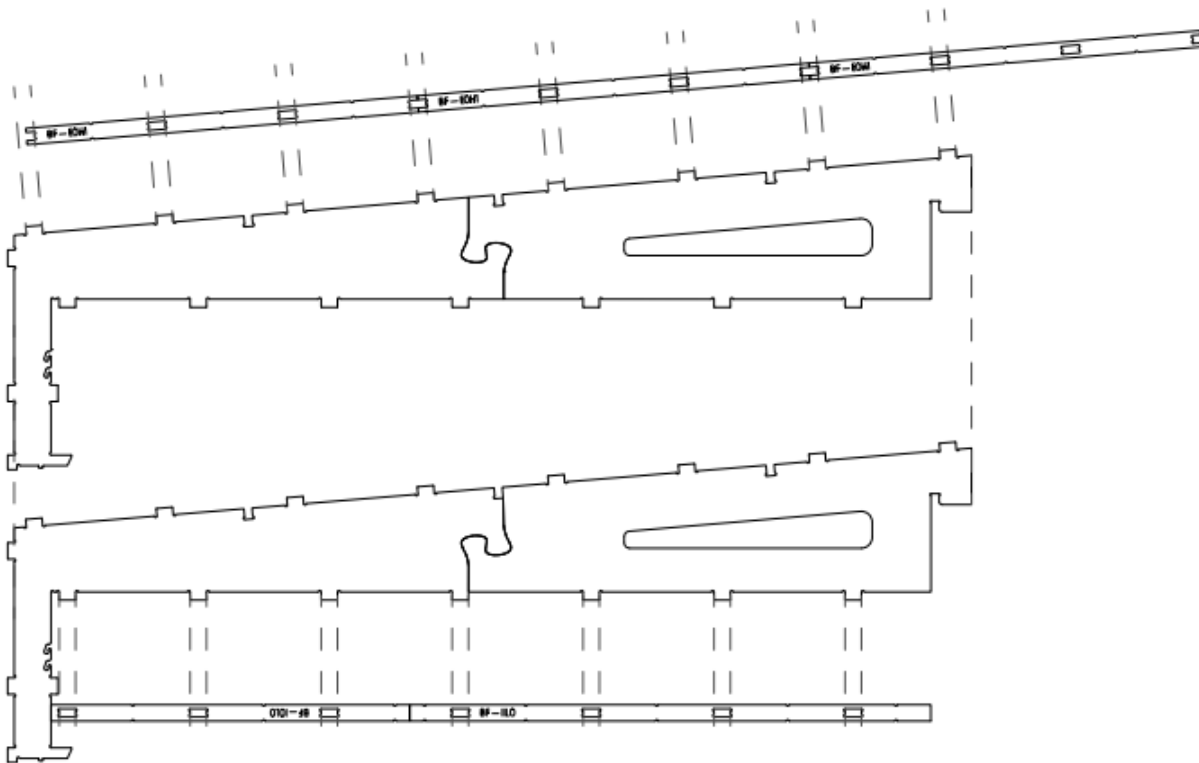


Figure 24: Sim[PLY] Rafter Specimen Components (2 web layers plus top and bottom flanges)



### Structural Test 6 Results: Rafter Flexure

The rafter tests were performed using a self-reacting frame on August 11, 2015. The rafter shown above was slightly modified for ease of testing. The vertical leg, which serves as a sort of cripple stud in the exterior wall, was cut off at the level of the bottom flange. The resulting test specimens then sat level on bearing supports at each end. They were loaded at the third points and braced against out-of-plane buckling at these locations as well. Figure 25 shows the test setup with a rafter in place. Using a hydraulic jack and dial gauge an estimate of the load displacement curve was obtained. This curve served to identify the initial stiffness of the rafter and the ultimate load. Table 10 displays the ultimate loads of each of the three rafter assemblies.

Rafter	Max Force (lbs)	Max Moment (lb-ft)
1	3164	6854
2	2933	6353
3	2810	6087

Table 10: Rafter Test Results



Figure 25: Rafter Test Setup

In each of the tests, rafter failure was primarily concentrated at the splice joint. This failure corresponded with a deflection of approximately 1.75 inches on average. After applying the safety factors, the average tested moment capacity was 4,373 lb-ft, which was more than twice the required moment capacity for the rafter. Figure 26 illustrates the failure mechanism and location, while Figure 27 shows the load displacement curves for the three tests.



Figure 26: Failure in S-joint

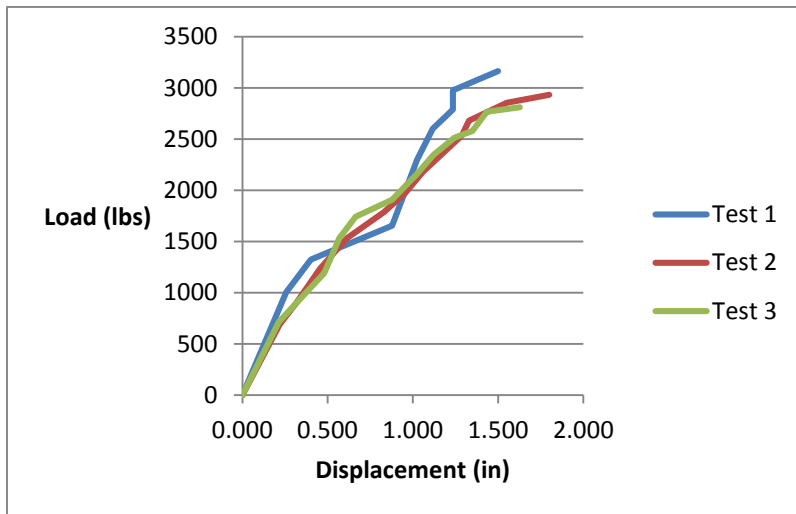


Figure 27: Load Displacement Curves for Rafter Tests

The results of the Structural Test 6 prove that for the given loads and spacing, the rafters have abundant capacity. The relative precision of the test (~12% difference between high max and low max) and the lack of out-of-plane motion validate the testing setup as being effective for isolating the moment capacity of the rafter assembly.



### Additional Analysis: Wall Assembly in Compression

The Indigo Pine wall assembly was originally scheduled to be tested according to the compressive load test outlined in **ASTM E72-14a: Conducting Strength Tests of Panels for Building Construction**. However, adapting the test setup from Structural Test 5 proved infeasible and the compression test was unable to be performed. Instead, the compression capacity of the wall was calculated using the approved compressive strength values for plywood determined by the NDS. The critical section of wall was determined to be the section underneath the box girder. Because the box girder itself carries approximately half of the roof's structural weight, each wall section supporting the ends of the box girder carries approximately 25% of the total roof load. Thus, the total load on each critical section directly below the box girder equates to approximately 3.4 kips of service dead load and 4.9 kips of service live load (see Appendix A), for a total factored load of 11.9 kips. Appendix A also includes the Euler Buckling force calculations for the double web stud cross-sections. These values of 21.0 kips in the strong axis and 6.9 kips in the weak axis represent the ultimate force, per stud, before buckling is likely to occur. With four studs directly supporting the box girder, the ultimate compression capacity well exceeds the maximum expected compression loads in the Indigo Pine house ( $4 \times 6.9 \text{ kips} = 27.8 \text{ kips} \gg 11.9 \text{ kips}$ ).

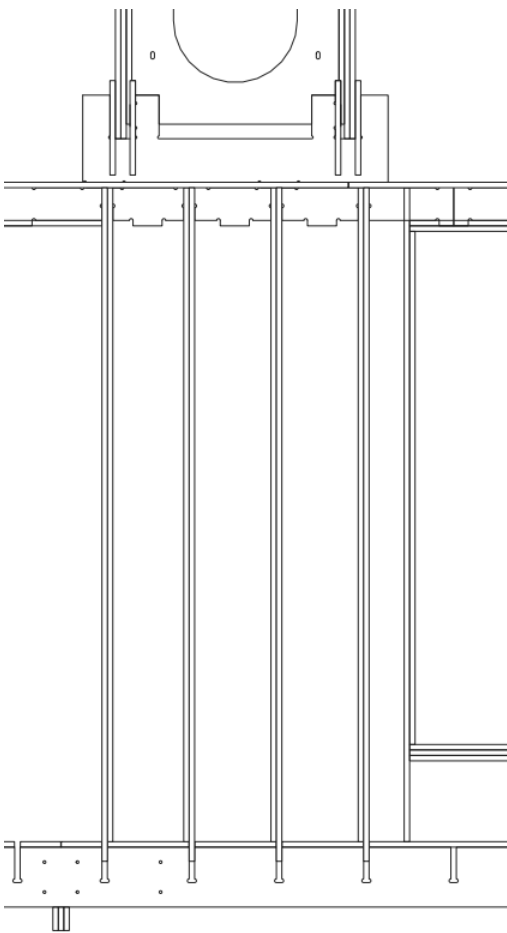


Figure 28: Wall Stud Layout at Box Girder



### Additional Analysis: Porch Framing

The Indigo Pine Porch framing was checked for the dead and live loads per DOE specifications using a structural design program called Enercalc. Appendix A details these calculations as they show 20 psf of applied dead load and 100 psf of applied live load. These calculations inspect three of the key structural members in the porch design: a 4x4 post, a 2x6 girder, and a 2x6 joist. Figure 29 illustrates typical framing for the porch. Douglas-Fir Larch lumber was used in the calculations as a place holder. The maximum stress ratio for each of these members was 0.2194, 0.408, and 0.298 respectively. These ratios show that the wood is abundantly sufficient to take the expected loads. In fact, with the robustness of the porch design, it ultimately will not matter which species of lumber is used, even a 50% reduction in capacity from what is shown here for Douglas-Fir Larch would still yield stress ratios less than 1.0.

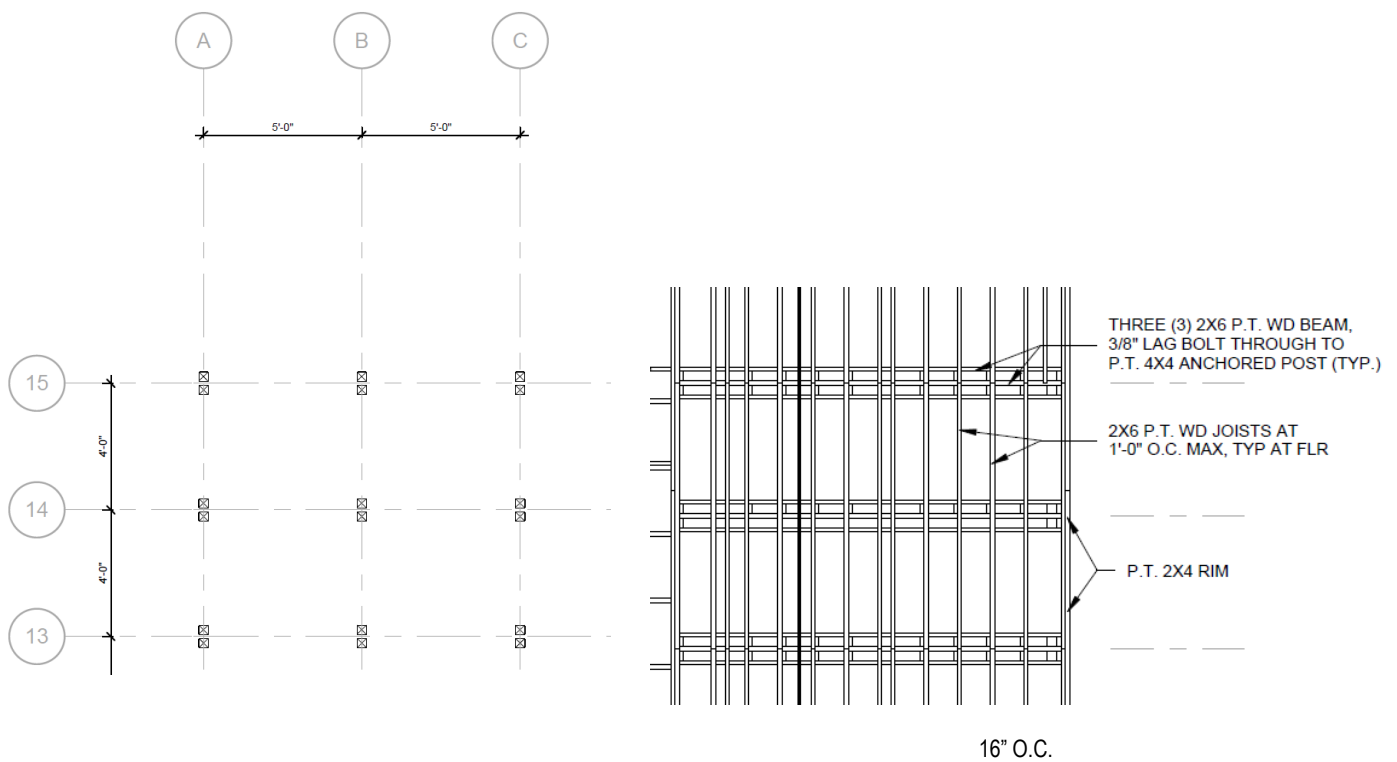


Figure 29: Indigo Pine Porch Framing (column layout on left, beams/girder layout on right)



## Detailed Water Budget

FUNCTION	WATER USE (GALLONS)	CALCULATIONS		NOTES
		GAL	EVENTS	
Hot Water Draws	240	15	16	Maintaining 110 F with a rate of 10 min/draw
Water Vaporization	3.6	0.6	6	Vaporizing 5 lb. of water per event
Dishwasher	16	3.2	5	Assume 3.2 gal. per cycle, maximum
Clothes Washer	96	12	8	Assuming one rinse and wash cycle for a load of 8 towels
Vegetation	100	12.5	8	Estimated
Fire Protection	350	350	1	Filling entire fire hydrant system
Thermal Storage Tanks	0	0	0	Not utilized at this time
Testing	120	120	1	Estimated
Initial Systems Fill	120	120	1	Estimated
Solar Thermal Collectors	0	0	0	Not utilized at this time
Aesthetic Purpose	0	0	0	Not utilized at this time
Radiant Flooring	0	0	0	Not utilized at this time
Safety Factor	313.68	313.68	1	30% of total estimated need
<b>WATER REQUIRED</b>	<b>1359.28</b>	gallons		

The water for the fire sprinkler system is stored in the Talco hydrant system located on the east side of the house. 350 gallons of water are used to fill the whole hydrant system so that it can handle three sprinklers utilizing 13 GPM and operating for 9 minutes, which is compliant with NFPA 13d.

Fresh water is stored in a 1065 gallon tank located on the northeast corner of the house. A Grundfos 1 hp pump is used to pump the fresh water into the manifold located next to the water heater inside the house. The pressure boosting pump and the storage tank would not be necessary if the house was connected to the city water system.

Saniflo Sanicubic 1 macerating system located on the north side of the house collects the sewage water and pumps it to a 535 gallon sewage water tank located on the northeast corner. It should be noted that the macerating unit is temporary for the competition purpose as in general usage the sewage outlet of the house will be connected to city's sewer line.

All the tanks used are located away from finished area of the house and are appropriately enclosed to stay shaded throughout the day.

The detailed sprinkler system calculations are provided in Appendix B: Sprinkler System Calculations.



## Summary of Unlisted Electrical Components

All electrical components carry an approved testing agency's listing per section 6-7 of the SD2015 Building Code.



## Summary of Reconfigurable Features

Section not used at this time.





## Interconnection Application Form

Team Clemson, Lot 106

Team Name and Lot Number

### PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
Solarworld	34 Solarworld 285W Sunmodule monocrystalline panels. 5 panels for DC water heater and 29 for generation of AC power. 10 panels on porch and 24 panels on roof.	9.7kW at STC

Total DC power of all arrays is 10.4 kW (in tenths)

### INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
Enphase	M250 Microinverter	208 – 240 VAC	.24 kW	29

Total AC power of all inverters is 8.16 kVA or kW (in whole numbers)

### REQUIRED INFORMATION

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

	Location
One-Line Electrical Schematic	A1/E-101
Calculations of service/feeder net computed load and neutral load (NEC 220)	E-301
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	B3/E-113 A1/G-105

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



## Quantity Takeoff of Competition Prototype House

Spec. Number	Brief Description	Detailed Description	Qty	Units
<b>Division 03 Concrete</b>				
03 21 00	Reinforcement Bars	#4 Steel Reinforcing Bars, 10' Length	33	Ea
03 21 00	Reinforcement Bars	#6 Steel Reinforcing Bars, 10' Length	36	Ea
03 21 00	Reinforcement Bars	7-1/2" Rebar Tie	2	Ea (100)
03 71 00	Mass Concrete for Raft Foundations	5000 lb PSI Early Strength Concrete Mix	60	Ea(80lb)
<b>Division 04 Masonry</b>				
04 22 00	Concrete Masonry Unit	8"x8"x16" Standard Concrete Block	440.0	Ea
04 22 00	Concrete Masonry Unit	8"x8"x16" Knockout Concrete Block	140.0	Ea
04 22 00	Concrete Masonry Unit	8"x2"x16" Solid Cap Concrete Block	400.0	Ea
<b>Division 05 Metals</b>				
05 05 23	Metal Fastenings	#8 x 1-1/4" Flat-Head Ceramic Screws, Star-Drive	150.0	Box (75)
05 05 23	Metal Fastenings	#8 x 1-1/4" Flat-Head Multi-Material Screw, Star-Drive, Yellow Zinc	40.0	Box (240)
05 05 23	Metal Fastenings	#8 1-5/8" Countersinking-Head Deck Screw, Star-Drive	8.0	Ea (5 lb)
05 05 23	Metal Fastenings	1-1/2" Galvanized Screw with Neoprene Gasket	10.0	Box (250)
05 05 23	Metal Fastenings	3/16" Aluminum Pop Rivets, 1/8" - 1/4" Grip Range, Yellow	8.0	Box (500)
05 05 23	Metal Fastenings	3/16" Aluminum Pop Rivets, 3/8" - 1/2" Grip Range, Yellow	4.0	Box (500)
05 05 23	Metal Fastenings	27" 150 lb Stainless Steel Cable Ties	27.0	Box (100)
05 05 23	Metal Fastenings	1/2"x3" Hex Head Bolt, Zinc, Low Carbon	86.0	Ea
05 05 23	Metal Fastenings	1/2"x4" Hex Head Bolt, Zinc, Low Carbon	150.0	Ea
05 05 23	Metal Fastenings	5/8"x3" Hex Head Bolt, Zinc, Low Carbon	45.0	Ea
05 05 23	Metal Fastenings	5/8"x3-1/2" Hex Head Bolt, Zinc, Low Carbon	52.0	Ea
05 05 23	Metal Fastenings	1/2" #13 Hex Nut, Zinc	450.0	Ea
05 05 23	Metal Fastenings	5/8" #11 Hex Nut, Zinc	125.0	Ea
05 05 23	Metal Fastenings	1/2"x1-3/8" Flat Washer, Zinc	700.0	Ea
05 05 23	Metal Fastenings	5/8"x1-3/4" Flat Washer, Zinc	175.0	Ea
05 05 23	Metal Fastenings	3/8"x1-1/2" Flat Washer, Zinc	200.0	Ea
05 05 23	Metal Fastenings	3/8" Heavy Duty Staples	3.0	Box (1250)
05 05 23	Metal Fastenings	3/4" Plastic Staples for Non-Metallic Cable, White	5.0	Box (175)
05 05 23	Metal Fastenings	1/2" Heavy Duty Staples	4.0	Box (5,000)
05 05 23	Metal Fastenings	3/8"x8" Threaded Rod	150.0	Ea
05 45 16	Electrical Metal Supports	Photovoltaic Roof Mount Bracket w/ PVC Foam Insert, 26 Ga.	130.0	Ea
05 45 16	Electrical Metal Supports	Photovoltaic Roof Mount Top Rail, 20' Lengths	7.0	Ea
05 45 16	Electrical Metal Supports	Photovoltaic Roof Mount Bottom Rail, 20' Lengths	7.0	Ea
05 45 16	Electrical Metal Supports	Photovoltaic Roof Mount Rail Splice Assembly	6.0	Ea
05 45 16	Electrical Metal Supports	Photovoltaic Roof Mount Mid Clamp, Grounding, 30-39 mm	55.0	Ea
05 45 16	Electrical Metal Supports	Photovoltaic Roof Mount End Clamp, Grounding, 33 mm	35.0	Ea
05 45 16	Electrical Metal Supports	Photovoltaic Roof Mount Micro Inverter Mounding Hardware	26.0	Ea
05 51 36.16	Metal Ramps	Aluminum Flush Modular Ramp Assembly	14.0	LF
<b>Division 06 Wood, Plastics, and Composites</b>				
06 09 00	Wood and Plastic Fastenings	4" x 4" Adjustable Post Bottom / Base	150.0	Ea
06 10 00	Rough Carpentry	4' x 8' BC 23/32"; Structural Grade Plywood	354.0	Ea
06 11 00	Wood Framing	2"x4"x16' Exterior Grade Dimensional Lumber	100.0	Ea
06 11 00	Wood Framing	2"x6"x12' Exterior Grade Dimensional Lumber	400.0	Ea
06 11 00	Wood Framing	2"x6"x16' Exterior Grade Dimensional Lumber	140.0	Ea
06 11 00	Wood Framing	2"x8"x12' Exterior Grade Dimensional Lumber	20.0	Ea
06 11 00	Wood Framing	2"x8"x16' Exterior Grade Dimensional Lumber	20.0	Ea



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Spec. Number	Brief Description	Detailed Description	Qty	Units
06 11 00	Wood Framing	4"x4"x12' Exterior Grade Dimensional Lumber	50.0	Ea
06 16 23.10	Subflooring	4'x8' 23/32" Oriented-Strand-Board Combo. Subfloor-Underlayment Sheathing	33.0	Ea
06 16 53	Moisture-Resistant Sheathing Board	4'x8' 7/16" Oriented-Strand-Board Wall Sheathing w/ Weather-Resistive Barrier	102.0	Ea
06 16 53	Moisture-Resistant Sheathing Board	4'x8' 5/8" Oriented-Strand-Board Roof Sheathing w/ Weather-Resistive Barrier	33.0	Ea
06 16 53	Moisture-Resistant Sheathing Board	3-3/4" Sheathing Joint Sealant Tape	19.0	Roll (90')
06 41 00	Architectural Wood Casework	4' x 8' B-2 3/4"; AA Birch Veneer Plywood	6.0	Ea
06 41 00	Architectural Wood Casework	4' x 8' B-2 1/2" AA Birch Veneer Plywood	149.0	Ea
06 41 00	Architectural Wood Casework	4' x 8' B-2 5/8" AA Birch Veneer Plywood	5.0	Ea
06 74 13	Fiberglass Reinforced Gratings	1-1/2"x1-1/2" Molded Grating,4'x12' Panel, Concave Surface, Yellow	6.0	Ea
06 74 13	Fiberglass Reinforced Gratings	1-1/2"x1-1/2" Molded Grating,4'x8' Panel, Concave Surface, Light Grey	6.0	Ea
<b>Division 07 Thermal and Moisture Protection</b>				
07 13 00	Sheet Waterproofing	Polyethylene Plastic Sheeting: 15 mil visqueen film; clear	1.0	Roll (140')
07 13 00	Sheet Waterproofing	4" Polyethylene Film Barrier Tape, Rubber-based Adhesive	1.0	Roll (180')
07 13 13	Felt Roofing Underlayment	30# Asphalt Saturated Organic Felt Paper	11.0	Ea
07 21 00	Thermal Insulation	Cellulose Batt Insulation	480.0	Batts
07 41 13	Aluminum Roof Panels	3'-0" x 10'-0" 26 Ga. Metal Roof Panel, PBR Profile	90.0	Ea
07 46 16	Aluminum Siding	4mm Aluminum Composite Material; Polyethelyne Core; White	78.0	Ea
07 92 21	Caulking & Sealant Options	3" Window Flashing Tape	5.0	Ea
07 71 43	Drip Edge	5" x 6" x 126" Steel Gable Trim	13.0	Ea
07 92 00	Joint Sealants	Window and Door Insulating Foam Sealant; Low Expanding	12.0	Ea
07 92 21	Caulking & Sealant Options	Silicone Sealant and Adhesive, White	24.0	Ea
07 92 21	Caulking & Sealant Options	3/8" Single Bead Butyl Tape Sealant, 50' Lengths	26.0	Ea
07 92 21	Caulking & Sealant Options	NP1 Polyurethane Sealant, White	8.0	Ea
<b>Division 08 Openings</b>				
08 14 23	Out-Swing Entry Doors	3'-0" x 6'-8" Hinged Patio Door, White	3.0	Ea
08 53 13	Vinyl Double-Hung Windows	3'-0" x 4'-0" Vinyl Window	3.0	Ea
08 53 13	Vinyl Double-Hung Windows	3'-0" x 6'-0" Vinyl Window	7.0	Ea
08 53 13	Vinyl Double-Hung Windows	1-1/4"x7-3/4" Wood Shims	4.0	Ea
08 71 00	Door Hardware	Cylindrical 1/2" dia, 1/2" length Industrial Strength Magnets	34.0	Ea
08 71 00	Door Hardware	Wave Style Lever Entry Door Lock, Satin Nickel	5.0	Ea
08 71 00	Door Hardware	Single Cylinder Deadbolt, Satin Nickel	3.0	Ea
08 71 00	Door Hardware	Above Door Track, Aluminum, 12'	2.0	Ea
08 71 00	Door Hardware	Above Door Track, Aluminum, 5'	2.0	Ea
08 71 00	Door Hardware	Floor Guide Track	4.0	Ea
08 71 00	Door Hardware	Track Stop	8.0	Ea
08 71 00	Door Hardware	Bottom Door Guide	8.0	Ea
08 71 00	Door Hardware	Side Mount Hanger	4.0	Ea
08 71 00	Door Hardware	Mounting Screws	2.0	Ea
<b>Division 09 Finishes</b>				
09 54 26	Suspended Wood Ceilings & Fasteners	4' x 8' BC 3/4"; AA Birch Veneer Plywood	48.0	Ea
09 60 00	Flooring	7" x 48" x 8mm Vinyl Floor Planks	29.0	Box (39 sqf)
09 65 13	Resilient Base and Accessories	2.5" x .125" x 4' Rubber Wall Base Molding; Black	30.0	Ea
09 65 13	Resilient Base and Accessories	Wall and Cove Base Adhesive	2.0	Ea (30 oz.)
09 72 00	Wall Coverings	4' Wide Smooth Textured Vinyl Coated Fiberglass Shoji Paper	50.0	LF
09 72 00	Wall Coverings	Polyester Laminating Resin, Bond Coat	2.0	Gal
09 72 00	Wall Coverings	Liquid Catalyst	1.0	Ea
09 74 13	Wood Wall Covering & Fastening	4'x8' AC 1/2" Pine Plywood; Sanded	34.0	Ea



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Spec. Number	Brief Description	Detailed Description	Qty	Units
09 91 13	Exterior Painting	Exterior Acrylic Solid Color House Stain	10.0	Ea
09 91 23	Interior Painting	Interior Acrylic Latex Paint, VOC Free, Semi-Gloss; Extra White	6.0	Ea
09 91 23	Interior Painting	Interior Semi-Transparent Stain , VOC Free; White	2.0	Ea
09 91 23	Interior Painting	Interior Semi-Transparent Stain , VOC Free; Natural	5.0	Ea
<b>Division 11 Equipment</b>				
11 11 36	Vehicle Charging Equipment	EV Charging Station, 30A, 25' Cord	1.0	Ea
11 30 13.13	Residential Kitchen Appliances	Residential Microwave, Stainless Steel	1.0	Ea
11 30 13.13	Residential Kitchen Appliances	Residential Oven / Range, Stainless Steel	1.0	Ea
11 30 13.13	Residential Kitchen Appliances	Residential Refrigerator / Freezer, Stainless Steel	1.0	Ea
11 30 13.13	Residential Kitchen Appliances	Residential ADA Accessible Dishwasher, Stainless Steel	1.0	Ea
11 30 13.23	Residential Laundry Appliances	Residential Washer, White	1.0	Ea
11 30 13.23	Residential Laundry Appliances	Residential Dryer, White	1.0	Ea
11 30 34	Residential Ceiling Fan	52" Ceiling Fan w/ LED Light Kit; Exterior Rated; White	3.0	Ea
<b>Division 12 Furnishings</b>				
12 32 23.35	Casework Hardware	Invisible Door Hinges, satin chrome	9.0	Ea
12 32 23.35	Casework Hardware	Concealed Cabinet Hinges, 100 degree	74.0	Ea
12 32 23.35	Casework Hardware	Cabinet Door Hinge Mounting Brackets	74.0	Ea
12 32 23.35	Casework Hardware	9" Concealed Drawer Runner Set	2.0	Ea
12 32 23.35	Casework Hardware	12" Concealed Drawer Runner Set	6.0	Ea
12 32 23.35	Casework Hardware	15" Concealed Drawer Runner Set	3.0	Ea
12 32 23.35	Casework Hardware	18" Concealed Drawer Runner Set	5.0	Ea
12 32 23.35	Casework Hardware	21" Concealed Drawer Runner Set	11.0	Ea
12 32 23.35	Casework Hardware	21" Heavy Duty Concealed Drawer Runner Set	1.0	Ea
12 32 23.35	Casework Hardware	Drawer Side-to-Side Locking Device, Left	28.0	Ea
12 32 23.35	Casework Hardware	Drawer Side-to-Side Locking Device, Right	28.0	Ea
12 32 23.35	Casework Hardware	Cabinet Door Clower Wing Plate; Soft Close	37.0	Ea
12 32 23.35	Casework Hardware	Metal Support Pin	200.0	Ea
12 32 23.35	Casework Hardware	Cabinet Door Push-In Fittings	74.0	Ea
12 32 23.35	Casework Hardware	Reversible Flap Stays	6.0	Ea
12 36 61.16	Solid Surface Countertops	24" Solid Surface Countertops w/ 4" Backsplash; White	40.0	SQF
<b>Division 21 Fire Suppression</b>				
21 13 13	Wet-Pipe Sprinkler Systems	Concealed Pendant Fire Sprinkler Head, Brass	10.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	Concealed Cover Plate; White	10.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/4" CPVC Sprinkler Pipe SDR	105.0	LF
21 13 13	Wet-Pipe Sprinkler Systems	3/4" Sch 40 CPVC 90 ELL, Slip x Slip	20.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	1-1/4" x 3/4" Sch 40 CPVC Bushing	1.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/4" Sch 40 CPVC Tee, Slip x Slip	10.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/4" Sch 40 CPVC Union	1.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/4" Sch 40 CPVC Adapter	1.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/4" x 4" Steel Nipple; Black	2.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/4" Offset CPVC Hanger	25.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/4" Hanger Rings	15.0	Ea
21 13 13	Wet-Pipe Sprinkler Systems	3/8" All Threaded Rod	30.0	LF
21 13 13	Wet-Pipe Sprinkler Systems	Home Hydrant System w/ 1.5 HP Electric Motor	1.0	Ea
<b>Division 22 Plumbing</b>				



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Spec. Number	Brief Description	Detailed Description	Qty	Units
22 07 00	Plumbing Insulation	1/2" Foam Plumbing Tubular Pipe Insulation, 6' Length	7.0	Ea
22 11 16	Domestic Water Piping	14 Port Compression MANABLOC Package, NPT Supply	1.0	Ea
22 11 16	Domestic Water Piping	1-1/2" Schedule 40 CPVC Pipe, .154 Wall	40.0	LF
22 11 16	Domestic Water Piping	2" Schedule 40 CPVC Pipe, .154 Wall	20.0	LF
22 11 16	Domestic Water Piping	3/4" White PEX Pipe, 50' Length	1.0	Ea
22 11 16	Domestic Water Piping	1/2" Red PEX Pipe, 100' Length	2.0	LF
22 11 16	Domestic Water Piping	1/2" Blue PEX Pipe, 100' Length	2.0	LF
22 11 16	Domestic Water Piping	1-1/2" CPVC CTS 90 Degree Elbow	5.0	Ea
22 11 16	Domestic Water Piping	1/2" Brass 90-Degree Push-fit x FNPT Elbow Female	10.0	Ea
22 11 16	Domestic Water Piping	1/2" Brass 90-Degree Push-fit x MNPT Elbow Male	10.0	Ea
22 11 16	Domestic Water Piping	3/4" Brass 90-Degree Push-fit Elbow	4.0	Ea
22 11 16	Domestic Water Piping	3/4" Male NPTx MANABLOC Supply Adapter (Zero Lead)	2.0	Ea
22 11 16	Domestic Water Piping	1/2" Brass Push-Fit x MNPT Adapter (male)	10.0	Ea
22 11 16	Domestic Water Piping	1/2" Brass Push-Fit x FNPT Adapter (female)	10.0	Ea
22 11 16	Domestic Water Piping	1-1/2" x 1-1/2" x 1" CPVC CTS Reducer Tee	3.0	Ea
22 11 16	Domestic Water Piping	1/2" - 1/2" Dia PEX Rite Plastic Holdrite Bracket	30.0	Ea
22 11 16	Domestic Water Piping	1/2" - 1" Dia PEX Rite Galvanized Holdrite Bracket	10.0	Ea
22 11 16	Domestic Water Piping	3/4" Metal Pipe Support	45.0	Ea
22 11 16	Domestic Water Piping	1/2" Metal Pipe Support	30.0	Ea
22 11 16	Domestic Water Piping	1/2"x 3/8" Brass Multi-Turn Angle Valve with 12" Riser	1.0	Ea
22 11 16	Domestic Water Piping	3/4" Brass Push-Fit Ball Valve	1.0	Ea
22 11 16	Domestic Water Piping	1/2" x 3/8" Brass 90-Degree Push-fit x MNPT Dishwasher Elbow	1.0	Ea
22 11 16	Domestic Water Piping	1/2" Brass 90-Degree Push-fit x FNPT Drop-Ear Elbow	2.0	Ea
22 11 16	Domestic Water Piping	Rite Temp 1/2" pressure balancing valve	1.0	Ea
22 11 16	Domestic Water Piping	Clearflo Cable Bath Drain with PVC tubing, Polished Chrome	1.0	Ea
23 11 16	Domestic Water Piping	1/2" Female Brass Hose Bibb	2.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2" dia., 330 PSI, Sch. 40 PVC DWV Pipe, 10' Length	3.0	Ea
22 13 00	Facility Sanitary Sewage	2" dia., 280 PSI, Sch. 40 PVC DWV Pipe, 10' Length	2.0	Ea
22 13 00	Facility Sanitary Sewage	4" dia., Sch. 40 PVC DWV Pipe, 10' Length	6.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2" Dia. PVC P-Trap Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2" Dia. PVC P-Trap Fitting w/ Drain Plug	2.0	Ea
22 13 00	Facility Sanitary Sewage	2" Dia. PVC P-Trap Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2" Dia 90-Degree PVC Sch. 40 Slip Elbow	2.0	Ea
22 13 00	Facility Sanitary Sewage	2" Dia 90-Degree PVC Sch. 40 Slip Elbow	8.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2" Dia 90-Degree PVC Elbow Long Sweep Fitting	2.0	Ea
22 13 00	Facility Sanitary Sewage	2" Dia 90-Degree PVC Elbow Long Sweep Fitting	4.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia 90-Degree PVC Elbow Long Sweep Fitting	2.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia 90-Degree PVC Elbow Fitting	3.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia 45-Degree PVC Street Elbow Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	2"x2"x1-1/2" Dia PVC Sanitary Tee Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	4"x4"x2" Dia PVC Sanitary Tee Fitting	3.0	Ea
22 13 00	Facility Sanitary Sewage	4"x4"x4" Dia PVC Sanitary Tee Fitting	3.0	Ea
22 13 00	Facility Sanitary Sewage	2"x2"x2"x2" Dia PVC Double Sanitary Tee Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	2"x2"x1-1/2"x1-1/2" Dia PVC Double Sanitary Tee Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	4"x4"x4" 45-Degree PVC Combo Wye Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	4"x4"x2" 45-Degree PVC DWV Hub x Hub x Hub Wye Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	4"x4"x4" Dia PVC Wye Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2"x2" Dia PVC Adapter Coupling Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	11" to 16" Plastic Assembly, Continuous Waste Outlet w/ Branch Tailpiece	1.0	Ea
22 13 00	Facility Sanitary Sewage	12" Plastic Sink Tailpiece	2.0	Ea



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Spec. Number	Brief Description	Detailed Description	Qty	Units
22 13 00	Facility Sanitary Sewage	1/2" Washing Machine Outlet Box	1.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2" Foot Lock w/ Plastic Pipe, Chrome	1.0	Ea
22 13 00	Facility Sanitary Sewage	Perfect Seal Toilet Wax Ring	1.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia PVC Pipe Flange	1.0	Ea
22 13 00	Facility Sanitary Sewage	1-1/2" Dia, Sch 40 PVC Pipe Cap	1.0	Ea
22 13 00	Facility Sanitary Sewage	2" Dia, Sch 40 PVC Pipe Cap	2.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia, Sch 40 PVC Pipe Cap	5.0	Ea
22 13 00	Facility Sanitary Sewage	2"x4" Dia PVC Adapter Coupling Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	2" Dia PVC Coupling Fitting	2.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia PVC Coupling Fitting	3.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia PVC Cleanout Adapter Fitting	1.0	Ea
22 13 00	Facility Sanitary Sewage	4" Dia PVC Cleanout Plug Fitting	1.0	Ea
22 33 00	Electric Domestic Water Heaters	50 Gal. Solar Water Heating System	1.0	Ea
22 41 00	Residential Plumbing Fixtures	Bath and Shower Trim Set, Polished Chrome	1.0	Ea
22 41 00	Residential Plumbing Fixtures	Pull-Down Kitchen Faucet	1.0	Ea
22 41 00	Residential Plumbing Fixtures	Bathroom Faucet, Polished Chrome	2.0	Ea
22 41 16.13	Residential Lavatories	Drop-In Bathroom Sink, White	2.0	Ea
22 41 16.16	Residential Sink	33"x22" Top mount Kitchen Sink, White	1.0	Ea
22 41 16.16	Residential Sink	Kitchen Sink Strainer, Polished Chrome	2.0	Ea
22 41 19.10	Residential Bath Tubs	60"x30" Alcove Bath, Right Hand, White	1.0	Ea
22 41 19.10	Residential Bath Tubs	32"x72" Bath Wall Panel, White	2.0	ea.
22 41 19.10	Residential Bath Tubs	60"x72" Bath Wall Panel, White	1.0	ea.
22 41 13.40	Water Closets	Classic Toilet, White	1.0	Ea
22 41 13.40	Water Closets	Toilet Seat, Quick Release, White	1.0	Ea
<b>Division 23 HVAC</b>				
23 07 13	Duct Insulation	4'x10'x1" Quiet R Duct Board	12.0	Ea
23 07 13	Duct Insulation	Adhesive Tape for Duct Board	4.0	Ea
23 09 13	Instrumentation & Control Devices for HVAC	Navigation Remote Controller	1.0	Ea
23 09 13	Instrumentation & Control Devices for HVAC	Control cables for duct dampers (3 cables of length 19', 24', 38')	3.0	Ea
23 31 13	Metal Ducts and Casings	4mm Aluminum Composite Material; Polyethylene Core; White	5.0	Ea
23 31 13	Metal Ducts and Casings	Perforated Metal Hanging Straps	2.0	Ea
23 31 13	Metal Ducts and Casings	Silver Foil Tape, 2.5"	5.0	Ea
23 33 43	Flexible Connectors	6" dia flexible duct	15.0	LF
23 37 13	Diffusers, Registers, and Grilles	10"x 4-6" Universal Register Box with Flange	6.0	Ea
23 37 13	Diffusers, Registers, and Grilles	6" wall-mounted aluminum wall vents	2.0	Ea
23 72 00	Air-to-air Energy Recovery Equipment	Heat Recovery Ventilator	1.0	Ea
23 81 26	Split-System Air-Conditioners	1.5 Ton DC Mini Split, Ducted System	1.0	Ea
<b>Division 25 Integrated Automation</b>				
25 36 13	Integrated Automation Power Meters	Multi-Feed Power and Energy Metering System	1.0	Ea
25 36 16	Integrated Automation Sensors and Transmitters	Digital Temperature Sensor	5.0	Ea
25 36 16	Integrated Automation Sensors and Transmitters	Humidity Sensor	5.0	Ea
25 36 16	Integrated Automation Sensors and Transmitters	Light level Sensor	5.0	Ea
25 36 16	Integrated Automation Sensors and Transmitters	Infra-red Motion Detection Sensors	5.0	Ea
<b>Division 26 Electrical</b>				
26 05 19	Low-Voltage Power Connectors and Conductors	2/0 AWG Stranded Black Copper THHN Wire	50.0	LF
26 05 19	Low-Voltage Power Connectors and Conductors	6 AWG THHN Wire, Green	51.0	LF
26 05 19	Low-Voltage Power Connectors and Conductors	8/4 SOOW Cord, Black	1.0	Roll (1C



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Spec. Number	Brief Description	Detailed Description	Qty	Units
26 05 19	Low-Voltage Power Connectors and Conductors	10/4 SJE00W 30A Neoprene Bulk Wire, Black	2.0	Roll (50')
26 05 19	Low-Voltage Power Connectors and Conductors	12/3 Indoor Non-Metallic Wire	2.0	Roll (250')
26 05 19	Low-Voltage Power Connectors and Conductors	12/4 Indoor Non-Metallic Jacket Wire	400.0	LF
26 05 19	Low-Voltage Power Connectors and Conductors	14/3 Indoor Non-Metallic Wire	4.0	Roll (250')
26 05 19	Low-Voltage Power Connectors and Conductors	Wire Lug Nuts	30.0	Ea
26 05 19	Low-Voltage Power Connectors and Conductors	Bulk Portrait Trunk Cable	6.0	Ea
26 05 19	Low-Voltage Power Connectors and Conductors	6/3 with ground	10.0	LF
26 05 19	Low-Voltage Power Connectors and Conductors	6/3 with ground	40.0	LF
26 05 19	Low-Voltage Power Connectors and Conductors	3/4" NM/SE Connector	1.0	Ea
26 05 19	Low-Voltage Power Connectors and Conductors	18AWG wire	2,000.0	LF
26 05 33	Raceway and Boxes for Electrical Systems	3/4" Sch 40 PVC Conduit	80.0	LF
26 05 33	Raceway and Boxes for Electrical Systems	1-1/2" Sch 40 PVC Conduit	30.0	LF
26 05 33	Raceway and Boxes for Electrical Systems	3/4" Sch 40 PVC Pull Boxes; 90 deg Bend	4.0	Ea
26 05 33	Raceway and Boxes for Electrical Systems	3/4" Sch 40 PVC 90 deg Bend	6.0	Ea
26 05 33	Raceway and Boxes for Electrical Systems	3/4" Sch 40 PVC Coupling	10.0	Ea
26 05 33	Raceway and Boxes for Electrical Systems	3/4" Sch 40 PVC Junction Box w Lock-nut	5.0	Ea
26 05 33	Raceway and Boxes for Electrical Systems	1-1/2" Sch 40 PVC Pull Boxes; 90 deg Bend	2.0	Ea
26 05 33	Raceway and Boxes for Electrical Systems	1-1/2" Sch 40 PVC Junction Box w Lock-nut	4.0	Ea
26 24 16	Panel boards	40 Circuit, 40 Space, 200A Main Breaker Load Center	1.0	Ea
26 24 16	Panel boards	Load Center Ground Bar Kit	1.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	60A, Non-Automatic AC Disconnect	1.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	15A, 1" Single-Pole AFCI Circuit Breaker	12.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	20A, 1" Single-Pole AFCI Circuit Breaker	3.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	20A, 1" Single-Pole GFCI Circuit Breaker	5.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	30A, 1" Single-Pole Circuit Breaker	1.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	15A, 2" Double-Pole Circuit Breaker	3.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	20A, 2" Double-Pole Circuit Breaker	9.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	30A, 2" Double-Pole Circuit Breaker	2.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	40A, 2" Double-Pole Circuit Breaker	5.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	60A, 600V DC Switch	1.0	Ea
26 28 16	Enclosed Switches and Circuit Breakers	60A, 240V AC Switch	7.0	Ea
26 27 26	Wiring Devices	20A, 125V AFCI Receptacle, White	4.0	Ea
26 27 26	Wiring Devices	20A, 125V GFCI Receptacle, White	10.0	Ea
26 27 26	Wiring Devices	20A, 125V Duplex Receptacle, White	18.0	Ea
26 27 26	Wiring Devices	Receptacle Box	32.0	Ea
26 27 26	Wiring Devices	Receptacle Box Extensions	16.0	Ea
26 31 00	Photovoltaic Collectors	Sunmodule Plus 285W Solar Panels	34.0	Ea
26 51 13	Interior Lighting Fixtures, Lamps and Ballasts	T8 Instantfit Ballast	4.0	Ea
26 51 13	Interior Lighting Fixtures, Lamps and Ballasts	T8 Instantfit LED Lamp	10.0	Ea
26 51 13	Interior Lighting Fixtures, Lamps and Ballasts	5" Dia. Round LED Downlight, Slim Profile; White	27.0	Ea
26 51 13	Interior Lighting Fixtures, Lamps and Ballasts	7" Dia. Round LED Downlight, Slim Profile; White	5.0	Ea
26 51 13	Interior Lighting Fixtures, Lamps and Ballasts	20" Dia. LED Pendant Lamp; Aluminum	1.0	Ea
<b>Division 28</b>	<b>Electronic Safety and Security</b>			
28 31 43	Smoke Detection Sensors	Battery Operated Wireless Interconnectable Smoke Alarm	5.0	Ea
<b>Division 32</b>	<b>Exterior Improvements</b>			



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Spec. Number	Brief Description	Detailed Description	Qty	Units
32 93 00	Plants	16" Box Holly	24.0	Ea
32 93 00	Plants	12" Green Fern	12.0	Ea
32 93 00	Plants	16" Dwarf Gardenias	8.0	Ea
32 93 00	Plants	24" Carolina Jessamine	8.0	Ea
32 93 00	Plants	Terracotta Planters, 6"	20.0	Ea
32 93 00	Plants	Terracotta Planters, 8"	32.0	Ea
<b>Division 48 Electrical Power Generation</b>				
48 19 16	Electrical Power Generation Inverter	208/240 VAC Microinverter	29.0	Ea
48 19 16	Electrical Power Generation Inverter	DC Combiner Box	1.0	Ea
48 19 16	Electrical Power Generation Inverter	Water Tight Cap	7.0	Ea
48 19 16	Electrical Power Generation Inverter	Ground Clip	64.0	Ea
48 19 16	Electrical Power Generation Inverter	DC Disconnect	1.0	Ea
48 19 16	Electrical Power Generation Inverter	AC Combining Box	1.0	Ea
48 19 16	Electrical Power Generation Inverter	12/4 Wire, Harsh Environment	1.0	Ea
48 19 16	Electrical Power Generation Inverter	Trunk Cable Splice Kit	1.0	Ea





## Energy Analysis Results & Discussion

### Introduction

Numerical simulation was used to determine the impact of specific aspects of Indigo Pine and, in some instances, help make design decisions. EnergyPlus [1], version 7.2, was used. EnergyPlus is an energy analysis and thermal load simulation program that calculates heating and cooling loads necessary to maintain thermal control set points and the energy consumption of buildings.

### Preliminary considerations:

Two locations of interest defined by their respective weather file were considered:

- Clemson, CA (Latitude 34.7 deg N) (weather file: Anderson, SC) as representative of the Climate of South Carolina and surrounding States.
- Irvine, CA (Latitude 33.7 deg N) (weather file: Sant-Ana, CA) as the competition site.

### Two run periods were considered:

- Full year (Jan. 1 to Dec. 31) to simulate overall behavior of the house and predict payback periods.
- Ten days in October (October 8<sup>th</sup> to October 18<sup>th</sup>) to predict the behavior of the house during the Solar Decathlon competition in Irvine CA.

### Reference Design

#### Core Volume

For the purpose of this report, the as-built design of Indigo Pine was used as the reference. Several alternatives are considered for quantifying the effect of specific aspects on energy consumption. The house was modeled as a rectangular box with appropriate fenestration on each façade (dimensions are shown in Figure 30).

#### Assumptions

- Given the relatively large wall thickness (i.e., 12 inches), the centerline dimensions between exterior walls were considered as a good compromise when estimating the interior air volume and the overall building thermal mass.
- Flat roof. The actual roof has a 1 in 12 pitch with overall thickness between 12" (at South) and 36" (at North). The model assumes a flat roof with a uniform thickness of 24".
- The volume is considered as a single zone.

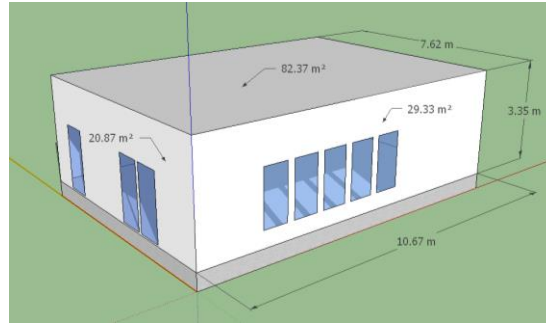


Figure 30 - Dimensions of Energy Plus numerical model

### Fenestration

Each façade includes several windows and doors. The South façade has five adjacent windows in the dining/leaving room. The East façade two windows, one in each bedroom. The North façade has three windows, one in the bathroom and two in the master bedroom. The West façade has three glass doors, one in the master bedroom and two adjacent in the dining room.

	Total	North	East	South	West
Gross Wall Area [m <sup>2</sup> ]	122.54	35.74	25.53	35.74	25.53
Window Opening Area [m <sup>2</sup> ]	15.20	2.44	1.63	6.41	4.72
Window-Wall Ratio [%]	12.40	6.83	6.37	17.94	18.49

Table 11 – Conditioned Window-to-Wall Ratio

### Assumption

- The fenestration considers only the glazing portion of each window/door and neglects the effects of the frame and trim.

### Shading

A porch provides almost complete shading on the doors of the West façade and a shading cover surrounds each window of the South façade as shown in Figure 31.

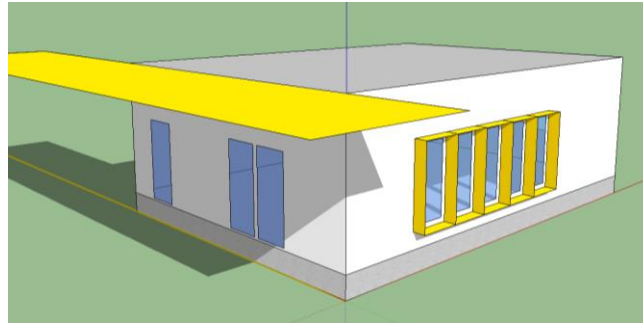


Figure 31 - Shading devices on West and South facades

## Floor Constructions

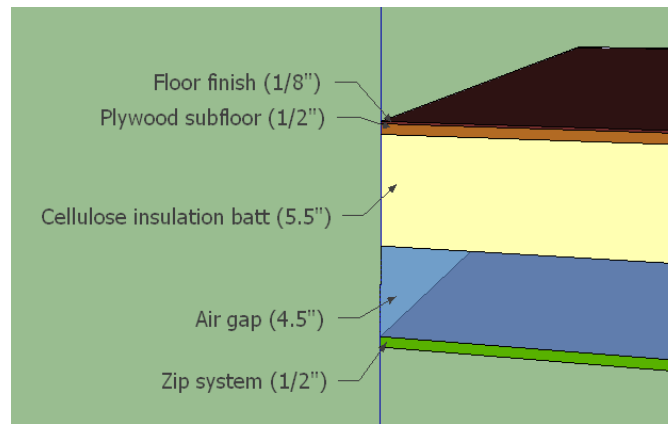


Figure 32 - Floor construction

	Conductivity (Btu-in/h-ft <sup>2</sup> -°F)	Thickness (in)	Conductance (Btu/h-ft <sup>2</sup> -°F)	R-value (h-ft <sup>2</sup> -°F/Btu)
Zip system	0.9	0.5	1.8	0.56
Air gap	-	4.5	0.4	2.5
Cellul. Insul. Batt	0.28	5.5	0.051	19.6
Plywood subfloor	0.9	0.5	1.8	0.56
Floor finish	1.5	0.125	12.0	0.08
			<b>TOTAL</b>	<b>23.3</b>

Table 12 - Evaluation of R-value of floor construction



## Roof Construction

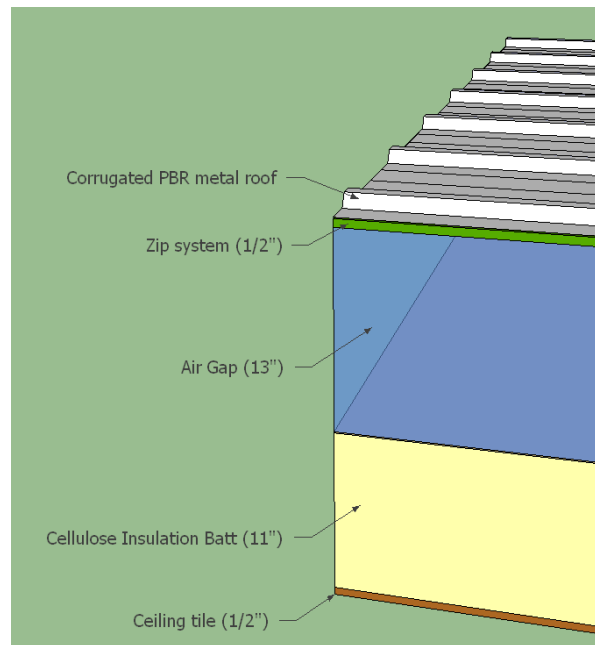


Figure 33 - Roof construction

	Conductivity (Btu-in/h-ft <sup>2</sup> -°F)	Thickness (in)	Conductance (Btu/h-ft <sup>2</sup> -°F)	R-value (h-ft <sup>2</sup> -°F/Btu)
PBR metal	-	0.08	-	-
Zip system	0.9	0.5	1.8	0.56
Air gap	-	13	0.5	2.0
Cellul. Insul. Batt	0.28	11	0.0255	39.3
Plywood ceiling	0.9	0.5	1.8	0.56
			<b>TOTAL</b>	<b>42.4</b>

Table 13 - Evaluation of R-value of roof construction



## Wall Construction

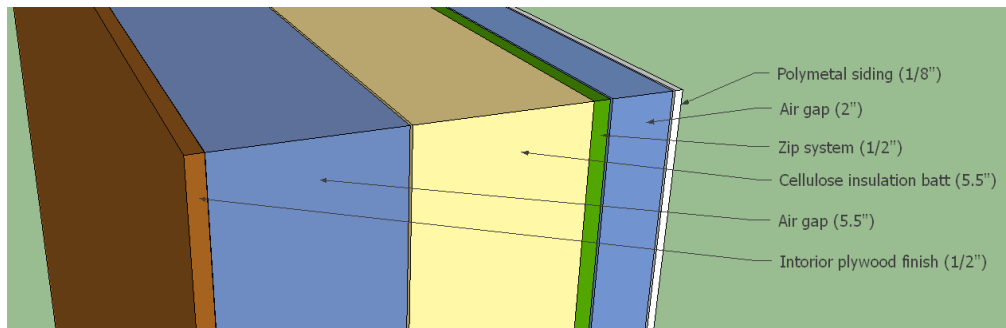


Figure 34 - Wall construction

	Conductivity (Btu-in/h-ft <sup>2</sup> -°F)	Thickness (in)	Conductance (Btu/h-ft <sup>2</sup> -°F)	R-value (h-ft <sup>2</sup> -°F/Btu)
Polymetal siding	65.7	0.125	525.8	0.002
Air gap	-	2	0.43	2.3
Zip system	0.9	0.5	1.8	0.56
Cellul. Insul. Batt	0.28	5.5	0.051	19.6
Air gap	-	5.5	0.43	2.3
Plywood finish	0.9	0.5	1.8	0.56
			<b>TOTAL</b>	<b>25.3</b>

Table 14 - Evaluation of R-value of floor construction

## Ground temperature

The foundation is a non-typical floor system made of staggered CMU blocks with forced ventilation of outside air. As a result, this system could be considered halfway between a crawlspace and slap-on-grade. For simplification purposes, the floor is assumed to be in direct contact with the foundation (defined as the ground in EnergyPlus). EnergyPlus allows defining the ground temperature at the building surface, i.e., below the floor envelope. In addition, the ground temperature can be defined for each month of the year. In reality, since the foundation is ventilated with outside air, its temperature may vary significantly during the day. However, for the numerical simulation of the reference design, we use that the foundation is not ventilated. The ground temperature is listed in Table 15.



	Temperature (°C)
January	19.2
February	19.2
March	19.2
April	19.6
Mai	20.4
June	21.4
July	21.8
August	21.8
September	21.4
October	19.8
November	19.3
December	19.3

Table 15 - Ground Temperature Reference

### HVAC system

We used the ideal load air system in EnergyPlus. The ideal loads air system is intended for load calculations. The supply air conditions of dry bulb and humidity ratio are provided, but the flow rate cannot be controlled [1]. The model operates by varying the flow rate to exactly meet the desired set point temperatures, which we defined as 22.2°C for heating and 24.4°C for cooling. These set point temperatures are defined for the entire year, which is a conservative approach since most typical thermostats allow only heating or cooling during each season.

For the reference design, we do not define the heat recovery ventilator (HRV). The effect of the HRV is studied subsequently and discussed below.

The ductwork includes three dampers that divide the house into four independently controlled zones. The purpose of this feature is not to reduce the energy consumption of the house but mainly to provide additional



control to the users and increase thermal comfort. In particular, it allows the user to adapt the supply of conditioned air to the zones based on user occupancy, hourly solar heat gain, and/or specific internal heat generation. As a result, the user is able to specifically define a more uniform temperature throughout the house, or, inversely, a more non-uniform temperature distribution according to his desire. However, the effect of this feature on energy consumption is not easily evaluated on such a small building with a single return. Therefore, we consider the building as a single zone and neglect the potential energy benefits of this feature.

### Additional assumptions

Air infiltration is neglected. As mentioned above, the effect of the HRV is discussed below.

User activity and internal heat generation from appliances and lighting are neglected for the reference design analysis. However, their respective effects on energy consumption are discussed below.

### Results of reference design

The main results are graphically represented below. They show the indoor temperature, hourly and monthly energy consumption, and heating and cooling rates under the weather of Clemson, South Carolina. The most compelling conclusions include:

- Based on Figure 35, the heating and cooling set point temperatures are simultaneously active on a daily basis during three months of the year. The heating set point temperature is exclusively active during four months of the year and the cooling set point temperature is exclusively active during five months of the year.
- Figures 36 and 37 show that heating and cooling energy consumptions are 56.4% and 43.6% of the total energy consumption, respectively.
- The hourly energy consumption is about 3 to 4 MJ/h with peaks at 5 MJ/h. This value is on target with the typical energy consumption of high efficiency homes [2].
- 5 MJ/h corresponds to 26% of the cooling capacity of the 1.5 ton HVAC system.
- Knowing that the HVAC heat pump has a 17 SEER, the consumption will be 278 W of electrical power to produce 5 MJ/h of heating/cooling. According to Figure 9, the heating/cooling energy rate is about 1200 W, which corresponds to an expected efficiency ratio of more than 4 for the HVAC heat pump.

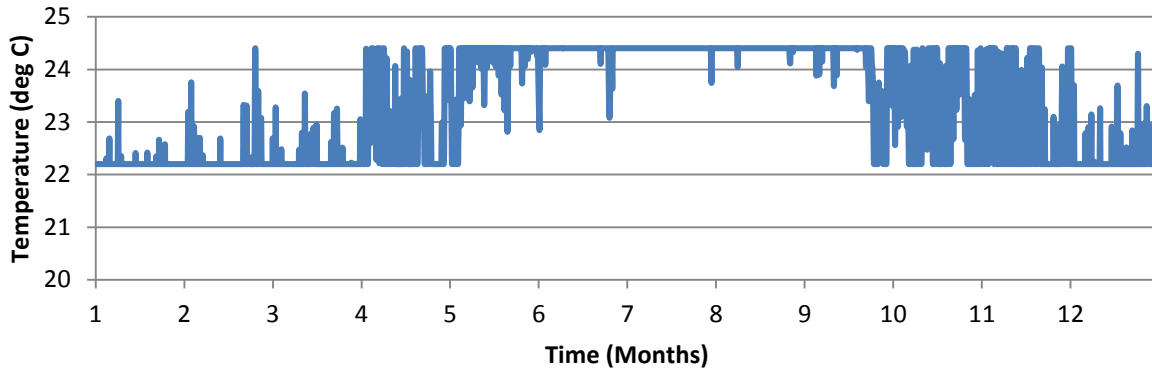


Figure 35 - Indoor temperature during the year based on set point temperatures

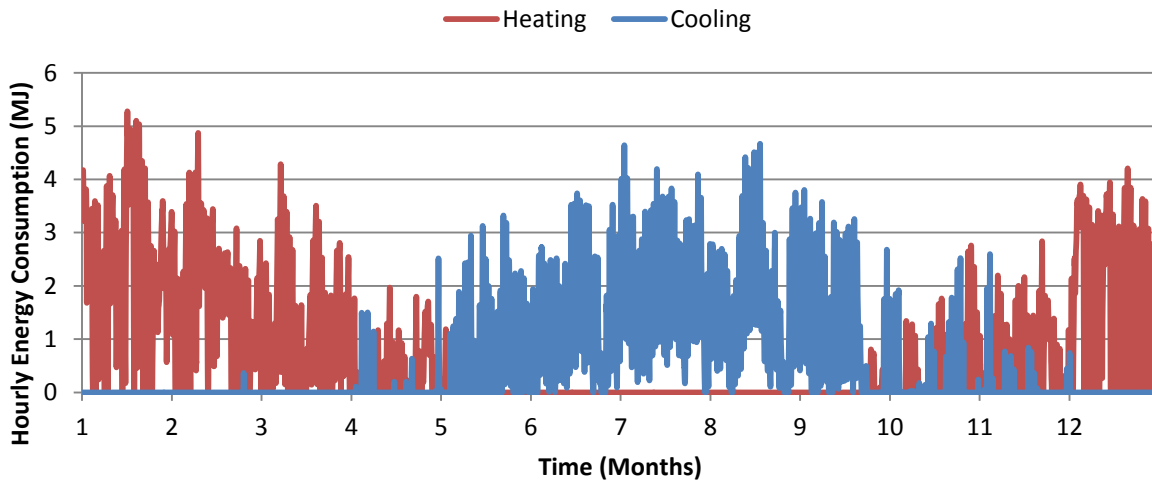


Figure 36 - Hourly energy consumption (MJ)



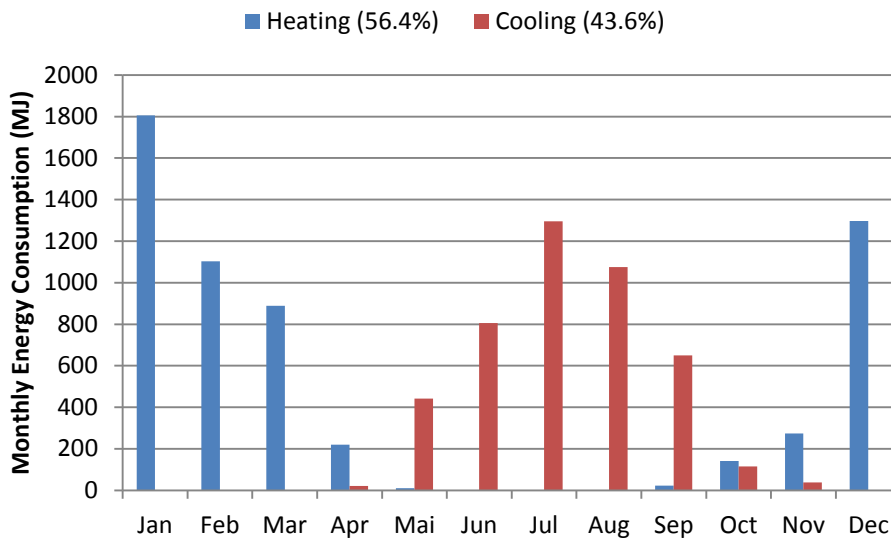


Figure 37 - Monthly energy consumption (MJ)

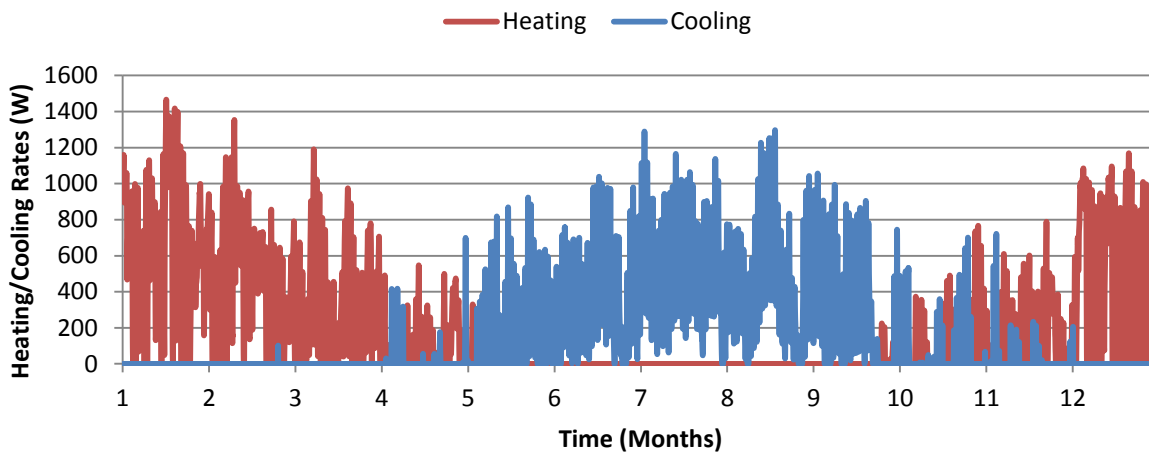


Figure 38 - Thermal energy rate (W)

### Expected results during competition

Using the weather file of the competition site (Santa-Ana, CA), the behavior of the house during the competition (October 8<sup>th</sup> to 18<sup>th</sup>) can be evaluated. As expected, the weather in Irvine CA in October is expected to be ideal and the HVAC system will not be solicited. The total energy load is expected to be about 10% of maximum load encountered during the year.

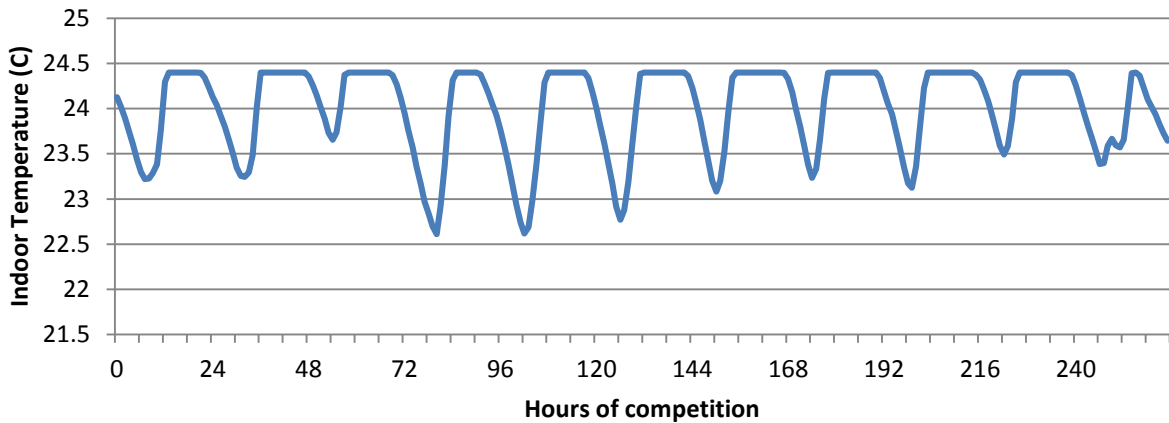


Figure 39 - Estimated indoor temperature

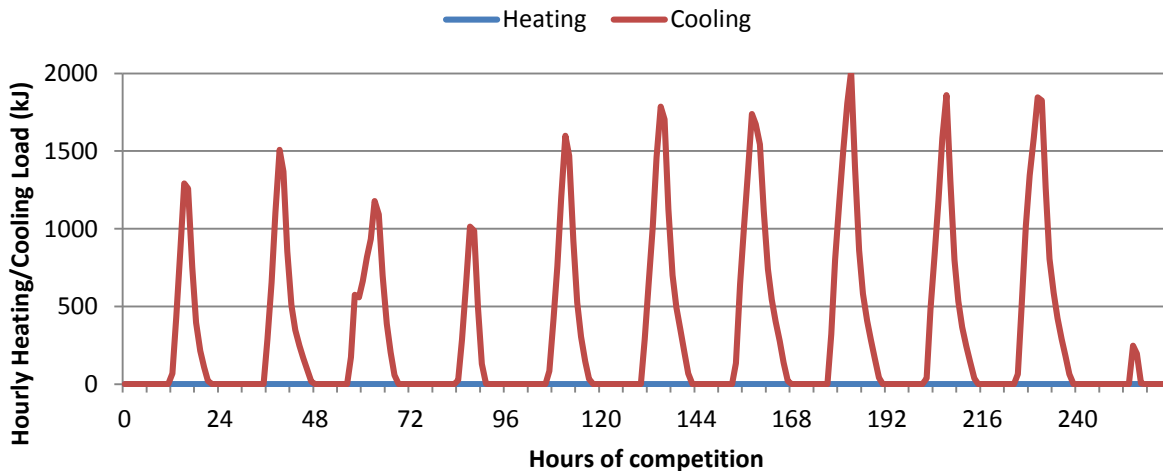


Figure 40 - Hourly heating/cooling load during competition in Irvine CA

### Effect of ventilation of the foundation

With ventilation of the CMU foundation, the foundation/ground temperature is expected to be lower during the winter months and higher during the summer months than without ventilation. For illustration purposes, the foundation temperature is assumed to be up to 1.5 deg C lower in winter and 1.5 deg C higher in summer (as listed in the Table below). Figure 13 shows that the yearly energy consumption is 3.6% greater, which is



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acceptable considering that the energy savings from running the ventilation system are expected to be of the order of 10%.

	Without ventilation	With ventilation
January	19.2	17.7
February	19.2	18.2
March	19.2	18.7
April	19.6	19.6
Mai	20.4	20.9
June	21.4	22.4
July	21.8	23.3
August	21.8	22.8
September	21.4	21.9
October	19.8	19.8
November	19.3	18.8
December	19.3	18.3

Table 16 - Assumed foundation temperature (deg C) with and without ventilation

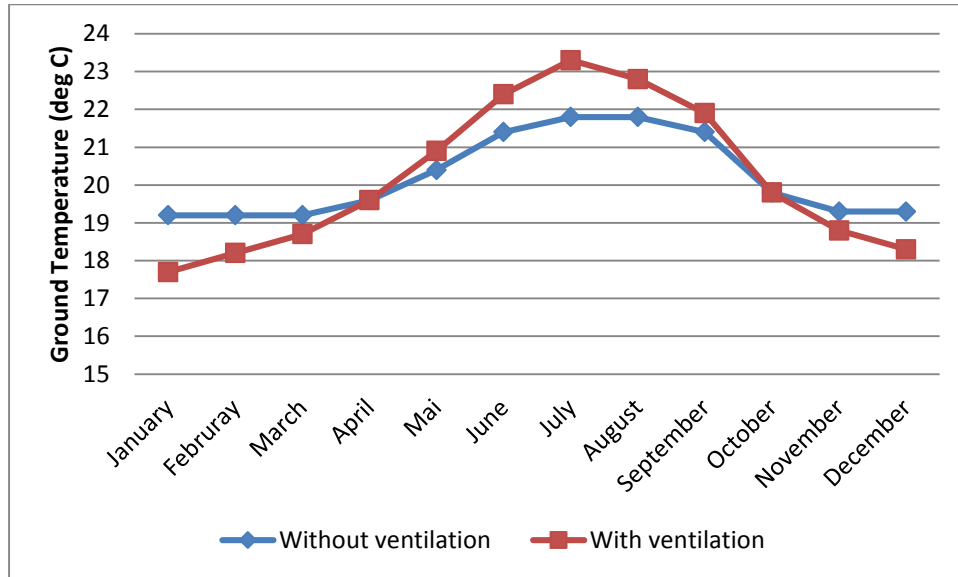


Figure 41 - Assumed foundation temperature with and without ventilation

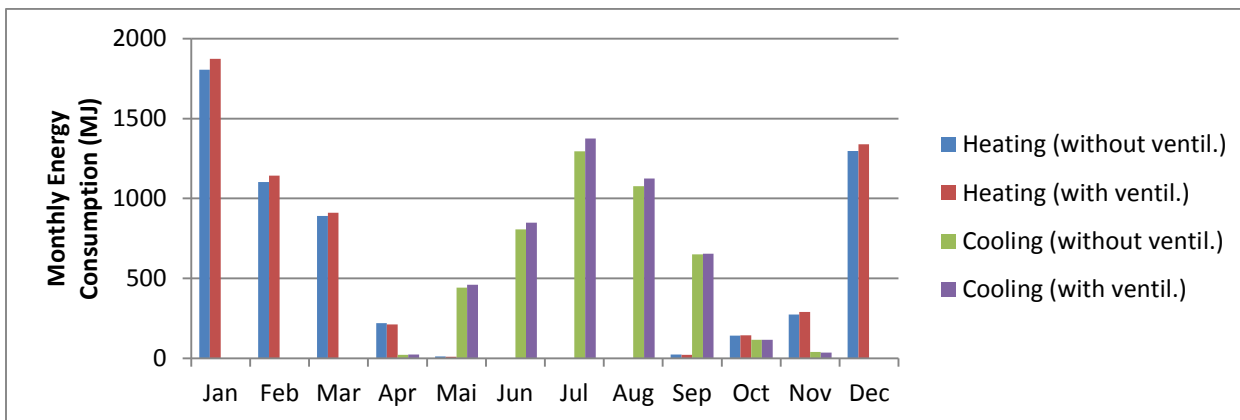


Figure 42 - Monthly energy consumption with and without ventilation

### Effect of Heat Recovery Ventilator (HRV)

The HRV brings fresh air into the interior space and exhausts the same amount of air while recycling up to 70% of the sensible heat of the air. Assuming that the HRV changes the entire interior air volume every two hours, the amount of energy that is lost in this process can be calculated and added to the thermal load.

The total air volume inside the thermal envelope is 240 m<sup>3</sup>. Knowing the density and specific heat of air, 1.2 kg/m<sup>3</sup> and 1.005 kJ/kg-K, respectively, the sensible heat stored in the air is 290.3 kJ/K. The monthly average temperature difference between inside and outside can be calculated to determine the energy lost by changing the air every two hours. Table 17 summarizes the calculations and Figure 12 shows the corresponding added monthly load.



Comparing without and with HRV, the yearly added load is 31%, which is a significant increase necessary for ensuring appropriate indoor air quality.

	Load w/o HRV (MJ)	Indoor temp (C)	Outdoor temp (C)	Sensible heat (MJ)	30% lost (MJ)	# changes per month	Lost heat (MJ)
Jan	1873.9	22.2	4.4	5.15	1.55	365	564.4
Feb	1142.7	22.2	6.7	4.51	1.35	365	493.8
Mar	910.8	22.2	10.0	3.54	1.06	365	387.8
Apr	234.1	23	15.6	2.16	0.65	365	236.6
Mai	469.5	24	18.3	1.65	0.49	365	180.1
Jun	848.7	24.4	22.8	0.47	0.14	365	51.6
Jul	1374.9	24.4	25.6	0.34	0.10	365	36.7
Aug	1124.4	24.4	22.8	0.47	0.14	365	51.6
Sep	675.0	24.4	19.4	1.44	0.43	365	157.5
Oct	257.1	24	15.6	2.45	0.74	365	268.4
Nov	324.3	23	11.1	3.45	1.04	365	377.9
Dec	1340.8	22.2	5.6	4.83	1.45	365	529.1

Table 17 - Calculation of energy lost from HRV air exhaust

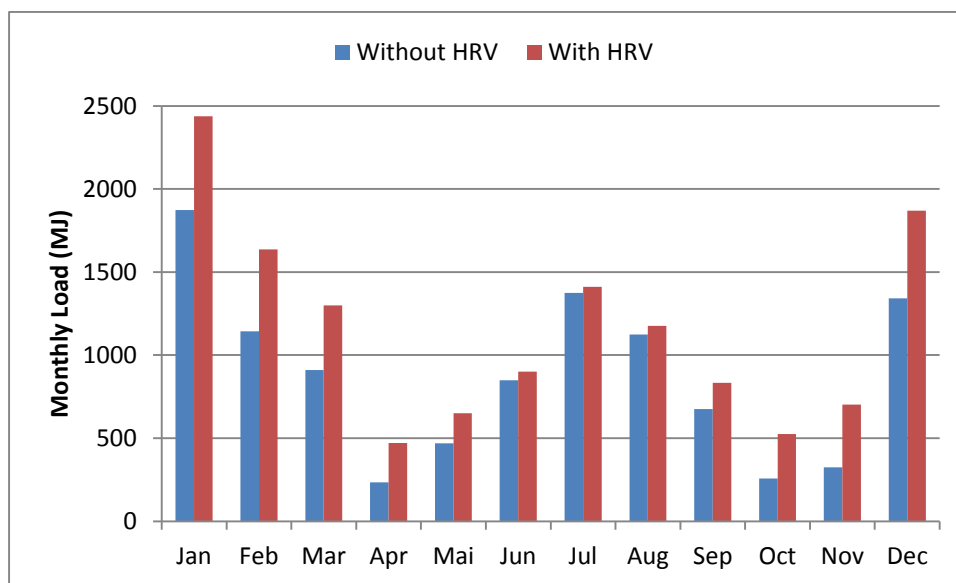


Figure 43 - Monthly heating and cooling load with and without HRV



## Construction Specifications

The below listed specifications are based on the construction of Team Clemson's first home, Indigo Pine East, and are reflective of the products, materials, and standards contained within the construction of Team Clemson's second home, Indigo Pine West, for competition in the Solar Decathlon 2015 in Irvine, CA.



## DIVISION 01 – GENERAL REQUIREMENTS

### 01 10 00 SUMMARY

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Summary of design intent and theory.
- B. Related sections: 01 40 00 QUALITY REQUIREMENTS
- C. General: The theory behind Indigo Pine is to think globally with respect to technologies while act locally with respect to targeted material sourcing, fabrication, and labor. Indigo Pine operates within an existing network of 1) CNC fabricators (utilizing a Computer Numeric Control machine) and 2) wholesale material suppliers; allowing the custom CNC cut structural and finishing components to be manufactured quickly and easily. See Appendix C: CNC-Milling Documentation. Nearly all components of the Indigo Pine house, from the structure, to the exterior and interior cladding, to cabinetry, exist as a numbered set of digital cut files that can be transferred over the internet. This, paired with the widespread and growing network of fabricators and suppliers, offers a host of benefits in terms of fabrication and production. Indigo Pine offers an unmatched potential for replication without being restrained to an offsite assembly space (assembly occurs on-site and does not require any heavy machinery for practical application). By leveraging networks of fabricators with access to large quantities of readily-available materials, Indigo Pine offers the affordable wholesale material prices available to these fabricators. And, through its front-end BIM assisted design and CNC processing, Indigo Pine offers supremely accurate building components that do not require additional measurements or cutting in the field.
- D. Sim[PLY] Structural System: All elements of Indigo Pine’s Sim[PLY] framing system are designed to be handled by average persons and to seamlessly interlock to adjacent parts based on a set of easy-to-understand, pictographic assembly drawings. The resulting ease of construction means Indigo Pine owners can participate in the construction process. See section 01 40 00 QUALITY REQUIREMENTS. The theory behind Indigo Pine is to replace



expensive on-site knowledge workers with largely unskilled labor. All CNC components of the home, including structure, finishes, and cabinetry, are premeasured, precut and pre-labeled. They are easily and quickly assembled like a 3D puzzle. This leaves the need for knowledge based work and workers until the end of the project to install more complex MEP systems. See section 01 40 00 QUALITY REQUIREMENTS. By using modern and available technologies to reimagine what it means to build a home, we can leverage fabricator networks with wholesale material supply chains in order to significantly reduce material costs, labor costs, and construction time.

## PART 2 – PRODUCTS

Section not used at this time.

## PART 3 - EXECUTION

Section not used at this time.

**END OF SECTION 01 10 00**





## 01 25 00 SUBSTITUTION PROCEDURES

### PART 1 – GENERAL

#### 1.01 GENERAL REQUIREMENTS

- A. Substitutions include changes in products, materials, equipment, and methods of construction from those required by the construction documents and Contractors.
- B. Substitution Requests: Identify product, fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  1. Identify product to be replaced and show compliance with requirements for substitutions. Include a detailed comparison of significant qualities of proposed substitution with those of the work specified, a list of changes needed to other parts of the work required to accommodate proposed substitution, and any proposed changes in the construction cost or the construction time should the substitution be accepted.
- C. Do not submit unapproved substitutions on Shop Drawings or other submittals.
- D. All substitutions noted during of construction of Indigo Pine East are to be submitted as soon as possible to allow time for accommodation of substitutions in Indigo Pine West.

### PART 2 – PRODUCTS

Section not used at this time.

### PART 3 - EXECUTION

Section not used at this time.

**END OF SECTION 01 25 00**



## 01 40 00 QUALITY REQUIREMENTS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Quality assurance requirements for all Work.
- B. General: Indigo Pine includes several types and divisions of Work, including Work associated with CNC labor, skilled labor and unskilled labor as described in the section below. The construction process designed as part of Indigo Pine includes Work that may be performed by unskilled labor as detailed below; including assembly of foundation components, structural components, interior and exterior finishes, and cabinetry modules. Indigo Pine is designed to be assembled as a kit-of-parts with assistance from a set of pictographic assembly drawings; allowing owners and other non-skilled laborers to partake in the construction process through the installation of complex MEP systems. See Appendix E: On Site Labor Division for clarification of the types and numbers of workers associated with each phase of construction.

#### 1.02 QUALITY ASSURANCE

- A. CNC Fabricator Qualifications: Utilize labor skilled in the programming and operation of CNC machines to mill all structural, interior and exterior finishes, and cabinetry components of Indigo Pine as described in the specifications below.
- B. Installer Qualifications:
  1. Labor Types:
    - a. Skilled workers: Persons having experience with the Work being performed in the section.
    - b. Unskilled workers: Persons not having experience with the Work being performed in the section.
  2. Labor Division: Utilize labor type as described in the section to perform all associated Work. Ensure at least one Skilled worker is on site at all times for quality assurance



and to oversee any and all unskilled persons participating in any and all aspects of the Work as described in the sections below.

## **PART 2 – PRODUCTS**

Section not used at this time.

## **PART 3 - EXECUTION**

Section not used at this time.

**END OF SECTION 01 40 00**



## 01 42 00 REFERENCES

### PART 1 – GENERAL

#### 1.02 GENERAL REQUIREMENTS

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Abbreviation and Acronyms: Where abbreviations and acronyms are used in specifications or other contract documents, they shall mean the recognized name of entities in the following list. Names are subject to change and are believed to be accurate and up-to-date as of the date of the contract documents.

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ACMA	American Composites Manufacturers Association
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ARI	Air Conditioning Refrigeration Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BHMA	Builders Hardware Manufacturers Association



CPSC	Consumer Product Safety Commission
CSA	Canadian Standards Association
DOC	Department of Commerce (US)
ETL	Electrical Testing Labs
FCC	Federal Communications Commission
FDA	Food and Drug Administration
FM	Factory Mutual
FSC	Forest Stewardship Council
HI	Hydraulic Institute
IBC	International Building Code
ICC	International Code Council
ICC-ES	International Code Council - Evaluation Service
IEEE	Institute of Electrical and Electronics Engineers
IRC	International Residential Code
NAIMA	North American Insulation Manufacturers Association
NBC	National Building Code (Canada)
NDS	National Design Specification
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association



NRTL	Nationally Recognized Testing Laboratory
NSF	National Sanitation Foundation
OSHA	Occupational Health & Safety Administration
SAE	Society of Automotive Engineers
SCS	Scientific Certification Systems
SFI	Sustainable Forestry Initiative
SMA	Screen Manufacturers Association
TAPPI	Technical Association of the Pulp and Paper Industry
UL	Underwriters Laboratories
WDMA	Window and Door Manufacturers Association

## PART 2 – PRODUCTS

Section not used at this time.

## PART 3 - EXECUTION

Section not used at this time.

**END OF SECTION 01 42 00**



## 01 50 00 TEMPORARY FACILITIES

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Temporary facilities and controls, including support facilities and sanitary and protection facilities.
- B. Support facilities include, but are not limited to, the following:
  - 1. Temporary scaffolding
  - 2. Powered personnel lifts
  - 3. Material handling and lifting equipment
- C. Sanitary and protection facilities include, but are not limited to, the following:
  - 1. Temporary construction toilets, wash facilities, and drinking-water.
  - 2. Fire protection equipment.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.

#### 1.03 HANDLING

- A. All material lifting equipment must be controlled by certified personnel.
- B. Scaffolding must follow normatively specified standards and be used in accordance with the Indigo Pine Health & Safety Plan.

### PART 2 – PRODUCTS

#### 2.01 SCAFFOLDING



- A. General: Provide and maintain scaffolding, ramps, ladders, and platforms required for Scope of Work requiring access. Coordinate placement and notification of affected Team Crew Members.
- B. Training: Provide adequate training for all Team Members working on elevated surfaces.
- C. Werner Steel Rolling Scaffold:
  - 1. Minimum Height: 6'
  - 2. Minimum Weight Rating: 1,000 lbs.

## 2.02 PERSONNEL LIFT

- A. General: Provide equipment suitable for use intended. Provide location for storage of equipment and fuel when not in use for construction. Remove key when not in use.
- B. Training: Provide adequate training from certified persons for all Team Members who will operate motorized equipment.
- C. Basis-of-Design Product: Self-Propelled Scissor Lift by Genie:
  - 1. Substitutions: Permitted.
  - 2. Maximum Working Height: 21'
  - 3. Toeboard: Yes
  - 4. Maximum Platform Occupancy: 2 Persons
  - 5. Minimum Lift Capacity: 600 lbs

## 2.03 MATERIAL LIFT

- A. General: Provide equipment suitable for use intended for Scope of Work. Provide location for storage of equipment and fuel when not in use for construction. Remove key when not in use, where applicable.
- B. Training: Provide adequate training from certified persons for all Team Members who will operate all motorized and non-motorized equipment.
- C. Motorized Equipment:
  - 1. Minimum Material Capacity: 2,000 lbs.
  - 2. Tire Type: Cushion.





3. Maximum Lift Height: 15'

D. Non-Motorized Equipment:

1. Basis-of-Design Product: Superlift Contractor Material Lift by Genie:

a. Substitutions: Permitted.

2. Minimum Lifting Height: 16'-0"

3. Power Options: Two-Speed Manual Wench

4. Electric: Not Permitted.

5. Minimum Lift Capacity: 500 lbs

## 2.04 SANITARY FACILITIES

A. All sanitary facilities to be provided by organizers of the Solar Decathlon 2015. Refer to DOE site map for specific locations of facilities.

## 2.05 FIRE PROTECTION

A. Install and maintain temporary fire protection facilities of types needed to protect against reasonably predictable and controllable fire losses until permanent facilities are complete and operational. In accordance with requirements of authorities having jurisdiction and NFPA 241 96, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

B. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above including, but not limited to the following:

1. Class ABC dry chemical extinguishers or a combination of extinguishers of NFPA recommended classes for exposures.

2. Locate fire extinguishers where convenient and effective for their intended purpose as per the Indigo Pine Health & Safety Plan.

C. Store combustible materials in containers in fire safe locations as per the Indigo Pine Health & Safety Plan.



- D. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities and other access routes for firefighting. Prohibit smoking in hazardous fire exposure areas.

## 2.06 SHEDS AND STORAGE

- A. There is limited space available on site for the placement of shed and enclosed storage facilities. Indigo Pine will utilize a custom, on-site facility for secure storage of small tools and batteries, safety equipment, and drinking water. This facility in no way represents a permanent installation, is not reflected in the quantities or materials represented in this manual, and should in no way be reflected in the cost estimate of the Indigo Pine home.

## PART 3 - EXECUTION

### 3.01 INSTALLATION, GENERAL

- A. Locate all above facilities where they will serve the project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

### 3.02 SUPPORT FACILITIES INSTALLATION

- A. Locate site offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.

### 3.03 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Secure construction site against illegal entry at end of each work day in accordance with competition organizer operations. Equip exterior temporary doors and Indigo Pine on-site facility with appropriate hardware and locks.
- B. Provide protection, operate temporary facilities, and conduct construction in ways and by methods that in accordance with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.



- C. Provide barricades, warning signs, and lights in accordance with competition organizer operations, standards and rules.

END OF SECTION 01 50 00



## 01 60 00 PRODUCT REQUIREMENTS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.
  1. Show compliance with requirements for comparable product requests.
- C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.
- D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.
- E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
  1. Schedule delivery to site and subsequent placement on site to coordinate with construction logistics plan. Reduce long-term storage of materials and equipment on project site to prevent overcrowding of construction spaces.
  2. Deliver products to team-specified warehouse site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  3. Deliver products to competition site with team-specified modes of transportation, as appropriate for materials or equipment being transported. See construction specifications and site logistics plans.
  4. Inspect products upon delivery to warehouse and again upon delivery to site to ensure that products are undamaged and properly protected.
  5. Store products that are subject to damage by the elements, under cover in a weather-tight enclosure above ground, with ventilation adequate to prevent condensation.



## PART 2 – PRODUCTS

### 2.01 PRODUCT SELECTION REQUIREMENTS

- A. Provide products that are undamaged, and, unless otherwise indicated, are new at the time of installation.
  - 1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
  - 2. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Where the following headings are used to list products or manufacturers, the options for product selection are as follows:
  - 1. Products:
    - a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
    - b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.
  - 2. Manufacturers:
    - a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
    - b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.
  - 3. Basis-of-Design Product: Provide the product named, indicated on the construction documents, or a comparable product by one of the listed manufacturers.

### 2.02 COMPARABLE PRODUCTS

- A. Requests for comparable product will be considered when the following conditions are satisfied:



1. Evidence that the proposed product does not require revisions to the Scope of Work, that it is consistent with the construction documents and manual, will produce the indicated results, and that it is compatible with other portions of the project.
2. Detailed comparison of significant qualities of proposed product with those named in the specifications is carried out.
3. List of similar installations for completed projects, if requested.
4. Samples, if requested.

### PART 3 - EXECUTION

Section not used at this time.

END OF SECTION 01 60 00



## 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Construction waste management tactics from pre-fabrication to on-site construction.
- B. Pre-Assembly Waste Management:
  - 1. General: All applicable materials and components for Indigo Pine are to be pre-fabricated for on-site construction by the following means:
    - a. A local, offsite CNC fabricator will mill all plywood (including but not limited to structural, sheathing, and paneling pieces) along with all aluminum composite material components (including but not limited to siding and ductwork components).
    - b. The Indigo Pine team will receive these and other parts, prefabricate necessary structural, paneling, etc. and sort / load for shipment to site.
- C. Assembly and Disassembly Waste Management:
  - 1. General: Team Clemson will construct two homes, Indigo Pine East (IPE) in Clemson, SC and Indigo Pine West (IPW) in Irvine, CA for the Solar Decathlon 2015 competition. Construction Waste Management and Disposal plans for the assembly and disassembly processes of both separate homes are to follow the regulations herein.
  - 2. IPE will be assembled on the team-selected site from prefabricated units, modules and products. Disassembly will occur post-competition on team-specified date, following regulations herein.
  - 3. IPW will be assembled on competition site from prefabricated units, modules and products. Disassembly will occur on competition site within the schedule set forth by the Solar Decathlon organizers, following regulations herein.

#### 1.02 SUBMITTALS



- A. Informational Submittals:
1. Waste Reduction Progress Reports: Include total quantity of waste, total quantity of waste salvaged and recycled, and percentage of total waste salvaged and recycled.
  2. CNC Fabrication Waste Reports: Include number of plywood and aluminum composite material sheets used in fabrication, calculation of efficiency of material usage, treatment of waste products and percentage of recycling.
  3. Recycling and Processing Facility Records: Manifests, weight tickets, receipts, and invoices.
  4. Landfill and Incinerator Disposal Records: Manifests, weight tickets, receipts, and invoices.
- B. Waste Management Plan: Develop a waste management plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
1. Salvaged Materials for Reuse: Identify materials that will be salvaged and reused.
  2. Salvaged Materials for Sale: Identify materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
  3. Salvaged Materials for Donation: Identify materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
  4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  5. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan.

## PART 2 – PRODUCTS

Section not used at this time.

## PART 3 – PRODUCTS





### 3.01 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan for pre-fabrication, assembly and disassembly of both homes, IPE and IPW. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the project.
- B. Training: Train Team Members on proper waste management procedures, as appropriate for the Work occurring at project pre-fabrication and construction sites, as applicable.
  - 1. Distribute waste management plan to entities when they first begin work on-site.  
Review plan procedures and locations established for salvage, recycling, and disposal.

### 3.02 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Clean salvaged items and install salvaged items to comply with installation requirements for new materials and equipment.
- B. Salvaged Items for Owner's Use: Clean salvaged items and store in a secure, off-site area until delivery to owner after team-use.
- C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs.
- E. Plumbing Fixtures: Separate by type and size.
- F. Lighting Fixtures: Separate lamps by type and protect from breakage.

### 3.03 RECYCLING WASTE

- A. General: Recycle paper, stainless steel zip-tie waste, beverage containers, etc. used by in-warehouse and on-site workers.
- B. Packaging:
  - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location for later processing.
  - 2. Polystyrene Packaging: Separate and bag materials.



3. Pallets: As much as possible, require deliveries using pallets to remove pallets from project site. For pallets that remain in warehouse, reuse or break down pallets into component wood pieces. For pallets that remain on-site, remove pallets from competition site before breaking down into component wood pieces. In all cases, comply with requirements for recycling wood.

C. Wood Materials:

1. Sort and stack reusable members according to type, part number and location on house. Separate lumber, engineered wood products, panel products, and treated wood materials.
2. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
3. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

D. Metals: Separate metals by type. Recycle all stainless steel and other material properly.

E. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

F. Conduit: Reduce conduit to straight lengths and store by type and size.

### 3.04 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from project warehouse and construction sites and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

B. Do not burn waste materials.

**END OF SECTION 01 74 19**



## DIVISION 03 – CONCRETE

### 03 31 00 STRUCTURAL CONCRETE

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Concrete for use in perimeter bond beams in CMU foundation.
- B. Related sections: 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY

##### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's maintenance data and warranty information.

##### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. All concrete applications to comply with ASTM C 387.

#### PART 2 – PRODUCTS

##### 2.01 MATERIALS

- A. Concrete Mix:
  - 1. Basis-of-Design Product: 5000 High Early Strength Concrete Mix by Quikrete or a comparable product:



a. Manufacturers: Quickrete, Sakrete.

B. High Strength Concrete Mix:

1. Minimum Compressive Strength: 5,000 psi

## 2.02 ACCESSORIES

A. Reinforcing Bars:

1. Install as per structural requirements at specified intervals and locations and with specified minimum overlaps to form CMU bond beams applications. See section 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY.

B. Wire Rebar Ties:

1. Install per manufacturer's recommendations at intervals specified to secure rebar in CMU bond beams.

C. Anchoring Pins:

1. Install as per structural requirements at specified intervals and locations to securely anchor CMU bond beam applications to ground. See section 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY.
2. Type: #6 Reinforcing bar

## 2.03 FABRICATION

A. Prefabricate all reinforcing bars and ground anchoring ties for CMU bond beam application, including cutting to length and bending to shape (where required) as per structural requirements.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

A. Mix and install concrete as per manufacturer's instructions, ASTM C 387 and safety regulations per Indigo Pine Health and Safety Plan procedures.



- B. Install all reinforcing bars into CMU bond beam locations as per structural requirements to form a secure foundation.

### 3.02 CLEANING

- A. After mixing concrete, clean all tools and site components with approved materials and in approved location. See event site map by Solar Decathlon 2015 organizers.

**END OF SECTION 03 31 00**



## DIVISION 04 – MASONRY

### 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Concrete masonry unit (CMU) for thermal mass foundation system.
- B. Related Sections: 03 31 00 STRUCTURAL CONCRETE, 23 81 26 SPLIT-SYSTEM HEAT PUMPS
- C. General: Indigo Pine utilizes a system of CMU bond beams and side-stacked CMU to form a dually-functional element that serves as 1) the home's foundation and 2) a thermal mass system:
  - 1. CMU and fabricated CMU bond beam blocks will be positioned under the house as noted in the drawings to form the foundation and thermal mass system for reducing the temperature of intake air into the condensing unit.
  - 2. Air will be drawn through the system at specified gaps by AC condensing unit.
  - 3. As air travels through the thermal mass, energy in the form of heat will be transferred from the air to the thermal mass resulting in a temperature gradient between the air entering the system and air exiting in the system; providing a cooler intake at the AC unit, see section 23 81 26 SPLIT-SYSTEM HEAT PUMPS for additional information.
  - 4. By reducing the input temperature to the AC unit, it is possible to increase the overall efficiency, thus reducing the energy used by the unit.
  - 5. Note: no air passing through the thermal mass system enters the thermal envelope of the home, and thus no occupants are exposed to air passing through the system.

##### 1.02 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Layout: Utilize an installer having demonstrated experience in laying out foundations on projects of similar size and complexity. Ensure that foundation perimeter is laid to



dimensions specified in construction documents; and that foundation perimeter is laid square.

- a. Labor Type: Skilled labor.
2. General Labor for CMU thermal mass system: No qualifications required.
  - a. Labor Type: Unskilled labor.

## PART 2 – PRODUCTS

### 2.01 CONCRETE MASONRY UNIT

#### A. Standard CMU:

1. Install in pattern as indicated on construction documents to provide adequate airflow through thermal mass system.
2. Dimensions: 8" x 8" x 16"

#### B. Stretcher CMU:

1. Install in pattern as indicated on construction documents to provide adequate airflow through thermal mass system.
2. Dimensions: 8" x 1-5/8" x 16"

#### C. Knockout CMU:

1. Install in locations, with all reinforcing bars and concrete applications as per structural requirements to form CMU bond beams around perimeter of home. See section 03 31 00 STRUCTURAL CONCRETE.
2. Dimensions: 8" x 8" x 16"

### 2.02 ACCESSORIES

- A. See section 03 31 00 STRUCTURAL CONCRETE for accessories pertaining to CMU bond beams.

### 2.03 FABRICATION

- A. CMU Bond Beam:



1. Remove center support and edges of Knockout CMU to form bond beam condition around perimeter of foundation as indicated in structural documents. Comply with section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL to ensure proper disposal of CMU waste materials.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: All CMU to be dry-stacked and fit tightly together on bearing condition (fully graded or otherwise) in pattern as indicated in construction documents, with sole exception of CMU bond beam conditions.
- B. CMU bond beam: Secure applications to bearing surface condition with anchoring pins at specified intervals and locations. Fabricate beams with reinforcing bars and concrete as per structural requirements. See section 03 31 00 STRUCTURAL CONCRETE.

**END OF SECTION 04 22 23**





## DIVISION 05 – METALS

### 05 45 16 ELECTRICAL METAL SUPPORTS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Components for mounting photovoltaic panel system.
- B. Related Sections: 07 41 13 ALUMINUM ROOF PANELS, 26 31 00 PHOTOVOLTAIC COLLECTORS

##### 1.02 SYSTEM DESCRIPTION

- A. Manufacturer's Structural Analysis: Determination of number of attachments and locations is based on manufacturer performed structural analysis and verified by tensile tests in a laboratory.
- B. Design Requirements: Provide photovoltaic racking system which have been manufactured, fabricated and installed to meet the following minimum design criteria:
  - 1. Compliant with IBC 2012.
- C. Grounding and Bonding Equipment: Provide grounding and bonding equipment that have been manufactured and fabricated to meet the following minimum design criteria:
  - 1. ANSI/UL Standard 467 – Grounding and Bonding Equipment

##### 1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.
- B. Shop Drawings: Provide drawings indicating required component locations, interface with adjacent materials, installation, anchorage, fastening and similar information.

##### 1.04 QUALITY ASSURANCE

- A. General: Consult with manufacturer to ensure structural safety of all electrical metal supports and subsequent photovoltaic mounting equipment.



- B. Structural Safety: Verification of the roof capacity and its connection to substructure is not included in the manufacturer's general structural analysis of attachments. The appropriate calculations and checks should be performed to ensure roof and substructure can accommodate the weight of the system in addition to snow and wind loads; including increased loads at roof edges and corner zones. In cases where metal support is attaching to roof cladding rather than directly to the substructure, verification of the connection forces of the roof cladding to the substructure is not part of the design and must be verified by the owner / installer.
- C. Labor Type: Skilled labor.
- D. Qualifications: None required.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions as recommended by the manufacturer.

#### 1.06 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.
  - 1. Warranty Period: 20 years against defects in materials or workmanship on aluminum systems, 5 years against defects in materials or workmanship on steel systems.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Schletter  
1001 Commerce Center Drive  
Shelby, North Carolina 28150



Phone: 888-608-0234

<http://www.schletter.us/>

- B. Substitutions: Permitted.

## 2.02 PHOTOVOLTAIC ROOF MOUNT

- A. General: Roof attachment and track systems are to be designed and installed to provide angled PV connection to roof structures in locations as per construction documents. Include the following minimum components:
  - 1. Sheet Metal Roof Attachments:
    - a. Material: Stainless Steel.
    - b. PVC Foam Insert: UV Resistant Rubber.
  - 2. Roof System Components:
    - a. Tilt: 5° - 7° in addition to slope of roof.
    - b. Material: Aluminum.
    - c. Include top and bottom tracks and track splices where necessary.
  - 3. Photovoltaic Module Clamps:
    - a. Material: Aluminum
    - b. Grounding: Yes.
    - c. ETL Listed: Yes.

## 2.03 ACCESSORIES

- A. Microinverter Mounting Hardware:
  - 1. Grounding Conductor Plate: Yes.
  - 2. ETL Listed: Yes.

## 2.04 FASTENERS

- A. Screw Connections: Secure roof mount components with screw with neoprene gasket, to be applied with standards as per manufacturer's instructions and in pattern as recommended by manufacturer to ensure compliance with regional wind and snow loads.



## PART 3 - EXECUTION

### 3.01 EXAMINATION

#### A. Site Verification of Conditions:

1. Verify that substructure materials and conditions and structural capabilities of roof system assembly are acceptable for installation of electrical metal supports and subsequently mounted components. See section 26 31 00 PHOTOVOLTAIC COLLECTORS.
2. Do not proceed with installation of electrical metal supports until unacceptable conditions are corrected and approved.

### 3.02 INSTALLATION

- A. Mounting Location: Comply with construction drawings and approved shop drawings.
- B. Install system components as per manufacturer's installation requirements. Ensure compliance with Indigo Pine Health & Safety plan for all elevated work.
- C. Ensure that grounding and breaking components are properly installed to eliminate risk of system damage during course of subsequent product installation.

### 3.03 CLEANING AND PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION 05 45 16



## 05 51 36 METAL RAMPS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Modular ramp assemblies for threshold condition at porch ramp.

#### 1.02 SYSTEM DESCRIPTION

- A. Design Requirements: Provide threshold and seal products which have been manufactured, fabricated and installed to meet the following minimum design criteria:
  1. Performance obtained from test procedures ICC / ANSI A117.1.
  2. Compliant with UL 410.
  3. Compliant with ADA standards.

#### 1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.
- B. Shop Drawings: Provide drawings indicating required component locations, interface with adjacent materials, installation, anchorage, fastening and similar information.
- C. Samples: Submit one each of manufacturer's standard selection samples.
- D. Quality Assurance / Control Submittals:
  1. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

#### 1.04 QUALITY ASSURANCE

- A. Labor type: Unskilled labor.
- B. Qualifications: No qualifications required.

#### 1.05 DELIVERY, STORAGE, AND HANDLING



- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

#### 1.06 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.
  - 1. Warranty Period: 3 years against defects in materials or workmanship, beginning with Date of Substantial Completion.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURER

- A. Pemko Manufacturing Company  
PO Box 3780, 4226 Transport Street  
Ventura, CA 93003  
Phone: (800) 283-9988  
[www.pemko.com](http://www.pemko.com)
- B. Substitutions: Permitted

#### 2.02 PRODUCTS

- A. Modular Ramp Threshold Assemblies:
  - 1. Material: Tempered Aluminum.
  - 2. Finish (ANSI / BHMA 156.18): Mill finish aluminum.

#### 2.03 FASTENERS

- A. Screw Connections: #10 Stainless Steel Wood Screws. Install at spacings as per manufacturer's requirements.



## PART 3 - EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the threshold manufacturer.
- B. Install units with 1 screw per foot at each connection between individual units.

### 3.02 EXAMINATION

- A. Site Verification of Conditions:
  - 1. Verify that site conditions are acceptable for installation of thresholds.
  - 2. Do not proceed with installation of thresholds until unacceptable conditions are corrected.

### 3.03 INSTALLATION

- A. Mounting Location: Comply with construction drawings and approved shop drawings.
- B. Adjust and reinforce attachment substrates as necessary for proper installation and operation of threshold assemblies.
- C. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

### 3.04 ADJUSTING

- A. Perform adjustments required to ensure that thresholds function in compliance with manufacturer's performance criteria.

### 3.05 CLEANING AND PROTECTION

- A. Remove any protective films and clean components as necessary following manufacturer's recommended procedures.
- B. Ensure compliance with section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.



- C. Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION 05 51 36





## DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

### 06 09 00 WOOD AND PLASTIC FASTENINGS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Pre-engineered metal connectors used to support a wood from an asphalt surface.
- B. Related Sections: 06 11 00 WOOD FRAMING

##### 1.02 REFERENCES

- A. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot-Dip Process
- B. ASTM A1011 – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
- C. ASTM D2395 – Standard Test Methods for Specific Gravity of Wood and Wood-Based Materials
- D. ASTM F1575 – Standard Test Method for Determining Bending Yield Moment of Nails
- E. ASTM F1667 – Driven Fasteners: Nails, Spikes, and Staples
- F. ICC-ES AC116 – Acceptance Criteria for Nails and Spikes
- G. ICC-ES AC155 – Acceptance Criteria for Hold-Downs (Tie-Downs) Attached to Wood Members

##### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.
- B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.



## 1.04 QUALITY ASSURANCE

### A. Installer qualifications:

1. Layout: Utilize an installer having demonstrated experience in laying out foundations on projects of similar size and complexity. Ensure that foundation posts are laid to dimensions specified in construction documents; and that foundation perimeter is laid square.
  - a. Labor Type: Skilled labor.
2. General Labor for porch anchors: No qualifications required.
  - a. Labor Type: Unskilled labor.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. Basis-of-Design Product: ABU44Z Adjustable and Standoff Post Bases by Simpson Strong-Tie or a comparable product of one of the following:
  1. Simpson Strong-Tie.
- B. Post Base:
  1. Post Size: 4x4
  2. Corrosion Resistant: Yes.

### 2.02 FASTENERS

- A. Fasten using nails or Simpson Strong-Drive Connector screws or bolts as per manufacturer's installation instructions.

### 2.03 FABRICATION

- A. Shop assembly to occur per the manufacturer's approved production drawings.
- B. Fabrication tolerances per manufacturer.
- C. The manufacturer's identification shall be stamped into the metal or wood part and a label may be attached to the part with adhesive.



## 2.04 TESTING

- A. Allowable loads published in manufacturer's catalog to be determined using the minimum load from static and/or cyclic analysis and one or more of the following test methods:
  - 1. Static load tests in wood assemblies
  - 2. Static load tests in steel jigs
  - 3. Static load tests of products embedded in concrete or masonry
- B. Testing to determine allowable loads shall be performed as per the applicable ICC-ES Acceptance Criteria or ASTM standard.
- C. Manufacturer to provide code testing data on all products that have been code tested upon request.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Unless otherwise noted in the manufacturer's catalog, allowable loads are for Douglas Fir-Western Larch under continuously dry conditions. Allowable loads for other species or conditions must be adjusted according to the code. See manufacturer's catalog for additional notes and requirements.
- B. Verify that the dimensions of the supporting member are sufficient to receive the specified fasteners.

### 3.02 INSTALLATION

- A. Unless otherwise noted in the manufacturer's catalog, bolts, screws and/or nails shall not be combined.
- B. All nails shall be common unless otherwise noted in the manufacturer's catalog or substituted by the engineer of record with a reduction taken.
- C. Unless otherwise noted in the manufacturer's catalog, bending steel in the field may cause fractures at the bend line. Fractured steel will not carry the allowable load and must be



replaced. When bending is allowed or required in the catalog, the connector shall be allowed one cycle bend, one time only.

- D. Galvanized connectors should not be placed in contact with treated wood unless the treated wood is adequately verified to be suitable for such contact. Some wood treatments may accelerate metal deterioration. See the manufacturer's catalog for specific recommendations.
- E. A fastener that splits the wood will not carry the allowable load. Evaluate splits to determine if the connection will perform as required. Dry wood will split more easily and should be evaluated as needed. If wood tends to split, consider pre-boring holes.
- F. Wood shrinkage will be taken into consideration when designing and installing connections.
- G. Do not overload by exceeding the manufacturer's catalog allowable load values.
- H. Unless otherwise noted in the manufacturer's catalog, fill all fastener holes with fastener types as specified in the manufacturer's catalog.
- I. All specified fasteners must be installed according to the instructions in the manufacturer's catalog.
- J. Bolt holes shall be a minimum of 1/32" and a maximum of 1/16" larger than the bolt diameter (2005 NDS 11.1.2.2).
- K. Install all specified fasteners before loading the connection.
- L. Use proper safety equipment.
- M. Anchor bolt nuts should be finger-tight plus 1/3 to 1/2 turn with a wrench. Do not use an impact wrench to tighten nuts on the anchor bolts.
- N. Modifications to products or changes in installation procedures should only be made by a qualified designer. The performance of such modified products or altered installation procedure is the sole responsibility of the designer.

### 3.03 FIELD QUALITY CONTROL

- A. Determine that the proper part is being used in the correct application and has been fabricated by the approved manufacturer by observation of the stamp into the metal part and/or the adhesive label on the product denoting part and manufacturer name.



- B. Before substituting another brand, confirm load capacity based on published testing data and calculations. The engineer/designer of record shall evaluate and give written approval for substitution prior to installation.

**END OF SECTION 06 09 00**



## 06 10 00 ROUGH CARPENTRY

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Plywood material for custom, CNC-milled structural system.
- B. General: Assemble and install all components of custom, CNC-milled structural system as per construction and assembly documents. Utilize local plywood materials, in grade specified, that comply with the specifications herein.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's maintenance data and warranty information.
- C. Shop drawings for CNC milling.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: At least one person with experience with the custom structural system is required in performing work of this section. The remaining labor may be unskilled, insofar as the experienced person fully explains the simple tab and zip-tie joints, construction process, quality control process, and safety information.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Route all plywood material for this section directly to the local, offsite CNC fabricator to mill custom pieces.
- B. Delivery: Deliver milled materials to storage facility for competition pre-fabrication purposes. In residential applications, package and deliver products as per Indigo Pine logistics plan and deliver to owner-specified site.



1. Protect edges and ends of panels. Place panels to be moved by forklift on pallets or bunks when received to avoid damage by fork tines.
  2. Panels to be transported on open truck beds should be covered with standard tarpaulins.
  3. Whenever possible, store panels under a roof. If moisture absorption is expected, cut steel banding on panel bundles to prevent edge damage.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

## PART 2 – PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. All structural plywood materials, members, and connections are to comply with the structural calculations provided in Appendix A: Structural Calculations and all APA regulations.

### 2.02 MATERIALS

- A. Basis-of-Design Product: Plywood products by Plum Creek Timber Company, Inc.
1. Substitutions: Permitted provided that substituted material meets all performance requirements.
- A. 4'x8' Structural Grade Plywood:
1. Species: Local to project site.
  2. Grade: BC Sanded
  3. Thickness: 23/32" nominal

### 2.03 FASTENERS

- A. General: Align pre-fabricated tabs and holes as per construction documents. Secure in place with stainless steel zip ties, U.N.O. Slot all jointed connections together and fasten with team-specified connector. Ensure compliance with Indigo Pine Health & Safety Plan.



- B. Stainless Steel Zip Ties Connections: 27". See "Structural Calculations" section of this manual.
- C. Screw Connections: #8 x 1-1/4" Wood Screws.
- D. Bolt Connections: Sized as per construction documents.
  - 1. Hex head bolt, zinc, low carbon.
  - 2. Flat washer on both sides of connection.
  - 3. Hex nut, zinc.

## 2.04 FABRICATION

- A. All plywood pieces to be used for rough carpentry are precut using a CNC milling machine by an offsite local fabricator:
  - 1. Design custom plywood structural members (sized to withstand all load requirements).
  - 2. Generate CAD cut files to be compatible with fabricator's CNC milling machine and send to offsite local fabricator for milling.
- B. Prefabricate plywood pieces as per construction schedule:
  - 1. Securely attach plywood with stainless steel zip tie connectors in pre-cut holes as per structural drawings.
  - 2. Organize plywood pieces in containers to arrive on site in pre-specified order of construction.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Acquire precut CNC-routed members from local fabricator:
  - 1. Organize plywood pieces in containers to arrive on site in pre-specified order of construction.
- B. Assemble structural plywood members as per assembly processes:





1. Securely attach plywood members using sequential interlocking processes or by installing stainless steel zip tie, screw or bolt connectors in pre-cut holes, as per construction documents.

**END OF SECTION 06 10 00**



## 06 11 00 WOOD FRAMING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Dimensional wood framing at porch and parapet.
- B. Related Sections: 06 09 00 WOOD AND PLASTIC FASTENINGS

#### 1.02 QUALITY ASSURANCE

- A. All dimensional lumber materials are to be SFI certified.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to storage facility for competition pre-fabrication purposes. In residential applications, package and deliver products as per Indigo Pine logistics plan and deliver to owner-specified site.
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Dimensional Lumber:
  - 1. Species: Local to project site.
  - 2. Grade: #2 minimum.
  - 3. Size: Varies: as per construction documents.
  - 4. Exterior Rated: Where indicated on construction documents.

#### 2.02 FASTENERS

- A. 4"x4" Adjustable Post Base: See section 06 09 00 WOOD AND PLASTIC FASTENINGS



- B. Screw Connections: #8 x 3" Wood Screws.
- C. Bolt Connections: 1/2" x 3" Hex Head Lag Bolts.

### 2.03 FABRICATION

- A. Precut and pre-fabricate members as per construction documents.
- B. Organize members to arrive on site in pre-specified order of construction.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install members as per construction documents.
- B. See section 06 09 00 WOOD AND PLASTIC FASTENINGS for installation of 4"x4" posts at base of porch columns.

**END OF SECTION 06 11 00**



## 06 16 00 SHEATHING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Wall sheathing with integral water-resistive barrier and air barrier, roof sheathing with integral roof underlayment, and subflooring. All sheathing is custom, CNC-milled plywood for exterior wall, roof, foundation overlay and interior subfloor conditions.
- B. Related Sections: 06 10 00 ROUGH CARPENTRY

#### 1.02 REFERENCES

- A. ASME B18.6.1 - Wood Screws (Inch Series)
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials
- D. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials
- F. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- G. DOC PS 2 - Performance Standard for Wood-Based Structural Panels
- H. ICC IBC - International Building Code
- I. ICC IRC - International Residential Code for One- and Two-Family Dwellings
- J. ICC-ES AC38 – Acceptance Criteria for Weather Resistive Barriers
- K. ICC-ES AC116 - Acceptance Criteria for Nails and Spikes
- L. ICC-ES AC148 - Acceptance Criteria For Flexible Flashing Materials
- M. ICC-ES AC201 - Acceptance Criteria for Staples
- N. ICC-ES AC266 - Acceptance Criteria for Wood Structural Panel Roof Sheathing Factory-Laminated with an Alternate Roof Underlayment
- O. ICC-ES AC310 - Acceptance Criteria for Water-Resistive Membranes Factory-bonded to Wood-based Structural Sheathing, Used as Water-Resistive Barriers



P. SFI 2010 - 2014 Standard

1.03 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Evaluation Reports: From ICC-ES, for wood sheathing and seam tape.
- D. Product Certifications: From manufacturer, indicating that sheathing products comply with ICC-ES AC266 and ICC-ES AC310.
- E. Shop drawings for CNC milling.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide wood products from manufacturer certified by SFI, FSC, or comparable sustainable forestry program acceptable to Indigo Pine Team.
- B. Provide wall sheathing products meeting requirements for water-resistive barrier in accordance with ICC-ES AC310.
- C. Provide roof sheathing products meeting requirements for roof underlayments in accordance with ICC-ES AC266.
- D. Provide subfloor products meeting requirements in accordance with ICC-ES ESR-1785 and DOC PS2-10, "Performance Standard for Wood-Based Structural-Use Panels."
- E. Installer Qualifications: At least one person with experience with the custom sheathing system (tab system) is required in performing work of this section. The remaining labor may be unskilled, insofar as the experienced person fully explains the simple tab and screw joints.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for protection of sheathing products from weather prior to installation.
  - 1. Set panel bundles on supports to keep off ground.



2. Cover panels loosely with waterproof protective material.
  3. Anchor covers on top of stack, but keep away from sides and bottom to assure adequate air circulation.
  4. When high moisture conditions exist, but banding on panel stack to prevent edge damage.
- B. Route all plywood material for this section directly to the local, offsite CNC fabricator to mill custom pieces before shipment to job site.

## 1.06 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which sheathing manufacturer agrees to repair or replace sheathing products that demonstrate deterioration or failure under normal use due to manufacturing defects within warranty period specified, when installed according to manufacturer's instructions.
- C. Roof and Wall Panel Warranty:
1. Warranty Period for Sheathing Products: 30 years following date of Substantial Completion.
  2. Warranty Conditions: Special warranties exclude deterioration or failure due to structural movement resulting in stresses on sheathing products exceeding manufacturer's written specifications, or due to air or moisture infiltration resulting from cladding failure or mechanical damage.
- D. Subfloor Warranty:
1. For subflooring and roof and wall sheathing applications, manufacturer shall warrant that the panels will not delaminate nor require sanding due to moisture absorption during installation within 300 days of purchase.
  2. Warranty Period: 50 years from date of manufacture.

## PART 2 – PRODUCTS



## 2.01 MANUFACTURERS

- A. Huber Engineered Woods  
10925 David Taylor Drive  
Suite 300  
Charlotte, NC 28262  
Phone: 1-800-933-9220  
<http://www.huberwood.com/>

- B. Substitutions: Not permitted.

## 2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Exterior Fire-Test Exposure: ASTM E108, Class A, when covered with approved Class A coverings.
  - 2. Fire-Resistance Ratings: Where indicated, provide assemblies tested for fire resistance per ASTM E119.
- B. Air-Barrier Assembly Air Leakage: Less than 0.04 cfm/sq. ft. at 1.57 lbs/sq. ft. (0.2 L/s x sq. m at 75 Pa), per ASTM E2375.
- C. Water-Vapor Permeance, Facer: Minimum 12 perms (689 ng/Pa x s x sq. m), ASTM E96/E96M.
- D. Weather Exposure: Manufacturer warranty applies for maximum allowable exposure period of 180 days.

## 2.02 MATERIALS

- A. Single Source Limitations: Provide wall and roof sheathing by a single manufacturer.
- B. Wall Sheathing with Integral Water-Resistive Barrier and Air Barrier:
  - 1. Oriented-Strand-Board Wall Sheathing: Exposure 1 sheathing with factory-laminated water-resistive barrier facer with printed fastener location symbols.
  - 2. Span Rating, Panel Grade and Performance Category: Not less than 24/16; Rated Sheathing; 7/16 Performance Category.



3. Edge Profile: Self-spacing.
  4. Facer: Medium-density, phenolic-impregnated sheet material qualifying as a Grade D weather-resistive barrier in accordance with ICC AC38.
    - a. Provide fastener spacing symbols on facer for 16-inch (406 mm) and 24-inch (610 mm) on center spacing.
- C. Roof Sheathing with Integral Roof Underlayment:
1. Oriented-Strand-Board Roof Sheathing: Exposure 1 sheathing with factory-laminated water-resistive barrier facer with printed fastener location symbols.
  2. Span Rating, Panel Grade and Performance Category: Not less than 40/20; Structural 1; 5/8 Performance Category.
  3. Edge Profile: Self-spacing.
  4. Exterior Surface Facer: Medium-density, phenolic-impregnated kraft paper overlay in accordance with ICC AC266.
    - a. Provide fastener spacing symbols on facer for 16-inch (406 mm) and 24-inch (610 mm) on center spacing.
- D. Subflooring:
1. Oriented-Strand-Board Combination Subfloor-Underlayment: Exposure 1 single-floor panels.
  2. Span Rating and Performance Category: Not less than 24 oc, 23/32 Performance Category.
  3. Edge Detail: Square Edge.
  4. Surface Finish: Fully sanded face.
  5. Performance Standard: DOC PS2-10 and ICC-ES ESR-1785 (24 oc, 23/32 Performance Category).
  6. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 16-inches (406 mm), 19.2-inches (488 mm) and 24-inches (610 mm) on center spacings.

## 2.03 FASTENERS





- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article by the authority having jurisdiction, International Building Code, International Residential Code, Wood Frame Construction manual, and National Design Specification.
- B. Wall and Roof Panels:
  - 1. Align pre-fabricated holes with tabs on exterior structure as per construction documents. Secure in place with #8 1-1/4" exterior wood screws.
- C. Subflooring:
  - 1. Secure to floor noggings with #8 1-1/4" wood screws.

#### 2.04 WALL AND ROOF SHEATHING ACCESSORIES

- A. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, seam tape consisting of polyolefin film with acrylic adhesive, meeting ICC-ES AC148, and tested as part of an assembly meeting performance requirements.
  - 1. Thickness: 0.012 inch (0.3 mm).

#### 2.05 FABRICATION

- A. All plywood pieces to be used for exterior wall sheathing, roof sheathing, and interior subfloor are precut using a CNC milling machine by an offsite local fabricator.
- B. Label precut sheathing panels as per construction documents.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Wall and Roof Sheathing:
  - 1. Install sheathing panels in accordance with manufacturer's written instructions, requirements of applicable Evaluation Reports, and requirements of authorities having jurisdiction.



2. Do not bridge expansion joints; allow joint spacing equal to spacing of structural supports.
  3. Install panels with laminated face to exterior. Stagger end joints of adjacent panel runs. Support all panel edges.
    - a. Space square-edged panels 0.125 inch (3 mm).
    - b. Butt edges of self-spacing edge panels.
  4. Install sheathing onto structure as per assembly processes:
    - a. Place exterior sheathing members onto interlocking tabs and secure to structure with #8 1-1/4" exterior wood screws.
  5. Apply ZIP System Tape at all panel seams, penetrations, and facer defects or cracks to form continuous weathertight surface. Apply tape according to manufacturer's written instructions and requirements of ICC-ES applicable to tape application.
- B. Floor Sheathing:
1. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
  2. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
  3. Attach panels to floor noggings with #8 1-1/4" wood screws. Make tight connections. Install fasteners without splitting wood.

**END OF SECTION 06 16 00**



## 06 41 00 ARCHITECTURAL WOOD CASEWORK

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Plywood material for custom, CNC-milled interior cabinetry.
- B. Related Sections: 09 91 23 INTERIOR PAINTING, 08 71 00 DOOR HARDWARE, 09 91 00 PAINTING, 12 32 23 CASEWORK HARDWARE

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Shop drawings for CNC milling.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: At least one person with experience with the custom cabinetry system is required in performing the work of this section. The remaining labor may be unskilled, insofar as the experienced person fully explains the simple tab and screw joints. Installer of system components (MEP) must have experience in performing work of related sections which are to be integrated into cabinet modules before arriving to final site.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for protection of plywood products from weather prior to installation.
  - 1. Set panel bundles on supports to keep off ground.
  - 2. Cover panels loosely with waterproof protective material.
  - 3. Anchor covers on top of stack, but keep away from sides and bottom to assure adequate air circulation.



4. When high moisture conditions exist, but banding on panel stack to prevent edge damage.
- B. Route all plywood material for this section directly to the local, offsite CNC fabricator to mill custom pieces before shipment to job site.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. 4'x8' Plywood:
1. Species: Local to project site.
  2. Grade: AA
  3. Veneer: Birch
  4. Thickness: 3/4", 5/8", 1/2" as indicated on construction documents.

### 2.02 FASTENERS

- A. General: Align pre-fabricated tabs and holes where necessary as per construction documents.
- B. Secure pieces with 1-1/4" wood screws, gold color.

### 2.03 FABRICATION

- A. All plywood pieces to be used for interior cabinetry are precut using a CNC milling machine by an offsite local fabricator:
1. Design custom plywood cabinetry members.
  2. Generate CAD cut files to be compatible with fabricator's CNC milling machine and send to offsite local fabricator for milling.
  3. Organize all drawing files such that finish face wood grain runs horizontal (east/west or left/right). It is important that the parts are not rotated when nested.
  4. Cut all parts with "B" side of plywood facing up. The "A," or finish side, needs to be opposite side of cut.



- B. Prefabricate plywood pieces into modules as per construction schedule:
  - 1. Securely attach plywood pieces for cabinetry into respective modules with steel screws in pre-drilled holes as per structural drawings.
  - 2. Integrate mechanical systems into cabinet modules as required per construction documents.
  - 3. Organize cabinetry modules in containers to arrive on site in pre-specified order of construction.
- C. Pre-stain cabinetry components as per finish schedule. See section 09 91 00 PAINTING.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Assemble cabinetry modules on site as per assembly processes:
  - 1. Install in pre-specified order of construction, ensuring that modules align with precut tab holes in subfloor and finish floor.
  - 2. Securely attach prefabricated cabinetry members to each other or to superstructure using wood screws in predrilled holes, as per construction documents.
  - 3. Connect mechanical systems contained within cabinetry modules to adjacent modules or to superstructure of home as required.
- B. Touch up panels with paint as necessary. See section 09 91 00 PAINTING.

**END OF SECTION 06 41 00**



## 06 74 13 FIBERGLASS REINFORCED GRATINGS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Shop fabricated fiberglass reinforced plastic molded fiberglass gratings and treads for use as railing on Indigo Pine porch structure.

#### 1.02 REFERENCES

- A. Fiberglass Reinforced Plastics Grating Manual, ACMA, latest edition
- B. ASTM D-635-Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- C. ASTM D-495-High Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
- D. ASTM D-696-Coefficient of Linear Thermal Expansion for Plastics
- E. ASTM E-84-Surface Burning Characteristics of Building Materials
- F. OSHA Code of Federal Regulations (CFR), Volume 29

#### 1.03 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Shop drawings of all fabricated systems and accessories in accordance with the provisions of this Section.
- C. Manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, ledge angles, embedded angles, member sizes, and connection details.
- D. Manufacturer's product samples for approval of material quality and color.

#### 1.04 QUALITY ASSURANCE



- A. All items to be provided under this Section shall be furnished only by manufacturers having experience in the design and manufacture of similar products and systems. If requested, experience shall be demonstrated by a record of at least five (5) previous, separate, similar successful installations in the last five (5) years.
- B. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
- C. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.
- D. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. All fiberglass gratings and components shall be shop fabricated; piece match marked to assembly or erection drawings.
- B. Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.
- C. All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins and their catalysts and hardeners in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURER



- A. American Grating, LLC.  
1191 Center Point Dr.  
Henderson, NV 89074  
(702) 567-0303
- B. Substitutions: Permitted.

## 2.02 GENERAL

- A. All FRP items under this Section shall be composed of fiberglass reinforcements and resins in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
- B. Fiberglass reinforcement shall be a combination of continuous in sufficient quantities as needed by the application and/or physical properties required.
- C. Resin shall be polyester for all systems.
- D. All finished surfaces of FRP items and fabrications shall be smooth, resin rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
- E. All FRP fiberglass gratings and systems shall have a tested flame spread rating of 25 or less when tested in accordance with the ASTM E 84 Tunnel Test. Fiberglass gratings shall also have a tested burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per ASTM D635. Manufacturer may be required to provide certification of ASTM E84 test on grating panels from an independent testing laboratory.
- F. All grating clips and hardware shall be manufactured of Type 316SS.
- G. After fabrication, all cut ends, holes and abrasions of FRP fiberglass grating shall be sealed with a resin comparable to the fiberglass grating panel.

## 2.03 MATERIALS

- A. Basis-of-Design Product: GRIDWALK Square Mesh Fiberglass Grating by American Grating, LLC.
  - 1. Substitutions: Permitted.





2. General: Fiberglass gratings shall be reinforced with rovings of equal number of layers in each direction.
3. Non slip surfacing: Fiberglass grating shall be manufactured with a secondarily applied grit on the top of each bar providing excellent slip resistance.
4. Color: By owner.
5. Depth: 1-1/2" with a tolerance of plus or minus 1/16".
6. Mesh Configuration: 1-1/2" x 1-1/2" with a tolerance of plus or minus 1/16" mesh centerline to centerline.
7. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Measurements: FRP fiberglass grating systems supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by manufacturer to complete the work. When field dimensions are not required, contractor shall determine correct size and locations of required holes or cutouts from field dimensions before fiberglass grating fabrication.

### 3.02 INSPECTION

- A. Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor prior to the beginning of any fabrication work so that inspection may be provided.
- B. The fiberglass grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, delaminations, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).



### 3.03 INSTALLATION

- A. Contractor shall install FRP gratings in accordance with construction documents.
- B. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION 06 74 13



## DIVISION 07 – THERMAL AND MOISTURE PROTECTION

### 07 13 00 SHEET WATERPROOFING

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Material for vapor barrier over application over CMU raft foundation.

##### 1.02 REFERENCES

- A. ASTM E 1745-09 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- B. ASTM E 154-99 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- C. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials.
- D. ASTM F 1249-06 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
- E. ASTM E 1643-09 Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- F. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

##### 1.03 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Summary of test results as per paragraph 8.3 of ASTM E 1745.

##### 1.04 QUALITY ASSURANCE

- A. Installer qualifications:



1. Labor Type: Unskilled labor.
2. Qualifications: No qualifications required.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- B. Basis-of-Design Product: Stego Wrap Vapor Barrier (15-mil) by Stego Industries, LLC.
  1. Substitutions: Permitted.
- C. Vapor Barrier:
  1. Type: Polyethylene plastic.
  2. Vapor barrier must have following qualities:
    - a. Permanence of less than 0.01 Perms as tested in accordance with ASTM E 1745 Section 7.
    - b. Other performance criteria:
      - 1) Strength: ASTM E 1745 Class A.
      - 2) Thickness: 15 mil minimum.
- D. Barrier Tape:
  1. Width: 4”
  2. Material: Polyethylene Film.
  3. Adhesive: Rubber-based, pressure sensitive.

### 2.02 ACCESSORIES

- A. Visqueen vapor barrier: Barrier tape at all seams and at perimeter to form weather-tight barrier.

### 2.03 FABRICATION

- A. Precut vapor barrier materials to length as per construction documents. Ensure 6 inch minimum overlap as per manufacturer’s installation instructions.



## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643.
  - 1. Overlap joints 6 inches and seal with manufacturer's recommended tape or equivalent.
  - 2. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities. Seal penetrations with barrier tape or equivalent.
  - 3. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.
- B. Additional requirements per construction sequencing:
  - 1. Seal to exterior wall sheathing with barrier tape as per construction documents.

END OF SECTION 07 13 00



## 07 13 13 FELT ROOFING UNDERLAYMENT

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Material for roofing underlayment.
- B. Related sections: 07 41 13 ALUMINUM ROOF PANELS.

#### 1.02 REFERENCES

- A. ASTM D 4869 Type 1 – Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing.

#### 1.03 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.04 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.
  - 3. Ensure compliance with all safety requirements for Work on elevated surfaces as noted in the Indigo Pine Health & Safety Plan.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Basis-of-Design Product: Asphalt Saturated Organic Felt Paper by Grip-Rite.
  - 1. Substitutions: Permitted.
- B. Asphalt Saturated Organic Felt Paper:



1. Weight: 30#

## 2.02 FASTENERS

- A. Staple Connection: 1/2" Heavy Duty Staples.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Ensure that base material is flat and free of debris before installation.

### 3.02 INSTALLATION

- A. Install felt underlayment in accordance with manufacturer's instructions.
  1. Overlap joints 6 inches minimum.
- B. Secure to Zip sheathing with staples, spaced as per manufacturer's installation instructions.
- C. For roof slopes less than 2:12, install a double layer of felt underlayment before installation of roof finish, see section 07 41 13 ALUMINUM ROOF PANELS.

**END OF SECTION 07 13 13**



## 07 21 00 THERMAL INSULATION

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Cellulose batt insulation at wall, roof, and floor cavities.

#### 1.02 REFERENCE STANDARDS

- A. ASTM C739 – Corrosion Resistance and Moisture Vapor Sorption
- B. ASTM E84, UL 723 – Standard Test Method for Surface Burning Characteristics of Building Materials
- C. ASTM E 90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- D. ASTM C1338 – Standard Test Method for Determining Fungi Resistance of Insulation materials and Facings
- E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the heat Flow Meter Apparatus
- F. ASTM E970 - Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant heat Energy Source
- G. ASTM C167 - Standard Test Method for Thickness and Density of Blanket or Batt Thermal insulations
- H. ASTM C1304 - Standard Test Method for Assessing the Odor Emission of Thermal Insulation Materials

#### 1.03 SUBMITTALS

- A. Manufacturer's product data.
- B. Manufacturer's certification that materials comply with specified requirements and are suitable for intended applications.
- C. Manufacturer's installation instructions, maintenance data, and warranty information.





#### 1.04 QUALITY ASSURANCE

- A. Manufacturer's qualifications: Manufacturer regularly engaged, for past 4 years, in manufacture of materials of similar type to those specified in this section.
- B. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
  - 1. Store and handle materials in accordance with manufacturer's instructions.
  - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
  - 3. Store materials in clean, dry area indoors.
  - 4. Protect materials during storage, handling, and installation to prevent damage.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURER

- A. Cellulose Materials Solutions, LLC  
2472 Port Sheldon Street  
Jenison, Michigan 49428  
Phone: (616) 669-2990  
[www.cmsgreen.com](http://www.cmsgreen.com)
- B. Substitutions: Permitted.



## 2.02 MATERIALS

### A. Cellulose Batt Insulation:

1. Basis-of-Design Product: ECOCELL Cellulose Batt Insulation by Cellulose Materials Solutions, LLC.
  - a. Substitutions: Permitted.
2. Manufactured from Recycled Fibers: Primarily Paper.
3. Post-Consumer Recycled Content: 55% Minimum.
4. Fibers: Treated with borate chemicals to impart flame resistance and antimicrobial characteristics.
5. Settled Density: 2.5 lbs per cu ft. maximum.
6. Average Thermal Resistance (R-value) per inch: 3.7
7. Flammability Characteristics:
  - a. Critical Radiant Flux: 0.12 W/cm<sup>2</sup> minimum.
  - b. Smoldering Combustion: No evidence of flaming and weight loss of 15.0% maximum.
8. Moisture Gain in Insulation: 15% maximum by weight.
9. Environmental Characteristics: Does not support fungal growth.
10. Surface Burning Characteristics: ASTM E 84 and UL 723
  - a. Flame Spread Index: 15
  - b. Smoke Developed Index: <450.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas to receive insulation materials of this section.
- B. Do not begin installation until unacceptable conditions are corrected.

### 3.02 PREPARATION

- A. Keep insulation products away from heat sources.



- B. Identify locations of recessed lights, furnace flues, heating vents, chimneys and other sources of heat or combustion in the attic. Install barriers around heat sources with clearances of at least 3 inches from the heat source. Check local code requirements for barriers. Heat trapped by any type of insulation can be a fire hazard.

### 3.03 INSTALLATION

- A. Install insulation materials of this section in accordance with manufacturer's instructions at locations indicated in construction documents.

### 3.04 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse.
- B. Do not place insulation over fixtures that could trap heat unless they are type IC rated for contact with insulation. Keep insulation away from exhaust flues of furnaces, water heaters, space heaters or other heat-producing devices.

**END OF SECTION 07 21 00**



## 07 41 13 ALUMINUM ROOF PANELS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Metal roof panels for application on the home.
- B. Related sections: 07 92 00 JOINT SEALANTS.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data.
- B. Manufacturer's warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.
  - 3. Ensure compliance with all safety requirements for Work on elevated surfaces as noted in the Indigo Pine Health & Safety Plan.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Basis-of-Design Product: PBR Profile Metal Panel by American Building Components.
  - 1. Substitutions: Permitted
- B. Metal Roofing:
  - 1. Profile: PBR
  - 2. Thickness: 26 Ga.
  - 3. Coating: Galvalume Plus
  - 4. Minimum Slope: Rated for performance for roof slopes of 1":12" at minimum.



## 2.02 FASTENERS

- A. Screw Connection: 1-1/2" screw with neoprene gasket to be applied per manufacturer's instructions.
- B. Joint Sealants: 3/8" butyl tape sealer to be applied between weather infiltration point and fastener.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Inspect substructure for proper alignment and uniformity to avoid panel distortion.

### 3.02 INSTALLATION

- A. Install directly onto Zip roof sheathing panels and roofing underlayment per manufacturer's instructions.
- B. Periodically check panel alignment to ensure proper panel installation.
- C. Keep panels clean during installation. Do not allow panels to come into contact with water runoff from lead, copper or graphite.
- D. Ensure 6" minimum overlap at leading end of panels.

**END OF SECTION 07 41 13**



## 07 42 00 WALL PANELS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Aluminum panel material for custom, CNC-milled exterior aluminum cladding.
- B. Related Sections: 07 71 23 MANUFACTURED GUTTERS AND DOWNSPOUTS, 23 31 13 METAL DUCTS AND CASINGS

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of color.
- D. Shop drawings for CNC milling.

#### 1.03 QUALITY ASSURANCE

- A. Composite Panel Manufacturer shall have a minimum of 20 years' experience in the manufacturing of this product.
- B. Composite Panel Manufacturer shall be solely responsible for panel manufacture and application of the finish.
- C. Fabricator shall be acceptable to the composite panel manufacturer.
- D. Fabricator shall have a minimum 5 years' experience of metal panel work similar in scope and size to this project.
- E. Installer Qualifications: At least one person with experience with the custom siding system (tab and rivet system) is required in performing work of this section. The remaining labor may be unskilled, insofar as the experienced person fully explains the simple tab, rivet, and screw joints to properly fabricate individual panels and attach panels to structure.



#### 1.04 REFERENCES

- A. AA-C22-A41: Anodized - Clear Coatings.
- B. AA-C22-A42: Anodized - Integral Color Coatings.
- C. AAMA 508-05: Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
- D. ASTM E 330: Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads
- E. ASTM E 283: Rate of Leakage through Exterior Windows, Curtain Walls, and Doors
- F. ASTM D 1781: Climbing Drum Peel Test for Adhesives
- G. ASTM E 84: Surface Burning Characteristics of Building Materials
- H. ASTM D 3363: Method for Film Hardness by Pencil Test
- I. ASTM D 2794: Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- J. ASTM D 3359: Methods for Measuring Adhesion by Tape Test
- K. ASTM D 2247: Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
- L. ASTM B 117: Method of Salt Spray (Fog) Testing
- M. ASTM D 822: Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products
- N. ASTM D 1308: Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- O. ASTM D 1735: Method for Water Fog Testing of Organic Coatings.
- P. ASTM D 1929: Standard Test Method for Determining Ignition Temperature of Plastics
- Q. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect finish and edges in accordance with panel manufacturer's recommendations.
- B. Store material in accordance with panel manufacturer's recommendations.



- C. Route all plywood material for this section directly to the local, offsite CNC fabricator to mill custom pieces before shipment to job site.
- D. Transport milled materials in a vertical orientation. Do not remove protective film from material until components are assembled in their final form.

## 1.06 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. Basis-of-Design Product: Alpolic ACM by Mitsubishi Plastics Composites America, Inc.
  - 1. Substitutions: Permitted.
- B. Aluminum Composite Panels:
  - 1. Finish: Bone White
  - 2. Thickness: 4mm (0.157")
  - 3. Core: Polyethylene

### 2.02 FASTENERS

- A. General: Fold pre-fabricated tabs to align holes and secure tabs with steel rivets.
- B. Panel Fasteners: 3/16" steel rivets
- C. Fasteners to exterior sheathing: #8 1-1/4" exterior wood screws

### 2.03 FABRICATION

- A. All aluminum siding panels to be used for exterior finish are precut using a CNC milling machine by an offsite local fabricator:
  - 1. Design custom aluminum siding panels, including window treatments, gutter and downspout system, and porch siding and details.





2. Generate CAD cut files to be compatible with fabricator's CNC milling machine and send to offsite local fabricator for milling.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Acquire precut CNC-routed members from local fabricator:
  1. Organize siding, gutter, window and porch pieces in containers to arrive on site in pre-specified order of construction.
- B. Assemble siding panels and window treatments as per assembly processes:
  1. Align pre-fabricated tabs and holes and secure tabs with steel rivets to assemble individual siding panels.
  2. Align assembled panels with pre-drilled pilot holes in Zip sheathing and secure panels to sheathing with exterior wood screws.
  3. Secure panels at overlap with steel rivets.

END OF SECTION 07 42 00



## 07 65 00 FLEXIBLE FLASHING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Exterior window flashing tape, drip edge at roof.

#### 1.02 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.
  - 3. Ensure compliance with all safety requirements for Work on elevated surfaces as noted in the Indigo Pine Health & Safety Plan.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Window and Door Tape:
  - 1. Basis-of-Design Product: SmartFlash Sealant Tape by Pella Corporation.
    - a. Substitutions: Permitted.
  - 2. Type: Foil backed butyl.
  - 3. Width: 3”
  - 4. UV Resistant: Yes.
- B. Gable Trim Flashing:
  - 1. Material: Aluminum
  - 2. Depth: 5”
  - 3. Width: 6”
  - 4. Gauge: .014”



## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install per manufacturer's instructions.

**END OF SECTION 07 65 00**



## 07 92 00 JOINT SEALANTS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Materials for sealing windows and doors, and sealant tape for metal roofing.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of color.

#### 1.03 PROJECT CONDITIONS

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

#### 1.04 PERFORMANCE REQUIREMENTS

- A. All sealant applications to comply with ASTM C 1193, ASTM C920, ASTM C1184.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Low-Emitting Materials:
  - 1. Exterior reactive sealants shall have a VOC content of not more than 50g/L or 4 percent by weight, whichever is greater.



2. Other exterior caulks and sealants shall have a VOC content of not more than 30 g/L or 2 percent by weight, whichever is greater.
- B. Sealant for General Exterior use where another type is not specified:
  1. Color: White
  2. Polymer: 100% Silicone
- C. Sealant for Roof Panels (see section 07 41 13 ALUMINUM ROOF PANELS):
  1. Sealant:
    - a. Color: White
    - b. Polymer: Polyurethane
  2. Butyl Tape Sealant:
    - a. Type: Single Bead
    - b. Width: 3/8"
- D. Window and Door Sealant:
  1. Type: Low Expansion
  2. Insulating: Yes

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions are acceptable for installing product in accordance with manufacturer's instructions.

### 3.02 PREPARATION

- A. Substrate Preparation: Prepare manufacturer's recommended substrates to be clean, dry, and sound prior to application of the sealant. All contaminants, impurities, or other adhesion inhibitors must be removed from the surfaces to which the sealant is intended to adhere.

### 3.03 INSTALLATION



- A. Spray in foamed-in-place insulation into cavity at window and door openings to seal from thermal and air infiltration.
- B. Install joint sealant per manufacturer's instructions.

**END OF SECTION 07 92 00**



## DIVISION 08 – OPENINGS

### 08 14 23 OUT-SWING ENTRY DOORS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Out-swing entry doors.
- B. Related sections: 07 21 00 THERMAL INSULATION, 07 92 00 JOINT SEALANTS, 08 71 00 DOOR HARDWARE

##### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of color.

##### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Installation: Installer experienced in performing work of this section.
    - a. Labor Type: Skilled labor.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.
- B. Storage: Store materials in an upright position, off ground, under cover, and protected from weather, direct sunlight, and construction activities.
- C. Handling: Protect materials and finish during handling and installation to prevent damage.



## 1.05 REFERENCES

- A. AAMA 502 – Voluntary Specification for Field Testing of Windows and Sliding Doors.
- B. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM B 368 – Copper-Accelerated Acetic Acid - Salt Spray (Fog) Testing (CASS Test).
- D. ASTM C 1036 – Flat Glass.
- E. ASTM C 1048 – Heat-Treated Flat Glass–Kind HS, Kind FT Coated and Uncoated Glass.
- F. ASTM D 1149 – Rubber Deterioration – Surface Ozone Cracking in a Chamber.
- G. ASTM D 2803 – Filiform Corrosion Resistance of Organic Coatings on Metal.
- H. ASTM D 4060 – Abrasion Resistance of Organic Coatings by the Taber Abraser.
- I. ASTM E 283 – Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
- J. ASTM E 330 – Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- K. ASTM E 331 – Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- L. ASTM G 85 – Modified Salt Spray (Fog) Testing.
- M. ASTM E 1300 – Standard Practice for Determining Load Resistance of Glass in Buildings.
- N. AAMA / WDMA / CSA 101 / I.S.2 / A440 – Windows, Doors and Unit Skylights.
- O. WDMA I.S.4 – Water Repellent Preservative Treatment for Millwork.
- P. WDMA CS2 Hallmark Program Procedural Guide for Side Hinged Exterior Door Systems

## 1.06 PERFORMANCE REQUIREMENTS

- A. Door Unit Air Leakage, ASTM E 283, 1.57 psf (25 mph): 0.30 cfm per square foot of frame or less.
- B. Door Unit Water Penetration: No water penetration through door unit when tested in accordance with ASTM E 331 with water applied at rate of 5 gallons per hour per square





foot. Doors with standard sill shall have water resistance performance level up to 7.5 psf and low profile sill (ADA) shall have water resistance performance level of 0 psf.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Pella Corporation  
102 Main Street  
Pella, Iowa 50219  
Phone: 641-621-1000  
<http://www.pella.com/home/default.aspx>
- B. Substitutions: Permitted.

### 2.02 MATERIALS

- A. Basis-of-Design Product: Pella 450 Series Out-Swing Entry Door by Pella Corporation.
  - 1. Substitutions: Permitted.
- B. Out-Swing Entry Doors:
  - 1. Factory-assembled doors with outward-swing door panels installed in frames.
  - 2. Frames:
    - a. General: Softwood, water-repellent, preservative-treated.
    - b. Interior Exposed Surfaces: Clear pine, veneered, and edge banded ready for site finishing with no visible fastener holes.
    - c. Exterior Surfaces: Aluminum Clad Wood
    - d. Sills: Extruded aluminum.
  - 1. Door Panels:
    - a. Fiberglass Door Panels:
      - 1) 0.072-inch minimum fiberglass skin on exterior and interior surfaces with CFC-free injected foam insulating core.



- 2) Rails and Stiles: Wood top rails and stiles and wood plastic composite bottom rails secured with structural adhesive between skins at perimeter.
- 3) Fiberglass Grain: Smooth.
- 4) Lock Block: 12-inches or greater, solid wood.
- 5) Panel Thickness: 1-11/16 inches (43 mm).

## 2. Weather Strip

- a. Head: Dual-seal weatherstrip shall contact interior face and side of door panel and extruded leaf rain screen shall cover the exterior face of door panel.
- b. Jambs: Dual-seal weatherstrip shall contact interior face and side of door panel.
- c. Sill: Bristle rain screen at exterior face of door panel with bulb weatherstrip on threshold shall contact interior face of door panel.

## 2.02 GLAZING

- A. Float Glass: ASTM C 1036, Quality 1.
  1. Tempered Glass: ASTM C 1048.
  2. ASTM E1300 compliant.
- B. Type:
  1. Tempered Insulating Glass: Multi-layer Low-E coated with argon, dual-seal insulating glass, installed into high-performance glazing frames.

## 2.03 TOLERANCES

- A. Doors shall accommodate the following opening tolerances:
  1. Vertical Dimensions Between High and Low Points: Plus 1/4 inch, minus 0 inch.
  2. Width Dimensions: Plus 1/4 inch, minus 0 inch.
  3. Building Columns or Masonry Openings: Plus or minus 1/4 inch from plumb.

## 2.04 INSTALLATION ACCESSORIES

- A. Flashing/Sealant Tape:
  1. Aluminum-foil-backed butyl window and door flashing tape.



2. Maximum Total Thickness: 0.013 inch.
  3. UV resistant: Yes.
  4. Verify sealant compatibility with sealant manufacturer. See section 07 92 00 JOINT SEALANTS.
- B. Interior Insulating-Foam Sealant: Low-expansion, low-pressure insulating window and door foam sealant. See section 07 92 00 JOINT SEALANTS.
- C. Exterior Perimeter Sealant: See section 07 65 00 FLEXIBLE FLASHING.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify openings are ready to receive work and opening dimensions and clearances are as indicated on approved drawings. Do not begin installation until openings have been properly prepared.
- B. If opening preparation is the responsibility of another installed, notify on-site Site Manager of unsatisfactory preparation before proceeding.

### 3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and approved shop drawings.
- B. Install doors to be weather-tight and freely operating.
- C. Maintain alignment with adjacent work.
- D. Secure assembly to framed openings, plumb and square, without distortion.
- E. Integrate door system installation with exterior weather-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with weather-resistant barrier using watershed principles in accordance with door manufacturer's instructions.
- F. Place interior seal around door perimeter to maintain continuity of building thermal and air barrier using insulating-foam sealant.
- G. Seal door to exterior wall cladding with sealant and related backing materials at perimeter of assembly.



- H. Leave doors closed.

### 3.03 CLEANING

- A. Do not use harsh cleaning materials or methods that would damage finish.
- B. Remove manufacturer's proprietary labels and visible markings.

### 3.04 PROTECTION

- A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

**END OF SECTION 08 14 23**



## 08 53 13 VINYL DOUBLE-HUNG WINDOWS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Vinyl windows.
- B. Related sections: 07 21 00 THERMAL INSULATION, 07 92 00 JOINT SEALANTS

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of color.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Installation: Installer experienced in performing work of this section.
    - a. Labor Type: Skilled labor.

#### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
  - 1. Deliver windows to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name.
  - 2. Include installation instructions.
- B. Storage and Handling:
  - 1. Store and handle windows in accordance with manufacturer's instructions.
  - 2. Store windows off ground and under cover.
  - 3. Provide full support under framework when storing, handling, and installing windows.



4. Allow sufficient spacing between windows during storage for ventilation.
5. Do not lift windows by head member only.
6. Protect windows from weather, direct sunlight, and construction activities.
7. Protect windows and finish during handling and installation to prevent damage.

#### 1.05 REFERENCE STANDARDS

- A. AAMA 502 – Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
- B. ASTM C 1036 – Standard Specification for Flat Glass.
- C. ASTM C 1048 – Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
- D. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- E. ASTM F 588 – Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact.
- F. SMA 1201 – Specifications for Insect Screens for Windows, Sliding Doors and Swinging Doors.
- G. AAMA / WDMA / CSA 101/I.S.2/A440 – North American Fenestration Standard/Specification for Windows, Doors, and Skylights.

#### 1.06 PERFORMANCE REQUIREMENTS

- A. Standard Performance:
  1. Meets or exceeds AAMA / WDMA / CSA 101/I.S.2/A440 Ratings: R-PG20 to R-PG35, WDMA Hallmark Certified.
  2. Unit assembly shall withstand both positive and negative uniform static air pressure difference without damage when tested according to ASTM E 330.
  3. Air Infiltration, 1.57 psf wind pressure: 0.30 cfm/ft<sup>2</sup> of frame.
  4. Design Pressure: 20 to 35 psf.
  5. Water Penetration Resistance: 3.14 to 5.43 psf.



- B. Performance Upgrade:
  - 1. Meets or exceeds AAMA / WDMA / CSA 101/I.S.2/A440 Ratings: R-PG50, WDMA Hallmark Certified.
  - 2. Unit assembly shall withstand both positive and negative uniform static air pressure difference without damage when tested according to ASTM E 330.
  - 3. Air Infiltration, 1.57 psf wind pressure: 0.30 cfm/ft<sup>2</sup> of frame.
  - 4. Design Pressure: 50 psf.
  - 5. Water Penetration Resistance: 7.52 psf.
- C. Forced Entry Resistance, ASTM F 588, Minimum Security Grade: 10.
- D. Maximum Operating Force:
  - 1. Initiate Motion: 35 lbs.
  - 2. Maintain Motion: 20 lbs.
- E. Meets U.S. ENERGY STAR guidelines.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Pella Corporation  
102 Main Street  
Pella, Iowa 50219  
Phone: 641-621-1000  
<http://www.pella.com/home/default.aspx>
- B. Substitutions: permitted.

### 2.02 MATERIALS

- A. Basis-of-Design Product: Pella 250 Series Double-Hung Vinyl Window by Pella Corporation.
  - 1. Substitutions: Permitted.
- B. Exterior Windows:
  - 1. Type: Double-Hung



2. Material: Vinyl
- C. Window Frame:
  1. Interior and Exterior Frame Surfaces: Extruded, rigid, polyvinyl chloride (PVC).
  2. Overall Frame Depth: 3-1/4 inches.
  3. Frame Members: Mitered and heat fused to provide fully welded corner.
  4. Sill: Fitted with weeps.
- D. Window Sash:
  1. Sash Members:
    - a. Extruded, rigid, PVC with foam insulation.
    - b. Mitered and heat fused to provide fully welded corner.
  2. Integral extruded sash lift.
  3. Contains sealed insulating glass.
- E. Window Glazing:
  1. Float Glass: ASTM C 1036.
    - a. Glass Type: Annealed
  2. Dual-Pane Insulating Glass:
    - a. Total Thickness: 3/4 inch
    - b. Advanced Low-E coated.
- F. Weather-stripping:
  1. Sash: Weather-stripped around sash perimeter with fin-type, pile weather-stripping in 3 locations.

## 2.03 HARDWARE

- A. Balances: Inverted Constant Force Coil Balances.
- B. Locks: Factory-installed, zinc-die-cast, self-aligning, cam-action locks located on check rail.
  1. Sash Locks: Two sash locks installed on windows with minimum of 29-1/2 inches frame width.
- C. Tilt Latches: Factory-installed, nylon, located on check rail of lower sash and the top rail of the upper sash.





- D. Fasteners: Corrosion-resistant, PVC-compatible material.
- E. Hardware Finish: Matches window interior.

## 2.04 TOLERANCES

- A. Windows shall accommodate the following opening tolerances:
  - 1. Horizontal Dimensions Between High and Low Points: Plus 1/4 inch, minus 0 inch.
  - 2. Width Dimensions: Plus 1/4 inch, minus 0 inch.
  - 3. Building Columns or Masonry Openings: Plus or minus 1/4 inch from plumb.

## 2.05 FINISH

- A. Exposed PVC Surfaces: Smooth, glossy, and uniform in appearance.
- B. Frame Colors:
  - 1. Exterior / Interior:
    - a. White: Integral color extruded throughout profiles.

## 2.06 INSTALLATION ACCESSORIES

- A. Flashing/Sealant Tape:
  - 1. Aluminum-foil-backed butyl window and door flashing tape.
  - 2. Maximum Total Thickness: 0.013 inch.
  - 3. UV resistant.
  - 4. Verify sealant compatibility with sealant manufacturer. See section 07 92 00 JOINT SEALANTS.
- B. Interior Insulating-Foam Sealant: Low-expansion, low-pressure insulating window and door foam sealant See section 07 92 00 JOINT SEALANTS..
- C. Exterior Perimeter Sealant: See section 07 65 00 FLEXIBLE FLASHING.

# PART 3 - EXECUTION

## 3.01 EXAMINATION



- A. Examine rough opening to receive vinyl Double-Hung windows.
  - 1. Verify rough opening is plumb, level, square, and of proper dimensions.
  - 2. Verify a minimum of 1-1/2 inches of solid wood blocking is installed around perimeter of rough opening.
- B. Notify Site Manager of conditions that would adversely affect installation or subsequent use.
- C. Do not proceed with installation until unsatisfactory conditions are corrected.

### 3.02 INSTALLATION

- A. Install vinyl double-hung windows in accordance with manufacturer's instructions.
- B. Install windows plumb, level, square, and without distortion.
- C. Maintain alignment with adjacent work.
- D. Install windows to be weather-tight.
- E. Install windows to be freely operating.
- F. Verify proper operation of operating hardware.

### 3.03 CLEANING AND PROTECTION

- A. Clean vinyl double-hung windows in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish, vinyl, or glass.
- C. Remove labels and visible markings.
- D. Keep window tracks clear of dirt and debris.
- E. Keep weep holes open and clear of obstructions.
- F. Protect installed vinyl double-hung windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

**END OF SECTION 08 53 13**



## 08 71 00 DOOR HARDWARE

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Interior and exterior door hardware.
- B. Related sections: 08 14 00 WOOD DOORS, 06 41 00 ARCHITECTURAL WOOD CASEWORK

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of color.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Installation: Installer experienced in performing work of this section.
    - a. Labor Type: Skilled labor.

### PART 2 – PRODUCTS

#### 2.01 INTERIOR SLIDING AND SWINGING DOOR HARDWARE

- A. Interior Door Latches:
  - 1. All locksets and latchsets are fabricated with magnet components.
  - 2. Type: Cylindrical
  - 3. Size: .5" dia., .5" length
- B. Sliding Door Hardware:
  - 1. Kit including:
    - a. Above door track



- b. Floor guide track
- c. Track stop
- d. Bottom door guide
- e. Side mount hanger

## 2.02 EXTERIOR DOOR HARDWARE

- A. Basis-of-Design Product: Entry Door Knob by Master Lock Company LLC.
  - 1. Substitutions: Permitted.
- B. Master Lock Lever Entry Door Knobs:
  - 1. Style: Wave
  - 2. Finish: Satin Nickel
  - 3. Dimensions: 2-3/8"
- C. Master Lock Single Cylinder Deadbolt:
  - 1. Finish: Satin Nickel
  - 2. Dimensions: 2-3/8"

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install per manufacturer's instructions.
- B. Install hardware level, plumb, sure, true and straight.
- C. Adjust hardware as necessary to ensure smooth, quiet, and effortless operation and safety.
- D. Clean track and hardware surfaces before hanging sliding doors.

**END OF SECTION 08 71 00**



## DIVISION 09 – FINISHES

### 09 50 00 CEILINGS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Plywood material for custom, CNC-milled ceiling finish.
- B. Related sections: 09 91 00 PAINTING, 26 51 00 INTERIOR LIGHTING

##### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Shop drawings for CNC milling.

##### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: At least one person with experience with the custom ceiling system (tab system) required in performing work of this section. The remaining labor may be unskilled, insofar as the experienced person fully explains the simple tab and screw joints.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Route all plywood material for this section directly to the local, offsite CNC fabricator to mill custom pieces.
- B. Delivery: Deliver milled materials to storage facility.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer.



## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. 4'x8' BC 1/2" 13-ply Maple Plywood:
  - 1. Species: Local to project site.
  - 2. Grade: AC Sanded
  - 3. Thickness: 1/2" as indicated on construction documents.

### 2.02 FASTENERS

- A. Screw Connections: 8-18 x 1-1/4" Self-Drilling Screws, Flat.

### 2.03 FABRICATION

- A. All plywood pieces to be used for ceiling panels are precut using a CNC milling machine by an offsite, local fabricator:
  - 1. Design custom plywood members with excavations to receive tabs on superstructure.
  - 2. Generate CAD cut files to be compatible with fabricator's CNC milling machine and send to offsite local fabricator for milling.
- B. Pre-stain all plywood pieces prior to shipment to site:
  - 1. Apply one coat of multi-purpose Interior Latex Primer.
  - 2. After dry, apply two coats of paint. See section 09 91 00 PAINTING.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Acquire precut CNC-routed pieces from local fabricator:
  - 1. Organize plywood pieces in containers to arrive on site in pre-specified order of construction.
- B. Align panels to ceiling rafters with precut tabs and notches.
- C. Attach plywood to structure with self-drilling screws.
- D. Touch up panels with paint as necessary. See section 09 91 00 PAINTING.



END OF SECTION 09 50 00



## 09 60 00 FLOORING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Materials for interior finish flooring.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of finishes, colors, and textures.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
- B. Regulatory Requirements:
  - 1. Product complies with the following testing standards: ASTM E648, ASTM E492-09, ASTM E90-09, ASTM C518, NALFA 33.2, NALFA 3.3, NALFA 3.4 NALFA 3.5, NALFA 3.6, NALFA 3.8, NALFA 3.9, NALFA 3.10, ASTM C1028-96, ASTM F-970-07, ASTM F2753, ASTM F1514, ASTM 1515

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements in order to receive parts in time for prefabrication and container loading procedures.
- B. Delivery: Deliver materials to storage facility in manufacturer's original, unopened, undamaged containers with identification labels intact.





- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer.

#### 1.05 SEQUENCING AND SCHEDULING

- A. Finishing Operations: Install vinyl floor planks after all cabinet modules have been installed and finalized, and before other finishing operations begin in order of operations as per logistics plan.

#### 1.06 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Warranty Period: COREtec Plus flooring planks are warranted for a limited lifetime for residential wear, structure, and waterproofing.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. US Floors  
2580 Corporate Dr.  
Dalton, GA 3072  
Phone: 706-278-9491  
<http://www.usfloorsllc.com/>

- B. Substitutions: Permitted

#### 2.02 MATERIALS

- A. Vinyl Floor Plank:
  - 1. Finish: By owner.
  - 2. Construction: Engineered Vinyl Plank
  - 3. Attached Underlayment: Cork



4. Installation: Glueless
5. Gloss Level: 8-10%

### 2.03 FABRICATION

- A. Pre-cut vinyl floor planks to size for each room, accommodating system holes as per construction documents.
- B. Pre-cut T-molding to sizes as per construction documents.
- C. Label panels and store in containers for on-site construction as per operations plans.

## PART 3 - EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's instructions for installation.

### 3.02 EXAMINATION

- A. Site Verification of Conditions: Verify subfloor conditions are acceptable for installing product in accordance with manufacturer's instructions.
- B. Material Inspection: In accordance with manufacturer's installing requirements, visually inspect materials prior to installing. Do not install material with visual defects.

### 3.03 PREPARATION

- A. Substrate Preparation: Prepare manufacturer's recommended substrates in areas to receive vinyl floor planks to be dry, structurally sound, clean, and level to 3/16" per 10' radius.

### 3.04 INSTALLATION

- A. Install COREtec Plus Vinyl Planks following manufacturer's recommended installation requirements, in order as determined by labels created during fabrication phase.
  1. Maintain 1/4" expansion gap between perimeter walls to allow for expansion and contraction due to changing temperatures.



### 3.05 MAINTENANCE

- A. Compliance: Comply with manufacturer's instructions for post-installation protection, cleaning and maintenance.

**END OF SECTION 09 60 00**



## 09 65 13 RESILIENT BASE

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Resilient rubber wall base.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of finishes, colors, and textures.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.
- B. Regulatory Requirements:
  - 1. Fire Performance Characteristics: Provide resilient sheet vinyl floor covering with the following fire performance characteristics as determined by testing products in accordance with ASTM E 648 (NFPA 253), ASTM E 662 (NFPA 258), ASTM E 84 (NFPA 255)

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements in order to receive parts in time for prefabrication and container loading procedures.
- B. Delivery: Deliver materials to storage facility in manufacturer's original, unopened, undamaged containers with identification labels intact.



- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer.

## 1.05 PROJECT CONDITIONS

- A. Environmental Requirements: Conditions: In accordance with manufacturer's recommendations, areas to receive resilient wall base shall be clean, fully enclosed, weather tight with the permanent HVAC set at a uniform temperature of 65-85°F for 48 hours prior to, during, and thereafter installation of resilient wall base. Resilient wall base and adhesive shall be conditioned in the same manner. Resilient wall base must be unboxed and acclimated in area of use at least 48 hours prior to installation. Minimum temperature shall be at 65°F after installation.

## 1.06 SEQUENCING AND SCHEDULING

- A. Finishing Operations: Install resilient wall base before finishing operations begin, directly against structural plywood stud members. Interior finish panels include a reveal at base to incorporate thickness of resilient wall base.

## 1.07 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Warranty Period: 1 year limited warranty commencing on Date of Substantial Completion.
  - 2. Limited Wear Warranty: 3 year limited wear warranty.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Roppe Corporation  
P.O. Box 1158



Fostoria, Ohio 44830

Phone: 419-435-8546

<http://www.roppe.com/>

- B. Substitutions: Permitted.

## 2.02 MATERIALS

- A. Rubber Wall Base:
  1. Thickness: 1/8" nominal
  2. Recycled Content: 10% minimum.
  3. Profile: Standard Cove
  4. Nominal Height: 4"
  5. Length: 4' Pieces

## PART 3 - EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's instructions for installation.
- B. Adhesive: Roberts 7200 Wall and Cove Base Adhesive or equivalent.

### 3.02 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions are acceptable for installing product in accordance with manufacturer's instructions.
- B. Material Inspection: In accordance with manufacturer's installing requirements, visually inspect materials prior to installing. Do not install material with visual defects.

### 3.03 PREPARATION

- A. Substrate Preparation: Prepare manufacturer's recommended substrates to be smooth, rigid, flat, level, permanently dry, clean and free of foreign materials such a paint, dust, grease,



oils, solvent, old adhesive residue, vinyl wall coverings, non-porous surfaces and all other contaminants that may interfere with adhesive bond.

### 3.04 INSTALLATION

- A. Install resilient floor base directly onto stud members to provide closure at base of interior wall panel. Install as per construction documents and manufacturer's instructions.

**END OF SECTION 09 65 13**



## 09 72 00 WALL COVERINGS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Opaque privacy screen for application on selected interior doors.
- B. Related Sections: 06 41 00 ARCHITECTURAL WOOD CASEWORK

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of finishes and textures.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer.

#### 1.04 SEQUENCING AND SCHEDULING

- A. Finishing Operations: Install shoji paper before during prefabrication process for interior cabinetry. Shoji paper to be installed between door panels as per construction documents.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Vinyl Coated Fiberglass Shoji Paper:
  - 1. Width: 4' roll
  - 2. Texture: Smooth





## 2.02 INSTALLATION ACCESSORIES

- A. Bond Coat Resin:
  - 1. Type: Polyester
- B. Liquid Catalyst:
  - 1. Type: Methyl Ethyl Ketone Peroxide (MEKP)

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Substrate Preparation: Prepare door panels to be smooth, clean and free of foreign materials such a paint, dust, solvent, old adhesive residue and all other contaminants that may interfere with adhesive bond.

### 3.02 INSTALLATION

- A. Install shoji paper per manufacturer's instructions.

**END OF SECTION 09 72 00**



## 09 74 13 WOOD WALL COVERING AND FASTENING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Plywood material for custom, CNC-milled interior wall panels.
- B. Related Sections: 09 91 00 PAINTING

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Shop drawings for CNC milling.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Route all plywood material for this section directly to the local, offsite CNC fabricator to mill custom pieces.
- B. Delivery: Deliver milled materials to storage facility.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer.

### PART 2 – PRODUCTS



## 2.01 MATERIALS

- A. 4'x8' Plywood:
  - 1. Species: Local to project site.
  - 2. Grade: AC Sanded
  - 3. Thickness: 1/2" as indicated on construction documents.

## 2.02 FASTENERS

- A. Screw Connections: 8-18 x 1-1/4" Self-Drilling Screws, Flat.

## 2.03 FABRICATION

- A. All plywood pieces to be used for wall panels are precut using a CNC milling machine by an offsite local fabricator:
  - 1. Design custom plywood members with excavations to receive tabs on superstructure.
  - 2. Generate CAD cut files to be compatible with fabricator's CNC milling machine and send to offsite local fabricator for milling.
- B. Pre-stain all plywood pieces prior to shipment to site:
  - 1. Apply one coat of multi-purpose Interior Latex Primer.
- C. After dry, apply two coats of paint. See section 09 91 00 PAINTING

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Acquire precut CNC-routed pieces from local fabricator:
  - 1. Organize plywood pieces in containers to arrive on site in pre-specified order of construction.
- B. Align panels to walls of superstructure with precut tabs and notches.
- C. Attach plywood to structure with self-drilling screws.
- D. Touch up panels with paint as necessary. See section 09 91 00 PAINTING.

## END OF SECTION 09 74 13



## 09 91 00 PAINTING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Paint for exterior and interior application.

#### 1.02 SUBMITTALS

- A. Manufacturer's product and safety data.
- B. Product samples for verification of finishes, colors, and textures.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver paint materials to storage facility.
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer, according to Indigo Pine Health and Safety Procedures.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. Sherwin Williams  
15475 Jeffrey Rd  
Suite 400  
Irvine, CA, 92618-4106



Phone: (949) 552-5631

<http://www.sherwin-williams.com/>

- B. Substitutions: permitted.

## 2.02 MATERIALS

- A. Interior Walls and Cabinetry Paint:

1. Type: Acrylic Latex
2. Finish: Semi-Gloss
3. Color: By owner.
4. VOC free: Yes

- B. Interior Walls and Cabinetry Stain:

1. Type: Semi-Transparent
2. Color: By owner.
3. VOC free: Yes

- C. Exterior Porch Stain:

1. Type: Acrylic Solid
2. Color: By owner.
3. VOC free: Yes

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Substrate Preparation: Prepare manufacturer's recommended substrates to be smooth, permanently dry, clean and free of foreign materials such as dust, grease, oils, solvent, old adhesive residue and all other contaminants that may interfere with product bond.

### 3.02 INSTALLATION

- A. Apply coats of paint onto prepared interior and exterior surfaces as per manufacturer's recommendations.



- B. Protect painted surfaces from damage due to activities occurring later in the construction process.

END OF SECTION 09 91 00



## DIVISION 11 – EQUIPMENT

### 11 11 36 VEHICLE CHARGING EQUIPMENT

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Information on the electric vehicle charger.

##### 1.02 SUBMITTALS

- A. Manufacturer’s product data, including manufacturer’s specification summary sheet for specified products.
- B. Manufacturer’s installation instructions, maintenance data, and warranty information.

##### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has required training in installing work similar to that required for this project.
  - 1. Labor Type: Skilled labor.
  - 2. Qualifications: No qualifications required.
- B. Regulatory Requirements:
  - 1. Product complies with the following standards: SAE J1772, NEC 625 and NEMA 3R

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with manufacturer’s ordering instructions and lead-time requirements in order to receive parts in time for prefabrication and container loading procedures.
- B. Delivery: Deliver materials to storage facility in manufacturer’s original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer.



## 1.05 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Limited Warranty: Power Max Cables and Connectors are warranted against defects in materials and workmanship for 90 days from date of delivery.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Bosch Automotive Service Solutions  
28635 Mound Road  
Warren, MI 48092  
Phone: 1-877-805-3873  
<http://www.pluginnow.com/>
- B. Substitutions: Permitted.

### 2.02 MATERIALS

- A. Electric Vehicle Charging Station:
  - 1. Input Rating: 208-240 VAC, 30A
  - 2. Output Rating: 208-240 VAC, 30A
  - 3. Breaker: 2-pole, 40A, dedicated circuit, non-GFCI type
  - 4. Mounting Type: Wall-Mount

## PART 3 - EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's instructions for installation.

### 3.02 EXAMINATION





- A. Site Verification of Conditions: Verify substrate conditions are acceptable for installing product in accordance with manufacturer's instructions.
- B. Material Inspection: In accordance with manufacturer's installing requirements, visually inspect charging station components prior to installing. Do not install any components with visual defects.

### 3.03 INSTALLATION

- A. Install charging station per manufacturer's instructions.
- B. Install in compliance with all local and national mechanical and electrical codes.

### 3.04 MAINTENANCE

- A. Keep exterior clean at all times.
- B. Do not spray water directly at the charging station.
- C. Replace the charging plug in the plug dock after charging to avoid damage.
- D. Store the power cable on charging station after use to avoid damage.
- E. If the power cable or charging plug is damaged, contact charging station provider.

**END OF SECTION 11 11 36**



## 11 30 00 RESIDENTIAL EQUIPMENT

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Kitchen and laundry equipment and ceiling fans.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications: Installer who has experience with products of similar type and with project of similar scope.
  - 1. Labor Type: Skilled labor.
  - 2. Qualifications: No qualifications required.

#### 1.04 REGULATORY REQUIREMENTS

- A. Comply with the following at minimum, further code compliance listed per unit:
  - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to storage facility in manufacturer's original, unopened, undamaged containers with identification labels intact.



- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions and acclimated to site conditions at temperature and humidity conditions recommended by manufacturer.

## 1.06 FABRICATION

- A. Pre-locate mount all mounting brackets associated with individual units on respective cabinetry face and pre-install wires, motors, doors and finishes in individual units for ease of on-site construction.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Bosch Home Appliances Corporation  
Robert Bosch LLC,  
38000 Hills Tech Drive,  
Farmington Hills, Michigan 48331 USA  
Phone: 917-421-7209  
<http://www.bosch-home.com/us/>
- B. Big Ass Solutions  
2348 Innovation Drive  
Lexington, KY 40511, U.S.A.  
877 BIG-FANS  
Phone: 877-244-3267  
<http://www.bigassolutions.com/>
- C. Substitutions: Permitted

### 2.02 APPLIANCES

- A. Refrigerator:
  - 1. Finish: Stainless Steel



2. Capacity (refrigerator): 7.7ft<sup>3</sup>
  3. Capacity (freezer): 3.3ft<sup>3</sup>
  4. Dimensions: 78-7/8" x 23-1/2" x 25-7/8"
  5. Energy Star Qualified: Yes
- B. Microwave:
1. Finish: Stainless Steel
  2. Capacity: 2.1 ft<sup>3</sup>
  3. Dimensions: 17 1/2" x 29 7/8" x 15 7/8"
- C. Dishwasher:
1. Finish: Stainless Steel
  2. Energy Star Qualified: Yes
  3. Dimensions: 32 1/6" x 23 9/16" x 22 9/16"
  4. ADA Compliant: Yes
- D. Oven / Range:
1. Finish: Stainless Steel
  2. Dimensions: 35 1/2" x 31 1/4" x 26 3/4"
- E. Clothes Washer:
1. Finish: White
  2. Capacity: 2.2 ft<sup>3</sup>
  3. Energy Star Qualified: Yes
  4. ADA Compliant: Yes
  5. Dimensions: 33 1/4" x 23 1/2" x 24 1/4"
- F. Clothes Dryer:
1. Finish: White
  2. Capacity: 4.0 ft<sup>3</sup>
  3. Dimensions: 33 1/4" x 23 1/2" x 25"
- G. Ceiling Fans:
1. LED light kit addition: Yes
  2. Foil Material: Composite material airfoils, Exterior Rated



3. Foil Color: White

**PART 3 - EXECUTION**

3.01 INSTALLATION

- A. Assemble and install per manufacturer's instructions.

3.02 MAINTENANCE

- A. General: Keep exterior clean at all times.
- B. Follow manufacturer's operation and maintenance requirements for individual units.

**END OF SECTION 11 30 00**



## DIVISION 12 – FURNISHINGS

### 12 32 23 CASEWORK HARDWARE

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Hardware for all custom, interior cabinetry elements, including interior door hinges, cabinet hinges, drawer runners, drawer locking devices, desk flap stays and chase panel mounting hardware.
- B. Related sections: 06 41 00 ARCHITECTURAL WOOD CASEWORK

##### 1.02 REFERENCES

- A. Cabinet Hardware:
  - 1. ANSI / BHMA – Meets Grade 1 – drawer runner systems. Grade 2 – hinge systems. Requirements for cycle, life, static load and self-closing performance.
- B. Door Hinges:
  - 1. ANSI A156.18: Materials and Finishes.

##### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

##### 1.04 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.



## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store cabinet hardware products in manufacturer's unopened packaging until ready for installation.

## 1.06 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results, where required. Do not install products under environmental conditions outside manufacturer's recommended limits.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Blum, Inc.  
7733 Old Plank Road  
Stanley, NC 28164  
Phone: 704-827-1345  
<http://www.blum.com/us/en/index.php/>
- B. Häfele America Co.  
3901 Cheyenne Drive  
Archdale, N.C. 27263  
Phone: 1-800-423-3531  
<http://www.hafele.com/us/index.htm>
- C. Substitutions: Permitted.

### 2.02 MATERIALS

- A. Concealed Cabinet Door Hinges:
  - 1. Cabinet Construction: Face frame with the following door type, as per construction documents:
    - a. Inset.



2. Hinge Type: Full-cranked.
  3. Closing: Self-close.
  4. Dampening System: Yes.
  5. Mounting: Screw-on.
  6. Angle: 100 degree.
  7. Hinges per door: As per construction documents.
- B. Concealed Runners for Wood Drawers:
1. Size: As per construction documents.
  2. Cabinet Construction: Face frame with the following drawer type, as per construction documents:
    - a. Inset.
    - b. Waste / Recycle.
  3. Closing: Self close.
  4. Mounting: Screw-on.
  5. Drawer Length: As per construction documents.
  6. Locking Devices: One right and one left required per drawer.
    - a. Depth adjustable locking device (inset).
- C. Push-In Fittings:
1. Material: Plastic
  2. Color / Finish: Black
- D. Reversible Drawer Flap Stay:
1. Material: Aluminum
  2. Color / Finish: Nickel
- E. Invisible Door Hinges:
1. Construction: Constructed with interpolated, laminated links connected with non-removable, riveted pins which provide moving pivot points and allow 180 degrees opening.
  2. Materials: High strength, plated steel and heavy duty, zinc alloy castings.
  3. Finish: Satin Chrome, ANSI No. 682





4. Type: Standard type invisible hinge: 4-5/8" high, invisible hinge for application on cabinet door and frames; No. 218 Soss Invisible Hinge as manufactured by Universal Industrial Products Company, Inc.

### 2.03 FASTENERS

- A. Fasteners: Type, size, and quantity as recommended by product manufacturer for properly installing cabinet hardware for type of application and substrate.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to installation, verify that all substrates including cabinetry doors, frames, and drawers are ready to receive hardware.

### 3.02 PREPARATION

- A. Coordination: Coordinate provision of cabinet hardware as per construction documents.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 INSTALLATION

- A. Assemble with cabinet modules prior to assembly on site. See section 06 41 00 ARCHITECTURAL WOOD CASEWORK.
- B. Install cabinet hardware in accordance with product manufacturer installation instruction and approved shop drawings.
- C. Install quantity of hardware as recommended by manufacturer for specific application.
- D. Placement: Locate cabinet hardware as recommended by manufacturer and indicated on approved shop drawings.



- E. Use manufacturer recommended router guides and equipment for product installation, where required.
- F. Thoroughly clean, polish, and protect cabinet hardware finish during fabrication, shipping, and on-site installation.

## END OF SECTION 12 32 23

## 12 36 00 COUNTERTOPS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Solid surface countertops for application in the kitchen and bathrooms.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples of minimum 6" x 6" in specified gloss for verification of finishes, colors, and textures.
- D. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components:
  - 1. Show full-size details, edge details, thermoforming requirements, attachments, etc.
  - 2. Show location and sizes of furring, blocking, including concealed blocking and reinforcement.
  - 3. Show locations and sizes of cutouts and holes for plumbing fixtures installed in solid surface.

#### 1.03 QUALITY ASSURANCE

- A. Qualifications:



1. Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.
- B. Installer qualifications: Installer who has experience with products of similar type and with project of similar scope.
  1. Labor Type: Skilled labor.
  2. Qualifications: No qualifications required.
- C. Applicable standards:
  1. Fire Test Response Characteristics:
    - a. Provide with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
      - 1) Flame Spread Index: 25 or less.
      - 2) Smoke Developed Index: 450 or less.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver no components to project site until areas are ready for installation, as per logistics plan.
- B. Store components indoors prior to installation.
- C. Handle materials to prevent damage to finished surfaces.
  1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

#### 1.05 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document against defects in materials.
  1. Warranty shall provide material and labor to repair or replace defective materials.
  2. Warranty Period: 10 years from date of substantial completion.



## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

#### A. DuPont

<http://www.dupont.com/>

#### B. Substitutions: Permitted.

### 2.02 MATERIALS

#### A. Solid Surface Countertops:

1. General: Cast, nonporous, filled polymer, not coated, laminated or of composite construction through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
2. Superficial damage to a depth of 0.010 inch shall be repairable by sanding and/or polishing.
3. Color / Finish: Designer White
4. Depth: 24”
5. Backsplash: 4”
6. Thickness: 1/4”
7. Core: 3/4” MDF

### 2.03 ACCESSORIES

#### A. Sealant:

1. Manufacturer’s standard mildew resistant, FDA compliant, NSF 51-compliant (food zone – any type), UL-listed silicone sealant in colors matching components.

### 2.04 FABRICATION

#### A. Shop assembly:

1. Fabricate components to greatest extent practical to sizes and shapes indicated in construction documents, in accordance with approved shop drawings and manufacturer’s printed instructions and technical bulletins.



2. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
3. Rout and finish component edges with clean, sharp returns.
  - a. Rout cutouts, radii and contours to template.
  - b. Smooth edges.
  - c. Repair or reject defective and inaccurate work.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Install countertops level, rigid and plumb to a tolerance of 1/8 inch in 8 feet.
- B. Install countertops with no more than 1/8 inch sag, bow or other variation from a straight line.

### 3.03 CLEANING

- A. Clean countertops as work progresses with a damp cloth and soap.
- B. Remove adhesives, sealants and other stains.

**END OF SECTION 12 36 00**



## DIVISION 21 - FIRE SUPPRESSION

### 21 13 00 FIRE-SUPPRESSION SPRINKLER SYSTEMS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Materials for residential fire sprinkler system.

##### 1.02 SUBMITTALS

- A. Product Data for valves, sprinklers, specialties, and alarms.
- B. Submit sprinkler system drawings identified as "working plans" and calculations according to NFPA 13D.
- C. Submit required number of sets to authorities having jurisdiction for review, comment, and approval. Include system hydraulic calculations.

##### 1.03 QUALITY ASSURANCE

- A. Installer qualifications: Installer who has experience with products of similar type and with project of similar scope.
  - 1. Labor Type: Skilled labor.
  - 2. Qualifications: No qualifications required.

#### PART 2 – PRODUCTS

##### 2.01 PERFORMANCE REQUIREMENTS

- A. Design and Installation Approval: Acceptable to authorities having jurisdiction.
- B. Hydraulically design sprinkler systems according to NFPA 13D.
- C. Comply with NFPA 13D and NFPA 70.
- D. UL-listed and UL-labeled and FM-approved pipe and fittings.



## 2.02 MATERIALS

### A. Sprinkler Head:

1. Type: Concealed Pendant
2. Maximum Coverage Area: 12 x 12 ft<sup>2</sup>
3. Minimum Flow: 13 GPM
4. Minimum Pressure: 7 PSI
5. Maximum Working Pressure: 175 psi (12,1 bar)
6. Discharge Coefficient:  $K = 4.9 \text{ GPM}/\text{psi}^{1/2}$  (70,6 LPM/bar<sup>1/2</sup>)
7. Temperature Rating Sprinkler: 160°F (71°C) Cover Plate: 139°F (59°C)
8. Vertical Adjustment: 1/2 inch (12,7 mm)
9. Minimum Spacing: 8 ft.

### B. Pipe and fittings:

1. Pipe and Fitting Material: CPVC
2. Max Pressure : 175 psi
3. Max Temp: 150°F
4. Pipe Sizes: 1"
5. Fittings Types: Various types of adapters available to accommodate metallic fittings and connect pipes as listed in the parts list.
6. Sealant: 1 Step CPVC Cement

### C. Hangers:

1. Hanger Type: One-hole wrap around strap for CPVC Pipe
2. Holding size: 1" CPVC pipe
3. Surface Finish: Electro-zinc plated
4. Function: Support CPVC pipe horizontally from top or side of beam, flared edges to protect the CPVC piping

### D. Home hydrant system:

1. Supply: 40 GPM @ 40PSI Minimum.
2. Motor: 1.5 HP electric motor



## 2.03 PIPING INSULATION

- A. As per manufacturer's manual.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Sprinkler Head Installation:

- 1. Install per manufacturer's assembly instructions in accordance with NFPA 13D.

- B. Piping Installation:

- 1. Use CPVC plastic pipe and fittings and metal-to-plastic transition fittings with solvent-cemented joints.
  - 2. Install shutoff valve, check valve, pressure gage, drain and other accessories indicated at connection to water service piping.
  - 3. Install all per manufactures instructions.

### 3.02 TESTING

- A. Flush, test, and inspect sprinkler piping systems according to NFPA 13D.

**END OF SECTION 21 13 00**





## DIVISION 22 - PLUMBING

### 22 07 00 PLUMBING INSULATION

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Pipe insulation for plumbing applications.
- B. Related sections: 22 11 16 DOMESTIC WATER PIPING, 22 13 00 FACILITY SANITARY SEWAGE

##### 1.02 SECTION REQUIREMENTS

- A. Comply with NSF 14 for plastic, potable domestic water piping and components.
- B. Comply with NSF 61 for potable domestic water piping and components.
- C. This section relates to insulation for the hot PEX tubing whose purpose is specifically to avoid heat losses.

##### 1.03 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

##### 1.04 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

#### PART 2 – PRODUCT



## 2.01 MATERIALS

### A. Pipe insulation:

1. Basis-of-Design Product: Tubular Foam Pipe Insulation by Frost King.
  - a. Substitutions: Permitted.
1. Fits pipe diameter: ½”
2. Wall thickness: 3/8”
3. Type: Pre-slit polyethylene
4. R-value: R-2 Minimum.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Cut to length required.
- B. Install around PEX piping; remove the tape and ensure a snug fit.

**END OF SECTION 22 07 00**



## 22 11 16 DOMESTIC WATER PIPING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Pipe and fittings for plumbing applications.
- B. Related sections: 22 07 00 PLUMBING INSULATION

#### 1.02 SECTION REQUIREMENTS

- A. Comply with NSF 14 for plastic, potable domestic water piping and components.
- B. Comply with NSF 61 for potable domestic water piping and components.

#### 1.03 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.04 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

### PART 2 – PRODUCT

#### 2.01 MATERIALS

- A. Manifold:
  - 1. Basis-of-Design Product: ManaBloc Manifold by Viega LLC.
    - a. Substitutions: Permitted.
  - 2. Type: 14 port



3. Loop Size: ½”
  4. Outlet Type: PEX
  5. Number of Outlets: 14
    - a. Number of Outlets (Cold): 8
    - b. Number of Outlets (Hot): 6
  6. Fitting System Compatibility: PEX Compression
  7. Inlet Type: Male Threaded (IPS)
  8. Inlet Size: ¾”
  9. Supply Connection: Male NPT
  10. Loop Connection: PEX Compression
- B. PEX pipe:
1. Basis-of-Design Product: PEX Piping by SharkBite.
    - a. Substitutions: Permitted.
  2. Certifications and Listings: ANSI Certified, CSA Listed, IAPMO Certified
  3. Color: White (Main Supply), Blue (Cold Supply), Red (Hot Supply)
  4. Material: Cross Linked Polyethylene (PEX)
  5. Max Working Temperature: 200°F
  6. Max working pressure: 160psi
  7. Min working temperature: 32°F
- C. Shark Bite Fittings
1. Basis-of-Design Product: Push-Fit Fittings by SharkBite.
    - a. Substitutions: Not Permitted.
  2. Certifications and Listings:
    - a. ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing
    - b. ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
  3. Fitting or Connector Type: Adapter or Coupling, various types of adapters available to accommodate fittings and connect pipes as listed in the parts list.
  4. Material: Brass



5. Max working pressure: 200psi
  6. Push to connect: Yes
  7. Warranty: SharkBite warrants Push-Fit Fittings against defects in material and workmanship for 25 years from date of purchase.
- D. Shower Mixing Valve:
1. Basis-of-Design Product: Rite-Temp Pressure-Balancing Valve by Kohler Co.
    - a. Substitutions: Permitted.
  2. Type: Rite Temp ½” pressure balancing valve
  3. Water temperature gradient: +/- 3°F
  4. Anti-scald protection and temperature regulation: Yes
  5. Max operating temperature: 120°F
  6. Flow rate: 5.0 GPM
  7. Trim required: Yes
- E. Toilet riser kit:
1. ½” Nominal Comp x 3/8” OD Comp Brass Multi-Turn Angle Valve with 12” Riser, Escutcheon
  2. Finish: Chrome
  3. Max Pressure rating: 125 psi

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install PEX pipes, plumbing fixtures and fittings to the tubing as per manufacturer’s recommendations and as indicated in the installation handbook.
- B. Do not install PEX tubing within 6 inches [152 mm] of gas appliance vents or within 12 inches [305 mm] of any recessed light fixtures.
- C. Do not solder within 18 inches [457 mm] of PEX tubing in the same waterline. Make sweat connections prior to PEX connections.
- D. Do not expose PEX tubing to direct sunlight for more than 30 days.



- E. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
- F. Protect PEX tubing with sleeves where abrasion may occur.
- G. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
- H. Do not bend PEX so that it creates a block.

### 3.02 INSPECTING AND CLEANING

- A. Inspect and test piping systems as follows:
  - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
- B. Clean and disinfect potable domestic water piping by filling system with water/chlorine solution with at least 50 mg/L of chlorine. Isolate with valves and allow to stand for 24 hours. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

### 3.03 PIPING SCHEDULE

- A. Connect the CPVC pipes under the floor to the pump system. Connect PEX pipes above the floor to feed all the faucets and appliances through a manifold system.

**END OF SECTION 22 11 16**



## 22 12 19 FACILITY GROUND-MOUNTED, POTABLE-WATER STORAGE TANKS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Domestic water and sewage water storage tanks.
- B. Related sections: 22 11 23 DOMESTIC WATER PACKAGED BOOSTER PUMPS
- C. All components and materials in this section are for competition purposes only.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Domestic water storage tank
  - 1. Basis-of-Design Product: Plastic Water Storage Tank by Plastic-Mart.
    - a. Substitutions: Permitted.
  - 2. Material: Molded HDPE or PE custom fabricated
  - 3. Make: Custom Fabricated
  - 4. Shape: Cylindrical
  - 5. Dimensions: 60" dia. X 73" hgt.
  - 6. No of outlets: 3
  - 7. Outlet: 2"NPT
  - 8. Top lid: 16"
  - 9. Number of tanks: 2
  - 10. Capacity: 865 gallons



11. Total Capacity: 1,730 gallons
  12. Warranty: Plastic-Mart warrants tanks to be free of defects in material and workmanship for 5 years.
- B. Sewage basin:
1. Item Weight: 18.5 lbs.
  2. Dimensions: 18" dia. X 30"H
  3. Material: Thermoplastic
  4. Inlet accepts: 4" PVC with seal
- C. Check Valve Union:
1. Full 2" flow design: meets BOCA (P.604.2)
  2. Part Number: 30-0151
  3. Weight: 4 lbs.
  4. Dimensions: 11" x 12" x 8.2"

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install polyethylene potable-water storage tanks according to guidelines:
1. Accessibility, ease of maintenance, and removal should be taken into consideration when installing tanks.
  2. Adequately support all pipes and valves. Do not apply excess weight on water tanks.
  3. Tanks are not designed for storage of fluid in vacuum conditions or higher pressure above atmospheric.
  4. Use caution when handling all tanks.
- B. Fill potable-water storage tank with water from tankers when supplied.
- C. After competition, pump water from tanks back to tankers when supplied.

**END OF SECTION 22 12 19**





## 22 13 00 FACILITY SANITARY SEWAGE

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Plastic piping components.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. PVC Pipes and Fittings:
  - 1. Sub Type: Schedule 40
  - 2. Color: White
  - 3. End Type: Plain End
  - 4. Size Diameter: 1 ½", 2", 4"
  - 5. Fittings types: various types of adapters available to accommodate fittings and connect pipes as listed in the parts list.
  - 6. Sealant: Oatey PVC Cement
  - 7. Max PSI Rating: 330 psi



8. Max Working Temperature: 140°F
- B. Kitchen Sink Connector:
  1. Type: End outlet continuous waste
  2. Sub type: Direct connect end outlet continuous waste with branch tailpiece  $\frac{3}{4}$ " OD outlet
  3. Material: Plastic
  4. Size: 1  $\frac{1}{2}$ " dia.
  5. Length 11"-16"
  6. Color: White
- C. PVC P-trap:
  1. Size: 1  $\frac{1}{2}$ ", 2"
  2. Includes reducer washer: Yes
  3. Color: White
- D. Kitchen sink Strainer
  1. Strainer Basket type: fixed post
  2. Fits Drain Opening: 3.5"
  3. Finish: Stainless steel
  4. Strainer Material: Stainless steel
  5. Deep Cup (Universal Fit): No
- E. Tub overflow:
  1. Type: Foot Lock Stop Style Complete Plastic Bath Drain
  2. Finish: Polished Chrome
  3. Size: 1  $\frac{1}{2}$ "
  4. Features:
    - a. Fits all standard size tubs.
    - b. Includes everything necessary for the installation of one complete bath drain.
- F. Washer connector box:
  1. Connection type: PEX
  2. Valve Type: Quarter turn ball valve



3. Discharge Hose Placement: Center drain
4. Max PSI Rating: 150 PSI

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  2. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe.
  3. Straight tees, elbows, and crosses may be used on vent lines.
  4. Do not change direction of flow more than 90 degrees.
  5. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- B. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  1. Building Sanitary Drain: 2 percent downward in direction of flow for piping DN 80 and smaller; 1 percent downward in direction of flow for piping DN 100 and larger.
  2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- C. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- D. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- E. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

**END OF SECTION 22 13 00**



## 22 33 00 ELECTRIC DOMESTIC WATER HEATERS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Solar electric water heater.
- B. Related sections: 26 31 00 PHOTOVOLTAIC COLLECTORS
- C. Compliance: The water heater and electrical components required for proper operation shall be adequately certified and labeled by testing agencies and acceptable to appropriate authorities.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications: Installer who has experience with products of similar type and with project of similar scope.
  - 1. Labor Type: Skilled labor.
  - 2. Qualifications: No qualifications required.

### PART 2 – PRODUCT

#### 2.01 MANUFACTURERS

- A. Energy Labs, Inc.  
5191-A Shawland Rd.  
Jacksonville, FL 32254  
Phone: (904) 693-4555



<http://www.energylabsinc.com>

- B. Substitutions: Not permitted.

## 2.02 MATERIALS

- A. Water Heater:
  - 1. Type: Hybrid Solar Electric
  - 2. Capacity: 50 gal

## PART 3 - EXECUTION

### 3.01 MANUFACTURERS INSTRUCTIONS

- A. Installation should be in accordance with all national and/or local codes. In the absence of local codes, refer to NFPA 54 or ANSI Z21.10.1.

### 3.02 INSTALLATION

- A. Install all parts and components as per manufacturer's installation instructions.

**END OF SECTION 22 33 00**



## 22 41 00 RESIDENTIAL PLUMBING FIXTURES

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Plumbing fixtures, including water closet, lavatories, and kitchen sinks.
- B. Related sections: 22 11 16 DOMESTIC WATER PIPING

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer qualifications: Installer who has experience with products of similar type and with project of similar scope.
  - 1. Labor Type: Skilled labor.
  - 2. Qualifications: No qualifications required.

#### 1.04 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document against defects in materials.
- B. Warranty shall provide material and labor to repair or replace defective materials.
- C. Warranty Period: 10 years from date of substantial completion.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. Kohler Co.



Phone: (800) 456-4537

[www.kohler.com](http://www.kohler.com)

B. Substitutions: Permitted.

## 2.02 PRODUCTS

A. Water Closet:

1. Style: Two-Piece Round
2. Handle Type: Lever
3. Max flow rate: 1.28 GPF

B. Shower:

1. Type: Tub-Shower Stall, Right-hand drain, 4 piece, Direct to stud
2. Caulkless: Yes
3. Color / Finish Family: By owner.
4. Exterior bath shape: Rectangle
5. Faucet mount: Wall
6. Material: Composite
7. Slip resistant tub floor: Yes
8. Water capacity: 37gal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Install all fixtures per manufacturer's installation requirements.

**END OF SECTION 22 41 00**



## DIVISION 23 – HVAC

### 23 07 13 DUCT INSULATION

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Provide fibrous glass duct board and closure system for residential and commercial HVAC rigid duct systems.
- B. HVAC duct systems operating at internal air velocities not exceeding rated duct liner limitations as listed below, and internal air temperatures between 40°F (4°C) and 250°F (121°C) and air velocities to 6,000 fpm (30.5 m/s).
- C. Duct board material to be cut, formed, sealed, and used as ductwork as per construction documents.

##### 1.02 REFERENCES

- A. Duct liner insulation materials shall meet the requirements of one or more of the following specifications as applicable to the specific product or end use:
  - 1. UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
  - 2. UL 181A, Standard for Closure Systems for Use with Rigid Air Ducts.
  - 3. UL 181B, Standard for Closure Systems for Use with Flexible Air Ducts and Air Connectors.
  - 4. UL 723, Test for Surface Burning Characteristics of Building Materials.
  - 5. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 6. NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - 7. NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.





### 1.03 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

### 1.04 QUALITY ASSURANCE

- A. Installer qualifications: Installer who has experience with products of similar type and with project of similar scope.
  - 1. Labor Type: Skilled labor.
  - 2. Qualifications: No qualifications required.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original packaging.
- B. Storage: Store and protect products in accordance with manufacturer's instructions. Store in a dry indoors location. Protect insulation materials from moisture and soiling.
- C. Do not install insulation that has been damaged or wet. Remove it from jobsite.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURER

- A. Owens Corning Insulation Systems, LLC  
Toledo, OH 73659  
[www.owenscorning.com](http://www.owenscorning.com)
- B. Substitutions: Permitted.

### 2.02 MATERIALS

- A. General:
  - 1. Duct Board: Rigid, resin bonded fibrous glass board with a damage-resistant, flame retardant, reinforced aluminum foil (FRK) facing and a veil faced airstream surface.



- B. Acceptable Product: Owens Corning QuietR® Duct Board or equal.
  - 1. Type 475: R-4.3, 1 in (25mm) thick, NRC 0.70, density 4.4 pcf.
  - 2. Type 800: R-4.3, 1 in (25mm) thick, NRC 0.70, density 5.3 pcf.
  - 3. Type 800: R-6.5, 1-1/2 in (38mm) thick, NRC 0.85, density 3.8 pcf.
  - 4. Type 1400: R-8.7, 2 in (51mm) thick, NRC 1.00, density 3.8 pcf.

### 2.03 ACCESSORIES

- A. Accessories: Provide accessories per duct board system manufacturer's recommendations, including the following:
  - 1. Adhesive Tape: UL 181A, Part I (P), pressure sensitive type.
  - 2. Fabric Closure: UL 181A, Part III (M), mastic and glass fabric type.
  - 3. Staples: Outward flaring types, 1/2 in min size.
  - 4. Hanging Strap: Perforated metal hanging straps, 3/4" suggested width.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that materials and accessories can be installed in accordance with Contract Documents and material manufacturers' recommendations.
- B. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.
- C. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

### 3.02 SAFETY PRECAUTIONS



- A. Insulation contractor's employees shall be properly protected during installation of insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include, but not be limited to, disposable dust respirators, gloves, hard hats, and eye protection.

### 3.03 INSTALLATION

- A. Install duct systems in accordance with the NAIMA Fibrous Glass Duct Construction Standards.
- B. Staple longitudinal and circumferential joints at 2 in o.c. max.
- C. Seal ducts with one of the following closure methods:
  - 1. Pressure Sensitive Tape: Clean surface prior to applying tape, as recommended by tape manufacturer. Apply pressure sensitive tape firmly and seal with hot iron when ambient temperature is below 50F.
  - 2. Mastic and Glass Fabric: Brush mastic onto joint, embed glass fabric in mastic, and brush second coat of mastic over fabric until completely filled.
- D. Seal joints between duct board ductwork:
  - 1. Staple close.
  - 2. Seal with pressure sensitive tape.
- E. Attach to structure with metal hanging straps.

### 3.04 FIELD QUALITY ASSURANCE

- A. Upon completion of insulation work and before operation is to commence, visually inspect the work and verify that it has been correctly installed.
- B. Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct system. Allow for a means of removal of such material.
- C. Check the duct system to ensure that there are no air leaks through joints.

### 3.05 PROTECTION



- A. Replace damaged insulation, which cannot be satisfactorily repaired, including insulation with duct liner damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

## END OF SECTION 23 07 13

## 23 09 13 INSTRUMENTATION & CONTROL DEVICES FOR HVAC

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Thermostat for controlling mini-split air-exchange unit.
- B. Related Sections: 23 81 26 SPLIT-SYSTEM HEAT PUMPS

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. The units shall be tested by a NRTL, in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
- B. All wiring shall be in accordance with the NEC
- C. The system shall be rated in accordance with ARI Standard 210/240 and bear the ARI label.
- D. Installer qualifications: Installer who has experience with products of similar type and with project of similar scope.



3. Labor Type: Skilled labor.
4. Qualifications: No qualifications required.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURER

- A. Basis-of-Design Product: Navigation Remote Controller by Daikin.
  1. Substitutions: Permitted.
- B. HVAC Controller:
  1. Description: Navigation remote controller
  2. Power: 16VDC supplied by indoor unit (1.58VA maximum)

## PART 3 - EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the thermostat manufacturer.

**END OF SECTION 23 09 13**



## 23 31 13 METAL DUCTS AND CASINGS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Materials for assembling custom tees.
- B. Related sections: 23 07 13 DUCT INSULATION
- C. General: All ductwork tees will be fabricated off site with CNC milling machine from a local fabricator and assembled on site.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Product samples for verification of color.
- D. Shop drawings for CNC milling.

#### 1.03 QUALITY ASSURANCE

- A. Composite Panel Manufacturer shall have a minimum of 20 years' experience in the manufacturing of this product.
- B. Composite Panel Manufacturer shall be solely responsible for panel manufacture and application of the finish.
- C. Fabricator shall be acceptable to the composite panel manufacturer.
- D. Fabricator shall have a minimum 5 years' experience of metal panel work similar in scope and size to this project.
- E. Installer Qualifications: At least one person with experience with the custom siding system (tab and rivet system) is required in performing work of this section. The remaining labor may be unskilled, insofar as the experienced person fully explains the simple tab, rivet, and screw joints to properly fabricate individual panels and attach panels to structure.



#### 1.04 REFERENCES

- A. AA-C22-A41: Anodized - Clear Coatings.
- B. AA-C22-A42: Anodized - Integral Color Coatings.
- C. AAMA 508-05: Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
- D. ASTM E 330: Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads
- E. ASTM E 283: Rate of Leakage through Exterior Windows, Curtain Walls, and Doors
- F. ASTM D 1781: Climbing Drum Peel Test for Adhesives
- G. ASTM E 84: Surface Burning Characteristics of Building Materials
- H. ASTM D 3363: Method for Film Hardness by Pencil Test
- I. ASTM D 2794: Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- J. ASTM D 3359: Methods for Measuring Adhesion by Tape Test
- K. ASTM D 2247: Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
- L. ASTM B 117: Method of Salt Spray (Fog) Testing
- M. ASTM D 822: Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products
- N. ASTM D 1308: Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- O. ASTM D 1735: Method for Water Fog Testing of Organic Coatings.
- P. ASTM D 1929: Standard Test Method for Determining Ignition Temperature of Plastics
- Q. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect finish and edges in accordance with panel manufacturer's recommendations.
- B. Store material in accordance with panel manufacturer's recommendations.
- C. Route all plywood material for this section directly to the local, offsite CNC fabricator to mill custom pieces before shipment to job site.



- D. Transport milled materials in a vertical orientation. Do not remove protective film from material until components are assembled in their final form.

## 1.06 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

#### A. CNC Fabricated Ductwork Tees:

1. Basis-of-Design Product: Alpolic ACM by Mitsubishi Plastics Composites America, Inc.
  - a. Substitutions: Permitted
2. 4' x 8' Standard Aluminum Panel:
  - a. Finish: Bone White
  - b. Thickness: 4mm
  - c. Core: Polyethylene

#### B. Sealant:

1. 2.5-in x 150-ft Silver Foil Tape

### 2.02 ACCESSORIES

- A. Ductwork Fasteners: 3/16" steel rivets
- B. Ductwork Sealant: 2.5" silver foil tape

### 2.03 FABRICATION

- A. All aluminum composite material to be used for ductwork is precut using a CNC milling machine by an offsite, local fabricator.
- B. Prefabricate ductwork tees into modules as per construction schedule:
  1. Fold ductwork tees to form rectangular modules.





2. Secure folded form with tabs and steel rivets in pre-drilled holes as per mechanical drawings.
3. Seal any resulting cracks between folds with silver foil tape.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install in compliance with installation manuals provided by the manufacturer and all local and national mechanical and electrical codes.
- B. Acquire precut CNC milled tees:
  1. Attach tees to sheet metal ductwork with steel rivets as per construction sequencing.
  2. Seal joint between tees and ductwork with silver foil tape.

**END OF SECTION 23 31 13**



## 23 37 13 DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Diffusers and grilles.
- B. Related sections: 09 50 00 CEILINGS

#### 1.02 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

### PART 2 – PRODUCTS

#### 2.01 SUPPLY

- A. Registers:
  - 1. Ceiling Register:
    - a. Material: Integrated into plywood ceiling panels.
    - b. General: Install above ceiling register box directly onto plywood ceiling panels at specified locations as per construction documents.
    - c. Opening Area: See Mechanical drawings for compliance.

#### 2.02 RETURN

- A. Sidewall Register:
  - 1. Material: Integrated into interior plywood wall panels.
  - 2. Opening Area: 4 sqft min.

#### 2.03 ACCESSORIES



- A. Register Box:
  - 1. Type: Above ceiling.
  - 2. Flange: Yes

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. All diffusers, registers, and grilles are formed from voids milled into CNC routed interior panels.
- B. Screw attach flanged register box to interior wall or ceiling panel as required. See mechanical drawings.
- C. Seal register box to interior wall and ceiling panels and attach ductwork prior to panel installation.

END OF SECTION 23 37 13



## 23 72 00 AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Specifications for heat recovery ventilator.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.02 QUALITY ASSURANCE

- A. The units shall be tested by a NRTL, in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
- B. All wiring shall be in accordance with the NEC
- C. The system shall be rated in accordance with ARI Standard 210/240 and bear the ARI label.
- D. Installer qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - 1. Labor type: Skilled labor.
  - 2. Qualifications: No qualifications required.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A.

#### 1.03 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Warranty Period: Broan HRV Fresh Air System is warranted for 2 years on parts and 10 years on core unit.



## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Broan  
926 W. State Street  
Hartford, WI 53027  
Phone: 1-800-558-1711  
[www.broan.com](http://www.broan.com)
- B. Substitutions: Permitted.

### 2.02 PRODUCTS

- A. Heat Recovery Ventilator:
  - 1. Energy Star Qualified: Yes
  - 2. Flow rate: 45-96 CFM
  - 3. Coverage Area: 3,000 sqft
  - 4. Voltage: 120V

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install as per installation manuals provided by the manufacturer and all local and national mechanical and electrical codes.

**END OF SECTION 23 72 00**



## 23 81 26 SPLIT-SYSTEM HEAT PUMPS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Packaged indoor and outdoor unit heat pumps with related equipment, accessories, and controls.
- B. Related sections: 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY, 23 09 13 INSTRUMENTATION & CONTROL DEVICES FOR HVAC
- C. General: Locate outdoor heat pump unit in close proximity to opening in CMU thermal mass system on north side of house. Outdoor unit air intake will be pre-conditioned air directly from CMU thermal mass system. See section 04 22 23 ARCHITECTURAL CONCRETE UNIT MASONRY for additional information.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. The units shall be tested by a NRTL, in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
- B. All wiring shall be in accordance with the NEC
- C. The system shall be rated in accordance with ARI Standard 210/240 and bear the ARI label.
- D. Installer qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - 1. Labor type: Skilled labor.
  - 2. Qualifications: No qualifications required.



#### 1.04 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Warranty Period: Daikin Mini Split System is warranted for 10 years from date of installation.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. Daikin North America LLC  
5151 San Felipe  
Suite 500  
Houston, TX 77056  
[www.daikinac.com](http://www.daikinac.com)
- B. Substitutions: Permitted.

#### 2.02 MATERIALS

- A. Ducted Mini-Split System:
  - 1. System Performance:
    - a. Rated cooling capacity: 18,000 Btu/hr
    - b. Sensible capacity: 14,800 Btu/hr
    - c. Cooling input power: 2.12 kW
    - d. Heating input power: 2.12 kW
    - e. SEER: 17.5
  - 2. Refrigerant:
    - a. Type: R-410A
  - 3. Outdoor unit:
    - a. 1.5-Ton Heat Pump
    - b. Power supply (V/Hz/Ph): 208-230 / 60 / 1



- c. Airflow Rate (H/M/L) (cfm): 635 / 582 / 529
- 4. Indoor unit:
  - a. Power supply (V/Hz/Ph): 208-230 / 60 / 1
  - b. Airflow Rate (H/M/L) (cfm): 635 / 582 / 529
- 5. Controller:
  - a. See section 23 09 13 INSTRUMENTATION & CONTROL DEVICES FOR HVAC

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation shall be executed as per installation manuals provided by the manufacturer and all local and national mechanical and electrical codes.
- B. 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.
- C. Correct deficiencies in or remove and reinstall units that do not comply with requirements.
- D. Repair, refinish, or replace products or finishes damaged during installation or transit, as directed by Architect.

**END OF SECTION 23 81 26**





## DIVISION 25 - INTEGRATED AUTOMATION

### 25 36 16 Integrated Automation Sensors and Transmitters

#### PART 1 – GENERAL

##### 1.05 SUMMARY

- A. Section includes: Sensors for measurement of temperature, humidity, light level, and motion detection. Also includes microcontroller for data acquisition and laptop computer for processing and displaying data.
- B. Integration of four sensors in electrical box and custom-made 3D printed cover.

##### 1.06 SUBMITTALS

- C. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- D. Shop drawings for 3D printing of box cover.

##### 1.07 QUALITY ASSURANCE

- E. All wiring shall be in accordance with the NEC

#### PART 2 – PRODUCTS

##### 2.03 MANUFACTURERS

- A. Adafruit, inc.  
[www.adafruit.com](http://www.adafruit.com)
- B. Substitutions: Permitted.

##### 2.04 MATERIALS

- A. Temperature sensor:
  - 1. System Performance:



- a. Three pin connection resistive digital sensor
- b. Precision +/-0.5 deg C.
- B. Humidity sensor:
  1. System Performance:
    - a. Three pin connection capacitive digital sensor
    - b. Precision +/-1% relative humidity.
- C. Light level sensor:
  1. System Performance:
    - a. Two pin connection photo sensitive analog resistor
- D. Motion detection sensor PIR:
  1. System Performance:
    - a. Three pin connection pyroelectric infrared sensor
    - b. Sensitive to 20 ft radius
- E. Low voltage wire:
  1. Specifications
    - a. 18 AWG
- F. Microcontroller Arduino Mega 2560 R3
  1. System Performance:
    - a. USB connection for data transfer to laptop computer.
    - b. 54 digital input/output connection pins and 16 analog inputs.
    - c. Power with AC-to-DC adapter, or battery, or USB connection.
- G. Laptop computer
  1. System Performance:
    - a. USB connection to microcontroller for data transfer and power.

## PART 3 - EXECUTION

### 3.02 INSTALLATION



- A. The four sensors are inserted and secured in place in an electrical box and exposed through a custom-made 3D-printed cover plate.
- B. Install electrical box such that the sensors are exposed to space and plate cover is flush with the ceiling or wall.
- C. Connect wires to set of sensors at one end and to the microcontroller at the other.
- D. Connect microcontroller to laptop through USB cable.
- E. Run software for data acquisition, processing and display.

END OF SECTION 25 36 16



## DIVISION 26 – ELECTRICAL

### 26 24 16 PANELBOARDS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Panel box for home.
- B. Related sections: 26 28 16.13 ENCLOSED CIRCUIT BREAKERS

##### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

##### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - 1. Labor Type: Skilled Labor.
  - 2. Qualifications: All installers performing hot work must be NEC Certified at minimum.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to storage facility in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions.



## PART 2 – PRODUCTS

### 2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures:
  - 1. Flush- and surface-mounted cabinets; NEMA 250, Type 1.
- B. Service Equipment Label:
  - 1. NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- C. Future Devices:
  - 1. Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- D. Panelboard Short-Circuit Current Rating:
  - 1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
- E. Panelboard Short-Circuit Current Rating:
  - 1. Rated to interrupt symmetrical short-circuit current available at terminals.

### 2.02 PANELBOARDS

- A. Mains: Circuit breaker.
- B. Branch Overcurrent Protective Devices: Plug-in circuit breakers.
- C. Main Service Panel:
  - 1. Basis-of-Design Product: PowerMark Gold Panel Box by GE.
    - a. Substitutions: Permitted.
  - 2. Maximum Amperage: 200A
  - 3. Voltage: 240V
  - 4. Equipment Ground Kit: Yes
  - 5. Number Spaces: 40
  - 6. Number Phases: 1



## 2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
  - 2. Single-Pole Breakers: 30A
  - 3. Single-Pole AFCI Breakers: 15A, 20A
  - 4. Single-Pole AFCI Breakers: 20A
  - 5. Double-Pole Breakers: 15A, 20A, 30A, 40A
- B. AC Disconnect:
  - 1. Basis-of-Design Product: Puller type AC Disconnect by GE.
    - a. Substitutions: Permitted.
  - 2. Type: Non-Automatic Switch
  - 3. Maximum Amperage Rating: 60A
  - 4. Voltage: 240V
  - 5. Enclosure: Steel. Enclosure to comply with NEMA Type 3R.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of unit 72 inches above finished floor unless otherwise indicated.
- C. Arrange conductors into groups; bundle and wrap with wire ties.
- D. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory.



END OF SECTION 26 24 16



## 26 27 26 WIRING DEVICES

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Receptacles.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - 1. Labor Type: Skilled Labor.
  - 2. Qualifications: None required.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to storage facility in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions.

### PART 2 – PRODUCTS

#### 2.01 RECEPTACLES

- A. General: All receptacles shall be UL listed.
- B. Basis-of-Design Product: Receptacles by Leviton Manufacturing Co, Inc.





1. Substitutions: Permitted.
- C. Duplex Receptacles: The ungrounded pole of each receptacle shall be provided with a separate terminal.
  1. Arc Fault Interrupter Duplex Receptacles: Shall be an integral unit, suitable for mounting in a standard outlet box.
  2. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, suitable for mounting in a standard outlet box.
- D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof cover plate. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

## 2.02 ACCESSORIES

- A. Receptacle Box: 1-Gang, 14 in<sup>3</sup> work box.
- B. Receptacle Box Extension: 1-Gang

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install in compliance with NEC and as shown unless otherwise noted.
- B. Install devices and assemblies plumb, level, and square with building lines.
- C. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multi-gang wall plates.

**END OF SECTION 26 27 26**



## 26 31 00 PHOTOVOLTAIC COLLECTORS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Photovoltaic panels.
- B. Related sections: 05 45 16 ELECTRICAL METAL SUPPORTS, 48 19 16 ELECTRICAL POWER GENERATION INVERTERS, 22 33 00 ELECTRIC DOMESTIC WATER HEATERS

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - 1. Labor Type: Skilled Labor.
  - 2. Qualifications: All installers performing hot work must be NEC Certified at minimum.
  - 3. Ensure compliance with all safety requirements for Work on elevated surfaces as noted in the Indigo Pine Health & Safety Plan.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
- B. Provide spacers between frames and glass of panel top faces during storage and transportation.

#### 1.05 WARRANTY



- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Warranty Period: SolarWorld Americas, Inc. warrants product for functional capability for 10 years from purchase.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. SolarWorld Americas, Inc.  
25300 NW Evergreen Rd.  
Hillsboro, OR 97124  
Phone: 1-503-844-3414  
[www.solarworld-usa.com](http://www.solarworld-usa.com)
- B. Substitutions: Not Permitted.

### 2.02 MATERIALS

- A. Photovoltaic Collector:
  - 1. Cell Type: Mono crystalline
  - 2. Electrical Characteristics:
    - a. Max Power Voltage ( $V_{mp}$ ): 31.3 V
    - b. Max Power Current ( $I_{mp}$ ): 9.2 A
    - c. Open Circuit Voltage ( $V_{oc}$ ): 39.7 V
    - d. Short Circuit Current ( $I_{sc}$ ): 9.84 A

### 2.03 ASSEMBLY DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Metal weather proof junction box on each string to convert from photovoltaic wire to THWN electrical wire.



## 2.04 ACCESSORIES

### A. PV Mounting:

1. Install photovoltaic collector racking system directly onto roof material. See section 05 45 16 ELECTRICAL METAL SUPPORTS. Bolt to electrical metal supports as recommended by manufacturer to ensure compliance with regional wind and snow loads.
2. Used to mount photovoltaic modules onto the roof and porch canopy, on an angle as follows:
  - a. Roof: 30°
  - b. Porch: 15 °

### B. Inverters:

1. See section 48 19 16 ELECTRICAL POWER GENERATION INVERTERS.

### C. Wires:

1. Type: MC4 PV Extension
2. Size: #14 AWG

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Wiring Method: Conceal conductors and cables in accessible raceways and under PVs where possible.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitation on bending radii. Install lacing bars and distribution spools.

**END OF SECTION 26 31 00**



## 26 51 00 INTERIOR LIGHTING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section Includes: 26 51 13 INTERIOR LIGHTING FIXTURES, LAMPS AND BALLASTS

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - 1. Labor Type: Skilled Labor.
  - 2. Qualifications: All installers performing hot work must be NEC Certified at minimum.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to storage facility in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURER

- A. Philips Corporation  
[www.usa.philips.com](http://www.usa.philips.com)



- B. Substitutions: Permitted as noted.

## 2.02 FIXTURES

- A. Uplighting:

1. 1-Light Strip Fixture:
  - a. Type: LED
  - b. Style: T8 InstantFit
  - c. Voltage: 120V
2. T8 InstantFit Ballast:
  - a. Voltage: 120V AC

- B. Downlighting:

1. Basis-of-Design Product: SlimSurface White LED Downlight by Philips.
  - a. Substitutions: Permitted.
2. Type: LED
3. Style: By owner.
4. Voltage: 120V
5. Dimming: Yes
6. Wet Listed: Yes
7. Size: 5" or 7" as per construction documents.

- C. Pendant Light:

1. Basis-of-Design Product: Cinta Aluminum LED Pendant Light by Philips.
  - a. Substitutions: Permitted.
2. Type: LED
3. Style: By owner.
4. Voltage: 120V

## PART 3 - EXECUTION

### 3.01 INSTALLATION



- A. Install all Work contained within this section as per manufacturer's recommendations.

END OF SECTION 26 51 00



## 26 56 00 EXTERIOR LIGHTING

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Light fixtures for exterior application.

#### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - A. Labor Type: Skilled Labor.
  - B. Qualifications: All installers performing hot work must be NEC Certified at minimum.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to storage facility in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful weather conditions.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURER

- A. Philips Corporation  
[www.usa.philips.com](http://www.usa.philips.com)





B. Substitutions: Permitted.

## 2.02 FIXTURES

A. Downlighting:

1. Basis-of-Design Product: SlimSurface White LED Downlight by Philips.
  - a. Substitutions: Permitted.
2. Type: LED
3. Style: By owner.
4. Voltage: 120V
5. Dimming: Yes
6. Wet Listed: Yes
7. Size: 5" or 7" as per construction documents.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Install all Work contained within this section as per manufacturer's recommendations.

**END OF SECTION 26 56 00**



## DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

### 28 31 43 SMOKE DETECTION SENSORS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Smoke Detector System.

##### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.
- C. Coordination Drawings: Reflected Ceiling Plan, drawn to scale, and coordinated with each other, using input from installers of the items involved.

##### 1.03 SYSTEM DESCRIPTION

- A. Fire alarm system with interconnect alarm signaling.
- B. Battery operated power supply with wirelessly interconnected units.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Smoke detection units to comply with the following standards: UL 217, NFPA 72, NFPA 101

##### 1.05 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

##### 1.06 WARRANTY



- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Limited Warranty: Kidde smoke detection alarms are warranted against defects in materials and workmanship or design under normal use and service for a period of 10 years from date of purchase.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Kidde  
1016 Corporate Park Dr.  
Mebane, NC 27302  
Phone: 1-800-880-6788
- B. Substitutions: Permitted.

### 2.02 MATERIALS

- A. Wireless Interconnect Smoke Alarm:
  - 1. Power Supply: Battery
  - 2. Interconnect System: Yes
  - 3. Audible Alarm: 85 dB at 10'
  - 4. Temperature Range: 40° F to 100° F
  - 5. Humidity Range: Up to 85% RH
  - 6. Wiring: None

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Visually inspect smoke detection units before installation. Reject if unit and accessories are wet, moisture damaged, or mold damaged and replace.



## 3.02 INSTALLATION

- A. Install smoke detection units as per manufacturer's installation instructions.

END OF SECTION 28 31 43



## DIVISION 32 - EXTERIOR IMPROVEMENTS

### 32 93 00 PLANTS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Plants and soil conditions.
- B. Related sections: 32 97 00 PLANTERS

##### 1.02 SUBMITTALS

- A. Product data and certificates.

##### 1.03 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

#### PART 2 – PRODUCTS

##### 2.01 PLANTING MATERIALS

- A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1. See planting schedule in construction documents.

##### 2.02 SOIL AND AMENDMENTS

- A. Topsoil: As recommended by local plant supplier.
- B. Fertilizer: As recommended by local plant supplier.

##### 2.03 PLANTING SOIL MIX

- A. Mix topsoil with the following soil amendments and fertilizers in the following quantities:



1. As recommended by local plant supplier.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Plant plants in planters sized as indicated in construction documents, see section 32 97 00 PLANTERS. Dig holes large enough to allow root spread. Plant stock working soil around roots and leave a slight saucer around plants to hold water. Water after planting. Do not cover plant crowns with wet soil.

### 3.02 MAINTENANCE

- A. Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings. Harvest according to plant schedule.
- B. Maintain ground covers and plants until established, but not less than six months.

**END OF SECTION 32 93 00**



## 32 97 00 PLANTERS

### PART 1 – GENERAL

#### 1.01 SUMMARY

- A. Section includes: Terra cotta planters.
- B. Related sections: 32 93 00 PLANTS

#### 1.02 QUALITY ASSURANCE

- A. Installer qualifications:
  - 1. Labor Type: Unskilled labor.
  - 2. Qualifications: No qualifications required.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Planters:
  - 1. Material: Terracotta
  - 2. Shape: Round
  - 3. Size: As per construction documents.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Ensure that porch and ramp contains holes to accept planters as per construction documents.
- B. Do not install until all unacceptable conditions are remedied.

#### 3.02 INSTALLATION



- A. Install along porch and ramp in locations as per construction documents:
  1. Ensure plants are potted in planters as per manufacturer's recommendations, see section 32 97 00 PLANTS.
  2. Gently align planters with provided holes along porch and ramp and insert planters into porch and ramp, ensuring that planters are not cracked or otherwise damaged during installation.

**END OF SECTION 32 97 00**





## DIVISION 48 - ELECTRICAL POWER GENERATION

### 48 19 16 ELECTRICAL POWER GENERATION INVERTERS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

- A. Section includes: Product information pertaining to inverters.
- B. Related sections: 26 31 00 PHOTOVOLTAIC COLLECTORS

##### 1.02 SUBMITTALS

- A. Manufacturer's product data, including manufacturer's specification summary sheet for specified products.
- B. Manufacturer's installation instructions, maintenance data, and warranty information.

##### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installing work similar to that required for this project.
  - 1. Labor Type: Skilled Labor.
  - 2. Qualifications: All installers performing hot work must be NEC Certified at minimum.
  - 3. Ensure compliance with all safety requirements for Work on elevated surfaces as noted in the Indigo Pine Health & Safety Plan.

##### 1.04 WARRANTY

- A. Manufacturer's Material Warranty: Submit manufacturer's standard warranty document.
  - 1. Warranty Period: 25 year limited warranty beginning on date of original purchase to cover defects in material and workmanship.

#### PART 2 – PRODUCT



## 2.01 REFERENCE STANDARDS

- A. UL 1741 – Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
- B. IEEE 1547 – Standard for Interconnecting Distributed Resources with Electric Power Systems
- C. FCC Part 15, Class B – Unlicensed RF Devices
- D. CAN/CSA – C22.2, No. 0-M91,0.4-04, and 107.1-01 – General Requirements – Canadian Electrical Code, Part II

## 2.02 PRODUCTS

- A. Basis-of-Design Product: Enphase M250 Microinverter by Enphase Energy.
  - 1. Substitutions: Permitted.
- B. Microinverter Product:
  - 1. Maximum DC input voltage: 48V
  - 2. Maximum input current: 23.4A at 600V AC
  - 3. AC voltage range: 208-240 VAC
  - 4. Maximum output current: 24.0A

## 2.03 ACCESSORIES

- A. Combiner Box:
  - 1. DC Voltage: 600 V
  - 2. Max Current: 120A
  - 3. Fusible: Yes
- B. Wires:
  - 1. Location: Combiner boxes to inverters
    - a. Type: Stranded Black Copper THHN Wire
    - b. Size: #10 AWG
  - 2. Location: Inverters to electrical breaker panel.
    - a. Type: MC4 PV Extension
    - b. Size: #14 AWG



## PART 3 - EXECUTION

### 3.01 INSTALLATION

1. Install as per installation manuals provided by the manufacturer.
2. Ensure compliance with all local and national mechanical and electrical codes.
3. 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.
4. Correct deficiencies in or remove and reinstall units that do not comply with requirements.
5. Repair, refinish, or replace products or finishes damaged during installation or transit, as directed by Architect.

END OF SECTION 48 19 16



## Appendix A: Structural Calculations

### Dead and Live Loads

#### DEAD AND LIVE LOADS

DEAD LOADS	Uniform Load (psf)
<b>Porch</b>	
Plywood Panels	3.12
<b>Total Porch Dead Load</b>	<b>3.12</b>
<b>Floor</b>	
Subflooring (HUBER Zip Panel - 7/16")	1.5
Finished Plywood Flooring	2.2
Floor Joist Self Weight	2
<b>Total Floor Dead Load Subtotal</b>	<b>5.7</b>
<b>Roof</b>	
Sheathing (HUBER Zip Panel - 5/8")	1.5
30 lb Roofing Felt	0.14
PBR Metal Roof	0.8
Photovoltaic Panels (30 at 41lb)	2.33
PV Panel Frame (30 at 20lb)	0.4
Roof Joist Self Weight	3
MEP	3
Interior Sheathing	1.5
<b>Total Roof Dead Load Subtotal</b>	<b>13.67</b>

#### ROOF

<b>Span (ft)</b>	10	13
<b>Dead Load (psf)</b>	14	14
<b>Live Load (psf)</b>	20	20
<b>Factored Load (psf)</b>	48.80	48.80
<b>Tributary Width (ft)</b>	2	2
<b>Roof Slope (in/ft)</b>	1	1
<b>Line Load (plf)</b>	97.6	97.6
<b>Max Shear (lbs)</b>	488.0	634.4
<b>Max Moment (lb-ft)</b>	1220	2061.8

\*According to ASCE the roof slope is negligible. It is slightly conservative to do this

\*Snow in Irvine, CA doesn't ever control ( $0 < p_g < 5$ psf)

#### FLOOR

<b>Span (ft)</b>	
<b>Dead Load (psf)</b>	3.7
<b>Live Load (psf)</b>	50
<b>Factored Load (psf)</b>	84.44

\*The span for the floor is relatively small (a few feet) as it is spanned almost continuously



## Wind Loads: 85 MPH

### WIND CALCULATION - 85 MPH - SERVICE

\*This documents the calculation of the expected wind loads on the Irvine, CA site

\*The loads calculated here are based on ASCE 7-10 Chapters 26-31

### BUILDING SITE/STRUCTURE CHARACTERISTICS

Risk Category	II
Ultimate Velocity (mph)	110 *Given by DOE as 85 mph service
Kd	0.85
Exposure	C
Kzt	1
G	0.85
Enclosure	Enclosed *See below calculation
Gcpi	±0.18

### Enclosure Calculation

### ASCE 26.2

Face	Windows (ft <sup>2</sup> )	Gross Area (ft <sup>2</sup> )		
North	36.8	566.2		
South	125.9	499.3		
East	65.0	404.5		
West	72.7	404.5		
Roof	0.0	972.2		
	Aoi	Agi	1.1 x Aoi	Aoi/Agi
	263.6	2280.5	289.96	0.12
	174.5	2347.4	191.95	0.07
	235.4	2442.2	258.94	0.10
	227.7	2442.2	250.47	0.09
	--	--	--	--

\*Because  $Aoi/Agi < 0.2$  the building is considered enclosed

### MWFRS CALCULATIONS - CHAPTER 27.2-1

h (ft)	Kh	q (psf)
15	0.85	22.4
16.125	0.86125	22.7

\*All subsequent pressures were calculated at the eave height (16.125').  
It is slightly conservative but very close (see bolded values)

### CP DETERMINATIONS

Cp (windward)	Cp (leeward N/S)	Cp (leeward E/W)	Cp (side)
0.8	-0.433	-0.5	-0.7



## Wind Loads: 135 MPH

### WIND CALCULATION - 135 MPH

\*This documents the calculation of the expected wind loads on a coastal site in SC

\*The loads calculated here are based on ASCE 7-10 Chapters 26-31

### BUILDING SITE/STRUCTURE CHARACTERISTICS

Risk Category	II
Ultimate Velocity (mph)	135 *Coastal wind speed in SC
Kd	0.85
Exposure	C
Kzt	1
G	0.85
Enclosure	Enclosed *See below calculation
Gcpi	±0.18

### Enclosure Calculation

Face	Windows (ft <sup>2</sup> )	ASCE 26.2 Gross Area (ft <sup>2</sup> )		
North	36.8	566.2		
South	125.9	499.3		
East	65.0	404.5		
West	72.7	404.5		
Roof	0.0	972.2		
	<b>Aoi</b>	<b>Agi</b>	<b>1.1 x Aoi</b>	<b>Aoi/Agi</b>
	263.6	2280.5	289.96	0.12
	174.5	2347.4	191.95	0.07
	235.4	2442.2	258.94	0.10
	227.7	2442.2	250.47	0.09
	--	--	--	--

\*Because Aoi/Agi < 0.2 the building is considered enclosed

### MWFRS CALCULATIONS - CHAPTER 27.2-1

h (ft)	Kh	q (psf)
15	0.85	<b>33.7</b>
16.125	0.86125	<b>34.2</b>

\*All subsequent pressures were calculated at the eave height (16.125').

It is slightly conservative but very close (see bolded values)

### CP DETERMINATIONS

Cp (windward)	Cp (leeward N/S)	Cp (leeward E/W)	Cp (side)
0.8	-0.433	-0.5	-0.7



## Seismic Load Calculations

### SEISMIC LOAD CALCULATIONS

\*The loads calculated in this section correspond to the seismic design criteria of Irvine, CA

\*The assumptions of this calculation are in line with those made in ASCE 7-10 Chapters 11-14

#### Seismic Design Values (usgs.gov)

Ss	1.547 Sms	1.547 Sds	1.032
S1	0.569 Sm1	0.854 Sd1	0.569

#### Response Modification Factor

R	6.5 *Table 12.2-1
---	-------------------

#### Importance Factor

Ie	1 *Table 1.5-2
----	----------------

#### Approximate Fundamental Period

Ta	0.161 s
Ct	0.02
hn	16.125 ft
x	0.75

\*This fundamental period is based on the structural height and Eq. 12.8-7

#### Seismic Weight, W

\*The estimates for structural weight are made using ASCE 7 Chapter C3-1

<b>Roof:</b>	Ext. Sheathing:	1.5 psf	<b>Walls:</b>	Ext. Sheathing:	1.4 psf
	Felt:	0.14 psf		Studs:	2 psf
	Metal:	0.8 psf		Int. Sheathing:	2 psf
	Solar:	2.33 psf		Insulation:	0.5 psf
	Frames:	0.4 psf		Cladding:	1 psf
	Joists:	4 psf		TOTAL:	6.9 psf
	MEP:	3 psf		Length:	27 ft
	Int. Sheathing:	1.5 psf		Width:	36 ft
	TOTAL:	13.67 psf		Avg. Height:	14.0625 ft
				*This is the height changes due to the monoslope building	

#### Seismic Response Coefficient, Cs

Cs	0.544 *Eq. 12.8-2	Wall Area:	1771.875 ft <sup>2</sup>
		1/2 Wall Area:	885.9375 ft <sup>2</sup>
		Roof Area:	972 ft <sup>2</sup>

#### Seismic Base Shear, V

V	10.55 kips	<b>TOTAL WEIGHT:</b>	19.4 kips
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#### Shear in Diaphragm, Vd

\*These are the values of the applied shear load on the top of the wall assembly

E-W Shaking	<b>Vd</b>	<b>0.147 klf</b>
N-S Shaking	<b>Vd</b>	<b>0.195 klf</b>



## Shear Tab & Screw Loads

\*The shear tabs will not likely receive very much load; however, we will assume that all the load travels from the sheathing to the studs and through the flange to web connection

\*These calculations will be done using EQ loads as they control in this case

Shear Tab Test				
Test Number	1_A	1_B	1_C	1_D
Maximum Force (lbs)	955.80	1161.50	991.00	1006.80
Displacement (in)	0.24	0.65	0.32	0.32

Test Number	1_E	Average	Factored	Safety Factors	
Maximum Force (lbs)	993.3	1021.7	613.0	$\lambda$	0.8
Displacement (in)	0.3	0.4	N/A	$\phi_v$	0.75

	Shear (plf)	Total Shear (kips)	Number of Tabs	Area (sf)	Tabs/sf
North Wall	195	10.55	17.21	566.2	0.0304
South Wall	195	10.55	17.21	499.3	0.0345
East Wall	147	10.55	17.21	404.5	0.0425
West Wall	147	10.55	17.21	404.5	0.0425

\*This assumes that shear tabs at the top of the wall and bottom of the wall take all the shear and there is one line of tabs at the top and one at the bottom

\*This assumptions are greatly conservative and result in unrealistic situations but prove the tab strength is sufficient

Screw Shear Test						
Test Number	2_A	2_B	2_C	2_D	2_E	Average
Maximum Force (lbs)	616.35	618.98	561.28	674.80	498.70	<b>594.02</b>
Displacement at Failure (in)	0.57	0.45	0.65	0.57	0.39	<b>0.53</b>

\*A 1 5/8" exterior wood screw was tested between two typical plywood flanges.





## Cable Tie Loads

Test Number	Cable tie Test					Average
	1_A	1_B	1_C	1_D	1_E	
Maximum Force (lbs)	383.30	289.60	363.10	310.60	357.10	340.74
Displacement at Failure (in)	0.36	0.37	0.47	0.28	0.36	0.37

\*The cable ties are part of the main wind force resisting system (MWFRS)

FACTORED				
	85 mph	135 mph	Factor of Safety	1.33
Maximum Wall Pressure (psf)	13.5	20.3		
Maximum Roof Pressure (psf)	18.9	28.4		

\*These come from the previous worksheets on wind calculation

\*These pressures are maximum negative pressures

WALL	85 mph	135 mph
Cable Ties per Square Foot	0.053	0.079
ROOF	85 mph	135 mph
Cable Ties per Square Foot	0.074	0.111

	Gross Area (sf)	Cable Ties	
		85 mph	135 mph
NORTH WALL	566.2	29.91	44.98
SOUTH WALL	499.3	26.38	39.66
EAST WALL	404.5	21.37	32.13
WEST WALL	404.5	21.37	32.13
ROOF	972.2	71.90	108.04



## Screw Withdrawal Loads

Test Number	Screw Withdrawal					Average
	4_A	4_B	4_C	4_D	4_E	
<b>Maximum Force (lbs)</b>	391.20	480.33	312.49	470.98	333.09	<b>397.62</b>
<b>Displacement at Failure (in)</b>	0.09	0.09	0.08	0.12	0.08	<b>0.09</b>

\*Withdrawal of 1 5/8" screw was tested. A minimum number of screws was determined using wind pressures calculated in wind calculations

	FACTORED		Factor of Safety	6.00
	85 mph	135 mph		
<b>Maximum Wall Pressure (psf)</b>	13.5	20.3		
<b>Maximum Roof Pressure (psf)</b>	18.9	28.4		

\*These come from the previous worksheets on wind calculation

\*These pressures are maximum negative pressures

	85 mph	135 mph
<b>WALL</b>	85 mph	135 mph
<b>Cable Ties per Square Foot</b>	0.204	0.306
<b>ROOF</b>	85 mph	135 mph
<b>Cable Ties per Square Foot</b>	0.285	0.429

	Gross Area (sf)	Screws	
		85 mph	135 mph
<b>NORTH WALL</b>	566.2	115.34	173.44
<b>SOUTH WALL</b>	499.3	101.71	152.95
<b>EAST WALL</b>	404.5	82.40	123.91
<b>WEST WALL</b>	404.5	82.40	123.91
<b>ROOF</b>	972.2	277.27	416.64



Wall Assembly Test Data

**SAMPLE RESULTS WALL 1**

Actuator in	LVDT in	Force lbs
0	0	0
-0.004821	0.00057	-3.83134
0.0001137	-9.3E-07	-7.89018
-0.004199	7.99E-05	-10.6231
-0.001089	0.000409	-9.31268
-0.002849	0.00049	-9.29024
-0.003638	0.000409	-8.45113
-0.000113	-0.00025	-5.91139
-0.002395	0.00016	-6.58852
-0.000943	-1.6E-06	0.003685
-0.003867	-8E-07	3.605514
0.0007722	7.93E-05	7.123058
-0.003177	-0.00041	10.22961
0.0009799	-8E-07	11.8744
-0.002349	0	12.84697
-0.000377	0.000409	15.10551
-0.001134	-8.2E-05	17.15383
0.0001388	-8.2E-05	19.05801
-0.00079	0.000409	20.76212
0.000461	0.00049	21.63933
0.0037048	0.00049	27.6758
0.0003116	0.000409	27.23623
0.0033821	-8E-07	31.12327
-0.000487	0.00049	32.33709
0.004094	-0.00041	34.17604
0.0003685	0.00049	35.70243
0.0031353	-8E-07	37.76404
0.0019928	0.00049	39.68851
0.0027926	-8.2E-05	39.75673
0.0033894	0.000409	43.51554
-0.000979	0.00049	44.41557
0.0036317	0.000409	46.47557
0.0026071	0.000409	48.23653
0.0041558	7.99E-05	50.97551
0.0006462	-0.00016	52.85111
0.0058584	0.000409	52.46963
0.0035836	-8.2E-05	57.0796
0.00496	0.000409	58.25716
0.0070706	0.000329	60.04847
0.0045679	-8.2E-05	59.83395
0.0062926	-0.00041	65.02978
0.0022346	7.92E-05	66.55616
0.007077	-8E-07	68.96814

**SAMPLE RESULTS WALL 2**

Actuator in	LVDT in	Force lbs
-0.00102	-0.00636	0.853552
-0.00028	-0.00644	1.468916
0.000272	-0.00677	0.769649
-0.00405	-0.00693	-0.22343
0.000997	-0.00685	2.164803
-0.00444	-0.00677	2.845937
0.001817	-0.00685	6.750493
-0.0029	-0.00693	10.71805
0.000771	-0.00595	14.24697
-0.00095	-0.00595	14.18212
1.52E-05	-0.00636	18.20592
-0.00037	-0.0062	18.58341
-0.00024	-0.00677	18.36704
0.003996	-0.00628	21.78401
-0.00172	-0.00685	24.59591
0.003659	-0.00693	25.30378
-0.00103	-0.00685	28.33081
0.003044	-0.00636	30.11229
0.000265	-0.00636	30.22385
0.001921	-0.00685	32.14493
-0.00162	-0.00636	35.98833
0.000115	-0.0057	34.29437
0.00287	-0.00612	38.87145
-5.61E-05	-0.00587	40.26415
0.005708	-0.00693	41.06853
0.000966	-0.00693	42.90448
0.006994	-0.00644	45.69724
0.002087	-0.00644	46.01971
0.00388	-0.00644	48.21832
0.00445	-0.0062	51.13525
0.005558	-0.00677	49.78627
0.004127	-0.00636	53.09729
0.00515	-0.00758	55.10589
0.005392	-0.00693	56.32124
0.002973	-0.00595	58.70618
0.008278	-0.0084	61.36341
0.003446	-0.00693	62.47981
0.008026	-0.00693	63.47903
0.003046	-0.00636	63.96102
0.007536	-0.0075	66.46973
0.003917	-0.00709	67.49024
0.007008	-0.00717	69.40978
0.009507	-0.00709	71.02468



### Rafter Test Data

#### RAFTER RESULTS

RCH 302 Hydraulic Cylinder Information

Effective Load Area

46.6 cm<sup>2</sup>

7.223 in<sup>2</sup>

Reference:

[http://www.enerpac.com/sites/default/files/rch\\_326e\\_gb.pdf](http://www.enerpac.com/sites/default/files/rch_326e_gb.pdf)

TEST 1			
Pressure (psi)	Deflection (in)	Force (lbs)	Moment (lb-ft)
0	0.000	0	0
139	0.258	1004	2175
183	0.402	1322	2864
229	0.878	1654	3584
318	1.025	2297	4976
360	1.116	2600	5634
386	1.235	2788	6040
412	1.235	2976	6447
438	1.500	3164	6854

TEST 2			
Pressure (psi)	Deflection (in)	Force (lbs)	Moment (lb-ft)
0	0.000	0	0
96	0.220	693	1502
125	0.318	903	1956
171	0.456	1235	2676
212	0.614	1531	3318
247	0.829	1784	3865
273	0.955	1972	4272
302	1.060	2181	4726
331	1.195	2391	5180
351	1.288	2535	5493
371	1.329	2680	5806
395	1.550	2853	6181
406	1.800	2933	6353

TEST 3			
Pressure (psi)	Deflection (in)	Force (lbs)	Moment (lb-ft)
0	0.000	0	0
99	0.214	715	1549
165	0.480	1192	2582
212	0.568	1531	3318
241	0.665	1741	3771
264	0.878	1907	4131
299	1.025	2160	4679
325	1.122	2347	5086
348	1.245	2514	5446
357	1.350	2579	5587
383	1.433	2766	5993
389	1.626	2810	6087

Rafter	Max Force (lbs)	Max Moment (lb-ft)	Factored Moment Capacity (lb-ft)
1	3164	6854	4661
2	2933	6353	4320
3	2810	6087	4139
AVERAGE:			4373



## Wall Assembly in Compression Test Data

### COMPRESSION LOAD ON WALL SUPPORTING BOX GIRDER

#### PLAN DIMENSIONS OF SOLAR HOUSE

Width 36 ft  
Length 27 ft

Area 972 ft<sup>2</sup>

#### EXPECTED LOADS

Dead Load on Box Girder Support 3402 lbs  
Live Load on Box Girder Support 4860 lbs

Factored Compression Load 11858.4 lbs

#### EULER BUCKLING CHECK

	Y - Axis		X - Axis		
Moment of Inertia (I)	174.0586	in <sup>4</sup>	I	3.585938	in <sup>4</sup>
Area (A)	9	in <sup>2</sup>	A	9	in <sup>2</sup>
End Condition Factor (n)	4		n	4	
$\pi$	3.141593		$\pi$	3.141593	
Modulus of Elasticity (E)	1540	psi	E	1540	psi *Estimate
Unbraced Length (L)	12	in <sup>2</sup>	L	3	in <sup>2</sup>
Buckling Force (F)	21052.62	lbs	F	6939.582	lbs



# CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

## Supplemental Porch Framing Data

### Wood Column

File = I:\180007-300H1PC-EWMichael\Solarporch.ec6  
ENERCALC, INC. 1993-2015, Build 6.15.3.9, Ver 6.15.3.9

Lic. #: KW-06006800 Licensee:

Description: (2) 4x4 Posts - 20sf Trib

#### Code References

Calculations per 2012 NDS, IBC 2012, CBC 2013, ASCE 7-10  
Load Combinations Used: IBC 2012

#### General Information

Analysis Method: <b>Allowable Stress Design</b>	Wood Section Name: <b>4x4</b>	
End Fixities: <b>Top &amp; Bottom Pinned</b>	Wood Grading/Manuf.: <b>Graded Lumber</b>	
Overall Column Height: <b>6.0 ft</b> <small>(Used for non-slender calculations)</small>	Wood Member Type: <b>Sawn</b>	
Wood Species: <b>Douglas Fir - Larch (North)</b>	Exact Width: <b>3.50 in</b>	Allow Stress Modification Factors
Wood Grade: <b>No. 1/No. 2</b>	Exact Depth: <b>3.50 in</b>	Cf or Cv for Bending: <b>1.50</b>
Fb - Tension: <b>850.0 psi</b>	Area: <b>12.250 in<sup>2</sup></b>	Cf or Cv for Compression: <b>1.150</b>
Fb - Compr: <b>850.0 psi</b>	Ix: <b>12.505 in<sup>4</sup></b>	Cf or Cv for Tension: <b>1.50</b>
Fc - Prll: <b>1,400.0 psi</b>	Iy: <b>12.505 in<sup>4</sup></b>	Cm : Wet Use Factor: <b>1.0</b>
Fc - Perp: <b>625.0 psi</b>		Ct : Temperature Factor: <b>1.0</b>
E : Modulus of Elasticity . . .		Cfu : Flat Use Factor: <b>1.0</b>
x-x Bending: <b>1,600.0</b>		Kf : Built-up columns: <b>1.0</b> <small>NDS 15.3.2</small>
y-y Bending: <b>1,600.0</b>		Use Cr : Repetitive?: <b>No</b> <small>(non-glb only)</small>
Axial: <b>1,600.0 ksi</b>		
Basic: <b>580.0</b>		
Minimum: <b>580.0</b>		

Brace condition for deflection (buckling) along columns:  
X-X (width) axis: **Unbraced Length for X-X Axis buckling = 6.0 ft, K = 1.0**  
Y-Y (depth) axis: **Unbraced Length for X-X Axis buckling = 6.0 ft, K = 1.0**

#### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included: 16.114 lbs \* Dead Load Factor

AXIAL LOADS . . .

Axial Load at 6.0 ft, D = 0.40, Lr = 2.0 k

#### DESIGN SUMMARY

##### Bending & Shear Check Results

<b>PASS</b> Max. Axial+Bending Stress Ratio = Load Combination: <b>+D+Lr+H</b> Governing NDS Formula: <b>Comp Only, fc/Fc'</b> Location of max.above base: <b>0.0 ft</b> At maximum location values are . . . Applied Axial: <b>2.416 k</b> Applied Mx: <b>0.0 k-ft</b> Applied My: <b>0.0 k-ft</b> Fc : Allowable: <b>899.14 psi</b>	<b>Maximum SERVICE Lateral Load Reactions . .</b> Top along Y-Y: <b>0.0 k</b> Bottom along Y-Y: <b>0.0 k</b> Top along X-X: <b>0.0 k</b> Bottom along X-X: <b>0.0 k</b> <b>Maximum SERVICE Load Lateral Deflections . . .</b> Along Y-Y: <b>0.0 in</b> at <b>0.0 ft</b> above base for load combination: <b>n/a</b> Along X-X: <b>0.0 in</b> at <b>0.0 ft</b> above base for load combination: <b>n/a</b> Other Factors used to calculate allowable stresses . . . Bending: <b>1.500</b> Compression: <b>1.150</b> Tension: <b>1.150</b> Cf or Cv : Size based factors
<b>PASS</b> Maximum Shear Stress Ratio = Load Combination: <b>+0.60D+0.70E+0.60H</b> Location of max.above base: <b>6.0 ft</b> Applied Design Shear: <b>0.0 psi</b> Allowable Shear: <b>180.0 psi</b>	

#### Load Combination Results

Load Combination	C <sub>D</sub>	C <sub>P</sub>	Maximum Axial + Bending Stress Ratios			Maximum Shear Ratios		
			Stress Ratio	Status	Location	Stress Ratio	Status	Location
+D+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+D+L+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+D+Lr+H	1.000	0.558	0.2194	PASS	0.0ft	0.0	PASS	6.0ft
+D+S+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+D+0.750Lr+0.750L+H	1.000	0.558	0.1740	PASS	0.0ft	0.0	PASS	6.0ft
+D+0.750L+0.750S+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+D+0.60W+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+D+0.70E+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+D+0.750Lr+0.750L+0.450W+H	1.000	0.558	0.1740	PASS	0.0ft	0.0	PASS	6.0ft
+D+0.750L+0.750S+0.450W+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+D+0.750L+0.750S+0.5250E+H	1.000	0.558	0.03778	PASS	0.0ft	0.0	PASS	6.0ft
+0.60D+0.60W+0.60H	1.000	0.558	0.02267	PASS	0.0ft	0.0	PASS	6.0ft



# CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

## Wood Column

File = I1180007-300H1PC-E\Michael\Solar\porch.ec6  
ENERCAL, INC. 1993-2015, Build 6.15.3.9, Ver 6.15.3.9

Lic. #: KW-06006800

Licensee

Description: (2) 4x4 Posts - 20sf Trib

### Load Combination Results

Load Combination	C <sub>D</sub>	C <sub>P</sub>	Maximum Axial + Bending Stress Ratios			Maximum Shear Ratios		
			Stress Ratio	Status	Location	Stress Ratio	Status	Location
+0.60D+0.70E+0.60H	1.000	0.558	0.02267	PASS	0.0 ft	0.0	PASS	6.0 ft

### Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		Y-Y Axis Reaction		Axial Reaction @ Base
	@ Base	@ Top	@ Base	@ Top	
+D+H		k		k	0.416 k
+D+L+H		k		k	0.416 k
+D+Lr+H		k		k	2.416 k
+D+S+H		k		k	0.416 k
+D+0.750Lr+0.750L+H		k		k	1.916 k
+D+0.750L+0.750S+H		k		k	0.416 k
+D+0.60W+H		k		k	0.416 k
+D+0.70E+H		k		k	0.416 k
+D+0.750Lr+0.750L+0.450W+H		k		k	1.916 k
+D+0.750L+0.750S+0.450W+H		k		k	0.416 k
+D+0.750L+0.750S+0.5250E+H		k		k	0.416 k
+0.60D+0.60W+0.60H		k		k	0.250 k
+0.60D+0.70E+0.60H		k		k	0.250 k
D Only		k		k	0.416 k
Lr Only		k		k	2.000 k
L Only		k		k	k
S Only		k		k	k
W Only		k		k	k
E Only		k		k	k
H Only		k		k	k

### Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
+D+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+L+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+Lr+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+S+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750Lr+0.750L+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.60W+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.70E+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750Lr+0.750L+0.450W+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+0.450W+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+D+0.750L+0.750S+0.5250E+H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D+0.60W+0.60H	0.0000 in	0.000 ft	0.000 in	0.000 ft
+0.60D+0.70E+0.60H	0.0000 in	0.000 ft	0.000 in	0.000 ft
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
Lr Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
S Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
W Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
E Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
H Only	0.0000 in	0.000 ft	0.000 in	0.000 ft

## Wood Column

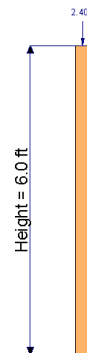
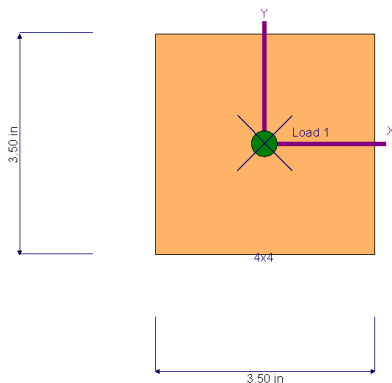
File = I1180007-300H1PC-E\Michael\Solar\porch.ec6  
ENERCAL, INC. 1993-2015, Build 6.15.3.9, Ver 6.15.3.9

Lic. #: KW-06006800

Licensee

Description: (2) 4x4 Posts - 20sf Trib

### Sketches



Loads are total entered value. Arrows do not reflect absolute direction.



# CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

## Wood Beam

File = I:\180007-300H1PC-ElMichaelSolarporch.ec6  
ENERCALC, INC. 1993-2015, Build 6.15.3.9, Ver.6.15.3.9

Lic. #: KW-06006800      Licensee:  
Description: 2x6 Joists @ 16" OC

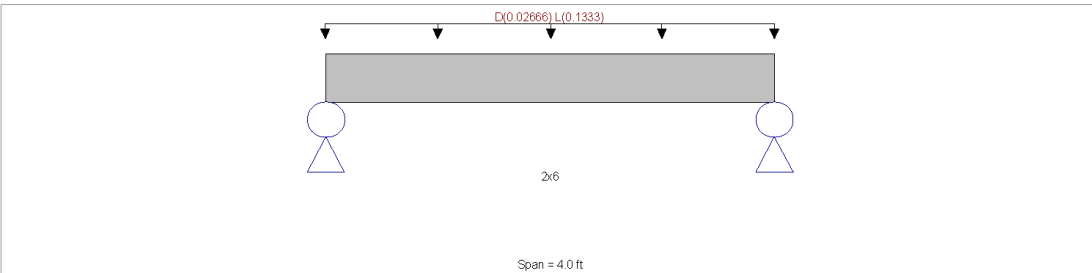
### CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10  
Load Combination Set : IBC 2012

### Material Properties

Analysis Method : Load Resistance Factor D	Fb - Tension	850 psi	E : Modulus of Elasticity
Load Combination IBC 2012	Fb - Compr	850 psi	Ebend- xx
	Fc - Prll	1400 psi	Eminbend- xx
Wood Species : Douglas Fir - Larch (North)	Fc - Perp	625 psi	
Wood Grade : No. 1/No. 2	Fv	180 psi	
	Ft	500 psi	Density
			31.57 pcf

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling



### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Uniform Load : D = 0.020, L = 0.10 ksf, Tributary Width = 1.333 ft

### DESIGN SUMMARY

Design OK

<p>Maximum Bending Stress Ratio = <b>0.408</b> 1</p> <p>Section used for this span = <b>2x6</b></p> <p>fb : Actual = <b>778.38</b> psi</p> <p>FB : Allowable = <b>1,908.56</b> psi</p> <p>Load Combination = <b>+1.20D+0.50Lr+1.60L+1.60H</b></p> <p>Location of maximum on span = <b>2.000</b> ft</p> <p>Span # where maximum occurs = <b>Span # 1</b></p> <p><b>Maximum Deflection</b></p> <p>Max Downward Transient Deflection <b>0.023</b> in Ratio = <b>2068</b></p> <p>Max Upward Transient Deflection <b>0.000</b> in Ratio = <b>0</b> &lt; 360</p> <p>Max Downward Total Deflection <b>0.028</b> in Ratio = <b>1723</b></p> <p>Max Upward Total Deflection <b>0.000</b> in Ratio = <b>0</b> &lt; 180</p>	<p>Maximum Shear Stress Ratio = <b>0.222</b> : 1</p> <p>Section used for this span = <b>2x6</b></p> <p>f<sub>v</sub> : Actual = <b>69.01</b> psi</p> <p>F<sub>v</sub> : Allowable = <b>311.04</b> psi</p> <p>Load Combination = <b>+1.20D+0.50Lr+1.60L+1.60H</b></p> <p>Location of maximum on span = <b>3.547</b> ft</p> <p>Span # where maximum occurs = <b>Span # 1</b></p>
--	--

### Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values					Shear Values				
			M	V	λ	C <sub>FN</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	Mu	f <sub>b</sub>	F <sub>b</sub>	Vu	f <sub>v</sub>	F <sub>v</sub>			
+1.40D+1.60H	Length = 4.0 ft	1	0.083	0.045	0.60	1.300	1.00	1.00	1.00	1.00	1.00	0.07	118.45	1431.42	0.00	0.00	0.00	0.00	10.50	233.28
+1.20D+0.50Lr+1.60L+1.60H	Length = 4.0 ft	1	0.408	0.222	0.80	1.300	1.00	1.00	1.00	1.00	1.00	0.49	778.38	1908.56	0.00	0.38	69.01	311.04	0.00	0.00
+1.20D+1.60L+0.50S+1.60H	Length = 4.0 ft	1	0.408	0.222	0.80	1.300	1.00	1.00	1.00	1.00	1.00	0.49	778.38	1908.56	0.00	0.38	69.01	311.04	0.00	0.00
+1.20D+1.60Lr+0.50L+1.60H	Length = 4.0 ft	1	0.164	0.089	0.80	1.300	1.00	1.00	1.00	1.00	1.00	0.20	313.05	1908.56	0.00	0.15	27.75	311.04	0.00	0.00
+1.20D+1.60L+0.50W+1.60H	Length = 4.0 ft	1	0.053	0.029	0.80	1.300	1.00	1.00	1.00	1.00	1.00	0.06	101.53	1908.56	0.00	0.05	9.00	311.04	0.00	0.00
+1.20D+0.50L+1.60S+1.60H	Length = 4.0 ft	1	0.164	0.089	0.80	1.300	1.00	1.00	1.00	1.00	1.00	0.20	313.05	1908.56	0.00	0.15	27.75	311.04	0.00	0.00





# CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

## Wood Beam

File = I:\18007~300H1PC-E\Michael\Solar\porch.ec6  
ENERCALC, INC. 1983-2015, Build 6.15.3.9, Ver.6.15.3.9

Lic. #: KW-06006800

Licensee :

Description : 2x6 Joists @ 16" OC

Load Combination	Segment Length	Span #	Max Stress Ratios		$\lambda$	$C_{FN}$	$C_i$	$C_r$	$C_m$	$C_t$	$C_L$	$\mu$	Moment Values		Shear Values			
			M	V									ft	Fb	Vu	fv	Fv	
+1.20D+1.60S+0.50W+1.60H	Length = 4.0 ft	1	0.053	0.029	0.80	1.300	1.00	1.00	1.00	1.00	1.00	0.06	101.53	1908.56	0.00	0.00	0.00	0.00
+1.20D+0.50Lr+0.50L+W+1.60H	Length = 4.0 ft	1	0.131	0.071	1.00	1.300	1.00	1.00	1.00	1.00	1.00	0.20	313.05	2385.70	0.15	27.75	388.80	0.00
+1.20D+0.50L+0.50S+W+1.60H	Length = 4.0 ft	1	0.131	0.071	1.00	1.300	1.00	1.00	1.00	1.00	1.00	0.20	313.05	2385.70	0.15	27.75	388.80	0.00
+1.20D+0.50L+0.70S+E+1.60H	Length = 4.0 ft	1	0.131	0.071	1.00	1.300	1.00	1.00	1.00	1.00	1.00	0.20	313.05	2385.70	0.15	27.75	388.80	0.00
+0.90D+W+0.90H	Length = 4.0 ft	1	0.032	0.017	1.00	1.300	1.00	1.00	1.00	1.00	1.00	0.05	76.15	2385.70	0.04	6.75	388.80	0.00
+0.90D+E+0.90H	Length = 4.0 ft	1	0.032	0.017	1.00	1.300	1.00	1.00	1.00	1.00	1.00	0.05	76.15	2385.70	0.04	6.75	388.80	0.00

### Overall Maximum Deflections

Load Combination	Span	Max. "+" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0279	2.015		0.0000	0.000

### Vertical Reactions

Load Combination	Support 1	Support 2
Overall MAXimum	0.320	0.320
Overall MINimum	0.032	0.032
+D+H	0.053	0.053
+D+L+H	0.320	0.320
+D+Lr+H	0.053	0.053
+D+S+H	0.053	0.053
+D+0.750Lr+0.750L+H	0.253	0.253
+D+0.750L+0.750S+H	0.253	0.253
+D+0.60W+H	0.053	0.053
+D+0.70E+H	0.053	0.053
+D+0.750Lr+0.750L+0.450W+H	0.253	0.253
+D+0.750L+0.750S+0.450W+H	0.253	0.253
+D+0.750L+0.750S+0.5250E+H	0.253	0.253
+0.60D+0.60W+0.60H	0.032	0.032
+0.60D+0.70E+0.60H	0.032	0.032
D Only	0.053	0.053
Lr Only		
L Only	0.267	0.267
S Only		
W Only		
E Only		
H Only		



# CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

## Wood Beam

File = I:\1800C7-300H1PC-EWMichaelSolarporch.ec6  
ENERCALC, INC. 1993-2015, Build 6.15.3.9, Ver 6.15.3.9

Lic. #: KW-06006800

Licensee:

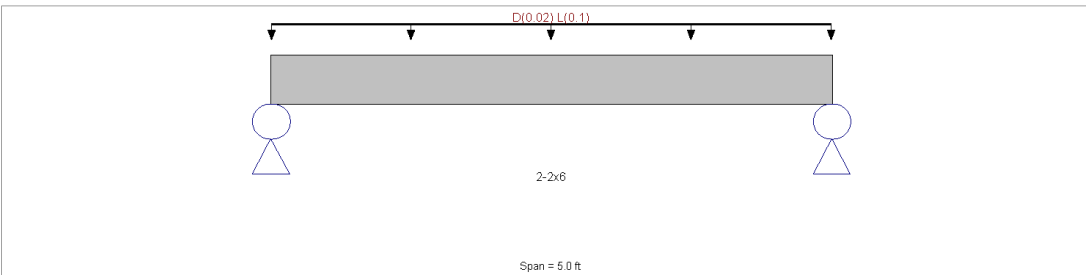
Description: (2) 2x6 Girders @ 4' OC

### CODE REFERENCES

Calculations per NDS 2012, IBC 2012, CBC 2013, ASCE 7-10  
Load Combination Set: IBC 2012

### Material Properties

Analysis Method: Allowable Stress Design	Fb - Tension	1,000.0 psi	E : Modulus of Elasticity
Load Combination IBC 2012	Fb - Compr	1,000.0 psi	Ebend-xx
	Fc - Prll	1,000.0 psi	Eminbend-xx
Wood Species :	Fc - Perp	1,000.0 psi	
Wood Grade :	Fv	65.0 psi	
	Ft	65.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsion buckling			34.0 pcf



**Applied Loads** Service loads entered. Load Factors will be applied for calculations.  
Uniform Load : D = 0.020, L = 0.10 ksf, Tributary Width = 1.0 ft

DESIGN SUMMARY	Design OK
Maximum Bending Stress Ratio = <b>0.298</b> 1	Maximum Shear Stress Ratio = <b>0.343</b> : 1
Section used for this span = <b>2-2x6</b>	Section used for this span = <b>2-2x6</b>
fb : Actual = 297.52 psi	fv : Actual = 22.30 psi
FB : Allowable = 1,000.00 psi	Fv : Allowable = 65.00 psi
Load Combination = +D+L+H	Load Combination = +D+L+H
Location of maximum on span = 2.500ft	Location of maximum on span = 0.000ft
Span # where maximum occurs = Span # 1	Span # where maximum occurs = Span # 1
<b>Maximum Deflection</b>	
Max Downward Transient Deflection = 0.026 in	Ratio = 2293
Max Upward Transient Deflection = 0.000 in	Ratio = 0 < 360
Max Downward Total Deflection = 0.031 in	Ratio = 1911
Max Upward Total Deflection = 0.000 in	Ratio = 0 < 180

### Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values				
			M	V	C <sub>d</sub>	C <sub>FN</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	fb	Fb	V	fv	Fv	
+D+H	Length = 5.0 ft	1	0.055	0.064	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.06	49.59	900.00	0.00	0.04	3.72	58.50
+D+L+H	Length = 5.0 ft	1	0.298	0.343	1.00	1.000	1.00	1.00	1.00	1.00	0.38	297.52	1000.00	0.25	22.30	65.00	0.00	
+D+Lr+H	Length = 5.0 ft	1	0.040	0.046	1.25	1.000	1.00	1.00	1.00	1.00	0.06	49.59	1250.00	0.04	3.72	81.25	0.00	
+D+S+H	Length = 5.0 ft	1	0.043	0.050	1.15	1.000	1.00	1.00	1.00	1.00	0.06	49.59	1150.00	0.04	3.72	74.75	0.00	
+D+0.750L+0.750L+H	Length = 5.0 ft	1	0.188	0.217	1.25	1.000	1.00	1.00	1.00	1.00	0.30	235.54	1250.00	0.19	17.65	81.25	0.00	
+D+0.750L+0.750S+H	Length = 5.0 ft	1	0.205	0.236	1.15	1.000	1.00	1.00	1.00	1.00	0.30	235.54	1150.00	0.19	17.65	74.75	0.00	



# CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON) INDIGO PINE WEST | AS-BUILT PROJECT MANUAL

## Wood Beam

File = I:\1800C7-300H\IPC-E\Michael\Solar\porch.ec6  
ENERCALC, INC. 1983-2015, Build 6.15.3.9, Ver. 6.15.3.9

Lic. #: KW-06006800

Licensee :

Description : (2) 2x6 Girders @ 4' OC

Load Combination	Segment Length	Span #	Max Stress Ratios		Moment Values										Shear Values									
			M	V	C <sub>d</sub>	C <sub>FN</sub>	C <sub>i</sub>	C <sub>r</sub>	C <sub>m</sub>	C <sub>t</sub>	C <sub>L</sub>	M	f <sub>b</sub>	F' <sub>b</sub>	V	f <sub>v</sub>	F' <sub>v</sub>							
+D+0.60W+H	Length = 5.0 ft	1	0.031	0.036	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.06	49.59	1600.00	0.00	0.00	0.00	0.04	3.72	104.00
+D+0.70E+H	Length = 5.0 ft	1	0.031	0.036	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.06	49.59	1600.00	0.00	0.00	0.00	0.04	3.72	104.00	
+D+0.750L+0.750L+0.450W+H	Length = 5.0 ft	1	0.147	0.170	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.30	235.54	1600.00	0.00	0.00	0.00	0.19	17.65	104.00	
+D+0.750L+0.750S+0.450W+H	Length = 5.0 ft	1	0.147	0.170	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.30	235.54	1600.00	0.00	0.00	0.00	0.19	17.65	104.00	
+D+0.750L+0.750S+0.5250E+H	Length = 5.0 ft	1	0.147	0.170	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.30	235.54	1600.00	0.00	0.00	0.00	0.19	17.65	104.00	
+0.60D+0.60W+0.60H	Length = 5.0 ft	1	0.019	0.021	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.04	29.75	1600.00	0.00	0.00	0.00	0.02	2.23	104.00	
+0.60D+0.70E+0.60H	Length = 5.0 ft	1	0.019	0.021	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.04	29.75	1600.00	0.00	0.00	0.00	0.02	2.23	104.00	

### Overall Maximum Deflections

Load Combination	Span	Max. "+" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0314	2.518		0.0000	0.000

### Vertical Reactions

Load Combination	Support 1	Support 2
Overall MAXimum	0.300	0.300
Overall MINimum	0.030	0.030
+D+H	0.050	0.050
+D+L+H	0.300	0.300
+D+L+H	0.050	0.050
+D+S+H	0.050	0.050
+D+0.750L+0.750L+H	0.238	0.238
+D+0.750L+0.750S+H	0.238	0.238
+D+0.60W+H	0.050	0.050
+D+0.70E+H	0.050	0.050
+D+0.750L+0.750L+0.450W+H	0.238	0.238
+D+0.750L+0.750S+0.450W+H	0.238	0.238
+D+0.750L+0.750S+0.5250E+H	0.238	0.238
+0.60D+0.60W+0.60H	0.030	0.030
+0.60D+0.70E+0.60H	0.030	0.030
D Only	0.050	0.050
Lr Only		
L Only	0.250	0.250
S Only		
W Only		
E Only		
H Only		



## Appendix B: Sprinkler System Calculations

As per SECTION P2904 the system should be able to keep two sprinkler heads active for at least 7 minutes. As this value turns out to be pretty high section P2904.4.2 says the following:

*5. For the purpose of this section, it shall be permissible to reduce the design flow rate for a room by subdividing the space into two or more rooms, where each room is evaluated separately with respect to the required design flow rate. Each room shall be bounded by walls and a ceiling. Openings in walls shall have a lintel not less than 8 inches (203 mm) in depth and each lintel shall form a solid barrier between the ceiling and the top of the opening.*

No. of sprinkler heads active = 2

Design flow rate for the system = 226GPM

Total water supply required = 26 X 7min = 182 gallons

$$P_L = \text{Pressure Losses} = 8 + 7.1 + 1.0 + 6.5 = 22.6 \text{ psi}$$

$PL_d$  = Pressure losses from other devices apart from water meter:

Device	Pressure loss (psi)
1" Thread ball shut off valve	0.6
1" CVPC Tee at top of riser and for drain	$0.3 * 5 = 1.5$
1" CVPC 90 Degree Elbow at the bottom of riser and two in between the pump and riser	$1.4 * 4 = 5.6$
Total loss	8

$PL_{svc}$  = Pressure loss in the water service pipe = 7.1 psi  
## Length of service pipe run falls in the range of 41 to 75 ft.

$PL_{svc}$  = Pressure loss in water meter = 1 psi  
## 1 " meter

$PL_e$  = Pressure loss associated with changes in elevation = 6.5 psi  
## Elevation from the water supply to the top of the riser = 14 ft.

$P_{sp}$  = Minimum pressure required by a sprinkler = 7.0 psi

$P_{sup}$  = Pressure available from the water supply source = 65 psi  
## based on pressure pump specification



$$\text{Pressure Consumed} = P_{\text{sup}} - P_L - P_{\text{sp}} = 22.6 + 7 = 29.6 \text{ psi}$$

Allowable pipe length for 1 –inch CVPC pipe for the above available pressure = 997 ft.

## based on design flow rate

Required pump specifications to feed sprinkler systems:

Flow rate  $\geq$  26 GPM

Pressure  $\geq$  29.6 psi

### Residential Water System Sizing

A properly designed residential water supply system should deliver water at the desired quantity, quality, and pressure to any outlet on the system during periods of heaviest use. To accomplish this, the peak demand for the home is determined and the well and pump are sized to meet or exceed the demand. If local geological conditions prohibit the development of a water supply with quantity to meet the demand, additional storage facilities are necessary.

### Determining the Pump Capacity

A simple method of determining pump capacity is based on the number of water using fixtures or outlets. The pump capacity (in gallons per minute or GPM) should equal the total number of fixtures in the home.

The seven minute peak demand and minimum pump size for modern residences may be obtained from Table 1.

TABLE 1		
No. of Bathrooms	7 Minute Peak Demand (GAL)*	Minimum Pump Size to Meet PD (GPM)**
1	45	7
1.5	70	10
2 to 2.5	98	14
3 to 4	122	17

\* Includes water usage for kitchen sink, washing machine, and dishwasher. Additional demand for farm, irrigation, and sprinkling must be added to peak demand figures if usage will occur during peak demand periods.

\*\* Minimum pump size to meet peak demands without supplemental storage.

Just taking the irrigation needs to occur during the peak demand periods as competition doesn't involve sprinkler testing while other appliances are being tested.

The minimum pump size required to meet the peak demand = 14 GPM

### PUMP REQUIREMENTS SUGGESTED:

Based on the above calculations we can deduce the following



Minimum water to be supplied during the peak hours = 14GPM

Pressure losses due to domestic water supply = 5 psi

**Required pump specifications to feed both sprinkler and domestic systems:**

**Flow rate  $\geq$  14 GPM**

**Pressure  $\geq$  5 psi**



## Appendix C: CNC-Milling Documentation

The following information documents the CNC labor costs for the complete set of Indigo Pine parts, including structure, interior and exterior finishes, and cabinetry. Appendix listings include invoices for material and labor at market rates, direct from the respective companies. Team Clemson has worked closely with Universal Forest Products (UFP) for the milling of our plywood components and with Guernsey Architectural Solutions (Guernsey) for the milling of our ACM components. Additionally, contained within this appendix is an internal analysis of these invoices (conducted by members of Team Clemson), undertaken in order to understand the breakdown of material and labor costs associated with the completion of this project. Please find below a summary of our findings, reflected in the following analyses:

### UFP CNC Milling: Plywood

Total 4'x8' Sheets: 857

Total Material Sqft: 27,424

Total Labor: 147 Hours

Total Labor Cost: \$10,275.00

Average Total Time per Sheet: 11.57 min.

Average Total Labor Cost per Minute: \$1.16

Average Total Labor Cost per Sheet: \$13.48

### Guernsey CNC Milling: ACM

Total 50" x 146" Sheets: 80

Total Material Sqft: 4,058.80

Total Labor: 35.33 Hours

Total Labor Cost: \$2,650.00

Average Total Time per Sheet: 26.50 min.

Average Total Labor Cost per Minute: \$1.25

Average Total Labor Cost per Sheet: \$33.13



The data gained through this analysis is used in Appendix D: CNC Part Data in the calculation of actual market rate CNC labor costs associated with each disputed line item.

Invoices and subsequent analyses are provided to clarify the actual, market-rate labor costs associated with the CNC milling process undertaken by the fabricators.

Below is an analysis of data acquired from Indigo Pine's CNC fabricator and represents the total cost of the following custom, CNC-fabricated parts of the home as detailed in this manual and in the construction documents:

- A. All plywood structural units (including leveling joists, floor system, wall and roof assemblies). See section 06 10 00 ROUGH CARPENTRY.
- B. All plywood sheathing (including exterior sheathing and subflooring). See section 06 16 00 SHEATHING.
- C. All interior finishes not included in cabinetry package (including wall and ceiling panels). See sections 09 50 00 CEILINGS and 09 72 00 WALL COVERINGS.

As shown in the document below, there is a learning curve involved with all aspects of the innovative CNC fabricating system. The below document indicates the approximate cost of fabricating Indigo Pine East (IPE) – Team Clemson's first home in Clemson, SC. The final numbers are still in development to date, and this document will be updated to reflect these values as soon as they are made available.

Similar documentation will be provided for the CNC fabricated cabinetry package (utilizing plywood material – see section 06 41 00 ARCHITECTURAL WOOD CASEWORK) and for the CNC fabricated siding panels (see section 07 42 00 WALL PANELS). The final numbers for these materials are still in development to date, and this document will be updated to reflect these values as soon as they are made available.

Team Clemson is working with a CNC fabricator with locations across the nation. As such, the programming and processing exists in a well-documented and consistent manner for Team Clemson throughout the competition process, leading to a consistently more efficient CNC milling process. As Team Clemson plans to build two identical homes, Indigo Pine East (IPE) and Indigo Pine West (IPW), the values in the document below apply for Team Clemson's competition home, IPW, as well.





# UFP Salisbury, LLC

A Universal Forest Products Company

July 15, 2015

RE: Indigo Pine Project

Dear Clemson Solar Decathlon Team;

As requested, following are the labor and materials details for design and manufacturing of the Indigo Pine project.

Phase II Actual	Supplied	Inventory	Purchased		
Complete House at Clemson					
Material 23/32 Plytanium Plywood	528	45	483		\$0.00
Material 19/32 Plytanium Plywood	34	25	9		\$0.00
Material 15/32 Plytanium Plywood	115	20	95		\$0.00
Advantech Flooring 23/32"	45	11	34		\$0.00
Huber Zip System Wall Pannels 7/16"	80	8	72		\$0.00
Huber Zip System Roof Panels 5/8", with Radiant Barrier	55	17	38		\$0.00
Total 4 x 8 sheets	857	126	731		\$0.00
5/8 Radiant Barrier Purchased by UFP to replace Mis-Cut	40	0	40	\$27.25	\$1,089.91
Freight in From Huber Commerce, GA.					\$200.00
Grand Total UFP Material Cost					\$5,926.71

Phase II Estimated based on actual programmed cut time	Hours	Rate	Value
Complete House at Clemson			
Programming and Andy's Time:			
Meetings and Consultation	10	\$50.00	\$500.00
Drawing Clean Up	12	\$50.00	\$600.00
Programming	8	\$50.00	\$400.00
Actual Cutting	117	\$75.00	\$8,775.00
Total Hours	147		\$10,275.00
Grand Total Labor			\$17,350.00

If you have any further information needs, please let us know.

Sincerely,

J.F. Granger  
Regional Vice President, East Central

Guernsey Architectural Solutions, Inc.

# Invoice

Phone: 386-734-5572  
 1701 Airport Terminal Drive  
 Suite 100A-1  
 DeLand, FL 32724

Date	Invoice #
4/28/2015	1556

Bill To
2015_014_Clemson Solar Decathlon Attn: Alex Latham Clemson University Clemson, SC

Ship To
Clemson University

P.O. Number	Terms	Rep	Ship	Via	F.O.B.	Project
	Due on receipt		4/28/2015			

Quantity	Item Code	Description	Price Each	Amount
	ACM	Project: Clemson University Solar Decathlon House / Indigo Pines Programming and cutting 4,085 square feet of ACM for above referenced project.	2,650.00	2,650.00

Phone #	Fax #
386-734-5572	386-734-5573

<b>Total</b>	\$2,650.00
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**CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON)  
INDIGO PINE WEST | AS-BUILT PROJECT MANUAL**

**Materials:**

**Phase 1: Mockup**

<b>Estimated % of Complete House</b>	40%			
		4 x 8	Cost	Value
Material 23/32 CDX Plywood		166	\$22.08	\$3,665.28

**Phase II: IPE (Estimated)**

**Complete House: Clemson**

Material 23/32 CDX Plywood		415	\$22.08	\$9,163.20
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**Phase III: IPW (Estimated)**

**Complete House: Solar Decathlon 2015**

Material 23/32 CDX Plywood		415	\$22.08	\$9,163.20
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**Total Materials**

Material 23/32 CDX Plywood		996		\$21,991.68
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**Labor:**

**Phase 1: Mockup**

<b>Estimated % of Complete House</b>	40%			
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Programming Time:	Hours	Rate	Value
Meetings and Consultation:	19	\$50.00	\$950.00
Drawing Clean Up	16	\$50.00	\$800.00
Programming	27	\$50.00	\$1,350.00
Actual Cutting	53	\$75.00	\$3,975.00
<b>Total</b>	115		\$7,075.00

**Phase II: IPE (Estimated)**

**Complete House: Clemson**

Programming Time:	Hours	Rate	Value
Meetings and Consultation	19	\$50.00	\$950.00
Drawing Clean Up	0	\$50.00	\$0.00
Programming	8	\$50.00	\$400.00
Actual Cutting	113	\$75.00	\$8,446.88
<b>Total Hours</b>	140		\$9,796.88

**Phase III: IPW (Estimated)**

**Complete House: Solar Decathlon 2015**

Programming Time:	Hours	Rate	Value
Meetings and Consultation	19	\$50.00	\$950.00
Drawing Clean Up	0	\$50.00	\$0.00
Programming	8	\$50.00	\$400.00
Actual Cutting	113	\$75.00	\$8,446.88
<b>Total Hours</b>	140		\$9,796.88

<b>Total Labor</b>		<b>394</b>		<b>\$26,668.75</b>
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## Analysis

### Phase 1: Mockup (Actual)

#### Material Data:

	Qty	Unit
Plywood Materials:	166	Sheets
Cutting Time (minutes):	3180	Min.
<b>Time per Sheet:</b>	<b>19.16</b>	<b>Min. / Sheet</b>

#### Cost Data:

	Total	Per Sheet	% of Cost
Material Cost:	\$ 3,665.28	\$ 22.08	34%
Labor Cost:	\$7,075.00	\$ 42.62	66%
Total:	\$ 10,740.28	\$ 64.70	100%

**Total cost per sheet: \$ 64.70**

### Phase II: IPE (Estimated CNC Data, 2014.11.20)

#### Material Data:

	Qty	Unit
Plywood Materials:	415	Sheets
Cutting Time (minutes):	6757.5	Min.
Cutting Time (hours):	112.63	Hr.
<b>Time per Sheet:</b>	<b>16.28</b>	<b>Min. / Sheet</b>

#### Cost Data:

	Total	Per Sheet	% of Cost
Material Cost:	\$9,163.20	\$ 22.08	48%
Labor Cost:	\$9,796.88	\$ 23.61	52%
Total:	\$ 18,960.08	\$ 45.69	100%

**Total cost per sheet: \$ 45.69**

### Phase II: IPE (As of 2015.03.24)

#### Material Data:

	Qty	Unit
Plywood Materials:	762	Sheets
Cutting Time Estimated (minutes):	12407.7	Min.
Cutting Time (hours):	206.80	Hr.
<b>Time per Sheet:</b>	<b>16.28</b>	<b>Min. / Sheet</b>

#### Cost Data:

	Total	Per Sheet	% of Cost
Material Cost:	\$16,824.96	\$ 22.08	50%
Labor Cost:	\$16,824.96	\$ 22.08	50%
Total:	\$ 33,649.92	\$ 44.16	100%

**Total cost per sheet: \$ 44.16**



## Appendix D: CNC Part Data

The following information offers an application of the content provided in Appendix A and seeks to find direct correlation between the estimated values of line items as found by Faithful & Gould and the actual, market rate CNC labor cost associated with each item. Appendix listings contained herein include a side-by-side comparison of total cost (as estimated by Faithful & Gould) and actual CNC labor cost (as found by Team Clemson through an analysis based on the above listed CNC labor invoices). Team Clemson has chosen to report these values in the table below in accordance with the specified groups of line items as estimated by Faithful & Gould to aid comparison. These line items in no way reflect the internal grouping of parts by Team Clemson. In a practical setting, all components milled from material of the same size (ie 3/4" plywood) are "nested" together in one file using a "nesting software." This software allows Team Clemson to input our component data (including all component's cut files, desired space between parts, the particular material size, etc) and will arrange all parts onto sheets in the most efficient manner possible; ultimately resulting in the least number of sheets required to cut all parts. Nesting files in groups of parts (as done below for clarity of comparison) results in lower efficiencies than those that can be found in the actual cutting of the Indigo Pine home.

As well, contained within this appendix is a listing of all CNC cut plywood and ACM components (including their respective part name, use, qty, and square footage) to substantiate the "Sqft of Material" column used in the cost analysis.

When sorting through the cost analysis, please refer to the guide below for further clarification and substantiation of formulas, information, etc:

### Column: "Sqft of Parts"

Values listed here are the total square footages of parts in each respective line item grouping. All data used to populate this column can be found in the listing of CNC cut plywood or ACM components provided in the subsequent tables. Parts have been broken into groupings of line items as provided by Faithful & Gould in order to draw direct association with estimated values.



To clarify, these values are the sqft of parts, NOT the sqft of material required to mill the parts (this value does not factor in efficiency, but is the raw sqft data of components).

### Column: “# of Sheets”

Data represented in this column is the total number of sheets required to cut each group of components contained within the line item. The data is a result of “nesting” all components within the line item (as listed in the table below) onto sheets of the appropriate material.

### Columns: CNC Milling: “re Appendix A”

Please note that all data used to calculate values in this set of columns is gleaned from Team Clemson’s analysis of the cost data indicated in the fabricator provided invoices found within Appendix A.

### Column: “Time (min)”

Data represented in this column is the total CNC cut time (in minutes) required to fabricate all components in the respective line item. The values are found by multiplying the (# of Sheets) \* (Average Total Time per Sheet of the CNC fabricator). Please find a summary of the minutes of cut time for CNC fabricators of respective materials below:

UFP – Plywood Material: 11.57 minutes per sheet

Guernsey – ACM Material: 26.50 minutes per sheet

### Column: “Total Cost (\$/Type)”

Values in this column represent the **TOTAL COST** of the CNC labor required to mill **ALL PARTS** in the respective line item (ie, total CNC cost to mill all “ 9” x 3/4” CNC Cut Plywood Floor Framing” is \$859.51). Values are found by multiplying the (minutes of cut time) \* (Average Total Labor Cost per Minute of the CNC fabricator). Please find a summary of the cost per minute for CNC fabricators of respective materials below:

UFP – Plywood Material: \$1.16

Guernsey – ACM Material: \$1.25

### Column: “Unit Cost (\$/Unit)”

Data in this column displays the unit cost of each line item (reported in the respective units listed by Faithful & Gould) in order to further clarify and justify the claim of reduction of CNC labor costs on a unit basis. For example, the cost per unit to mill all “ 9” x 3/4” CNC Cut Plywood Floor Framing” is \$6.64 per joist; the “1’-3” Leveling Plywood Joists Series” cost



\$0.88 per sqft to mill, etc. These values shed light on the actual market rates to produce one unit of the respective line item; however reflect ONLY the CNC milling costs and not the on-site construction rates. For further clarification on on-site data, see the Appendices C, D, and E below.

**Data: “Total CNC Milling Sqft”**

This number is the total square footage of all milled materials.

**Data: “Total CNC Milling Cost”**

This number is the total cost of milling all components of the listed groupings of line items. Please note that this number is but a fraction of the total estimate previously made by Faithful & Gould.

All data in this section provided to further clarify the actual market rate CNC labor costs required to mill components for each line item.

Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft2)
<b>B1010 Floor Construction</b>						
<b>9' x 3/4' CNC Cut Plywood Floor Framing (Structural Plywood)</b>						
Short Joist - Hidden	Joist	Floor	EJ-E000	23	1.00	23.00
Short Joist - Corner	Joist	Floor	EJ-E00C	4	1.00	4.00
Short Joist - Stud	Joist	Floor	EJ-E00P	24	1.00	24.00
Base Plate - Corner	Seat	Floor	FP-E000	4	10.40	41.60
Base Plate - West	Seat	Floor	FP-I000	2	7.00	14.00
Base Plate - East	Seat	Floor	FP-I001	2	7.00	14.00
Base Plate - Common	Seat	Floor	FP-I00S	8	7.64	61.09
Joist Connector	Joist	Floor	G-E001	99	-	-
End Joist Connector	Joist	Floor	G-E002	6	0.25	1.50
Full Joist - Hidden	Joist	Floor	IJ-E000	32	5.29	169.14
Full Joist - Stud	Joist	Floor	IJ-E00P	34	5.33	181.33
End Joist - Inner	Joist	Floor	IJ-EE00	4	4.00	16.00
Full Joist - Interior	Joist	Floor	IJ-I000	66	4.43	292.29
End Joist - Outer	Joist	Floor	IJ-IE00	4	5.00	20.00
Nogging End	Nogging	Floor	N-E000	24	2.00	48.00
Nogging Interior	Nogging	Floor	N-I000	48	2.00	96.00
Rim Joist- North/South Corner	Rim Joist	Floor	RJ-EE00	4	5.80	23.20
Rim Joist- North/South Intermediate	Rim Joist	Floor	RJ-IE00	4	4.71	18.86
Rim Joist- North/South Center	Rim Joist	Floor	RJ-SE00	2	4.67	9.33
Rim Joist- East/West- Outside Layer- Corner	Rim Joist	Floor	RJ1-4-EE00	4	5.40	21.60
Rim Joist- East/West- Inside Layer- Corner	Rim Joist	Floor	RJ1-4-IE00	4	5.00	20.00
Rim Joist- East/West- Middle Layer- Corner	Rim Joist	Floor	RJ1-4-EM00	4	5.00	20.00
Rim Joist- East/West- Outside Layer- Intermediate Long	Rim Joist	Floor	RJ2-IE	2	5.00	10.00
Rim Joist- East/West- Inside Layer- Intermediate Long	Rim Joist	Floor	RJ2-II00	2	4.00	8.00
Rim Joist- East/West- Middle Layer- Intermediate Short	Rim Joist	Floor	RJ2-IM00	2	3.50	7.00
Rim Joist- East/West- Outside Layer- Intermediate Short	Rim Joist	Floor	RJ3-IE00	2	3.33	6.67
Rim Joist- East/West- Inside Layer- Intermediate Short	Rim Joist	Floor	RJ3-II00	2	3.00	6.00
Rim Joist- East/West- Middle Layer- Intermediate Long	Rim Joist	Floor	RJ3-IM00	2	5.00	10.00
<b>Total Sqft. CNC Cut Plywood Floor Framing Parts</b>						<b>1,166.61</b>
<b>1'-3" Leveling Plywood Joists Series (Marine Grade Plywood)</b>						
Leveling Joist 11-1 (LJ-N-1)	Leveling Joist	Floor	LJ-E000-11-1	2	5.00	10.00
Leveling Joist 11-2 (LJ-N-2)	Leveling Joist	Floor	LJ-E000-11-2	2	5.00	10.00
Leveling Joist 11-3 (LJ-N-3)	Leveling Joist	Floor	LJ-E000-11-3	2	5.00	10.00
Leveling Joist 11-4 (LJ-N-4)	Leveling Joist	Floor	LJ-E000-11-4	2	5.00	10.00
Leveling Joist 11-5 (LJ-N-5)	Leveling Joist	Floor	LJ-E000-11-5	2	6.00	12.00
Leveling Joist 12-1 (LJ-N-6)	Leveling Joist	Floor	LJ-E000-12-1	1	3.00	3.00
Leveling Joist 12-2 (LJ-N-7)	Leveling Joist	Floor	LJ-E000-12-2	1	5.00	5.00
Leveling Joist 12-3 (LJ-N-8)	Leveling Joist	Floor	LJ-E000-12-3	1	6.00	6.00
Leveling Joist 12-4 (LJ-N-9)	Leveling Joist	Floor	LJ-E000-12-4	1	5.00	5.00
Leveling Joist 12-5 (LJ-N-10)	Leveling Joist	Floor	LJ-E000-12-5	1	5.00	5.00
Leveling Joist 12-6 (LJ-N-11)	Leveling Joist	Floor	LJ-E000-12-6	1	2.00	2.00
Leveling Joist 21-1	Leveling Joist	Floor	LJ-E000-21-1	2	6.00	12.00
Leveling Joist 21-2	Leveling Joist	Floor	LJ-E000-21-2	2	6.00	12.00
Leveling Joist 21-3	Leveling Joist	Floor	LJ-E000-21-3	2	6.00	12.00
Leveling Joist 21-4	Leveling Joist	Floor	LJ-E000-21-4	2	6.00	12.00
Leveling Joist 21-5	Leveling Joist	Floor	LJ-E000-21-5	2	6.00	12.00
Leveling Joist 22-1	Leveling Joist	Floor	LJ-E000-22-1	1	3.00	3.00
Leveling Joist 22-2	Leveling Joist	Floor	LJ-E000-22-2	1	6.00	6.00
Leveling Joist 22-3	Leveling Joist	Floor	LJ-E000-22-3	1	7.00	7.00
Leveling Joist 22-4	Leveling Joist	Floor	LJ-E000-22-4	1	7.00	7.00
Leveling Joist 22-5	Leveling Joist	Floor	LJ-E000-22-5	1	6.00	6.00
Leveling Joist 22-6	Leveling Joist	Floor	LJ-E000-22-6	1	3.00	3.00
Leveling Joist 31-1 (LJ-M-1)	Leveling Joist	Floor	LJ-E000-31-1	2	7.00	14.00
Leveling Joist 31-2 (LJ-M-2)	Leveling Joist	Floor	LJ-E000-31-2	2	7.00	14.00
Leveling Joist 31-3 (LJ-M-3)	Leveling Joist	Floor	LJ-E000-31-3	2	7.00	14.00
Leveling Joist 31-4 (LJ-M-4)	Leveling Joist	Floor	LJ-E000-31-4	2	7.00	14.00
Leveling Joist 31-5 (LJ-M-5)	Leveling Joist	Floor	LJ-E000-31-5	2	7.00	14.00
Leveling Joist 32-1 (LJ-M-6)	Leveling Joist	Floor	LJ-E000-32-1	1	3.00	3.00
Leveling Joist 32-2 (LJ-M-7)	Leveling Joist	Floor	LJ-E000-32-2	1	7.00	7.00
Leveling Joist 32-3 (LJ-M-8)	Leveling Joist	Floor	LJ-E000-32-3	1	7.00	7.00
Leveling Joist 32-4 (LJ-M-9)	Leveling Joist	Floor	LJ-E000-32-4	1	7.00	7.00
Leveling Joist 32-5 (LJ-M-10)	Leveling Joist	Floor	LJ-E000-32-5	1	7.00	7.00
Leveling Joist 32-6 (LJ-M-11)	Leveling Joist	Floor	LJ-E000-32-6	1	3.00	3.00
Leveling Joist 41-1	Leveling Joist	Floor	LJ-E000-41-1	2	7.00	14.00
Leveling Joist 41-2	Leveling Joist	Floor	LJ-E000-41-2	2	7.00	14.00
Leveling Joist 41-3	Leveling Joist	Floor	LJ-E000-41-3	2	7.00	14.00
Leveling Joist 41-4	Leveling Joist	Floor	LJ-E000-41-4	2	7.00	14.00
Leveling Joist 41-5	Leveling Joist	Floor	LJ-E000-41-5	2	8.00	16.00
Leveling Joist 42-1	Leveling Joist	Floor	LJ-E000-42-1	1	3.00	3.00
Leveling Joist 42-2	Leveling Joist	Floor	LJ-E000-42-2	1	7.00	7.00
Leveling Joist 42-3	Leveling Joist	Floor	LJ-E000-42-3	1	8.00	8.00
Leveling Joist 42-4	Leveling Joist	Floor	LJ-E000-42-4	1	8.00	8.00
Leveling Joist 42-5	Leveling Joist	Floor	LJ-E000-42-5	1	8.00	8.00
Leveling Joist 42-6	Leveling Joist	Floor	LJ-E000-42-6	1	4.00	4.00
Leveling Joist 51-1	Leveling Joist	Floor	LJ-E000-51-1	2	4.00	8.00
Leveling Joist 51-2	Leveling Joist	Floor	LJ-E000-51-2	2	8.00	16.00
Leveling Joist 51-3	Leveling Joist	Floor	LJ-E000-51-3	2	9.00	18.00
Leveling Joist 51-4	Leveling Joist	Floor	LJ-E000-51-4	2	9.00	18.00
Leveling Joist 51-5	Leveling Joist	Floor	LJ-E000-51-5	2	8.00	16.00
Leveling Joist 52-1	Leveling Joist	Floor	LJ-E000-52-1	1	4.00	4.00
Leveling Joist 52-2	Leveling Joist	Floor	LJ-E000-52-2	1	8.40	8.40
Leveling Joist 52-3	Leveling Joist	Floor	LJ-E000-52-3	1	8.00	8.00
Leveling Joist 52-4	Leveling Joist	Floor	LJ-E000-52-4	1	8.00	8.00
Leveling Joist 52-5	Leveling Joist	Floor	LJ-E000-52-5	1	8.00	8.00
Leveling Joist 52-6	Leveling Joist	Floor	LJ-E000-52-6	1	9.00	9.00
<b>Total Sqft. Leveling Plywood Joists Series Parts:</b>						<b>505.40</b>
<b>B1020 Roof Construction</b>						



**Indigo Pine: Plywood Part Schedule**

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
<b>3/4" CNC Cut Plywood Roof Joists</b>						
<b>(Structural Plywood)</b>						
Rafter South Wall 1	Rafter	Roof	B1-EE00	15	10.67	160.00
Wall Rafter South Wall 1	Rafter	Roof	B1-EE0P2	4	11.00	44.00
Rafter South Wall 2	Rafter	Roof	B1-EI00	15	11.00	165.00
Wall Rafter South Wall 2	Rafter	Roof	B1-EI0P	4	11.00	44.00
Rafter South 1	Rafter	Roof	B2-IE00	15	12.00	180.00
Wall Rafter South 1	Rafter	Roof	B2-IE0P2	4	13.00	52.00
Rafter South 2	Rafter	Roof	B2-II00	15	12.00	180.00
Wall Rafter South 2	Rafter	Roof	B2-II0P	4	13.00	52.00
Rafter North 1	Rafter	Roof	B3-IE00	15	12.00	180.00
Wall Rafter North 1	Rafter	Roof	B3-IE0P1	4	15.00	60.00
Rafter North 2	Rafter	Roof	B3-II00	15	13.00	195.00
Wall Rafter North 2	Rafter	Roof	B3-II0P	4	15.00	60.00
Rafter North Wall 1	Rafter	Roof	B4-EE00	15	9.00	135.00
Wall Rafter North Wall 1	Rafter	Roof	B4-EE0P2	4	10.00	40.00
Rafter North Wall 2	Rafter	Roof	B4-EI00	15	9.00	135.00
Wall Rafter North Wall 2	Rafter	Roof	B4-EI0P	4	10.00	40.00
Rafter Top Flange Long	Rafter Interior Flange	Roof	BF-E0H0	57	1.00	57.00
Rafter Top Flange Short	Rafter Interior Flange	Roof	BF-E0HM	38	1.00	38.00
Rafter Bottom Flange Long	Rafter Interior Flange	Roof	BF-I0L0	38	2.00	76.00
Rafter Bottom Flange Medium	Rafter Interior Flange	Roof	BF-I1L0	19	1.00	19.00
Rafter Bottom Flange Short	Rafter Interior Flange	Roof	BF-I1LS	19	-	-
Corner Flange Northeast	Roof Corner Flange	Roof	CF-OE0L	1	13.00	13.00
Corner Flange South	Roof Corner Flange	Roof	CF-OELM	2	8.33	16.67
Corner Flange East/West	Roof Corner Flange	Roof	CF-OELS	4	7.80	31.20
Corner Flange Northwest	Roof Corner Flange	Roof	CF-OLE0-1	1	13.00	13.00
Side Angle Flange 1	East/West Roof Flange	Roof	CF1-OEH0	2	3.00	6.00
Side Angle Flange 2	East/West Roof Flange	Roof	CF2-OEH0	2	7.00	14.00
Side Angle Flange 3	East/West Roof Flange	Roof	CF3-OEH0	2	11.25	22.50
Side Angle Flange 4	East/West Roof Flange	Roof	CF4-OEH0	2	17.00	34.00
Roof Flange Common	Rafter Exterior Flange	Roof	F-OEH0	7	1.80	12.60
West Girder Exterior Flange	Rafter Exterior Flange	Roof	F-OEHT	1	13.50	13.50
East Girder Exterior Flange	Rafter Exterior Flange	Roof	F-OEHU	1	12.50	12.50
Rafter Interior Flange	Rafter Interior Flange	Roof	F-SILO1-1	61	0.50	30.50
Exterior Opening Flange 1	Rafter Exterior Flange	Roof	F1-OEHW	7	2.00	14.00
Exterior Opening Flange Switch	Rafter Exterior Flange	Roof	F1-SEHW1	5	1.50	7.50
Exterior Opening Flange Custom	Rafter Exterior Flange	Roof	F1-SEHW1-1	2	1.25	2.50
Exterior Opening Top Flange	Rafter Exterior Flange	Roof	F1-SEHW2	10	2.18	21.82
North Exterior Roof Flange Common	Rafter Exterior Flange	Roof	F2-OEH2	10	2.45	24.55
North Exterior Opening Flange	Rafter Exterior Flange	Roof	F2-SEHW1	2	2.00	4.00
North Exterior Window Top Flange	Rafter Exterior Flange	Roof	F2-SEHW2	3	2.75	8.25
Rafter Purlin End	Purlins	Roof	G-E000	10	1.33	13.33
Rafter Connector	Purlins	Roof	G-E00S	72	-	-
Rafter Purlin - Common	Purlins	Roof	G-I000	70	1.00	70.00
Box Girder	Box Girder	Roof	LT-EE00	8	17.00	136.00
Box Girder	Box Girder	Roof	LT-ES00	4	8.00	32.00
Box Girder	Box Girder	Roof	LT-IE00	8	16.00	128.00
Box Girder	Box Girder	Roof	LT-IS00	4	16.00	64.00
Box Girder	Box Girder	Roof	LT-SE00	4	14.00	56.00
Box Girder	Box Girder	Roof	LT-SS00	4	16.00	64.00
Box Girder	Box Girder	Roof	MT-000T	10	5.00	50.00
Box Girder	Box Girder	Roof	MT-E00T	20	2.00	40.00
Side Rafter South 1	Side Rafter	Roof	SB1-0E00	4	3.00	12.00
Side Rafter North 10	Side Rafter	Roof	SB10-0000	4	4.00	16.00
Side Rafter North 11	Side Rafter	Roof	SB11-0E00	4	4.00	16.00
Side Rafter North 12	Side Rafter	Roof	SB12-0I00	4	4.00	16.00
Side Rafter South 2	Side Rafter	Roof	SB2-0000	4	3.00	12.00
Side Rafter South 3	Side Rafter	Roof	SB3-0000	4	3.00	12.00
Side Rafter South 4	Side Rafter	Roof	SB4-0000	4	4.00	16.00
Side Rafter South 5	Side Rafter	Roof	SB5-0000	4	4.00	16.00
Side Rafter South 6	Side Rafter	Roof	SB6-0000	4	4.00	16.00
Side Rafter South 7	Side Rafter	Roof	SB7-0000	4	4.00	16.00
Side Rafter North 8	Side Rafter	Roof	SB8-0000	4	4.00	16.00
Side Rafter North 9	Side Rafter	Roof	SB9-0000	4	4.00	16.00
Roof Rim Top - Common	Roof Rim	Roof	TE-OEH0	16	1.78	28.44
Roof Rim Top Medium	Roof Rim	Roof	TE-OEHM	6	1.20	7.20
Roof Rim - Common	Roof Rim	Roof	TE-OE0L	8	2.00	16.00
Roof Rim Medium	Roof Rim	Roof	TE-OELM	4	1.29	5.14
Box Girder Saddle 1	Box Girder	Roof	TH-000T	6	3.00	18.00
Box Girder Saddle 2	Box Girder	Roof	TW-000T	8	1.00	8.00
<b>Total Sqft. CNC Cut Plywood Roof Joist Parts:</b>						<b>3,130.20</b>
<b>B2010 Exterior Walls</b>						
<b>7/16" CNC Cut Huber Zip System Sheathing</b>						
<b>(Huber Zip Panels)</b>						
Exterior Paneling	East Paneling	Exterior	EP-E01	1	9.00	9.00
Exterior Paneling	East Paneling	Exterior	EP-E02	1	9.00	9.00
Exterior Paneling	East Paneling	Exterior	EP-E03	1	10.00	10.00
Exterior Paneling	East Paneling	Exterior	EP-E04	1	8.00	8.00
Exterior Paneling	East Paneling	Exterior	EP-E05	1	12.00	12.00
Exterior Paneling	East Paneling	Exterior	EP-E06	1	12.00	12.00
Exterior Paneling	East Paneling	Exterior	EP-E07	1	13.00	13.00
Exterior Paneling	East Paneling	Exterior	EP-E08	1	18.00	18.00
Exterior Paneling	East Paneling	Exterior	EP-E09	1	11.00	11.00
Exterior Paneling	East Paneling	Exterior	EP-E10	1	11.00	11.00
Exterior Paneling	East Paneling	Exterior	EP-E11	1	18.00	18.00
Exterior Paneling	East Paneling	Exterior	EP-E12	1	7.00	7.00
Exterior Paneling	East Paneling	Exterior	EP-E13	1	11.00	11.00
Exterior Paneling	East Paneling	Exterior	EP-E14	1	18.00	18.00
Exterior Paneling	East Paneling	Exterior	EP-E15	1	2.00	2.00
Exterior Paneling	East Paneling	Exterior	EP-E16	1	1.00	1.00
Exterior Paneling	East Paneling	Exterior	EP-E17	1	2.00	2.00
Exterior Paneling	East Paneling	Exterior	EP-E18	1	1.00	1.00
Exterior Paneling	North Paneling	Exterior	EP-N-01	1	16.00	16.00
Exterior Paneling	North Paneling	Exterior	EP-N-02	1	17.00	17.00
Exterior Paneling	North Paneling	Exterior	EP-N-03	1	16.00	16.00

Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Exterior Paneling	North Paneling	Exterior	EP-N-04	1	16.00	16.00
Exterior Paneling	North Paneling	Exterior	EP-N-05	1	17.00	17.00
Exterior Paneling	North Paneling	Exterior	EP-N-06	1	8.00	8.00
Exterior Paneling	North Paneling	Exterior	EP-N-07	1	16.00	16.00
Exterior Paneling	North Paneling	Exterior	EP-N-08	1	16.00	16.00
Exterior Paneling	North Paneling	Exterior	EP-N-09	1	7.00	7.00
Exterior Paneling	North Paneling	Exterior	EP-N-10	1	8.00	8.00
Exterior Paneling	North Paneling	Exterior	EP-N-11	1	8.00	8.00
Exterior Paneling	North Paneling	Exterior	EP-N-12	1	8.00	8.00
Exterior Paneling	North Paneling	Exterior	EP-N-13	1	17.00	17.00
Exterior Paneling	North Paneling	Exterior	EP-N-14	1	17.00	17.00
Exterior Paneling	North Paneling	Exterior	EP-N-15	1	11.00	11.00
Exterior Paneling	North Paneling	Exterior	EP-N-16	1	11.00	11.00
Exterior Paneling	North Paneling	Exterior	EP-N-17	1	17.00	17.00
Exterior Paneling	North Paneling	Exterior	EP-N-18	1	9.00	9.00
Exterior Paneling	North Paneling	Exterior	EP-N-19	1	11.00	11.00
Exterior Paneling	North Paneling	Exterior	EP-N-20	1	13.00	13.00
Exterior Paneling	North Paneling	Exterior	EP-N-21	1	10.00	10.00
Exterior Paneling	North Paneling	Exterior	EP-N-22	1	15.00	15.00
Exterior Paneling	South Paneling	Exterior	EP-S-01	1	6.00	6.00
Exterior Paneling	South Paneling	Exterior	EP-S-02	1	11.00	11.00
Exterior Paneling	South Paneling	Exterior	EP-S-03	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-04	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-05	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-06	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-07	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-08	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-09	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-10	1	5.00	5.00
Exterior Paneling	South Paneling	Exterior	EP-S-11	1	11.00	11.00
Exterior Paneling	South Paneling	Exterior	EP-S-12	1	11.00	11.00
Exterior Paneling	South Paneling	Exterior	EP-S-13	1	11.00	11.00
Exterior Paneling	South Paneling	Exterior	EP-S-14	1	6.00	6.00
Exterior Paneling	South Paneling	Exterior	EP-S-15	1	8.00	8.00
Exterior Paneling	South Paneling	Exterior	EP-S-16	1	11.00	11.00
Exterior Paneling	South Paneling	Exterior	EP-S-17	1	4.25	4.25
Exterior Paneling	South Paneling	Exterior	EP-S-18	1	4.25	4.25
Exterior Paneling	South Paneling	Exterior	EP-S-19	1	4.25	4.25
Exterior Paneling	South Paneling	Exterior	EP-S-20	1	4.25	4.25
Exterior Paneling	South Paneling	Exterior	EP-S-21	1	11.00	11.00
Exterior Paneling	South Paneling	Exterior	EP-S-22	1	17.00	17.00
Exterior Paneling	South Paneling	Exterior	EP-S-23	1	17.00	17.00
Exterior Paneling	South Paneling	Exterior	EP-S-24	1	8.00	8.00
Exterior Paneling	South Paneling	Exterior	EP-S-25	1	4.00	4.00
Exterior Paneling	South Paneling	Exterior	EP-S-26	1	4.00	4.00
Exterior Paneling	South Paneling	Exterior	EP-S-27	1	4.00	4.00
Exterior Paneling	South Paneling	Exterior	EP-S-28	1	4.00	4.00
Exterior Paneling	South Paneling	Exterior	EP-S-29	1	4.00	4.00
Exterior Paneling	West Paneling	Exterior	EP-W-01	1	13.00	13.00
Exterior Paneling	West Paneling	Exterior	EP-W-02	1	12.00	12.00
Exterior Paneling	West Paneling	Exterior	EP-W-03	1	12.00	12.00
Exterior Paneling	West Paneling	Exterior	EP-W-04	1	8.00	8.00
Exterior Paneling	West Paneling	Exterior	EP-W-05	1	10.00	10.00
Exterior Paneling	West Paneling	Exterior	EP-W-06	1	9.00	9.00
Exterior Paneling	West Paneling	Exterior	EP-W-07	1	9.00	9.00
Exterior Paneling	West Paneling	Exterior	EP-W-08	1	4.00	4.00
Exterior Paneling	West Paneling	Exterior	EP-W-09	1	16.00	16.00
Exterior Paneling	West Paneling	Exterior	EP-W-10	1	15.00	15.00
Exterior Paneling	West Paneling	Exterior	EP-W-11	1	9.00	9.00
Exterior Paneling	West Paneling	Exterior	EP-W-12	1	11.00	11.00
Exterior Paneling	West Paneling	Exterior	EP-W-13	1	2.00	2.00
Exterior Paneling	West Paneling	Exterior	EP-W-14	1	11.00	11.00
Exterior Paneling	West Paneling	Exterior	EP-W-15	1	9.00	9.00
Exterior Paneling	West Paneling	Exterior	EP-W-16	3	1.00	3.00
Exterior Paneling	West Paneling	Exterior	EP-W-17	3	1.00	3.00
<b>Total Sqft. CNC Cut Huber Zip System Sheathing Parts:</b>						<b>818.00</b>
<b>3/4" CNC Cut Plywood Wall Framing</b>	<b>(Structural Plywood)</b>					
Corner 3	Corner	Wall	C-EE01	4	7.00	28.00
Corner 4	Corner	Wall	C-EE02	4	7.00	28.00
Corner 1	Corner	Wall	C-EI01	4	8.20	32.80
Corner 2	Corner	Wall	C-EI02	4	8.20	32.80
REVIT "Subfloor 11" (Door Sill)	Door Casing	Wall	CA-DB1	3	3.11	9.33
REVIT "DOORjamSIDE" (Door Side Jamb)	Door Casing	Wall	CA-DS1	6	3.67	22.00
REVIT "doorjamp" (Door Head Jamb)	Door Casing	Wall	CA-DT1	3	1.67	5.00
REVIT "IP-CS-WJB" (Window Sill Lower)	Window Casing	Wall	CA-WB	10	3.20	32.00
REVIT "CS-WJT" (Window Sill and Head Jamb)	Window Casing	Wall	CA-WBT	20	2.80	56.00
REVIT "windowjam5side" (4' Window Side Jamb)	Window Casing	Wall	CA-WS1	6	3.67	22.00
REVIT "windowjam6side" (6' Window Side Jamb)	Window Casing	Wall	CA-WS2	14	5.57	78.00
Interior Girder Flange	Interior Flange	Wall	F-OEHV	2	11.67	23.33
Exterior Flange - Common	Exterior Flange	Wall	F-OELO	28	1.68	46.97
Exterior Flange - 6' Window	Exterior Flange	Wall	F-OELO-1	7	0.13	0.88
Exterior Opening Flange	Exterior Flange	Wall	F-OELW	19	6.15	116.85
Exterior Door Flange Custom	Exterior Flange	Wall	F-OELW-1	2	3.00	6.00
Interior Flange - Common	Interior Flange	Wall	F-OIL0	4	2.80	11.20
Interior Opening Flange 1	Interior Flange	Wall	F-OILW	3	7.25	21.75
Interior Opening Flange 2	Interior Flange	Wall	F-OILW-1	10	4.00	40.00
Under Window Flange	Interior Flange	Wall	F-OILW2	3	0.50	1.50
Exterior Flange - 4' Window	Exterior Flange	Wall	F-EOLW1	3	1.00	3.00
Interior Corner Flange	Interior Flange	Wall	F-EIHP	7	2.75	19.25
Interior Opening Flange 5	Interior Flange	Wall	F-EIHW1P	1	7.00	7.00
Interior Opening Flange 3	Interior Flange	Wall	F-SIHW1P	14	6.73	94.27
Double Door Center Flange	Interior Flange	Wall	F-SIHW1P-1	1	3.50	3.50
Interior Opening Flange 4	Interior Flange	Wall	F-SIHW1P-2	1	6.00	6.00
Interior Opening Top Flange	Interior Flange	Wall	F-SIHW2P	14	1.67	23.33
Interior Straight Flange 2	Interior Flange	Wall	F-SILO1	1	1.50	1.50
Interior Straight Flange	Interior Flange	Wall	F-SILO1-0	7	1.50	10.50

Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Header Top - Girder	Header	Wall	H-000T	2	5.33	10.67
Stud Spacer (in Header)	Header	Wall	H-00LO	26	1.59	41.24
Opening Jamb Spacers	Header	Wall	H-00LW	22	2.46	54.15
Door Opening Spacers	Header	Wall	H-00LW-1	3	2.50	7.50
Window Support Flange	Header	Wall	H-00LWS	20	2.10	41.90
Header Top - Common	Header	Wall	H-10HO	12	4.87	58.40
Header Top - Corner 1	Header	Wall	H-E0HO	4	3.20	12.80
Header Top - N/S Custom	Header	Wall	H-S0HO	2	3.50	7.00
Header Top - Corner 1	Header	Wall	H-S0HS	4	2.50	10.00
Interior Corner Support (interiorcornersupport) (G-I001)	Corner	Wall	ICS	8	0.50	4.00
Stud - Full	Stud	Wall	S-E000	49	4.33	212.33
Stud - Doubling	Stud	Wall	S-E001	8	4.00	32.00
Opening Jamb	Stud	Wall	S-E00W	26	6.00	156.00
Stud - Short	Stud	Wall	S-E00W1	7	1.00	7.00
Stud - Medium	Stud	Wall	S-E00W2	3	2.00	6.00
Header Spine - Girder W	Header	Wall	VH-000T	1	2.50	2.50
Header Spine - Girder E	Header	Wall	VH-000T-1	1	2.50	2.50
Header Spine - Corner Left	Header	Wall	VH-E00C1	4	1.00	4.00
Header Spine - Corner Right	Header	Wall	VH-E00C2	4	1.00	4.00
Header Spine - Short East	Header	Wall	VH-E00C2-1	1	1.00	1.00
Header Spine - Short West	Header	Wall	VH-E00C2-2	1	1.00	1.00
Header Spine - Common	Header	Wall	VH-I000	14	2.35	32.94
<b>Total Sqft. CNC Cut Plywood Wall Framing Parts:</b>						<b>1,491.70</b>
<b>1/2" CNC Cut Finish Grade Wall Panels</b>	<b>(Pine Plywood)</b>					
East Paneling	East Paneling	Interior	IP-LE01	1	15.00	15.00
East Paneling	East Paneling	Interior	IP-LE02	1	15.00	15.00
East Paneling	East Paneling	Interior	IP-LE03	1	4.00	4.00
East Paneling	East Paneling	Interior	IP-LE04	1	15.00	15.00
East Paneling	East Paneling	Interior	IP-LE05	1	10.00	10.00
East Paneling	East Paneling	Interior	IP-LE06	1	15.00	15.00
East Paneling	East Paneling	Interior	IP-LE07	1	15.00	15.00
East Paneling	East Paneling	Interior	IP-LE08	1	15.00	15.00
North Interior	North Interior	Interior	IP-LN01	1	11.00	11.00
North Interior	North Interior	Interior	IP-LN02	1	17.00	17.00
North Interior	North Interior	Interior	IP-LN03	1	13.00	13.00
North Interior	North Interior	Interior	IP-LN04	1	17.00	17.00
North Interior	North Interior	Interior	IP-LN05	1	17.00	17.00
North Interior	North Interior	Interior	IP-LN06	1	16.00	16.00
North Interior	North Interior	Interior	IP-LN0S	3	20.67	62.00
South Paneling	South Paneling	Interior	IP-LS01	1	16.00	16.00
South Paneling	South Paneling	Interior	IP-LS02	1	16.00	16.00
South Paneling	South Paneling	Interior	IP-LS0S	2	20.50	41.00
South Paneling	South Paneling	Interior	IP-LS0S-W	5	8.60	43.00
West Paneling	West Paneling	Interior	IP-LW01	1	15.00	15.00
West Paneling	West Paneling	Interior	IP-LW02	1	6.00	6.00
West Paneling	West Paneling	Interior	IP-LW03	1	6.00	6.00
West Paneling	West Paneling	Interior	IP-LW04	1	15.00	15.00
West Paneling	West Paneling	Interior	IP-LW05	1	6.00	6.00
West Paneling	West Paneling	Interior	IP-LW06	1	15.00	15.00
West Paneling	West Paneling	Interior	IP-LW0S	2	10.50	21.00
Upper Panel 1	Upper Paneling	Interior	IP-U1	2	5.00	10.00
Upper Panel 2	Upper Paneling	Interior	IP-U2	20	6.55	131.00
Upper Panel 3	Upper Paneling	Interior	IP-U3	2	5.50	11.00
Upper Panel 4	Upper Paneling	Interior	IP-U4	2	5.00	10.00
Upper Panel 5	Upper Paneling	Interior	IP-U5	2	3.00	6.00
Upper Panel 6	Upper Paneling	Interior	IP-U6	2	3.00	6.00
Upper Panel 7	Upper Paneling	Interior	IP-U7	2	5.50	11.00
<b>Total Sqft. CNC Cut Finish Grade Wall Panel Parts:</b>						<b>642.00</b>
<b>B3010 Roof Coverings</b>						
<b>5/8" Huber Zip System Sheathing</b>	<b>Huber Zip</b>					
Roof Paneling	Roof Paneling	Roof	R1-A	1	21	21.00
Roof Paneling	Roof Paneling	Roof	R1-B	3	21	63.00
Roof Paneling	Roof Paneling	Roof	R1-C	1	11	11.00
Roof Paneling	Roof Paneling	Roof	R2-A	1	13	13.00
Roof Paneling	Roof Paneling	Roof	R2-B	3	26	78.00
Roof Paneling	Roof Paneling	Roof	R2-C	1	26	26.00
Roof Paneling	Roof Paneling	Roof	R3-A	1	26	26.00
Roof Paneling	Roof Paneling	Roof	R3-B	3	26	78.00
Roof Paneling	Roof Paneling	Roof	R3-C	1	13	13.00
Roof Paneling	Roof Paneling	Roof	R4-A	1	13	13.00
Roof Paneling	Roof Paneling	Roof	R4-B	3	26	78.00
Roof Paneling	Roof Paneling	Roof	R4-C	1	26	26.00
Roof Paneling	Roof Paneling	Roof	R5-A	1	26	26.00
Roof Paneling	Roof Paneling	Roof	R5-B	3	26	78.00
Roof Paneling	Roof Paneling	Roof	R5-C	1	13	13.00
Roof Paneling	Roof Paneling	Roof	R6-A	1	13	13.00
Roof Paneling	Roof Paneling	Roof	R6-B	3	26	78.00
Roof Paneling	Roof Paneling	Roof	R6-C	1	26	26.00
Roof Paneling	Roof Paneling	Roof	R7-A	1	26	26.00
Roof Paneling	Roof Paneling	Roof	R7-B	3	26	78.00
Roof Paneling	Roof Paneling	Roof	R7-C	1	13	13.00
<b>Total Sqft. Huber Zip System Sheathing Parts:</b>						<b>797.00</b>
<b>C1020 Interior Doors</b>						
<b>3'-0" x 7'-0" Wood Door</b>	<b>(5/8" Maple Plywood)</b>					
Door Panel	Door Panel	Bedroom Door	D.5.1	2	14.8869	29.77
Door Panel	Door Panel	Bedroom Door	D.5.2	2	14.8005115	29.60
Door Panel	Door Panel	Bedroom Door	D.5.3	2	14.8618105	29.72
Door Panel	Door Panel	Bedroom Door	D.6.1	1	14.8910005	14.89

**Indigo Pine: Plywood Part Schedule**

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Door Panel	Door Panel	Bedroom Door	D.6.2	1	14.8005115	14.80
Door Panel	Door Panel	Bedroom Door	D.6.3	1	14.8618105	14.86
<b>Total Sqft 3'-0" Wood Door Panel Parts:</b>						<b>133.65</b>
<b>5'-8" x 7'-0" Wood Sliding Barn Door (3/4" Maple Plywood)</b>						
Door Panel	Door Panel	Bathroom Door	D.3.1	1	13.21195	13.21
Door Panel	Door Panel	Bathroom Door	D.3.2	1	19.2237	19.22
Door Panel	Door Panel	Bathroom Door	D.3.3	1	20.02295	20.02
Door Panel	Door Panel	Bathroom Door	D.3.4	1	12.4127	12.41
Door Panel	Door Panel	Bathroom Door	D.4.1	1	12.4127	12.41
Door Panel	Door Panel	Bathroom Door	D.4.2	1	20.02295	20.02
Door Panel	Door Panel	Bathroom Door	D.4.3	1	19.2237	19.22
Door Panel	Door Panel	Bathroom Door	D.4.4	1	13.21195	13.21
<b>Total Sqft 5'-8" Wood Door Panel Parts:</b>						<b>129.74</b>
<b>3'-0" x 7'-0" Wood Sliding Barn Door (3/4" Maple Plywood)</b>						
Door Panel	Door Panel	Hallway Door	D.1.1	1	16.5549	16.55
Door Panel	Door Panel	Hallway Door	D.1.2	1	16.54795	16.55
Door Panel	Door Panel	Hallway Door	D.2.1	1	16.5549	16.55
Door Panel	Door Panel	Hallway Door	D.2.2	1	16.54795	16.55
<b>Total Sqft 5'-8" Wood Door Panel Parts:</b>						<b>66.21</b>
<b>C1030 Fittings</b>						
<b>Custom Base &amp; Upper Kitchen Cabinets w/ Support Structure (Various sizes, Maple Plywood)</b>						
Storage Box	Base Cabinet	Kitchen	K.1.1	2	1.7931	3.59
Storage Box	Base Cabinet	Kitchen	K.1.2	1	1.70275	1.70
Storage Box	Base Cabinet	Kitchen	K.1.3	1	2.2101	2.21
Storage Box	Base Cabinet	Kitchen	K.1.4	1	4.99705	5.00
Storage Box	Base Cabinet	Kitchen	K.1.5	1	4.99705	5.00
Storage Box	Base Cabinet	Kitchen	K.1.6	1	0.34055	0.34
Storage Box	Base Cabinet	Kitchen	K.1.7	1	1.6402	1.64
Storage Box	Base Cabinet	Kitchen	K.1.8	1	1.61935	1.62
Storage Box	Wall Cabinet	Kitchen	K.2.1	3	2.77305	8.32
Storage Box	Wall Cabinet	Kitchen	K.2.2	3	2.39775	7.19
Storage Box	Wall Cabinet	Kitchen	K.2.3	3	2.39775	7.19
Storage Box	Wall Cabinet	Kitchen	K.2.4	3	6.9639	20.89
Storage Box	Wall Cabinet	Kitchen	K.2.5	12	1.20235	14.43
Storage Box	Wall Cabinet	Kitchen	K.2.6	3	2.20315	6.61
Storage Box	Wall Cabinet	Kitchen	K.2.7	3	3.25955	9.78
Storage Box	Wall Cabinet	Kitchen	K.2.8	4	3.25955	13.04
Storage Box	Wall Cabinet	Kitchen	K.2.9	3	2.8495	8.55
Storage Box	Base Cabinet	Kitchen	K.3.1	1	0.6394	0.64
Storage Box	Base Cabinet	Kitchen	K.3.2	1	0.5421	0.54
Storage Box	Base Cabinet	Kitchen	K.3.3	1	6.7832	6.78
Storage Box	Base Cabinet	Kitchen	K.3.4	1	5.004	5.00
Storage Box	Base Cabinet	Kitchen	K.3.5	1	5.004	5.00
Storage Box	Base Cabinet	Kitchen	K.3.6	1	5.7546	5.75
Storage Box	Base Cabinet	Kitchen	K.3.7	1	0.52125	0.52
Storage Box	Base Cabinet	Kitchen	K.3.8	1	1.3205	1.32
Storage Box	Base Cabinet	Kitchen	K.3.9	1	1.1398	1.14
Storage Box	Base Cabinet	Kitchen	K.3.10	1	2.66185	2.66
Storage Box	Base Cabinet	Kitchen	K.3.11	1	2.66185	2.66
Storage Box	Base Cabinet	Kitchen	K.4.1	1	1.4039	1.40
Storage Box	Wall Cabinet	Kitchen	K.4.2	1	3.25955	3.26
Storage Box	Wall Cabinet	Kitchen	K.4.3	1	1.3205	1.32
Storage Box	Wall Cabinet	Kitchen	K.4.4	4	0.5004	2.00
Storage Box	Wall Cabinet	Kitchen	K.4.5	1	6.9639	6.96
Storage Box	Wall Cabinet	Kitchen	K.4.6	1	1.1815	1.18
Storage Box	Wall Cabinet	Kitchen	K.4.7	1	0.9869	0.99
Storage Box	Wall Cabinet	Kitchen	K.4.8	1	1.1815	1.18
Storage Box	Base Cabinet	Kitchen	K.5.1	4	5.838	23.35
Storage Box	Base Cabinet	Kitchen	K.5.2	2	4.71905	9.44
Storage Box	Base Cabinet	Kitchen	K.5.3	2	2.73135	5.46
Storage Box	Base Cabinet	Kitchen	K.5.4	2	7.089	14.18
Storage Box	Base Cabinet	Kitchen	K.5.5	2	2.73135	5.46
Storage Box	Base Cabinet	Kitchen	K.5.6	4	2.5993	10.40
Storage Box	Base Cabinet	Kitchen	K.5.7	2	4.8789	9.76
Storage Box	Base Cabinet	Kitchen	K.5.8	2	4.8789	9.76
Storage Box	Base Cabinet	Kitchen	K.5.9	4	0.556	2.22
Storage Box	Base Cabinet	Kitchen	K.5.10	2	2.66185	5.32
Storage Box	Base Cabinet	Kitchen	K.5.11	2	2.66185	5.32
Storage Box	Wall Cabinet	Kitchen	K.6.1	1	2.4742	2.47
Storage Box	Wall Cabinet	Kitchen	K.6.2	1	2.27265	2.27
Storage Box	Wall Cabinet	Kitchen	K.6.3	1	2.34215	2.34
Storage Box	Wall Cabinet	Kitchen	K.6.4	1	1.0425	1.04
Storage Box	Wall Cabinet	Kitchen	K.6.5	1	0.9035	0.90
Storage Box	Wall Cabinet	Kitchen	K.6.6	1	1.0425	1.04
Storage Box	Wall Cabinet	Kitchen	K.6.7	1	1.09115	1.09
Storage Box	Wall Cabinet	Kitchen	K.6.8	1	1.09115	1.09
Storage Box	Tall Cabinet	Kitchen	K.12.1	2	3.92675	7.85
Storage Box	Tall Cabinet	Kitchen	K.12.2	1	0.4587	0.46
Storage Box	Tall Cabinet	Kitchen	K.12.3	1	13.93475	13.93
Storage Box	Tall Cabinet	Kitchen	K.12.4	1	0.7089	0.71
Storage Box	Tall Cabinet	Kitchen	K.12.5	1	13.21195	13.21
Ceiling	Ceiling Cabinet	All Ceiling	C.K.1	283	0.0417	11.80
Ceiling	Ceiling Cabinet	All Ceiling	C.K.2	1	0.03475	0.03
Plinth	Plinth Cabinet	Kitchen	K.13.1	11	0.2224	2.45
Plinth	Plinth Cabinet	Kitchen	K.13.2	4	0.59075	2.36
Plinth	Plinth Cabinet	Kitchen	K.13.3	11	0.7367	8.10
Plinth	Plinth Cabinet	Kitchen	K.13.4	2	0.24325	0.49
Plinth	Plinth Cabinet	Kitchen	K.13.5	1	5.6295	5.63
Plinth	Plinth Cabinet	Kitchen	K.13.7	1	0.25715	0.26
Plinth	Plinth Cabinet	Kitchen	K.13.8	1	0.72975	0.73

Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Plinth	Plinth Cabinet	Kitchen	K.13.9	3	0.53515	1.61
Plinth	Plinth Cabinet	Kitchen	K.13.10	1	0.3336	0.33
Plinth	Plinth Cabinet	Kitchen	K.13.11	1	0.7089	0.71
Plinth	Plinth Cabinet	Kitchen	K.14.1	1	0.92435	0.92
Plinth	Plinth Cabinet	Kitchen	K.14.2	1	1.668	1.67
Plinth	Plinth Cabinet	Kitchen	K.14.3	1	0.72975	0.73
Plinth	Plinth Cabinet	Kitchen	K.14.4	1	0.74365	0.74
Plinth	Plinth Cabinet	Kitchen	K.14.5	3	0.68805	2.06
Plinth	Plinth Cabinet	Kitchen	K.14.6	1	9.2991	9.30
Plinth	Plinth Cabinet	Kitchen	K.14.7	1	5.0874	5.09
Plinth	Plinth Cabinet	Kitchen	K.14.9	1	0.84095	0.84
Plinth	Plinth Cabinet	Kitchen	K.14.10	1	2.0016	2.00
Plinth	Plinth Cabinet	Kitchen	K.15.1	1	0.20155	0.20
Plinth	Plinth Cabinet	Kitchen	K.15.2	1	0.17375	0.17
Plinth	Plinth Cabinet	Kitchen	K.15.3	1	0.21545	0.22
Plinth	Plinth Cabinet	Kitchen	K.15.4	1	0.7228	0.72
Plinth	Plinth Cabinet	Kitchen	K.15.5	1	0.5282	0.53
Plinth	Plinth Cabinet	Kitchen	K.15.6	1	2.00855	2.01
Plinth	Plinth Cabinet	Kitchen	K.15.7	1	0.21545	0.22
Plinth	Plinth Cabinet	Kitchen	K.15.8	2	0.0556	0.11
Plinth	Plinth Cabinet	Kitchen	K.15.9	1	0.66025	0.66
Plinth	Plinth Cabinet	Kitchen	K.15.10	1	0.8757	0.88
Plinth	Plinth Cabinet	Kitchen	K.16.1	1	0.79925	0.80
Plinth	Plinth Cabinet	Kitchen	K.16.2	1	0.79925	0.80
Plinth	Plinth Cabinet	Kitchen	K.16.3	1	7.27665	7.28
Plinth	Plinth Cabinet	Kitchen	K.16.4	1	0.97995	0.98
Plinth	Plinth Cabinet	Kitchen	K.16.5	2	0.53515	1.07
Plinth	Plinth Cabinet	Kitchen	K.16.6	1	0.81315	0.81
Plinth	Plinth Cabinet	Kitchen	K.16.7	1	1.0008	1.00
Soffit	Soffit Cabinet	Kitchen	P.6.1	1	1.0286	1.03
Soffit	Soffit Cabinet	Kitchen	P.6.2	1	0.99385	0.99
Soffit	Soffit Cabinet	Kitchen	P.6.3	1	12.01655	12.02
Soffit	Soffit Cabinet	Kitchen	P.6.4	8	1.23015	9.84
Soffit	Soffit Cabinet	Kitchen	P.6.5	1	0.7645	0.76
Soffit	Soffit Cabinet	Kitchen	P.6.6	1	0.6533	0.65
Soffit	Soffit Cabinet	Kitchen	P.6.7	1	3.75995	3.76
Soffit	Soffit Cabinet	Kitchen	P.7.1	5	5.37235	26.86
Soffit	Soffit Cabinet	Kitchen	P.7.2	1	16.9024	16.90
Soffit	Soffit Cabinet	Kitchen	P.7.3	1	1.3622	1.36
Soffit	Soffit Cabinet	Kitchen	P.7.4	1	1.42475	1.42
Soffit	Soffit Cabinet	Kitchen	P.8.1	10	1.5846	15.85
Soffit	Soffit Cabinet	Kitchen	P.8.2	2	20.28705	40.57
<b>Total Sqft. Kitchen Cabinet Parts:</b>						<b>524.87</b>
<b>Custom Full Height Living rm Cabinet w/ Support Structure</b>	<b>(Various sizes, Maple Plywood)</b>					
Storage Box	Entertainment Center Cabinet	Living Room	B.1.2	1	5.58085	5.58
Storage Box	Entertainment Center Cabinet	Living Room	B.1.3	1	3.34295	3.34
Storage Box	Entertainment Center Cabinet	Living Room	B.1.4	1	5.58085	5.58
Storage Box	Entertainment Center Cabinet	Living Room	B.1.5	1	5.2959	5.30
Storage Box	Entertainment Center Cabinet	Living Room	B.1.7	2	5.8797	11.76
Storage Box	Entertainment Center Cabinet	Living Room	B.1.8	6	1.4873	8.92
Storage Box	Entertainment Center Cabinet	Living Room	B.1.9	1	12.4266	12.43
Storage Box	Entertainment Center Cabinet	Living Room	B.2.1	1	3.34295	3.34
Storage Box	Entertainment Center Cabinet	Living Room	B.2.2	1	2.4742	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.2.3	1	3.45415	3.45
Storage Box	Entertainment Center Cabinet	Living Room	B.2.4	1	2.4742	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.2.5	1	5.4488	5.45
Storage Box	Entertainment Center Cabinet	Living Room	B.2.6	1	1.88345	1.88
Storage Box	Entertainment Center Cabinet	Living Room	B.2.8	1	2.57845	2.58
Storage Box	Entertainment Center Cabinet	Living Room	B.2.9	2	1.2371	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.2.10	1	5.41405	5.41
Storage Box	Entertainment Center Cabinet	Living Room	B.2.11	1	2.57845	2.58
Storage Box	Entertainment Center Cabinet	Living Room	B.2.12	2	1.2371	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.3.1	1	3.56535	3.57
Storage Box	Entertainment Center Cabinet	Living Room	B.3.2	1	5.5461	5.55
Storage Box	Entertainment Center Cabinet	Living Room	B.3.3	1	5.5461	5.55
Storage Box	Entertainment Center Cabinet	Living Room	B.3.4	1	12.92005	12.92
Storage Box	Entertainment Center Cabinet	Living Room	B.3.5	1	2.1406	2.14
Storage Box	Entertainment Center Cabinet	Living Room	B.3.6	1	3.45415	3.45
Storage Box	Entertainment Center Cabinet	Living Room	B.3.7	1	3.4611	3.46
Storage Box	Entertainment Center Cabinet	Living Room	B.3.8	1	3.5167	3.52
Electrical Chase	Entertainment Center Cabinet	Living Room	B.4.1	2	2.0711	4.14
Electrical Chase	Entertainment Center Cabinet	Living Room	B.4.2	1	1.39	1.39
Electrical Chase	Entertainment Center Cabinet	Living Room	B.4.4	1	1.39	1.39
Electrical Chase	Entertainment Center Cabinet	Living Room	B.4.5	1	5.71985	5.72
Electrical Chase	Entertainment Center Cabinet	Living Room	B.4.6	2	1.1259	2.25
Electrical Chase	Entertainment Center Cabinet	Living Room	B.4.7	1	5.71985	5.72
Storage Box	Entertainment Center Cabinet	Living Room	B.5.1	2	3.85725	7.71
Storage Box	Entertainment Center Cabinet	Living Room	B.5.2	1	5.56	5.56
Storage Box	Entertainment Center Cabinet	Living Room	B.5.3	1	5.58085	5.58
Storage Box	Entertainment Center Cabinet	Living Room	B.5.4	1	5.2959	5.30
Storage Box	Entertainment Center Cabinet	Living Room	B.5.5	1	5.58085	5.58
Storage Box	Entertainment Center Cabinet	Living Room	B.5.6	2	5.8797	11.76
Storage Box	Entertainment Center Cabinet	Living Room	B.5.7	3	1.4873	4.46
Storage Box	Entertainment Center Cabinet	Living Room	B.5.8	3	1.4873	4.46
Storage Box	Entertainment Center Cabinet	Living Room	B.5.9	1	14.26835	14.27
Storage Box	Entertainment Center Cabinet	Living Room	B.5.10	3	0.417	1.25
Storage Box	Entertainment Center Cabinet	Living Room	B.6.1	1	3.8086	3.81
Storage Box	Entertainment Center Cabinet	Living Room	B.6.2	1	2.4742	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.6.3	1	3.9337	3.93
Storage Box	Entertainment Center Cabinet	Living Room	B.6.4	1	2.52285	2.52
Storage Box	Entertainment Center Cabinet	Living Room	B.6.5	1	1.84175	1.84
Storage Box	Entertainment Center Cabinet	Living Room	B.6.6	1	2.4742	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.6.7	1	6.3662	6.37
Storage Box	Entertainment Center Cabinet	Living Room	B.6.8	1	5.5044	5.50
Storage Box	Entertainment Center Cabinet	Living Room	B.6.9	1	2.57845	2.58
Storage Box	Entertainment Center Cabinet	Living Room	B.6.10	1	2.57845	2.58

Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Storage Box	Entertainment Center Cabinet	Living Room	B.6.11	2	1.2371	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.6.12	2	1.2371	2.47
Storage Box	Entertainment Center Cabinet	Living Room	B.6.13	1	0.45175	0.45
Plinth	Ceiling Cabinet	Living / Bed 103	B.13.1	1	8.68055	8.68
Plinth	Ceiling Cabinet	Living / Bed 103	B.13.2	2	0.7645	1.53
Plinth	Ceiling Cabinet	Living / Bed 103	B.13.3	4	0.61855	2.47
Plinth	Ceiling Cabinet	Living / Bed 103	B.13.4	2	0.973	1.95
Plinth	Ceiling Cabinet	Living / Bed 103	B.13.6	2	1.39695	2.79
Plinth	Ceiling Cabinet	Living / Bed 103	B.13.7	1	8.84735	8.85
Plinth	Ceiling Cabinet	Living / Bed 103	B.13.8	2	1.4595	2.92
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.1	1	9.80645	9.81
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.2	2	0.7089	1.42
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.3	4	0.4865	1.95
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.4	2	1.1537	2.31
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.5	2	1.73055	3.46
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.6	2	1.668	3.34
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.7	1	0.7089	0.71
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.8	1	0.5699	0.57
Plinth	Ceiling Cabinet	Living / Bed 103	B.14.9	1	9.66745	9.67
<b>Total Sqft. Living Room Cabinet Parts:</b>						<b>316.10</b>
<b>Custom Full Hgt. Mstr Cab. w/ Support Structure - 11' Wide</b>		<b>(Various sizes, Maple Plywood)</b>				
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.1	1	2.11975	2.12
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.2	2	0.89655	1.79
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.3	1	2.21705	2.22
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.4	2	1.7514	3.50
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.5	1	1.6402	1.64
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.6	1	4.89975	4.90
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.7	1	2.1962	2.20
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.11.8	1	2.1962	2.20
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.1	1	2.24485	2.24
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.2	1	2.03635	2.04
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.3	1	2.0989	2.10
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.4	1	2.0433	2.04
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.5	1	2.1684	2.17
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.6	2	3.4055	6.81
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.7	1	3.21785	3.22
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.8	1	1.20235	1.20
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.9	1	3.07885	3.08
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.12.10	1	11.33545	11.34
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.1	4	2.66185	10.65
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.2	2	2.4464	4.89
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.3	2	2.50895	5.02
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.4	2	2.55065	5.10
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.5	2	3.42635	6.85
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.6	2	3.42635	6.85
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.7	2	5.7268	11.45
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.13.8	2	12.9826	25.97
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.14.1	2	2.48115	4.96
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.14.2	2	1.75835	3.52
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.14.3	2	1.75835	3.52
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.14.4	2	4.32985	8.66
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.14.5	2	5.46965	10.94
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.15.1	2	0.32665	0.65
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.15.2	1	4.309	4.31
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.15.3	1	4.2812	4.28
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.15.4	1	2.3352	2.34
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.15.5	1	3.1136	3.11
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.1	1	2.00855	2.01
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.2	1	1.7931	1.79
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.3	1	1.85565	1.86
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.4	1	1.9043	1.90
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.5	2	0.7506	1.50
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.6	1	4.2673	4.27
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.7	1	4.2673	4.27
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.8	1	11.7733	11.77
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.9	1	5.0596	5.06
Storage Box	Master Bed Cabinet	Master Bedroom / Kitchen	S.16.10	1	5.2125	5.21
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.17.1	2	0.417	0.83
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.17.2	1	5.19165	5.19
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.17.3	1	5.23335	5.23
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.17.4	1	5.19165	5.19
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.17.5	1	5.26115	5.26
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.17.6	1	3.42635	3.43
Electrical Chase	Master Bed Cabinet	Master Bedroom / Kitchen	S.17.7	1	2.0989	2.10
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.1	2	3.84335	7.69
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.2	2	1.59155	3.18
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.3	1	1.64715	1.65
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.4	1	1.6958	1.70
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.5	1	5.21945	5.22
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.6	1	5.2125	5.21
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.7	1	13.344	13.34
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.8	1	4.10745	4.11
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.9	1	13.87915	13.88
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.10	1	5.08045	5.08
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.11	1	13.9417	13.94
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.12	1	0.46565	0.47
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.13	1	8.63885	8.64
Storage Box	Hallway Cabinet	Hallway / Kitchen	S.18.14	1	13.344	13.34
Plinth	Plinth Cabinet	Master Bedroom	F.2.1	2	16.89545	33.79
Plinth	Plinth Cabinet	Master Bedroom	F.3.1	2	13.67065	27.34
Plinth	Plinth Cabinet	Master Bedroom	F.4.2	2	21.13495	42.27
Plinth	Plinth Cabinet	Master Bedroom	F.4.3	1	0.2085	0.21
Plinth	Plinth Cabinet	Master Bedroom	F.4.4	1	0.11815	0.12
Plinth	Plinth Cabinet	Master Bedroom	F.4.5	1	1.5985	1.60
Soffit	Soffit Cabinet	Master Bedroom	P.1.1	1	1.41085	1.41
Soffit	Soffit Cabinet	Master Bedroom	P.1.2	1	11.23815	11.24

Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Soffit	Soffit Cabinet	Master Bedroom	P.1.3	1	1.38305	1.38
Soffit	Soffit Cabinet	Master Bedroom	P.1.4	1	5.60865	5.61
Soffit	Soffit Cabinet	Master Bedroom	P.1.5	4	1.02165	4.09
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.1	4	5.1291	20.52
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.2	2	12.05825	24.12
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.3	2	0.43785	0.88
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.4	2	5.4349	10.87
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.5	2	5.4349	10.87
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.6	2	8.7153	17.43
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.7	2	8.7153	17.43
Storage Box	Master Bed Cabinet	Master Bedroom	S.5.8	2	1.0564	2.11
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.1	1	5.0874	5.09
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.2	2	4.99705	9.99
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.3	2	5.143	10.29
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.4	2	5.52525	11.05
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.5	2	1.2371	2.47
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.6	4	1.71665	6.87
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.7	2	4.031	8.06
Storage Box	Master Bed Cabinet	Master Bedroom	S.7.8	2	4.031	8.06
Storage Box	Master Bed Cabinet	Master Bedroom	S.8.1	1	5.06655	5.07
Storage Box	Master Bed Cabinet	Master Bedroom	S.8.2	2	4.99705	9.99
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.1	2	0.97995	1.96
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.2	1	3.6279	3.63
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.3	1	1.9182	1.92
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.4	1	1.0703	1.07
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.5	1	11.58565	11.59
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.6	1	12.75325	12.75
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.7	1	12.8714	12.87
Storage Box	Master Bed Cabinet	Master Bedroom	S.9.8	1	12.8714	12.87
Plinth	Plinth Cabinet	Master Bedroom	S.10.1	1	11.1895	11.19
Plinth	Plinth Cabinet	Master Bedroom	S.10.2	1	1.9738	1.97
Plinth	Plinth Cabinet	Master Bedroom	S.10.3	1	1.9877	1.99
Plinth	Plinth Cabinet	Master Bedroom	S.10.4	1	1.61935	1.62
Plinth	Plinth Cabinet	Master Bedroom	S.10.5	1	1.67495	1.67
Plinth	Plinth Cabinet	Master Bedroom	S.10.6	1	1.668	1.67
Plinth	Plinth Cabinet	Master Bedroom	S.10.7	1	0.0556	0.06
Plinth	Plinth Cabinet	Master Bedroom	S.10.8	1	0.61855	0.62
Plinth	Plinth Cabinet	Master Bedroom	S.10.9	1	0.0278	0.03
Plinth	Plinth Cabinet	Master Bedroom	S.10.10	1	0.49345	0.49
Plinth	Plinth Cabinet	Master Bedroom	S.10.11	1	0.53515	0.54
Plinth	Plinth Cabinet	Master Bedroom	S.10.12	5	0.53515	2.68
Plinth	Plinth Cabinet	Master Bedroom	S.10.13	1	0.53515	0.54
Plinth	Plinth Cabinet	Master Bedroom	S.10.14	1	0.556	0.56
<b>Total Sqft. Kitchen Cabinet Parts:</b>						<b>738.69</b>
<b>Custom Full Height Bedroom Cabinet w/ Support Structure</b>	<b>(Various sizes, Maple Plywood)</b>					
Office Box	Bedroom Cabinet	Bedroom 103	B.7.1	1	3.2248	3.22
Office Box	Bedroom Cabinet	Bedroom 103	B.7.2	1	5.14995	5.15
Office Box	Bedroom Cabinet	Bedroom 103	B.7.4	1	5.14995	5.15
Office Box	Bedroom Cabinet	Bedroom 103	B.7.5	1	12.2459	12.25
Office Box	Bedroom Cabinet	Bedroom 103	B.7.7	1	3.0719	3.07
Office Box	Bedroom Cabinet	Bedroom 103	B.7.8	1	3.09275	3.09
Office Box	Bedroom Cabinet	Bedroom 103	B.7.9	1	3.09275	3.09
Office Box	Bedroom Cabinet	Bedroom 103	B.7.10	1	1.9321	1.93
Office Box	Bedroom Cabinet	Bedroom 103	B.7.11	2	1.45255	2.91
Office Box	Bedroom Cabinet	Bedroom 103	B.7.12	1	1.16065	1.16
Office Box	Bedroom Cabinet	Bedroom 103	B.7.15	1	4.0588	4.06
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.1	1	3.13445	3.13
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.2	1	2.3352	2.34
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.3	1	3.30125	3.30
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.4	1	2.3352	2.34
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.5	2	3.1692	6.34
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.8	1	2.00855	2.01
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.10	1	1.54985	1.55
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.11	1	1.3483	1.35
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.1	2	3.32905	6.66
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.2	1	5.2125	5.21
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.3	1	5.1986	5.20
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.4	1	12.73935	12.74
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.5	1	5.1986	5.20
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.7	3	2.48115	7.44
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.1	1	4.7399	4.74
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.2	1	3.38465	3.38
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.3	1	4.89975	4.90
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.4	2	3.3499	6.70
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.6	1	5.69205	5.69
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.7	2	3.96845	7.94
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.60	1	7.1863	7.19
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.61	1	7.23495	7.23
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.62	1	7.2558	7.26
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.67	1	3.1831	3.18
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.68	6	1.36915	8.21
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.69	2	4.4341	8.87
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.70	2	4.4341	8.87
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.71	2	2.0016	4.00
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.72	2	2.0016	4.00
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.73	1	6.66505	6.67
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.74	1	7.44345	7.44
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.75	1	2.93985	2.94
Storage Box	Bedroom Cabinet	Bedroom 103	B.12.11	1	1.18845	1.19
Storage Box	Bedroom Cabinet	Bedroom 103	B.12.12	1	1.3622	1.36
Storage Box	Bedroom Cabinet	Bedroom 103	B.12.13	1	1.7653	1.77
Plinth	Plinth Cabinet	Bedroom 103	F.1.2	7	1.668	11.68
Soffit	Soffit Cabinet	Bedroom 103	P.4.1	7	1.7653	12.36
Soffit	Soffit Cabinet	Bedroom 103	P.4.2	1	12.41965	12.42
Soffit	Soffit Cabinet	Bedroom 103	P.4.3	1	5.33065	5.33
Soffit	Soffit Cabinet	Bedroom 103	P.5.1	1	8.31915	8.32

Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Office Box	Bedroom Cabinet	Bedroom 103	B.7.1	1	3.2248	3.22
Office Box	Bedroom Cabinet	Bedroom 103	B.7.2	1	5.14995	5.15
Office Box	Bedroom Cabinet	Bedroom 103	B.7.4	1	5.14995	5.15
Office Box	Bedroom Cabinet	Bedroom 103	B.7.5	1	12.2459	12.25
Office Box	Bedroom Cabinet	Bedroom 103	B.7.7	1	3.0719	3.07
Office Box	Bedroom Cabinet	Bedroom 103	B.7.8	1	3.09275	3.09
Office Box	Bedroom Cabinet	Bedroom 103	B.7.9	1	3.09275	3.09
Office Box	Bedroom Cabinet	Bedroom 103	B.7.10	1	1.9321	1.93
Office Box	Bedroom Cabinet	Bedroom 103	B.7.11	2	1.45255	2.91
Office Box	Bedroom Cabinet	Bedroom 103	B.7.12	1	1.16065	1.16
Office Box	Bedroom Cabinet	Bedroom 103	B.7.15	1	4.0588	4.06
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.1	1	3.13445	3.13
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.2	1	2.3352	2.34
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.3	1	3.30125	3.30
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.4	1	2.3352	2.34
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.5	2	3.1692	6.34
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.8	1	2.00855	2.01
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.10	1	1.54985	1.55
Desk Storage Box	Bedroom Cabinet	Bedroom 103	B.8.11	1	1.3483	1.35
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.1	2	3.32905	6.66
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.2	1	5.2125	5.21
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.3	1	5.1986	5.20
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.4	1	12.73935	12.74
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.5	1	5.1986	5.20
Storage Box	Bedroom Cabinet	Bedroom 103	B.9.7	3	2.48115	7.44
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.1	1	4.7399	4.74
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.2	1	3.38465	3.38
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.3	1	4.89975	4.90
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.4	2	3.3499	6.70
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.6	1	5.69205	5.69
Storage Box	Bedroom Cabinet	Bedroom 103	B.10.7	2	3.96845	7.94
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.60	1	7.1863	7.19
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.61	1	7.23495	7.23
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.62	1	7.2558	7.26
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.67	1	3.1831	3.18
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.68	6	1.36915	8.21
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.69	2	4.4341	8.87
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.70	2	4.4341	8.87
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.71	2	2.0016	4.00
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.72	2	2.0016	4.00
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.73	1	6.66505	6.67
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.74	1	7.44345	7.44
Storage Box	Bedroom Cabinet	Bedroom 103	B.11.75	1	2.93985	2.94
Storage Box	Bedroom Cabinet	Bedroom 103	B.12.11	1	1.18845	1.19
Storage Box	Bedroom Cabinet	Bedroom 103	B.12.12	1	1.3622	1.36
Storage Box	Bedroom Cabinet	Bedroom 103	B.12.13	1	1.7653	1.77
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.1	1	4.1422	4.14
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.2	1	6.67895	6.68
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.3	1	4.09355	4.09
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.4	1	6.67895	6.68
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.5	1	12.2598	12.26
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.6	1	4.0171	4.02
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.7	1	4.0171	4.02
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.8	1	3.9893	3.99
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.9	1	2.46725	2.47
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.10	2	1.89735	3.79
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.11	1	4.0588	4.06
Storage Box	Bedroom Cabinet	Bedroom 104	B.15.12	1	1.4734	1.47
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.1	1	3.9893	3.99
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.2	1	2.9468	2.95
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.3	1	4.1422	4.14
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.4	1	2.9607	2.96
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.5	1	5.56695	5.57
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.6	1	5.5183	5.52
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.7	2	3.1136	6.23
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.8	1	1.3483	1.35
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.9	1	1.54985	1.55
Storage Box	Bedroom Cabinet	Bedroom 104	B.16.10	1	2.00855	2.01
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.1	1	4.32985	4.33
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.2	1	6.70675	6.71
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.3	1	4.32985	4.33
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.4	1	6.6859	6.69
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.5	1	12.71155	12.71
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.6	1	6.6859	6.69
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.7	3	3.2943	9.88
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.8	1	5.27505	5.28
Storage Box	Bedroom Cabinet	Bedroom 104	B.17.9	1	5.13605	5.14
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.1	1	4.26035	4.26
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.2	1	3.0024	3.00
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.3	1	4.32985	4.33
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.4	1	2.91205	2.91
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.5	1	5.6156	5.62
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.6	2	3.5584	7.12
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.7	1	1.18845	1.19
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.8	1	1.3622	1.36
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.9	1	1.7653	1.77
Storage Box	Bedroom Cabinet	Bedroom 104	B.18.11	1	2.91205	2.91
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.0	1	1.43865	1.44
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.1	1	4.01015	4.01
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.2	1	8.3956	8.40
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.3	1	9.41725	9.42
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.4	1	9.37555	9.38
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.5	1	7.99945	8.00
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.6	1	20.57895	20.58
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.7	1	19.60595	19.61
Storage Box	Bedroom Cabinet	Bedroom 104	B.19.8	1	9.58405	9.58
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.1	1	7.17935	7.18
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.2	1	0.45175	0.45



Indigo Pine: Plywood Part Schedule

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.3	5	0.29885	1.49
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.4	1	1.4039	1.40
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.5	2	2.06415	4.13
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.6	2	1.96685	3.93
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.7	1	7.29055	7.29
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.20.8	1	0.3058	0.31
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.1	1	3.37075	3.37
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.2	2	0.39615	0.79
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.3	3	0.2641	0.79
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.4	1	0.78535	0.79
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.5	2	1.1398	2.28
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.6	2	1.11895	2.24
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.7	1	0.4031	0.40
Plinth	Ceiling Cabinet	Toilet / Bed 104	B.21.8	1	3.45415	3.45
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.1	1	16.26995	16.27
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.2	1	16.1796	16.18
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.3	2	4.27425	8.55
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.4	3	2.6549	7.96
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.5	1	5.12215	5.12
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.6	1	1.99465	1.99
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.7	1	1.8626	1.86
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.8	2	0.84095	1.68
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.9	4	0.21545	0.86
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.10	1	4.9762	4.98
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.11	1	3.9337	3.93
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.12	1	1.53595	1.54
Ceiling	Ceiling Cabinet	Bedroom Closet	C.6.13	2	0.1807	0.36
Plinth	Plinth Cabinet	Bedroom 104	F.1.1	2	9.77865	19.56
Plinth	Plinth Cabinet	Bedroom 103	F.1.2	7	1.668	11.68
Soffit	Soffit Cabinet	Bedroom 104	P.2.1	3	3.19005	9.57
Soffit	Soffit Cabinet	Bedroom 104	P.2.2	1	5.16385	5.16
Soffit	Soffit Cabinet	Bedroom 104	P.2.3	5	0.7506	3.75
Soffit	Soffit Cabinet	Bedroom 104	P.2.4	1	0.86875	0.87
Soffit	Soffit Cabinet	Bedroom 104	P.2.5	1	0.8479	0.85
Soffit	Soffit Cabinet	Bedroom 104	P.3.1	2	0.7506	1.50
Soffit	Soffit Cabinet	Bedroom 104	P.3.2	1	0.59075	0.59
Soffit	Soffit Cabinet	Bedroom 104	P.3.3	1	0.1112	0.11
Soffit	Soffit Cabinet	Bedroom 104	P.3.4	1	4.865	4.87
Soffit	Soffit Cabinet	Bedroom 104	P.3.5	2	4.6843	9.37
Soffit	Soffit Cabinet	Bedroom 104	P.3.6	1	1.2649	1.26
Soffit	Soffit Cabinet	Bedroom 104	P.3.7	1	1.20235	1.20
Soffit	Soffit Cabinet	Bedroom 103	P.4.1	7	1.7653	12.36
Soffit	Soffit Cabinet	Bedroom 103	P.4.2	1	12.41965	12.42
Soffit	Soffit Cabinet	Bedroom 103	P.4.3	1	5.33065	5.33
Soffit	Soffit Cabinet	Bedroom 103	P.5.1	1	8.31915	8.32
Storage Box	Closet Cabinet	Bedroom Closet	S.1.1	1	3.1553	3.16
Storage Box	Closet Cabinet	Bedroom Closet	S.1.2	2	2.31435	4.63
Storage Box	Closet Cabinet	Bedroom Closet	S.1.3	1	2.3908	2.39
Storage Box	Closet Cabinet	Bedroom Closet	S.1.4	1	2.3491	2.35
Storage Box	Closet Cabinet	Bedroom Closet	S.1.5	1	3.2526	3.25
Storage Box	Closet Cabinet	Bedroom Closet	S.1.6	1	11.9401	11.94
Storage Box	Closet Cabinet	Bedroom Closet	S.1.7	1	2.77305	2.77
Storage Box	Closet Cabinet	Bedroom Closet	S.1.8	1	3.1831	3.18
Storage Box	Closet Cabinet	Bedroom Closet	S.1.9	1	2.9051	2.91
Storage Box	Closet Cabinet	Bedroom Closet	S.1.11	1	9.9246	9.92
Storage Box	Closet Cabinet	Bedroom Closet	S.1.12	1	1.11895	1.12
Storage Box	Closet Cabinet	Bedroom Closet	S.1.14	1	11.1339	11.13
Storage Box	Closet Cabinet	Bedroom Closet	S.1.15	1	10.8281	10.83
Storage Box	Closet Cabinet	Bedroom Closet	S.1.16	1	0.5143	0.51
Storage Box	Closet Cabinet	Bedroom Closet	S.2.1	1	3.1553	3.16
Storage Box	Closet Cabinet	Bedroom Closet	S.2.2	2	2.31435	4.63
Storage Box	Closet Cabinet	Bedroom Closet	S.2.3	2	2.3908	4.78
Storage Box	Closet Cabinet	Bedroom Closet	S.2.4	1	2.3491	2.35
Storage Box	Closet Cabinet	Bedroom Closet	S.2.5	1	3.2526	3.25
Storage Box	Closet Cabinet	Bedroom Closet	S.2.6	1	11.9401	11.94
Storage Box	Closet Cabinet	Bedroom Closet	S.2.7	1	2.77305	2.77
Storage Box	Closet Cabinet	Bedroom Closet	S.2.8	1	3.1831	3.18
Storage Box	Closet Cabinet	Bedroom Closet	S.2.9	1	2.9051	2.91
Storage Box	Closet Cabinet	Bedroom Closet	S.2.10	2	2.7244	5.45
Storage Box	Closet Cabinet	Bedroom Closet	S.2.11	1	9.9246	9.92
Storage Box	Closet Cabinet	Bedroom Closet	S.2.12	1	1.11895	1.12
Storage Box	Closet Cabinet	Bedroom Closet	S.2.13	2	10.9532	21.91
Storage Box	Closet Cabinet	Bedroom Closet	S.2.14	1	11.1339	11.13
Storage Box	Closet Cabinet	Bedroom Closet	S.2.15	1	10.8281	10.83
Storage Box	Closet Cabinet	Bedroom Closet	S.2.16	1	0.5143	0.51
Storage Box	Closet Cabinet	Bedroom Closet	S.3.1	2	4.27425	8.55
Storage Box	Closet Cabinet	Bedroom Closet	S.3.2	3	4.0866	12.26
Storage Box	Closet Cabinet	Bedroom Closet	S.3.3	2	4.1422	8.28
Storage Box	Closet Cabinet	Bedroom Closet	S.3.4	1	16.6939	16.69
Storage Box	Closet Cabinet	Bedroom Closet	S.3.5	1	11.07135	11.07
Storage Box	Closet Cabinet	Bedroom Closet	S.3.6	1	11.07135	11.07
Plinth	Plinth Cabinet	Bedroom Closet	S.4.1	1	10.59875	10.60
Plinth	Plinth Cabinet	Bedroom Closet	S.4.2	1	2.1267	2.13
Plinth	Plinth Cabinet	Bedroom Closet	S.4.3	1	2.224	2.22
Plinth	Plinth Cabinet	Bedroom Closet	S.4.4	1	1.7653	1.77
Plinth	Plinth Cabinet	Bedroom Closet	S.4.5	1	1.84175	1.84
Plinth	Plinth Cabinet	Bedroom Closet	S.4.6	2	0.04865	0.10
Plinth	Plinth Cabinet	Bedroom Closet	S.4.7	1	1.81395	1.81
Plinth	Plinth Cabinet	Bedroom Closet	S.4.8	2	0.50735	1.01
Plinth	Plinth Cabinet	Bedroom Closet	S.4.9	2	0.03475	0.07
Plinth	Plinth Cabinet	Bedroom Closet	S.4.10	2	0.417	0.83
Plinth	Plinth Cabinet	Bedroom Closet	S.4.11	2	0.45175	0.90
Plinth	Plinth Cabinet	Bedroom Closet	S.4.12	6	0.4587	2.75
<b>Total Sqft. Bedroom Cabinet Parts:</b>						<b>1,261.77</b>
<b>Custom 3'-0" x 4'-6" Built in Header</b>	<b>(Various sizes, Maple Plywood)</b>					

**Indigo Pine: Plywood Part Schedule**

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft <sup>2</sup> )
<b>Total Sqft. 3' Built in Header Parts:</b>						<b>-</b>
<b>Custom 2'-0" x 4'-6" Built in Header</b>						
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.1	2	1.3483	2.70
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.2	1	1.84175	1.84
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.3	1	1.7931	1.79
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.4	1	1.39	1.39
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.5	1	7.3809	7.38
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.6	1	1.77225	1.77
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.7	2	1.24405	2.49
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.8	1	2.35605	2.36
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.9	2	1.85565	3.71
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.10	1	3.3638	3.36
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.11	1	3.1553	3.16
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.12	1	6.9222	6.92
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.13	1	1.6958	1.70
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.14	2	0.43785	0.88
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.15	1	0.6533	0.65
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.16	2	0.1112	0.22
Ceiling	Ceiling Cabinet	Bathroom Header	C.7.17	1	0.1668	0.17
<b>Total Sqft. 2' Built in Header Parts:</b>						<b>42.49</b>
<b>Custom Bathroom Wall Cabinet</b>						
Ceiling	Ceiling Cabinet	Toilet / Washroom	C.1.1	9	0.8479	7.63
Ceiling	Ceiling Cabinet	Toilet / Washroom	C.1.2	8	1.8904	15.12
Ceiling	Ceiling Cabinet	Toilet / Washroom	C.1.3	8	0.72975	5.84
Ceiling	Ceiling Cabinet	Toilet / Washroom	C.1.4	12	2.9885	35.86
Ceiling	Ceiling Cabinet	Toilet / Washroom	C.1.5	4	13.2189	52.88
Plinth	Plinth Cabinet	Toilet / Washroom	F.5.1	4	1.32745	5.31
Plinth	Plinth Cabinet	Toilet / Washroom	F.5.2	2	1.1537	2.31
Plinth	Plinth Cabinet	Toilet / Washroom	F.6.1	2	1.84175	3.68
Plinth	Plinth Cabinet	Toilet / Washroom	F.6.2	2	1.4734	2.95
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.1	2	0.8896	1.78
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.2	1	3.0024	3.00
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.3	1	3.1275	3.13
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.4	4	0.5143	2.06
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.5	4	0.7089	2.84
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.6	1	1.3205	1.32
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.7	1	17.70165	17.70
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.8	1	5.977	5.98
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.9	1	2.63405	2.63
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.10	1	0.74365	0.74
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.11	1	0.67415	0.67
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.12	1	1.02165	1.02
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.13	3	0.32665	0.98
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.14	1	3.4889	3.49
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.2.15	1	7.69365	7.69
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.1	2	3.1553	6.31
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.2	1	1.3761	1.38
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.3	2	0.5838	1.17
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.4	1	1.3205	1.32
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.5	12	0.10425	1.25
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.6	1	9.8551	9.86
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.7	1	1.00775	1.01
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.8	1	1.00775	1.01
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.9	1	6.87355	6.87
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.10	1	6.87355	6.87
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.11	4	0.7506	3.00
Storage Box	Bathroom Cabinet	Toilet / Washroom	T.3.12	2	1.0703	2.14
Plinth	Plinth Cabinet	Toilet / Washroom	T.4.1	2	1.8626	3.73
Plinth	Plinth Cabinet	Toilet / Washroom	T.4.2	2	2.0294	4.06
Plinth	Plinth Cabinet	Toilet / Washroom	T.4.3	2	1.4039	2.81
Plinth	Plinth Cabinet	Toilet / Washroom	T.4.4	4	0.06255	0.25
Plinth	Plinth Cabinet	Toilet / Washroom	T.5.1	4	0.31275	1.25
Plinth	Plinth Cabinet	Toilet / Washroom	T.5.2	2	0.5282	1.06
Plinth	Plinth Cabinet	Toilet / Washroom	T.5.3	2	1.2788	2.56
Plinth	Plinth Cabinet	Toilet / Washroom	T.5.4	4	0.43785	1.75
Plinth	Plinth Cabinet	Toilet / Washroom	T.5.5	4	0.278	1.11
<b>Total Sqft. Bathroom Wall Cabinet Parts:</b>						<b>247.37</b>
<b>Vanity Cabinets</b>						
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.1	2	1.5568	3.11
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.2	4	0.4726	1.89
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.3	2	1.78615	3.57
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.4	2	1.78615	3.57
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.5	4	0.973	3.89
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.6	2	0.53515	1.07
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.7	2	0.5004	1.00
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.8	2	0.91045	1.82
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.9	2	0.91045	1.82
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.10	2	0.18765	0.38
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.11	2	1.0008	2.00
Storage Box	Bathroom Vanity Cabinet	Toilet	T.1.12	2	1.04945	2.10
<b>Total Sqft. Vanity Cabinet Parts:</b>						<b>26.23</b>
<b>C3030 Ceiling Finishes</b>						
<b>3/4" Maple Plywood Paneling</b>						
REVIT "ceilingstandard" (X have holes for Fire Protect)	Ceiling Paneling	Ceiling	CP-S1-1	39	7.90	307.97
REVIT "edgeceilingstandard"	Ceiling Paneling	Ceiling	CP-S1-2	5	4.67	23.33
REVIT "ceilingstandard_cabinet1"	Ceiling Paneling	Ceiling	CP-S1-A1	5	7.80	39.00
REVIT "ceilingstandard_cabinet2"	Ceiling Paneling	Ceiling	CP-S1-A2	3	8.00	24.00

**Indigo Pine: Plywood Part Schedule**

\*Note: all data interpreted based on values re:S-Series,A-Series

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft <sup>2</sup> )	Total Area (ft2)
REVIT "edgeceilingstandard2_cabinet1"	Ceiling Paneling	Ceiling	CP-S1-A3	1	5.00	5.00
REVIT "Ceilingstandard_ceiling3"	Ceiling Paneling	Ceiling	CP-S1-A4	1	8.00	8.00
REVIT "CeilingtrussSside1"	Ceiling Paneling	Ceiling	CP-S2-1	29	3.96	114.96
REVIT "edgeceilingtruss" (2 of 4)	Ceiling Paneling	Ceiling	CP-S2-2	2	2.33	4.67
REVIT "edgeceilingtruss" (2 of 4) ^MIRROR	Ceiling Paneling	Ceiling	CP-S2-3	2	2.33	4.67
REVIT "CeilingtrussSside1_cabinet 1" (1 of 3)	Ceiling Paneling	Ceiling	CP-S2-A1	1	4.00	4.00
REVIT "CeilingtrussSside1_cabinet 1" (2 of 3) ^MIRROR	Ceiling Paneling	Ceiling	CP-S2-A2	2	4.00	8.00
REVIT "Ceilingedge1"	Ceiling Paneling	Ceiling	CP-S3-1	28	6.18	173.00
REVIT "edgeceilingcorner2"	Ceiling Paneling	Ceiling	CP-S3-2	2	4.00	8.00
REVIT "edgeceilingcorner"	Ceiling Paneling	Ceiling	CP-S3-3	2	3.67	7.33
REVIT "Ceilingedge1_cabinet2"	Ceiling Paneling	Ceiling	CP-S3-A1	2	6.00	12.00
REVIT "Ceilingedge1_cabinet1"	Ceiling Paneling	Ceiling	CP-S3-A2	2	6.00	12.00
<b>Total Sqft Maple Plywood Paneling Parts:</b>						<b>755.93</b>

**Total Parts: 3322 Total Sqft. Parts: 11,930.75**

**Indigo Pine: ACM Part Schedule**

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft2)	Total Area (ft2)
<b>B2010 Exterior Walls</b>						
<b>1/8" CNC Cut Polymetal Siding</b>	<b>(ACM Material)</b>					
Wall Panel	Siding	East Wall	E.1.1	1	5.13	5.13
Wall Panel	Siding	East Wall	E.1.2	1	7.43	7.43
Wall Panel	Siding	East Wall	E.1.3	1	7.43	7.43
Wall Panel	Siding	East Wall	E.1.4	1	7.86	7.86
Wall Panel	Siding	East Wall	E.1.5	1	7.86	7.86
Wall Panel	Siding	East Wall	E.1.6	1	7.86	7.86
Wall Panel	Siding	East Wall	E.1.7	1	7.86	7.86
Wall Panel	Siding	East Wall	E.1.8	1	7.86	7.86
Wall Panel	Siding	East Wall	E.1.9	1	7.86	7.86
Wall Panel	Siding	East Wall	E.1.10	1	7.43	7.43
Wall Panel	Siding	East Wall	E.1.11	1	7.43	7.43
Wall Panel	Siding	East Wall	E.1.12	1	7.43	7.43
Wall Panel	Siding	East Wall	E.1.13	1	6.92	6.92
Wall Panel	Siding	East Wall	E.2.1	1	4.12	4.12
Wall Panel	Siding	East Wall	E.2.2	1	6.26	6.26
Wall Panel	Siding	East Wall	E.2.3	1	5.24	5.24
Wall Panel	Siding	East Wall	E.2.10	1	7.61	7.61
Wall Panel	Siding	East Wall	E.2.11	1	6.26	6.26
Wall Panel	Siding	East Wall	E.2.12	1	6.26	6.26
Wall Panel	Siding	East Wall	E.2.13	1	6.87	6.87
Wall Panel	Siding	East Wall	E.3.1	1	4.64	4.64
Wall Panel	Siding	East Wall	E.3.2	1	7.46	7.46
Wall Panel	Siding	East Wall	E.3.3	1	6.96	6.96
Wall Panel	Siding	East Wall	E.3.4	1	6.98	6.98
Wall Panel	Siding	East Wall	E.3.5	1	6.98	6.98
Wall Panel	Siding	East Wall	E.3.6	1	6.98	6.98
Wall Panel	Siding	East Wall	E.3.7	1	6.98	6.98
Wall Panel	Siding	East Wall	E.3.8	1	6.98	6.98
Wall Panel	Siding	East Wall	E.3.9	1	6.98	6.98
Wall Panel	Siding	East Wall	E.3.10	1	7.46	7.46
Wall Panel	Siding	East Wall	E.3.11	1	7.46	7.46
Wall Panel	Siding	East Wall	E.3.12	1	7.46	7.46
Wall Panel	Siding	East Wall	E.3.13	1	7.46	7.46
Wall Panel	Siding	East Wall	E.3.14	1	4.87	4.87
Wall Panel	Siding	East Wall	E.4.1	1	4.34	4.34
Wall Panel	Siding	East Wall	E.4.2	1	7.43	7.43
Wall Panel	Siding	East Wall	E.4.3	1	7.43	7.43
Wall Panel	Siding	East Wall	E.4.4	1	7.86	7.86
Wall Panel	Siding	East Wall	E.4.5	1	7.86	7.86
Wall Panel	Siding	East Wall	E.4.6	1	7.86	7.86
Wall Panel	Siding	East Wall	E.4.7	1	7.86	7.86
Wall Panel	Siding	East Wall	E.4.8	1	7.86	7.86
Wall Panel	Siding	East Wall	E.4.9	1	7.86	7.86
Wall Panel	Siding	East Wall	E.4.10	1	7.43	7.43
Wall Panel	Siding	East Wall	E.4.11	1	7.43	7.43
Wall Panel	Siding	East Wall	E.4.12	1	7.43	7.43
Wall Panel	Siding	East Wall	E.4.13	1	7.43	7.43
Wall Panel	Siding	East Wall	E.4.14	1	6.31	6.31
Wall Panel	Siding	East Wall	E.5.1	1	3.46	3.46
Wall Panel	Siding	East Wall	E.5.2	1	6.26	6.26
Wall Panel	Siding	East Wall	E.5.3	1	5.24	5.24
Wall Panel	Siding	East Wall	E.5.10	1	7.61	7.61
Wall Panel	Siding	East Wall	E.5.11	1	6.26	6.26
Wall Panel	Siding	East Wall	E.5.12	1	6.26	6.26
Wall Panel	Siding	East Wall	E.5.13	1	6.26	6.26
Wall Panel	Siding	East Wall	E.5.14	1	6.35	6.35
Wall Panel	Siding	East Wall	E.6.1	1	3.85	3.85
Wall Panel	Siding	East Wall	E.6.2	1	7.46	7.46
Wall Panel	Siding	East Wall	E.6.3	1	6.97	6.97
Wall Panel	Siding	East Wall	E.6.4	1	6.98	6.98
Wall Panel	Siding	East Wall	E.6.5	1	6.98	6.98
Wall Panel	Siding	East Wall	E.6.6	1	6.98	6.98
Wall Panel	Siding	East Wall	E.6.7	1	6.98	6.98
Wall Panel	Siding	East Wall	E.6.8	1	6.98	6.98
Wall Panel	Siding	East Wall	E.6.9	1	6.98	6.98
Wall Panel	Siding	East Wall	E.6.10	1	7.46	7.46
Wall Panel	Siding	East Wall	E.6.11	1	7.46	7.46

**CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON)**  
**INDIGO PINE I CONSTRUCTION COST REBUTTAL**  
APPENDIX B: CNC PART DATA

**Indigo Pine: ACM Part Schedule**

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft2)	Total Area (ft2)
Wall Panel	Siding	East Wall	E.6.12	1	7.46	7.46
Wall Panel	Siding	East Wall	E.6.13	1	7.46	7.46
Wall Panel	Siding	East Wall	E.6.14	1	7.46	7.46
Wall Panel	Siding	East Wall	E.6.15	1	4.24	4.24
Wall Panel	Siding	North Wall	N.1.1	1	4.85	4.85
Wall Panel	Siding	North Wall	N.1.2	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.3	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.4	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.5	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.6	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.7	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.8	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.9	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.10	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.11	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.12	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.13	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.14	1	10.12	10.12
Wall Panel	Siding	North Wall	N.1.15	1	8.51	8.51
Wall Panel	Siding	North Wall	N.2.1	1	2.61	2.61
Wall Panel	Siding	North Wall	N.2.2	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.3	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.4	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.5	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.6	1	6.07	6.07
Wall Panel	Siding	North Wall	N.2.7	1	6.07	6.07
Wall Panel	Siding	North Wall	N.2.8	1	6.07	6.07
Wall Panel	Siding	North Wall	N.2.9	1	6.07	6.07
Wall Panel	Siding	North Wall	N.2.10	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.11	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.12	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.13	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.14	1	5.63	5.63
Wall Panel	Siding	North Wall	N.2.15	1	4.71	4.71
Wall Panel	Siding	North Wall	N.3.1	1	2.91	2.91
Wall Panel	Siding	North Wall	N.3.2	1	6.26	6.26
Wall Panel	Siding	North Wall	N.3.3	1	6.26	6.26
Wall Panel	Siding	North Wall	N.3.4	1	6.26	6.26
Wall Panel	Siding	North Wall	N.3.5	1	5.24	5.24
Wall Panel	Siding	North Wall	N.3.10	1	7.61	7.61
Wall Panel	Siding	North Wall	N.3.11	1	6.26	6.26
Wall Panel	Siding	North Wall	N.3.12	1	6.26	6.26
Wall Panel	Siding	North Wall	N.3.13	1	6.26	6.26
Wall Panel	Siding	North Wall	N.3.14	1	6.26	6.26
Wall Panel	Siding	North Wall	N.3.15	1	5.25	5.25
Wall Panel	Siding	North Wall	N.4.1	1	4.52	4.52
Wall Panel	Siding	North Wall	N.4.2	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.3	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.4	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.5	1	9.46	9.46
Wall Panel	Siding	North Wall	N.4.6	1	9.51	9.51
Wall Panel	Siding	North Wall	N.4.7	1	9.51	9.51
Wall Panel	Siding	North Wall	N.4.8	1	9.51	9.51
Wall Panel	Siding	North Wall	N.4.9	1	9.51	9.51
Wall Panel	Siding	North Wall	N.4.10	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.11	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.12	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.13	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.14	1	9.87	9.87
Wall Panel	Siding	North Wall	N.4.15	1	8.26	8.26
Wall Panel	Siding	North Wall	N.5.1	1	4.48	4.48
Wall Panel	Siding	North Wall	N.5.2	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.3	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.4	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.5	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.6	1	10.30	10.30
Wall Panel	Siding	North Wall	N.5.7	1	10.30	10.30
Wall Panel	Siding	North Wall	N.5.8	1	10.30	10.30
Wall Panel	Siding	North Wall	N.5.9	1	10.30	10.30
Wall Panel	Siding	North Wall	N.5.10	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.11	1	9.87	9.87

CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON)  
INDIGO PINE I CONSTRUCTION COST REBUTTAL  
APPENDIX B: CNC PART DATA

**Indigo Pine: ACM Part Schedule**

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft2)	Total Area (ft2)
Wall Panel	Siding	North Wall	N.5.12	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.13	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.14	1	9.87	9.87
Wall Panel	Siding	North Wall	N.5.15	1	8.26	8.26
Wall Panel	Siding	North Wall	N.6.1	1	2.91	2.91
Wall Panel	Siding	North Wall	N.6.2	1	6.26	6.26
Wall Panel	Siding	North Wall	N.6.3	1	6.26	6.26
Wall Panel	Siding	North Wall	N.6.4	1	6.26	6.26
Wall Panel	Siding	North Wall	N.6.5	1	5.24	5.24
Wall Panel	Siding	North Wall	N.6.10	1	7.61	7.61
Wall Panel	Siding	North Wall	N.6.11	1	6.26	6.26
Wall Panel	Siding	North Wall	N.6.12	1	6.26	6.26
Wall Panel	Siding	North Wall	N.6.13	1	6.26	6.26
Wall Panel	Siding	North Wall	N.6.14	1	6.26	6.26
Wall Panel	Siding	North Wall	N.6.15	1	5.25	5.25
Wall Panel	Siding	North Wall	N.7.1	1	2.53	2.53
Wall Panel	Siding	North Wall	N.7.2	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.3	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.4	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.5	1	5.16	5.16
Wall Panel	Siding	North Wall	N.7.6	1	5.62	5.62
Wall Panel	Siding	North Wall	N.7.7	1	5.62	5.62
Wall Panel	Siding	North Wall	N.7.8	1	5.62	5.62
Wall Panel	Siding	North Wall	N.7.9	1	5.62	5.62
Wall Panel	Siding	North Wall	N.7.10	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.11	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.12	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.13	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.14	1	5.64	5.64
Wall Panel	Siding	North Wall	N.7.15	1	4.71	4.71
Wall Panel	Siding	North Wall	N.8.1	1	2.91	2.91
Wall Panel	Siding	North Wall	N.8.2	1	6.26	6.26
Wall Panel	Siding	North Wall	N.8.3	1	6.26	6.26
Wall Panel	Siding	North Wall	N.8.4	1	6.26	6.26
Wall Panel	Siding	North Wall	N.8.5	1	5.24	5.24
Wall Panel	Siding	North Wall	N.8.10	1	7.61	7.61
Wall Panel	Siding	North Wall	N.8.11	1	6.26	6.26
Wall Panel	Siding	North Wall	N.8.12	1	6.26	6.26
Wall Panel	Siding	North Wall	N.8.13	1	6.26	6.26
Wall Panel	Siding	North Wall	N.8.14	1	6.26	6.26
Wall Panel	Siding	North Wall	N.8.15	1	5.25	5.25
Corner Panel	Siding	North / East Wall	NE.C.1	1	3.67	3.67
Corner Panel	Siding	North / East Wall	NE.C.2	1	8.51	8.51
Corner Panel	Siding	North / East Wall	NE.C.3	1	8.56	8.56
Corner Panel	Siding	North / East Wall	NE.C.4	1	8.61	8.61
Corner Panel	Siding	North / East Wall	NE.C.5	1	8.65	8.65
Corner Panel	Siding	North / East Wall	NE.C.6	1	8.70	8.70
Corner Panel	Siding	North / East Wall	NE.C.7	1	8.74	8.74
Corner Panel	Siding	North / East Wall	NE.C.8	1	8.79	8.79
Corner Panel	Siding	North / East Wall	NE.C.9	1	8.83	8.83
Corner Panel	Siding	North / East Wall	NE.C.10	1	8.88	8.88
Corner Panel	Siding	North / East Wall	NE.C.11	1	8.92	8.92
Corner Panel	Siding	North / East Wall	NE.C.12	1	8.97	8.97
Corner Panel	Siding	North / East Wall	NE.C.13	1	9.01	9.01
Corner Panel	Siding	North / East Wall	NE.C.14	1	9.06	9.06
Corner Panel	Siding	North / East Wall	NE.C.15	1	7.02	7.02
Corner Panel	Siding	North / West Wall	NW.C.1	1	2.70	2.70
Corner Panel	Siding	North / West Wall	NW.C.2	1	6.67	6.67
Corner Panel	Siding	North / West Wall	NW.C.3	1	6.72	6.72
Corner Panel	Siding	North / West Wall	NW.C.4	1	6.45	6.45
Corner Panel	Siding	North / West Wall	NW.C.5	1	6.42	6.42
Corner Panel	Siding	North / West Wall	NW.C.6	1	6.49	6.49
Corner Panel	Siding	North / West Wall	NW.C.7	1	6.54	6.54
Corner Panel	Siding	North / West Wall	NW.C.8	1	6.58	6.58
Corner Panel	Siding	North / West Wall	NW.C.9	1	6.63	6.63
Corner Panel	Siding	North / West Wall	NW.C.10	1	7.03	7.03
Corner Panel	Siding	North / West Wall	NW.C.11	1	7.08	7.08
Corner Panel	Siding	North / West Wall	NW.C.12	1	7.12	7.12
Corner Panel	Siding	North / West Wall	NW.C.13	1	7.17	7.17
Corner Panel	Siding	North / West Wall	NW.C.14	1	7.21	7.21
Corner Panel	Siding	North / West Wall	NW.C.15	1	5.91	5.91

CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON)  
INDIGO PINE I CONSTRUCTION COST REBUTTAL  
APPENDIX B: CNC PART DATA

**Indigo Pine: ACM Part Schedule**

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft2)	Total Area (ft2)
Wall Panel	Siding	South Wall	S.1.1	1	4.65	4.65
Wall Panel	Siding	South Wall	S.1.2	1	6.26	6.26
Wall Panel	Siding	South Wall	S.1.3	1	6.26	6.26
Wall Panel	Siding	South Wall	S.1.4	1	6.69	6.69
Wall Panel	Siding	South Wall	S.1.5	1	6.69	6.69
Wall Panel	Siding	South Wall	S.1.6	1	6.69	6.69
Wall Panel	Siding	South Wall	S.1.7	1	6.69	6.69
Wall Panel	Siding	South Wall	S.1.8	1	6.69	6.69
Wall Panel	Siding	South Wall	S.1.9	1	6.69	6.69
Wall Panel	Siding	South Wall	S.1.10	1	6.26	6.26
Wall Panel	Siding	South Wall	S.1.11	1	6.26	6.26
Wall Panel	Siding	South Wall	S.1.12	1	6.26	6.26
Wall Panel	Siding	South Wall	S.1.13	1	4.43	4.43
Wall Panel	Siding	South Wall	S.2.1	1	4.64	4.64
Wall Panel	Siding	South Wall	S.2.2	1	6.26	6.26
Wall Panel	Siding	South Wall	S.2.3	1	5.24	5.24
Wall Panel	Siding	South Wall	S.2.10	1	7.61	7.61
Wall Panel	Siding	South Wall	S.2.11	1	6.26	6.26
Wall Panel	Siding	South Wall	S.2.12	1	6.26	6.26
Wall Panel	Siding	South Wall	S.2.13	1	4.43	4.43
Wall Panel	Siding	South Wall	S.3.1	1	1.48	1.48
Wall Panel	Siding	South Wall	S.3.2	1	2.12	2.12
Wall Panel	Siding	South Wall	S.3.3	1	1.86	1.86
Wall Panel	Siding	South Wall	S.3.4	1	2.00	2.00
Wall Panel	Siding	South Wall	S.3.5	1	2.00	2.00
Wall Panel	Siding	South Wall	S.3.6	1	2.00	2.00
Wall Panel	Siding	South Wall	S.3.7	1	2.00	2.00
Wall Panel	Siding	South Wall	S.3.8	1	2.00	2.00
Wall Panel	Siding	South Wall	S.3.9	1	2.00	2.00
Wall Panel	Siding	South Wall	S.3.10	1	2.12	2.12
Wall Panel	Siding	South Wall	S.3.11	1	2.12	2.12
Wall Panel	Siding	South Wall	S.3.12	1	2.12	2.12
Wall Panel	Siding	South Wall	S.3.13	1	1.52	1.52
Wall Panel	Siding	South Wall	S.4.1	1	4.64	4.64
Wall Panel	Siding	South Wall	S.4.2	1	6.26	6.26
Wall Panel	Siding	South Wall	S.4.3	1	5.24	5.24
Wall Panel	Siding	South Wall	S.4.10	1	7.61	7.61
Wall Panel	Siding	South Wall	S.4.11	1	6.26	6.26
Wall Panel	Siding	South Wall	S.4.12	1	6.26	6.26
Wall Panel	Siding	South Wall	S.4.13	1	4.43	4.43
Wall Panel	Siding	South Wall	S.5.1	1	1.48	1.48
Wall Panel	Siding	South Wall	S.5.2	1	2.12	2.12
Wall Panel	Siding	South Wall	S.5.3	1	1.86	1.86
Wall Panel	Siding	South Wall	S.5.4	1	2.00	2.00
Wall Panel	Siding	South Wall	S.5.5	1	2.00	2.00
Wall Panel	Siding	South Wall	S.5.6	1	2.00	2.00
Wall Panel	Siding	South Wall	S.5.7	1	2.00	2.00
Wall Panel	Siding	South Wall	S.5.8	1	2.00	2.00
Wall Panel	Siding	South Wall	S.5.9	1	2.00	2.00
Wall Panel	Siding	South Wall	S.5.10	1	2.12	2.12
Wall Panel	Siding	South Wall	S.5.11	1	2.12	2.12
Wall Panel	Siding	South Wall	S.5.12	1	2.12	2.12
Wall Panel	Siding	South Wall	S.5.13	1	1.52	1.52
Wall Panel	Siding	South Wall	S.6.1	1	4.64	4.64
Wall Panel	Siding	South Wall	S.6.2	1	6.26	6.26
Wall Panel	Siding	South Wall	S.6.3	1	5.24	5.24
Wall Panel	Siding	South Wall	S.6.10	1	7.61	7.61
Wall Panel	Siding	South Wall	S.6.11	1	6.26	6.26
Wall Panel	Siding	South Wall	S.6.12	1	6.26	6.26
Wall Panel	Siding	South Wall	S.6.13	1	4.43	4.43
Wall Panel	Siding	South Wall	S.7.1	1	1.48	1.48
Wall Panel	Siding	South Wall	S.7.2	1	2.12	2.12
Wall Panel	Siding	South Wall	S.7.3	1	1.86	1.86
Wall Panel	Siding	South Wall	S.7.4	1	2.00	2.00
Wall Panel	Siding	South Wall	S.7.5	1	2.00	2.00
Wall Panel	Siding	South Wall	S.7.6	1	2.00	2.00
Wall Panel	Siding	South Wall	S.7.7	1	2.00	2.00
Wall Panel	Siding	South Wall	S.7.8	1	2.00	2.00
Wall Panel	Siding	South Wall	S.7.9	1	2.00	2.00
Wall Panel	Siding	South Wall	S.7.10	1	2.12	2.12
Wall Panel	Siding	South Wall	S.7.11	1	2.12	2.12

CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON)  
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APPENDIX B: CNC PART DATA

**Indigo Pine: ACM Part Schedule**

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft2)	Total Area (ft2)
Wall Panel	Siding	South Wall	S.7.12	1	2.12	2.12
Wall Panel	Siding	South Wall	S.7.13	1	1.52	1.52
Wall Panel	Siding	South Wall	S.8.1	1	4.64	4.64
Wall Panel	Siding	South Wall	S.8.2	1	6.26	6.26
Wall Panel	Siding	South Wall	S.8.3	1	5.24	5.24
Wall Panel	Siding	South Wall	S.8.10	1	7.61	7.61
Wall Panel	Siding	South Wall	S.8.11	1	6.26	6.26
Wall Panel	Siding	South Wall	S.8.12	1	6.26	6.26
Wall Panel	Siding	South Wall	S.8.13	1	4.43	4.43
Wall Panel	Siding	South Wall	S.9.1	1	1.48	1.48
Wall Panel	Siding	South Wall	S.9.2	1	2.12	2.12
Wall Panel	Siding	South Wall	S.9.3	1	1.86	1.86
Wall Panel	Siding	South Wall	S.9.4	1	2.00	2.00
Wall Panel	Siding	South Wall	S.9.5	1	2.00	2.00
Wall Panel	Siding	South Wall	S.9.6	1	2.00	2.00
Wall Panel	Siding	South Wall	S.9.7	1	2.00	2.00
Wall Panel	Siding	South Wall	S.9.8	1	2.00	2.00
Wall Panel	Siding	South Wall	S.9.9	1	2.00	2.00
Wall Panel	Siding	South Wall	S.9.10	1	2.12	2.12
Wall Panel	Siding	South Wall	S.9.11	1	2.12	2.12
Wall Panel	Siding	South Wall	S.9.12	1	2.12	2.12
Wall Panel	Siding	South Wall	S.9.13	1	1.52	1.52
Wall Panel	Siding	South Wall	S.10.1	1	4.64	4.64
Wall Panel	Siding	South Wall	S.10.2	1	6.26	6.26
Wall Panel	Siding	South Wall	S.10.3	1	5.24	5.24
Wall Panel	Siding	South Wall	S.10.10	1	7.61	7.61
Wall Panel	Siding	South Wall	S.10.11	1	6.26	6.26
Wall Panel	Siding	South Wall	S.10.12	1	6.26	6.26
Wall Panel	Siding	South Wall	S.10.13	1	4.43	4.43
Wall Panel	Siding	South Wall	S.11.1	1	4.60	4.60
Wall Panel	Siding	South Wall	S.11.2	1	6.26	6.26
Wall Panel	Siding	South Wall	S.11.3	1	5.88	5.88
Wall Panel	Siding	South Wall	S.11.4	1	5.78	5.78
Wall Panel	Siding	South Wall	S.11.5	1	5.78	5.78
Wall Panel	Siding	South Wall	S.11.6	1	5.78	5.78
Wall Panel	Siding	South Wall	S.11.7	1	5.78	5.78
Wall Panel	Siding	South Wall	S.11.8	1	5.78	5.78
Wall Panel	Siding	South Wall	S.11.9	1	5.78	5.78
Wall Panel	Siding	South Wall	S.11.10	1	6.26	6.26
Wall Panel	Siding	South Wall	S.11.11	1	6.26	6.26
Wall Panel	Siding	South Wall	S.11.12	1	6.26	6.26
Wall Panel	Siding	South Wall	S.11.13	1	4.43	4.43
Wall Panel	Siding	South Wall	S.12.1	1	6.08	6.08
Wall Panel	Siding	South Wall	S.12.2	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.3	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.4	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.5	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.6	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.7	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.8	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.9	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.10	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.11	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.12	1	8.10	8.10
Wall Panel	Siding	South Wall	S.12.13	1	5.78	5.78
Wall Panel	Siding	South Wall	S.13.1	1	5.97	5.97
Wall Panel	Siding	South Wall	S.13.2	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.3	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.4	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.5	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.6	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.7	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.8	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.9	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.10	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.11	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.12	1	8.10	8.10
Wall Panel	Siding	South Wall	S.13.13	1	5.78	5.78
Corner Panel	Siding	South / East Wall	SE.C.1	1	4.03	4.03
Corner Panel	Siding	South / East Wall	SE.C.2	1	6.02	6.02
Corner Panel	Siding	South / East Wall	SE.C.3	1	6.06	6.06



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Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft2)	Total Area (ft2)
Corner Panel	Siding	South / East Wall	SE.C.4	1	6.08	6.08
Corner Panel	Siding	South / East Wall	SE.C.5	1	6.15	6.15
Corner Panel	Siding	South / East Wall	SE.C.6	1	6.20	6.20
Corner Panel	Siding	South / East Wall	SE.C.7	1	6.24	6.24
Corner Panel	Siding	South / East Wall	SE.C.8	1	6.29	6.29
Corner Panel	Siding	South / East Wall	SE.C.9	1	6.33	6.33
Corner Panel	Siding	South / East Wall	SE.C.10	1	6.38	6.38
Corner Panel	Siding	South / East Wall	SE.C.11	1	6.42	6.42
Corner Panel	Siding	South / East Wall	SE.C.12	1	6.47	6.47
Corner Panel	Siding	South / East Wall	SE.C.13	1	4.69	4.69
Corner Panel	Siding	South / West Wall	SW.C.1	1	3.16	3.16
Corner Panel	Siding	South / West Wall	SW.C.2	1	4.53	4.53
Corner Panel	Siding	South / West Wall	SW.C.3	1	4.57	4.57
Corner Panel	Siding	South / West Wall	SW.C.4	1	4.62	4.62
Corner Panel	Siding	South / West Wall	SW.C.5	1	4.66	4.66
Corner Panel	Siding	South / West Wall	SW.C.6	1	4.71	4.71
Corner Panel	Siding	South / West Wall	SW.C.7	1	4.75	4.75
Corner Panel	Siding	South / West Wall	SW.C.8	1	4.80	4.80
Corner Panel	Siding	South / West Wall	SW.C.9	1	4.84	4.84
Corner Panel	Siding	South / West Wall	SW.C.10	1	4.89	4.89
Corner Panel	Siding	South / West Wall	SW.C.11	1	4.93	4.93
Corner Panel	Siding	South / West Wall	SW.C.12	1	4.98	4.98
Corner Panel	Siding	South / West Wall	SW.C.13	1	3.45	3.45
Wall Panel	Siding	West Wall	W.1.1	1	3.05	3.05
Wall Panel	Siding	West Wall	W.1.2	1	6.56	6.56
Wall Panel	Siding	West Wall	W.1.3	1	6.99	6.99
Wall Panel	Siding	West Wall	W.1.4	1	6.99	6.99
Wall Panel	Siding	West Wall	W.1.5	1	6.99	6.99
Wall Panel	Siding	West Wall	W.1.6	1	6.99	6.99
Wall Panel	Siding	West Wall	W.1.7	1	6.99	6.99
Wall Panel	Siding	West Wall	W.1.8	1	6.99	6.99
Wall Panel	Siding	West Wall	W.1.9	1	6.99	6.99
Wall Panel	Siding	West Wall	W.1.10	1	6.56	6.56
Wall Panel	Siding	West Wall	W.1.11	1	6.56	6.56
Wall Panel	Siding	West Wall	W.1.12	1	6.56	6.56
Wall Panel	Siding	West Wall	W.1.13	1	6.56	6.56
Wall Panel	Siding	West Wall	W.1.14	1	6.56	6.56
Wall Panel	Siding	West Wall	W.1.15	1	4.63	4.63
Wall Panel	Siding	West Wall	W.2.1	1	3.46	3.46
Wall Panel	Siding	West Wall	W.2.2	1	6.85	6.85
Wall Panel	Siding	West Wall	W.2.10	1	8.20	8.20
Wall Panel	Siding	West Wall	W.2.11	1	6.72	6.72
Wall Panel	Siding	West Wall	W.2.12	1	6.72	6.72
Wall Panel	Siding	West Wall	W.2.13	1	6.72	6.72
Wall Panel	Siding	West Wall	W.2.14	1	6.72	6.72
Wall Panel	Siding	West Wall	W.2.15	1	3.47	3.47
Wall Panel	Siding	West Wall	W.3.1	1	3.96	3.96
Wall Panel	Siding	West Wall	W.3.2	1	6.94	6.94
Wall Panel	Siding	West Wall	W.3.3	1	6.75	6.75
Wall Panel	Siding	West Wall	W.3.4	1	6.75	6.75
Wall Panel	Siding	West Wall	W.3.5	1	6.75	6.75
Wall Panel	Siding	West Wall	W.3.6	1	6.75	6.75
Wall Panel	Siding	West Wall	W.3.7	1	6.75	6.75
Wall Panel	Siding	West Wall	W.3.8	1	6.75	6.75
Wall Panel	Siding	West Wall	W.3.9	1	6.75	6.75
Wall Panel	Siding	West Wall	W.3.10	1	7.23	7.23
Wall Panel	Siding	West Wall	W.3.11	1	7.23	7.23
Wall Panel	Siding	West Wall	W.3.12	1	7.23	7.23
Wall Panel	Siding	West Wall	W.3.13	1	7.23	7.23
Wall Panel	Siding	West Wall	W.3.14	1	7.07	7.07
Wall Panel	Siding	West Wall	W.4.1	1	4.25	4.25
Wall Panel	Siding	West Wall	W.4.2	1	7.20	7.20
Wall Panel	Siding	West Wall	W.4.3	1	7.63	7.63
Wall Panel	Siding	West Wall	W.4.4	1	7.63	7.63
Wall Panel	Siding	West Wall	W.4.5	1	7.63	7.63
Wall Panel	Siding	West Wall	W.4.6	1	7.63	7.63
Wall Panel	Siding	West Wall	W.4.7	1	7.63	7.63
Wall Panel	Siding	West Wall	W.4.8	1	7.63	7.63
Wall Panel	Siding	West Wall	W.4.9	1	7.63	7.63
Wall Panel	Siding	West Wall	W.4.10	1	7.20	7.20
Wall Panel	Siding	West Wall	W.4.11	1	7.20	7.20

CLEMSON UNIVERSITY SOLAR DECATHLON TEAM (TEAM CLEMSON)  
 INDIGO PINE I CONSTRUCTION COST REBUTTAL  
 APPENDIX B: CNC PART DATA

**Indigo Pine: ACM Part Schedule**

Part Description	Identifier	Location	Part No.	Quantity	Area Each (ft2)	Total Area (ft2)
Wall Panel	Siding	West Wall	W.4.12	1	7.20	7.20
Wall Panel	Siding	West Wall	W.4.13	1	7.20	7.20
Wall Panel	Siding	West Wall	W.4.14	1	5.58	5.58
Wall Panel	Siding	West Wall	W.5.1	1	8.64	8.64
Wall Panel	Siding	West Wall	W.5.2	1	13.34	13.34
Wall Panel	Siding	West Wall	W.5.3	1	1.00	1.00
Wall Panel	Siding	West Wall	W.5.4	1	1.00	1.00
Wall Panel	Siding	West Wall	W.5.5	1	1.00	1.00
Wall Panel	Siding	West Wall	W.5.6	1	1.00	1.00
Wall Panel	Siding	West Wall	W.5.7	1	1.00	1.00
Wall Panel	Siding	West Wall	W.5.8	1	1.00	1.00
Wall Panel	Siding	West Wall	W.5.9	1	1.00	1.00
Wall Panel	Siding	West Wall	W.5.10	1	16.02	16.02
Wall Panel	Siding	West Wall	W.5.11	1	13.09	13.09
Wall Panel	Siding	West Wall	W.5.12	1	13.09	13.09
Wall Panel	Siding	West Wall	W.5.13	1	12.06	12.06
Wall Panel	Siding	West Wall	W.5.14	1	5.23	5.23
Wall Panel	Siding	West Wall	W.6.1	1	4.68	4.68
Wall Panel	Siding	West Wall	W.6.2	1	6.31	6.31
Wall Panel	Siding	West Wall	W.6.3	1	6.14	6.14
Wall Panel	Siding	West Wall	W.6.4	1	6.14	6.14
Wall Panel	Siding	West Wall	W.6.5	1	6.14	6.14
Wall Panel	Siding	West Wall	W.6.6	1	6.14	6.14
Wall Panel	Siding	West Wall	W.6.7	1	6.14	6.14
Wall Panel	Siding	West Wall	W.6.8	1	6.14	6.14
Wall Panel	Siding	West Wall	W.6.9	1	6.14	6.14
Wall Panel	Siding	West Wall	W.6.10	1	6.61	6.61
Wall Panel	Siding	West Wall	W.6.11	1	6.61	6.61
Wall Panel	Siding	West Wall	W.6.12	1	6.61	6.61
Wall Panel	Siding	West Wall	W.6.13	1	5.76	5.76
<b>Total Sqft 3'-0" Wood Door Panel Parts:</b>						<b>2,795.72</b>

**Total Parts: 452 Total Sqft. Parts: 2,795.72**



## Appendix E: On-Site Labor Division

Please find below clarification of the types of labor associated with each step in the construction process of Indigo Pine. Included is a narrative explaining the “Number of Workers” and “Skill Level” of said workers in each Unifomat category of work. Please note the division between the need for UNSKILLED labor in the beginning phases of the project (for foundations and CNC milled components) and the need for SKILLED labor in the ending phases of the project (for more complex and specialized MEP systems).

Team Clemson provides this data as a supplement to further understand the construction costs associated with each line item based on its type and characteristics of the work. This information is meant to supplement the above analysis of CNC labor cost to provide a full picture of the labor cost savings gained through Indigo Pine’s unique innovations in constructability.



### A10 - FOUNDATIONS.

Number of Workers: MANY



Since there are a lot of CMU to set in place, it is best to have as many workers as possible. However, they can be an unskilled workforce.

Skill Level: EASY



It takes minimal training or skill to perform this task. Simply place the block in the proper location, drive the rebar, arrange the anchors, and pour in the concrete.



### B10 - SUPERSTRUCTURE\_FLOOR.

Number of Workers: MANY



The 5 leveling joists spanning east to west are large, and require at least 5 people to lift into place. The smaller, intermediate joists can be set by a single individual quickly and efficiently.

Skill Level: MODERATE



Locking the floor joists in place requires little to no skill, however, at least one skilled worker is needed to be sure the joists are leveled.



### B10 - SUPERSTRUCTURE\_ROOF.

Number of Workers: SIX



The box girder, as well as each roof truss, is lifted into place by a man-powered Genie lift (for the girder: two lifts per half), while two workers are situated at either end of the girder or trusses to guide them into place. Two more workers serves as spotters. Several lifts may operate at once.

Skill Level: MODERATE



Safety training is recommended for the workers at either end of the girder or truss, since they will be working at an elevated height. Also, the Genie lift operators should be knowledgeable of the machine to prevent falling objects.



### B20 - EXTERIOR\_CLOSURE\_WALLS.

Number of Workers: MANY



A minimum of eight workers per wall tilt is recommended: 5 lifting, 3 guiding the studs into place on the ground. Each sheathing and siding panel can be easily installed by two unskilled workers.

Skill Level: EASY



Perhaps more than any other component of construction, the exterior closure is specifically designed to snap together, tilt up, and/or lock into place with ease and no special skills.



## B20 - EXTERIOR CLOSURE\_WINDOWS+DOORS.

Number of Workers: THREE

Skill Level: EASY



Two workers are needed to lift each window or door into position, while a third provides assistance with levels, shims, and screws.



Simply follow the window and door manufacturer's guidelines, and choose workers who can comfortably lift the materials.



## B30 - ROOFING.

Number of Workers: TWO

Skill Level: MODERATE



Fall protection equipment is provided for no more than two workers. All equipment and materials they handle are safe (only tools are ZIP tape and roller, and screws and electric screw gun), and are easily controlled and maneuvered by a single individual.



Safety training such as fall protection is required for work performed on the roof, as well as a level of comfort associated with performing tasks at elevated heights.



## C10 - INTERIOR CONSTRUCTION\_DOORS+CABINETS.

Number of Workers: THREE

Skill Level: EASY



Designed using the same principles as the exterior closure, the flat-packed cabinet wall pieces are carried through the front door during the dried-in phase, and three workers assemble each box component inside the home. All interior doors are integrated into these cabinet walls.



The cabinetry walls are constructed according to the assembly instructions using embedded wood joinery, with screws to secure the piece. Finally, the cabinet components are moved into place and anchored to the subfloor with screws.



## C30 - INTERIOR FINISHES\_WALL+FLOOR+CEILING.

Number of Workers: TWO

Skill Level: EASY



Only two workers are required to perform the following interior finish tasks: install drop-and-lock flooring, pop interior panels onto register tabs in the stud walls and truss ceilings, and screw each panel into place.



Virtually no skill is required to perform these tasks. Follow manufacturer instructions on finished floor, and use a screwgun properly on wall and ceiling panels.



### D20 - PLUMBING.

Number of Workers: TWO



Two workers are sufficient in lifting and installing all equipment and materials associated with plumbing.

Skill Level: ADVANCED



In order to achieve properly functioning plumbing systems it is important for workers to be knowledgeable and competent of the installation process.



### D30 - MECHANICAL.

Number of Workers: TWO



Three workers are sufficient in lifting and installing all equipment associated with the mechanical systems.

Skill Level: ADVANCED



It is important to know how to install mechanical systems and equipment properly to prevent malfunctions. However, we've integrated locations and holes for ducts and equipment, so no power tools (only a screw gun) are needed during installation, making it a quick and easy process.



### D40 - FIRE PROTECTION.

Number of Workers: TWO



Two workers are sufficient in lifting and installing all equipment associated with the fire protection systems.

Skill Level: ADVANCED



Safety is the highest priority in any worksite or home. Therefore, we recommend that all fire protection systems be installed by knowledgeable and competent persons.



### D50 - ELECTRICAL.

Number of Workers: TWO



Two workers are sufficient in lifting, and installing all equipment associated with the electrical systems. Only one worker must have advanced skills, as long as that person is the only one to handle live equipment.

Skill Level: ADVANCED



Electrical training is required for workers who come in contact with live equipment, as well as fall safety training for installing PVs. The process is made faster and easier because all holes for wires and equipment are pre-cut in the structural pieces.



## E10 - EQUIPMENT\_APLIANCES.

Number of Workers: TWO

Skill Level: EASY



Two workers are sufficient in lifting, transporting, and installing all appliances.



All appliances used are commercially available, and installation is as simple as moving them into place and plugging them in, in addition to any other instructions listed by the manufacturer.



## F10 - SPECIAL CONSTRUCTION\_PORCH.

Number of Workers: MANY

Skill Level: MODERATE



The porch is large, so many tasks can be happening at one time. Only two or three skilled workers are needed for accurately providing the location of components, but most tasks can be completed with unskilled workers.



Similar to the floor system, a few skilled workers are needed to verify that all anchoring components are properly placed, and that the work is being performed accurately.



## F10 - SPECIAL CONSTRUCTION\_PV RACKS.

Number of Workers: TWO

Skill Level: MODERATE



Again, fall protection equipment is provided for no more than two workers. All equipment and materials they handle are safe if manufacturer's instructions are followed, and are easily controlled and maneuvered by a single individual.



Installation of the PV racks should be carried out by only competent workers who are trained in fall safety.



## G20 - SITE IMPROVMENTS\_LANDSCAPING.

Number of Workers: ONE

Skill Level: EASY



All plants are widely available, and may be purchased from any local home improvement store. The plants and their vessels are small enough that they can be easily lifted, transported, and placed by a single individual.



Almost no skill is required for this task.



## Appendix F: Manufacturer's Specifications

Please find below a listing of the complete set of manufacturer's product data sheets for products that will be utilized in the construction of Team Clemson's prototypical home for competition purposes, Indigo Pine West.

Team Clemson provides this data as a supplement the construction specifications listed above for verification of materials for competition purposes only. In terms of practical application, in which the contractor and owner would select materials within the context of the provided specifications, the particular materials chosen are subject to change given that they are within the provided criteria listed above.



# QUIKRETE® 5000 Concrete Mix

PRODUCT NO. 1007

## DIVISION 3

Structural Concrete  
03 31 00

### PRODUCT DESCRIPTION

QUIKRETE® 5000 Concrete Mix is a commercial grade blend of stone or gravel, sand and cement specially designed for higher early strength.

### PRODUCT USE

QUIKRETE® 5000 Concrete Mix is suitable for any concrete use requiring high early strength and rapid strength gains. QUIKRETE® 5000 sets quickly, making it ideal for cold weather applications. It has a walk-on time of 10 - 12 hours. QUIKRETE® 5000 can be used for any application requiring concrete in a minimum thickness of 2" (51 mm), such as slabs, footings, steps, columns, walls and patios.

### SIZES

- QUIKRETE® 5000 Concrete Mix –
  - 80 lb (36.3 kg) bags
  - 60 lb (27.2 kg) bags

### YIELD

- Each 80 lb (36.3 kg) bag yields approximately 0.60 cu ft (17 L). A 60 lb (27.2 kg) bag yields approximately 0.45 cu ft (12.7 L).

### TECHNICAL DATA

#### APPLICABLE STANDARDS

ASTM International - ASTM C387 Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete

#### PHYSICAL/CHEMICAL PROPERTIES

QUIKRETE® 5000 High Early Strength Concrete Mix exceeds the compressive strength requirements of ASTM C387, as shown in Table 1.

TABLE 1 TYPICAL PHYSICAL PROPERTIES<sup>1</sup>

#### Compressive strength, ASTM C39

1 day	1500 psi (10.3 MPa)
3 day	2500 psi (17.2 MPa)
7 days	3500 psi (24.1 MPa)
28 days	5000 psi (34.5 MPa)

Slump range 2" - 3" (51 - 76 mm)

<sup>1</sup> Tested under standard laboratory conditions in accordance with ASTM C387.



### INSTALLATION

#### SITE PREPARATION

Stake out the area and remove sod or soil to the desired depth. Nail and stake forms securely in place. Tamp the sub-base until firm.

#### MIXING

##### MACHINE MIXING

- QUIKRETE® 5000 can be mixed in a barrel-type concrete mixer or a mortar mixer. Choose the mixer size most appropriate for the size of the job to be done. Allow at least 1 cu ft (28 L) of mixer capacity for each 80 lb (36.3 kg) bag of QUIKRETE® 5000 to be mixed at a time
- For each 80 lb (36.3 kg) bag of QUIKRETE® 5000 to be mixed, add approximately 6 pt (2.8 L) of fresh water to the mixer. Turn on the mixer and begin adding the bags of concrete to the mixer
- If the material becomes too difficult to mix, add additional water until a workable mix is obtained
- If a slump cone is available, adjust water to achieve a 2" - 3" (51 - 76 mm) slump

Note - Final water content should be approximately 6 - 10 pt (2.8 - 4.7 L) per 80 lb (36.3 kg) bag and 4.5 - 7 pt (2.1 - 3.3 L) per 60 lb (27.2 kg) bag.

##### HAND MIXING

- Empty bags into a suitable mixing container
- Add approximately 6 pt (2.8 L) of clean water for each 80 lb (36.3 kg) bag
- Work the mix with a shovel, rake or hoe and add water as needed until a stiff, moldable consistency is achieved
- Do not exceed a total volume of 10 pt (4.7 L) per 80 lb (36.3 kg) bag or 7 pt (3.3 L) per 60 lb (27.2 kg) bag
- Be sure all material is wet; do not leave unabsorbed puddles of water

#### TEMPERATURE OF WATER

Set times will fluctuate in extremely hot or cold weather. Use cold water or water mixed with ice cubes in severely hot weather; use hot water when mixing in severely cold weather.

## APPLICATION

- Dampen the sub-grade before concrete is placed. Do not leave standing puddles
- Shovel or place the concrete into the form. Fill to the full depth of the form
- After the concrete has been compacted and spread to completely fill the forms, strike off and float immediately
- To strike off, use a straight board (screed), moving the edge back and forth with a saw-like motion to smooth the surface. Then use a darby or bull float to float the surface. This helps level any ridges and fill voids left by the straight edge
- Cut the concrete away from the forms by running an edging tool or trowel along the forms to compact the slab edges
- Cut 1" (25.4 mm) control joints into the slab every 6' - 8' (1.8 - 2.4 m) using a grooving tool
- Allow the concrete to stiffen slightly, waiting until all water has evaporated from the surface before troweling or applying a broom finish

Note - For best results, do not overwork the material.

## CURING

### GENERAL

Curing is one of the most important steps in concrete construction. Proper curing increases the strength and durability of concrete, and a poor curing job can ruin an otherwise well-done project. Proper water content and temperature are essential for good curing. In near freezing temperatures, the hydration process slows considerably. When weather is too hot, dry or windy, water is lost by evaporation from the concrete and hydration stops resulting in finishing difficulties and cracks. The ideal circumstances for curing are ample moisture and moderate temperature and wind conditions. Curing should be started as soon as possible and should continue for a period of 5 days in warm weather, 70°F (21°C) or higher, or 7 days in colder weather, 50 - 70°F (10 - 21°C).

### SPECIFIC CURING METHODS

QUIKRETE® Acrylic Cure & Seal – Satin Finish (#8730) provides the easiest and most convenient method of curing concrete.

- Apply by sprayer or roller after the final finishing operation when the surface is hard. The surface may be damp, but not wet, when applying curing compound. Complete coverage is essential.
- Other methods of providing proper curing include covering the surface with wet burlap, keeping the surface wet with a lawn sprinkler and sealing the concrete surface with plastic sheeting

- If burlap is used, it should be free of chemicals that could weaken or discolor the concrete. New burlap should be washed before use. Place it when the concrete is hard enough to withstand surface damage and sprinkle it periodically to keep the concrete surface continuously moist
- Water curing with lawn sprinklers or hoses must be continuous to prevent interruption of the curing process
- Curing with plastic sheets is convenient. They must be laid flat, thoroughly sealed at joints and anchored carefully along edges

### PRECAUTIONS

- When used in structural elements, comply with the steel reinforcing and additional requirements of applicable building codes.
- Curing compounds should not be applied if rain or temperatures below 50°F (10°C) are expected within 24 hours
- Curing with plastic or burlap can cause patchy discoloration in colored concrete. For colored concrete, wet curing or chemical curing compounds are recommended
- Use of Acrylic Cure & Seal – Satin Finish (#8730) or other curing compounds is not recommended during late fall in northern climates on surfaces where de-icers will be used to melt ice and snow. Using curing compounds at that time may prevent proper air curing of the concrete, which is necessary to enhance its resistance to damage caused by deicers
- Protect concrete from freezing during the first 48 hours. Plastic sheeting and insulation blankets should be used if temperatures are expected to fall below 32°F (0°)

### WARRANTY

The QUIKRETE® Companies warrant this product to be of merchantable quality when used or applied in accordance with the instructions herein. The product is not warranted as suitable for any purpose or use other than the general purpose for which it is intended. Liability under this warranty is limited to the replacement of its product (as purchased) found to be defective, or at the shipping companies' option, to refund the purchase price. In the event of a claim under this warranty, notice must be given to The QUIKRETE® Companies in writing. This limited warranty is issued and accepted in lieu of all other express warranties and expressly excludes liability for consequential damages.

The QUIKRETE® Companies  
One Securities Centre  
3490 Piedmont Rd., NE, Suite 1300, Atlanta, GA 30305  
(404) 634-9100 • Fax: (404) 842-1425

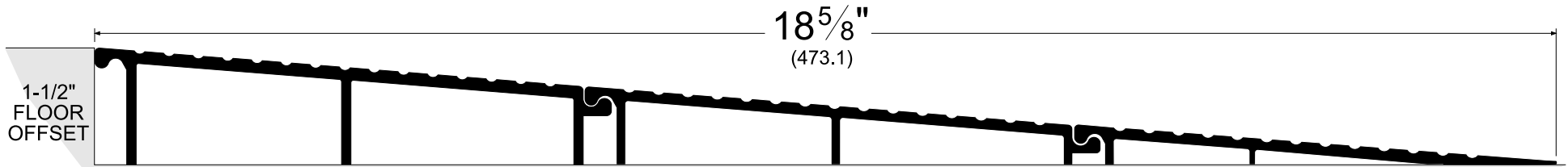
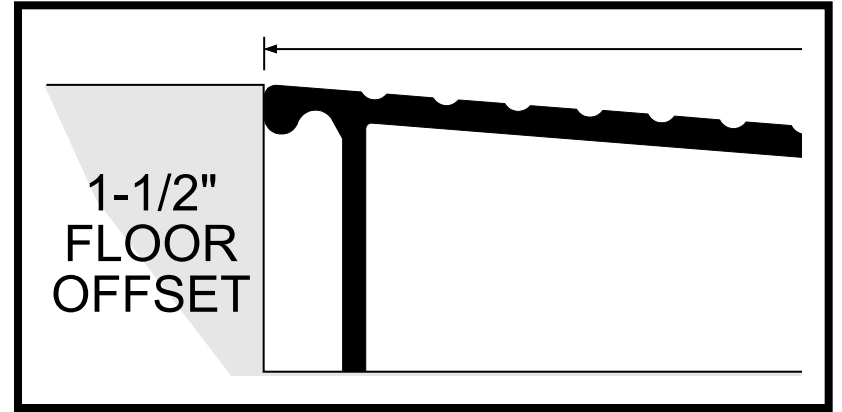
\* Refer to [www.quikrete.com](http://www.quikrete.com) for the most current technical data, MSDS, and guide specifications





ASSA ABLOY

OFFSET: 1-1/2"  
LENGTH: 18-5/8"  
# OF COMPONENTS: 3



This drawing has been reduced.

R1.5F\_

## FixZ-7

### Features and Benefits

- Quickly and easily fastens to the proven KlickTop™ connection system
- Ventilation aides in module cooling
- Distributes load evenly
- Increase in module pitch improves self cleaning
- Used with framed modules in vertical position



The **FixZ-7** is designed for flat trapezoidal sheet metal roofs (less than 10 degree slope). Such roofs are typically ill-equipped to support tradiational solar systems. The FixZ-7 is designed to distrubute the load evenly while optimizing the power output of the system by allowing for a 5 – 7 degree tilt angle.

### FixZ-7 and Fix2000™ KlickTop™

Simple to use and inexpensive, the FixZ-7 works in conjunction with Schletter's Fix2000 KlickTop connector for quick module mounting. The KlickTop eliminates additional on-site assembly by allowing for quick connection of the rails to the Fix2000 attachment, which penetrates directly into the corrugation with four self-drilling screws.

- ➔ [Fix2000 KlickTop Product Sheet](#)
- ➔ [General Roof Checklist for ordering](#)

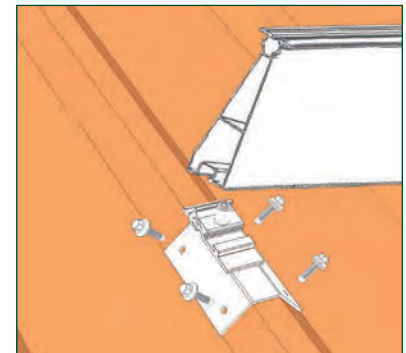
Due to structural considerations, using fastening elements other than the Fix2000 KlickTop requires the addition of a lower rail (cross rail interconnection).

### Application Suggestions

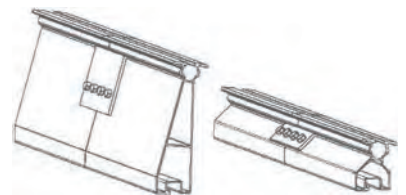
The FixZ-7 is designed for module heights from about 4.26 – 5.57 ft and setting angles from 5 – 7 degrees. For technical reasons, the FixZ-7 is only suitable for framed modules in the vertical position.

The position of the clamping locations should bewith the range of 1/4 – 1/5 of the module height (according to module manufacturer instructions). A minimum distance of 4.9 ft to the roof edges should be maintained, as well as 3.93 ft to both the north and south edges of the roof. Be sure to consult local regulations.

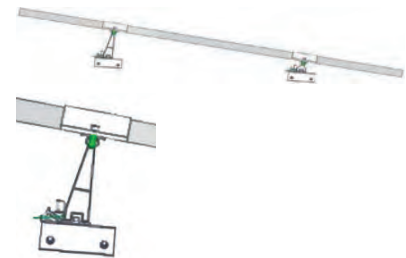
The FixZ-7 should not be used in conjunction with the SingleFix-V.



➊ Mount the Fix2000 with KlickTop connector with consideration to the shade distance to modules rows.

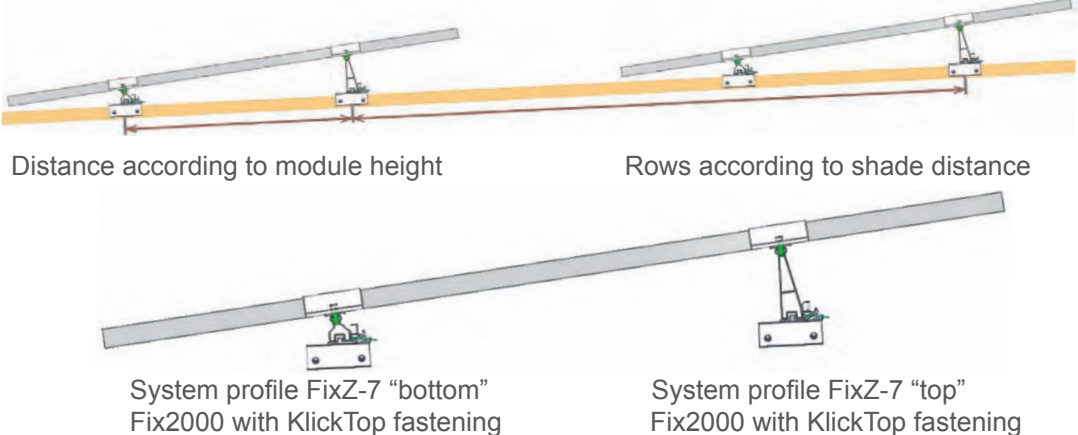


➋ Mount the cross beam rails of the FixZ-7. Attach profile joint with a connector plate and self-drilling screws.



➌ Mount the modules.

## Technical Data

<b>Material</b>	System profiles and KlickTop attachment made of aluminum Fix2000 components and screws, made of stainless steel
<b>Forms</b>	Suitable for all current forms of trapezoidal sheet metal; Production is customized and accurate to measurement according to General Roof Checklist.
<b>Structural analysis</b>	Structural analysis according to the IBC 2006 or 2009 Required attachments and structural dimensioning necessary based on structural analysis. Also pay attention to structural safety.
<b>System Structure</b>	 <p>Distance according to module height      Rows according to shade distance</p> <p>System profile FixZ-7 “bottom” Fix2000 with KlickTop fastening      System profile FixZ-7 “top” Fix2000 with KlickTop fastening</p>
<b>Calculation and Ordering</b>	Convenient project planning with our auto-calculator software.

For more information, please visit [www.schletter.us](http://www.schletter.us) or call technical sales at 888-608-0234.

# Fix2000 / Fix2000 KlickTop

## Features and Benefits

- Custom manufactured fastening element for trapezoidal sheet metal roofs
- Attaches quickly and easily with four self-drilling, self-sealing screws
- Penetrates directly into the corrugation — not the roof substructure

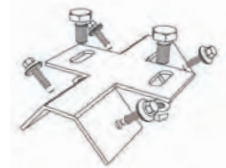
The **Fix2000** is a proven fastening element, custom manufactured for trapezoidal sheet metal roofs. Made of high-quality stainless steel, the Fix2000 uses four self-drilling, self-sealing screws to secure the device to the roof resulting in an even distribution of forces on the roof structure. The Fix2000 penetrates directly into the corrugation and not into the wooden or steel substructure of the building.

### Fix2000 with the KlickTop Connection

The addition of the KlickTop to the Fix2000 results in material cost and time savings. The KlickTop eliminates additional on-site assembly by allowing for quick connection of the rails to the Fix2000 attachment.

**Please note:** Distances between clamps in ridge-eaved direction have to be measured precisely as there is no adjustability once the screws are placed. However, it is easy to align them using a string or chalk line.

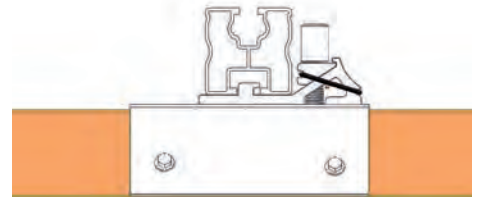
**With glass-glass laminates,** it is recommended to not begin installation of the mounting system until the modules have been received and are ready to be installed, since clearances can depend upon the modules. Refer to module manufacturer for additional information.



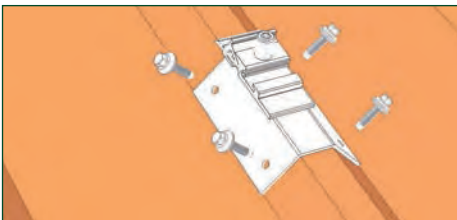
Fix2000



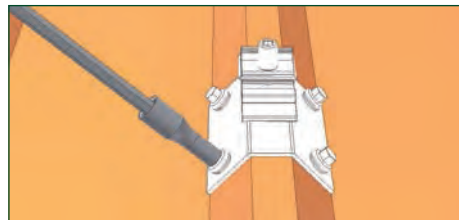
KlickTop



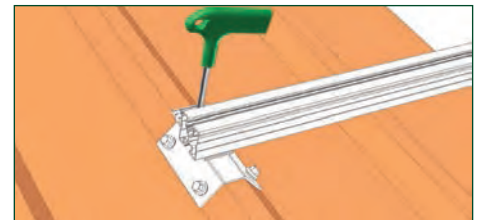
KlickTop



1 Fix2000 connection



2 Fasten with self-drilling screws until a slight pressure on gaskets occurs. Using a depth-stop is suggested.



3 If using the KlickTop, the rail may be connected directly and tightened with an Allen wrench. If using Fix2000 without the KlickTop, two hex-head screws are slid into the bottom rail channel and connected to the roof attachment using M10 nuts.

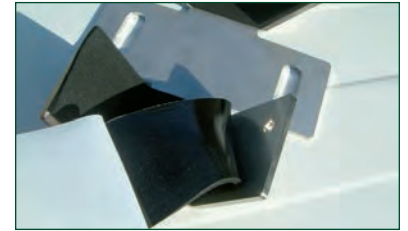
## Technical Considerations

### Assembly

- To ensure accurate transfer of compressive forces, the clamp should be in contact with the roof on all three sides while the plate is being screwed into place.
- The screws should be secured so that they are not able to strip out at any time during installation.
- Screws should not be uninstalled and reinstalled in the same location.
- The roof should be able to bear the additional weight of the PV system.
- The sheet metal thickness of the roof must be at least 26 gauge.
- The attachment of the trapezoidal sheet metal to the roof must be able to accommodate the uplift.
- Ensure that the components are accurately attached to the roof to avoid overlap.
- For better distribution of forces when using Fix2000 (not KlickTop) use two sets of M10 bolts.
- Note that the rail connector does not fall on the ridge of the trapezoidal sheet metal.
- The KlickTop fits with the Eco05, Solo05, Profi05, and ProfiPlus05 profiles.

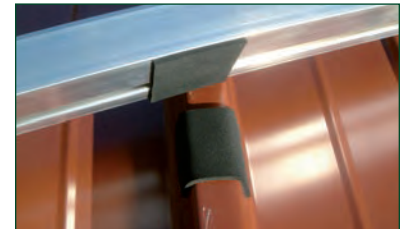
### Sealing

- The screws are fitted with seals to prevent water from entering the bracket.
- Note that in extreme weather conditions water can rise up into the bracket from below the holes.
- Rising water into the bracket does not cause corrosion problems due to the stainless steel sheet metal used.
- To prevent residual leakage in single-layer trapezoidal metal sheets, a PVC foam rubber mat is included on the interior of the trapezoid.
- Note that with trapezoidal sheet metal roofs, condensation is more of a problem than small leakage.



### Structural Analysis

- To determine the forces for the Fix2000 on a trapezoidal roof, structural analysis methods are used (with the addition of roof edge dimensions).
- When determining maximum snow load, the weight of the PV system should be taken into account. If the PV system will cover the entire trapezoidal roof, pressure-resistant rubber should be used at every junction point.
- Wind uplift calculations will determine how the clamps will be arranged. It may be useful to stagger clamps.



### Technical Data

<b>Material</b>	Fasteners: stainless steel 1.4301; bolts: stainless steel
<b>Shape</b>	Suitable for all standard trapezoidal sheet metal designs and overlapping elements
<b>Structural Analysis</b>	Calculations in accordance with current national standards Systems should be designed with the appropriate number of mounting points, based on structural analysis.
<b>Ordering</b>	Use the required checklist and contact a Schletter representative for design assistance and pricing.

## Rapid<sup>2+</sup> Grounding Clamps

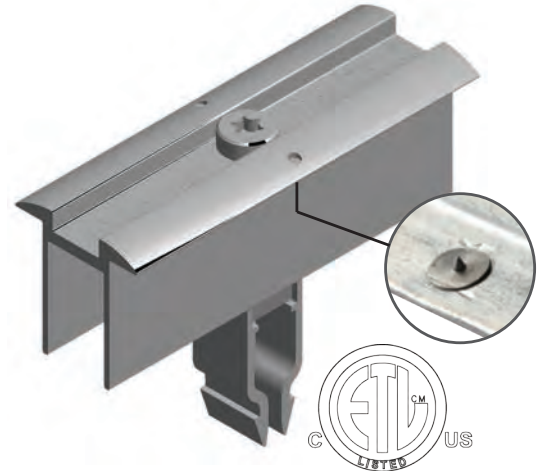
### Features and Benefits

- Integrated module clamping and grounding
- Reduces mounting time
- Pre-assembled and ready to use
- Rated to 10 AWG\*
- ETL Listed

For improved installation ease and cost reduction, Schletter now offers Rapid<sup>2+</sup> Grounding Middle and End Clamps. The Rapid<sup>2+</sup> Clamp is the quickest option for mounting modules to date, that includes integrated grounding as a standard feature.

Pre-assembled as a standard stock item, the Rapid<sup>2+</sup> Clamp is available in a variety of sizes, accommodating the industry's various module thicknesses. As with all Schletter components and systems, we offer a standard 20-year warranty.

For more information on this, or other Schletter products, please contact us at 888-608-0234 or visit [www.schletter.us](http://www.schletter.us).



### Step One:

The Rapid<sup>2+</sup> Grounding Clamps is pre-assembled for quick installation. Position clamp over mounting rail and insert pointed clamp end into rail groove.



### Step Two:

Tighten the Rapid<sup>2+</sup> Grounding Clamps using a standard drill, using a torque of no more than 10.5 ft-lbs. The size bit used to tighten the clamp is TORX T-40. Use of a hammer drill is not recommended.

Always follow safety procedures when installing any racking system.



Installer is responsible for verifying that installation meets applicable NEC guidelines.



**ABA/ABU/ABW Adjustable and Standoff Post Bases**

Additional standoff bases are on page 232.

The AB series of retrofit adjustable post bases provide a 1" standoff for the post, are slotted for adjustability and can be installed with nails, Strong-Drive® SD Connector screws or bolts (ABU). Depending on the application needs, these adjustable standoff post bases are designed for versatility, cost-effectiveness and maximum uplift performance.

**Features:**

- The slot in the base enables flexible positioning around the anchor bolt, making precise post placement easier
- The 1" standoff helps prevent rot at the end of the post and meets code requirements for structural posts installed in basements or exposed to weather or water splash

**MATERIAL:** Varies (see table)

**FINISH:** All galvanized, most offered in ZMAX®; see Corrosion Information, pages 13-15.

**INSTALLATION:** • Use all specified fasteners. See General Notes.

- See our *Anchoring and Fastening Systems for Concrete and Masonry* catalog, or visit [www.strongtie.com](http://www.strongtie.com) for retrofit anchor options or reference technical bulletin T-ANCHORSPEC.
- Post bases do not provide adequate resistance to prevent members from rotating about the base and therefore are not recommended for non top-supported installations (such as fences or unbraced carports).
- Place the base, load transfer plate and nut on the anchor bolt. Loosely tighten the nut.

**ABW**—Place the standoff base and then the post in the ABW and fasten on three vertical sides, using nails or Strong-Drive SD Connector screws.

- Make any necessary adjustments to post placement and tighten the nut securely on the anchor bolt.
- Bend up the fourth side of the ABW and fasten using the correct fasteners.

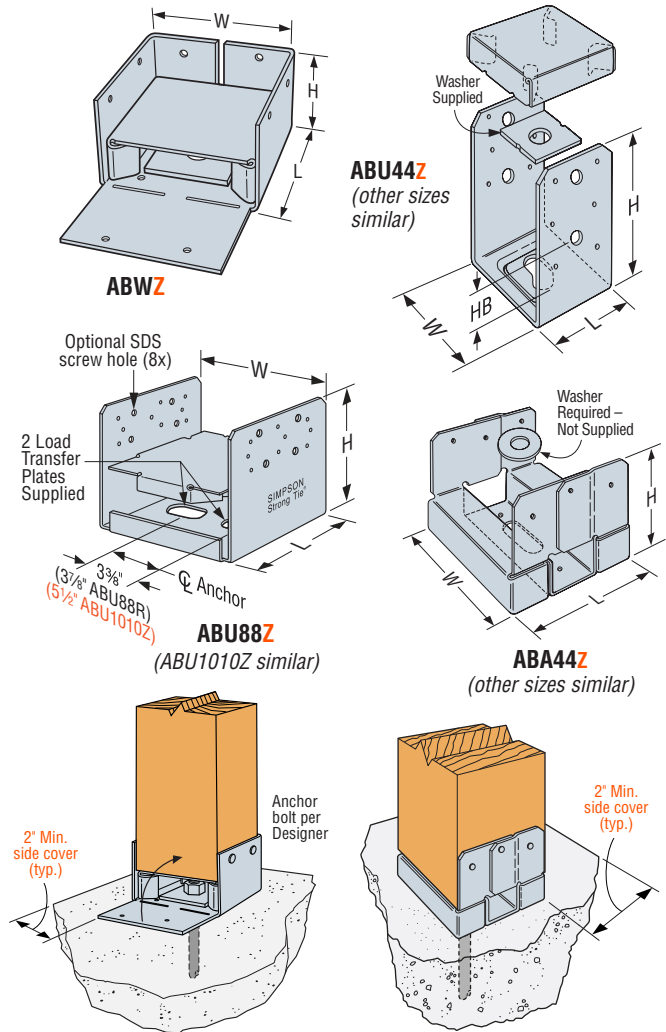
**ABU**—Place the standoff base and then the post in the ABU.

- Fasten using nails or Strong-Drive SD Connector screws or bolts (ABU88Z, ABU1010Z – SDS optional).

**ABA**—Place the post in the ABA.

- Fasten using nails or Strong-Drive SD Connector screws.

**CODES:** See page 12 for Code Reference Key Chart.



Typical ABWZ Installation

Typical ABA44Z Installation

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These products are approved for installation with the Strong-Drive® SD Connector screw. See page 27 for more information.

Model No.	Nominal Post Size	Material		Dimensions (in.)				Fasteners				Allowable Loads			Code Ref.
		Base (Ga)	Strap (Ga)	W	L	H	HB <sup>6</sup>	Anchor Dia. (in.)	Nails	Machine Bolts		Uplift Nails	Down Bolts	(100)	
										Qty.	Dia.				
ABA44Z	4x4	16	16	3 1/16	3 3/8	3 1/16	—	1/2	6-10d	—	—	555	—	6000	I3, F1, L5
ABW44Z	4x4	16	16	3 1/16	3 3/8	2 1/4	—	1/2	8-10d	—	—	1005	—	7180	170
ABU44Z	4x4	16	12	3 1/16	3	5 1/2	1 3/4	5/8	12-16d	2	1/2	2200	2160	6665	I3, F1, L2, L5
ABU44RZ	Rough 4x4	16	12	4	4	5 1/4	1 1/2	5/8	12-16d	2	1/2	2200	2160	6665	I3, F1, L5
ABA44RZ	Rough 4x4	16	16	4 1/16	3 3/8	2 13/16	—	1/2	6-10d	—	—	555	—	8000	I3, F1, L2, L5
ABW44RZ	Rough 4x4	16	16	4	4 1/16	1 32/33	—	1/2	8-10d	—	—	835	—	7180	170
ABW46Z	4x6	12	16	3 1/16	5 1/16	3	—	1/2	10-10d	—	—	845	—	4590	170
ABA46Z	4x6	14	14	3 1/16	5 1/16	3 3/8	—	5/8	8-16d	—	—	700	—	9435	I3, F1, L5
ABU46Z	4x6	12	12	3 1/16	5	7	2 5/8	5/8	12-16d	2	1/2	2300	2300	10335	I3, F1, L2
ABU46RZ	Rough 4x6	12	12	4	6	6 3/4	2 3/8	5/8	12-16d	2	1/2	2300	2300	10335	170
ABW46RZ	Rough 4x6	12	16	4	6	2 13/16	—	1/2	10-10d	—	—	780	—	4590	170
ABA46RZ	Rough 4x6	14	14	4 1/16	5 1/16	2 7/8	—	5/8	8-16d	—	—	700	—	12000	I3, F1, L5
ABU5-5	5 1/2 x 5 1/2	12	10	5 1/4	5	6 1/16	1 3/4	5/8	12-16d	2	1/2	2235	2235	12000	170
ABU5-6	5 1/2 x 6	12	10	6 1/8	5	6 1/16	1 3/4	5/8	12-16d	2	1/2	2235	2235	12000	170
ABA66Z	6x6	14	14	5 1/2	5 1/4	3 3/8	—	5/8	8-16d	—	—	720	—	10665	I3, F1, L5
ABW66Z	6x6	12	14	5 1/2	5 1/16	3	—	1/2	12-10d	—	—	1190	—	12935	170
ABU66Z	6x6	12	10	5 1/2	5	6 1/16	1 3/4	5/8	12-16d	2	1/2	2300	2300	12000	I3, F1, L2
ABU66RZ	Rough 6x6	12	10	6	6	5 13/16	1 1/2	5/8	12-16d	2	1/2	2300	2300	12000	170
ABA66RZ	Rough 6x6	14	14	6	5 3/16	2 7/8	—	5/8	8-16d	—	—	720	—	12665	I3, F1, L5
ABW66RZ	Rough 6x6	12	14	6	6	2 13/16	—	1/2	12-10d	—	—	1065	—	12935	170
ABU88Z	8x8	14	12	7 1/2	7	7	—	2 - 5/8	18-16d	—	—	2320	—	24335	I3, F1
ABU88R	Rough 8x8	14	12	8	7	7	—	2 - 5/8	18-16d	—	—	2320	—	24335	170
ABU1010Z	10x10	12	12	9 1/2	9	7 1/4	—	2 - 5/8	22-16d	—	—	2270	—	32020	170
ABU1010RZ	Rough 10x10	12	12	10	9	7	—	2 - 5/8	22-16d	—	—	2270	—	32020	170

1. Uplift loads have been increased for wind or earthquake with no further increase allowed; reduce where other loads govern.
2. Downloads may not be increased for short-term loading.
3. Specifier to design concrete for uplift capacity.
4. ABU products may be installed with either bolts or nails (not both) to achieve table loads. ABU88Z, ABU88R, ABU1010Z and ABU1010RZ may be installed with 8-1/4"x3" Strong-Drive® SDS Heavy-Duty Connector screws (sold separately) for the same table load.
5. For AB bases, higher download can be achieved by solidly packing grout under 1" standoff plate before installation. Base download on column, grout, or concrete according to the code.
6. HB dimension is the distance from the bottom of the post up to the first bolt hole.
7. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers. For SCL columns, the fasteners for these products should always be installed in the wide face.
8. Downloads shall be reduced where limited by the capacity of the post. See pages 245-246 for common post allowable loads.
9. **NAILS:** 16d = 0.162" dia. x 3 1/2" long, 10d = 0.148" dia. x 3" long. See pages 22-23 for other nail sizes and information.

## BC Sanded Plywood

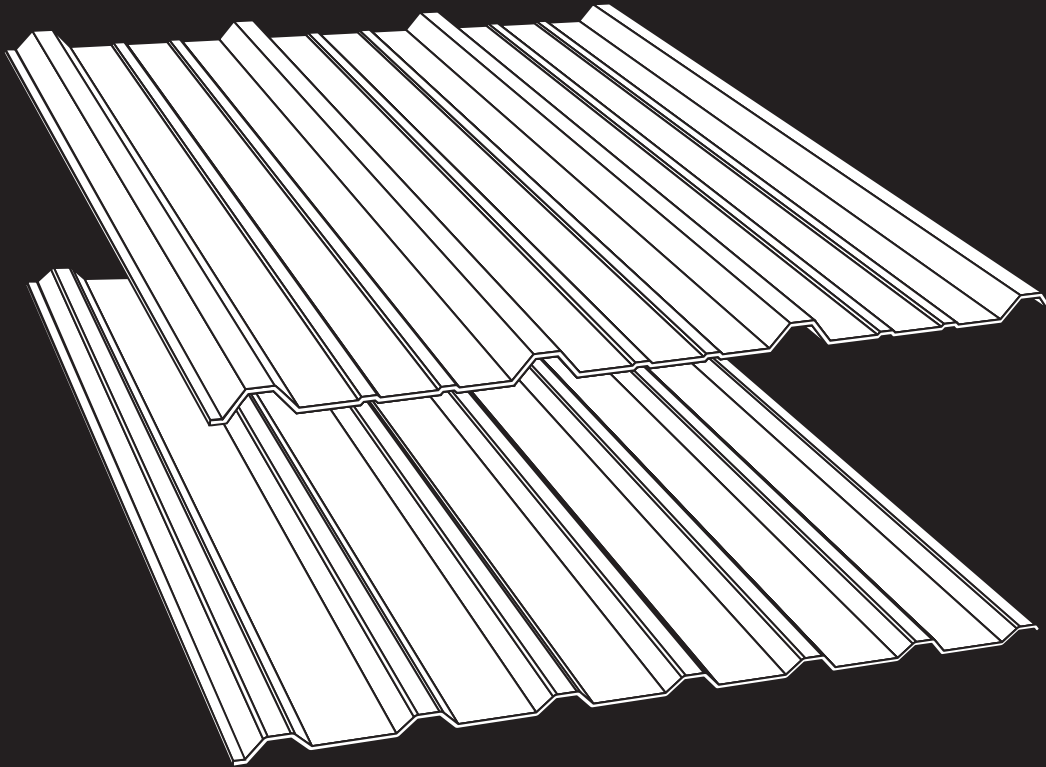
<b>Specs</b>	<b>Slow growing inland Douglas fir and Western larch yield fine-grained faces. All Group 1, Structural 1 Species</b>
<b>Faces</b>	<b>Premium "B" grade veneer Quality wood plugs or putty repairs, minimal use of polyurethane patch Unlimited plugs and repairs Fully sanded face with 60 grit paper</b>
<b>Backs, Centers &amp; Cores</b>	<b>Plum Creek's High Integrity Ultra-Core™ construction features composed cross-bands for tight core gap tolerances more stringent than APA specifications. One piece "C" grade or better center and back</b>
<b>Construction &amp; Thickness</b>	<b>Thickness Ply count 1/4" 3 Ply 3/8" 4 Ply 1/2" 5 Ply 5/8" 5 or 7 Ply 3/4" 7 Ply  Standard size 4' x 8' Panel thickness to 1 1/2" Solid long length to 102" Scarfed panels to 16'</b>



AMERICAN  
BUILDING  
COMPONENTS

## **“PBR” & “PBU” Panels**

**Technical/Product Information**



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For the most current information on our products and erection procedures, please check the ABC web site at  
[www.abcmetalroofing.com](http://www.abcmetalroofing.com)

Descriptions and specifications contained herein were in effect at the time this publication was approved for printing. In a continuing effort to refine and improve products, ABC reserves the right to discontinue products at any time or change specifications and/or designs without incurring obligation. **To insure you have the latest information available, please inquire or visit our Web Site at [www.abcmetalroofing.com](http://www.abcmetalroofing.com).** Application details are for illustration purposes only and may not be appropriate for all environmental conditions, building designs, or panel profiles. Projects should be engineered to conform to applicable building codes, regulations, and accepted industry practices. Insulation is not shown in these details for clarity. **If there is a conflict between this manual and the erection drawings, the erection drawings will take precedence.**

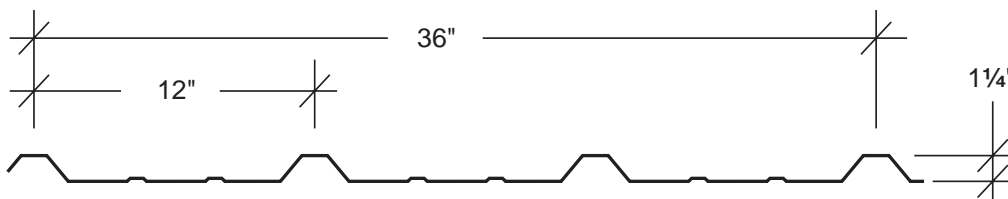
# PRODUCT INFORMATION

# "PBR" PANEL

## ARCHITECT/ENGINEER INFORMATION

1. "PBR" panel is a structural roof and wall panel. This panel can be installed directly over purlins or joists. Several different UL 90 construction numbers are available for this panel.
2. "PBR" panel is recommended for 1/2:12 or greater roof slopes.
3. Field applied sealant is required at panel sidelaps and endlaps.
4. "PBR" panel is a through-fastened panel. For proper fastener application, see page 6.
5. The information in this manual is believed to be correct and accurate. It should not be used for any specific application without being reviewed by a registered professional engineer.

## GENERAL DESCRIPTION



Coverage Width - 36"

Minimum Slope - 1/2:12

Panel Attachment - See page 6

Panel Substrate - Galvalume®

Gauge - 26 standard - 29, 24 and 22 also available

Coatings- Galvalume Plus®, Signature® 200\* and Signature® 300\*

## PRODUCT SELECTION CHART

GAUGE	GALVALUME PLUS®	SIGNATURE® 200*	SIGNATURE® 300*
22 gauge	●	■	■
24 gauge	●	■	■
26 gauge	●	●	●
29 gauge	●	●	■

● - Available in any quantity.

■ - Minimum quantity may be required.

\*See Commercial/Industrial color chart for available colors.

# "PBR" PANEL

# PRODUCT INFORMATION

## UL 90 REQUIREMENTS

### "PBR" PANEL

#### Construction #30

##### 26 MSG Min. Gauge "PBR" Panel Over Purlins at 5'- 0 1/4" O.C.

1. **For Class 90** - Panel to purlin connections to be #14 Hex Head with a 5/8" O.D. washer in a 4-8-4-8 in. pattern. Panel to panel connection to be 20" O.C. with faster located over each purlin.
2. **Purlins** - No. 14 MSG min. gauge steel, (55,000 psi min. yield strength.)

#### Construction #79

##### 26 MSG Min. Gauge "PBR" Panel Over Purlins at 5'- 0 1/4" O.C.

1. **Panel Fasteners** - Panel to purlin connections to be #14 Hex Head with a 5/8" O.D. washer, 6" O.C. in 5-7-5-7 in. pattern. Endlap spacing to be 6 in. O.C. Spacing for panel to panel connection to be 20" O.C.
2. **Purlins** - No. 16 MSG min. gauge steel. (55,000 psi min. yield strength); or min. H series open web steel joists.

#### Construction #161

##### 26 MSG Min. Gauge "PBR" Panel Over Purlins at 5'- 0 1/4" O.C.

1. **Panel Fasteners** - Panel to purlin connections to be 12-14 x 1" self-drilling Hex Head with a 5/8" O.D. washer, 12" O.C. Spacing at endlap to be in a 5-7-5-7 in. patterns. Spacing for panel to panel connection to be 20" O.C. with a fastener located over each purlin.
2. **Purlins** - No. 16 MSG min. gauge steel. (55,000 psi min. yield strength).

#### Construction #542

##### 26 MSG Min. Gauge "PBR" Panel Over Purlins at 5'- 0 3/16" O.C.

1. **Panel Fasteners** - Panel to purlin connections to be 12-14x1" self-drilling Hex Head with a 5/8" O.D. washer, 12" O.C. Spacing at endlap to be in a 5-7-5-7 in. pattern. Spacing for panel to panel connection to be 20" O.C. with a fastener located over each purlin.
2. **Building Units** - Translucent Panels.
3. **Translucent Panel Rib and Purlin Reinforcement** - See UL 90 light transmitting panel installation instructions.
4. **Purlins** - No. 16 MSG min. gauge steel. (55,000 psi min. yield strength).

## IMPACT RESISTANCE

"PBR" panels carry a Class 4 rating under UL-2218 "Test Standard For Impact Resistance"

## FIRE RESISTANCE RATING

1. **Deck: NC**  
**Class A**  
Incline: Unlimited  
The panel qualifies for a Class A Fire Rating in compliance with Underwriters laboratories Standard UL-263 when installed over a non-combustible substrate. A Class C Fire Rating will be qualified for over combustible substrate.

Look for classification marking on product.

## CAUTION

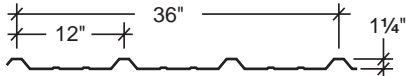
The above listings are summaries of Construction Numbers. For UL 90 rated roof requirements and complete design information, see the Underwriters Laboratories Building Materials Directory. If you have any questions, call ABC before proceeding.

# PRODUCT INFORMATION

# "PBR" PANEL

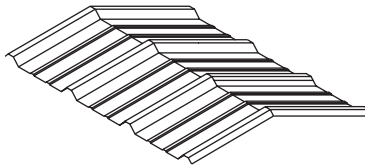
## PRODUCT CHECKLIST

"PBR" Panel



"PBR" Panel

Ridge Cap

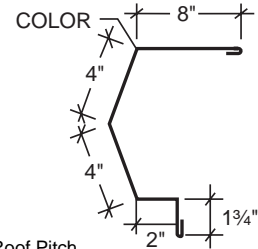


Maximum Roof Pitch 6:12  
Specify Pitch

FL-49 2'-6"

FL-51 3'-0"

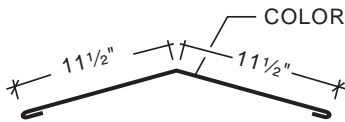
Sculptured High Side Eave



Specify Roof Pitch  
High Eave part at corner to be mitered  
Specify Left or Right

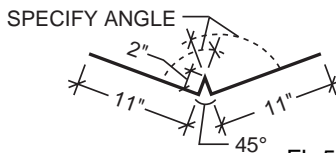
FL-17

Flat Ridge/Hip Flashing

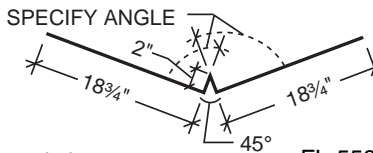


FL-38

Valley Flashing



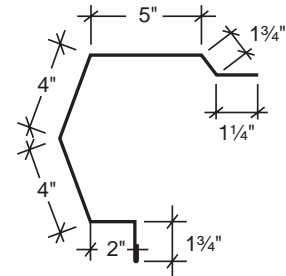
Standard



Extended

FL-558

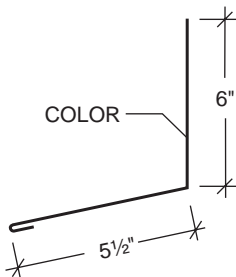
Sculptured Rake



Rake part at corner to be mitered.  
Specify Left or Right

FL-16

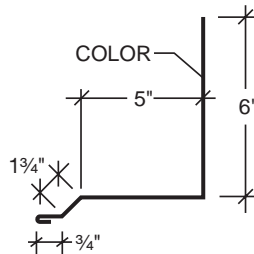
Parapet High Eave



FL-874

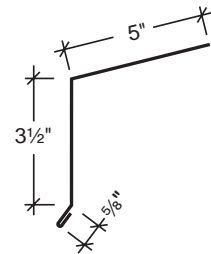
Specify Roof Slope

Parapet Rake



FL-952

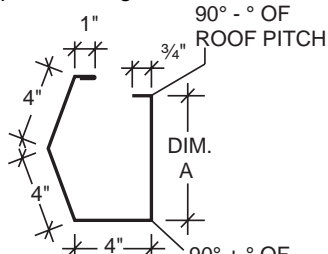
Eave Trim



Specify Roof Pitch

FL-19

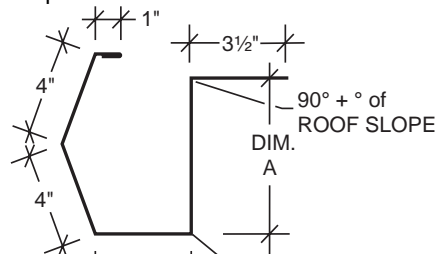
Sculptured Hang-On Gutter



Specify Roof Slope  
Gutter part at corner to be mitered.  
Specify Left or Right.

FL-180

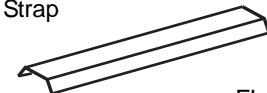
Sculptured Eave Gutter



Specify Roof Slope  
Gutter part at corner to be mitered.  
Specify Left or Right.

FL-18

Gutter Strap



FL-893

Gutter End



Specify Left or Right  
Specify Gutter part no.

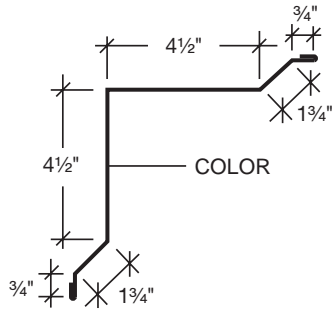
FL-18A

# "PBR" PANEL

# PRODUCT INFORMATION

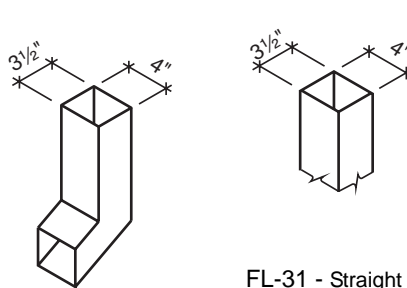
## PRODUCT CHECKLIST

### Inside Corner Trim



FL-800

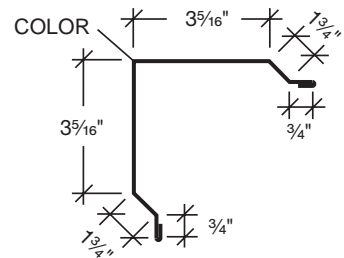
### Downspouts



FL-31 - Straight

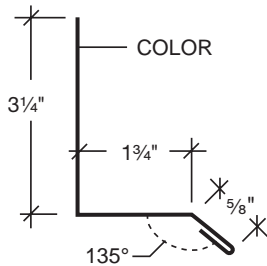
FL-31A - With Kick-Out

### Corner Trim - Outside



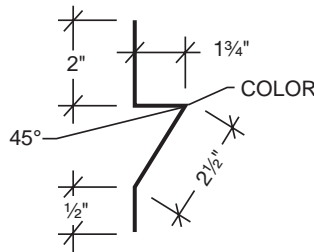
FL-830

### Base Trim (With Sheeting Notch)



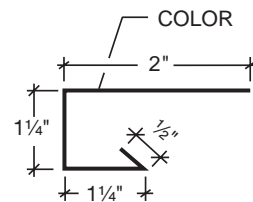
FL-72

### Base Trim (Without Sheeting Notch)



FL-530

### Jamb Trim

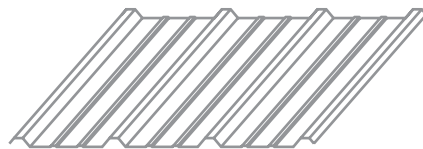


FL-23

### Fasteners

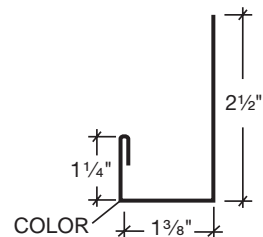
- #17A 12-14 X 1 1/4" Driller
- #4A 1/4"-14 X 7/8" Lap Tek
- #3 12-14 X 1 1/4" Long Life Driller
- #4 1/4"-14 X 7/8" Long Life Lap Tek

### LTP



Non-Reinforced Fiberglass  
High Strength Fiberglass

### Head Trim



FL-24

### Fasteners

- #43 1/4"-14 X 1 1/4" Driller with 1 1/8" O.D. washer
- #44 1/4"-14 X 7/8" Lap Tek with 1 1/8" O.D. washer
- #14 1/8 X 3/16" Stainless Steel Pop Rivet

### Sealant

- 1/2" x 3/32" HW-507
- Tri-Bead HW-504
- Triple Bead HW-502
- Urethane White HW-540
- TUBE SEALANT 11 OZ. Other Colors Available

NOTE: 25' Per tube at 1/4" bead

### Closures

- Inside HW-455
- Outside HW-456
- Beveled Inside\* HW-456
- Beveled Outside\* HW-456

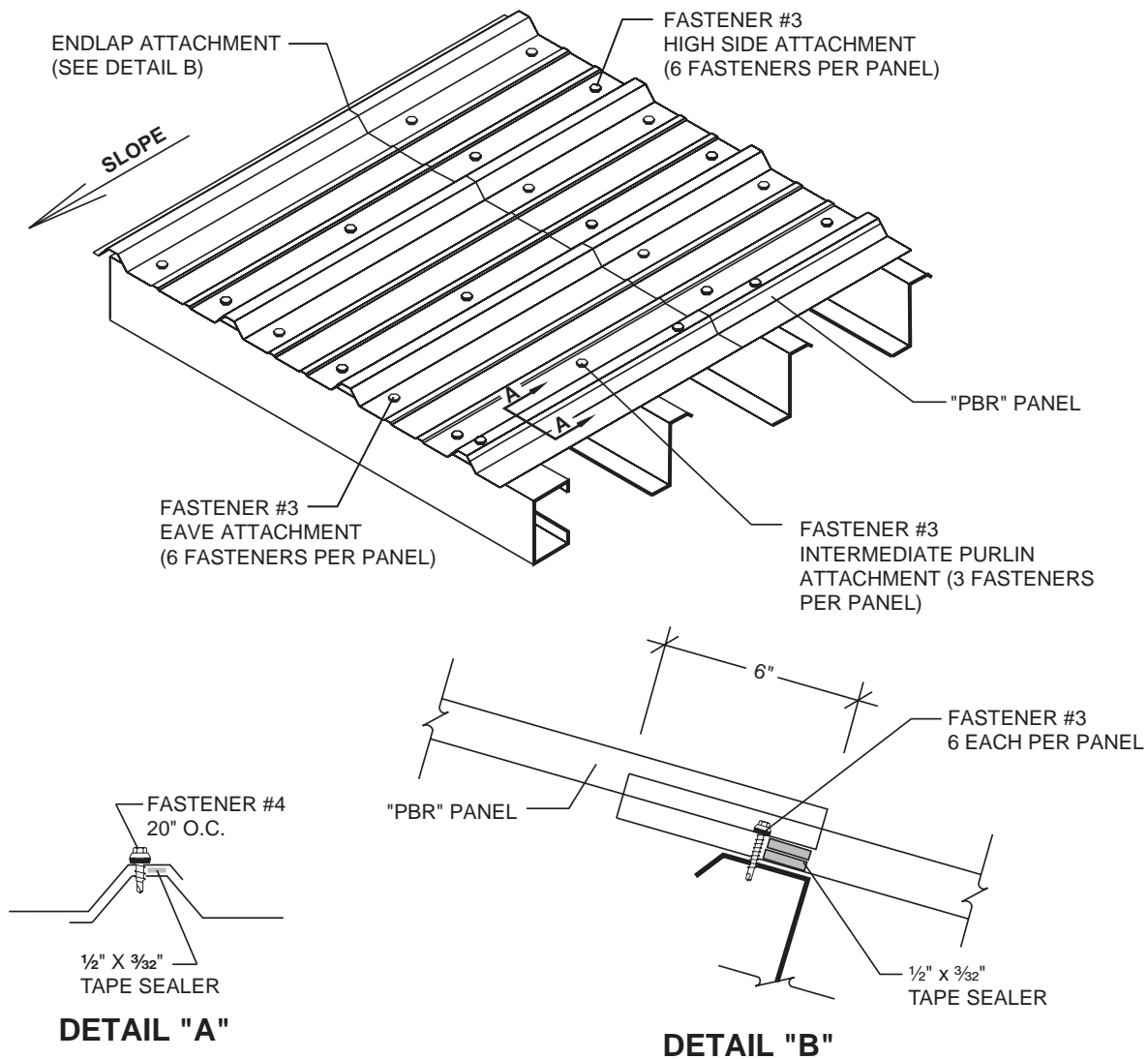
\*Special order - requires two-week lead time



# PRODUCT INFORMATION

# "PBR" PANEL

## ATTACHMENT "PBR" PANEL



**NOTES:**

**Sidelap**

1. 1/2" X 3/32" tape sealer must be installed between weather infiltration point and fastener.
2. Install Fastener #4 (1/4"-14 X 7/8" Long Life Lap Tek) at 20" on center.
3. When possible, install panels such that sidelaps are nested away from prevailing winds.
4. Fastener #4A (1/4"-14 X 7/8" Lap Tek) are available as an alternate when long life fasteners are not desired.

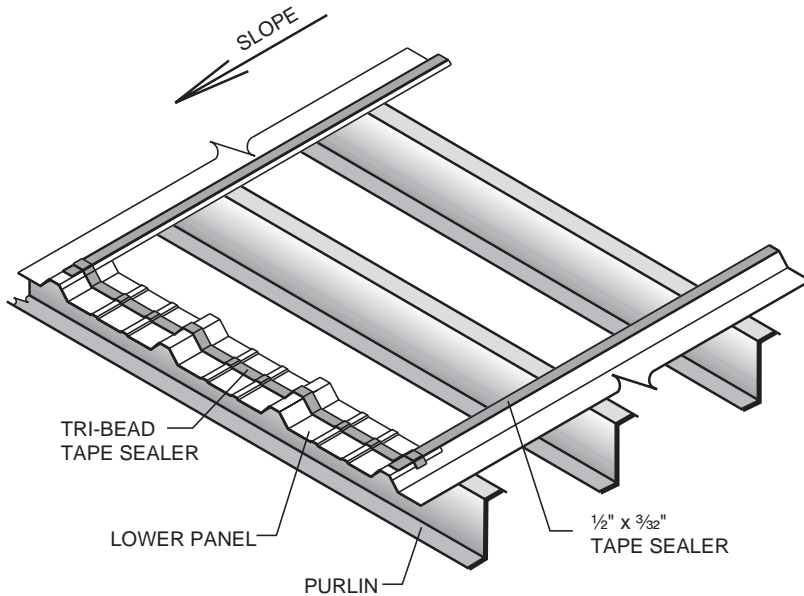
**Endlap**

1. Stack 2 continuous layers of 1/2" x 3/32" tape sealer on top of each other and must be installed between weather infiltration point and fastener.
2. Install Fastener #3 (12-14 X 1 1/4" Long Life driller) on each side of major ribs of panel (two fasteners per foot).
3. Fastener #17A (12-14 X 1 1/4" driller) are available as an alternate when long life fasteners are not desired.

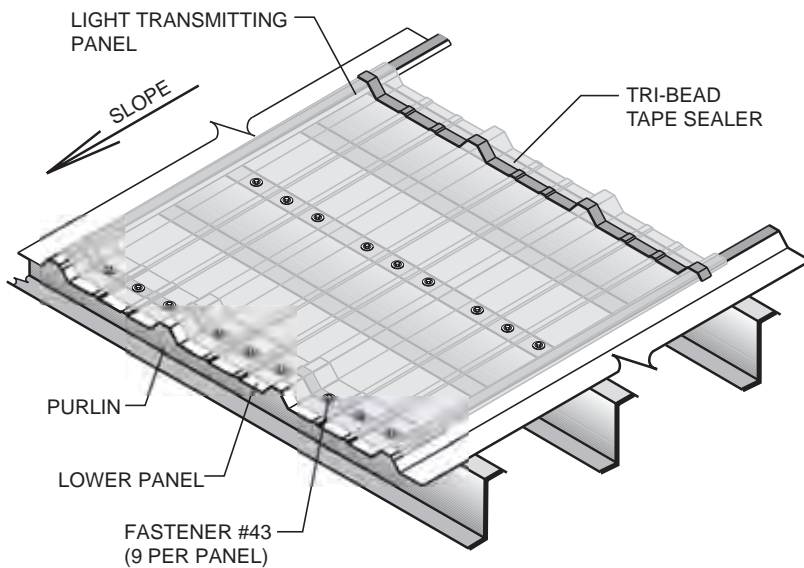
**“PBR” PANEL**

**PRODUCT INFORMATION**

**CONSTRUCTION NO. 542  
UL 90 LIGHT TRANSMITTING PANEL  
INSTALLATION**



Install roof panels, leaving the light transmitting panel run open, except for lower light transmitting panel run panel. Install tape sealer to panel sidelaps and across panel width as normal.



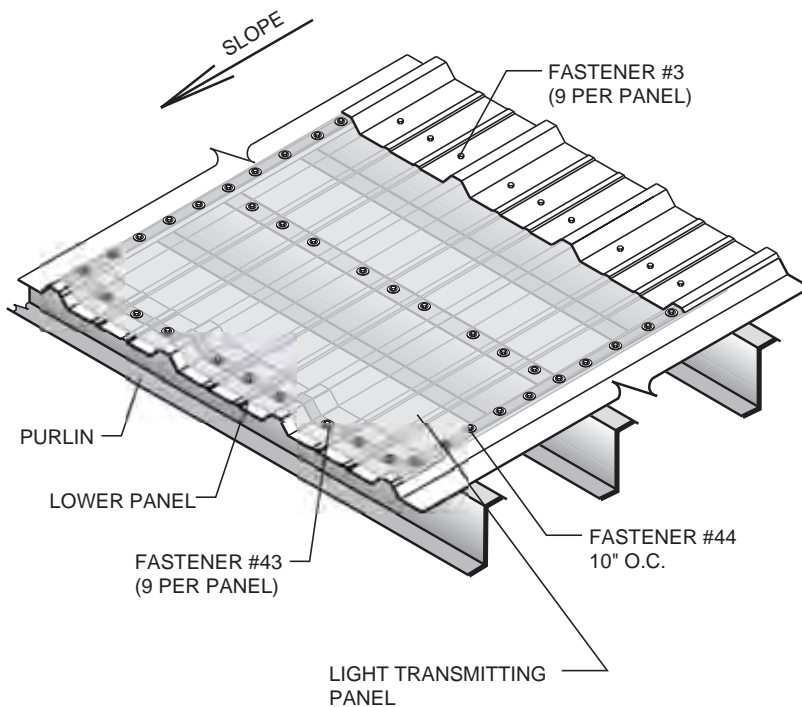
Attach light transmitting panels at the low and mid-slope connection to the purlin with nine Fastener #43 (1/4 - 14 x 1 1/4" driller with 1 1/8" O.D. washer).

# PRODUCT INFORMATION

## "PBR" PANEL

### CONSTRUCTION NO. 542 UL 90 LIGHT TRANSMITTING PANEL INSTALLATION (Continued)

Be sure the light transmitting panel sidelaps have complete run of (1/2" x 3/32") tape sealer between the light transmitting panel and the "PBR" panel. See Page 6 for lap detail.



Fasten light transmitting panel with Fastener #44 (1/4" - 14 x 7/8" Lap Tek with 1/8" O.D. washer) at 10" O.C. down each side lap.

Install upper metal panel in light transmitting panel run and fasten as at a normal endlap with nine Fastener #3 (12 - 14 X 1 1/4" Long Life drill).

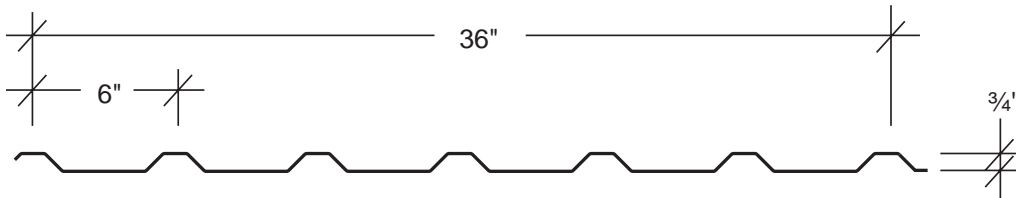
# "PBU" PANEL

# PRODUCT INFORMATION

## ARCHITECT/ENGINEER INFORMATION

1. "PBU" panel is a structural roof and wall panel. This panel can be installed directly over purlins or joists. "PBU" panel is UL 90 rated per construction number 39.
2. "PBU" panel is recommended for 1:12 or greater roof slopes.
3. Field applied sealant is required at panel sidelaps and endlaps.
4. "PBU" panel is a through-fastened panel. For proper fastener application, see page 13.
5. The information in this manual is believed to be correct and accurate. It should not be used for any specific application without being reviewed by a registered professional engineer.

## GENERAL DESCRIPTION



Coverage Width - 36"

Minimum Slope - 1:12

Panel Attachment - See page 13

Panel Substrate - Galvalume®

Gauge - 26 standard - 29, 24 and 22 also available

Coatings - Galvalume Plus®, Signature® 200\* and Signature® 300\*

## PRODUCT SELECTION CHART

GAUGE	GALVALUME PLUS®	SIGNATURE® 200*	SIGNATURE® 300*
22 gauge	●	■	■
24 gauge	●	■	■
26 gauge	●	●	●
29 gauge	●	●	■

● - Available in any quantity.

■ - Minimum quantity may be required.

\*See Commercial/Industrial color chart for available colors.

# PRODUCT INFORMATION

# "PBU" PANEL

## UL 90 REQUIREMENTS

### "PBU" PANEL

#### Construction #39

#### 26 MSG Min. Gauge "PBU" Panel over Purlins at 5'- 0 1/4" O.C.

1. **Panel Fasteners** - Panel to purlin connections to be #14 self-drilling, Hex Head with a 5/8" O.D. washer, 6" O.C. Spacing at endlaps to be 6" O.C. Spacing for panel to panel connections to be 12" O.C.
2. **Purlins** - No. 16 MSG min gauge steel. (55,000 psi min. yield strength)

#### IMPACT RESISTANCE

"PBU" panels carry a Class 4 rating under UL-2218 "Test Standard For Impact Resistance"

#### FIRE RESISTANCE RATING

1. **Deck: NC**

**Class A**

Incline: Unlimited

The panel qualifies for a Class A Fire Rating in compliance with Underwriters Laboratories Standard UL-263 when installed over a non-combustible substrate. A Class C Fire Rating will be qualified for over a combustible substrate.

**Look for classification marking on product.**

## CAUTION

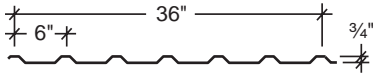
The above listings are summaries of Construction Numbers. For UL 90 rated roof requirements and complete design information, see the Underwriters Laboratories Building Materials Directory. If you have any questions, call ABC before proceeding.

# "PBU" PANEL

# PRODUCT INFORMATION

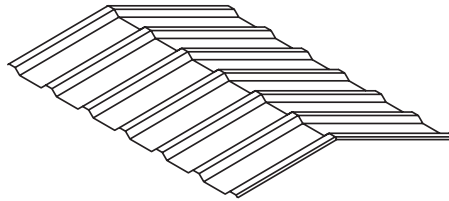
## PRODUCT CHECKLIST

"PBU" Panel



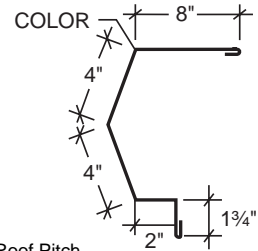
"PBU" Panel

Ridge Cap



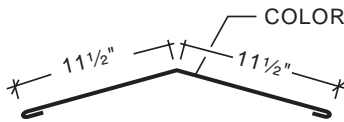
Maximum Roof Pitch 6:12 FL - 50 2'-6"  
Specify Pitch FL - 52 3'-0"

Sculptured High Side Eave



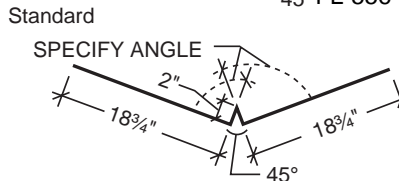
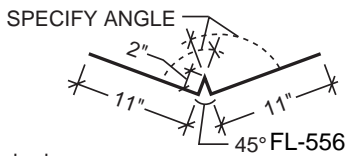
Specify Roof Pitch  
High Eave part at corner to be mitered  
Specify Left or Right FL-17

Flat Ridge/Hip Flashing



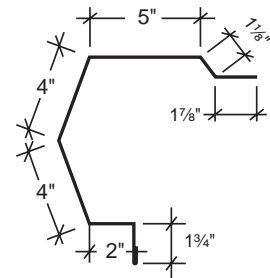
Specify Roof Slope FL-38

Valley Flashing



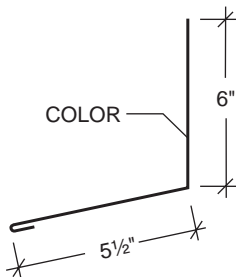
Standard  
Specify Angle  
Extended FL-558

Sculptured Rake



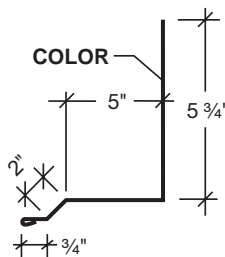
Rake part at corner to be mitered.  
Specify Left or Right FL-15

Parapet High Side Eave



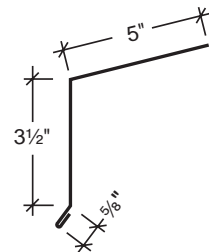
Specify Roof Slope FL-874

Parapet Rake



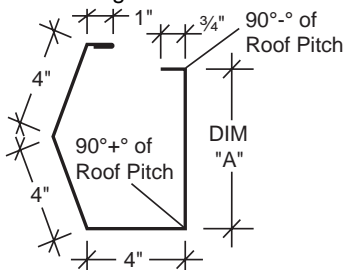
FL-954

Eave Trim



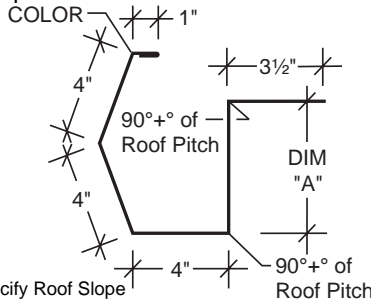
Specify Roof Slope FL-19

Sculptured Hang-On Gutter



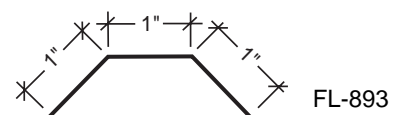
Specify Roof Slope  
Gutter part at corner to be mitered.  
Specify Left or Right. FL-C

Sculptured Eave Gutter



Specify Roof Slope  
Gutter part at corner to be mitered.  
Specify Left or Right. FL-512

Gutter Strap



Gutter End



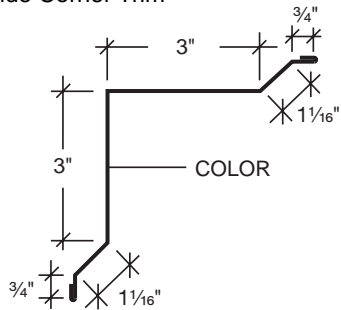
Specify Left or Right  
Specify Gutter Part No. FL-18A

# PRODUCT INFORMATION

# "PBU" PANEL

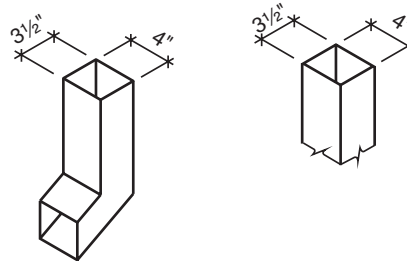
## PRODUCT CHECKLIST

### Inside Corner Trim



FL-810

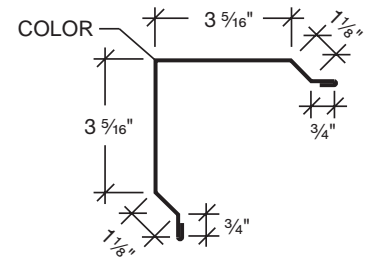
### Downspouts



FL-31 - Straight

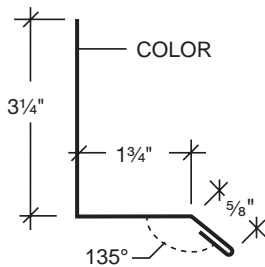
FL-31A - With Kick-Out

### Corner Trim - Outside



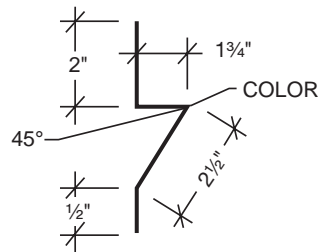
FL-840

### Base Trim (With Sheeting Notch)



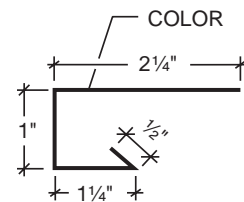
FL-72

### Base Trim (Without Sheeting Notch)



FL-530

### Jamb Trim

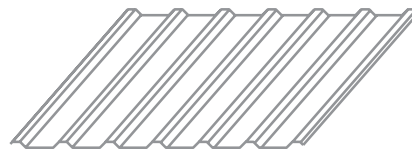


FL-21

### Fasteners

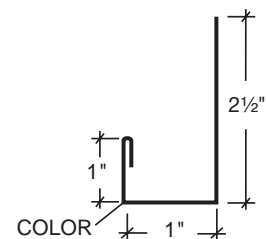
- #17A 12-14 X 1 1/4" Driller
- #4A 1/4"-14 X 7/8" Lap Tek
- #3 12-14 X 1 1/4" Long Life Driller
- #4 1/4"-14 X 7/8" Long Life Lap Tek

### LTP



Non-Reinforced Fiberglass  
High Strength Fiberglass

### Head Trim



FL-514A

### Fasteners

- #43 1/4"-14 X 1 1/4" Driller with 1 1/8" O.D. washer
- #44 1/4"-14 X 7/8" Lap Tek with 1 1/8" O.D. washer
- #14 1/8 X 3/16" Stainless Steel Pop Rivet

### Sealant

- 1/2" x 3/32" HW-507
- Tri-Bead HW-504
- Triple Bead HW-502
- Urethane White HW-540
- TUBE SEALANT 11 OZ. Other Colors Available

NOTE: 25' Per tube at 1/4" bead

### Closures

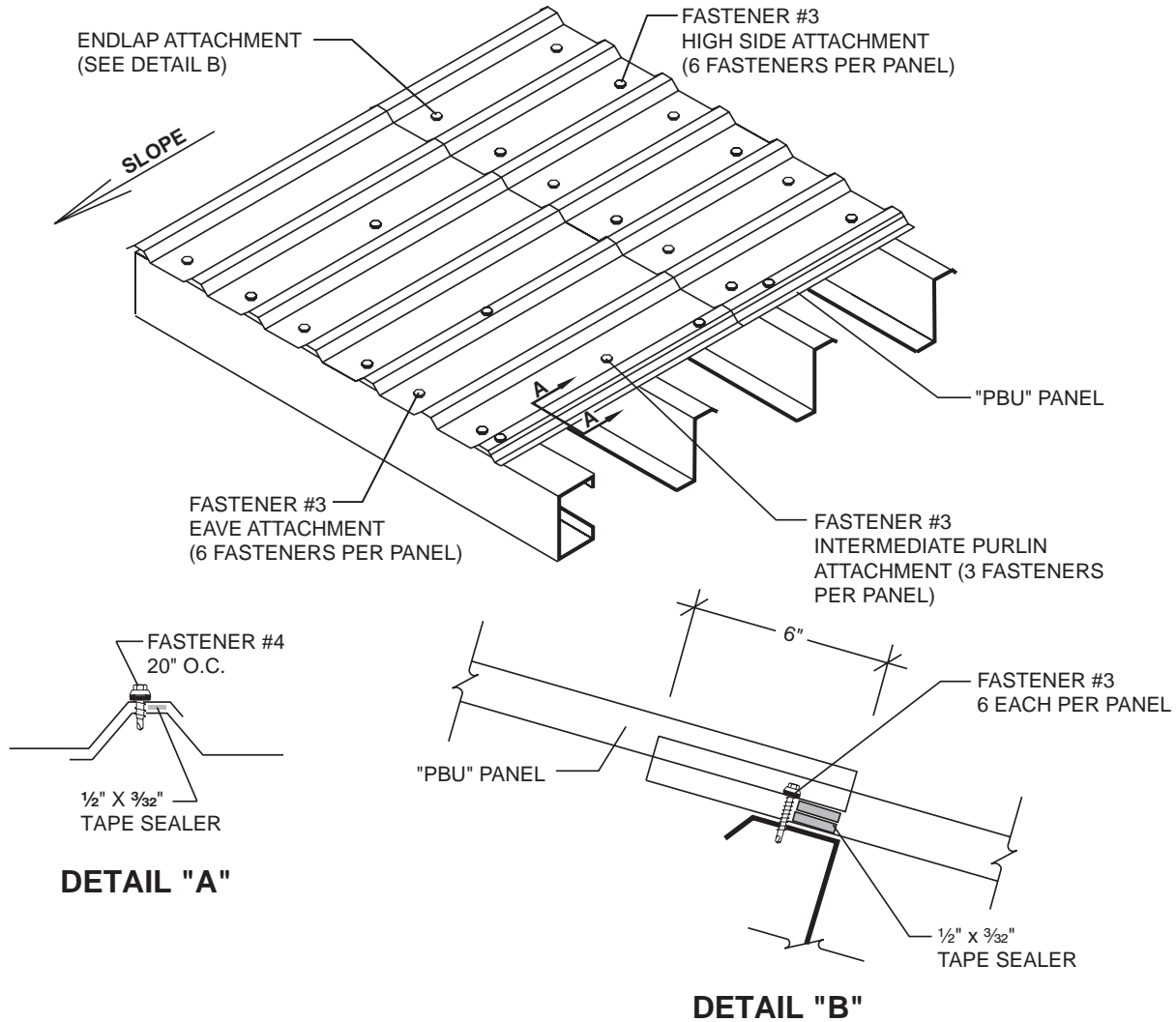
- Inside HW-459
- Outside HW-460
- Beveled Inside\*
- Beveled Outside\*

\*Special order - requires two-week lead time

# "PBU" PANEL

# PRODUCT INFORMATION

## ATTACHMENT "PBU" PANEL



**NOTES:**

**Sidelap**

1. 1/2" X 3/32" tape sealer must be installed between weather infiltration point and fastener.
2. Install Fastener #4 (1/4"-14 X 7/8" Long Life Lap Tek) at 20" on center.
3. When possible, install panels such that sidelaps are nested away from prevailing winds.
4. Fastener #4A (1/4"-14 X 7/8" Lap Tek) are available as an alternate when long life fasteners are not desired.

**Endlap**

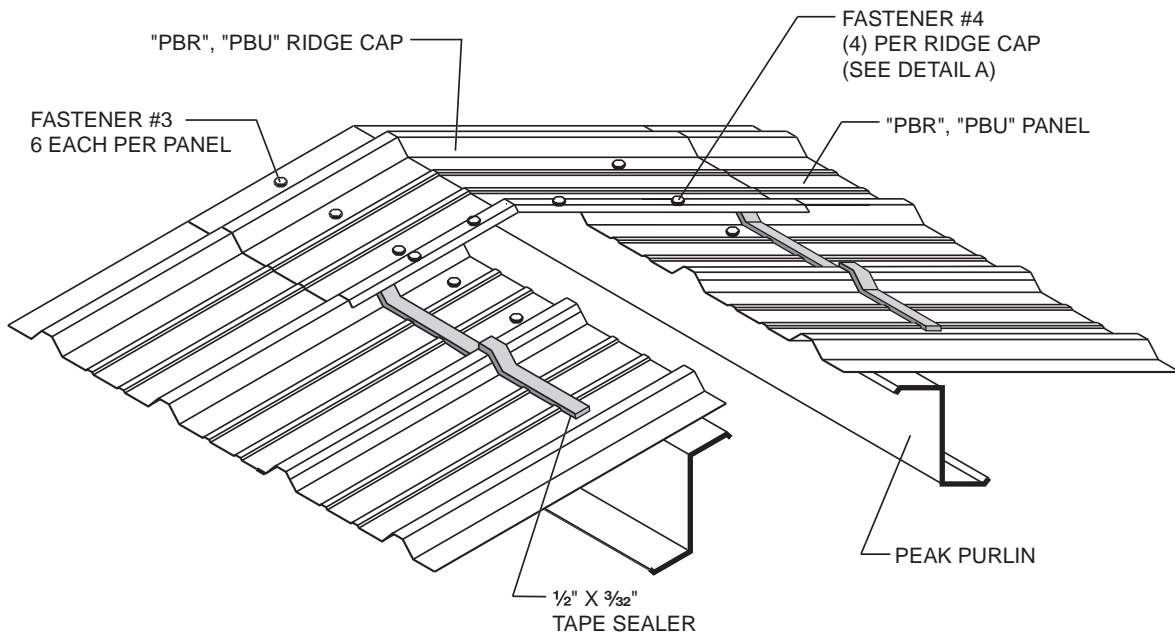
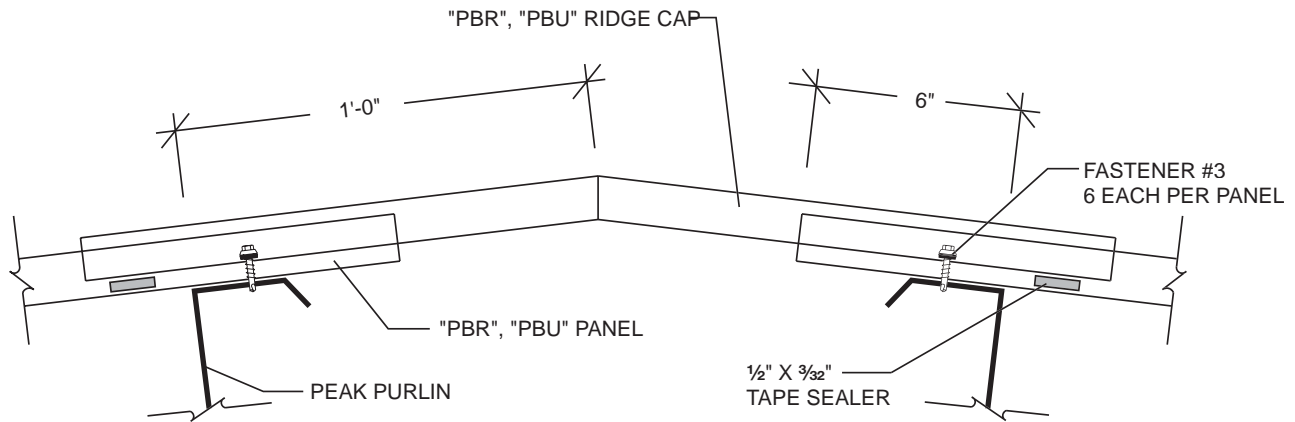
1. Stack 2 continuous layers of 1/2" x 3/32" tape sealer on top of each other and must be installed between weather infiltration point and fastener.
2. Install Fastener #3 (12-14 X 1 1/4" Long Life driller) on each side of major ribs of panel (two fasteners per foot).
3. Fastener #17A (12-14 X 1 1/4" self-driller) are available as an alternate when long life fasteners are not desired.



# PRODUCT INFORMATION

# "PBR" & "PBU" PANELS

## TYPICAL DETAILS Ridge



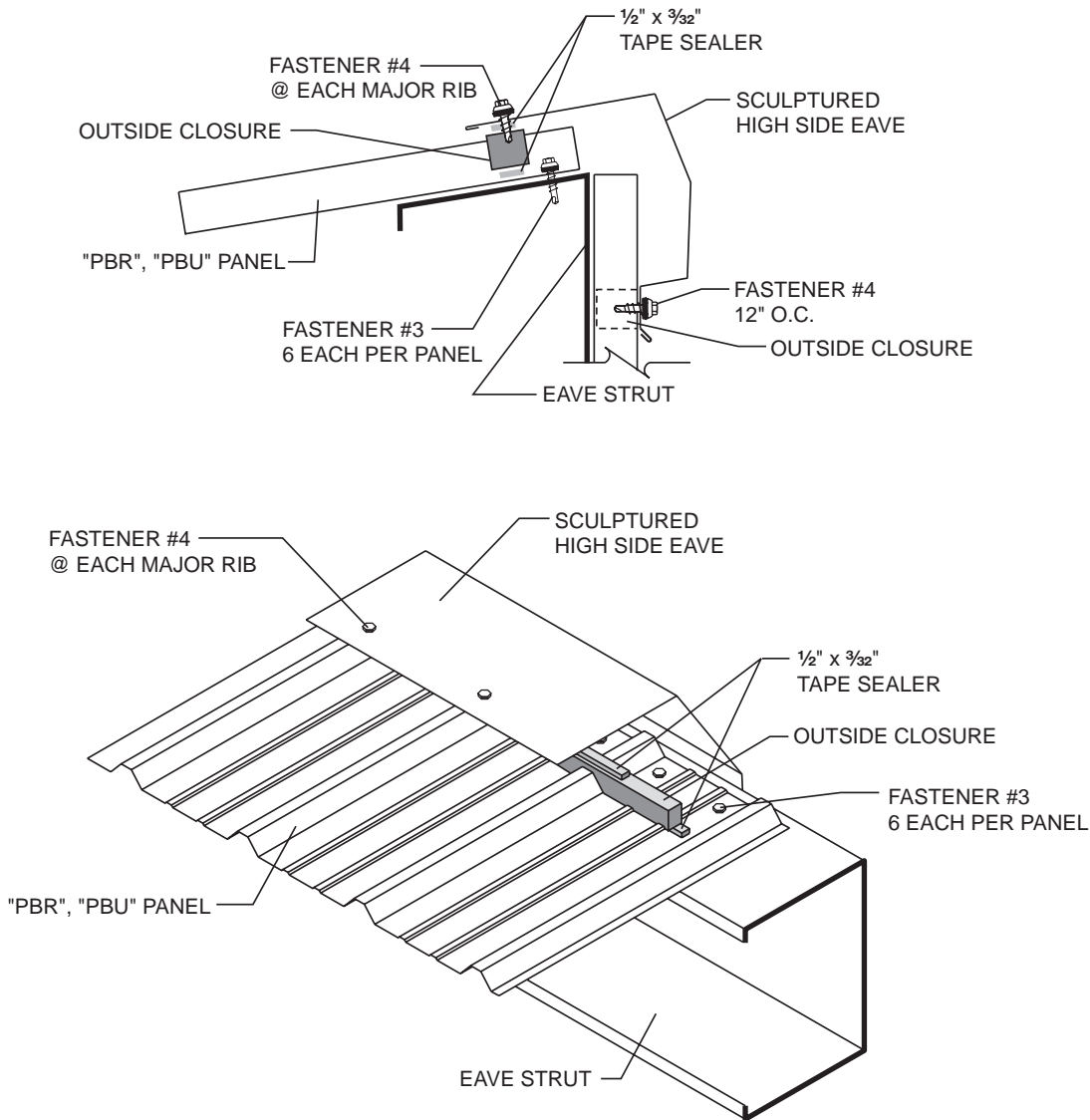
### NOTES:

1. When ordering ridge caps, specify roof slope. Refer to ABC price pages for maximum slope for each ridge cap.
2. Install 1/2" X 3/32" tape sealer across full width of ridge cap on both sides. Tape sealer must be installed between weather infiltration point and fasteners.
3. Install 1/2" X 3/32" tape sealer to the sidelap of the ridge cap that will lap onto adjacent ridge cap. Tape sealer must be installed between weather infiltration point and fasteners.
4. Install Fastener #3 (12-14 X 1 1/4" Long Life driller) on both sides of major ribs (two per foot).
5. Install four Fastener #4 (1/4"-14 X 7/8" Long Life Lap Tek) in each ridge cap sidelap. Place (1) one Lap Tek in high rib on each side of the ridge cap centerline and one in line with purlin fastener on each side of ridge line.

# "PBR" & "PBU" PANELS

# PRODUCT INFORMATION

## TYPICAL DETAILS High Side Eave



**NOTES:**

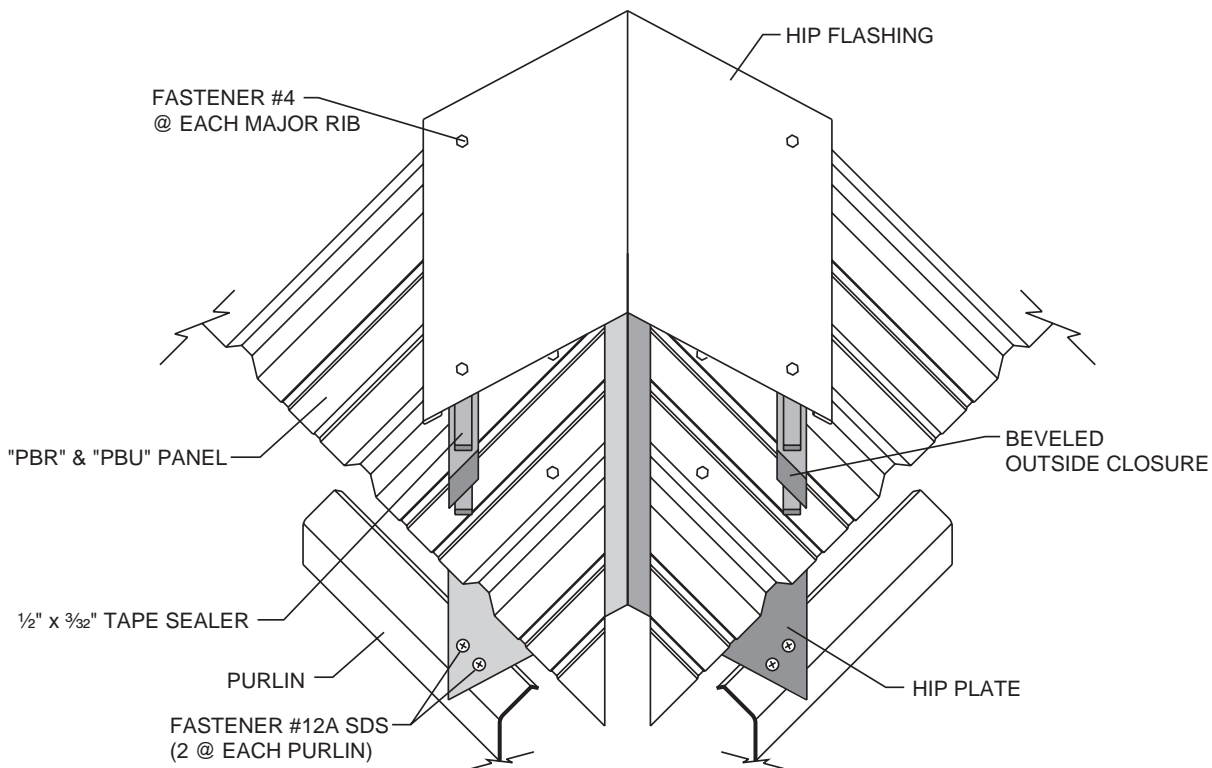
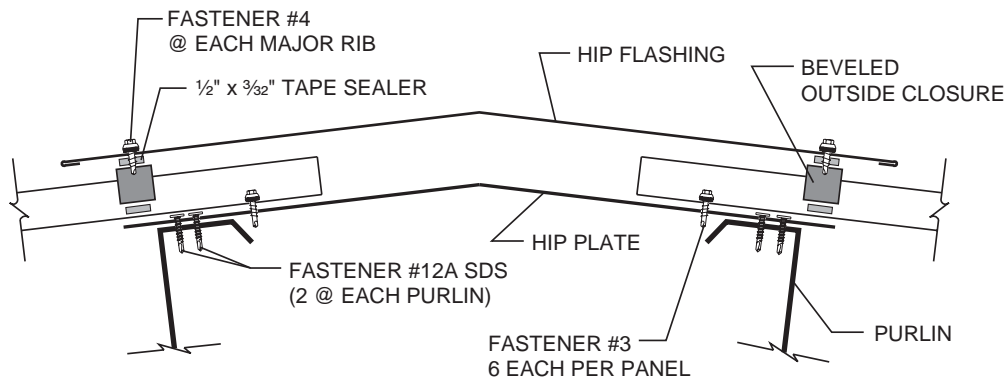
1. Install outside closure, with 1/2" X 3/32" tape sealer top and bottom, across width of "PBR" & "PBU" panels.
2. Install Sculptured High Side Eave to "PBR" & "PBU" panels at each major rib with Fastener #4 (1/4"-14 X 7/8" Long Life Lap Tek). Sculptured high side eave trim should overhang outside closures 1/2" - 1".
3. Attach front face of sculptured high side eave trim to wall with fasteners or cleat as required for wall substrate.
4. Trim laps should be approximately 3" with sufficient pop rivets to hold lap together. Apply bead of urethane sealant between trim at 3" lap.

# PRODUCT INFORMATION

# "PBR" & "PBU" PANELS

## TYPICAL DETAILS

### Hip



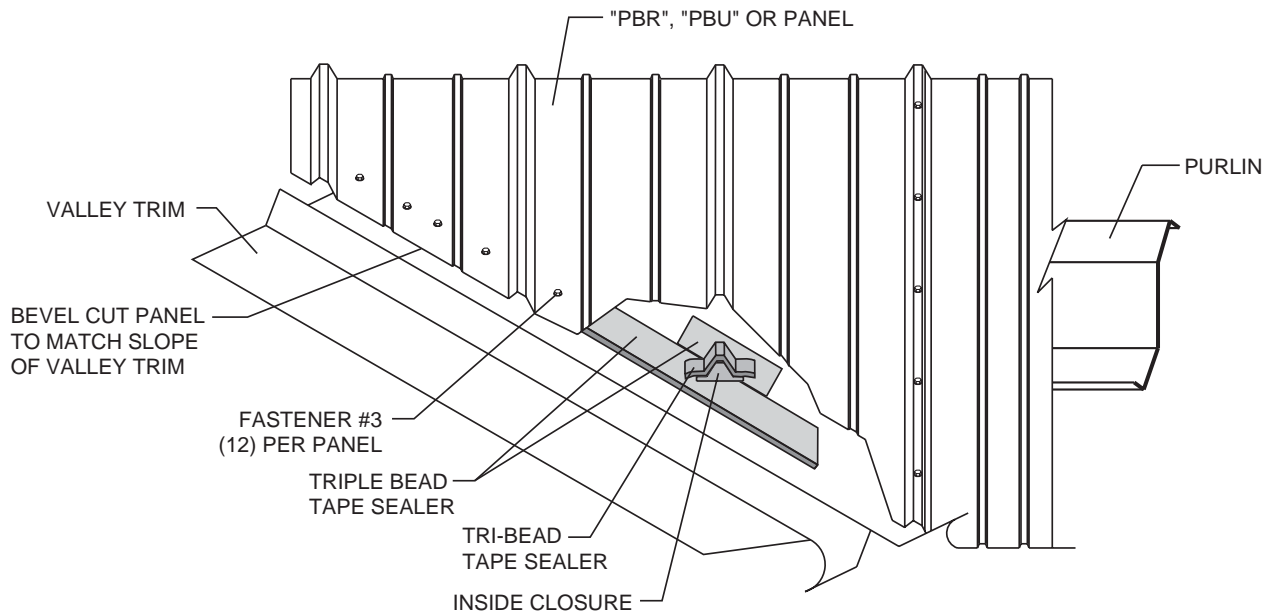
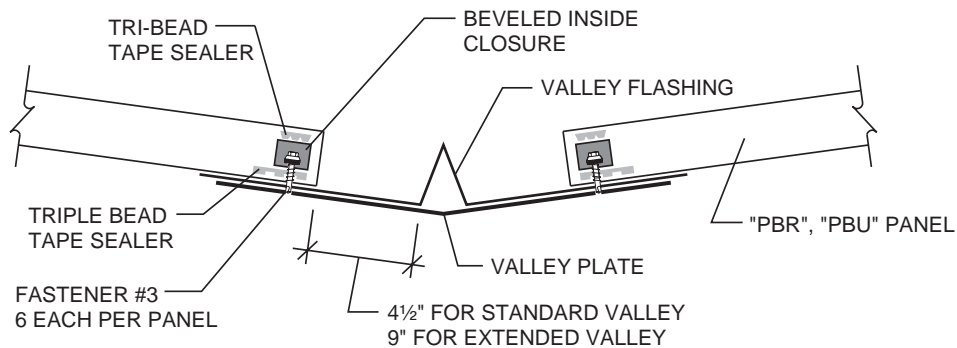
#### NOTES:

1. Bevel cut and install "PBR" & "PBU" panels to follow bevel of hip.
2. Install beveled outside closures to panels, with 1/2" x 3/32" tape sealer top and bottom, following bevel of hip. Beveled closures must be special ordered and require a two week lead time.
3. Install hip flashing to panel at each major rib with Fastener #4 (1/4"-14 X 7/8" Long Life Lap Tek). Hip flashing should overlap outside closures 1/2"-1".
4. Trim laps should overlap approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of pop rivets to hold lap together.

# "PBR" & "PBU" PANELS

# PRODUCT INFORMATION

## TYPICAL DETAILS Valley



### NOTES:

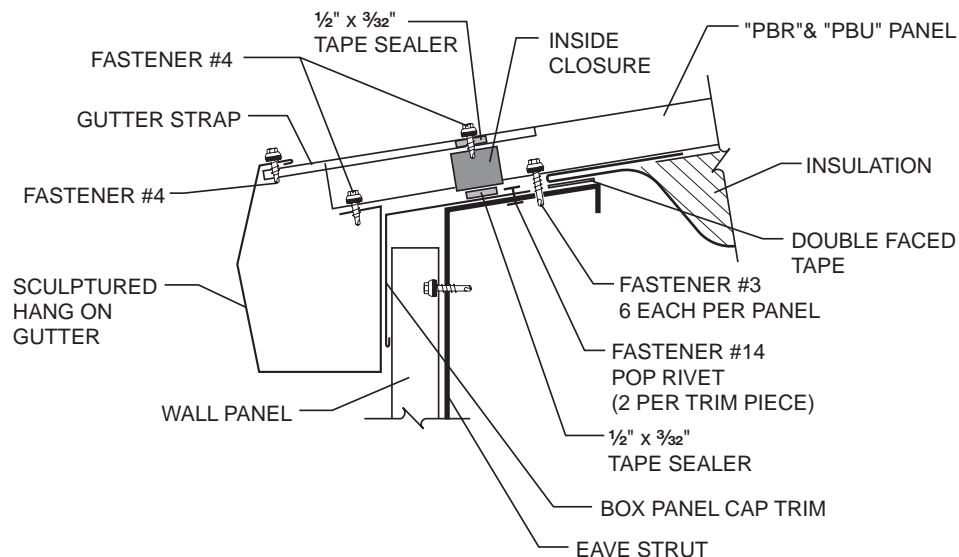
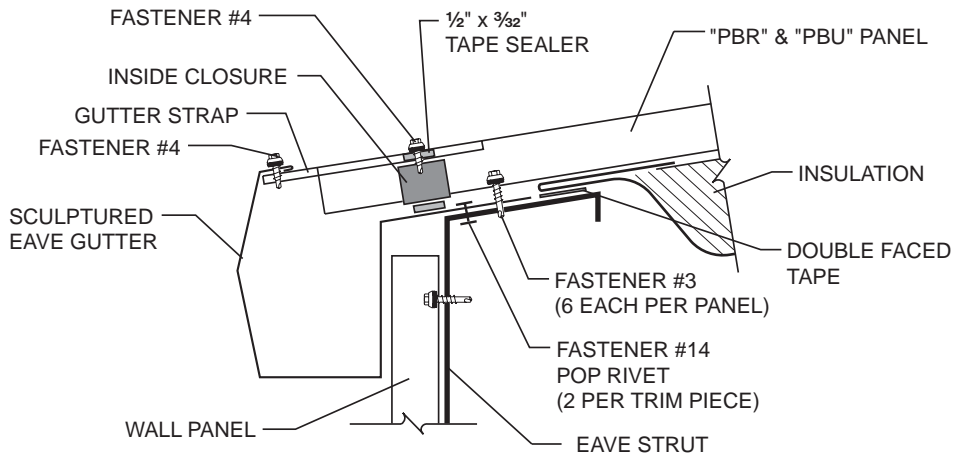
1. For valleys 30' or less in length, use standard valley trim. Valleys over 30' in length require extended valley trim.
2. Apply triple bead tape sealer to valley trim parallel to the slope of the valley. Lower edge of tape sealer should be 4½" from center of valley for standard valleys and 9" from the center of the valley for extended valleys.
3. Install high rib section of inside closure that has been field cut from standard 3'-0" straight closure. Place the cut closure square with the rib of the panel. Install Tri-Bead tape sealer to top of inside closure prior to laying panel edge down on top of the cut closure. The triple bead tape with proper fastener sequence will seal the minor ribs of the panel that are between the major ribs.
4. Bevel cut "PBR" & "PBU" panels to fit slope of valley and install to valley with Fastener #3 (12-14 X 1¼" Long Life driller) at 4" on center. Fasteners must be installed through the closures and into triple bead tape sealer.
5. Trim laps should overlap approximately 6" with a bead of urethane sealant in between. Do not rivet valley laps together. If laps gap open, install Fastener #4 (¼"-14 X 7/8" Long Life Lap Tek) into each side of water diverter while holding lap tightly together.

# PRODUCT INFORMATION

# "PBR" & "PBU" PANELS

## TYPICAL DETAILS

### Gutter



#### NOTES:

#### Eave Gutter

1. Attach gutter to eave strut with three Fastener #14 pop rivets per section.
2. Install inside closures to top leg of gutter with  $\frac{1}{2}'' \times \frac{3}{32}''$  tape sealer top and bottom.
3. Install "PBR" & "PBU" panel with Fastener #3 (12-14 X  $\frac{1}{4}''$  Long Life drill) on each side of major ribs (two fasteners per foot). Fasteners must be installed up slope from inside closures.
4. Gutter laps should be approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of pop rivets to hold lap together.
5. Install gutter straps 3'-0" on center with Fastener #4 ( $\frac{1}{4}''$ -14 X  $\frac{7}{8}''$  Long Life Lap Tek) fasteners at each end.

#### Hang-on Gutter

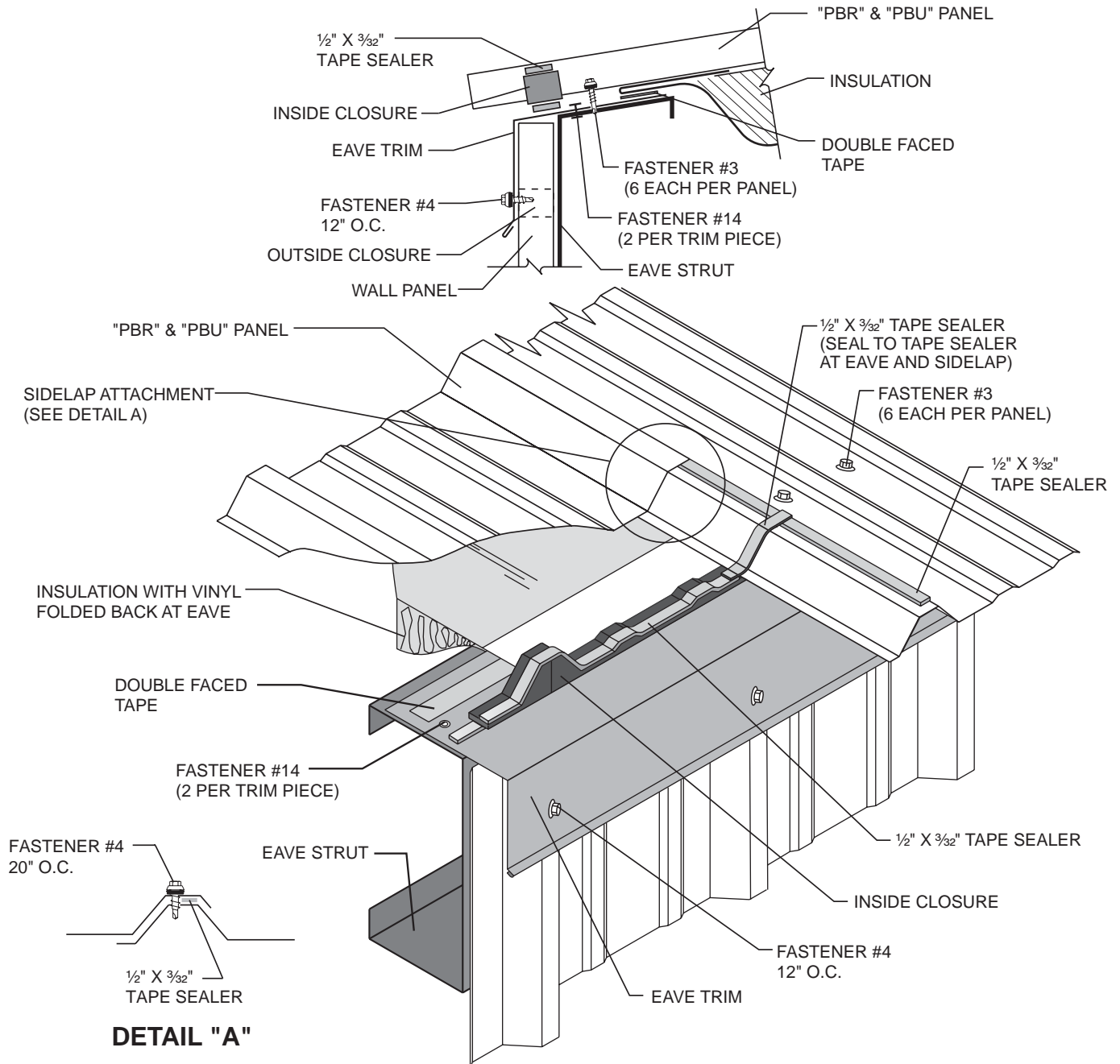
1. Attach Box Panel Cap Trim to top of eave strut with pop rivet #14 (three per 10'-0" section).
2. Install inside closure on top of Box Panel Cap Trim with  $\frac{1}{2}'' \times \frac{3}{32}''$  tape sealer top and bottom of closure.
3. Install "PBR" & "PBU" panels with Fastener #3 (12-14 X  $\frac{1}{4}''$  Long Life drill) on each side of the major ribs (two fasteners per foot). Fasteners must be installed up slope from inside closures.
4. Attach gutter to roof panels with Fastener #4 ( $\frac{1}{4}''$ -14 X  $\frac{7}{8}''$  Long Life Lap Tek) at each end.
5. Gutter laps should be approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of Fastener #14 (pop rivets) to hold lap together.
6. Install gutter straps 3'-0" on center with Fastener #4 ( $\frac{1}{4}''$ -14 X  $\frac{7}{8}''$  Long Life Lap Tek) at each end.

# "PBR" & "PBU" PANELS

# PRODUCT INFORMATION

## TYPICAL DETAILS

### Eave Trim



**NOTES:**

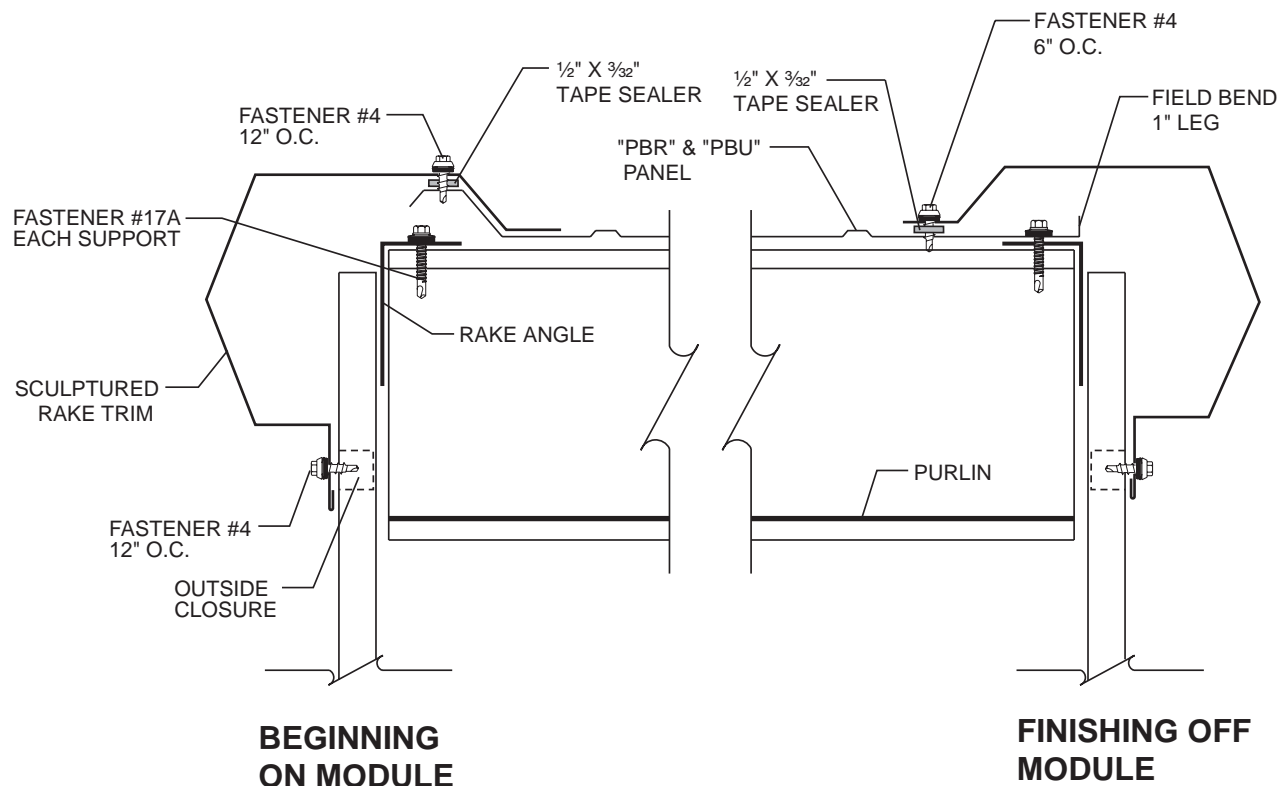
1. Install eave trim to structure with three pop rivets per section.
2. Install inside closures along top leg of eave trim with 1/2" x 3/32" tape sealer top and bottom.
3. Install "PBR" & "PBU" panel with Fastener #3 (12-14 X 1/4" Long Life driller) on each side of major ribs (2 fasteners per foot) allowing panel to overhang 1 1/2" plus wall thickness. Fasteners must be installed up slope from inside closures.
4. Attach front face of eave trim to wall with fasteners or cleat as required for wall substrate.
5. Trim laps should overlap approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of Fastener #14 pop rivets to hold lap together.

# PRODUCT INFORMATION

# "PBR" & "PBU" PANELS

## TYPICAL DETAILS

### Rake



#### NOTES:

##### Beginning on Module

1. Install  $\frac{1}{2}'' \times \frac{3}{32}''$  tape sealer to top of "PBR" & "PBU" panel rib.
2. Install rake trim to "PBR" & "PBU" panel rib with Fastener #4 ( $\frac{1}{4}''$ -14 X  $\frac{7}{8}''$  Long Life Lap Tek) at 1'-0" on center.
3. Attach front face of rake trim to wall with fasteners or cleat as required for wall substrate.
4. Trim laps should overlap approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of Fastener #14 pop rivets to hold lap together.

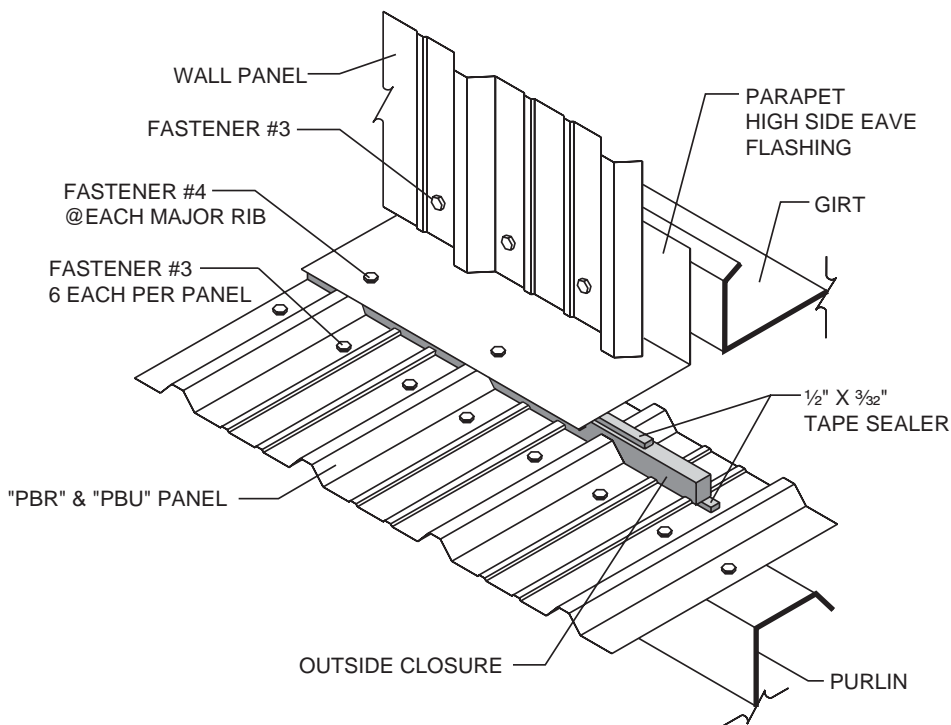
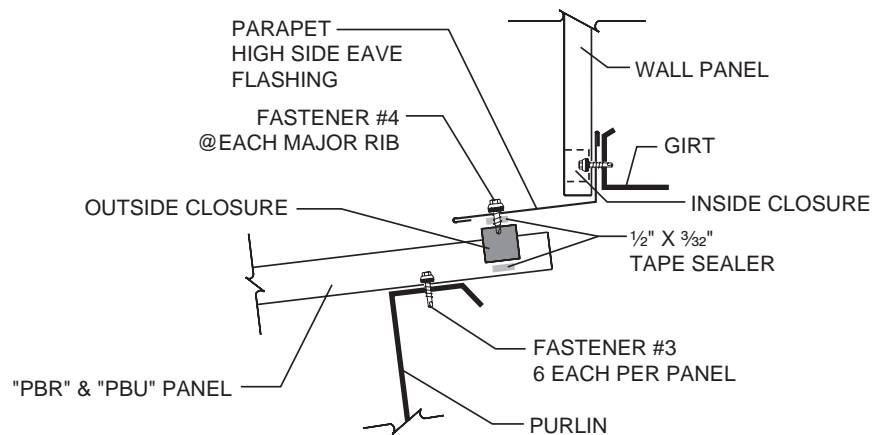
##### Finishing off Module

1. Cut and field bend a 1" leg on "PBR" & "PBU" panel.
2. Install  $\frac{1}{2}'' \times \frac{3}{32}''$  tape sealer to top of "PBR" & "PBU" panel.
3. Install rake trim to "PBR" & "PBU" panel with Fastener #4 ( $\frac{1}{4}''$ -14 X  $\frac{7}{8}''$  Long Life Lap Tek) at 6" on center.
4. Attach front face of rake trim to wall with fasteners or cleat as required for wall substrate.
5. Trim laps should overlap approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of pop rivets to hold lap together.

# "PBR" & "PBU" PANELS

# PRODUCT INFORMATION

## TYPICAL DETAILS Parapet High Side Eave



### NOTES:

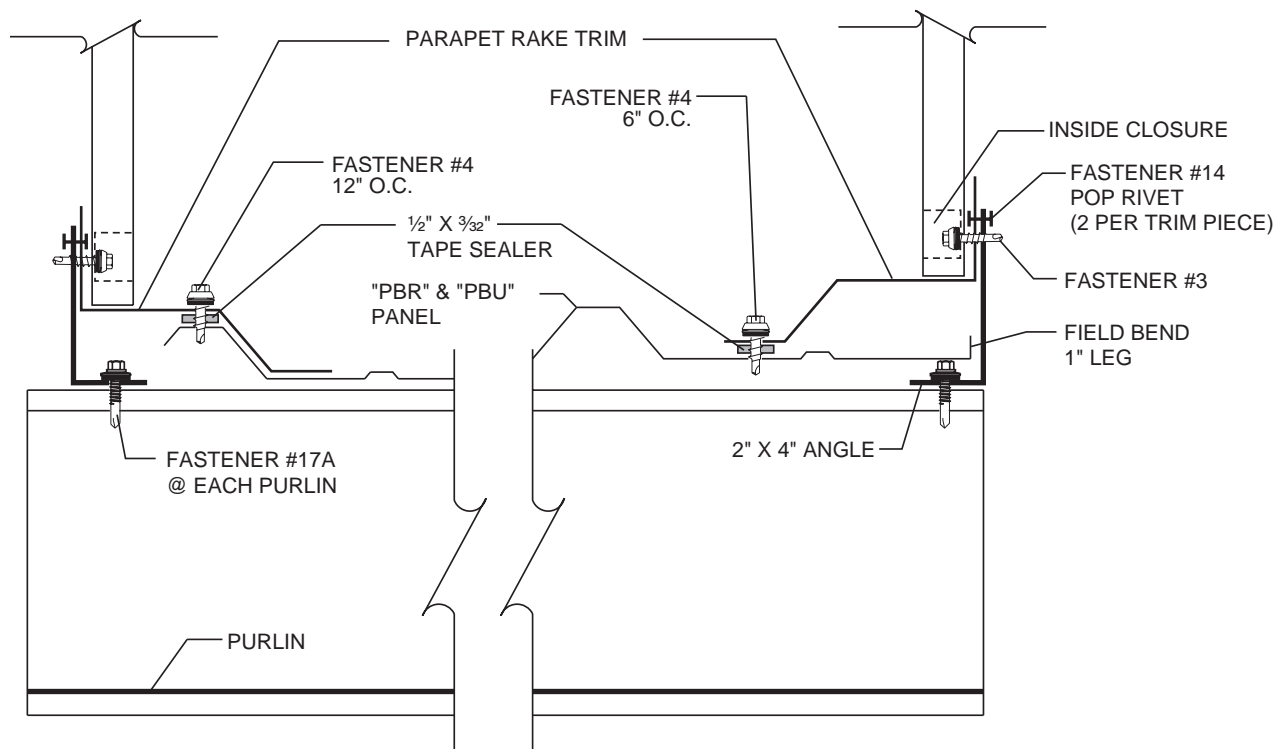
1. Install outside closure, with 1/2" x 3/32" tape sealer top and bottom, across width of "PBR" & "PBU" panels.
2. Install parapet high side trim to "PBR" & "PBU" panels at each major rib with Fastener #4 (1/4"-14 X 7/8" Long Life Lap Tek). Trim should overhang outside closures 1/2" - 1".
3. Attach top leg of parapet high side trim to wall with fasteners as required for wall substrate.
4. Trim laps should overlap approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of pop rivets to hold lap together.



# PRODUCT INFORMATION

# "PBR" & "PBU" PANELS

## TYPICAL DETAILS Parapet Rake



### NOTES:

#### Beginning on Module

1. Install  $\frac{1}{2}$ " x  $\frac{3}{32}$ " tape sealer to top of "PBR" & "PBU" panel rib.
2. Install parapet rake trim to "PBR" "PBU" panel rib with Fastener #4 ( $\frac{1}{4}$ "-14 X  $\frac{7}{8}$ " Long Life Lap Tek) at 1'-0" on center.
3. Attach top leg of parapet rake trim to 2" X 4" angle with Fastener #14 pop rivet. Elevate horizontal leg of parapet trim slightly, to provide for positive drainage of water.
4. Trim laps should overlap approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of Fastener #14 pop rivets to hold lap together.

#### Finishing off Module

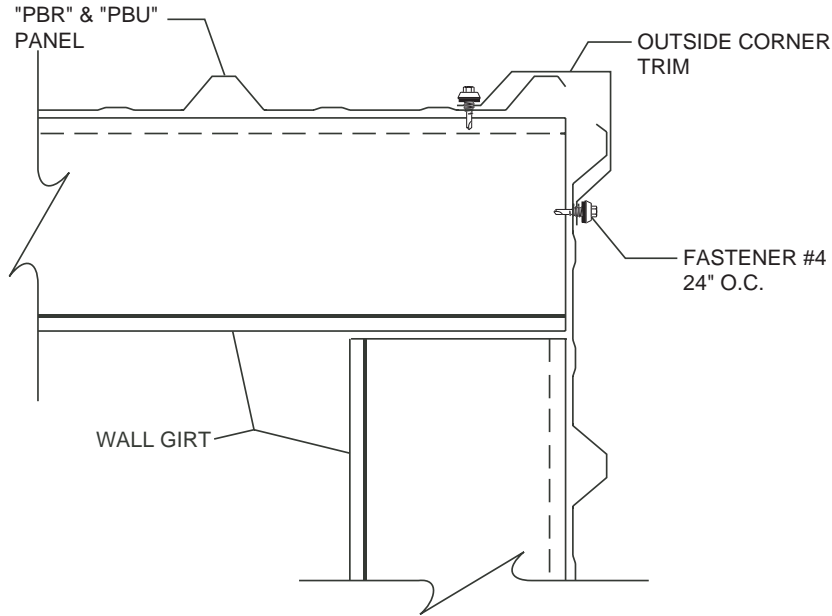
1. Cut and bend a 1" leg on "PBR" & "PBU" panel.
2. Install  $\frac{1}{2}$ " x  $\frac{3}{32}$ " tape sealer to top of "PBR" & "PBU" panel.
3. Install parapet rake trim to "PBR" & "PBU" panel with Fastener #4 ( $\frac{1}{4}$ "-14 X  $\frac{7}{8}$ " Long Life Lap Tek) at 6" on center.
4. Attach top leg of parapet rake trim to 2" X 4" angle with pop rivets. Elevate horizontal leg of parapet trim slightly, to provide for positive drainage of water.
5. Trim laps should overlap approximately 3" with a bead of urethane sealant in between. Install a sufficient amount of Fastener #14 pop rivets to hold lap together.

**"PBR" & "PBU" PANELS**

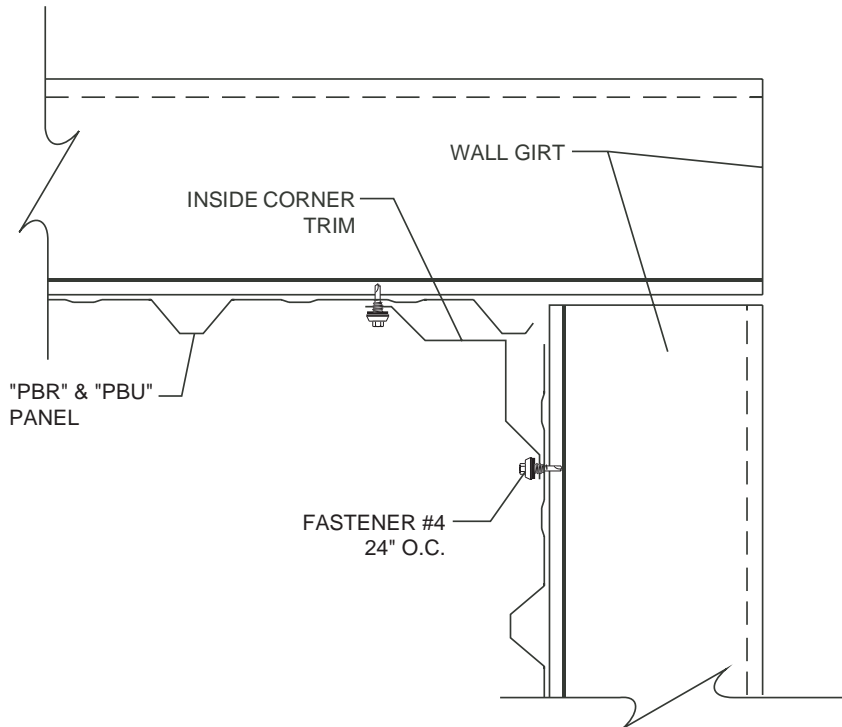
**PRODUCT INFORMATION**

**TYPICAL DETAILS**

**Corner**



**OUTSIDE CORNER DETAIL**



**INSIDE CORNER DETAIL**

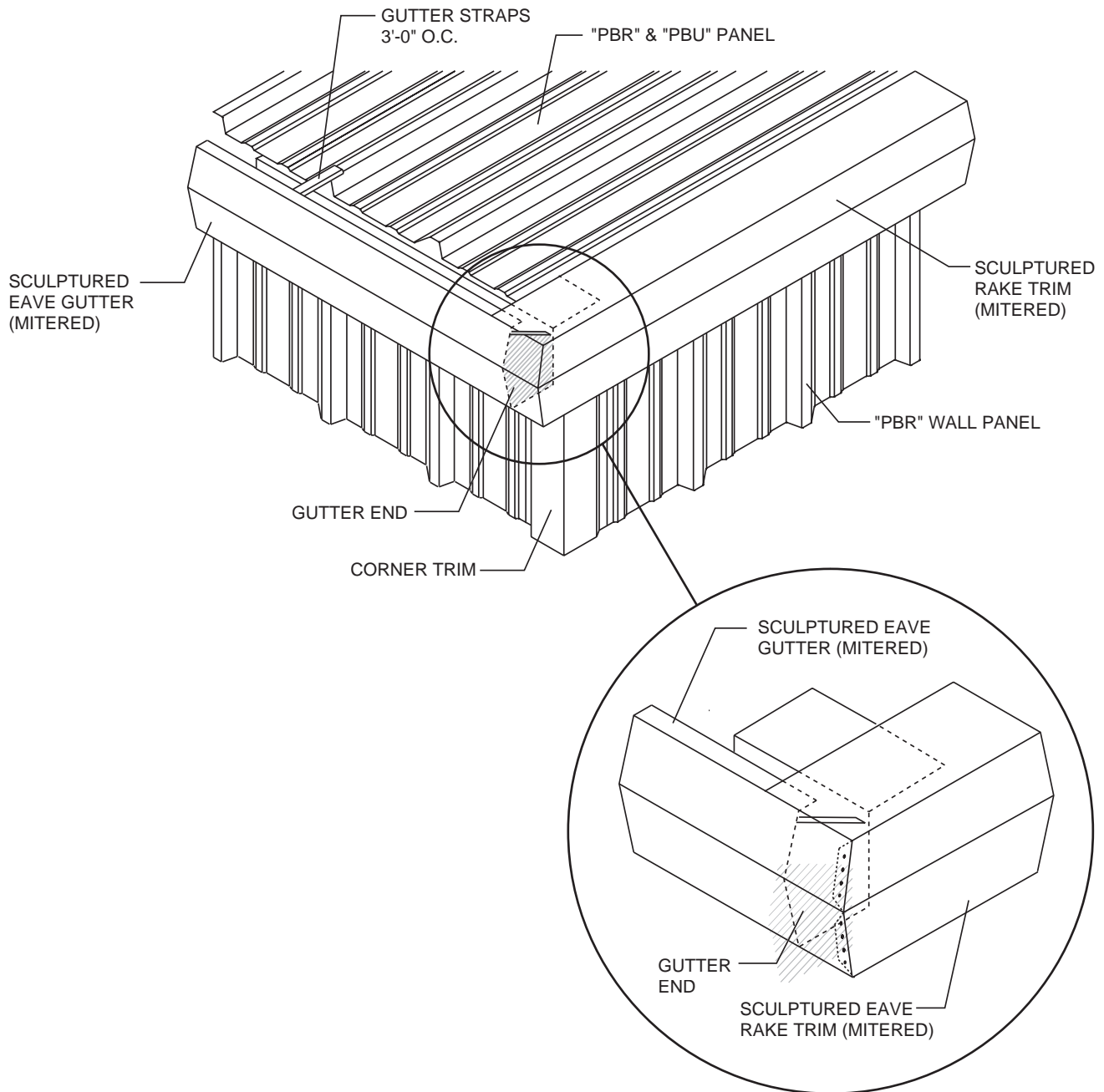
**NOTES:**

1. Install corner trim with Fastener #4 (1/4 - 14 X 7/8" Long Life Lap Tek) fastener 2'-0" O.C.

# PRODUCT INFORMATION

# "PBR" & "PBU" PANELS

## TYPICAL DETAILS Corner Box

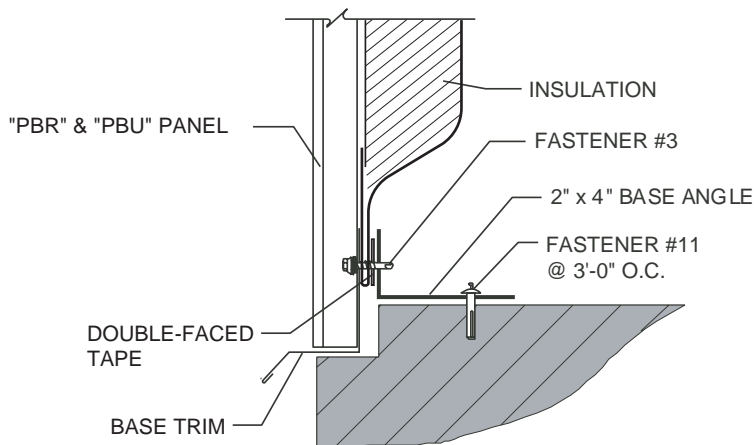
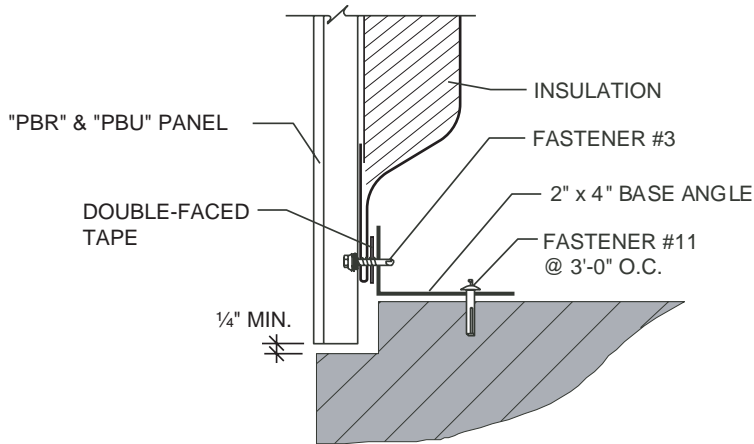


**NOTES:**

1. Gutter and rake trim must be ordered with a left and right mitered end. To determine left or right, stand on ground and look toward eave. **Roof slope must also be specified.**

# "PBR" & "PBU" PANELS PRODUCT INFORMATION

## TYPICAL DETAILS Base

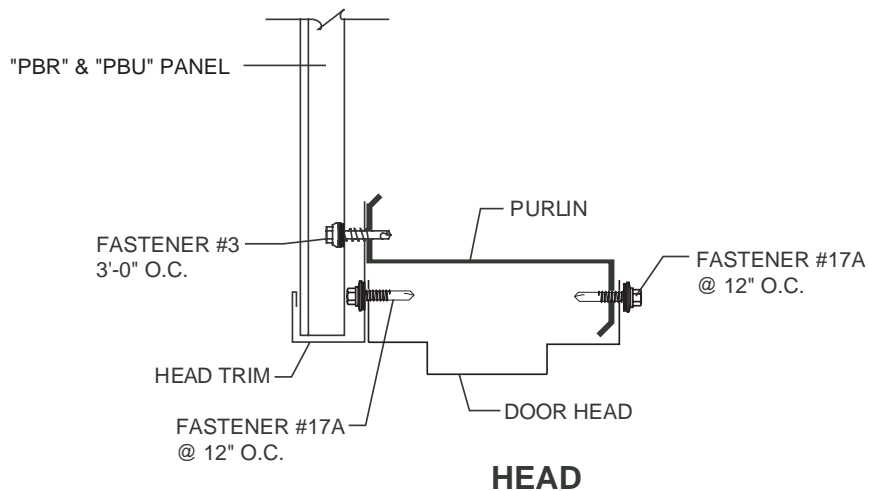
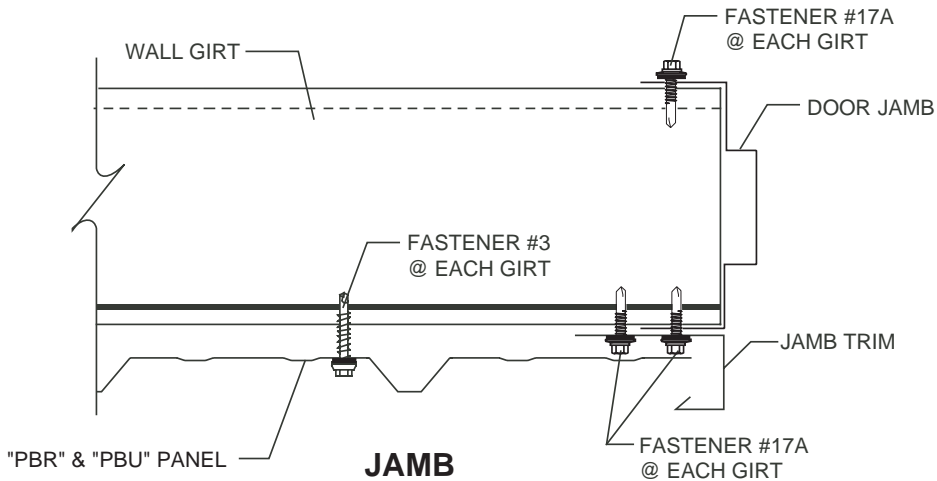


**NOTES:**

1. Wall with vinyl insulation, pull back fiberglass approximately 4" pull over end and staple. Apply double face tape to base angle and stick insulation to it before applying panel and fastening with Fastener #3 (1/4 - 14 x 1 1/4" Long Life Driller), six each per panel.
2. Should base trim be desired, temporarily attach trim to base angle with two Fastener #14 pop rivets until panels are installed.

# PRODUCT INFORMATION "PBR" & "PBU" PANELS

## TYPICAL DETAILS Head / Jamb



**NOTES:**

1. Install Jamb and Head Trim with pop rivets as required to support flashing during panel installation.

# “PBR” & “PBU” PANELS

# PRODUCT INFORMATION

## INSTALLATION GUIDELINES

### I. Pre-Order

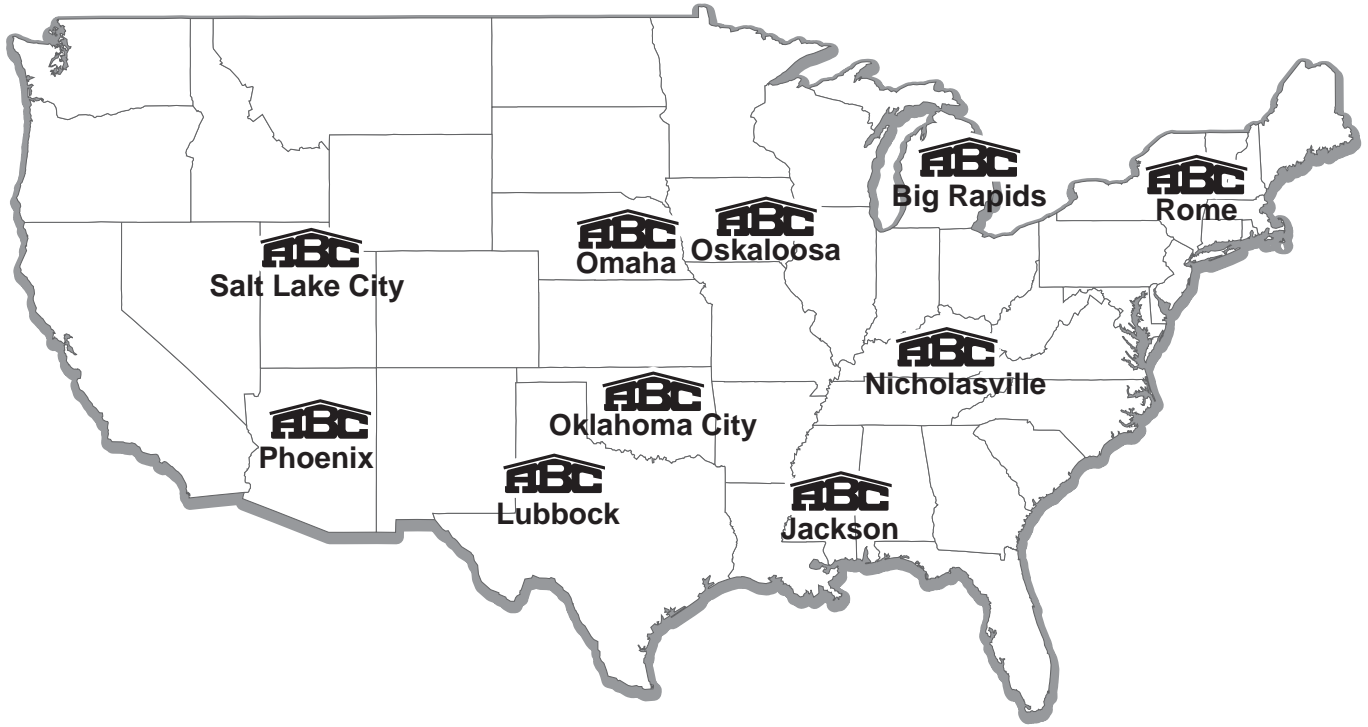
- A. Prior to ordering panels, all dimensions should be confirmed by field measurement.

### II. Job Site Storage and Handling

- A. Check the shipment against the shipping list.
- B. Damaged material must be noted on bill of lading.
- C. Panels should be handled carefully. A spreader bar of appropriate length is recommended for hoisting.
- D. Check to see that moisture has not formed inside the bundles during shipment. If moisture is present, panels should be wiped dry, then restacked and loosely covered so that air can circulate between the panels.

### III. Application Checklist

- A. Check substructure for proper alignment and uniformity to avoid panel distortion.
- B. Periodic check of panel alignment is crucial to proper panel installation.
- C. For proper appearance, ribs should line up at hips, valleys and ridges.
- D. Panels should be cut on ground to minimize cut filings on roof. Keep panels clean during installation. Do not allow panels to come into contact with water runoff from lead, copper or graphite.



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**SALT LAKE CITY, UT**  
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## Builders demanding maximum protection on their roofs use Grip-Rite® felt paper

Grip-Rite felt paper gives roofs maximum protection from rain and snow. Keeping water out from underneath roof shingles, Grip-Rite felt paper helps to extend the life of a roof.

Manufactured by top felt paper manufacturers, Grip-Rite felt paper can be depended on for its durability and strength in even the toughest of weather conditions.



SKU	Size		Description	ASTM Specifications
	Area	Dimensions		
FLT15D4869	432 ft. <sup>2</sup>	36 in. x 144 ft.	15# Asphalt Saturated Organic Felt Paper	Meets ASTM D4869 Type I
FLT30D4869	216 ft. <sup>2</sup>	36 in. x 72 ft.	30# Asphalt Saturated Organic Felt Paper	Meets ASTM D4869 Type I
FLT15D226	432 ft. <sup>2</sup>	36 in. x 144 ft.	15# Asphalt Saturated Organic Felt Paper	Meets ASTM D226 Type I & ASTM D4869 Type II
FLT30D226	216 ft. <sup>2</sup>	36 in. x 72 ft.	30# Asphalt Saturated Organic Felt Paper	Meets ASTM D226 Type I & ASTM D4869 Type IV



800-676-7777  
[www.grip-rite.com](http://www.grip-rite.com)  
[www.primesourcecbp.com](http://www.primesourcecbp.com)

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GRFPS  
07/2012





# Stego® Wrap Vapor Barrier

STEGO INDUSTRIES, LLC



**Vapor Retarders**  
**07 26 00, 03 30 00**

**1. Product Name**  
**Stego Wrap Vapor Barrier**

**2. Manufacturer**  
 Stego Industries, LLC  
 216 Avenida Fabricante, Suite 101  
 San Clemente, CA 92672  
 Sales, Technical Assistance  
 Ph: (877) 464-7834  
 Fx: (949) 257-4113  
 www.stegoindustries.com

**3. Product Description**  
 USES: Stego Wrap Vapor Barrier is used as a below-slab vapor barrier.  
 COMPOSITION: Stego Wrap Vapor Barrier is a multi-layer plastic extrusion manufactured with only high grade prime, virgin, polyolefin resins.  
 ENVIRONMENTAL FACTORS: Stego Wrap Vapor Barrier can be used in systems for the control of soil gases (radon, methane), soil poisons (oil by-products) and sulfates.

**5. Installation**  
 UNDER SLAB: Unroll Stego Wrap Vapor Barrier over an aggregate, sand or tamped earth base. Overlap all seams a minimum of six inches and tape using Stego Tape or Crete Claw® Tape. All penetrations must be sealed using a combination of Stego Wrap and Stego accessories.

For additional information, please refer to Stego's complete installation instructions.

**6. Availability & Cost**  
 Stego Wrap Vapor Barrier is available nationally via building supply distributors. For current cost information, contact your local Stego Wrap distributor or Stego Industries' sales department.

**7. Warranty**  
 Stego Industries, LLC believes to the best of its knowledge, that specifica-

tions and recommendations herein are accurate and reliable. However, since site conditions are not within its control, Stego Industries does not guarantee results from the use of the information provided and disclaims all liability from any loss or damage. No warranty, express or implied, is given as to the merchantability, fitness for a particular purpose, or otherwise with respect to the products referred to.

**8. Maintenance**  
 None required.

**9. Technical Services**  
 Technical advice, custom CAD drawings, and additional information can be obtained by contacting Stego Industries' technical assistance department or via the website.

- 10. Filing Systems**
- Stego Industries' website
  - Buildsite
  - 4Specs

**4. Technical Data**

**TABLE 1: PHYSICAL PROPERTIES OF STEGO WRAP VAPOR BARRIER**

PROPERTY	TEST	RESULTS
Under Slab Vapor Retarders	ASTM E 1745 Class A, B & C - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs	Exceeds Class A, B & C
Water Vapor Permeance	ASTM F 1249 - Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor	0.0086 perms *0.0036 WVTR
Puncture Resistance	ASTM D 1709 - Test Methods for Impact Resistance of Plastic Film by Free-Falling Dart Method	2266 grams
Tensile Strength	ASTM D 882 - Test Method for Tensile Properties of Thin Plastic Sheeting	70.6 lbf/in.
Permeance After Conditioning (ASTM E 1745 Sections 7.1.2 - 7.1.5)	ASTM E 154 Section 8, F 1249 - Permeance after wetting, drying, and soaking ASTM E 154 Section 11, F 1249 - Permeance after heat conditioning ASTM E 154 Section 12, F 1249 - Permeance after low temperature conditioning ASTM E 154 Section 13, F 1249 - Permeance after soil organism exposure	0.0098 perms 0.0091 perms 0.0097 perms 0.0095 perms
Methane Transmission Rate	ASTM D 1434 - Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting	**192.8 GTR mL(STP)/m <sup>2</sup> *day
Radon Diffusion Coefficient		5.5 x 10 <sup>-14</sup> m <sup>2</sup> /second
Thickness	ACI 302.1R-04 - Minimum Thickness (10 mils)	15 mils
Roll Dimensions		14 ft. wide x 140 ft. long or 1,960 ft <sup>2</sup>
Roll Weight		140 lbs.

Note: perm unit = grains/(ft<sup>2</sup> \*hr\* in.Hg) \* WVTR = Water Vapor Transmission Rate \*\* GTR = Gas Transmission Rate

Note: Test results above are for Stego Wrap products made as of March 15, 2013. If you have product made prior to March 15, 2013 please refer to Stego literature dated 10/12 for representative test results or call your local Stego Representative with questions.



**ALPOLIC<sup>®</sup>**  
**MATERIALS**

**1. Product Name**

ALPOLIC<sup>®</sup> Aluminum Faced Composite Panel

**2. Manufacturer**

Mitsubishi Plastics Composites America, Inc.  
 401 Volvo Parkway  
 Chesapeake, VA 23320  
 (800) 422-7270  
 Fax: (757) 436-1896  
 E-mail: [info@alpolic.com](mailto:info@alpolic.com)  
[www.alpolic-northamerica.com](http://www.alpolic-northamerica.com)

**3. Product Description**

**BASIC USE**

ALPOLIC<sup>®</sup> is a lightweight, rigid, bendable and durable aluminum faced composite panel widely used as an interior and exterior wall cladding in commercial and institutional applications. It offers design flexibility through a wide variety of fabrication techniques, including panels into curves, angles and pan configurations.

**COMPOSITION & MATERIALS**

ALPOLIC panels consist of a core of thermoplastic material thermally bonded to face sheets fabricated of aluminum 3105 H14 alloy, 0.020" (0.5 mm) thick or an equivalent.

**TYPES**

Several types of ALPOLIC panels are available, including:

- ALPOLIC standard panels
- ALPOLIC A-LOOK<sup>®</sup> reflective finish panels
- ALPOLIC Stone Series simulated stone finish panel
- ALPOLIC Timber Series simulated wood finish panels
- ALPOLIC Decorative Metal panels
- ALPOLIC Natural Metals copper mill finish panels
- ALPOLIC anodized class 1 finish panels

**SIZES**

ALPOLIC panels are available in 3, 4 and 6 mm thicknesses, in standard widths of 50" (1270 mm) and 62" (1575 mm) and standard lengths of 122", 146" and 196" (3099, 3708 and 4978 mm).

A range of custom sizes is available:

- Width - 32" - 62" (813 - 1575 mm)
- Length - 76" - 24' 2" (1930 - 7366 mm)

**FINISHES**

- Lumiflon<sup>®</sup> FEVE resin based fluoropolymer coil coat meets performance requirements of AAMA 2605 (standard)
- Kynar<sup>®</sup> PVDF resin based fluoropolymer coil coat meets performance requirements of AAMA 2605 (custom)
- Polyester
- Class I anodized - Clear, along with other colors

Standard ALPOLIC with Lumiflon FEVE fluoropolymer finishes are available in a broad spectrum of gloss levels, from 30 - 70%. Contact the manufacturer for minimum quantities and availability. Lumiflon, in its ambient cure spray product, allows close-matching field touch-up and recoat.

A-LOOK Series offers an array of reflective surfaces for interior and exterior application. Stocked colors are chrome, gold and bronze.

Stone Series is a simulated stone fluoropolymer finish combined with fluoropolymer colors in white marble and red, pink, white and black granite finishes.

ALPOLIC Lumiflon FEVE colors are available in full gloss range with minimum 1000 ft<sup>2</sup> (93 m<sup>2</sup>) coil coated orders. Allow 8 weeks for shipment of custom colors.

Complete custom color matching, available in ALPOLIC Lumiflon FEVE coatings, is subject to minimum order quantities. A selection of stock fluoropolymer colors is available in a quick ship program in 4 mm panel thickness.

Quick Ship stock 4 mm thick ALPOLIC panel selections. Contact Mitsubishi Plastics Composites America, Inc. (MPCA) customer service for color and size availability.

**SHAPES & FABRICATION**

ALPOLIC panels can be cut, routed and formed with conventional woodworking tools. Angle bends are formed by routing the back of the panel prior to shaping. The common pan shape is formed by routing the back edges, trimming the corners and bending and reinforcing the edges.

ALPOLIC can be rolled on a pyramid or 4-stand roll bender to a curved shape for curved corners or column covers. Bumping on a press brake also can be used to produce a curved surface.

The bending radius of ALPOLIC 4 mm panels is as small as 2" (51 mm). Corner radii can be detailed as small as 1/8" (3.2 mm) using the back routed method described in ALPOLIC literature.



**4. Technical Data**

**APPLICABLE STANDARDS**

American Architectural Manufacturers Association (AAMA) - AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

**ASTM International**

- ASTM C297 Standard Test Method for Tensile Strength on Flat Sandwich Constructions in Flatwise Plane
- ASTM C976 Standard Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box (Withdrawn 2002)
- ASTM D635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
- ASTM D696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
- ASTM D1037 Standard Test Method for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
- ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives
- ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics
- ASTM E8 Standard Test Method for Tension Testing of Metallic Materials
- ASTM E72 Standard Test Methods for Conducting Strength Tests of Panels for Building Construction
- ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials



Mitsubishi Plastics Composites America, Inc.



Properties	ALPOLIC		A-LOOK	
	4 mm	6 mm	2 mm	3 mm
Aluminum thickness, in (mm)	0.020 (0.5)	0.020 (0.5)	0.010 (0.25)	0.010 (0.25)
Weight, psf (kg/m <sup>2</sup> )	1.12 (5.5)	1.50 (7.32)	0.59 (2.9)	0.80 (3.9)
Coefficient of expansion, ASTM D696, in/in/°F	13 × 10 <sup>-6</sup>	13 × 10 <sup>-6</sup>	13 × 10 <sup>-6</sup>	13 × 10 <sup>-6</sup>
Tensile strength, ASTM E8, psi (MPa)	6913 (48)	4978 (35)	-	-
Yield strength, ASTM E8, psi (MPa)	6429 (44)	4466 (30)	-	-
Elongation	13.5%	17.5%	-	-
Thermal conductance, ASTM C976, Btu/(ft <sup>2</sup> × h × °F) (W/(m <sup>2</sup> × K))	10.75 (18)	8.53 (14)	-	-
Minimum Drum peel, ASTM D1781, in-lb/in(N-mm/mm)	22.5 (100)	22.5 (100)	-	-
Thermal resistance, ft <sup>2</sup> × h × °F/Btu (m <sup>2</sup> × K/W)	0.09 (0.016)	0.12 (0.021)	-	-
Sound transmission coefficient, ASTM E413	26	26	-	-

Properties	ALPOLIC	
	4 mm	6 mm
Surface burning characteristics, ASTM E84		
Smoke developed index	450 maximum	450 maximum
Flamespread index	25 maximum	25 maximum
Vertical transmission, ASTM E108 (modified)	Passed	Passed
Ignition temperature, ASTM D1929		
Flash ignition	716° F (380° C)	-
Self-ignition	752° F (400° C)	-
Rate of burning, ASTM D635	CCI	-

- ASTM E108 (Modified) Standard Test Methods for Fire Tests of Roof Coverings
- ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Difference Across the Specimen
- ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
- ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
- ASTM E413 Standard Classification for Rating Sound Insulation

**APPROVALS**

ALPOLIC® Aluminum Faced Composite Panel meets the following standards:

- International Building Code (IBC)
- Underwriters Laboratories (UL): UL94, UL879
- Miami Dade NOA
- Florida Building Code

**PHYSICAL/CHEMICAL PROPERTIES**

See Table 1.

**FIRE PERFORMANCE**

See Table 2.

**5. Installation**

**PREPARATORY WORK**

The manufacturer recommends field measurement prior to fabrication. Verify alignment of surfaces to receive panels.

**APPLICATION**

ALPOLIC surfaces can be attached to one another or to other materials by conventional methods of attachment - rivets, bolts or screws. For interior installation, flat surfaces of ALPOLIC can be attached to substrates such as gypsum

board using double-faced tape or non-hardening adhesive.

**PRECAUTIONS**

ALPOLIC panels are prefinished architectural products requiring care in handling to avoid damage to the finish. Handle, store, install and clean panels following the manufacturer's instructions. Comply with manufacturer's recommendations regarding expansion and contraction in detailing and installing ALPOLIC.

**6. Availability & Cost**

**AVAILABILITY**

ALPOLIC panels are available worldwide through the regional offices of Mitsubishi Plastics Composites America, Inc. Contact Mitsubishi for the location of an area ALPOLIC representative.

**COST**

Contact the area representative or the Mitsubishi Plastics Composites America, Inc., home office



*Choosing environmentally friendly building products today,  
ensures sustainable structures for future generations.*



## Industry first cellulose 3.5" and 5.5" batt insulation

Renewable and Recycled Fibers

Environmentally Responsible

No Scrap Production

Zero Landfill

Class A Building Material

Superior Noise Absorption

STC 50 in 2"x4" Steel Stud Wall

Friction Fit

LEED Eligible

Does not Irritate Skin

Easy to Install

R20 - 5.5" batt

R13 - 3.5" batt



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green

innovative

performance

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value

## Product Performance

- High R-value performance
  - R13 - ECOCELL® 3.5" batt
  - R20 - ECOCELL® 5.5" batt
- Meets or exceeds ASTM testing for both commercial and residential insulation
- Controls and deadens sound due to density of cellulose fibers and non-woven manufacturing process
- Reduces airborne sound transmission from room to room and blocks outdoor noise for a noticeable quietness
- Easy to handle and install, no special equipment required to install
- Manufactured for a tight, friction fit
  - available in 16" or 24"



## Environmental Responsibility

- Made from a combination of recycled and renewable fibers, majority of which is post-consumer recycled newspapers
- Contains a minimum of 70% recycled content
- Zero waste in the manufacturing process
- CMS creates a "greener" manufacturing process by reducing energy use and air pollution during manufacturing
- Environmentally responsible - entirely recyclable

## Product Safety

- Class A fire rating
- Easy to handle compared to fiberglass insulation products
- Contains no harmful airborne particles
- Does not itch or irritate skin
- Contains an EPA registered fungicide to resist the growth of mold



## Physical Properties

• Surface Burning Characteristics ASTM E-84, UL 723	Flame Spread	Class A	15
• Flammability Characteristics ASTM E-970	Smoke Developed	Class A	<450
• Environmental Characteristics ASTM C-739 ASTM C-739	Critical Radiant Flux	Greater than or equal to 0.12w/cm <sup>2</sup>	
• Physical Characteristics ASTM C-518 ASTM C-739 ASTM C-1304	Corrosiveness	Acceptable	
	Fungal Resistance	Acceptable	
• STC 50 in 2"x4" steel stud wall	Thermal Resistance	R-3.6 per inch	
	Moisture Absorption	Acceptable	
	Odor Emission	Acceptable	

cellulose material solutions, llc  
 2472 port sheldon st.  
 jenison, mi 49428  
 +888 968 9877  
 cmsgreen.com

for ALPOLIC pricing. Costs vary due to project size, finish selection and panel sizes.

**7. Warranty**

Contact the manufacturer for information on panel and finish warranties.

**8. Maintenance**

LUMIFLON FEVE fluoropolymer is a long-term, maintenance-free finish. Under normal exposure and use, it is self-cleaning through rain washing. Water flush or power washing with a mild detergent is recommended to remove heavy soil.

**9. Technical Services**

Contact ALPOLIC for technical assistance with design and specification or for the name of a nearby representative.

**10. Filing Systems**

- SmartBuilding Index (SBI)
- MANU-SPEC®
- Additional product information is available from the manufacturer.



# Technical Bulletin

2400 Boston Street, Suite 200, Baltimore, Maryland 21224  
Phone: 410-675-2100 or 800-543-3840

Revised: 03-22-11

## DAPtex<sup>®</sup> Plus Multi-Purpose Foam Sealant

- Seals, insulates and weatherproofs
- Easy water clean-up
- Won't overexpand
- Tough and durable
- Conserves energy to save money
- No paint thinner required
- Water resistant
- Paintable
- Toolable and moldable
- Reusable, non-clogging applicator
- Interior /Exterior

**Packaging:** Net Wt. 12oz (340g)  
**Color:** White  
**UPC Number:** 0 70798 18836 5, 0 70798 18822 8

### Company Identification:

Manufacturer: DAP Products Inc., 2400 Boston St., Baltimore, Maryland 21224  
Usage Information: DAP HELPLINE: 888-DAP-TIPS, 9:00 am to 7:00 pm EST.  
Order Information: 800-327-3339  
Fax Number: 410-534-2650  
Also, visit the DAP website at [dap.com](http://dap.com).

### Product Description:

DAPtex<sup>®</sup> Plus Multi-Purpose Foam Sealant is a latex-based product used for filling voids and sealing large gaps. Designed to meet the tough standards demanded for professional window & door installations while offering the easiest-to-use technology for DIYers. When applied properly, this patented formula helps reduce energy loss and damage that can be caused by air, rain and pest infiltration.

### Suggested Uses:

#### Seals and Insulates:

- Windows
- Doors
- Ducts
- Pipes
- Vents
- Electrical Box Perimeters

#### Great for:

- Wood
- Concrete
- Brick
- Vinyl
- Steel
- Aluminum

### **Performance Characteristics:**

- **DAPtex<sup>®</sup> Plus** will not over expand like polyurethane foams. **DAPtex<sup>®</sup> Plus** will expand to 90% of its full size immediately upon application. Full expansion will be achieved within 20-30 minutes, depending on bead size, temperature and humidity.
- Proven not to bow, buckle or distort window and door frames.
- Tack free in 10 minutes. A one inch bead fully cures in 24 hours depending on bead size, temperature and humidity.
- Toolable and moldable while wet. Do not trim or remove skin of the cured foam.
- Flexible when cured.
- Cured foam can be painted with latex paint.
- Easy soap and water clean-up when wet.
- When fully cured the product should be firm to the touch and withstand moderate pressure.

### **Surface Preparation & Application:**

#### **INSTRUCTIONS: READ DIRECTIONS AND SAFETY INFORMATION BEFORE USE!**

1. Product is **EXTREMELY FLAMMABLE WHILE DISPENSING!** Refer to label and Material Safety Data Sheet and extinguish all ignition sources during use and cure.
2. To avoid risk of electric shock when perimeter sealing electrical switches and outlet boxes, disconnect power during application of product and until product is fully cured. \*When perimeter sealing switches or electrical boxes, do not fill box.
3. Wear safety glasses and use in well-ventilated areas.
4. Clean and remove grease, dirt and debris from application area.
5. Shake can vigorously for 1 minute before use.
6. Push straw into nozzle located above the trigger.
7. Remove safety tab above trigger.
8. Apply at temperatures between 45°F -105°F. The product should be above 60°F for optimum dispensing rate.
9. Slowly dispense foam from can in upright position, filling cavity to 90% to allow for minimal expansion.
10. For best results, tool or shape while wet. Do not trim or remove skin of the cured foam.
- 11. For exterior applications, foam must be painted with a quality exterior latex paint after fully cured.**
12. If storing for reuse, remove straw and clean it and nozzle with warm water. Cured material can be removed from nozzle or straw with a pipe cleaner or paper clip.
13. Not recommended for use at or below grade, or for closed cavities. For gaps more than 2" deep, use multiple layers of 1"-2" each.

### **Physical & Chemical Characteristics:**

Color	White
Consistency:	Foam (cured product has sponge-like consistency)
Vehicle:	Latex
Flash Point(of blowing agent):	<0°F
Flammability:	Level I Aerosol
Propellant:	Proprietary
Shelf Life:	12 Months when stored at 60-100°F
Temperature Service Range:	0°F to 150°F
Temperature Application Range:	45°F to 105°F (45°F and rising)
Packaging:	Standard – 12 oz. Aerosol Can
MSDS No.:	000 77344 003
Coverage:	One 12 oz. Can yields 510 feet at a 1/4" bead

### **Clean Up and Storage:**

Uncured foam can be cleaned up with soap and water. Excess cured sealant can be scraped off.



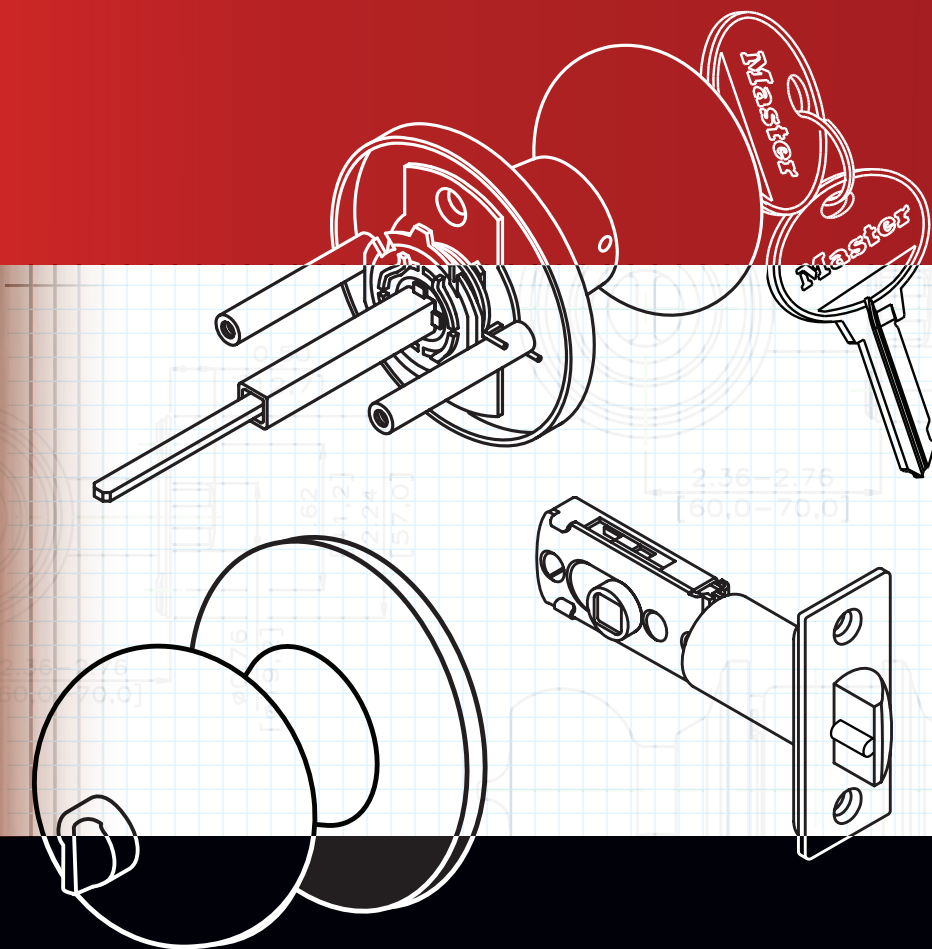
**Safety:**

See product label and Material Safety Data Sheet (MSDS) for complete safety information. You can request an MSDS by visiting our website at [dap.com](http://dap.com) or by calling 888-DAP-TIPS.

**Warranty Information:**

Buyer assumes all risks of use, handling and storage of product not in strict accordance with label directions. Liability for any incidental or consequential damages or loss is specifically excluded at all times. Any implied **warranty of fitness for a particular use** is excluded. Seller will not accept liability for more than product placement or purchase price refund.

An  Company



**Master  
Lock®**

Door Hardware  
Technical Manual  
Version 4.12



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## **BumpStop® ADVANCED CYLINDER TECHNOLOGY**

---

The BumpStop® advanced cylinder technology is standard equipment in all Grade 2 lock products. Because of the cylinder design, it cannot be offered as an option in the Grade 3 products.

One primary component of BumpStop® technology is a special stainless steel driver pin shown at the right. Only one of these special pins is required in a cylinder to make it bump resistant, but in some cylinders we actually place two to eliminate the potential for someone to develop a systematic method of defeating the BumpStop® technology.



Cylinders that are compatible with the BumpStop® pin have been specially manufactured to exacting specifications, and consequently, our BumpStop® pins may not be used effectively to prevent a bump attack in other cylinders. In fact, our BumpStop® pins may not be used in retrofit door hardware cylinders that were supplied by us prior to July 2008, or in other manufacturers' cylinders.

The current proposed ASTM standard for bump resistance has a highest grade level of 6, and to qualify for that level of resistance a number of cylinders must each successfully withstand 60 bump impacts without operating. Master Lock routinely subjects our test cylinders to 240 impacts without losing any of the bump resistance.

The location of the BumpStop® pin within the cylinder is a critical factor for the bump resistance. The last column of the table on the next page indicates which depths of cut must be associated with the location of the BumpStop® pin in the cylinder.

Cylinders keyed at our factory have the bible marked to indicate the month and year they were produced and a number indicating which chamber contains the BumpStop® pin(s). When rekeying, consult the table and relocate the BumpStop® pin in the appropriate pin chamber for your new combination.

Master Lock uses ITL key machines to produce door hardware keys to original manufacturer specifications. We also can take your existing bittings from a MK system and regenerate your entire system including all designed expansion. A copy of that expanded bitting list in both places allows you to select the exact keys you desire and be assured that they will be produced as you want them.

Because there may not be a constant cut of the correct depth for the specific brand, some MK system locks for existing systems cannot be BumpStop® compatible.

Master Lock also sells these cylinders Zero Bitted if you prefer to do your own keying. In those cases you can use the part number map on page 16 to determine the correct part number for the keyway you desire.

The BumpStop® pin will always be located in the 5th pin chamber in Zero Bitted locks for your convenience. Simply relocate the pin to the appropriate pin chamber for a compatible depth of cut as shown in the table on page 3. Zero Bitted cylinders will not have markings on the bible for the BumpStop® pin location.

# DOOR HARDWARE CODES

## Naming Convention

Two numbers = Keyway, one letter = # of pins V = 6/T = 5, four or five numbers = blind code.

Brand	Number of Pins	First Code	Last Code	ITL#	BumpStop® Compatible Cuts
Arrow®	5	10T1001	10T5668	027	0 – 1 – 2
Corbin® 59A1	5	01T1001	01T6404	113	1 – 2 – 3
Corbin® 59A1	6	01V10001	01V42433	113	1 – 2 – 3
Corbin® 60	5	29T1001	29T9252	126	0 – 1 – 2
Corbin® 60	6	29V10001	29V61173	126	0 – 1 – 2
Corbin® Russwin® L4	5	07T1001	07T3420	122	1 – 2
Corbin® Russwin® L4	6	07V1001	07V9995	122	1 – 2
Harloc®, Lori® L200, Sargent® S, Sargent® U	5	02T1001	02T6399	388	1 – 2 – 3
Kwikset®, Master®	5	12T1001	12T3658	265	1 – 2 – 3
Lockwood®	5	08T1001	08T9252	266	0 – 1 – 2
Lockwood®	6	08V10001	08V61173	266	0 – 1 – 2
Lori® 80	5	80T1001	80T6399	271	1 – 2 – 3
Lori® 90	6	90V10001	90V42432	271	1 – 2 – 3
Master®/Dexter®	5	32T1001	32T2728	142	0 – 1 – 2
Russwin® 981/852	5	11T1001	11T3221	378	0 – 1
Russwin® D1	5	30T1001	30T9252	379	0 – 1 – 2
Russwin® D1	6	30V10001	30V61173	379	0 – 1 – 2
Sargent® LA-LC	5	36T1001	36T6399	388	1 – 2 – 3
Sargent® LA-LC	6	36V10001	36V42432	388	1 – 2 – 3
Sargent® RA-RC	5	70T1001	70T6399	388	1 – 2 – 3
Sargent® RA-RC	6	70V10001	70V42432	388	1 – 2 – 3
Schlage® C, Schlage® P	5	04T1001	04T9252	391	0 – 1 – 2
Schlage® C, Schlage® P	6	04V10001	04V61173	391	0 – 1 – 2
Schlage® E	5	34T1001	34T9252	391	0 – 1 – 2
Schlage® E	6	34V10001	34V61173	391	0 – 1 – 2
Segal®	5	27T1001	27T3420	395	0 – 1 – 2
Weiser®	5	13T1001	13T9252	167	0 – 1 – 2
Weslock®	5	33T1001	33T9252	468	0 – 1 – 2
Yale® 8	5	03T1001	03T9252	476	0 – 1 – 2
Yale® 8	6	03V10001	03V61173	476	0 – 1 – 2
Yale® GA	5	15T1001	15T9252	476	0 – 1 – 2
Yale® GA	6	15V10001	15V61173	476	0 – 1 – 2

1176 Compatible Keyway	1145 Compatible Keyway
Use cuts 1, 2 or 3	Use cuts 0, 1 or 2

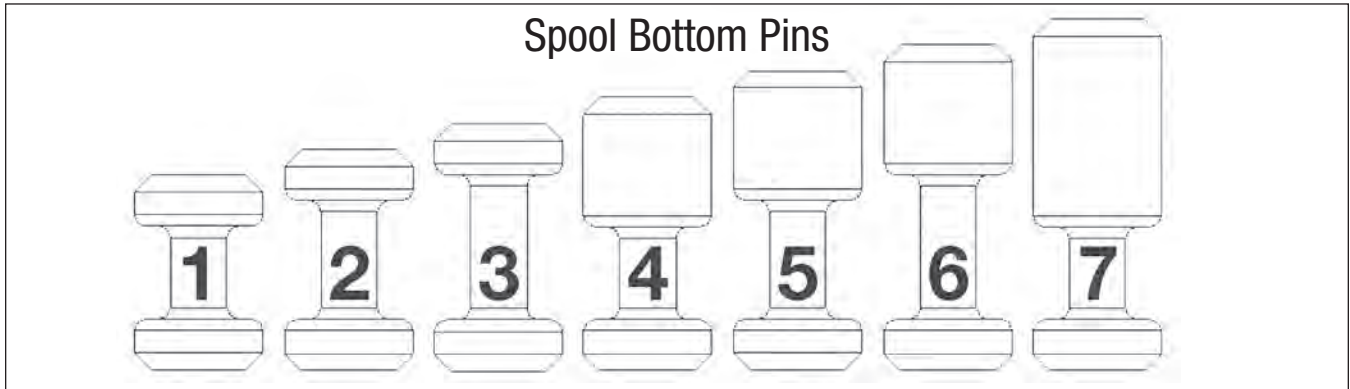
NOTE: From time to time customers will order Master Keying parameters, and in those cases, a special bitting list will be sent to the manufacturing facility along with the order.

All marks are registered trademarks of their respective owners

# Grade 2 Residential

The Grade 2 residential products are available only with a default keyway compatible with an Ilco 1176 key and an appropriate pinning kit. A second keyway is planned and will be compatible with an Ilco 1145 or 1145A key and an appropriate pinning kit. When available, the 1145 compatible keyway may be specified by adding D045 or D046 to the product part number.

There are some special requirements associated with the BumpStop® pins used in these products. Because of the PVD finish used on the cylinders, the BumpStop® technology requires the use of a spool bottom pin in conjunction with the BumpStop® pin for the 1176 compatible keyway. A single BumpStop® pin is required to make the lock bump resistant, but at times we install a second one in some cylinders to eliminate the potential for someone to develop a systematic method of defeating the BumpStop® technology.



The same principle applies to the use of the spool bottom pins associated with the BumpStop® pin. In order to eliminate the potential for someone to develop a systematic method of defeating the BumpStop® technology we install a second spool bottom pin in every cylinder. That second spool bottom pin does not have to be associated with a BumpStop® pin. Our supplemental pin kit 291BS1 consists of spool bottom pins of every potential size along with the correct driver spring for use in the cylinder.

The 1145/1145A compatible keyway does not require the use of spool bottom pins and standard .115" diameter pin tumblers may always be used in those cylinders. The table below indicates which cut depths/bottom pins must be associated with the BumpStop® pin in the cylinder.

1176 Compatible Keyway	1145 Compatible Keyway
Use cuts 1, 2 or 3	Use cuts 0, 1 or 2



291BS1 Rekeying Kit

## NightWatch® Function

## Grade 2 Residential

The NightWatch® mechanism consists of a simple mechanical deadbolt within the thumb turn mechanism. The inside view of the thumb turn assembly here displays the interlocking features. The spindle of the thumb turn has two depressions cast into it and those depressions match two projections from the mounting plate when the spindle is turned 90° to extend the bolt.



The movable button on the bottom of the mounting plate can be pressed upward, and that allows the thumb piece to be pulled outward and engage the interlocking features. Shown (left) is a side view of the spindle and mounting plate. Note the spindle deadlock and the groove in the spindle.

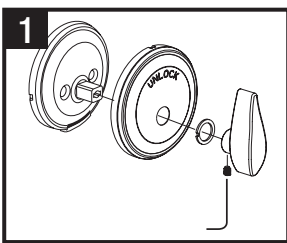
The button at the bottom of the mounting plate raises the spindle deadlock out of the groove in the spindle and allows it to be pulled outward. When it is pulled outward the two parts interlock and prevent the thumb turn from being turned at all unless it is first pushed inward.

Because the cylinder tailpiece also enters the spindle, when the spindle is immobilized, the tailpiece is too, and the cylinder cannot be used to operate the lock.

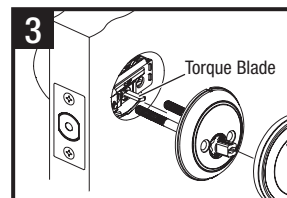
In the combination deadbolt, the dial mechanism is connected to a cam that turns the tailpiece, and this also is rendered inoperable.

The NightWatch® function is only available in single cylinder deadbolts and combination deadbolts.

### Install interior lever assembly — NightWatch deadbolt

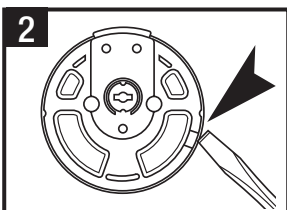


First, use the Allen wrench provided in the hardware package to remove thumb turn, washer and separate rose from rose plate. (see below)



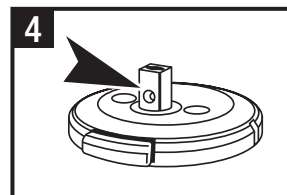
To install plate, align torque blade with turn piece assembly, insert screws through plate, through latch and into the threaded holes in the exterior housing. Tighten

screws. Snap rose onto rose plate. Attach thumb turn (see below) and tighten set screw with Allen wrench.



To separate the rose plate from the base, locate the notch on the back side of the base (the cover edge extends above the base in the notch area) and use a screwdriver to apply

pressure to the edge of the rose cover separating it from the base.

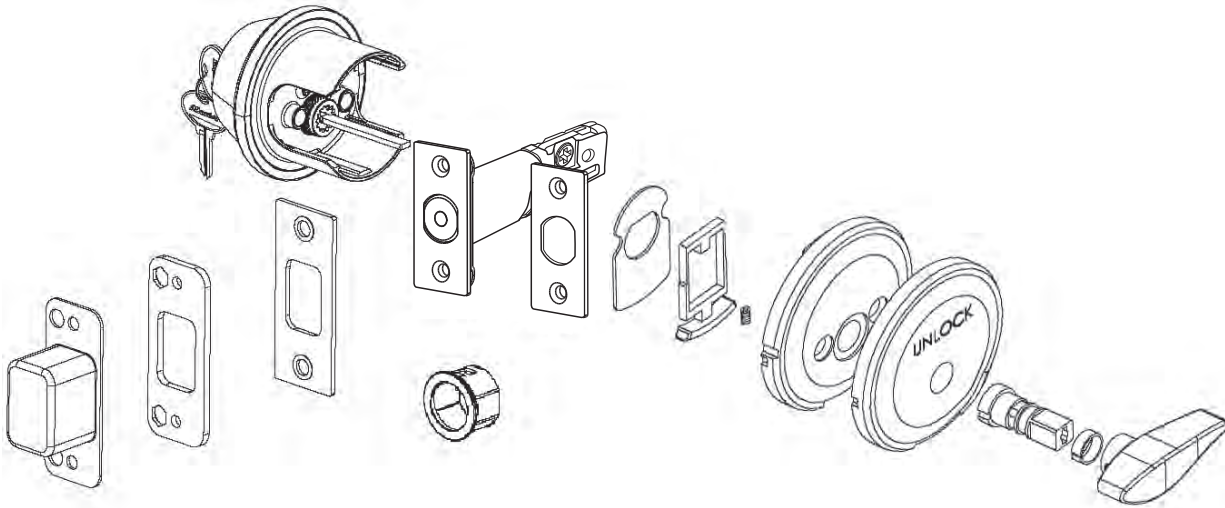


When you reattach the thumb turn, be sure that the recess in the spindle is pointing down. The set screw projects into this recess when tightened.



## Standard NightWatch® Deadbolt with BumpStop®

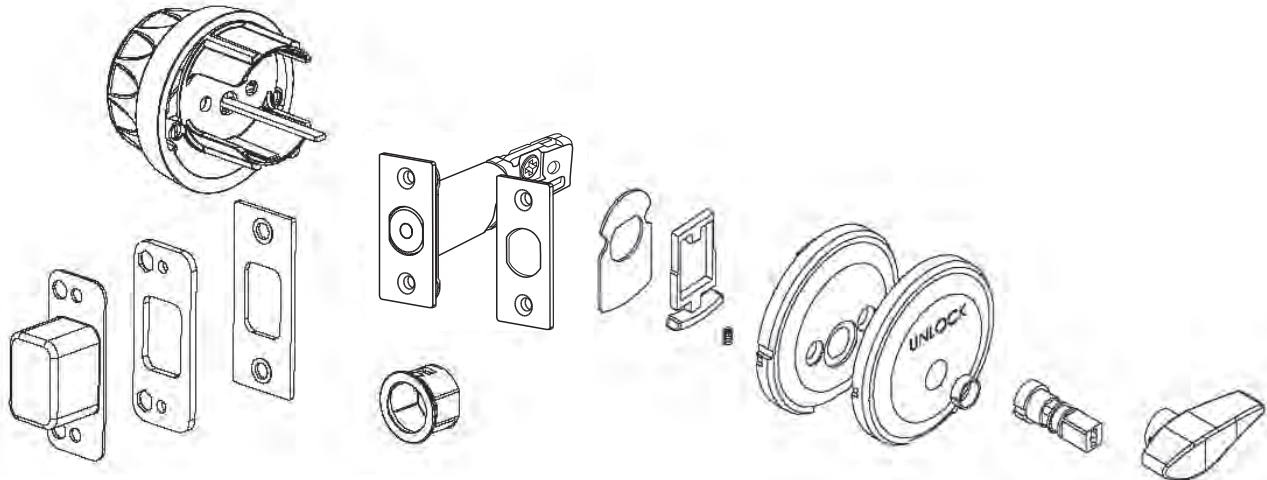
## Grade 2 Residential



Part Number		Product Description
Retail	Boxed	
DSRN0603P	DSNRN0603PKA4	NightWatch, Single Cylinder, Polished Brass with BumpStop®
DSNRN0605	DSNRN0605KA4	NightWatch, Single Cylinder, Antique Brass with BumpStop®
DSNRN0615	DSNRN0615KA4	NightWatch, Single Cylinder, Satin Nickel with BumpStop®
	DSRNSD03PD045	NightWatch, Single Cylinder (Schlage C Keyway), Polished Brass with BumpStop®
	DSRNSD05D045	NightWatch, Single Cylinder (Schlage C Keyway), Antique Brass with BumpStop®
	DSRNSD15D045	NightWatch, Single Cylinder (Schlage C Keyway), Satin Nickel with BumpStop®
	DSRNSD12PD045	NightWatch, Single Cylinder (Schlage C Keyway), Aged Bronze with BumpStop®

## Combination NightWatch® Deadbolt

## Grade 2 Residential

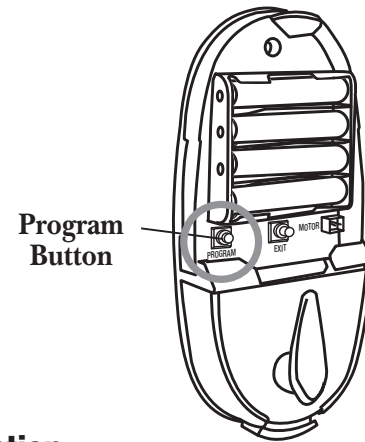
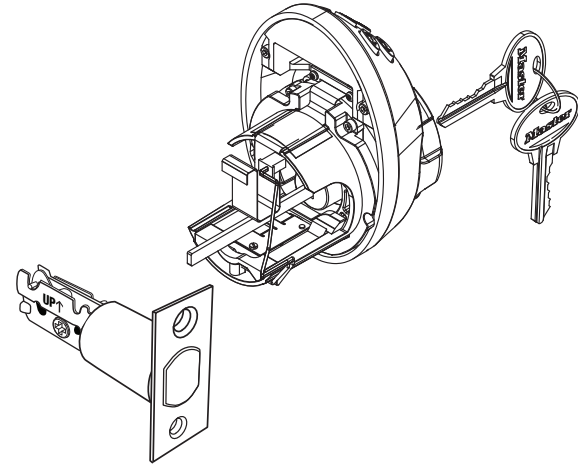
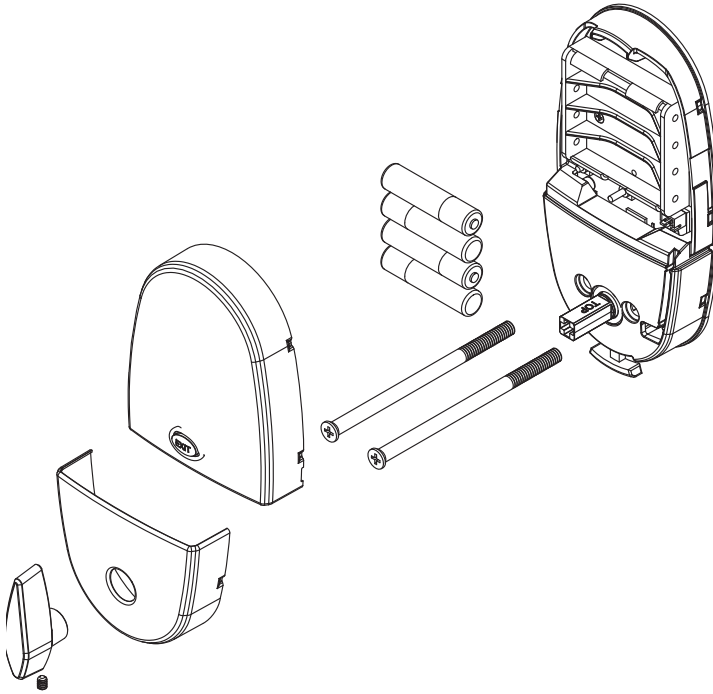


Part Number		Product Description
Retail	Boxed	
DSRN1003P	DSNRN1003PBOX	NightWatch, Single Cylinder, Polished Brass
DSRN1005	DSNRN1005BOX	NightWatch, Single Cylinder, Antique Brass
DSRN1015	DSNRN1015BOX	NightWatch, Single Cylinder, Satin Nickel

# Electronic Keypad NightWatch® Deadbolt

# Grade 2 Residential

Part Number		Product Description
Retail	Boxed	
DSKP0603PD	DSKP0603P	NightWatch, Electronic Keypad, Polished Brass
DSKP0605D	DSKP0605	NightWatch, Electronic Keypad, Antique Brass
DSKP0615D	DSKP0615	NightWatch, Electronic Keypad, Satin Nickel
DSKP0612PD	DSKP0612P	NightWatch, Electronic Keypad, Aged Bronze



## Keypad Deadbolt – Quick Reference for Programming Function

Step 1 Remove battery cover – Press and hold PROGRAM button until blue light flashes.

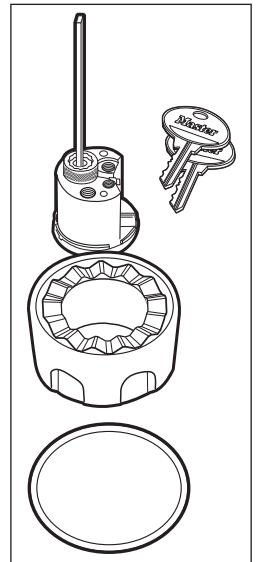
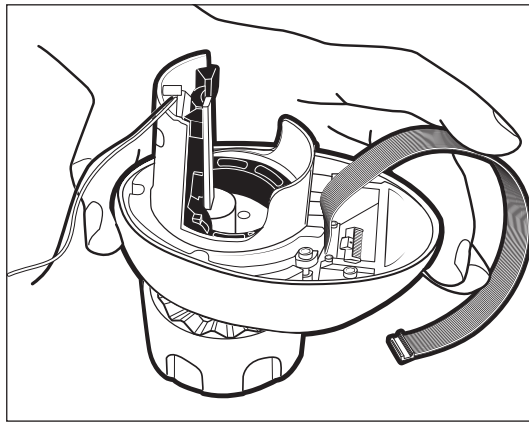
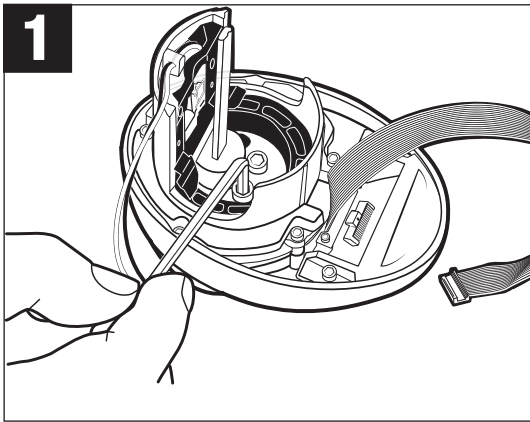
Step 2 Enter the data in the row below based on what you want to do.

- (Blue Light)
- (Green Light)
- (Red Light)

Steps >	2a	2b	2c	2d	2e	2f	2g	
Function	Enter Admin Code (from page 2 of User Guide)	Press Function Button	Press Enter	Enter	Press Enter	Data Confirmaton	Press Enter	Programming Completed
Add a User Code	Admin Code	1-2	ENTER	New 4 to 10 digit User Code	ENTER	New 4 to 10 digit User Code	ENTER	ENTER
Remove a User Code	Admin Code	1-2	ENTER	User Code to be removed	ENTER	User Code to be removed	ENTER	GREEN light is good RED light, restart at step 1
Change Admin Code	Admin Code	1-2	ENTER	New 6 digit Admin Code	ENTER	New 6 digit Admin Code	ENTER	
Delete All User Codes	Admin Code	1-2	ENTER	Current Admin Code	ENTER	ENTER GREEN light is good / RED light, restart at step 1		ENTER
Deactivate/Reactivate All user codes	Admin Code	1-2	ENTER		ENTER GREEN light is good / RED light, restart at step 1			ENTER

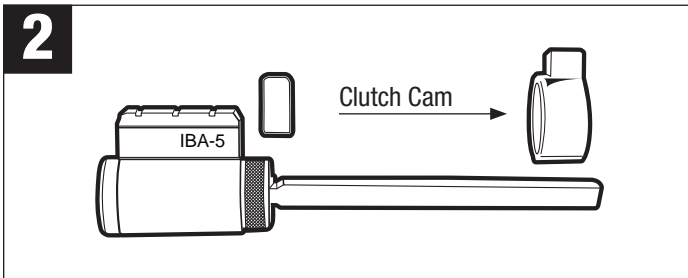
We recommend confirming changes by testing code after programming is complete

# Electronic Keypad NightWatch® Deadbolt Rekeying Grade 2 Residential



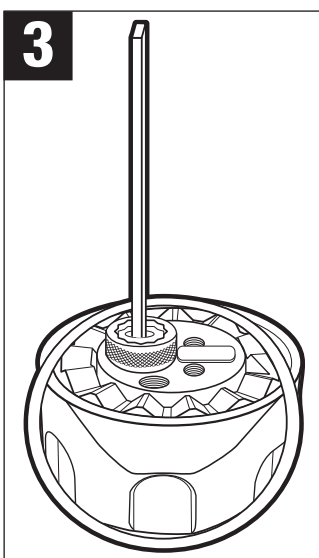
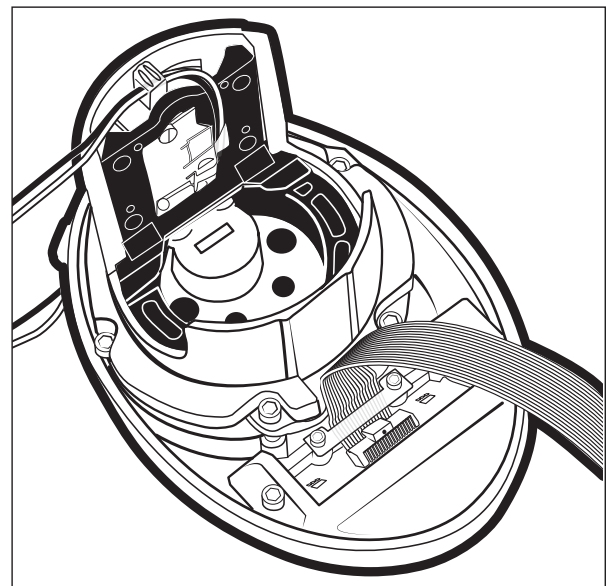
The cylinder housing is mounted via two screws in the exterior housing.

These screws have a thread locking substance on them. You will need to use the longer side of your hex wrench to loosen them. They are around 7/8" long and use a 9/64" hex. With the screws removed, lift the main housing to separate it from the trim.



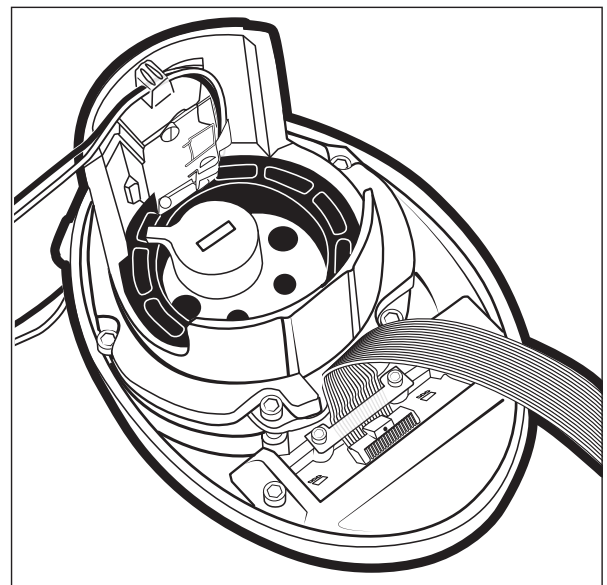
The cylinder bible has a spacer on the end. There is also a wave washer between the trim and the housing. Any original brand cylinder that has the same footprint can be used in place of this cylinder, just be sure to use the spacer and tailpiece from this cylinder.

Remove the black Clutch from the external housing to reveal the cam slot in the tailpiece activation mechanism. Put the clutch cam in place and replace the clutch.



Place the wave washer on the trim before mounting to the housing. The next step is to feed the tailpiece through the slot in the clutch cam and then tighten the screws to reassemble.

Looking at the tailpiece orientation from the back of the housing, it should be horizontal for mounting on a Right Hand door and vertical for a Left Hand door. Do not forget to pull the cable and wiring harness excess to the inside of the door when remounting. If not pulled there is a potential for the wiring to prevent free movement of the clutch.

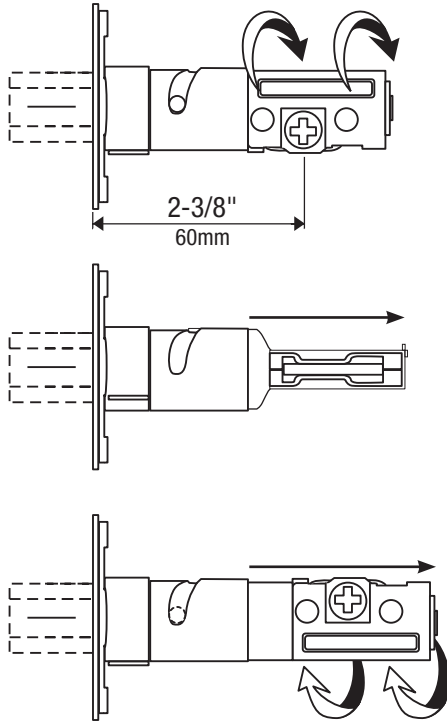


## Deadbolt Information

## Grade 2 Residential

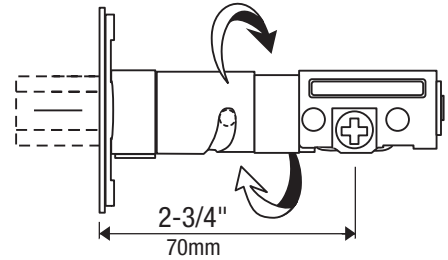
The deadbolt is available with a single or double cylinder function and may use any of the Master Lock Door Lock type BumpStop® cylinders, a Kaba Lori 1599 cylinder or any other 'size compatible' cylinder. The bolt has an adjustable backset for 2 3/8" or 2 3/4".

### Adjust the latch to match the backset dimension on your door



#### To change backset:

Changing your backset is as simple as gripping and turning the back portion of the latch. Turn clockwise to extend to 2-3/4" or counter-clockwise to return to 2-3/8". As the back rotates, it will 'spiral' in or out, as the mechanism follows the machined groove.



When extending to 2-3/4", be sure to flip the entire latch assembly before placing it in the door. The tailpiece receiver hole (⊕) should always be positioned at the bottom of the assembly.

## Combination NightWatch®

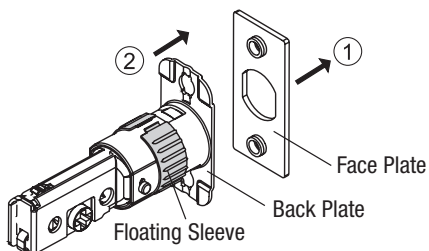
## Grade 2 Residential

The bolt has changeable face plates to allow square corners, radiused corners or a drive-in face plate.

### Attach the latch face that matches the mortise in the edge of your door

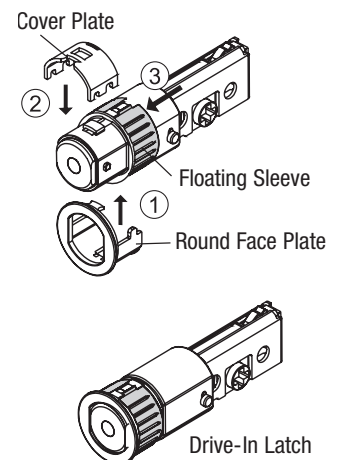
#### To change latch faces:

1. Use a flat screwdriver to separate the face plate.
2. Snap selected latch face onto back plate.



#### For drive-in installation:

1. Put the round face plate into latchbolt as illustrated.
2. Press the cover plate to lock in with latch and round face plate.
3. Push the floating sleeve forward until it is positioned at the latch.



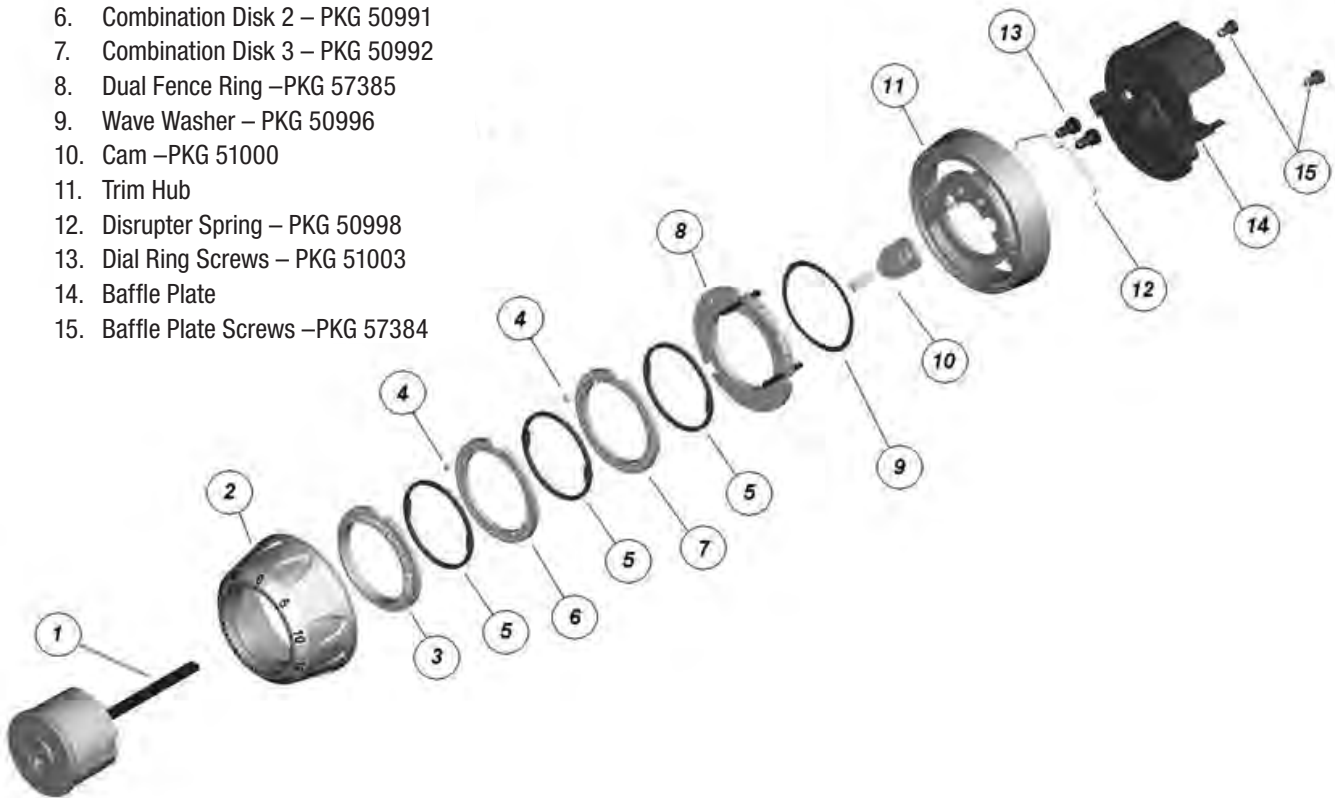
To change from a square to radiused corner face plate, pry off the existing face plate and then attach the new one. Face plates have a ferrule that is slightly swaged to hold it in place. Use a small screwdriver or chisel to make prying easier, then swage the new face plate in place.

If changing to a drive-in bolt, pry off the existing face plate. Then:

- Spread the floating sleeve and move it away from the back plate
- Push in on the back plate and turn counter-clockwise, then pull off
- Place the round face plate on the bolt
- Move the floating sleeve forward

Below is the exploded view of the cylinder/dial assembly. You will find instructions for decoding an existing combination and for encoding a new combination immediately after the exploded view. Two parts below are critical to lock operation: Item 4, the fly- PKG50994 and Item 12, the disruptor spring – PKG50998. Component parts are available.

1. Cylinder Tailpiece – PKG 50975
2. Dial
3. Drive Cam
4. Fly – PKG50994
5. Anti-friction Spacer –PKG 50993
6. Combination Disk 2 – PKG 50991
7. Combination Disk 3 – PKG 50992
8. Dual Fence Ring –PKG 57385
9. Wave Washer – PKG 50996
10. Cam –PKG 51000
11. Trim Hub
12. Disrupter Spring – PKG 50998
13. Dial Ring Screws – PKG 51003
14. Baffle Plate
15. Baffle Plate Screws –PKG 57384



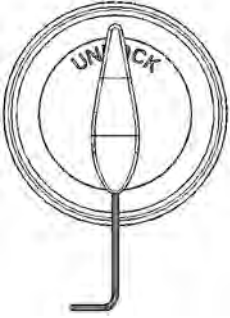
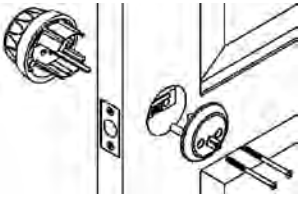
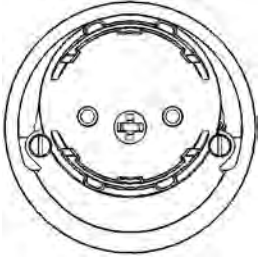
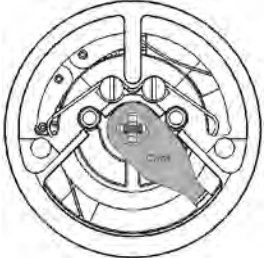
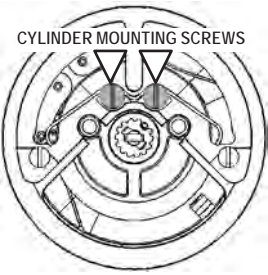
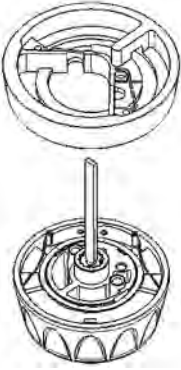




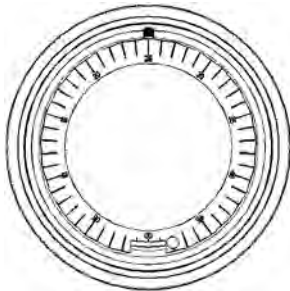
Because of the fixed fly design, a certain amount of calculation can be required when decoding or encoding. Master Lock also offers a software program that will do the calculations for you at:

<http://www.masterlock.com/combocalc.msi>

This software has been tested on Windows® XP and Vista® and runs correctly. It may be compatible with some earlier versions of Windows® but has not been tested. To complete the software installation, you must have the free Microsoft program 'net framework' installed.

The following instructions also are included in a help file in the software.

**Decode**

 <p>Use a 1/16" hex wrench to remove thumb turn</p>	 <p>Remove inside trim and dismount lock from door</p>	 <p>Loosen two screws and remove baffle plate from dial assembly</p>	 <p>Lift cam and remove from cylinder tailpiece</p>
 <p>CYLINDER MOUNTING SCREWS</p> <p>Loosen the two dial ring/cylinder mounting screws</p>	 <p>Remove dial ring with disrupter spring</p>	 <p>Remove the wave washer and the dual fence ring</p>	 <p>GENTLY lift dial ring from cylinder</p>
 <p>Remove a spacer washer and disk 3; DO NOT disturb disk 1</p>	 <p>Remove a spacer washer and disk 2; DO NOT disturb disk 1</p>	 <p>A groove is cast into the interior of the dial ring. Determine the number aligned with that groove and record it in the 'Set to Disk 1' column of the worksheet</p>	

Determine the numerical location of the fly in disks 2 and 3 and record them in the 'Set to' column in the worksheet. Note that the setting of the first disk is the third number of the combination.

Simple mathematics are required to figure out the first and second combination numbers. Next, we will calculate the combination for the disk locations shown.

**DECODING**

	Disk	Set to	Formula	Combination	
The disk that contacts the dial	<b>1</b>	<b>14</b>	Combination = where set	<b>14</b>	<b>3</b>
The middle disk	<b>2</b>	<b>25</b>	Add 1 & 2 plus 1, subtract 50 until answer is less than 50		<b>2</b>
The disk that comes out first	<b>3</b>	<b>17</b>	Subtract 50 from Total until answer is less than 50		<b>1</b>
	Add	6			
	Total =				

To determine the second number of the existing combination, you must add settings one and two plus 1; in this case,  $14 + 25 + 1 = 40$ . Because the total isn't 50 or more, you don't need to go further. If the total had been 50 or more, you would need to subtract 50 until the answer is less than 50. Write the answer in the combination 2 box.

**DECODING**

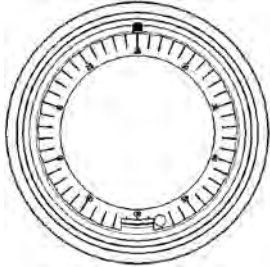



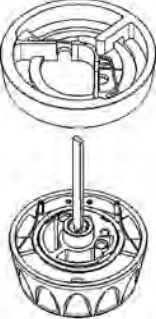
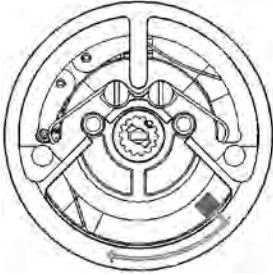
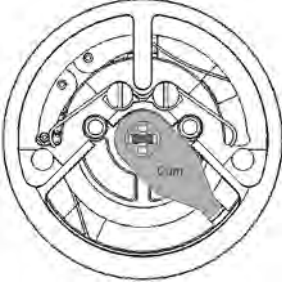
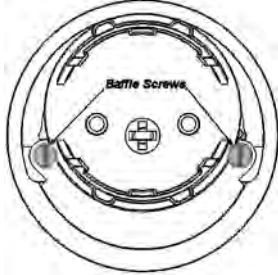
	Disk	Set to	Formula	Combination	
The disk that contacts the dial	<b>1</b>	<b>14</b>	Combination = where set	<b>14</b>	<b>3</b>
The middle disk	<b>2</b>	<b>25</b>	Add 1 & 2 plus 1, subtract 50 until answer is less than 50	<b>40</b>	<b>2</b>
The disk that comes out first	<b>3</b>	<b>17</b>	Subtract 50 from Total until answer is less than 50		<b>1</b>
	Add	6			
	Total =				

For the first number of the combination, add the set to column to get a total, e.g.  $14 + 25 + 17 + 6 = 62$ . Because the total is 50 or more, subtract 50 until the answer is less than 50.  $62 - 50 = 12$ . That is the first combination number and may be written into combination box 1.

**DECODING**

	Disk	Set to	Formula	Combination	
The disk that contacts the dial	<b>1</b>	<b>14</b>	Combination = where set	<b>14</b>	<b>3</b>
The middle disk	<b>2</b>	<b>25</b>	Add 1 & 2 plus 1, subtract 50 until answer is less than 50	<b>40</b>	<b>2</b>
The disk that comes out first	<b>3</b>	<b>17</b>	Subtract 50 from Total until answer is less than 50	<b>12</b>	<b>1</b>
	Add	6			
	Total =	<b>62</b>			

Use the following steps to reassemble the lock.

 <p>Ensure that drive disk 1 has not been moved from the decoded position and place it over the cylinder</p>	 <p>Install a spacer washer, disk 2 and another spacer washer</p>	 <p>Install disk 3 and another spacer washer</p>	 <p>Install fence ring and wave washer</p>
 <p>Install dial ring, making sure wave washer is centered and disrupter spring is correctly positioned</p>	 <p>Set handing by moving cam slot to bolt edge side and make tailpiece horizontal</p>	 <p>Reinstall cam</p>	 <p>Attach baffle plate and mount lock on door. Try the combination to lock and unlock to verify the decoding</p>

Unlike a safe, this combination is applied three times clockwise to 12, two times counterclockwise to 40 and one time clockwise to 14. At that point, you should feel the fence enter the gate and then may turn the dial in the direction required to throw or retract the bolt.

Encoding a lock to a new combination follows the same disassembly and reassembly steps but uses different calculations to determine fly locations on the various disks. As you can see here, the worksheet for encoding is different also.

### ENCODING

	Disk	Set to	Formula	Combination
The disk that contacts the dial	<b>1</b>		<b>Align with Dial Index</b>	<b>3</b>
The middle disk	<b>2</b>		Second number minus 1. Then subtract third number if less than zero, add 50 until between 0 and 49.	<b>2</b>
The disk that comes out first	<b>3</b>		Add set positions for disks 1 and 2 plus 6. Subtract that from combination 1. If less than zero, add 50 until between zero and 49.	<b>1</b>



There are some mechanical limitations that result in forbidden combinations:

- Disk 2 must be set on 2 thru 47 as positions 0, 1, 48 and 49 do not exist
- Disk 3 cannot be set on 0, 1 or 49 as those positions do not exist

The example below will calculate the drive disk and fly locations for a new combination of 18-25-38. The first step is to write the combination into the worksheet and automatically set the drive disk to the third number.

### ENCODING

	Disk	Set to	Formula	Combination	
The disk that contacts the dial	<b>1</b>	<b>38</b>	Align with Dial Index	<b>38</b>	<b>3</b>
The middle disk	<b>2</b>		Second number minus 1. Then subtract third number if less than zero, add 50 until between 0 and 49.	<b>25</b>	<b>2</b>
The disk that comes out first	<b>3</b>		Add set positions for disks 1 and 2 plus 6. Subtract that from combination 1. If less than zero, add 50 until between zero and 49.	<b>18</b>	<b>1</b>

To calculate the fly location for disk 2 we must take the second number of the combination and subtract 1. For the example, that is  $25 - 1 = 24$ . Then the third number also should be subtracted from that answer:  $24 - 38 = -14$ . Because that answer isn't between 0 and 49, we must add 50 until it is:  $-14 + 50 = 36$ . The answer is the location of the fly on disk 2 and should be written in the worksheet.

### ENCODING

	Disk	Set to	Formula	Combination	
The disk that contacts the dial	<b>1</b>	<b>38</b>	Align with Dial Index	<b>38</b>	<b>3</b>
The middle disk	<b>2</b>	<b>36</b>	Second number minus 1. Then subtract third number if less than zero, add 50 until between 0 and 49.	<b>25</b>	<b>2</b>
The disk that comes out first	<b>3</b>		Add set positions for disks 1 and 2 plus 6. Subtract that from combination 1. If less than zero, add 50 until between zero and 49.	<b>18</b>	<b>1</b>

The disk 3 calculations require adding the set positions for disk 1 and 2 plus 6, e.g.  $38 + 36 + 6 = 80$ . That answer must be subtracted from combination number 1:  $18 - 80 = -62$ . Because the answer is not between 0 and 49, you must add 50 until it is:  $-62 + 50 = -12$ ;  $-12 + 50 = 38$ . Write the answer in the worksheet.

## ENCODING

	Disk	Set to	Formula	Combination	
The disk that contacts the dial	<b>1</b>	<b>38</b>	<b>Align with Dial Index</b>	<b>38</b>	<b>3</b>
The middle disk	<b>2</b>	<b>36</b>	Second number minus 1. Then subtract third number if less than zero, add 50 until between 0 and 49.	<b>25</b>	<b>2</b>
The disk that comes out first	<b>3</b>	<b>38</b>	Add set positions for disks 1 and 2 plus 6. Subtract that from combination 1. If less than zero, add 50 until between zero and 49.	<b>18</b>	<b>1</b>

The next step is physical relocation of disk 1 so that the number 38 is aligned with the groove cast into the dial ring. Next the flys must be moved on disks 2 and 3.

That can be accomplished by firmly gripping the fly and pulling it from the disk while rocking it forward and back. The fly is pressed into place and should not be hard to relocate. Place it in the newly determined location and then press into place.

Use the reassembly directions given earlier to reassemble the lock and remount on the door. Operate the new combination with the door open to throw and retract the bolt.



## ***Rekeying***

Rekeying the key operated cylinder may be accomplished using a standard pinning kit and the BumpStop® procedures related on pages 2, 4 and 33. Rekeying the cylinder only requires removal of the baffle plate and cam to access the screw-on retainer cap for the plug. Remove the cap, cap pin and spring, then use a follower to remove the plug.

Rekey as desired and then reassemble. Always check the bible of the cylinder to ensure that there aren't master pins being left in the cylinder when rekeying and to reposition the BumpStop® pin if your new combination doesn't have a compatible bitting in the same chamber as the last combination.

The Master Lock software program available for locksmiths will do the encoding and decoding calculations for you. It is not recommended for the do-it-yourself end user but can be a valuable tool for the locksmith. For some computers, you may need to get a free upgrade from Microsoft called '.net framework' to be able to install the software. Enter the link below on your browser to access the program for installation.

<http://www.masterlock.com/combocalc.msi>

## Grade 2 Commercial

The Grade 2 Commercial products use a universal cylinder similar to a Kaba Lori 1599. Extra cylinders may be ordered and used for retrofit when a customer's existing locks need to be upgraded with our BumpStop® advanced cylinder technology.

Ordering cylinders is a simple process using the DL part number map below.

For BumpStop® pinning information, consult the table and information on pages 2, 3 and 4. All of these cylinders may be keyed with standard bottom pins found in aftermarket pinning kits for .115" diameter pin tumblers.

### DL045KD

Door Hardware Cylinder  
w/Cap Retainer

Keyway

Manufacturer's Brand Name			30
Arrow®	10	Sargent® LA-LC*	36
Corbin® 59A1-2	01	Sargent® RA-RC*	70
Corbin® 60	29	Sargent® S*	02
Corbin® Russwin® L4	07	Sargent® U*	02
Falcon® 1573, 1577*	14	Schlage® C	04
Harloc® SE-1*	02	Schlage® E	34
Kwikset®*	12	Schlage® P	28
Lockwood®	08	Segal® 9.265	27
Lori® L200*	02	Weiser®*	13
Lori® Locksmith 80	80	Weslock®	33
Loricentric® 90	90	Yale® 8	03
Master®/Dexter® 67*	32	Yale® GA	15
Russwin® 981/852	11	Master Lock® EDGE® System	200WP
		(Available with 4 or 6 pins only)	

Keying Specification

KD	–	Keyed Different
KA	–	Keyed Alike
KZ	–	Zero Bitted
KDMK	–	KD Master Keyed
KAMK	–	KA Masker keyed
UN	–	Uncombined**

Number of pins

4	–	four**
5	–	five
6	–	six

\* Indicates a composite keyway that accepts more than one key section. Example: Keyway 02 accepts the Sargent® S, Sargent® U, and Lori® L200 keys.

\*\* Exclusively available for the Master Lock EDGE™ Key Control System only.

All marks are registered trademarks of their respective owners

# Communicating Door Deadbolt

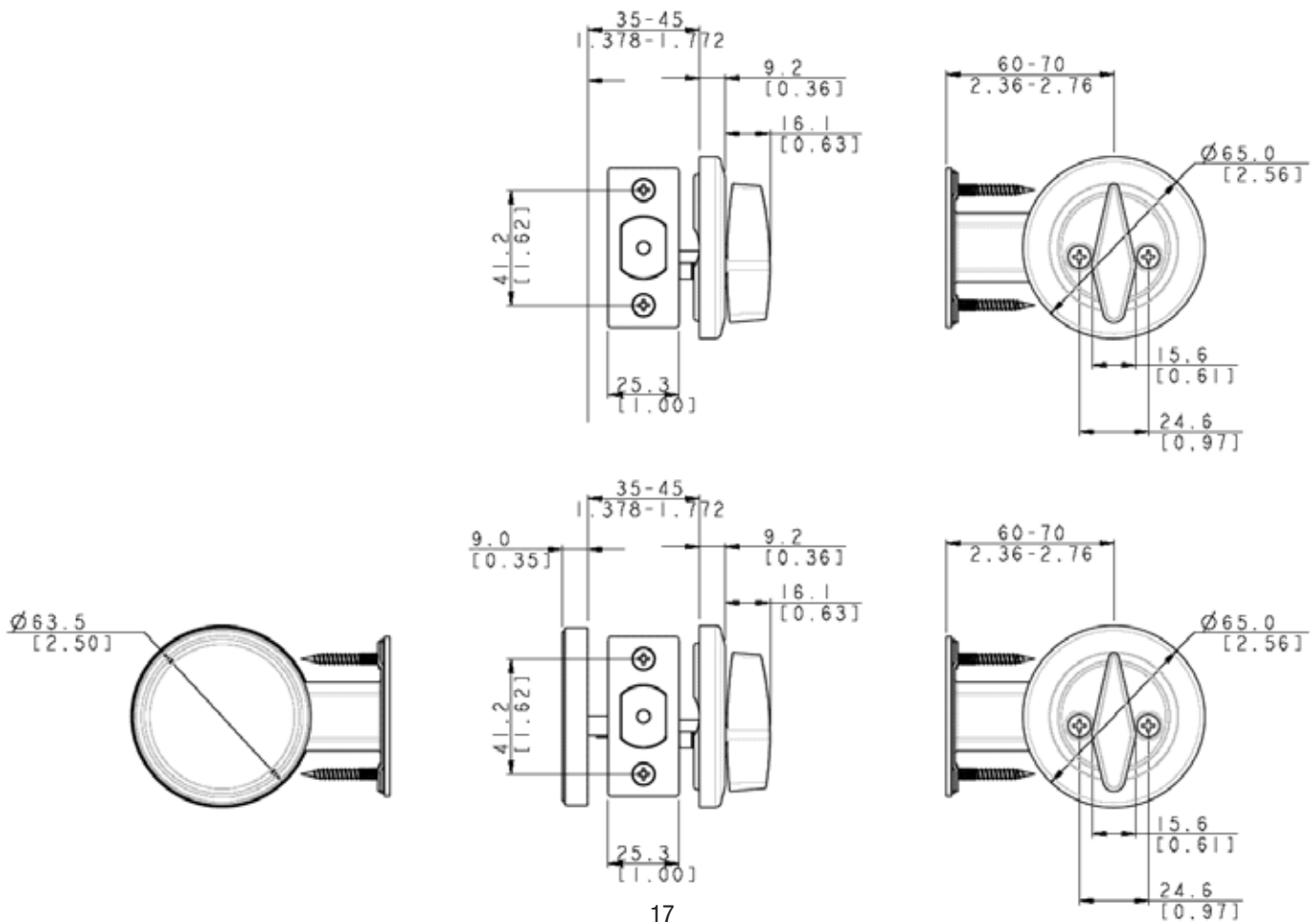
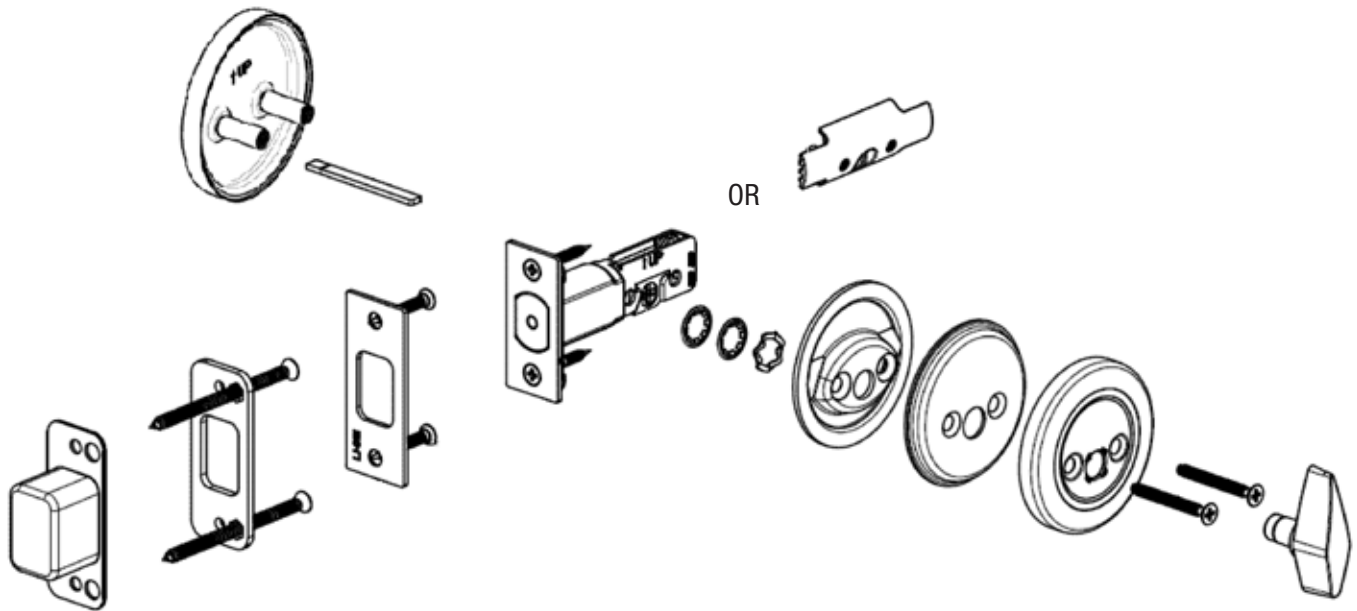
# Grade 2 Commercial

## Single-Sided/Communicating Door

FUNCTION: Handle or turn piece on one side to throw or retract bolt; no means of operation on opposite side.

DSC0532D *Brushed Chrome*

This is a combination unit designed for application to doors with a full crossbore or for doors where the crossbore is only visible on the inside. The adjustable backset bolt and reinforced strike are standard equipment.



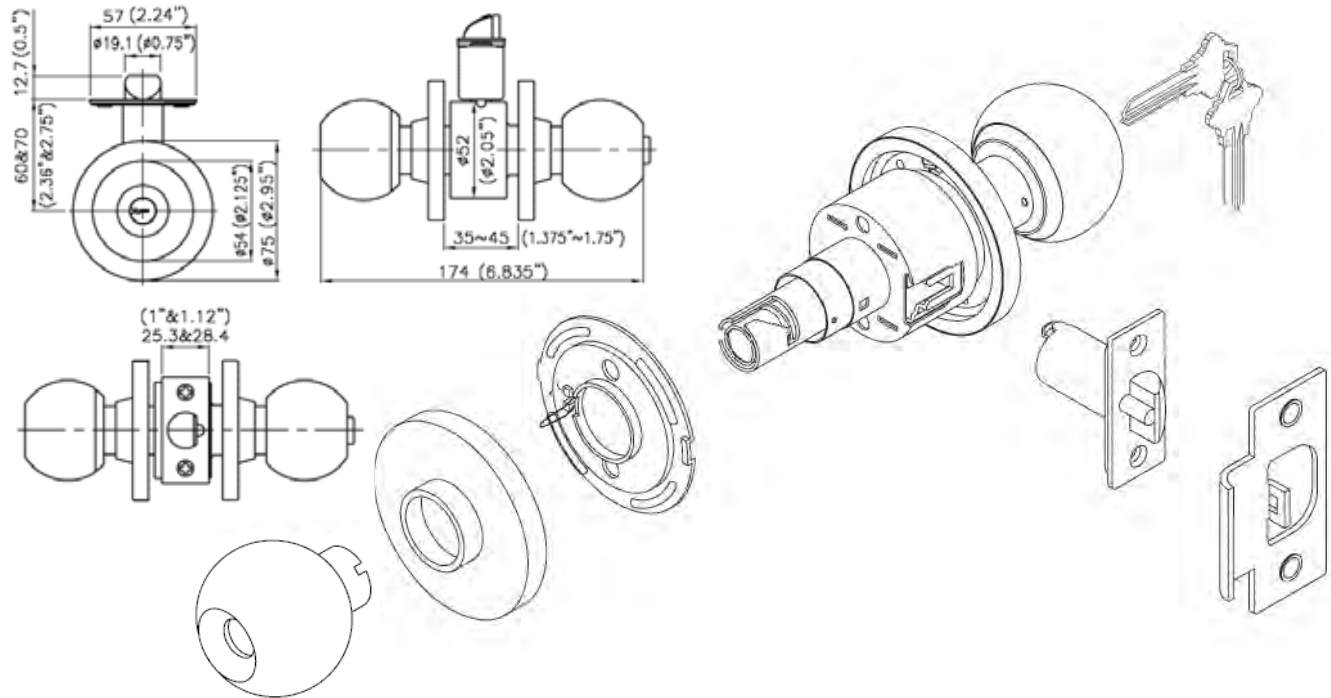
## Entry Knobset with BumpStop®

## Grade 2 Commercial

FUNCTION: Inside handle push button locks the outside handle. Unlock outside handle with a key or by turning inside handle.

BLC0132DKA4 *Brushed Chrome*

The Entry lockset may use any of the Master Lock DL type cylinders, a Kaba Lori 1539 cylinder or any other 'size compatible' cylinder. The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



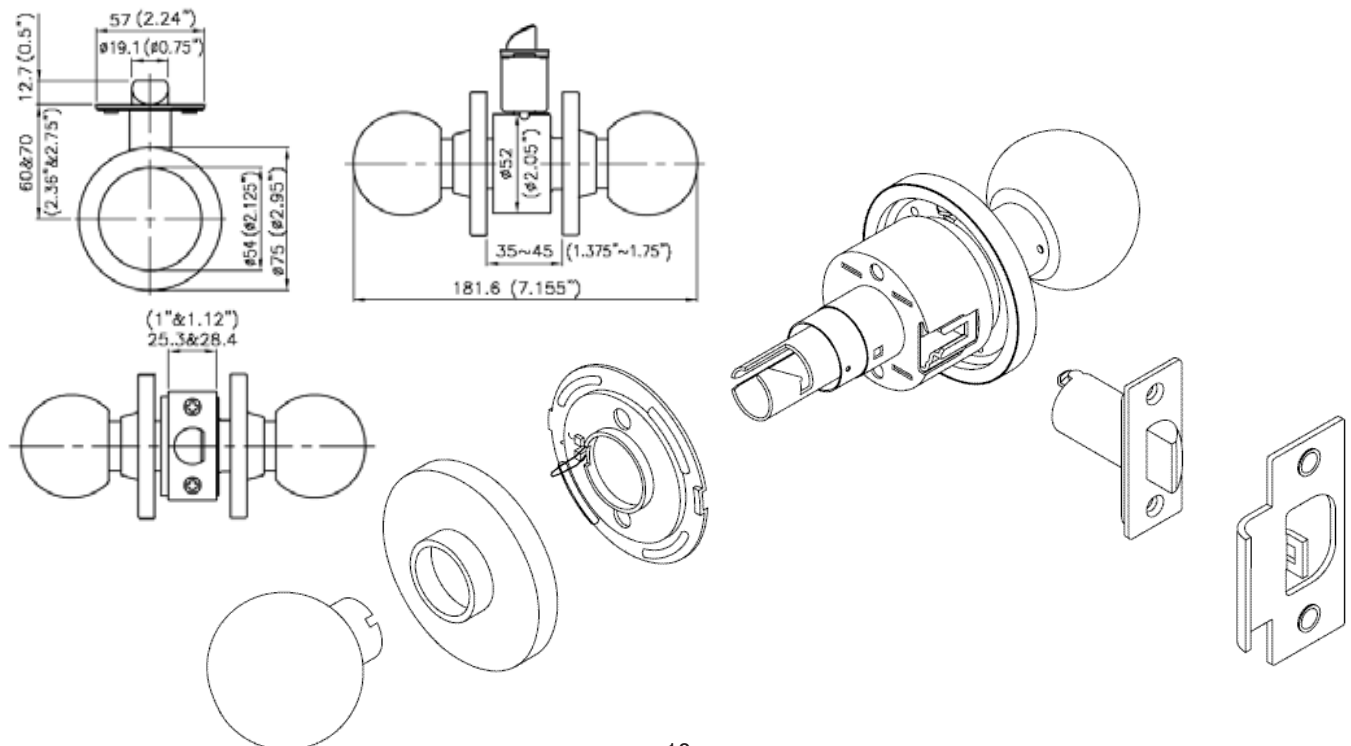
## Passage Knobset

## Grade 2 Commercial

FUNCTION: Inside and outside handles always unlocked; turning either retracts latch. No keys required.

BLC0432D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



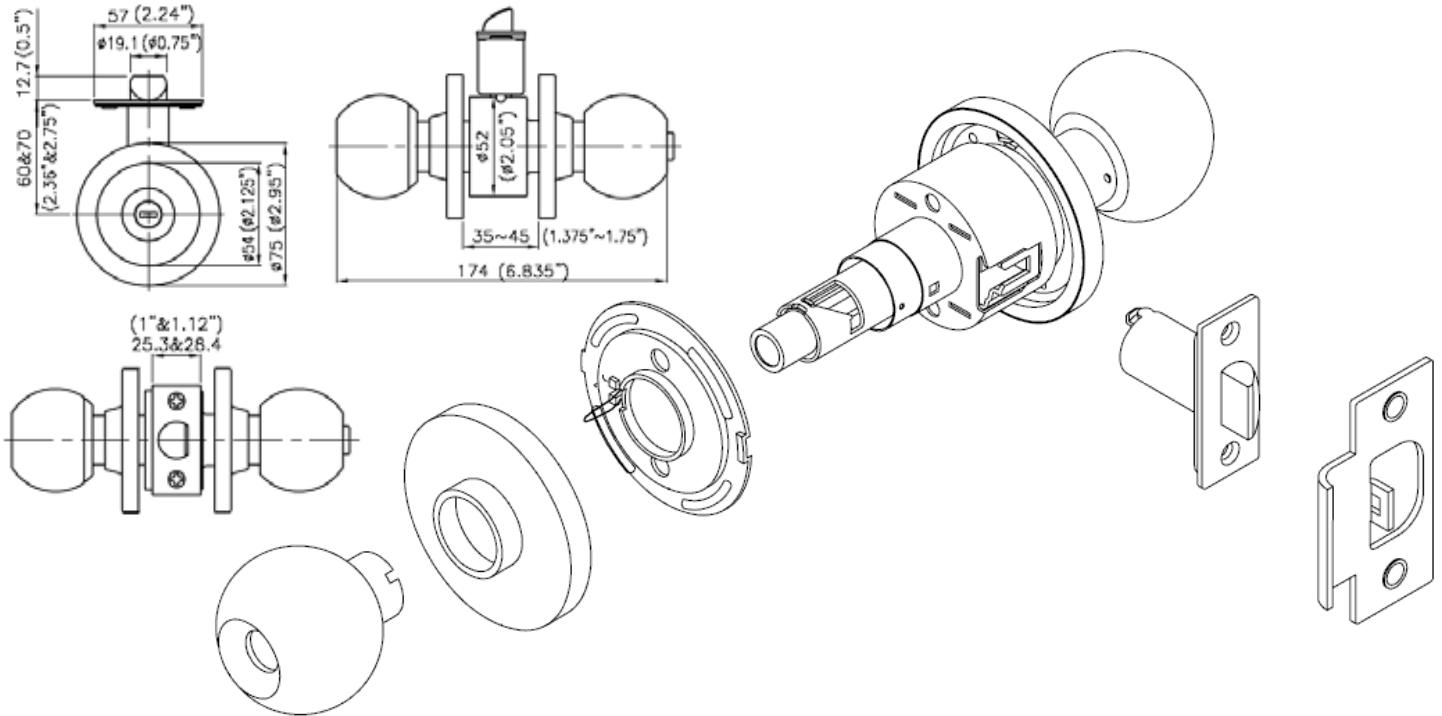
## Privacy Knobset

## Grade 2 Commercial

FUNCTION: Inside handle push button locks outside handle. Emergency release in outside handle. Closing the door or turning inside handle releases the push button.

BLC0332D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



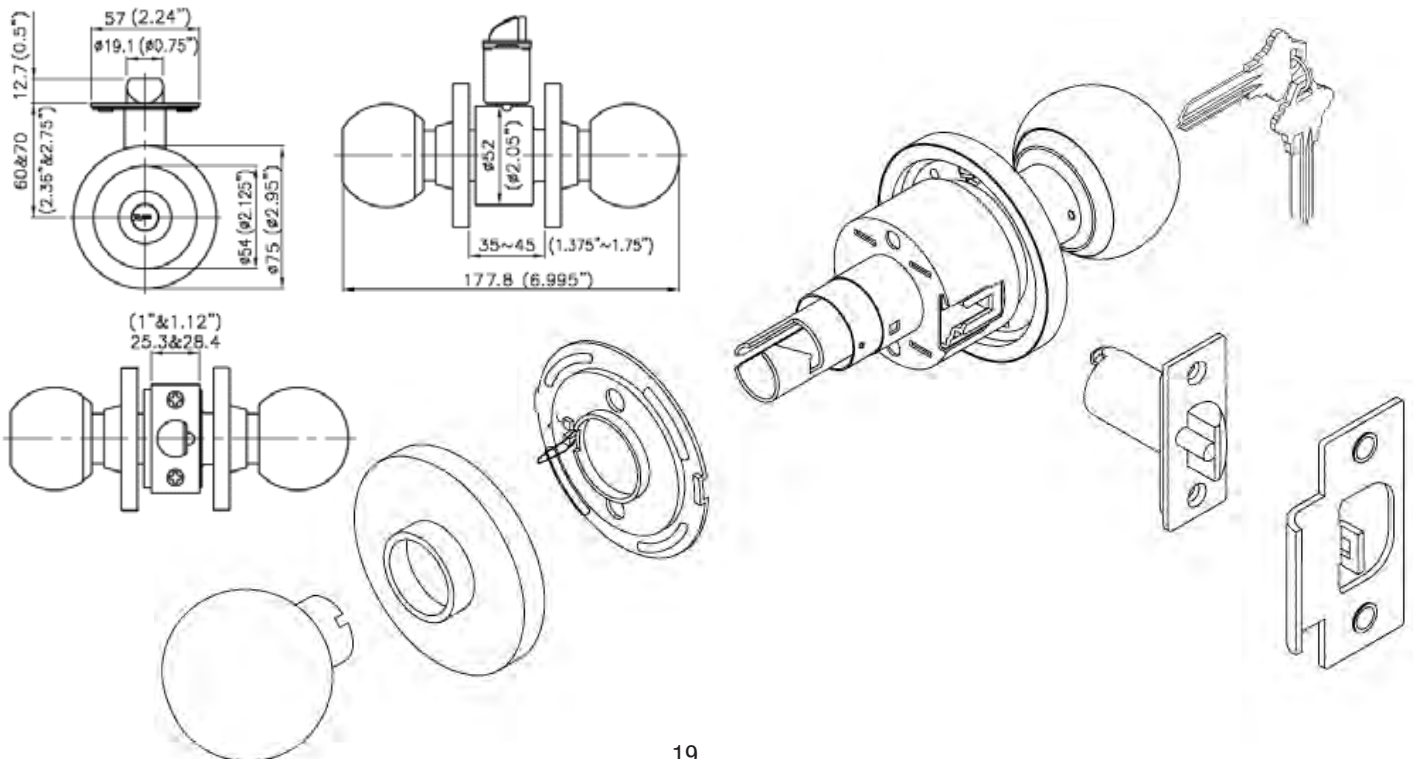
## Classroom Knobset with BumpStop®

## Grade 2 Commercial

FUNCTION: Inside always unlocked. Outside handle locked or unlocked by key.

BLC0932DKA4 *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4" (Classroom US32D).



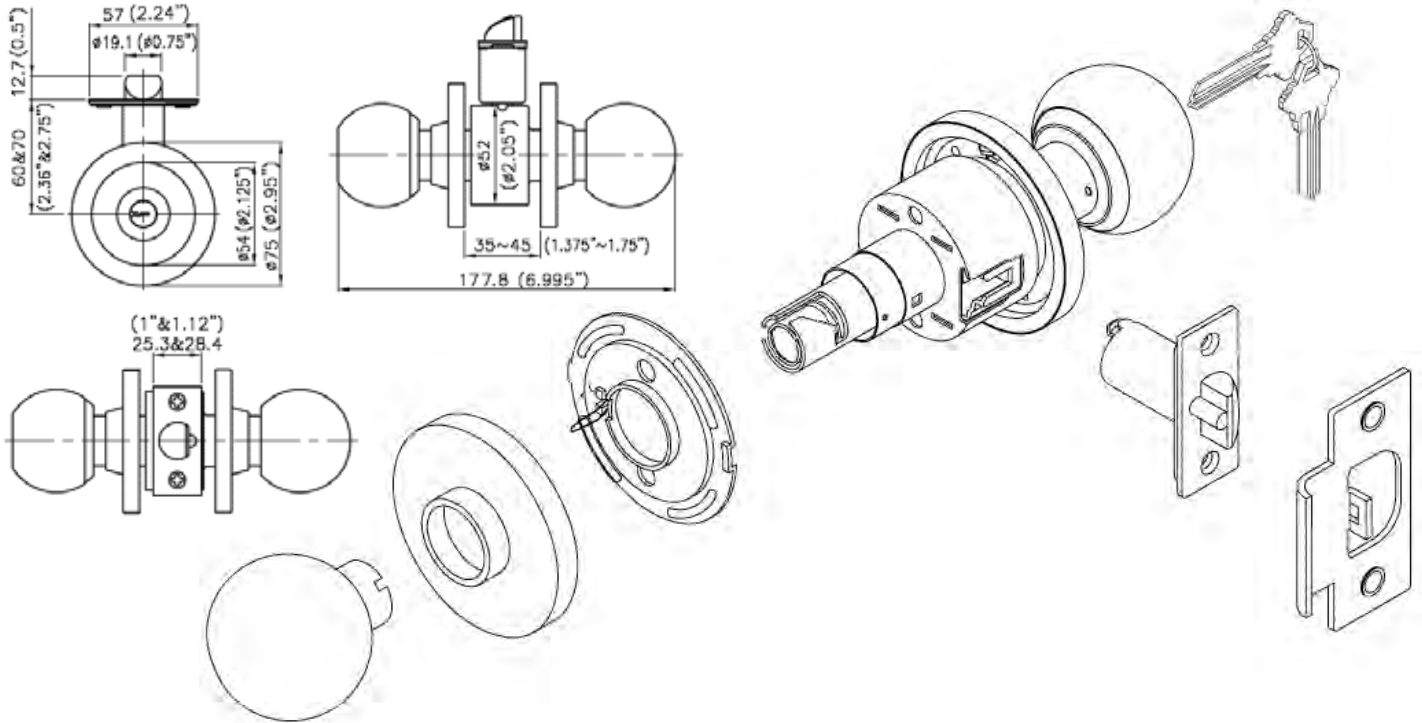
# Storeroom Knobset

# Grade 2 Commercial

FUNCTION: Inside always unlocked. Outside handle always locked. Latch retracted by turning key.

BLC0232DKA4 *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4" (Storeroom US32D).



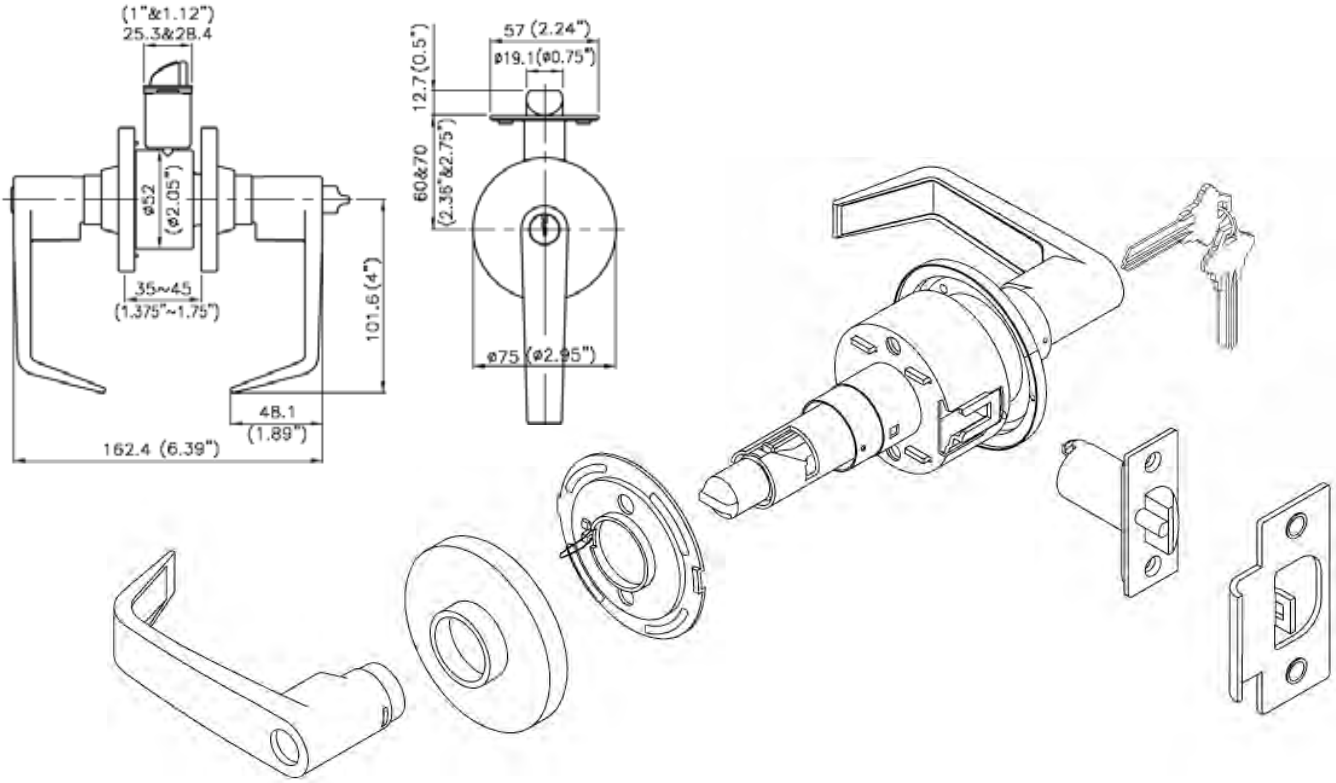
# Entry Leverset with BumpStop®

# Grade 2 Commercial

FUNCTION: Inside handle push button locks the outside handle. Unlock outside handle with a key or by turning inside handle.

SLC0126DKA4 *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



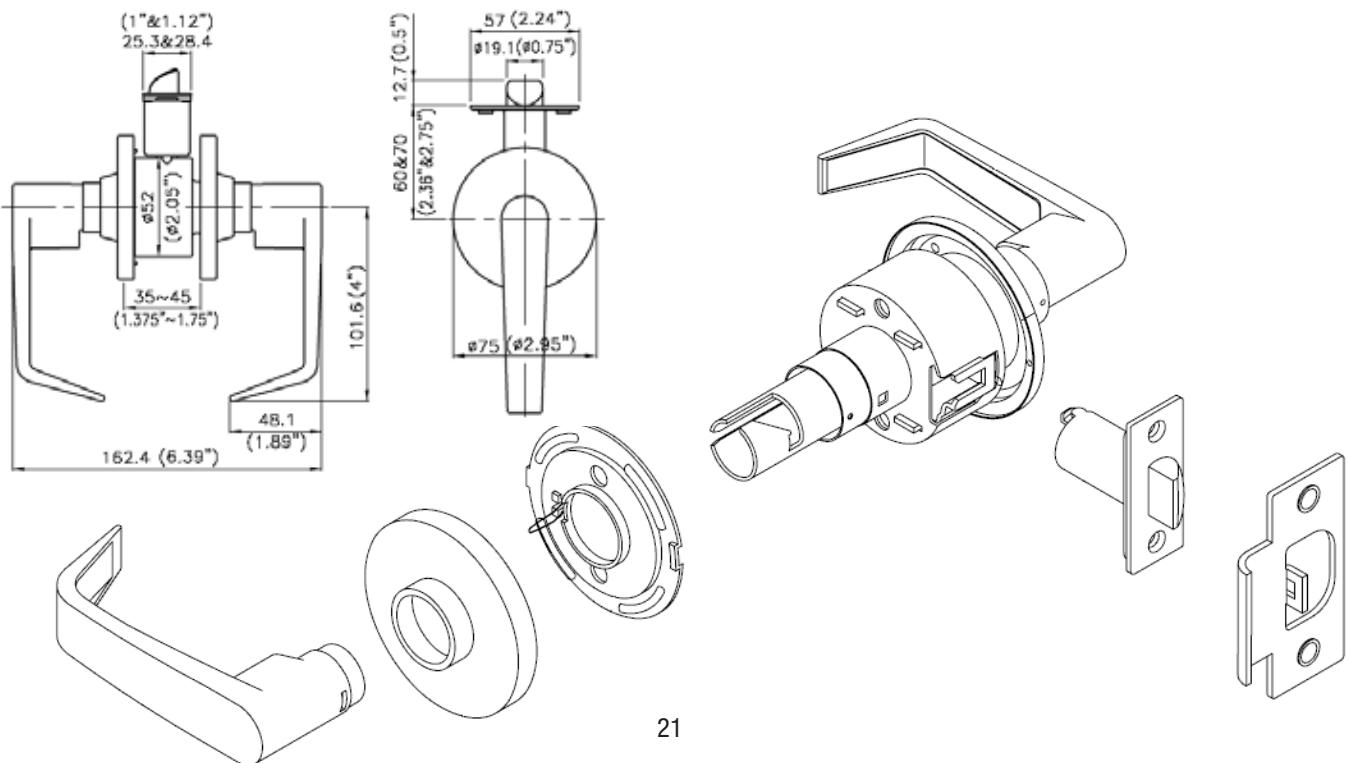
# Passage Leverset

# Grade 2 Commercial

FUNCTION: Inside and outside handles always unlocked; turning either retracts latch. No keys required.

SLC0426D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".





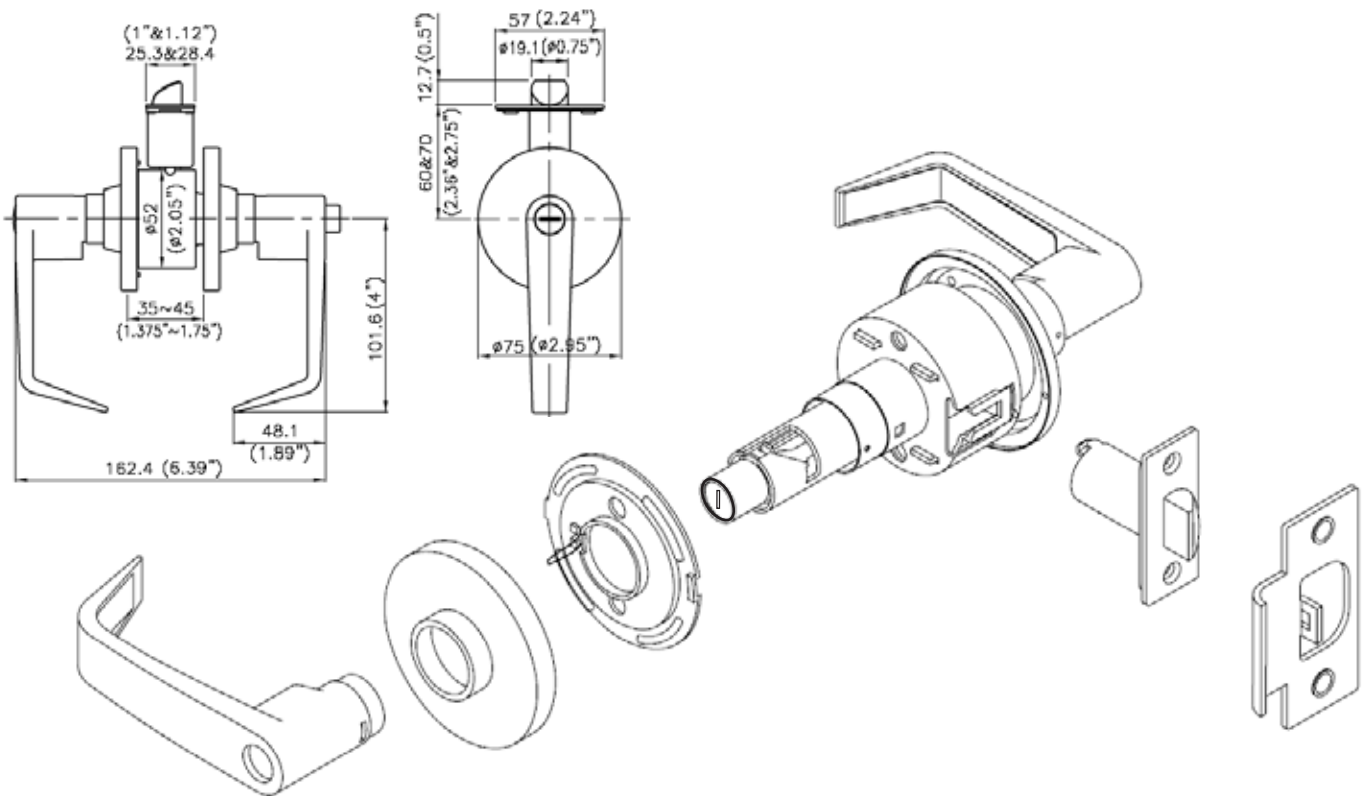
## Privacy Leverset

## Grade 2 Commercial

FUNCTION: Inside handle push button locks outside handle. Emergency release in outside handle. Closing the door or turning inside handle releases the push button.

SLC0326D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



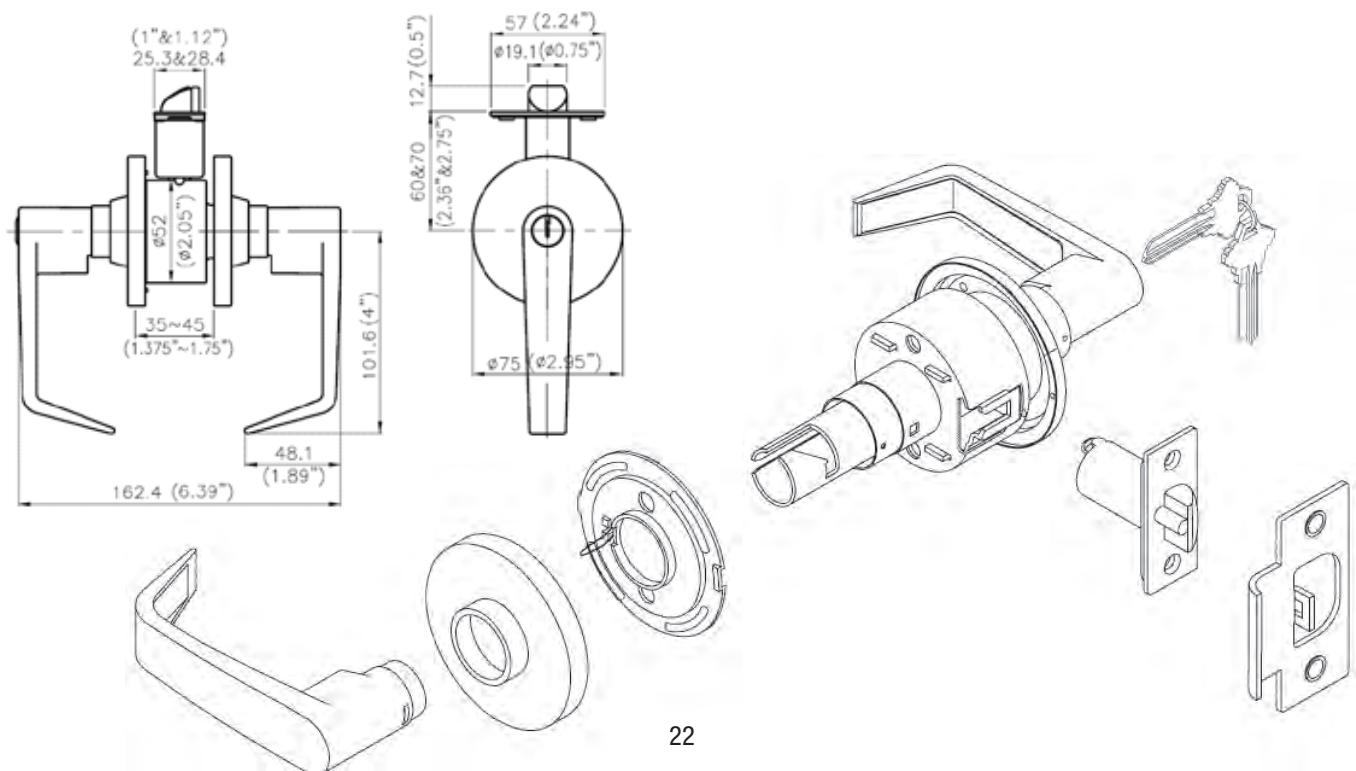
## Classroom Leverset with BumpStop®

## Grade 2 Commercial

FUNCTION: Inside always unlocked. Outside handle locked or unlocked by key.

SLC0926DKA4 *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



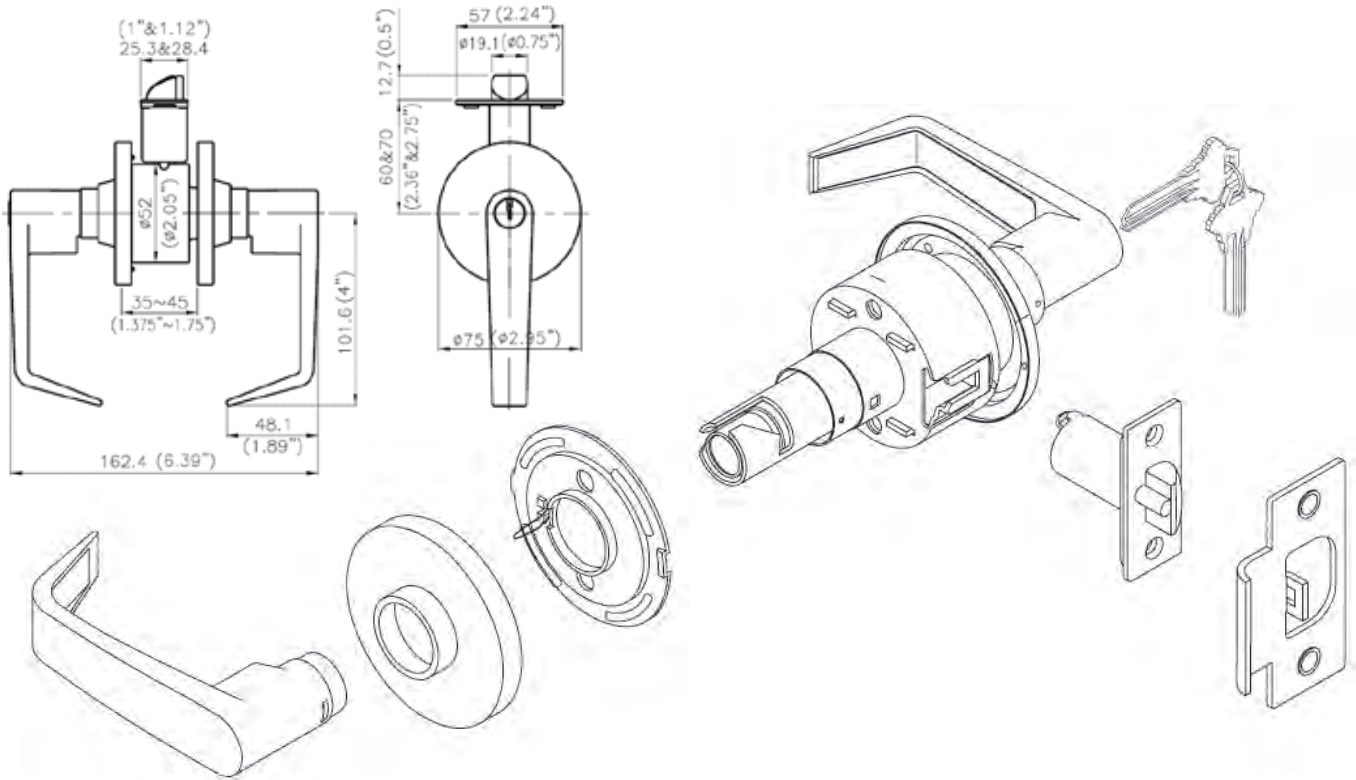
## Storeroom Leverset with BumpStop®

## Grade 2 Commercial

FUNCTION: Inside always unlocked. Outside handle always locked. Latch retracted by turning key.

SLC0226DKA4 *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



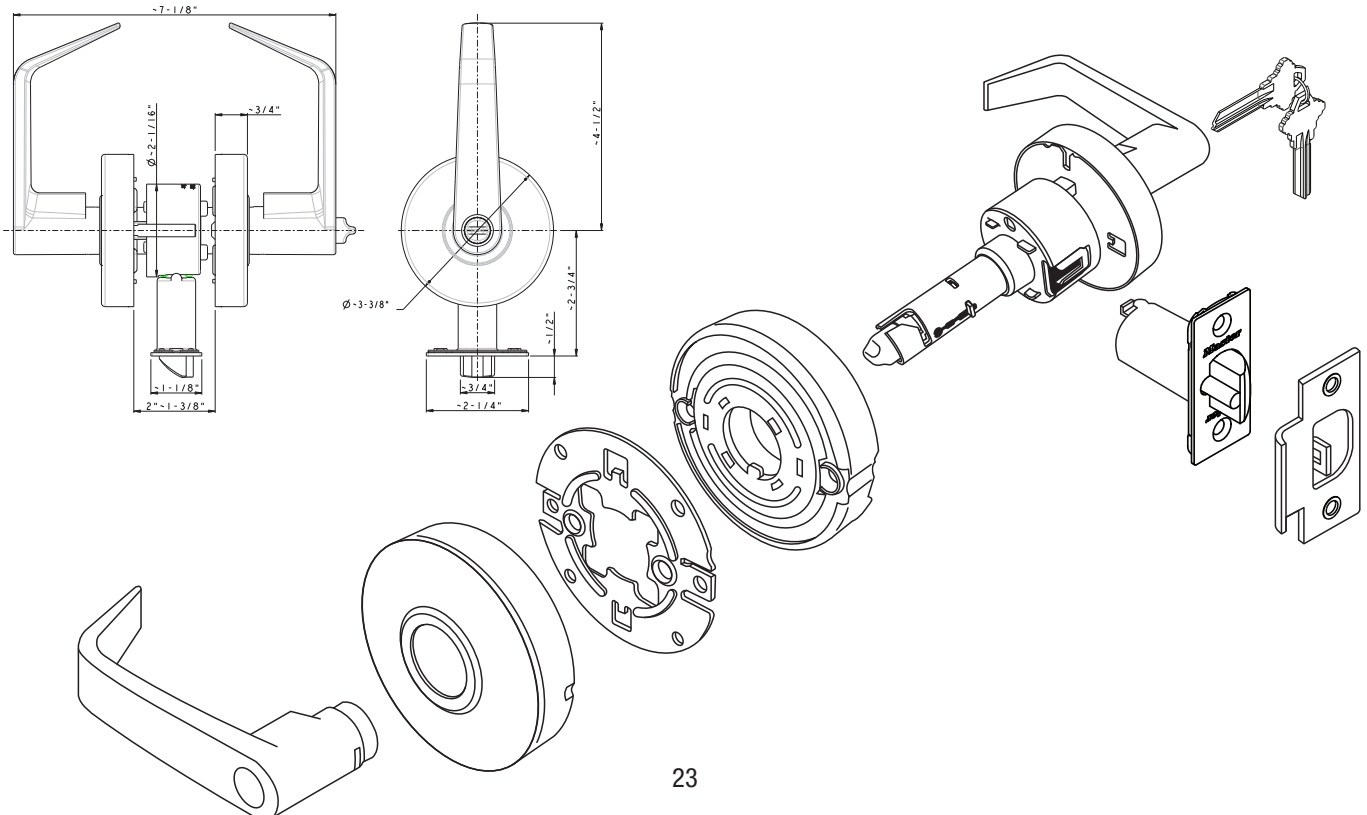
## Heavy Duty Entry Leverset with BumpStop®

## Grade 2 Commercial

FUNCTION: Inside handle turn button locks the outside handle. Unlock outside handle with a key or by turning inside handle.

SLCHKE26D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



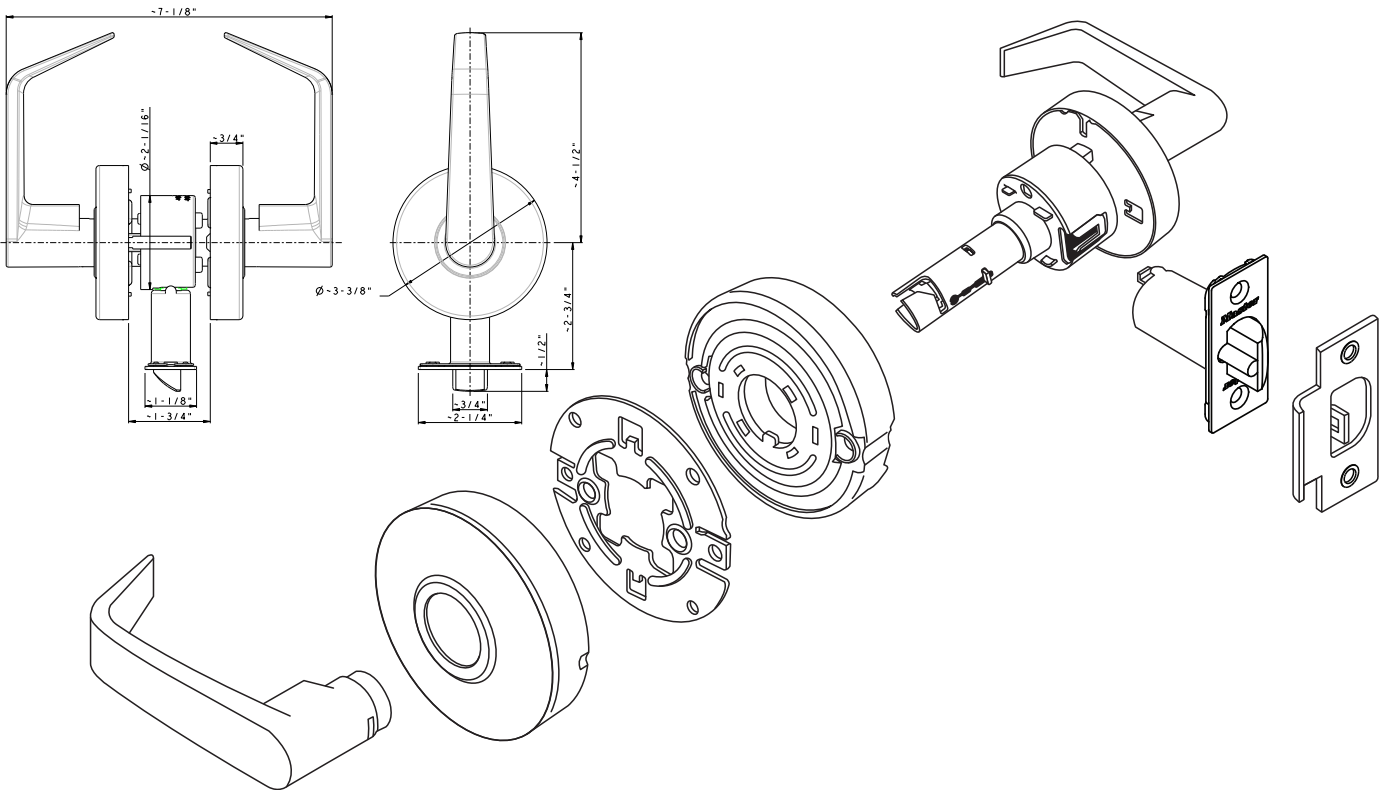
## Heavy Duty Passage Leverset

## Grade 2 Commercial

FUNCTION: Inside and outside handles always unlocked; turning either retracts latch. No keys required.

SLCHPG26D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



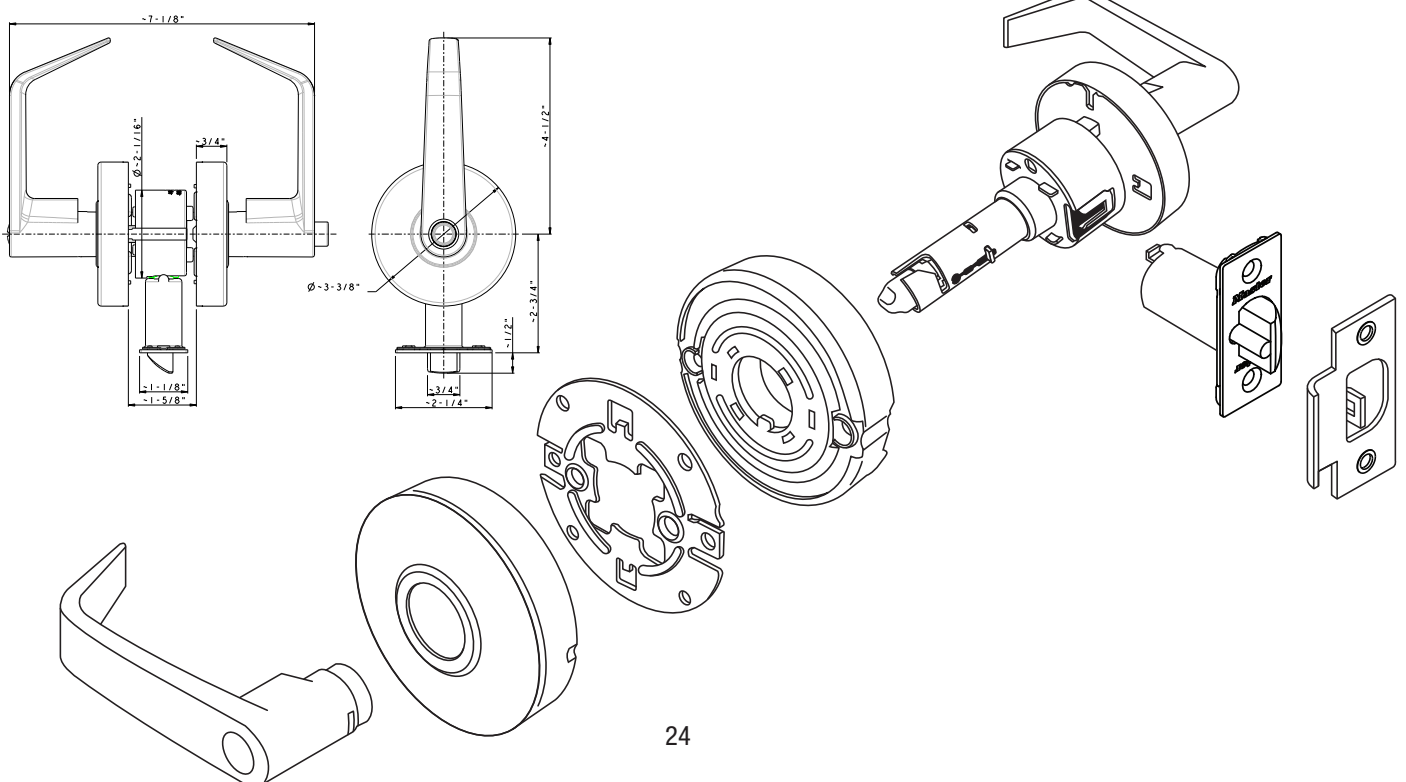
## Heavy Duty Privacy Leverset

## Grade 2 Commercial

FUNCTION: Inside handle turn button locks outside handle. Emergency release in outside handle. Closing the door or turning inside handle releases the push button.

SLCHPV26D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".

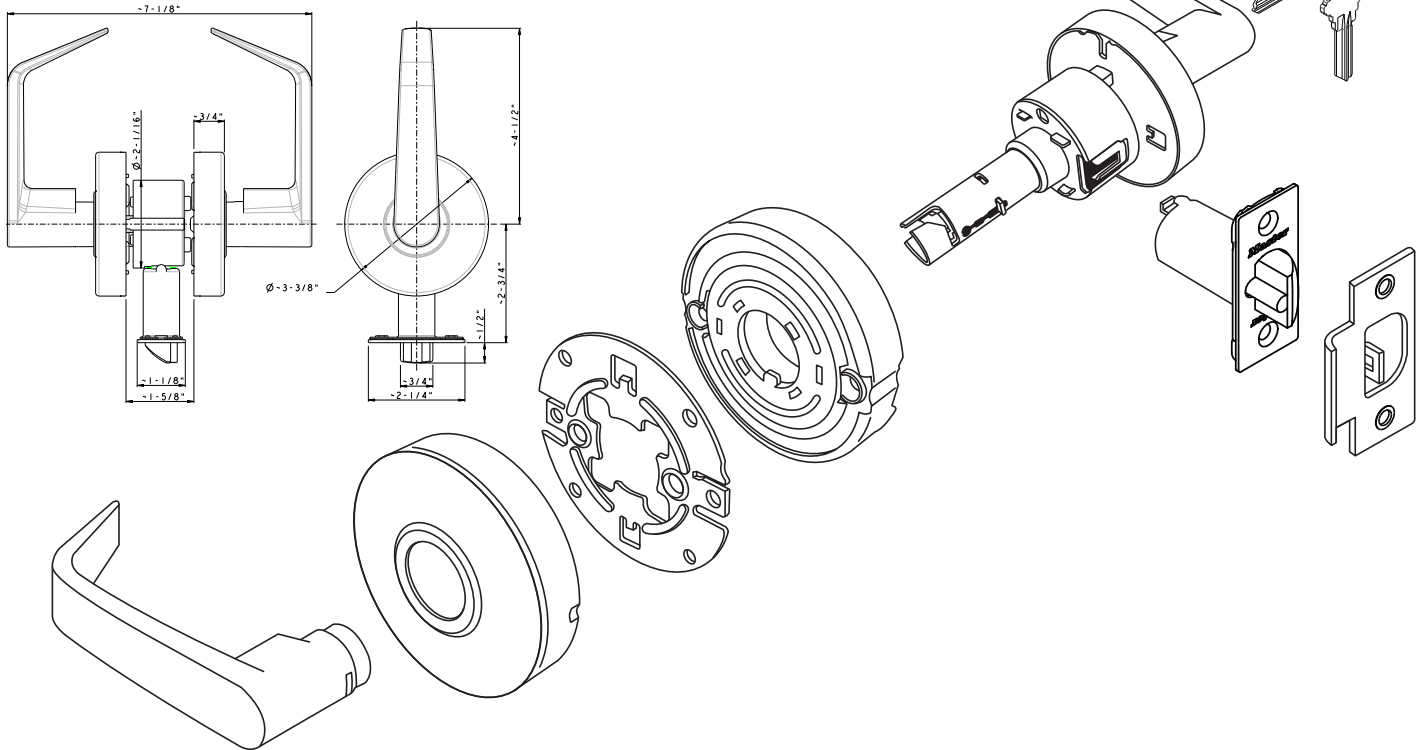


# Heavy Duty Storeroom Leverset w/BumpStop® Grade 2 Commercial

FUNCTION: Inside always unlocked. Outside handle locked or unlocked by key.

SLCHSR26D *Brushed Chrome*

The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".

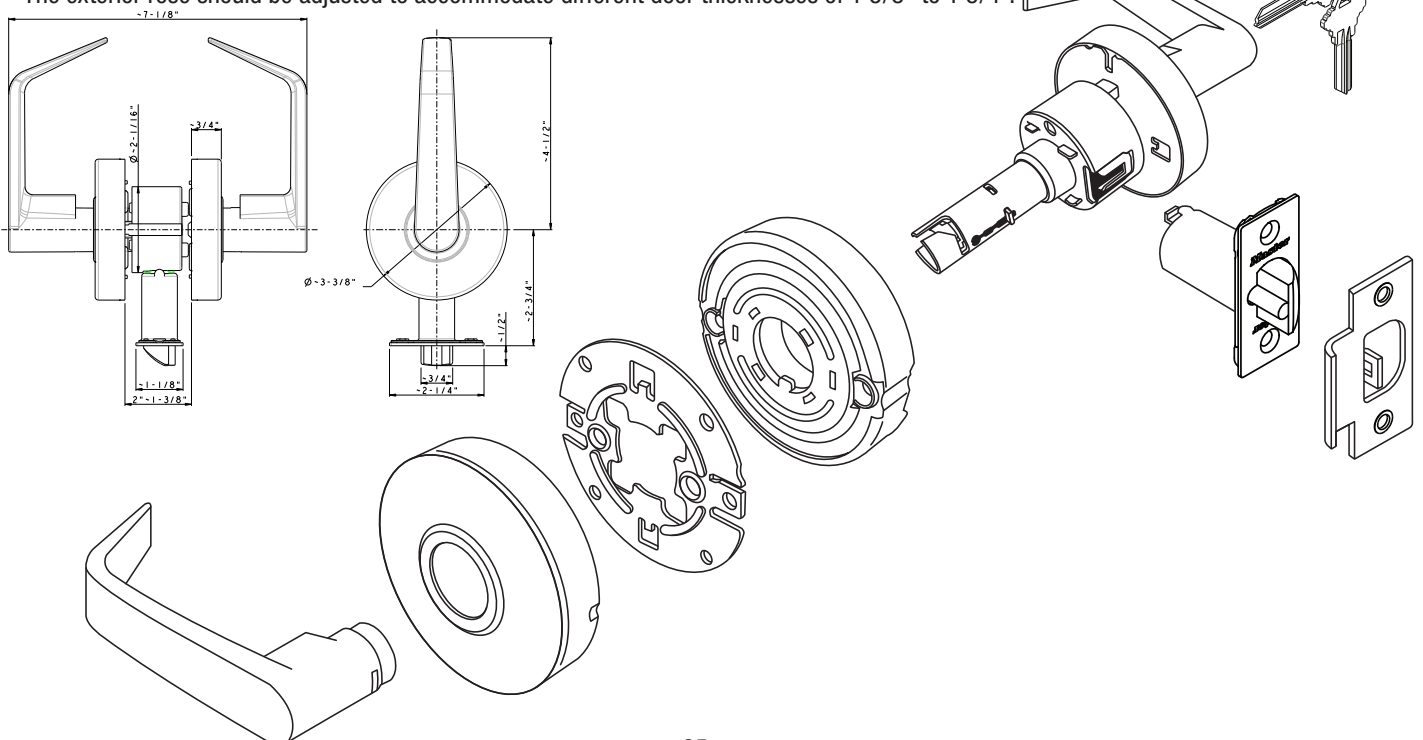


# Heavy Duty Classroom Leverset w/BumpStop® Grade 2 Commercial

FUNCTION: Inside always unlocked. Outside handle locked or unlocked by key.

SLCHCR26D *Brushed Chrome*

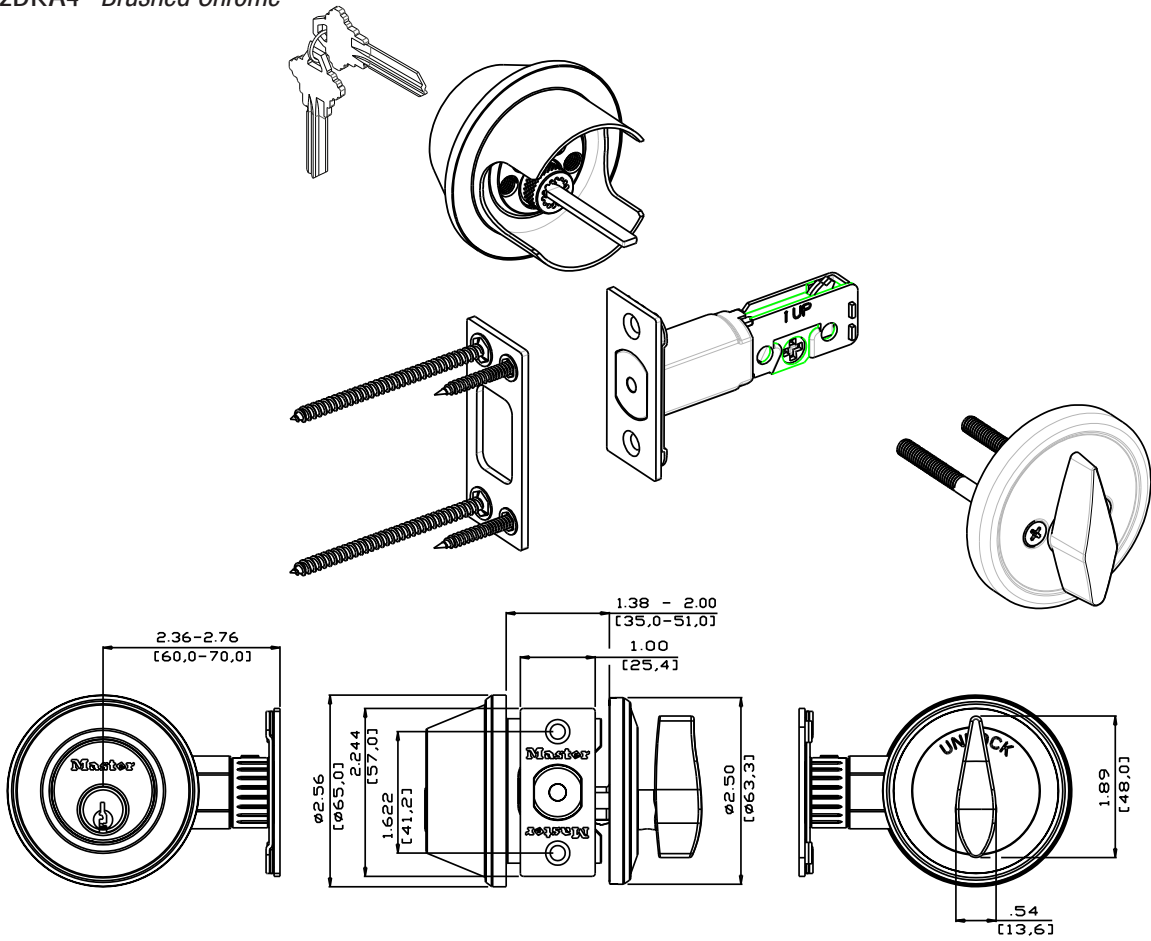
The exterior rose should be adjusted to accommodate different door thicknesses of 1 3/8" to 1 3/4".



# Single Cylinder Deadbolt with BumpStop®

# Grade 2 Commercial

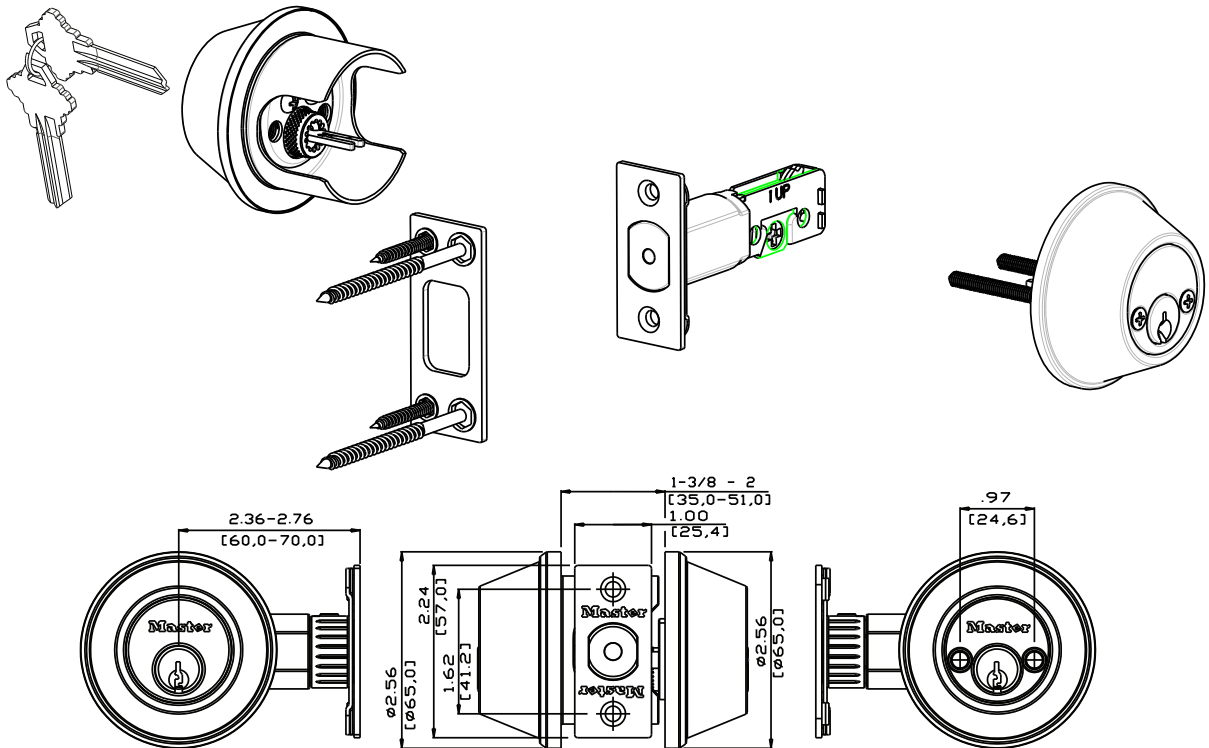
DSC0632DKA4 Brushed Chrome



# Double Cylinder Deadbolt with BumpStop®

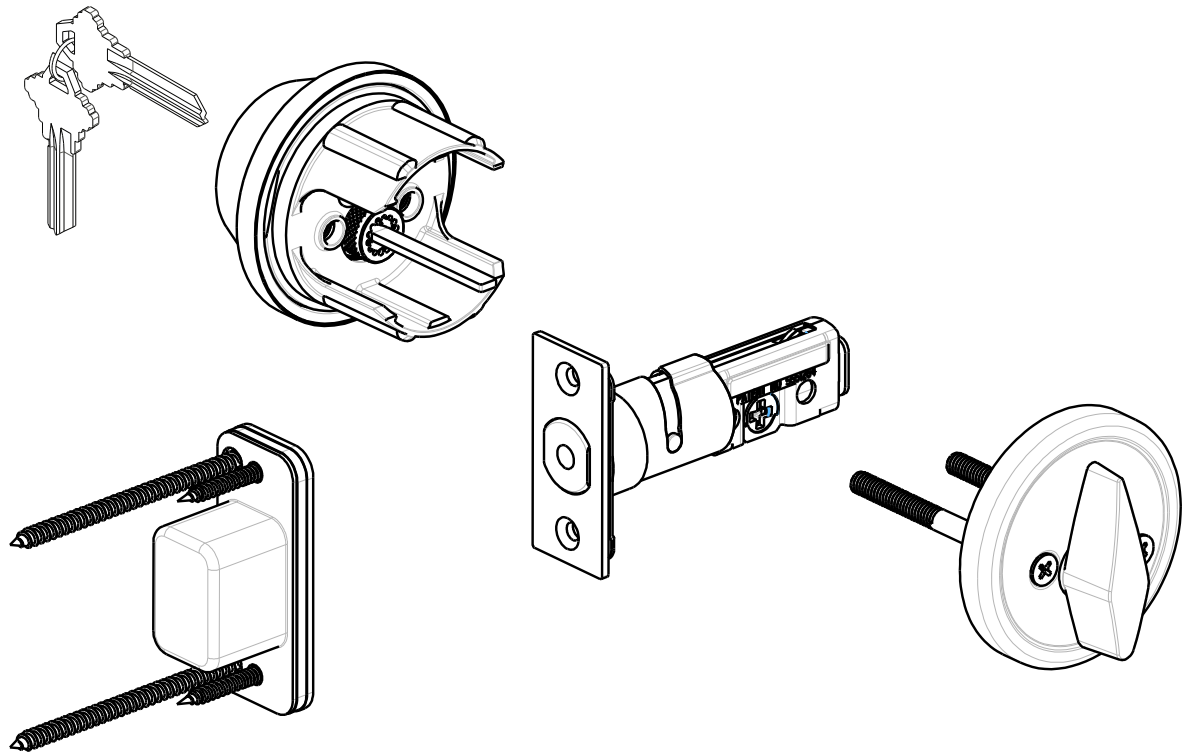
# Grade 2 Commercial

DSC0732DKA4 Brushed Chrome



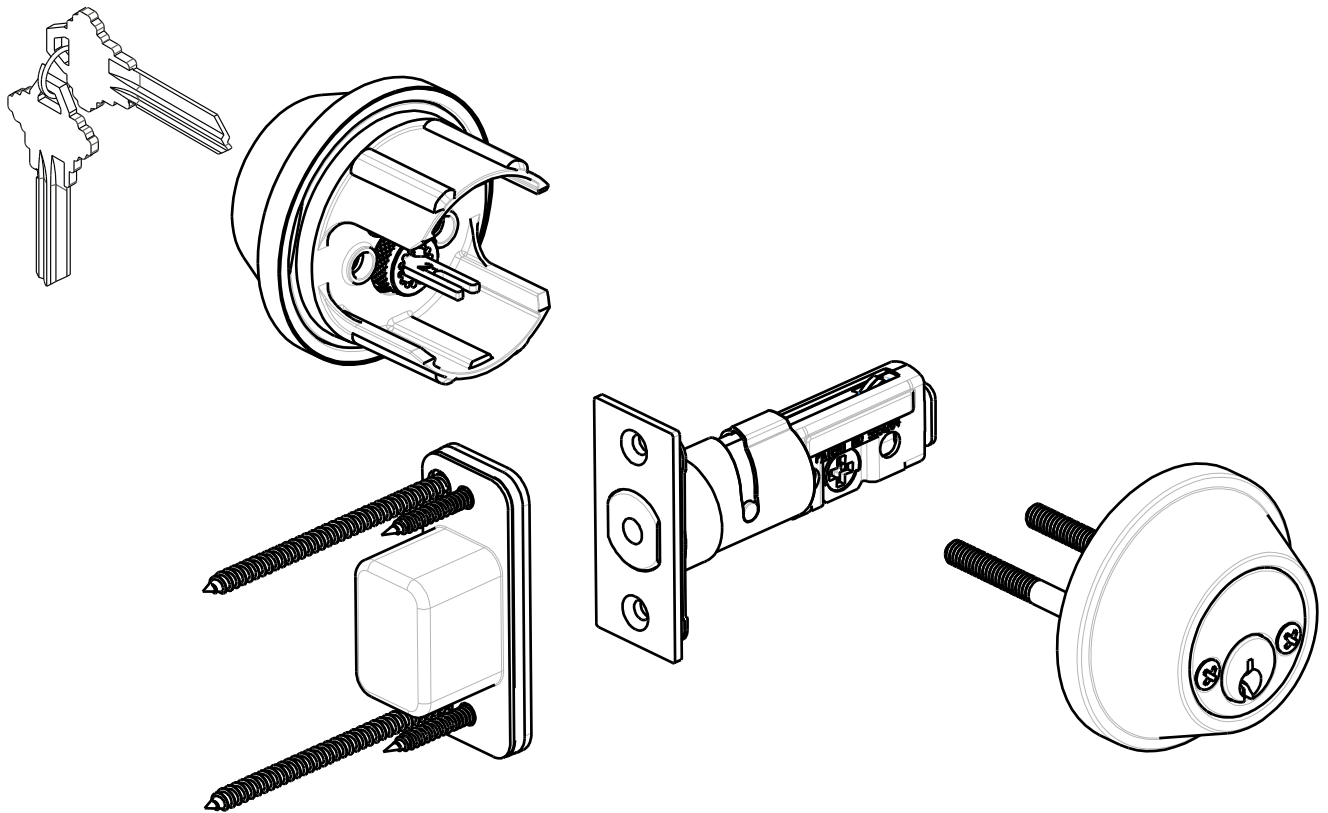
**Heavy Duty Single Cylinder Deadbolt w/ BumpStop® Grade 2 Commercial**

DSCHSD32D *Brushed Chrome*



**Heavy Duty Double Cylinder Deadbolt w/ BumpStop® Grade 2 Commercial**

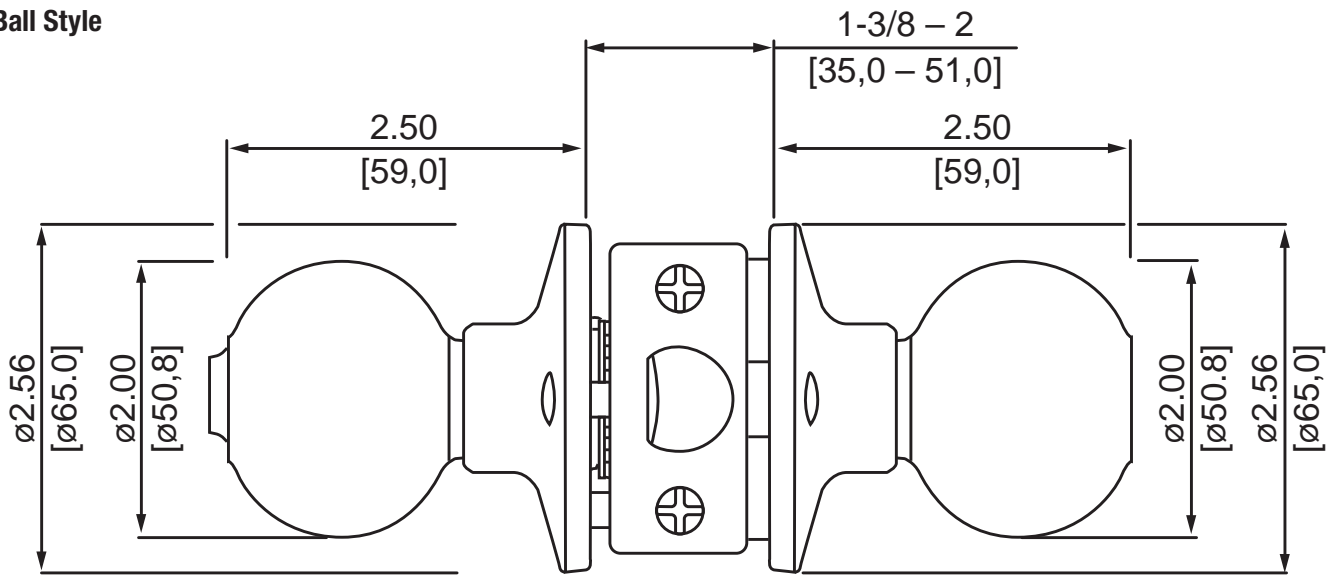
DSCHDD32D *Brushed Chrome*



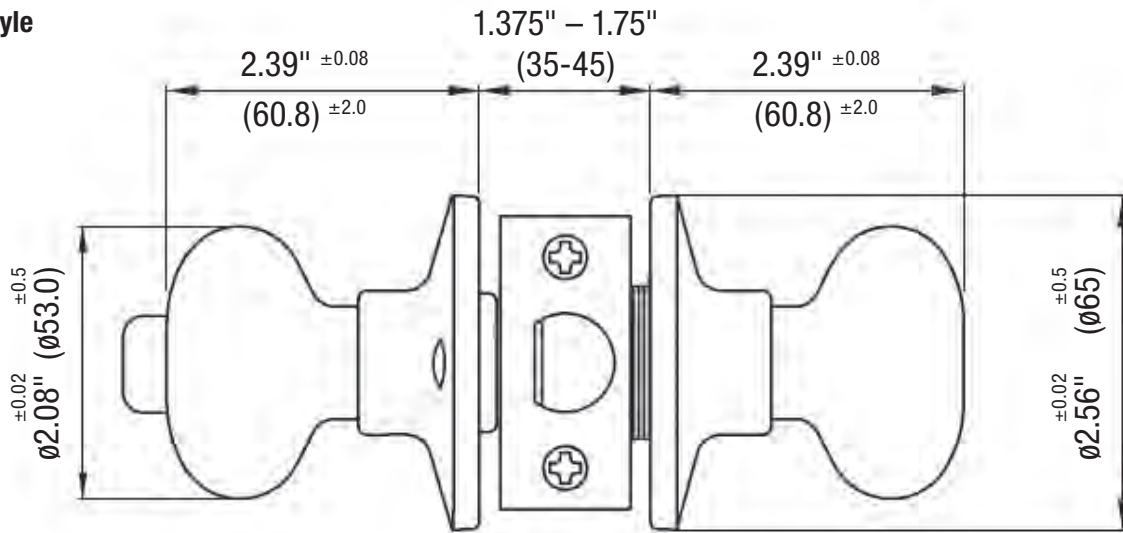
# Knob Styles

# Grade 3 Residential

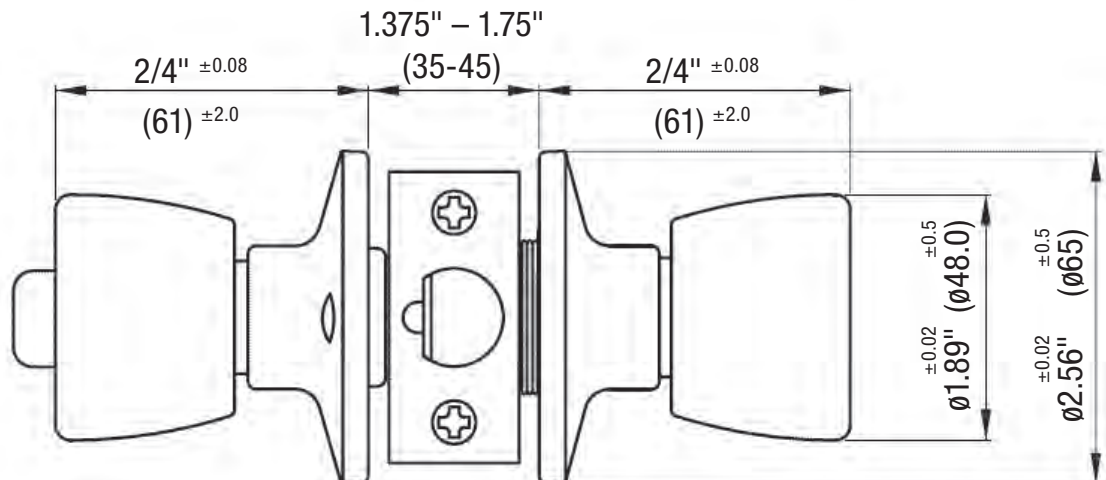
## Ball Style



## Biscuit Style



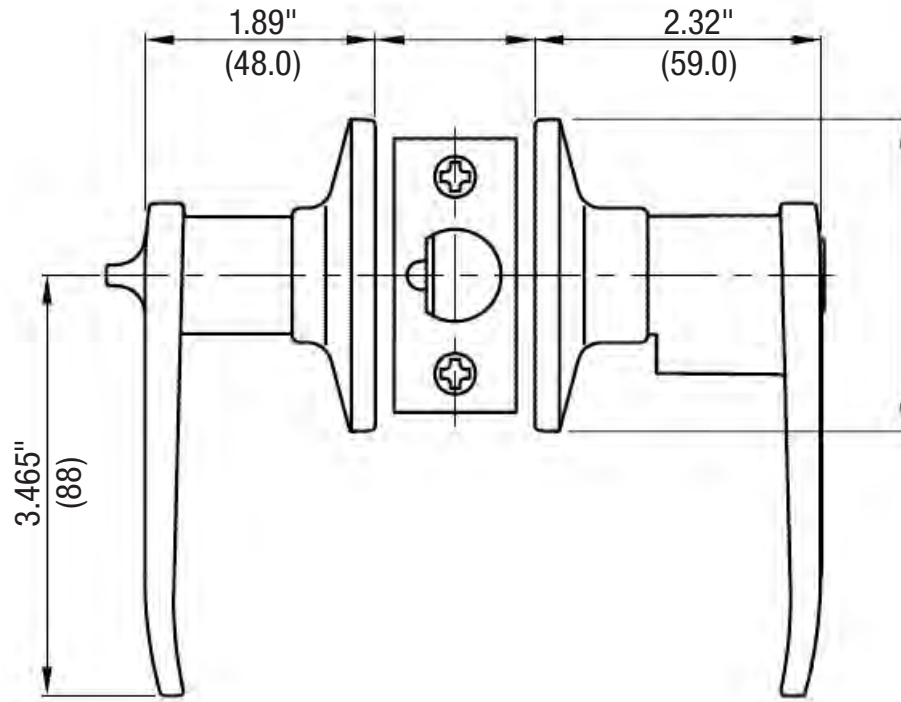
## Tulip Style



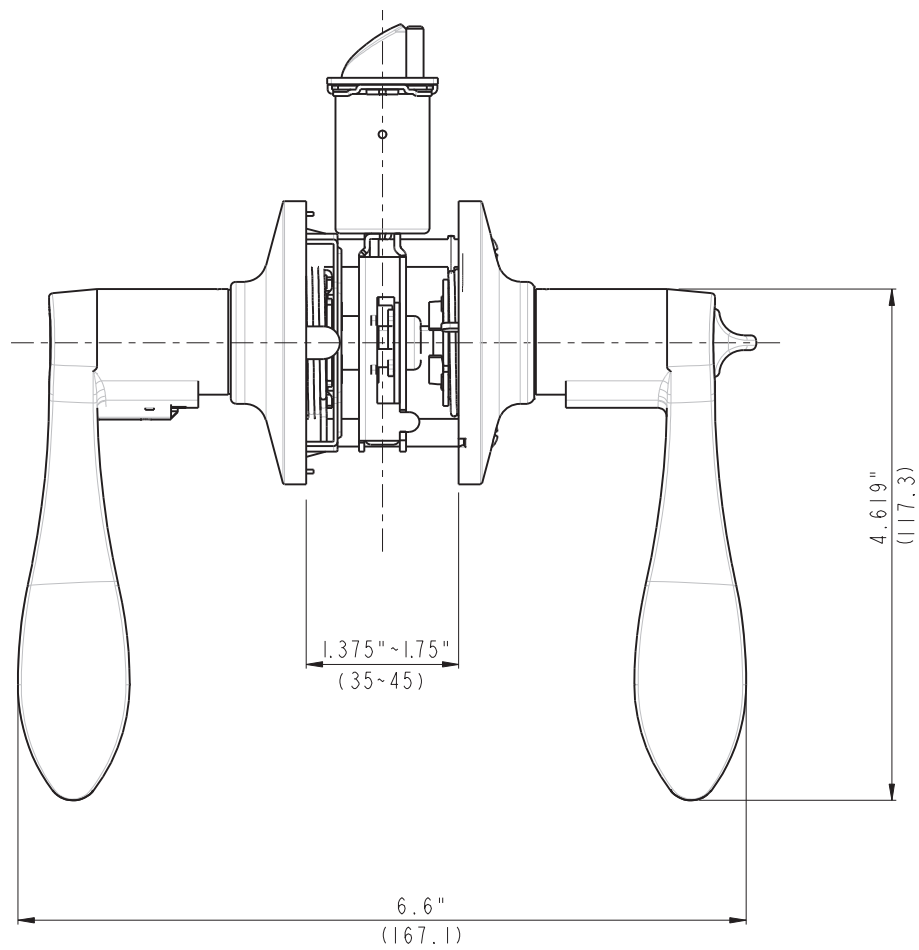
# Lever Styles

# Grade 3 Residential

## Straight Lever



## Wave Lever

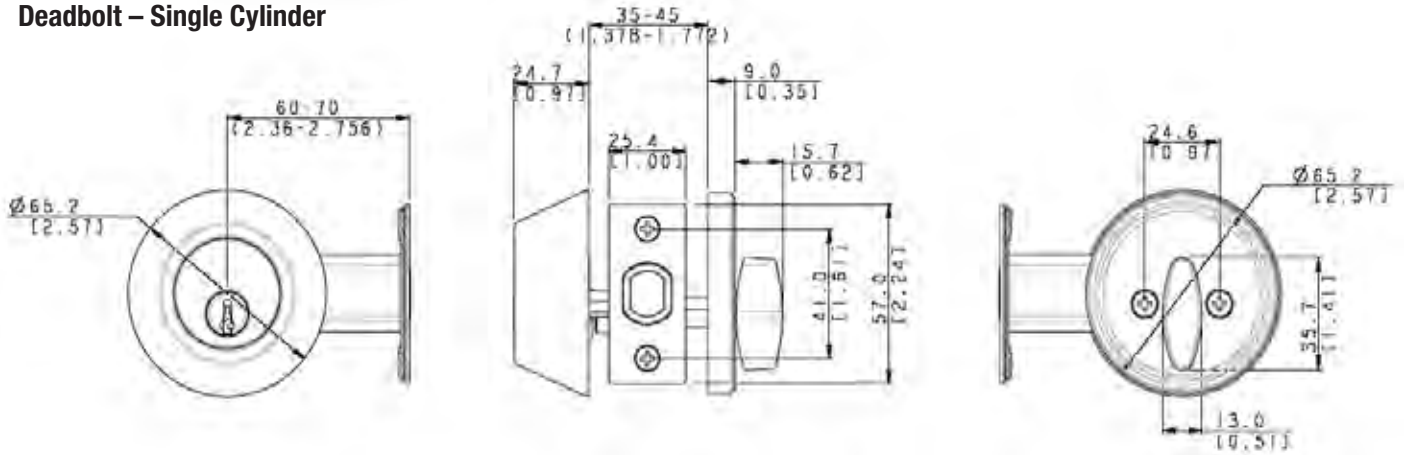




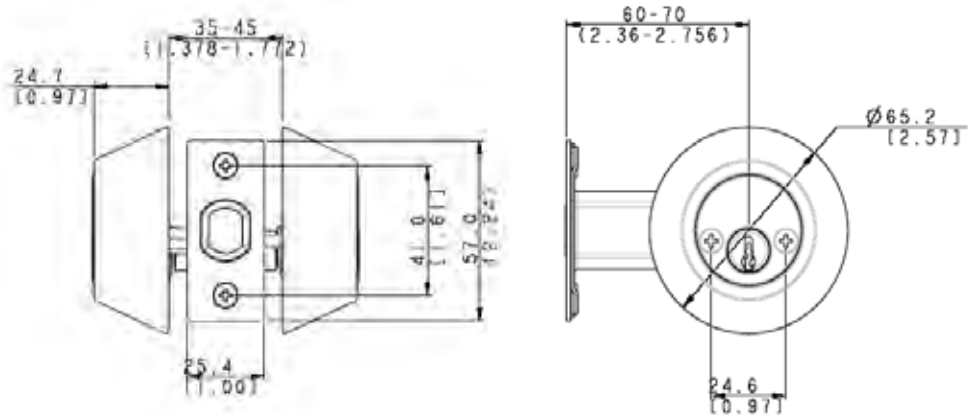
# Deadbolt and Handleset Styles

# Grade 3 Residential

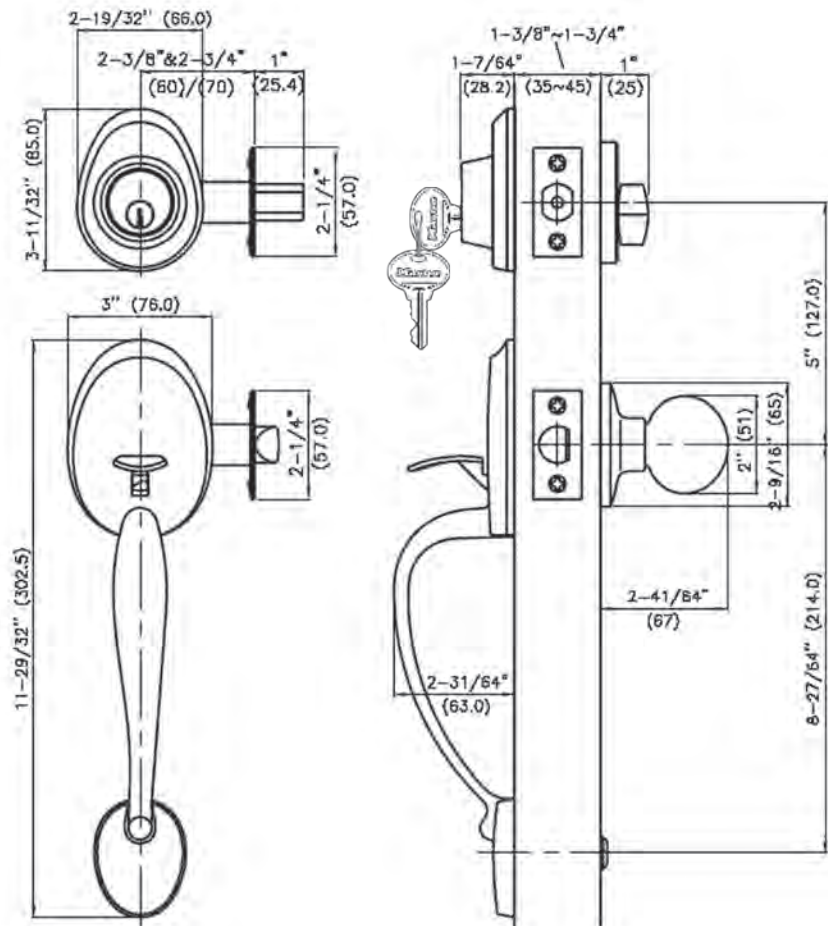
## Deadbolt – Single Cylinder



## Deadbolt – Double Cylinder



## Handleset



Interior available in:

- Ball Knob
- Biscuit Knob
- Tulip Knob
- Wave Lever

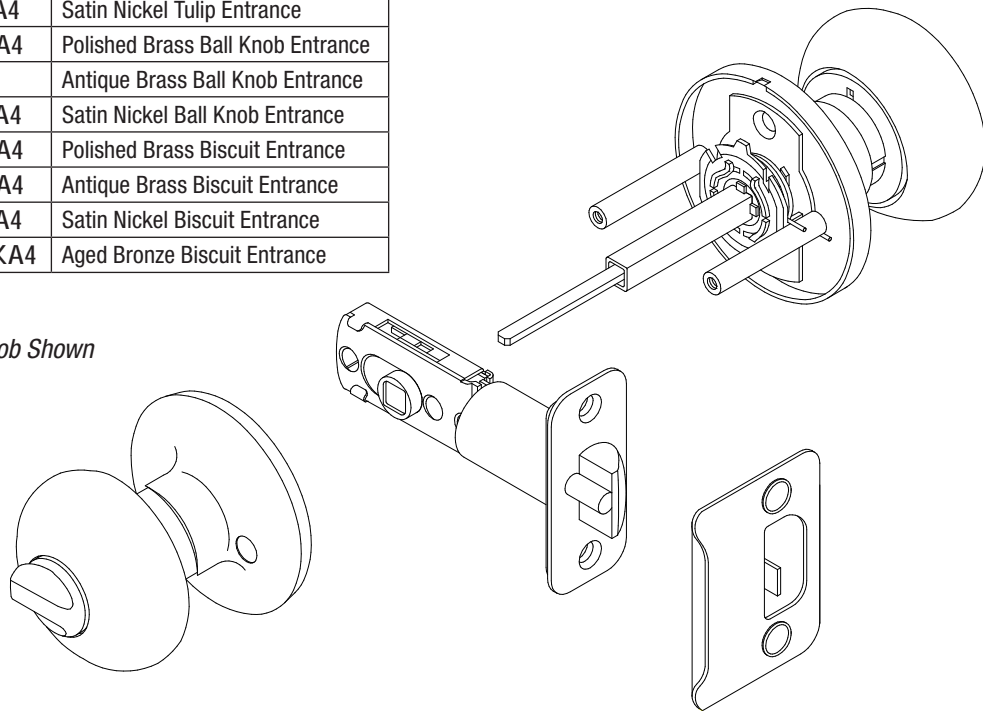
## Entry Knobset

## Grade 3 Residential

Part Number		Product Description
Retail	Boxed	
TUO0103	TUO0103KA4	Polished Brass Tulip Entrance
TUO0105	TUO0105KA4	Antique Brass Tulip Entrance
TUO0115	TUO0115KA4	Satin Nickel Tulip Entrance
BAO0103	BAO0103KA4	Polished Brass Ball Knob Entrance
BAO0105	N/A	Antique Brass Ball Knob Entrance
BAO0115	BAO0115KA4	Satin Nickel Ball Knob Entrance
BCO0103	BCO0103KA4	Polished Brass Biscuit Entrance
BCO0105	BCO0105KA4	Antique Brass Biscuit Entrance
BCO0115	BCO0115KA4	Satin Nickel Biscuit Entrance
BCO0112P	BCO0112PKA4	Aged Bronze Biscuit Entrance

**FUNCTION:** Turn button on inside handle locks or unlocks outside and inside. Key in outside locks or unlocks. When locked, handles are rigid. When unlocked, either will retract latch.

*Biscuit Knob Shown*



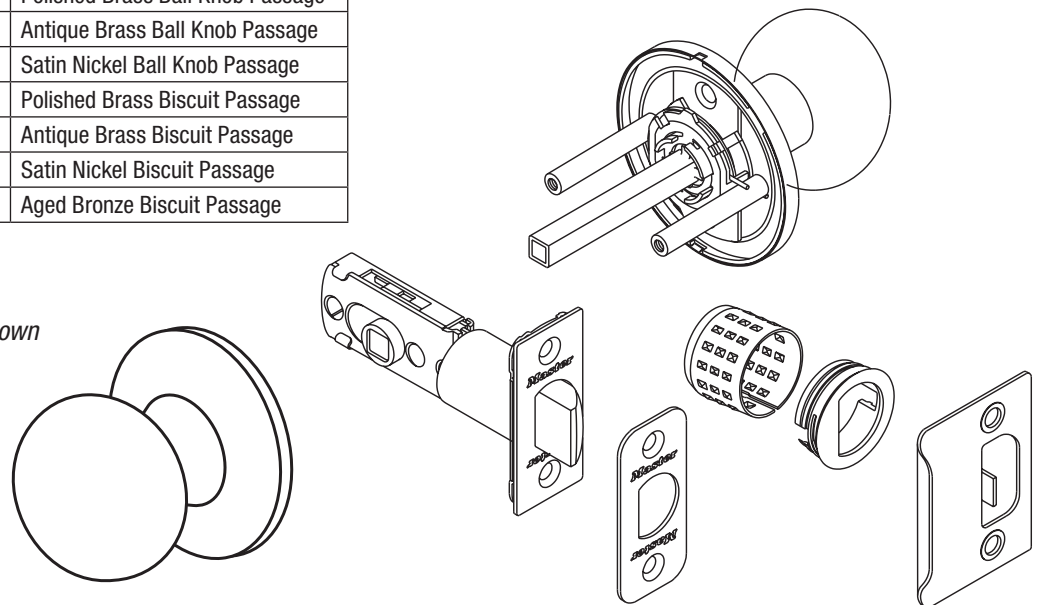
## Passage Knobset

## Grade 3 Residential

Part Number		Product Description
Retail	Boxed	
TUO0403	TUO0403/T6P	Polished Brass Tulip Passage
TUO0405	TUO0405/T6P	Antique Brass Tulip Passage
TUO0415	TUO0415/T6P	Satin Nickel Tulip Passage
BAO0403	BAO0403/T6P	Polished Brass Ball Knob Passage
BAO0405	N/A	Antique Brass Ball Knob Passage
BAO0415	BAO0415/T6P	Satin Nickel Ball Knob Passage
BCO0403	BCO0403/T6P	Polished Brass Biscuit Passage
BCO0405	BCO0405/T6P	Antique Brass Biscuit Passage
BCO0415	BCO0415/T6P	Satin Nickel Biscuit Passage
BCO0412P	BCO0412PT6P	Aged Bronze Biscuit Passage

**FUNCTION:** Inside and outside handles always unlocked; turning either retracts latch. No keys required.

*Ball Knob Shown*



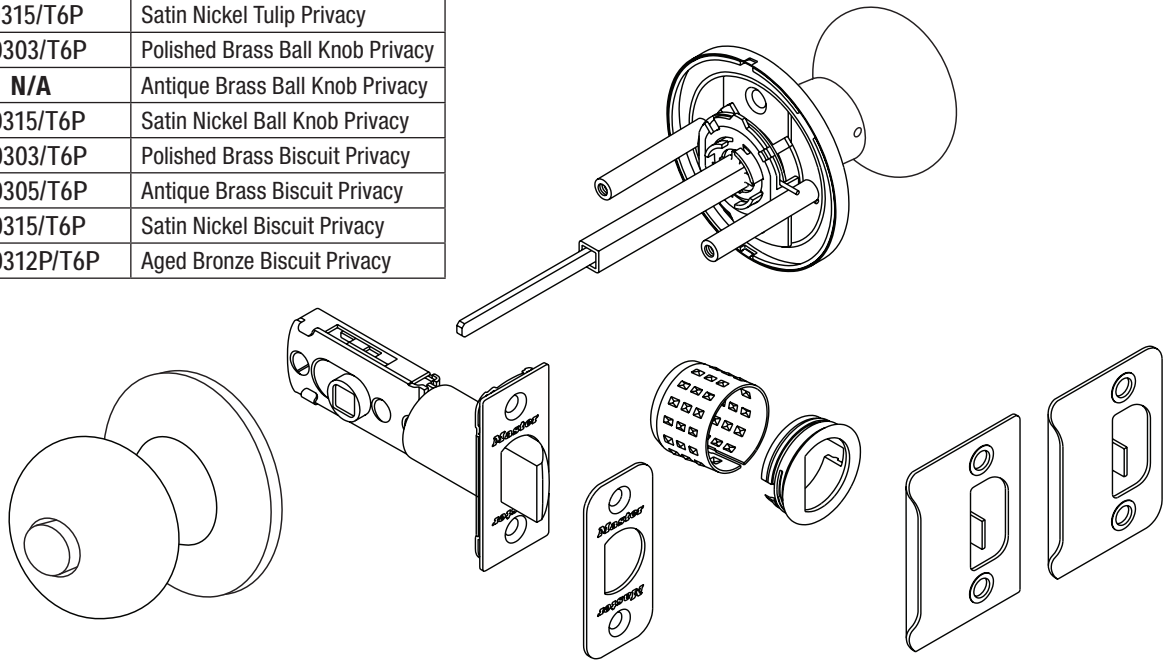
## Privacy Knobset

## Grade 3 Residential

Part Number		Product Description
Retail	Boxed	
TUO0303	TUO0303/T6P	Polished Brass Tulip Privacy
TUO0305	TUO0305/T6P	Antique Brass Tulip Privacy
TUO0315	TUO0315/T6P	Satin Nickel Tulip Privacy
BAO0303	BAO0303/T6P	Polished Brass Ball Knob Privacy
BAO0305	<b>N/A</b>	Antique Brass Ball Knob Privacy
BAO0315	BAO0315/T6P	Satin Nickel Ball Knob Privacy
BCO0303	BCO0303/T6P	Polished Brass Biscuit Privacy
BCO0305	BCO0305/T6P	Antique Brass Biscuit Privacy
BCO0315	BCO0315/T6P	Satin Nickel Biscuit Privacy
BCO0312P	BCO0312P/T6P	Aged Bronze Biscuit Privacy

**FUNCTION:** Inside handle push button locks outside handle. Emergency release in outside handle. Closing the door or turning inside handle releases the push button.

*Biscuit Knob Shown*



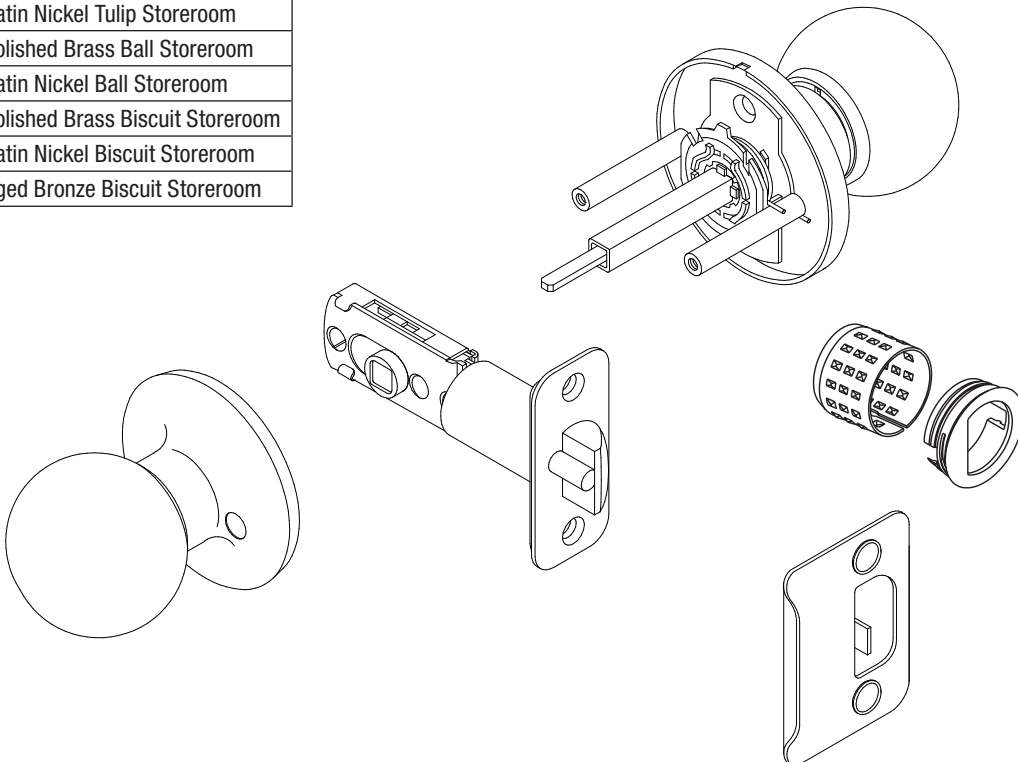
## Storeroom Knobset

## Grade 3 Residential

Part Number	Product Description
Boxed	
TUO0203KA4	Polished Brass Tulip Storeroom
TUO0215KA4	Satin Nickel Tulip Storeroom
BAO0203PKA4	Polished Brass Ball Storeroom
BAO0215PKA4	Satin Nickel Ball Storeroom
BCO0203KA4	Polished Brass Biscuit Storeroom
BCO0215KA4	Satin Nickel Biscuit Storeroom
BCO0212PKA4	Aged Bronze Biscuit Storeroom

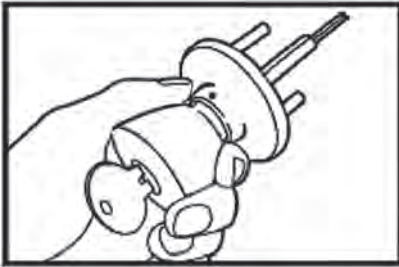
**FUNCTION:** Key in outside locks or unlocks. When locked, handle on outside is rigid. When unlocked will retract latch. Inside handle always unlocked, turning retracts latch.

*Ball Knob Shown*

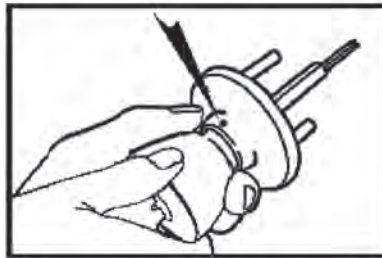


# Knobset Rekeying

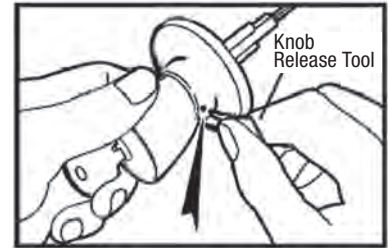
# Grade 3 Residential



Insert the operating key and unlock the knob. If an operating key is not available, pick to unlock.



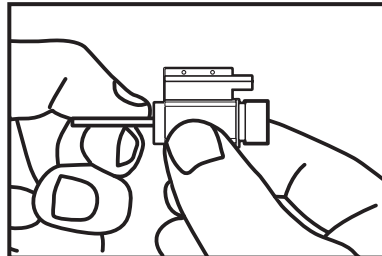
Turn the outside knob clockwise until the retainer aligns with and is visible under the poke hole.



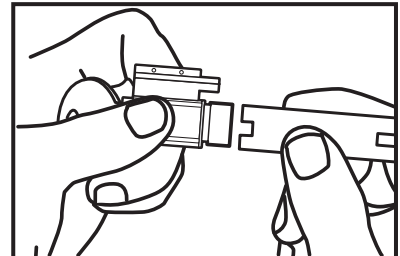
Use the knob release tool to depress the knob retainer and pull knob from the spindle.



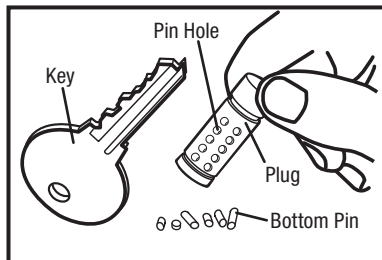
Remove knob ferrule and then remove cylinder from knob. Remove C clip from cylinder.



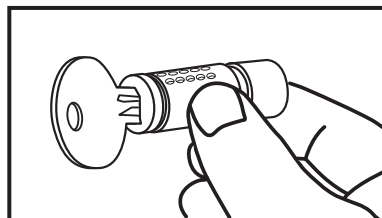
Turn plug 45° in either direction.



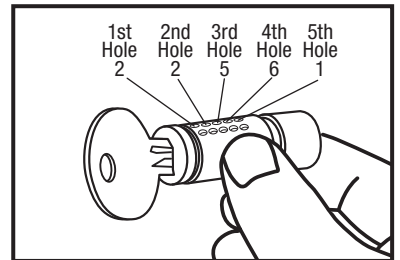
Use the plug follower to push the plug out of the shell. Note: Use the notched end against the end of the plug.



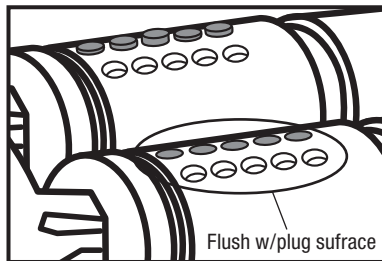
Pull the key from the plug and remove pins from all chambers.



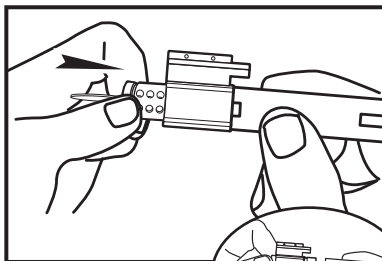
Insert new key. If the key isn't stamped with a direct code, decode. Our example key is combination 22561.



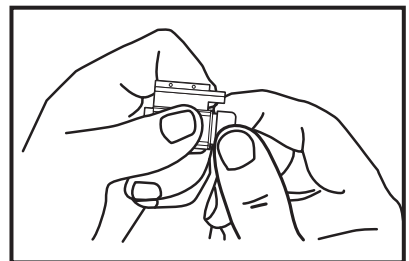
Select a bottom pin #2 from the keying kit and place it in the first pin chamber. Key the rest of the cylinder as: #2 in the second chamber, #5 in the third chamber, #6 in the fourth chamber, #1 in the fifth chamber.



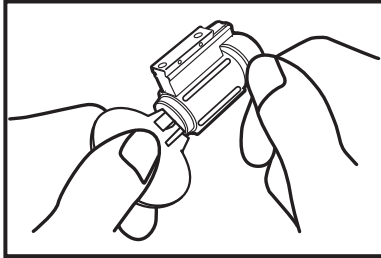
Check that all pins are flush with the surface of the plug with the new key inserted.



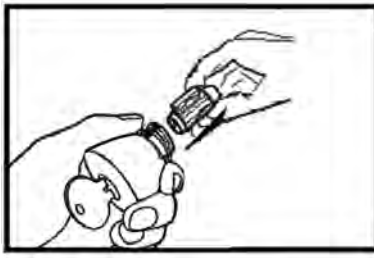
With the plug turned 90° from vertical, push follower from the shell with the plug.



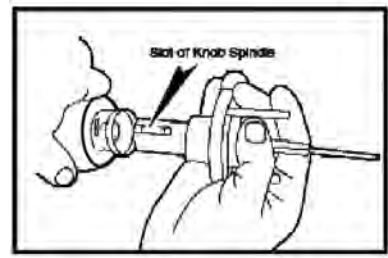
Push circlip retainer onto the end of the plug.



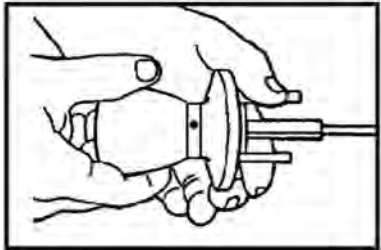
Check operation of key for functionality.  
Remove key.



Place plug in position inside shell and  
reinstall the C clip. Insert cylinder into  
knob and replace ferrule.



With key partially inserted, align the bible  
with the slot on the outside knob spindle.  
Align knob and push in to engage the  
retainer.



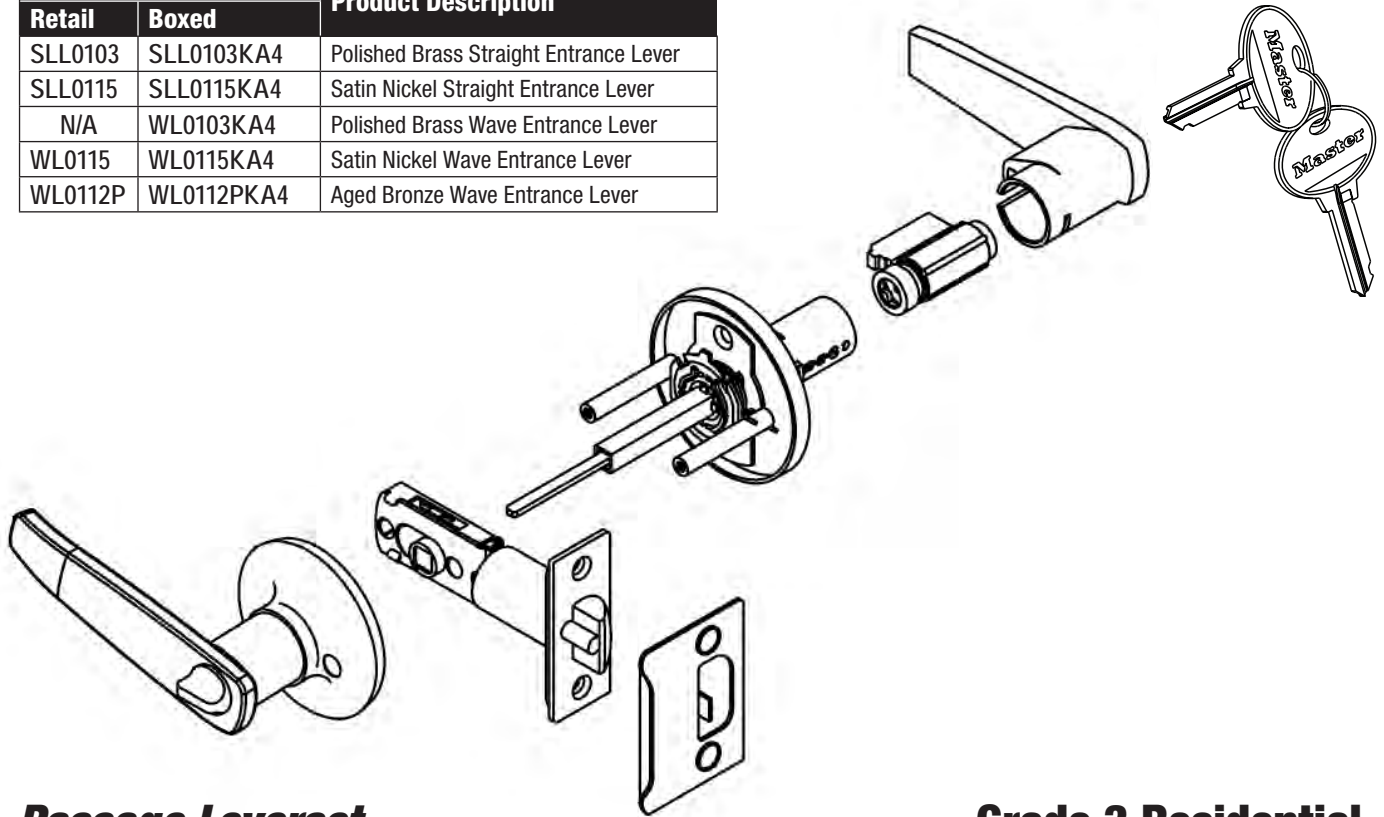
Check knob locked and unlocked to ensure  
it operates properly. Reinstall lock on door  
if it was removed for rekeying.

## Entry Leverset

## Grade 3 Residential

FUNCTION: Turn button on inside handle locks or unlocks outside and inside. Key in outside locks or unlocks. When locked, handles are rigid. When unlocked, either will retract latch.

Part Number		Product Description
Retail	Boxed	
SLL0103	SLL0103KA4	Polished Brass Straight Entrance Lever
SLL0115	SLL0115KA4	Satin Nickel Straight Entrance Lever
N/A	WL0103KA4	Polished Brass Wave Entrance Lever
WL0115	WL0115KA4	Satin Nickel Wave Entrance Lever
WL0112P	WL0112PKA4	Aged Bronze Wave Entrance Lever

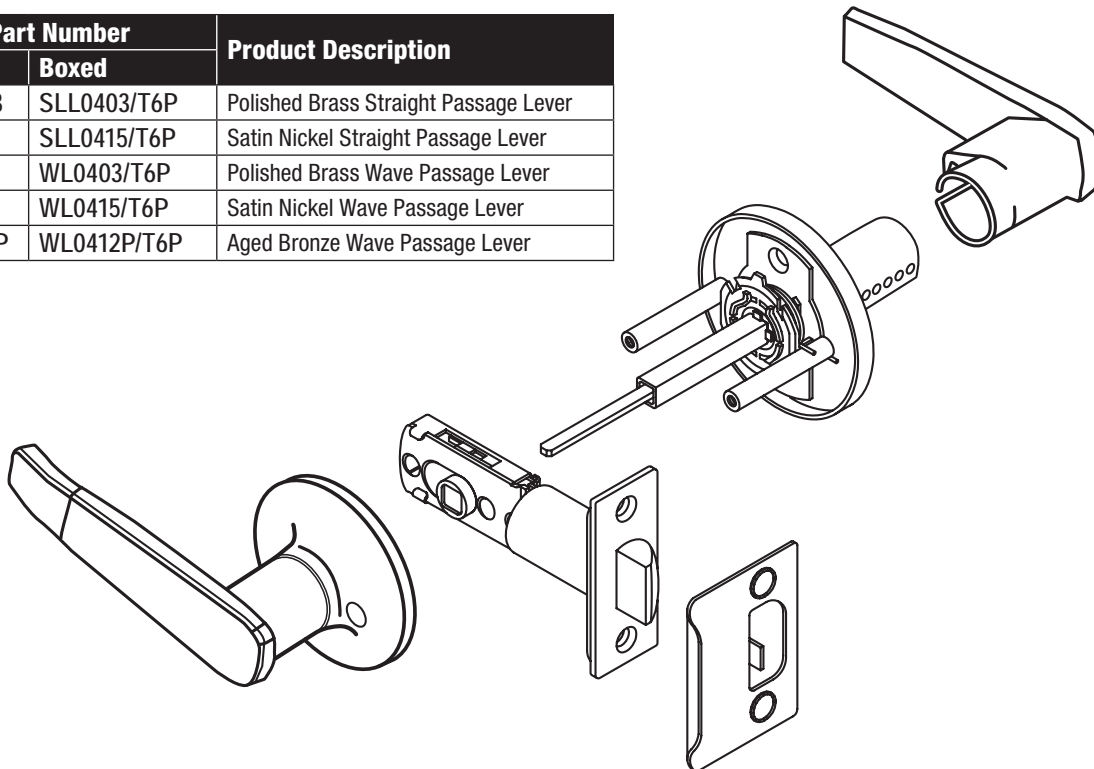


## Passage Leverset

## Grade 3 Residential

FUNCTION: Handle from either side retracts latch. No keys required.

Part Number		Product Description
Retail	Boxed	
SLL0403	SLL0403/T6P	Polished Brass Straight Passage Lever
SLL0415	SLL0415/T6P	Satin Nickel Straight Passage Lever
N/A	WL0403/T6P	Polished Brass Wave Passage Lever
WL0415	WL0415/T6P	Satin Nickel Wave Passage Lever
WL0412P	WL0412P/T6P	Aged Bronze Wave Passage Lever

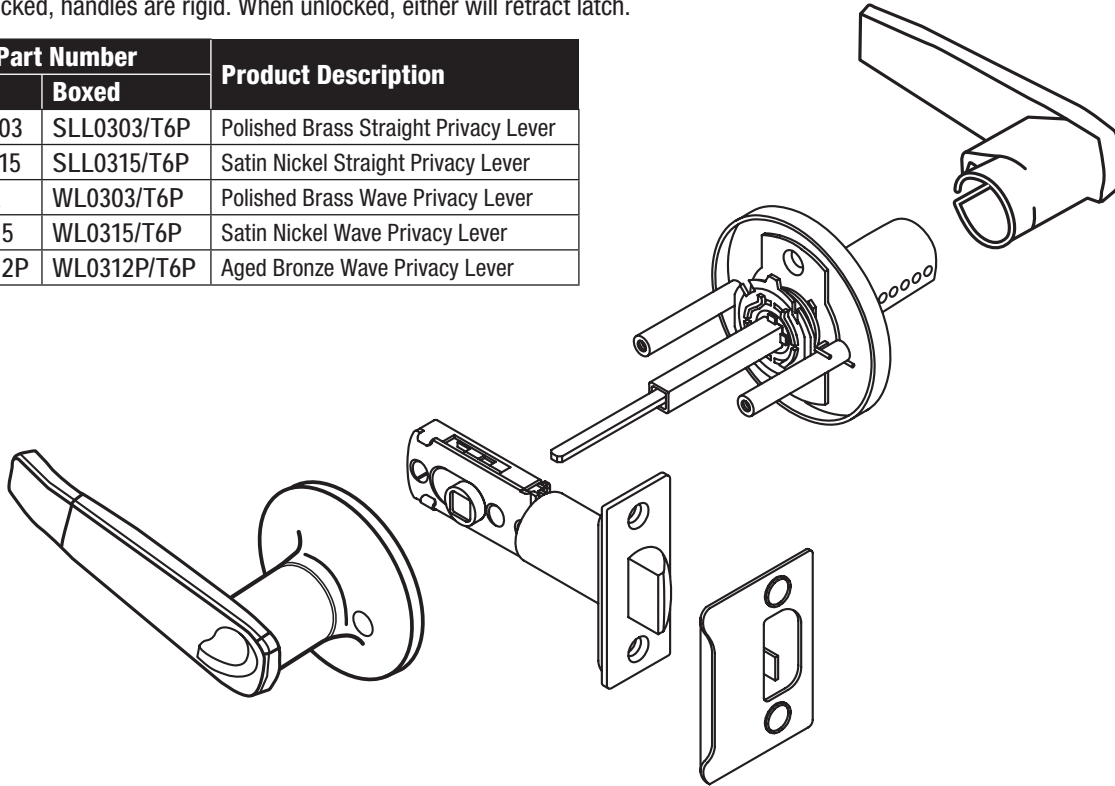


## Privacy Leverset

## Grade 3 Residential

FUNCTION: Turn button on inside handle locks or unlocks outside and inside. When locked, handles are rigid. When unlocked, either will retract latch.

Part Number		Product Description
Retail	Boxed	
SLL0303	SLL0303/T6P	Polished Brass Straight Privacy Lever
SLL0315	SLL0315/T6P	Satin Nickel Straight Privacy Lever
N/A	WL0303/T6P	Polished Brass Wave Privacy Lever
WL0315	WL0315/T6P	Satin Nickel Wave Privacy Lever
WL0312P	WL0312P/T6P	Aged Bronze Wave Privacy Lever

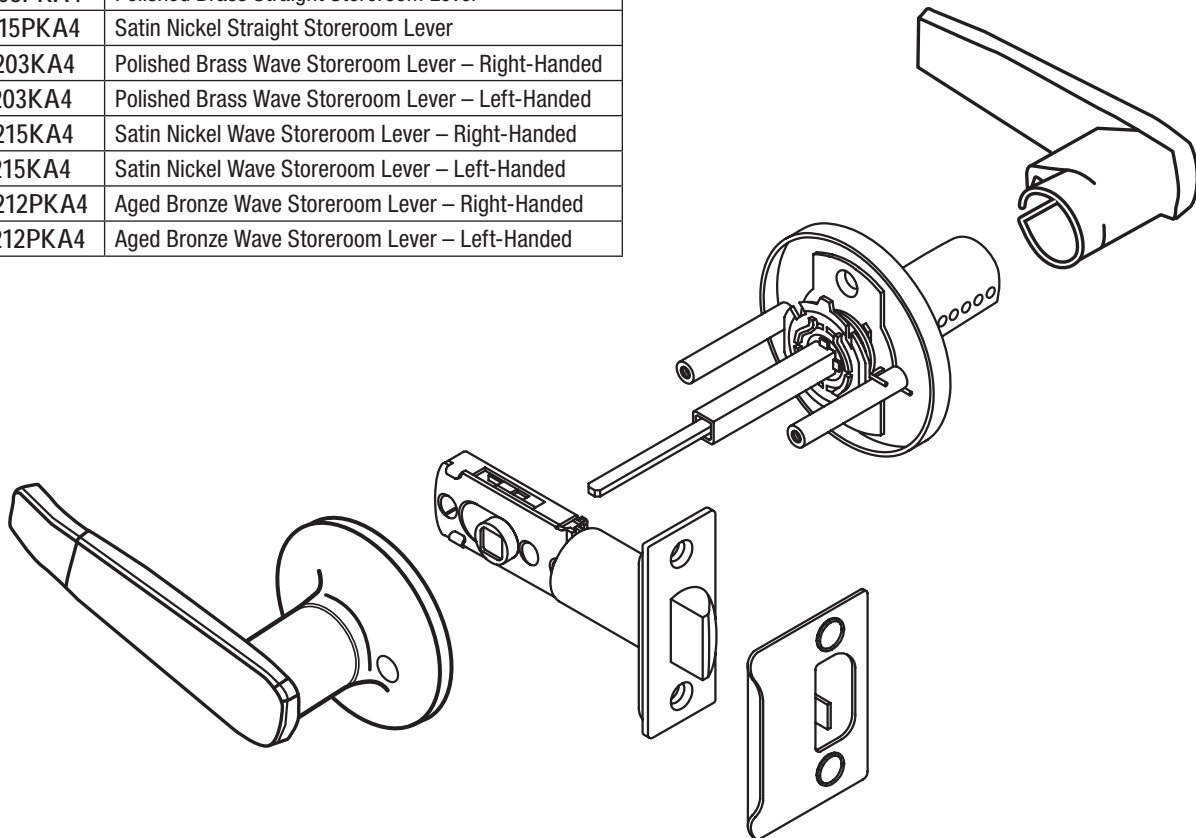


## Storeroom Leverset

## Grade 3 Residential

FUNCTION: Inside always unlocked. Outside handle always locked. Latch retracted by turning key.

Part Number	Product Description
Boxed	
SLLO0203PKA4	Polished Brass Straight Storeroom Lever
SLLO0215PKA4	Satin Nickel Straight Storeroom Lever
WLRH0203KA4	Polished Brass Wave Storeroom Lever – Right-Handed
WLLH0203KA4	Polished Brass Wave Storeroom Lever – Left-Handed
WLRH0215KA4	Satin Nickel Wave Storeroom Lever – Right-Handed
WLLH0215KA4	Satin Nickel Wave Storeroom Lever – Left-Handed
WLRH0212PKA4	Aged Bronze Wave Storeroom Lever – Right-Handed
WLLH0212PKA4	Aged Bronze Wave Storeroom Lever – Left-Handed

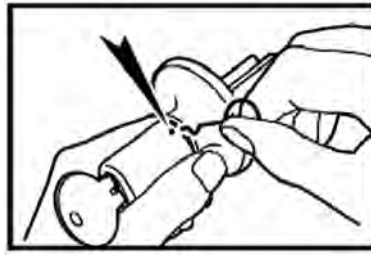


# Leverset Rekeying

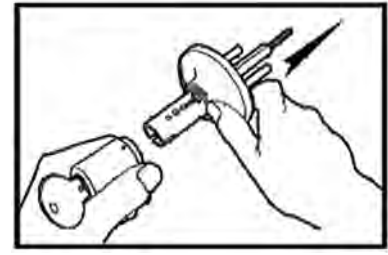
# Grade 3 Residential



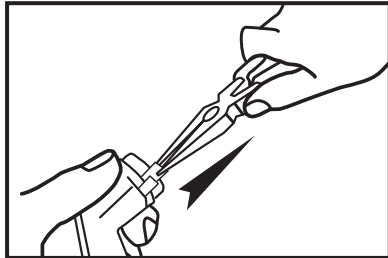
Use key to unlock, if no key is available, pick to unlock.



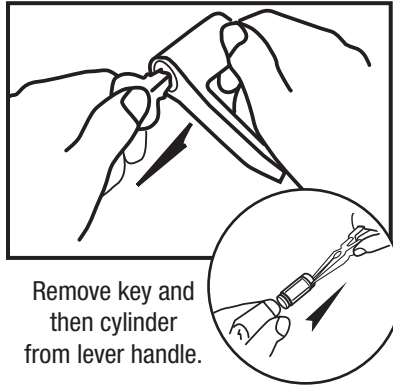
Use the lever release tool to depress the retainer and release the lever.



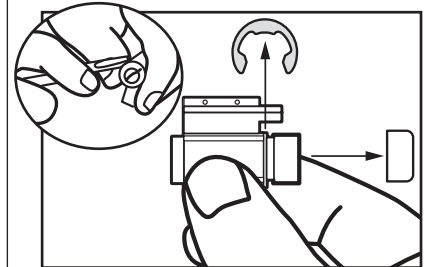
Pull lever handle from outside spindle.



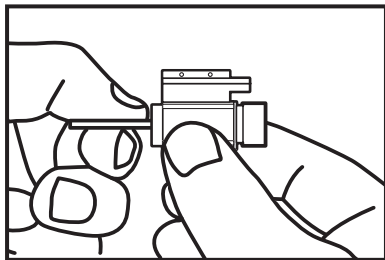
Remove plastic spacer from lever. Do not lose.



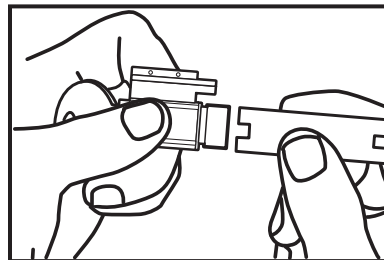
Remove key and then cylinder from lever handle.



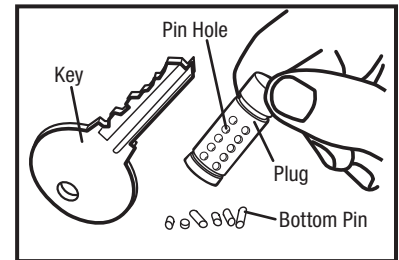
Remove C clip and pry cap from end of cylinder.



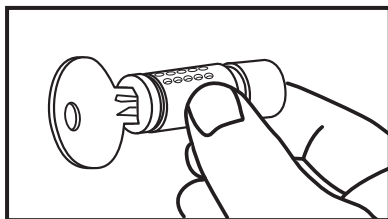
Turn plug 45° in either direction.



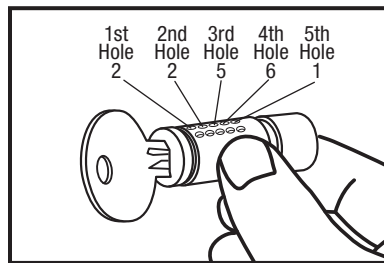
Use the plug follower to push the plug out of the shell. Note: Use the notched end against the end of the plug.



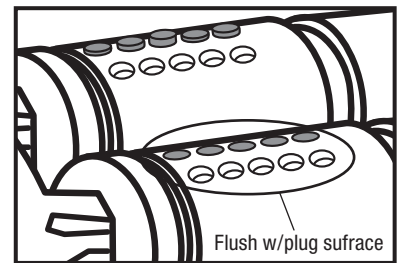
Pull the key from the plug and remove pins from all chambers.



Insert new key. If the key isn't stamped with a direct code, decode. Our example key is combination 22561.

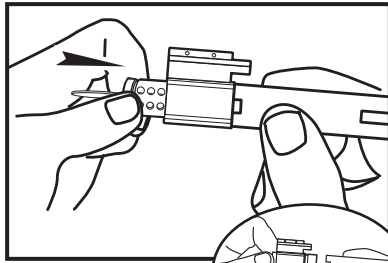


Select a bottom pin #2 from the keying kit and place it in the first pin chamber. Key the rest of the cylinder as: #2 in the second chamber, #5 in the third chamber, #6 in the fourth chamber, #1 in the fifth chamber.

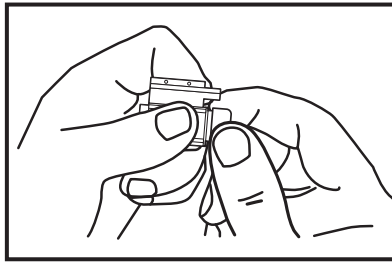


Check that all pins are flush with the surface of the plug with the new key inserted.

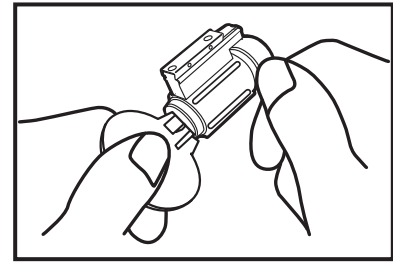




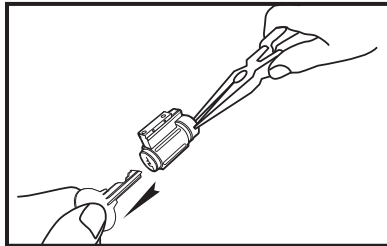
With the plug turned 90° from vertical, push follower from the shell with the plug.



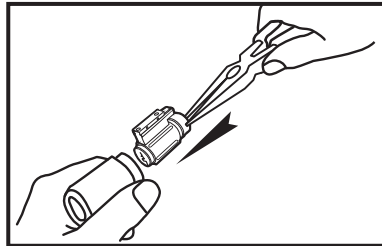
Push circlip retainer onto the end of the plug.



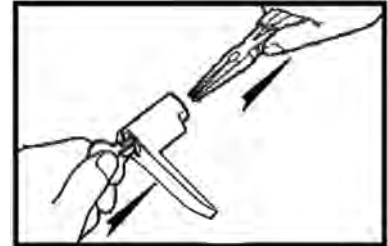
Check operation of key for functionality.



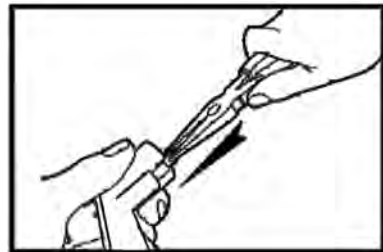
Pull key from cylinder and grab cylinder end with pliers.



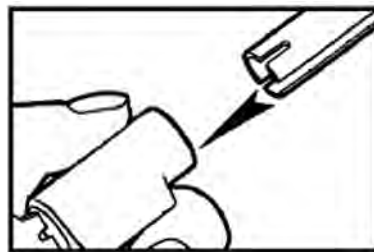
Push cylinder assembly into the lever handle using the pliers.



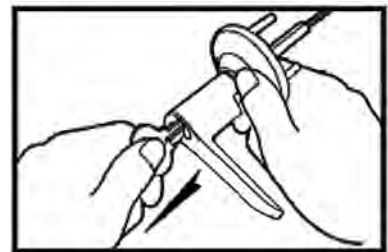
Partially insert key and remove the pliers.



Replace the plastic spacer with correct orientation.



Align the plastic spacer with the slot in the spindle, then push lever onto spindle until retainer snaps into place.



Check operation of lock in locked and unlocked modes to verify functionality.

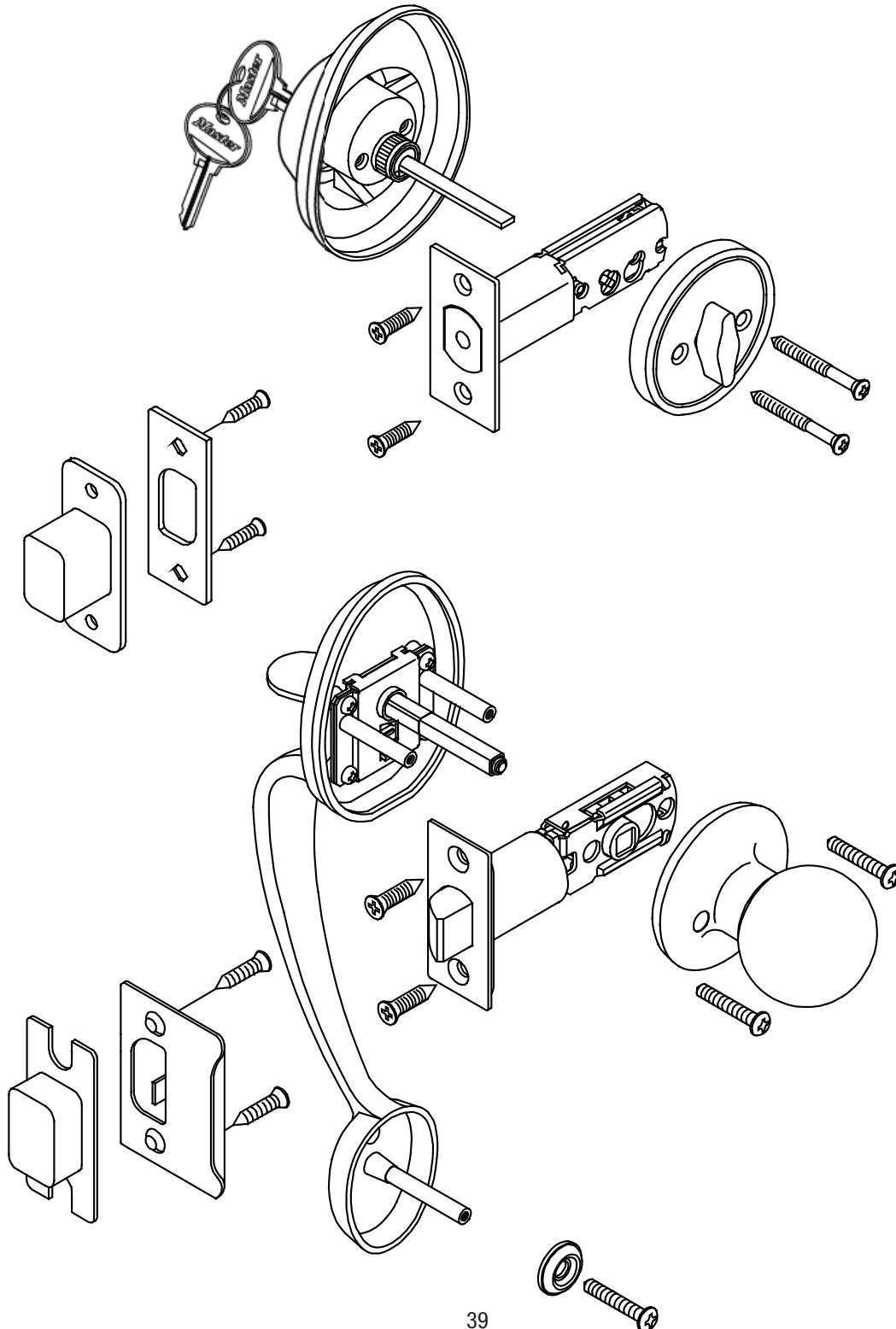
# Handleset

# Grade 3 Residential

FUNCTION: Deadbolt thrown or retracted by key outside or thumb turn inside. Latch bolt by thumb piece outside or knob inside. No keys required for latch bolt operation.

Part Number		Product Description
Retail	Boxed	
HDLBA0603	HDLBA0603KA4	Polished Brass Entrance Handleset, Ball Knob Interior
N/A	HDLTU0603KA4	Polished Brass Entrance Handleset, Tulip Knob Interior
N/A	HDLBA0615KA4	Satin Nickel Entrance Handleset, Ball Knob Interior
N/A	HDLBC0612PKA4	Aged Bronze Entrance Handleset, Biscuit Knob Interior
N/A	HDLWL0612PKA4	Aged Bronze Entrance Handleset, Wave Lever Interior

Handleset deadbolts are not available with the NightWatch® function

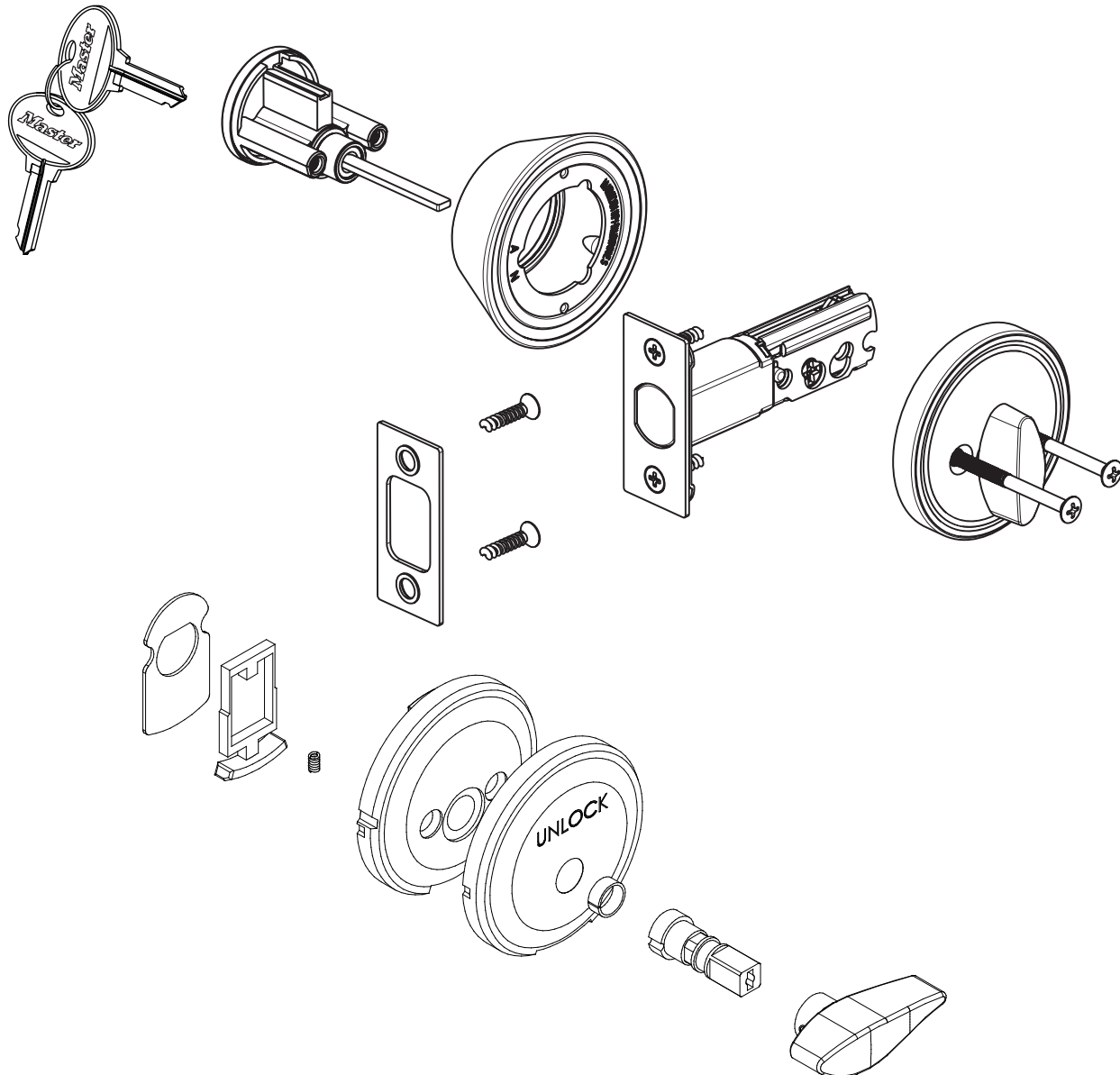


# Single Cylinder Deadbolt

# Grade 3 Residential

FUNCTION: Deadbolt thrown or retracted by key outside or by thumb turn inside.

Part Number		Product Description
Retail	Boxed	
DSO0603	DSO0603KA4	Polished Brass Single Cylinder Deadbolt
DSO0605	DSO0605KA4	Antique Brass Single Cylinder Deadbolt
DSO0615	DSO0615KA4	Satin Nickel Single Cylinder Deadbolt
DSO0612P	DSO0612PKA4	Aged Bronze Single Cylinder Deadbolt
N/A	DSNO0603KA4	Polished Brass Single Cylinder Deadbolt, with BumpStop®
N/A	DSNO0605KA4	Antique Brass Single Cylinder Deadbolt, with BumpStop®
N/A	DSNO0615KA4	Satin Nickel Single Cylinder Deadbolt, with BumpStop®
N/A	DSNO0612PKA4	Aged Bronze Single Cylinder Deadbolt with BumpStop®
DSON0603	DSON0603KA4	Polished Brass Single Cylinder Deadbolt, NightWatch®
DSON0605	DSON0605KA4	Antique Brass Single Cylinder Deadbolt, NightWatch®
DSON0615	DSON0615KA4	Satin Nickel Single Cylinder Deadbolt, NightWatch®
DSON0612P	N/A	Aged Bronze Single Cylinder Deadbolt, NightWatch®
N/A	DSNON0603KA4	Polished Brass Single Cylinder Deadbolt, NightWatch® with BumpStop®
N/A	DSNON0605KA4	Antique Brass Single Cylinder Deadbolt, NightWatch® with BumpStop®
N/A	DSNON0615KA4	Satin Nickel Single Cylinder Deabolt, NightWatch® with BumpStop®

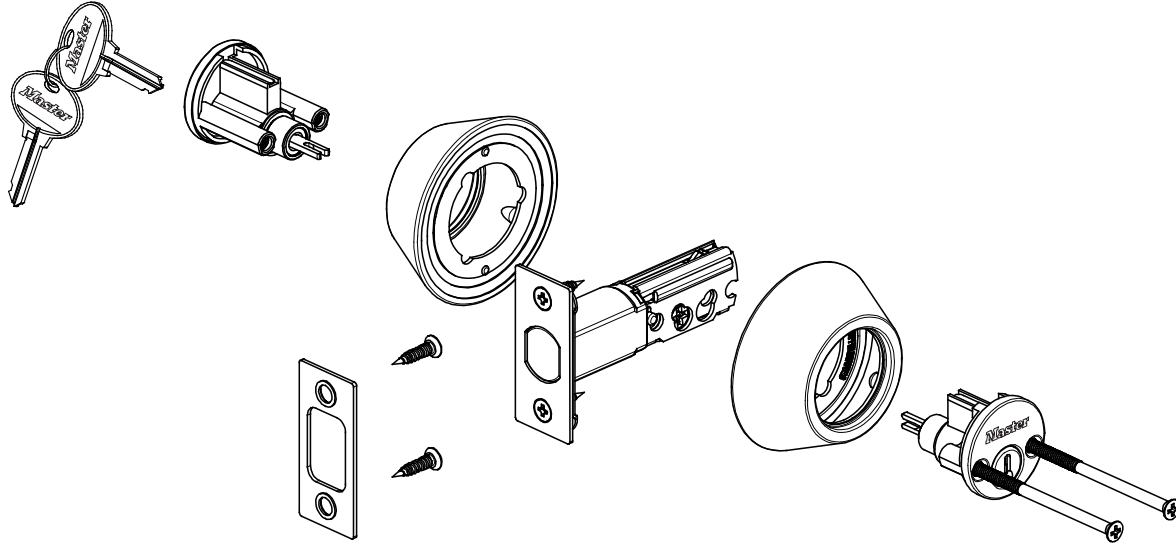


# Double Cylinder Deadbolt

# Grade 3 Residential

FUNCTION: Deadbolt thrown or retracted by key in either side.

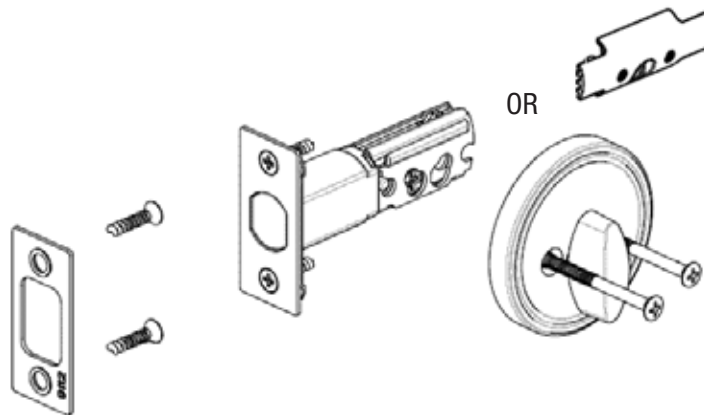
Part Number		Product Description
Retail	Boxed	
DSO0703	DSO0703KA4	Polished Brass Double Cylinder Deadbolt
DSO0705	DSO0705KA4	Antique Brass Double Cylinder Deadbolt
DSO0715	DSO0715KA4	Satin Nickel Double Cylinder Deadbolt
DSO0712P	DSO0712PKA4	Aged Bronze Double Cylinder Deadbolt with BumpStop®
N/A	DSNO0703KA4	Polished Brass Double Cylinder Deadbolt with BumpStop®
N/A	DSNO0705KA4	Antique Brass Double Cylinder Deadbolt with BumpStop®
N/A	DSNO0715KA4	Satin Nickel Double Cylinder Deadbolt with BumpStop®
N/A	DSNO0712PKA4	Aged Bronze Double Cylinder Deadbolt with BumpStop®



# One-Sided Deadbolt

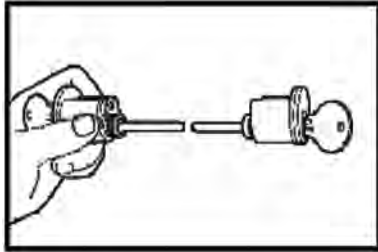
# Grade 3 Residential

Part Number	Product Description
DSO0503	Polished Brass Single-Sided Deadbolt
DSO0505	Antique Brass Single-Sided Deadbolt
DSO0515	Satin Nickel Single-Sided Deadbolt
DSO0512P	Aged Bronze Single-Sided Deadbolt



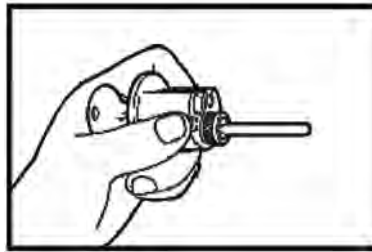
# Deadbolt Rekeying

# Grade 3 Residential

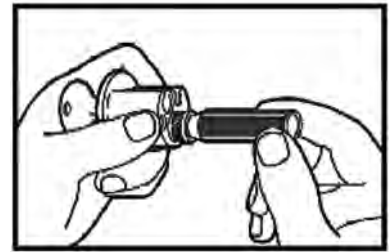


Insert key.

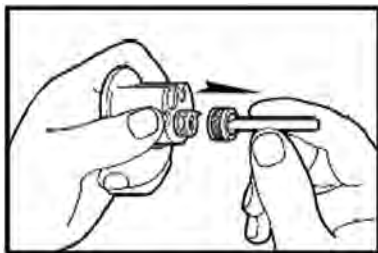
Note: The rekeying procedure is the same for brass cylinder housings or die cast housings.



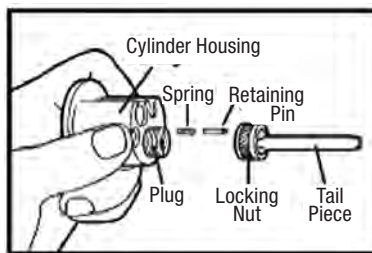
Disassemble the deadbolt, remove trim collar from the cylinder.



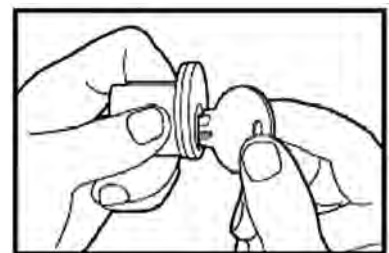
Rotate the cap tool counterclockwise to loosen the cap.



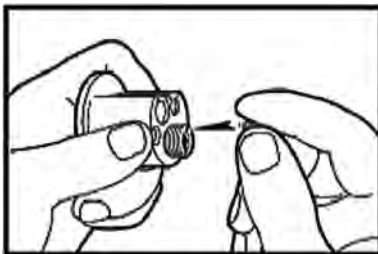
Remove cap and tailpiece.



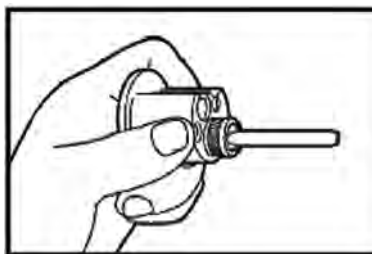
Remove cap pin and cap pin spring  
Rekey using a follower as instructed under Leverset Rekeying.



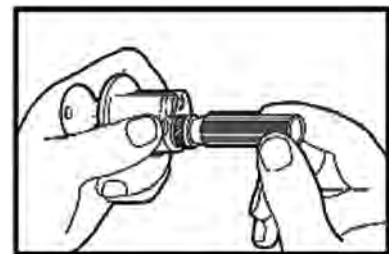
Check reassembled cylinder to ensure functionality but do not remove the key.



Insert the cap pin spring and the cap pin.



Put cap and tailpiece in position.



Tighten cap with cap tool and check key for ease in turning. If tight, loosen cap one retention point and check.

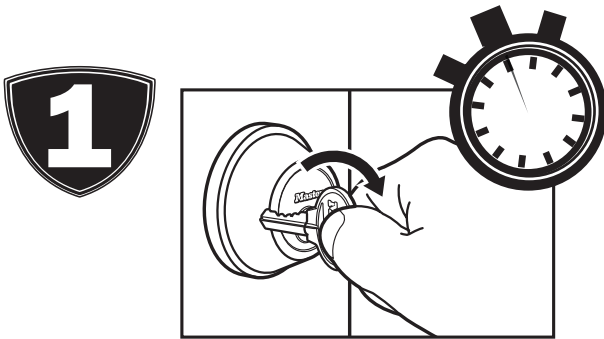
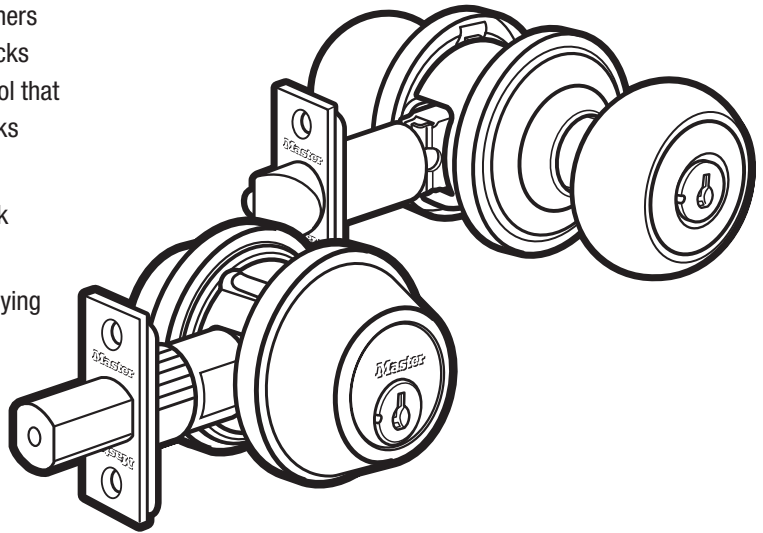
# Recodable Multi-Family

Master Lock Recodable Door Hardware allows property owners and managers to take control of the process of changing locks with every change in occupancy. With the simple change tool that is provided with each lock they can instantly rekey door locks whenever needed and as often as needed.

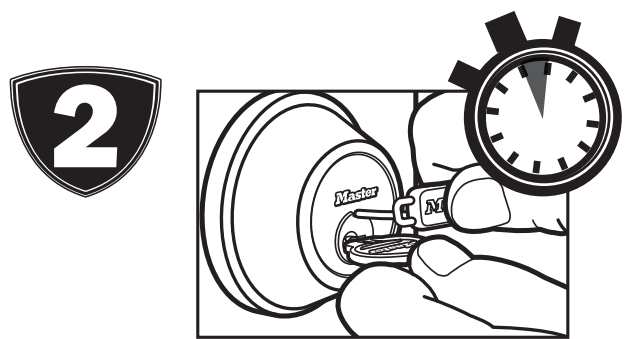
Quick – Literally takes just seconds to recode a Master Lock recodable lock

Cost Effective – Eliminates cost of lock replacement or rekeying

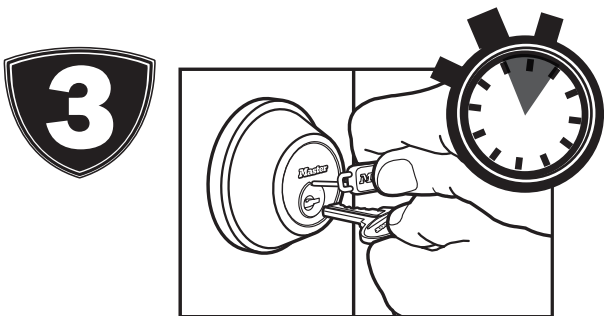
Easy – Takes just four easy steps



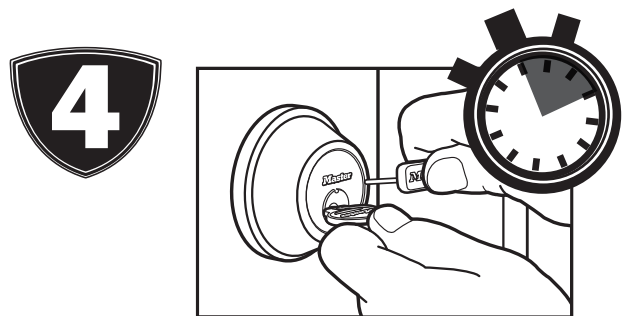
With door open, insert key into keyway of deadbolt. Turn key 90 degrees clockwise to recode position. Do not remove key from keyway.



With key still in keyway, insert Change Tool into notch above the keyway.



Without removing the Change Tool, remove old key. With Change Tool still in place, insert new key.



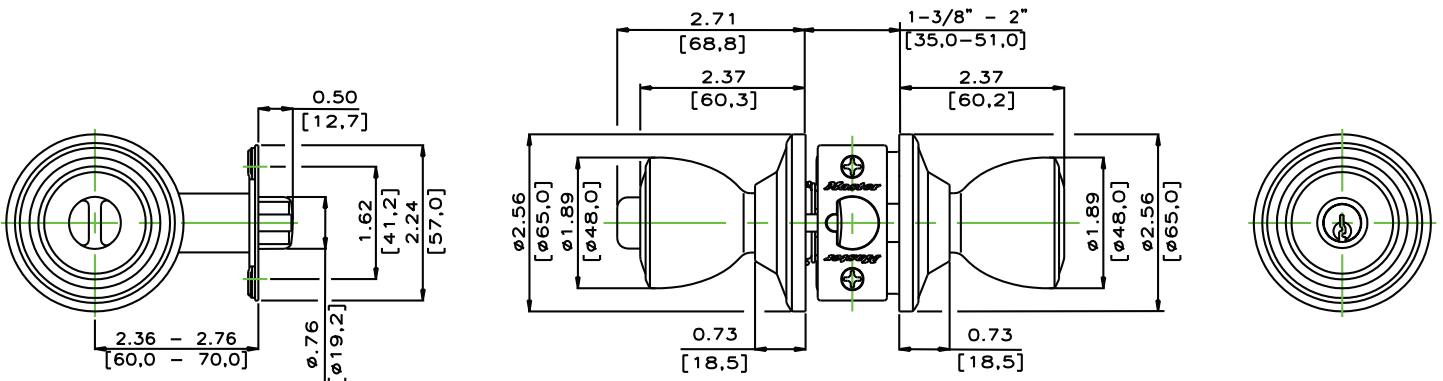
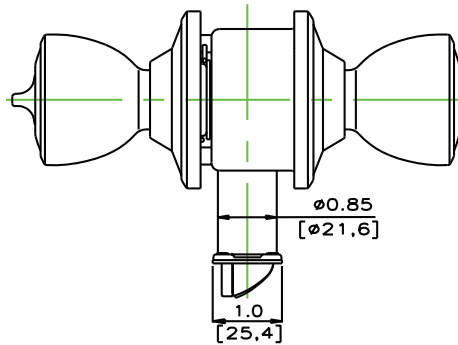
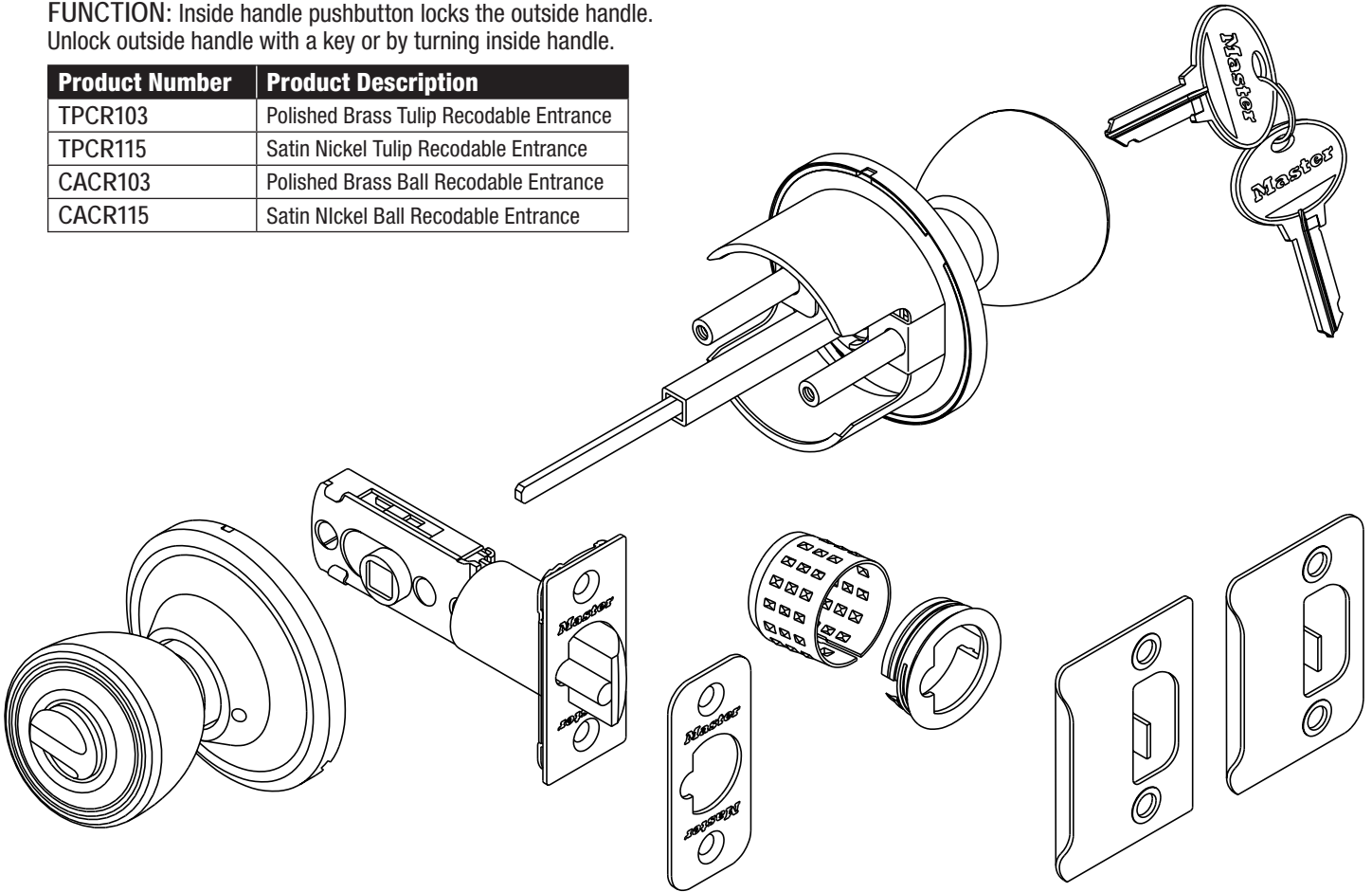
Remove Change Tool – your lock is now rekeyed to the new key.

# Entry Knobset

# Recodable Multi-Family

FUNCTION: Inside handle pushbutton locks the outside handle.  
 Unlock outside handle with a key or by turning inside handle.

Product Number	Product Description
TPCR103	Polished Brass Tulip Recodable Entrance
TPCR115	Satin Nickel Tulip Recodable Entrance
CACR103	Polished Brass Ball Recodable Entrance
CACR115	Satin Nickel Ball Recodable Entrance

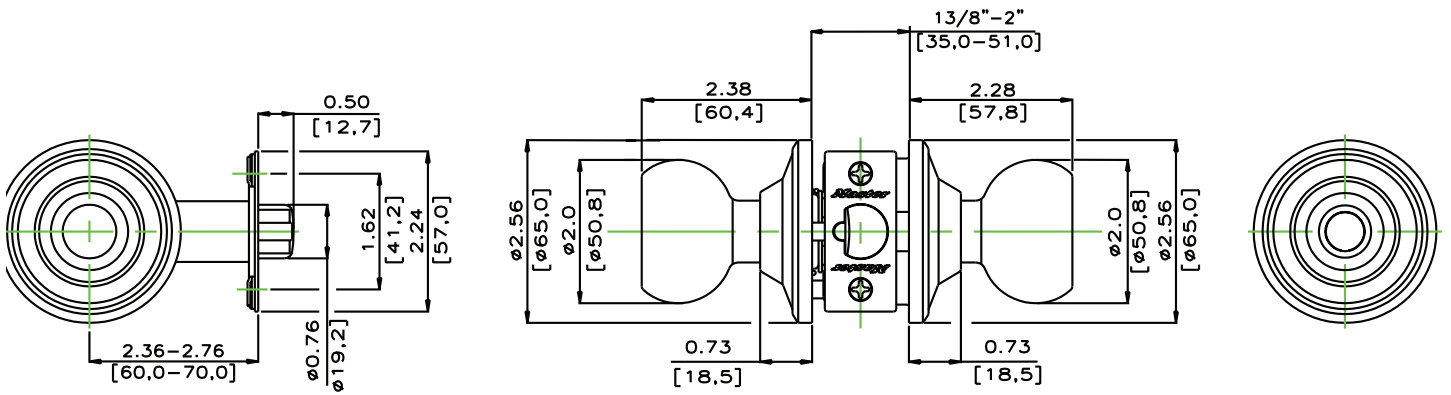
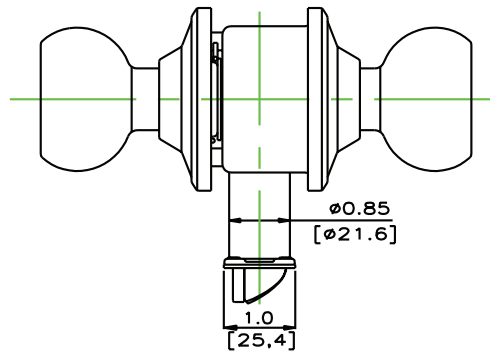
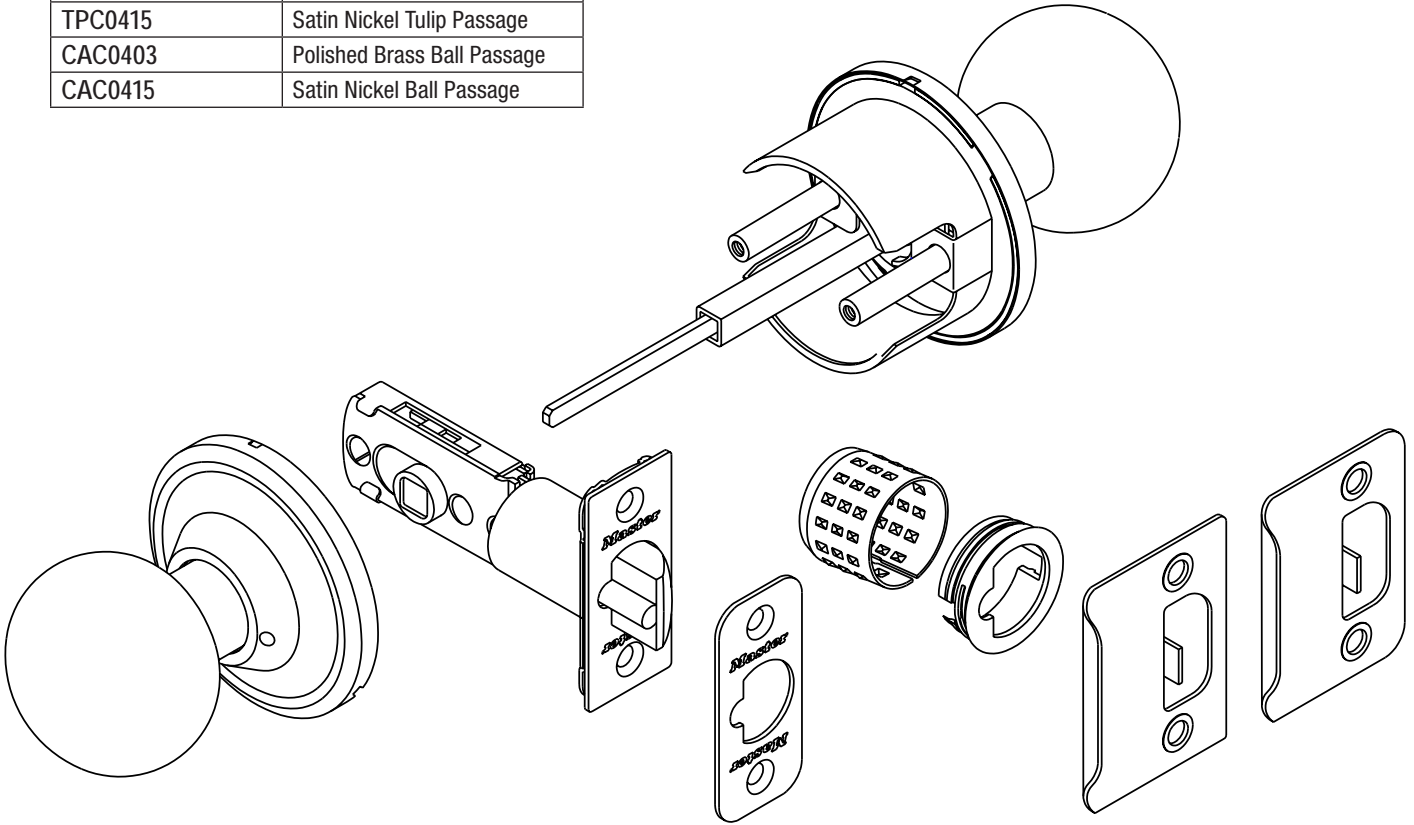


# Passage Knobset

# Recodable Multi-Family

FUNCTION: Inside and outside handles always unlocked; turning either retracts latch. No keys required.

Product Number	Product Description
TPC0403	Polished Brass Tulip Passage
TPC0415	Satin Nickel Tulip Passage
CAC0403	Polished Brass Ball Passage
CAC0415	Satin Nickel Ball Passage



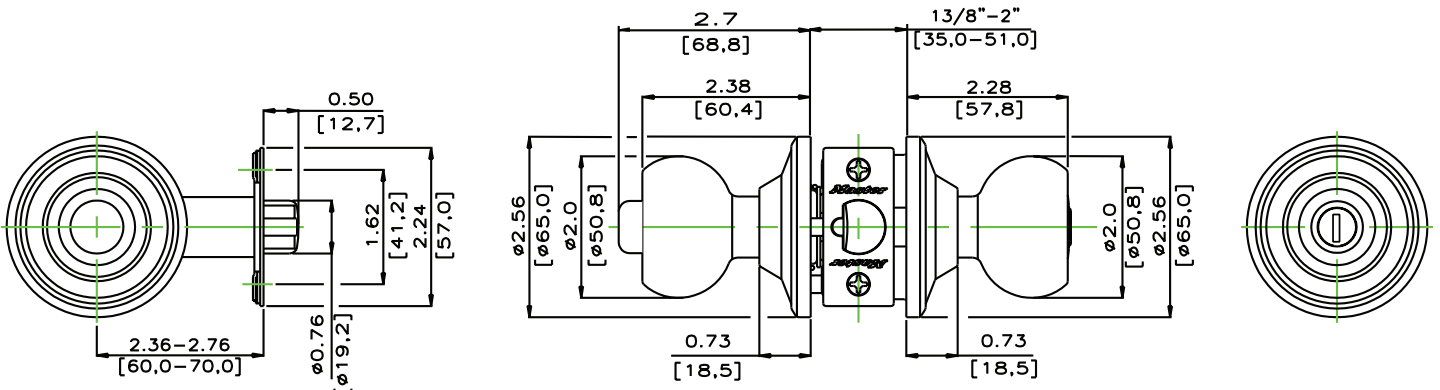
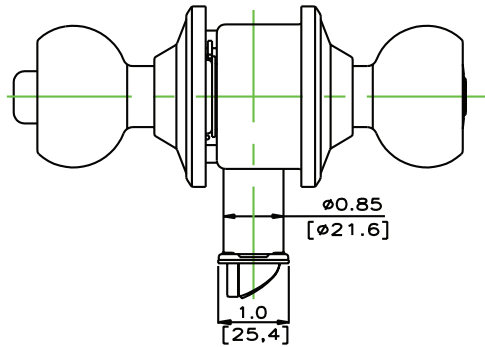
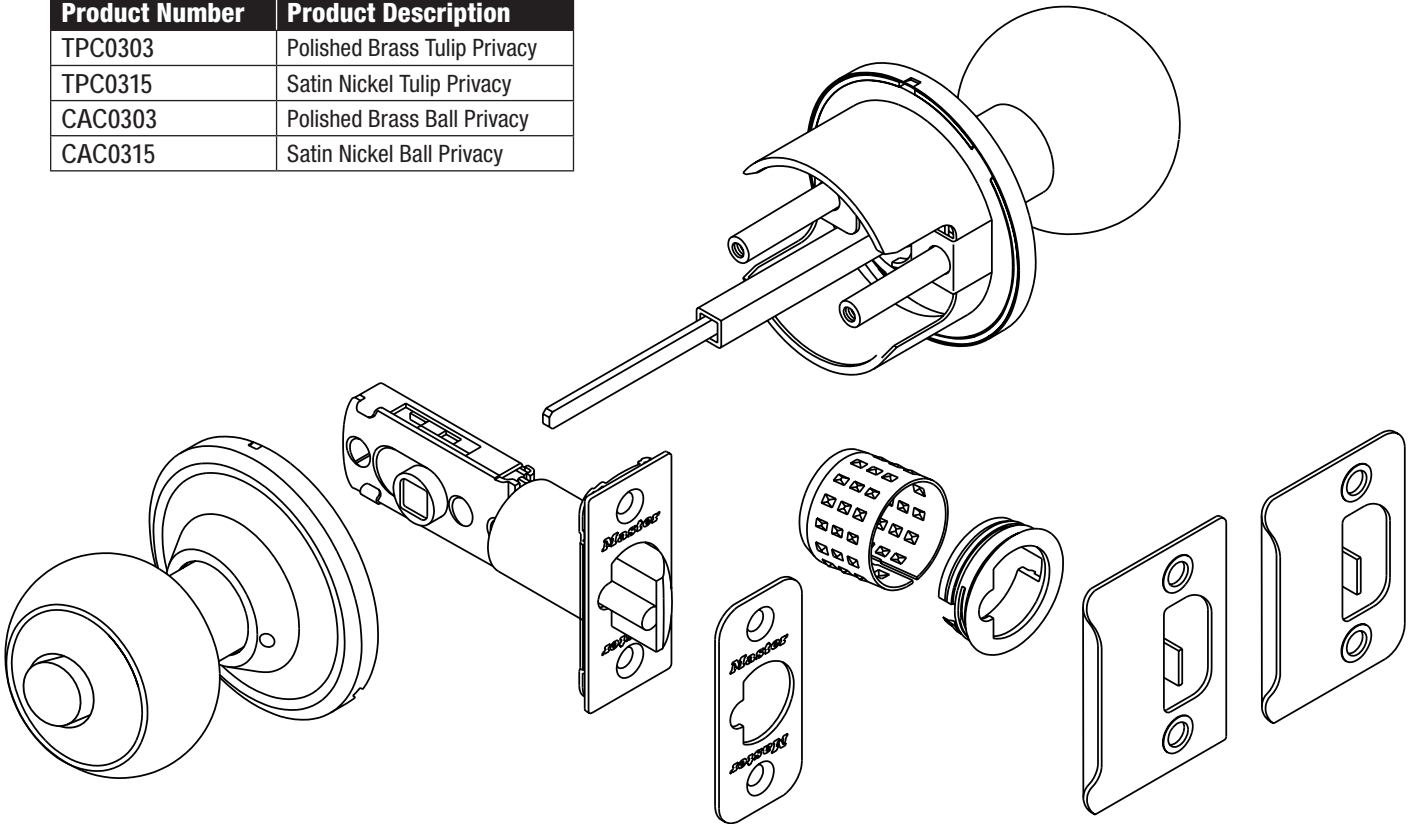


# Privacy Knobset

# Recodable Multi-Family

FUNCTION: Inside handle pushbutton locks outside handle. Emergency release in outside handle. Closing the door or turning inside handle releases the pushbutton.

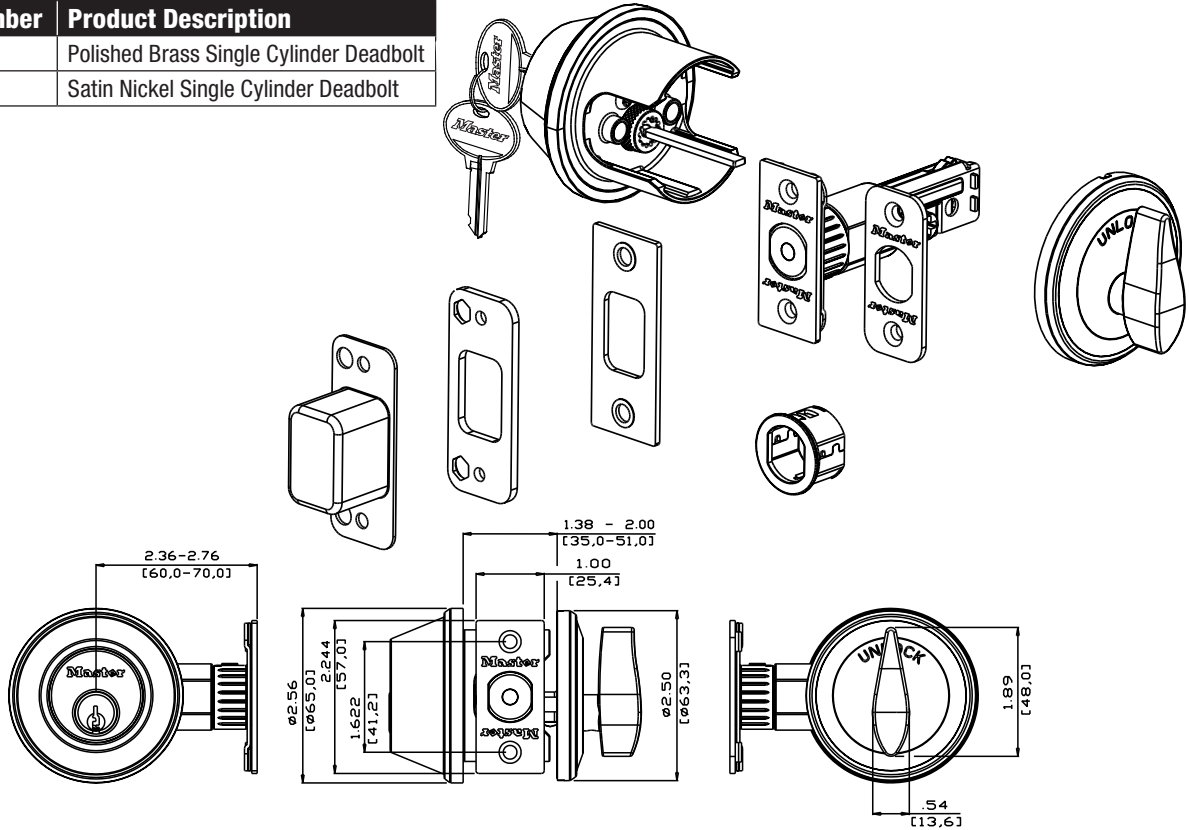
Product Number	Product Description
TPC0303	Polished Brass Tulip Privacy
TPC0315	Satin Nickel Tulip Privacy
CAC0303	Polished Brass Ball Privacy
CAC0315	Satin Nickel Ball Privacy



## Single Cylinder Deadbolt

FUNCTION: Deadbolt thrown or retracted by key outside or by thumb-turn inside.

Product Number	Product Description
DSCR603	Polished Brass Single Cylinder Deadbolt
DSCR615	Satin Nickel Single Cylinder Deadbolt

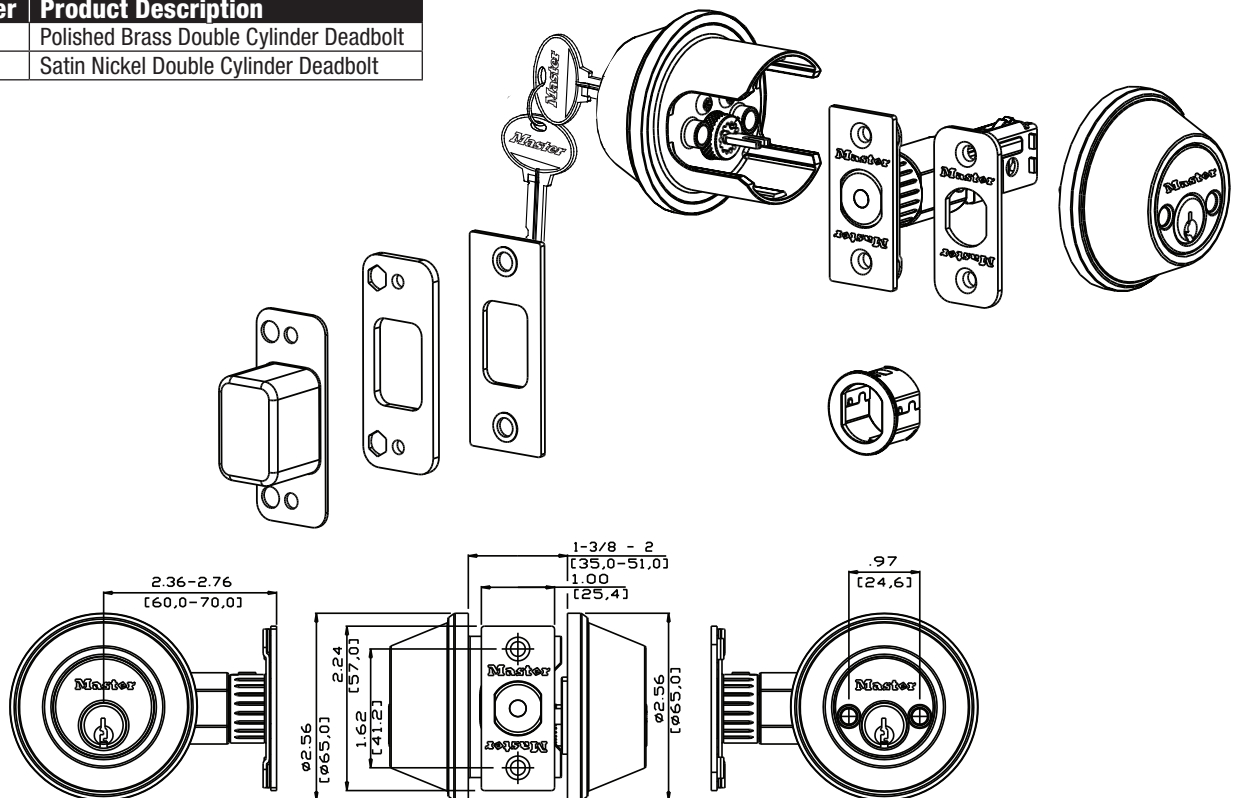


## Recodable Multi-Family

## Double Cylinder Deadbolt

FUNCTION: Deadbolt thrown or retracted by key in either side.

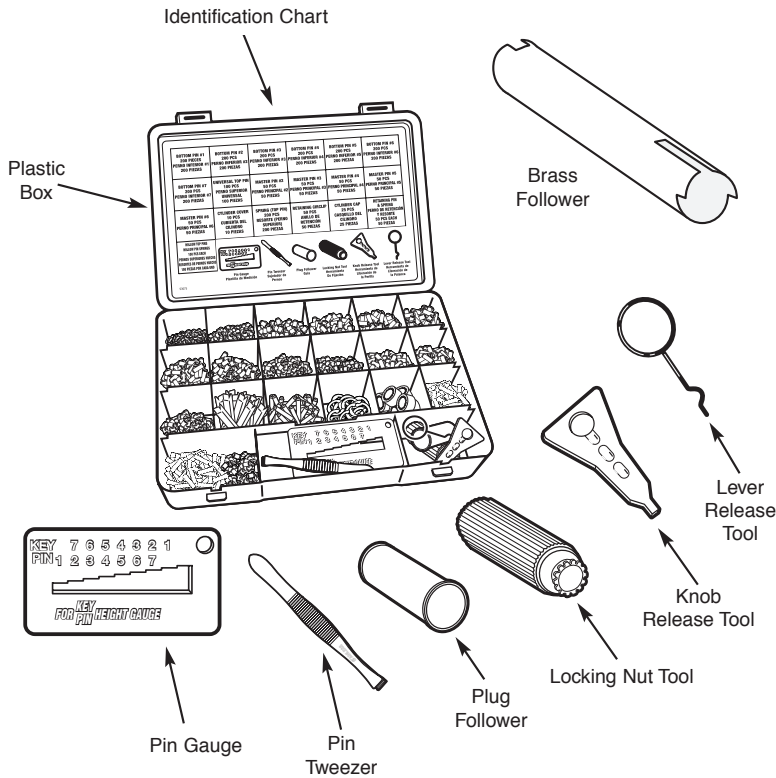
Product Number	Product Description
DDCR703	Polished Brass Double Cylinder Deadbolt
DDCR715	Satin Nickel Double Cylinder Deadbolt



## Recodable Multi-Family

# Service Kits and Component Parts

## Keying Kit 2201 (for 1176 Keyway)



### Contents

- 200 ea. Bottom Pins 1 through 7
- 50 ea. Master Pins 2 through 6
- 100 ea. Top Pins
- 200 ea. Driver Springs
- 10 ea. Retaining Caps
- 50 ea. C Clips
- 25 ea. Pin Covers
- 50 Cap Pins
- 50 ea. Cap Pin Springs
- 1 ea Tweezers
- 1 ea Cap Tool
- 1 ea Lever release Tool
- 1 ea Knob Release Tool
- 1 ea Follower
- 1 ea Pin & Key Gauge

## Supplemental Bottom Spool Pin Kit 291BS1 (for 1176 Keyway)



### Contents

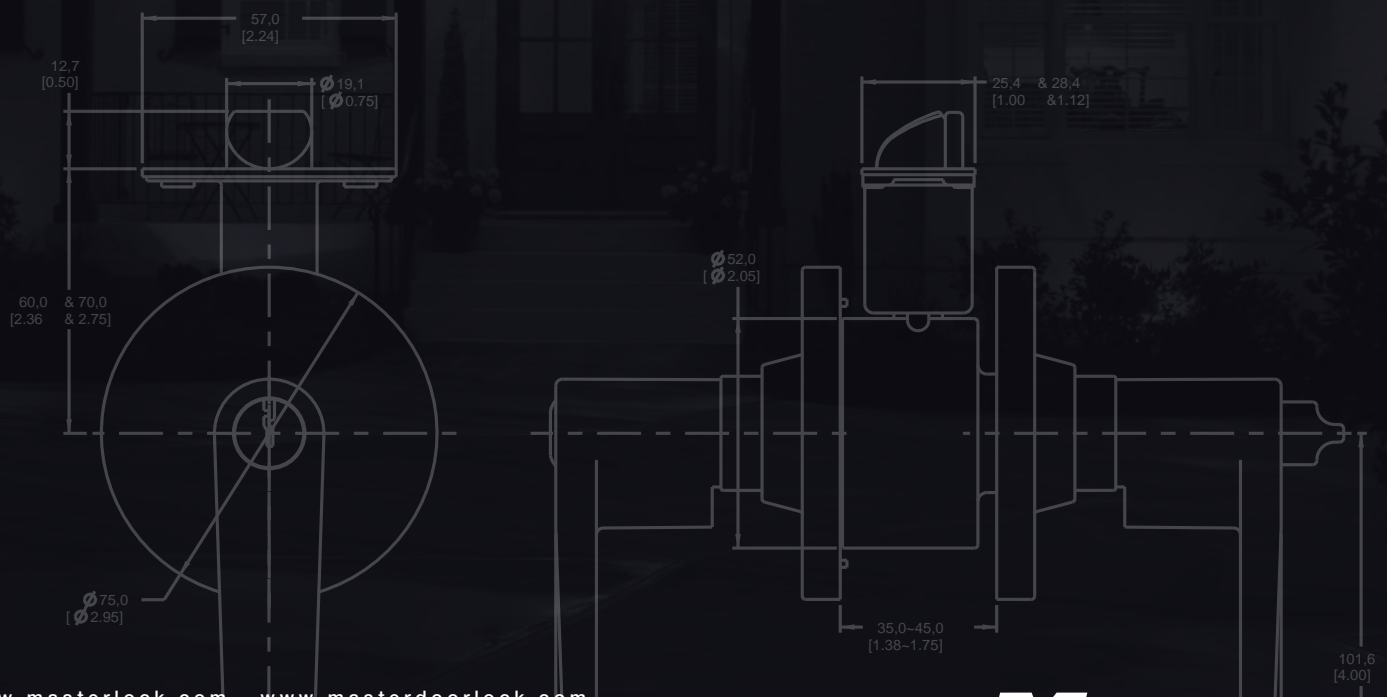
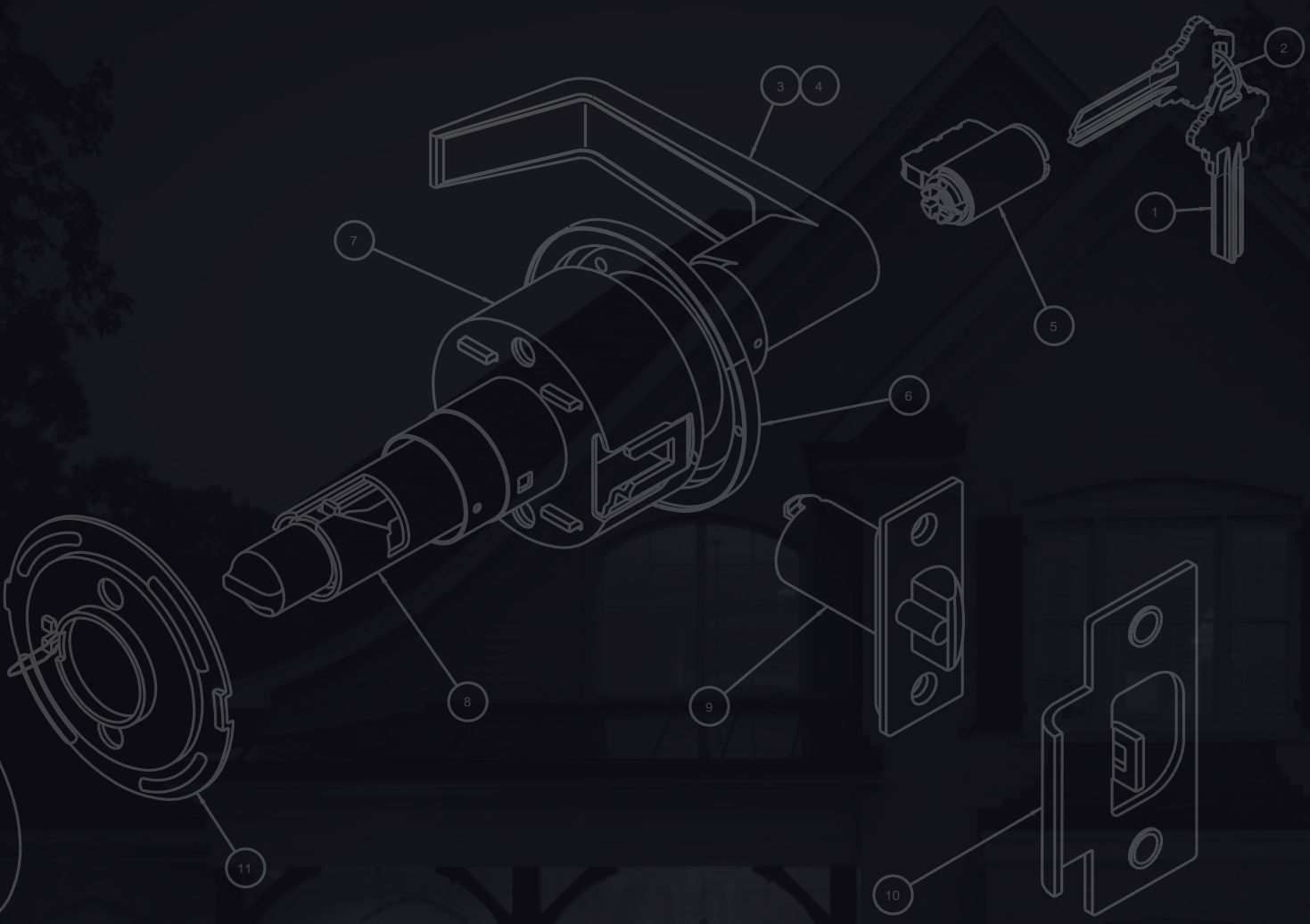
#### Spool Bottom Pins

- | Size | Part Number |
|------|-------------|
| 1    | 0291-82360  |
| 2    | 0291-82361  |
| 3    | 0291-82362  |
| 4    | 0291-83766  |
| 5    | 0291-83767  |
| 6    | 0291-83768  |
| 7    | 0291-83769  |
- Driver Springs 0291-80083

### Combination Deadbolt

- Disrupter Spring      PKG50998
- Fly                      PKG50994





[www.masterlock.com](http://www.masterlock.com) [www.masterdoorlock.com](http://www.masterdoorlock.com)

Master Lock Company LLC, Milwaukee, WI 53154 U.S.A. | 800-308-9244  
 Master Lock Canada, Oakville, Ontario L6H 5S7 Canada | 800-227-9599  
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ENTRY DOOR

## SECTION DIRECTORY



## General Overview

### Product Summary

Architect Series®, Pella®, Encompass by Pella® ..... ED-2

### Features and Options

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Panels and Finishes ..... ED-6

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Encompass by Pella ..... ED-85

In-Swing Doors ..... ED-85



ENTRY DOOR

## PRODUCT SUMMARY

### Entry Door Product Lines



**Architect** Series® Elegantly crafted. Built to last. Introducing Architect Series premium-grain fiberglass entry doors. With their richly beautiful stain finishes, natural-looking grain and solid, substantial feel, they might be mistaken for wood. But the ability to protect a home from the elements – while being incredibly low-maintenance – is unmistakably fiberglass. With Architect Series entry doors, expect the very best – inside and out. The most authentic look of wood, exceptional energy efficiency and one of the most weather-resistant entry door system in the industry.

**Pella**® A broad range of beautiful styles that stand up to the elements. Pella entry doors not only look beautiful – they've been redesigned from the inside out so they perform even more beautifully. Featuring PerformaSeal™, our exclusive patent-pending weather-resistant design, they provide superior protection from drafts and leaks. Pella entry doors put world-class performance and craftsmanship within reach.

**Encompass by Pella**® The options and quality you value. Pella's most popular style features and options at a great value, this collection of entry doors is designed to deliver. A Pella quality door that looks great and fits any budget.

#### ARCHITECT SERIES®

- The richest, most beautiful and realistic prefinished wood-grain fiberglass in the industry – available prefinished in six stain colors or unfinished.
- Sturdy, substantial door panel that feels like a wood door when it swings open.
- Straight-edge door panel lined in real oak with an optional mahogany frame gives the illusion of a solid wood door.
- Pella's exclusive AdvantagePlus™ protection system and PerformaSeal™ design provide superior weather

#### PELLA®

- Choose stainable or paintable wood-grained fiberglass – or paintable Smooth fiberglass or steel.
- Panel can arrive unfinished or prefinished in six stain colors or 12 paint colors.
- Pella's exclusive AdvantagePlus protection system and PerformaSeal design provide superior weather resistance.

#### ENCOMPASS BY PELLA®

- Pella's most popular styles at a great value.
- Choose Smooth fiberglass, Mahogany, Oak or a steel door panel that can be painted or stained.
- Frame design that guards against damaging moisture.



ENTRY DOOR

## PRODUCT SUMMARY

### Material Options

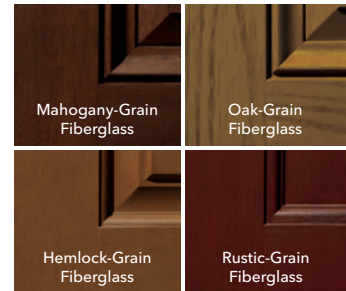


Pella entry doors are available in three material types, each offering its own unique benefits and distinctive style. A premium-grain fiberglass, fiberglass or steel entry door system will look great in any home.

### Premium-Grain Fiberglass

AUTHENTIC LOOK OF WOOD.

- Premium wood-grain fiberglass door panels enhance the home with a rich, realistic wood-grain appearance.
- Wood reinforcement inside the fiberglass panel creates a sturdy, substantial door that even feels like a wood door when it swings.
- Pella's exclusive multistep stain process adds dimension and luster – with richer wood tones than other comparable fiberglass entry doors.
- Low-maintenance benefits and outstanding performance of fiberglass.
- Choose from Mahogany, Oak, Hemlock and Rustic grains.

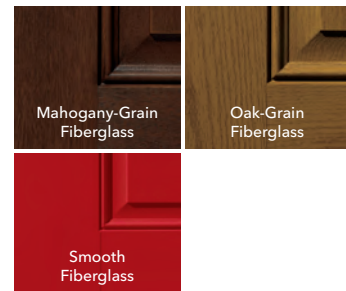


Available on: **ARCHITECT SERIES®**

### Fiberglass

HIGH PERFORMANCE. LOW MAINTENANCE.

- Grained fiberglass has the warm, rich look of wood.
- Dent-resistant and won't rust or corrode.
- Choose from Mahogany-grain, Oak-grain and Smooth fiberglass.
- Exclusive multistep stain process creates a beautiful appearance that will last for years.



Available on: **PELLA®** **ENCOMPASS BY PELLA®**

### Steel

NATURALLY STRONG AND DURABLE.

- Steel panels provide a quality appearance to any home that's easy to maintain.
- Smooth surface creates even color when painted.
- Premium steel provides extra durability.



Available on: **PELLA®** **ENCOMPASS BY PELLA®**





ENTRY DOOR

## FEATURES AND OPTIONS

### Glazing Options

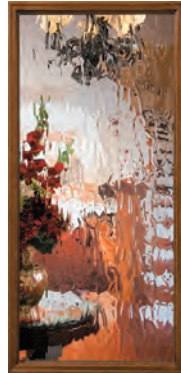


#### Low-E Glass



AS  
P  
EP

#### Textured Glass



AS  
P

Flemish



AS

Granite\*



AS

Mystic\*



AS  
P

Pebbled



AS  
P

Rain



AS  
P  
EP

Standard  
Obscure

\*Available on Architect Series® sidelights only.

#### Decorative Glass

##### ARTESIAN COLLECTION



P  
EP

Nickel  
caming

##### CASTLE COLLECTION



AS  
P

Brass  
caming  
Black  
Patina  
caming  
Nickel  
caming

##### FRANCESCA COLLECTION



AS

Brass  
caming  
Nickel  
caming

##### HOMESTEAD COLLECTION



AS  
P

Black  
Patina  
caming  
Nickel  
caming

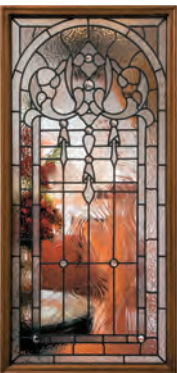
##### ISABELLA COLLECTION



AS  
P  
EP

Brass  
caming  
Nickel  
caming

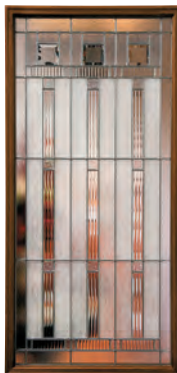
##### JULIET COLLECTION



AS

Black  
Patina  
caming

##### MADEIRA COLLECTION



AS  
P  
EP

Black  
Patina  
caming  
Nickel  
caming

##### ROSETTA COLLECTION



P  
EP

Brass  
caming  
Nickel  
caming

##### SHEFFIELD COLLECTION



AS  
P  
EP

Brass  
caming  
Black  
Patina  
caming  
Nickel  
caming

##### VERONA COLLECTION



AS  
P

Black  
Patina  
caming

NOTE: Colors shown are as accurate as the printing process permits.



ENTRY DOOR

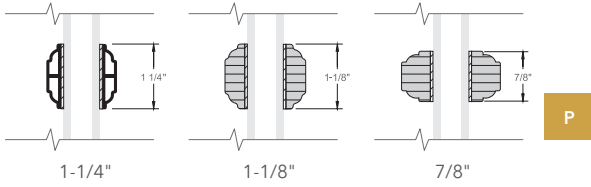
## FEATURES AND OPTIONS

### Grilles and Blinds

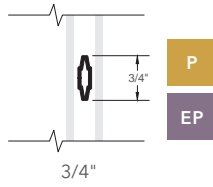


#### Grille Profiles

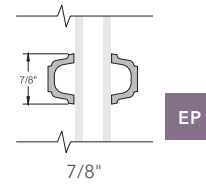
##### SIMULATED-DIVIDED-LIGHT GRILLES



##### GRILLES-BETWEEN-THE-GLASS

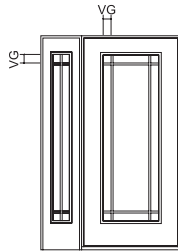


##### FIXED GRILLES



#### Grille Patterns

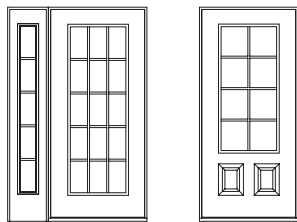
##### 9-LITE PRAIRIE



VG = Visible Glass  
 Standard corner lite dimension = 3-15/16" VG on GBG  
 Standard corner lite dimension = 3-1/8" VG on SDL

P

##### TRADITIONAL



All doors will be 2 or 3 lites wide.  
 For size and pattern availability contact your local Pella sales representative.

P

EP

#### Grille Patterns - Lites

##### SIMULATED-DIVIDED LIGHT GRILLES

		6' 8"		8' 0"	
		Lites Wide	Lites High	Lites Wide	Lites High
Door	Half Light	2 or 3	3	2 or 3	4
	3/4 Light	2 or 3	4	2 or 3	5
	Full Light	2 or 3	5	2 or 3	6
	Craftsman Light	2 or 3	1 or 2	2 or 3	1 or 2
Sidelight	Half Light	1	3	1	4
	3/4 Light	1	4	1	5
	Full Light	1	5	1	6

##### GRILLES-BETWEEN-THE-GLASS / FIXED

		6' 8"		8' 0"	
		Lites Wide	Lites High	Lites Wide	Lites High
Door	Half Light	3	3	3	4
	3/4 Light	3	4	3	5
	Full Light	3	5	3	6
	Fan Light	3	1	n/a	n/a
Sidelight	Half Light	1	3	1	4
	3/4 Light	1	4	1	5
	Full Light	1	5	1	6

#### Blinds-Between-the-Glass



Cordless white blinds offer light and privacy control and are protected between two panes of clear insulating glass so they don't need cleaning.

P

EP



ENTRY DOOR

## FEATURES AND OPTIONS

### Panels and Finishes



#### Architect Series® Prefinished Premium-Grain Fiberglass

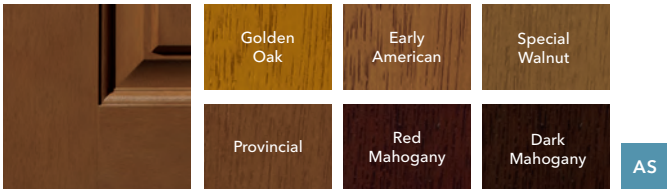
##### MAHOGANY-GRAIN FIBERGLASS



##### OAK-GRAIN FIBERGLASS



##### RUSTIC-GRAIN FIBERGLASS

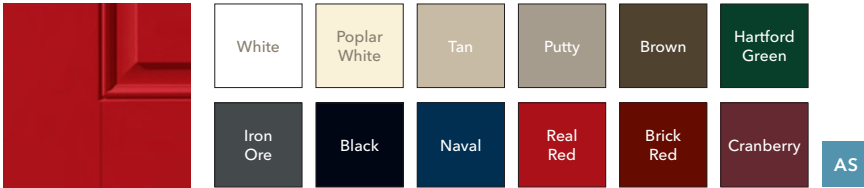


##### HEMLOCK-GRAIN FIBERGLASS



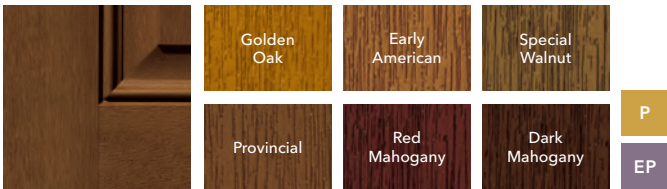
Unfinished premium-grain fiberglass panels are also available.

##### PAINTED FIBERGLASS

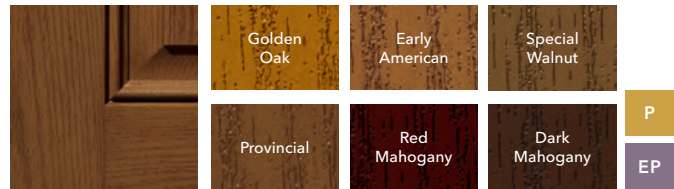


#### Pella® and Encompass by Pella® Prefinished Fiberglass and Steel

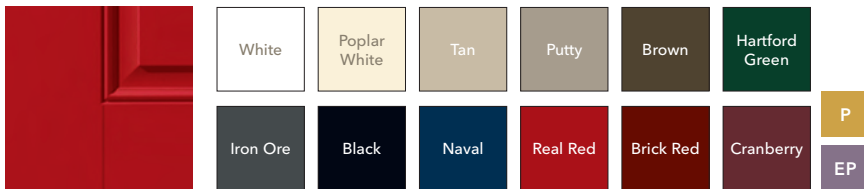
##### MAHOGANY-GRAIN FIBERGLASS



##### OAK-GRAIN FIBERGLASS



##### PAINTED FIBERGLASS OR STEEL



Unfinished fiberglass or primed steel panels are also available.

NOTE: The rich, distinctive look of our factory-prefinished doors is achieved through hand-finishing. Some color variation is expected. Colors shown are as accurate as the printing process permits.



ENTRY DOOR

## FEATURES AND OPTIONS

### Frame Options



### EnduraClad® Exterior

Pella's low-maintenance EnduraClad® exterior frames don't need painting – they're available in an impressive variety of colors. For a unified look, use the same EnduraClad exterior frame color for all Pella® windows, patio doors and entry doors.

Available on:

ARCHITECT SERIES®

PELLA®



White



Classic White



Vanilla Cream



Poplar White



Almond



Sand Dune



Honeysuckle



Tan



Fossil



Putty



Portobello



Deep Olive



Auburn Brown



French Roast



Brown



Summer Sage



Hemlock



Hartford Green



Morning Sky Gray



Eldridge Gray



Iron Ore



Black



Naval



Stormy Blue



Real Red



Brick Red



Cranberry

EnduraClad aluminum-clad exteriors have pine wood interiors.

### Exterior Finish

UNFINISHED MAHOGANY



AS  
P

PRIMED PINE



P  
EP

- Mahogany door frames come unfinished, ready to be stained.
- Pine wood frames are paintable on the exterior. The interior can be stained or painted.

### Interior Finish - Pine Frames Only

FACTORY PREFINISH STAIN



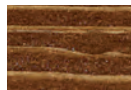
Golden Oak



Early American



Special Walnut



Provincial



Red Mahogany



Dark Mahogany

AS  
P

FACTORY PREFINISHED PAINTED PINE

- White
- Bright White
- Linen

AS  
P

NOTE: Colors shown are as accurate as the printing process permits.



ENTRY DOOR

FEATURES AND OPTIONS

Entry Door Combinations



Entry Door

Sidelight



Rectangular Transom



Half Circle Transom



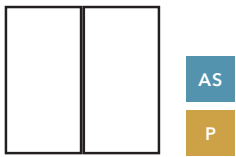
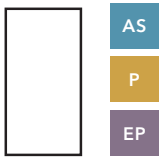
Elliptical Transom



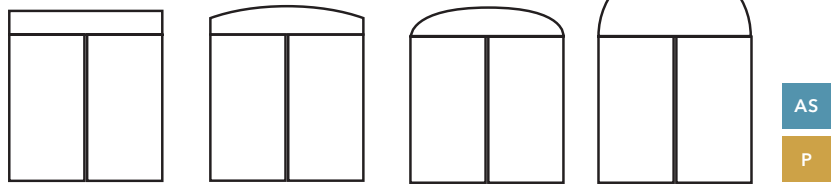
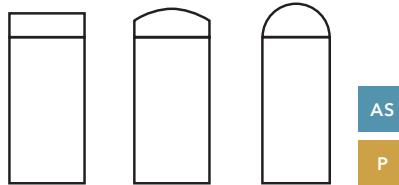
Arch Head Transom

- Transoms are available in Aluminum-Clad frame only.
- Availability of Aluminum-Clad frame transom shapes differ with decorative glass type.

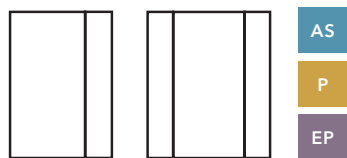
Single and Double Doors



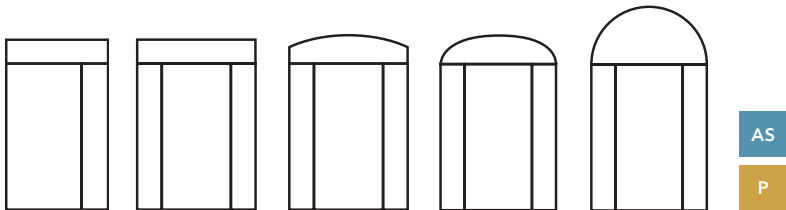
Single and Double Doors with Transoms



Single Door with Sidelights



Single Door with Sidelights and Transom



NOTE: See Sizes and Options pages in this section for complete double door offering.



ENTRY DOOR

## FEATURES AND OPTIONS

Hardware and Accessories



Available on:

ARCHITECT SERIES®

PELLA®

### Handle Sets

#### SAN JOSE



Available in Oil-Rubbed Bronze finish only.

#### SAVOY



Available in Satin Nickel or Distressed Nickel finishes only.

#### MILLBROOK



Available in Satin Nickel, Bright Brass or Oil-Rubbed Bronze finishes only.

#### WALDEN



Available in Satin Nickel, Bright Brass or Oil-Rubbed Bronze finishes only.

### Interior/Exterior Handles



### Multipoint Lock Exterior Handles



Available in Satin Nickel, Bright Brass or Oil-Rubbed Bronze finishes only.

Multipoint Mechanism

### Optional Deadbolts



Available in Satin Nickel, Bright Brass or Oil-Rubbed Bronze finishes only.

Available on:

ARCHITECT SERIES®

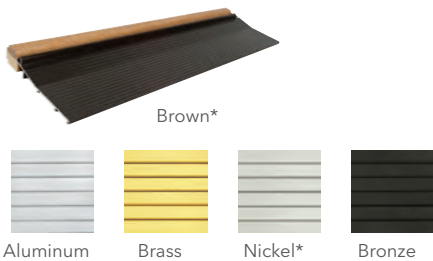
PELLA®

ENCOMPASS BY PELLA®

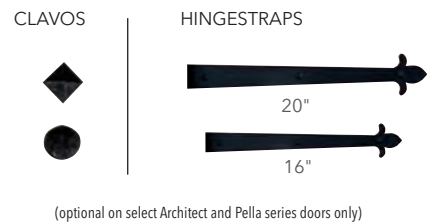
### Hinge Finishes



### Sill Options



### Decorative Accents



\* Available in Architect Series® and Pella® Entry Doors only.  
 \*\* Available in Encompass by Pella® Entry Doors only.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Features and Options

In-Swing and Out-Swing Doors



	ARCHITECT SERIES®				PELLA®				ENCOMPASS BY PELLA®			
	Mahogany	Oak	Hemlock	Rustic	Mahogany	Oak	Smooth	Steel	Mahogany	Oak	Smooth	Steel
<b>GLAZING</b>												
Low-E insulating glass	O	O	O	O	O	O	O	O	O	O	O	O
Textured glass	O	O	O	O	O	O	O	O	O	O	O	O
Decorative glass	O	O	O	O	O	O	O	O	O	O	O	O
<b>GRILLES AND BLINDS</b>												
Grilles-Between-the-Glass (Traditional, Prairie)	-	-	-	-	O	O	O	O	O	O	O	O
Simulated-Divided-Light	-	-	O	-	O	O	O	-	-	-	-	-
Fixed	-	-	-	-	-	-	-	-	-	-	O	O
Blinds-Between-the-Glass <sub>1</sub>	-	-	-	-	O	O	O	O	O	O	O	O
<b>INTERIOR / EXTERIOR FINISH – PANEL</b>												
Factory applied stain finish <sub>2</sub>	O	O	O	O	O	O	-	-	O	O	-	-
Factory applied paint finish <sub>2</sub>	-	-	-	-	O	O	O	O	O	O	O	O
<b>INTERIOR FINISH – FRAME</b>												
Primed pine	S	S	S	S	S	S	S	S	S	S	S	S
Unfinished stain-grade pine	O	O	O	O	O	O	O	O	-	-	-	-
Unfinished stain-grade mahogany	O	O	O	O	O	O	O	O	-	-	-	-
Factory finished <sub>2</sub>	O	O	O	O	O	O	O	O	-	-	-	-
<b>EXTERIOR FINISH – FRAME</b>												
EnduraClad® aluminum-clad exterior (White, Tan, Brown, or feature colors) <sub>2</sub>	S	S	S	S	O	O	O	O	-	-	-	-
Primed pine	-	-	-	-	S	S	S	S	S	S	S	S
Unfinished stain-grade mahogany	O	O	O	O	O	O	O	O	-	-	-	-
<b>SILL OPTIONS</b>												
Mill finish aluminum	S	S	S	S	S	S	S	S	S	S	S	S
Brown EnduraClad with protective finish	S	S	S	S	S	S	S	S	-	-	-	-
Bronze anodized aluminum	O	O	O	O	O	O	O	O	O	O	O	O
Brass anodized aluminum	O	O	O	O	O	O	O	O	O	O	O	O
Nickel anodized aluminum	O	O	O	O	O	O	O	O	-	-	-	-
Low profile/ADA compliant mill finish aluminum (Brown, Bronze, Brass, Nickel)	O	O	O	O	O	O	O	O	-	-	-	-
<b>THRESHOLD</b>												
Composite adjustable	-	-	-	-	-	-	-	-	S	S	S	S
Oak standard	S	S	S	S	S	S	S	S	-	-	-	-
Mahogany <sub>3</sub>	O	O	O	O	O	O	O	O	-	-	-	-
<b>WALL DEPTHS</b>												
In-Swing single panel, sidelight and transom – available from 4-9/16" to 7-1/4" on 1/8" increments <sub>5</sub>	O	O	O	O	O	O	O	O	O <sub>4</sub>	O <sub>4</sub>	O <sub>4</sub>	O <sub>4</sub>
Out-Swing single panel, sidelight and transom – available from 4-9/16" to 9-3/16" on 1/8" increments <sub>5</sub>	O	O	O	O	O	O	O	O	-	-	-	-

S = Standard; O = Optional; (-) = Not Available

(1) Blinds-Between-the-Glass are only available with clear IG.

(2) Contact your local Pella sales representative for current color options.

(3) Mahogany threshold only on Mahogany frame.

(4) Available for 4-9/16" and 6-9/16" wall depths only.

(5) In-swing units are frame extended. Out-swing units are jamb extended.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Features and Options  
In-Swing and Out-Swing Doors



	ARCHITECT SERIES®				PELLA®				ENCOMPASS BY PELLA®			
	Mahogany	Oak	Hemlock	Rustic	Mahogany	Oak	Smooth	Steel	Mahogany	Oak	Smooth	Steel
<b>HINGES – IN-SWING</b>												
Standard steel: Brasstone Zinc Dichromate	S	S	S	S	S	S	S	S	S	S	S	S
Standard steel: Satin Nickel, Oil-Rubbed Bronze, Bright Brass, Polished Chrome, Antique Brass, Stainless Steel	O	O	O	O	O	O	O	O	-	-	-	-
Standard steel: Satin Nickel, Black	-	-	-	-	-	-	-	-	O	O	O	O
Aluminum adjustable: Satin Nickel, Oil-Rubbed Bronze, Bright Brass, Polished Chrome, Antique Brass	O	O	O	O	O	O	O	-	-	-	-	-
Steel spring: Oil-Rubbed Bronze, Stainless Steel	O	O	O	O	O	O	O	O	-	-	-	-
Steel spring: Satin Nickel, Black	-	-	-	-	-	-	-	-	O	O	O	O
<b>HINGES – OUT-SWING</b>												
Standard steel: Stainless Steel	S	S	S	S	S	S	S	S	-	-	-	-
Standard aluminum: Satin Nickel, Oil-Rubbed Bronze, Bright Brass, Polished Chrome, Antique Brass	O	O	O	O	O	O	O	O	-	-	-	-
Aluminum adjustable: Satin Nickel, Oil-Rubbed Bronze, Bright Brass, Polished Chrome, Antique Brass	O	O	O	O	O	O	O	-	-	-	-	-
Ball bearing: Stainless Steel	O	O	O	O	O	O	O	O	-	-	-	-
Steel spring: Oil-Rubbed Bronze, Stainless Steel	O	O	O	O	O	O	O	O	-	-	-	-
<b>BORING OPTIONS<sup>1</sup></b>												
No bore	O	O	O	O	O	O	O	O	-	-	-	-
2-1/8" latch bore	S	S	S	S	S	S	S	S	S	S	S	S
2-1/8" latch bore with deadbolt	O	O	O	O	O	O	O	O	O	O	O	O
2-3/8" backset	S	S	S	S	S	S	S	S	S	S	S	S
2-3/4" backset	-	-	-	-	O	O	O	O	O	O	O	O
Multipoint bore with 2-3/8" backset	O	O	O	O	O	O	O	-	-	-	-	-
<b>DECORATIVE ACCENTS</b>												
Clavos	-	-	-	O	O	-	-	-	-	-	-	-
Dentil shelf	-	-	O	-	O	-	O	-	-	-	-	-
Hinge straps	-	-	-	O	-	-	-	-	-	-	-	-
Wrought Iron grilles	O	O	-	-	O	O	O	-	-	-	-	-

S = Standard, O = Optional, (-) = Not Available

(1) All options with a bore have a 2-1/8" crossbore.





ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data  
In-Swing Doors – Single Unit



	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>IN-SWING SOLID DOOR (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	0.2	–
Water Resistance*	3.76 psf	7.52 psf	3.76 psf	7.52 psf	0.75 psf	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	50 psf	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	0.2	–
Water Resistance*	3.14 psf	7.52 psf	3.14 psf	7.52 psf	0.75 psf	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	50 psf	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>IN-SWING FULL LIGHT DOOR (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	0.2	–
Water Resistance*	3.76 psf	7.52 psf	3.76 psf	7.52 psf	0.75 psf	–
Design Pressure	30 psf	55 psf	30 psf	55 psf	30 psf	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	0.2	–
Water Resistance*	3.14 psf	7.52 psf	3.14 psf	7.52 psf	0.75 psf	–
Design Pressure	30 psf	55 psf	30 psf	55 psf	30 psf	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles or glass seals. Published performance data is for single unit only.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data

In-Swing Doors – Single Unit with Sidelights



	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>IN-SWING SOLID DOOR WITH SIDELIGHTS (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.76 psf	7.52 psf	3.76 psf	7.52 psf	–	–
Design Pressure	40 psf	50 psf	40 psf	50 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	7.52 psf	3.14 psf	7.52 psf	–	–
Design Pressure	40 psf	50 psf	40 psf	50 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>IN-SWING FULL LIGHT DOOR WITH SIDELIGHTS (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.76 psf	7.52 psf	3.76 psf	7.52 psf	–	–
Design Pressure	30 psf	50 psf	30 psf	50 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	7.52 psf	3.14 psf	7.52 psf	–	–
Design Pressure	30 psf	50 psf	30 psf	50 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles, glass seals or mullions. Published performance data is for single unit only.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data

In-Swing Doors – Single Unit with Sidelights and Transom



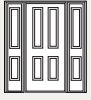
	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>IN-SWING SOLID DOOR WITH SIDELIGHTS AND TRANSMOM (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.76 psf	7.52 psf	3.76 psf	7.52 psf	–	–
Design Pressure	40 psf	50 psf	40 psf	50 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	7.52 psf	3.14 psf	7.52 psf	–	–
Design Pressure	40 psf	50 psf	40 psf	50 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>IN-SWING FULL LIGHT DOOR WITH SIDELIGHTS AND TRANSMOM (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.76 psf	7.52 psf	3.76 psf	7.52 psf	–	–
Design Pressure	30 psf	50 psf	30 psf	50 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	7.52 psf	3.14 psf	7.52 psf	–	–
Design Pressure	30 psf	50 psf	30 psf	50 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles, glass seals or mullions. Published performance data is for single unit only.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data

In-Swing Doors – Double Door



	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>IN-SWING SOLID DOUBLE DOOR</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	0 psf	0 psf	0 psf	0 psf	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	0 psf	0 psf	0 psf	0 psf	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>IN-SWING FULL LIGHT DOUBLE DOOR</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	0 psf	0 psf	0 psf	0 psf	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	0 psf	0 psf	0 psf	0 psf	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles or glass seals.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data

Out-Swing Doors – Single Unit



	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>OUT-SWING SOLID DOOR (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>OUT-SWING FULL LIGHT DOOR (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	35 psf	55 psf	35 psf	55 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	35 psf	55 psf	35 psf	55 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles or glass seals. Published performance data is for single unit only.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data

Out-Swing Doors – Single Unit with Sidelights



	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>OUT-SWING SOLID DOOR WITH SIDELIGHTS (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>OUT-SWING FULL LIGHT DOOR WITH SIDELIGHTS (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	35 psf	55 psf	35 psf	55 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	35 psf	55 psf	35 psf	55 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles, glass seals or mullions. Published performance data is for single unit only.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data

Out-Swing Doors – Single Unit with Sidelights and Transom



	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>OUT-SWING SOLID DOOR WITH SIDELIGHTS AND TRANSOM (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	50 psf	55 psf	50 psf	55 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>OUT-SWING FULL LIGHT DOOR SIDELIGHTS AND TRANSOM (SINGLE UNIT)</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	35 psf	55 psf	35 psf	55 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	7.52 psf	7.52 psf	7.52 psf	7.52 psf	–	–
Design Pressure	35 psf	55 psf	35 psf	55 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	–	–	–	–	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles, glass seals or mullions. Published performance data is for single unit only.



ENTRY DOOR

## PRODUCT SELECTION GUIDE

Performance Data

Out-Swing Doors – Double Door



	ARCHITECT SERIES*		PELLA®		ENCOMPASS BY PELLA®	
	Standard	MPL	Standard	MPL	Standard	MPL
<b>OUT-SWING SOLID DOUBLE DOOR</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	3.14 psf	3.14 psf	3.14 psf	–	–
Design Pressure	50 psf	50 psf	50 psf	50 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	3.14 psf	3.14 psf	3.14 psf	–	–
Design Pressure	50 psf	50 psf	50 psf	50 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	40 psf	40 psf	40 psf	40 psf	–	–
<b>OUT-SWING FULL LIGHT DOUBLE DOOR</b>						
<b>6'8" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	3.14 psf	3.14 psf	3.14 psf	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>6'8" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>8'0" Door Height / Standard Sill</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)*	0.15	0.15	0.15	0.15	–	–
Water Resistance*	3.14 psf	3.14 psf	3.14 psf	3.14 psf	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–
<b>8'0" Door Height / ADA Sill (Low Profile)</b>						
Air Infiltration (cfm / ft <sup>2</sup> of frame @ 1.57 psf wind pressure)	–	–	–	–	–	–
Water Resistance	–	–	–	–	–	–
Design Pressure	35 psf	35 psf	35 psf	35 psf	–	–

### Conversion Chart

AIR INFILTRATION		WATER RESISTANCE	
Pella	Industry Standard	Water	DP Equivalent
0.2 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	0.75 psf	5 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.14 psf	20 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	3.76 psf	25 psf
0.15 cfm/ft <sup>2</sup>	0.3 cfm/ft <sup>2</sup>	7.52 psf	50 psf

(–) = Not Applicable; (Standard) = Latch and Deadbolt; (MPL) = Multipoint Lock

\* Performance levels are for a single sample of the product tested to the applicable standard, actual results will vary. Performance values do not include the performance of handles or glass seals.





DOUBLE-HUNG

## SECTION DIRECTORY



## Product Summary

Product Selection Guide	
Size and Performance Data .....	V250-DH-3
Sound Transmission Class .....	V250-DH-3
Features and Options.....	V250-DH-4
Glazing Performance.....	V250-DH-5
Grille Types	
Grille Profiles .....	V250-DH-8
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Unit Sections .....	V250-DH-31



DOUBLE-HUNG

PRODUCT SUMMARY



# Pella® 250 Series Double-Hung

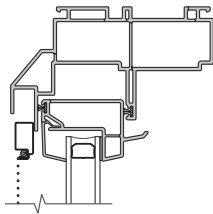
windows feature an extruded, rigid PVC (polyvinyl chloride) frame and sash with heat-fused mitered corners for a fully welded corner assembly. Double-Hung Windows meet industry standards for water infiltration and wind resistance and meet ENERGY STAR® guidelines with dual-pane or triple-pane insulated glass. Standard performance window sash are available with optional foam insulation for increased thermal performance.



BLOCK FRAME DESIGN

3-1/4" Block

- 3-1/4" block frame can be used in new construction block or concrete walls. They may also be used in replacement of old aluminum or steel frame windows or pocket replacement into wood frames from the exterior.
- The block frames include interior and exterior accessory grooves.
- Custom sizes are available in 1/8" increments - for a perfect fit.

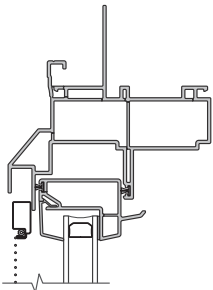


3-1/4" Block Frame

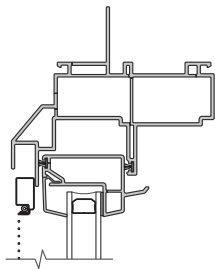
NAIL FIN FRAME DESIGN

With or Without Integrated J-Channel

- Continuous fin with welded corners adds a protective weather barrier and allows for hassle-free installation.
- The standard 3-1/4" frame depth includes interior and exterior accessory grooves.
- Nailing fin has a 1-1/8" setback from exterior face of window frame.
- Custom sizes are available in 1/8" increments - for a perfect fit.
- 4-9/16" and 6-9/16" factory applied primed jamb extensions are available.



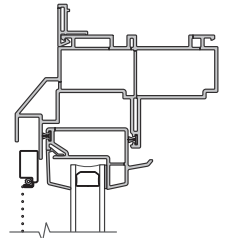
With J-Channel



Without J-Channel

INTEGRAL 5/8" FLANGE FRAME

- The integral 5/8" flange frame can be used in new construction block or concrete walls. Commonly used in Florida and often referred to as "Florida Flange" frame.
- The frame depth is 3-1/4" includes interior accessory groove.
- Custom sizes are available in 1/8" increments - for a perfect fit.





DOUBLE-HUNG

## PRODUCT SELECTION GUIDE

Size and Performance Data  
Sound Transmission Class



SIZES	
Standard Sizes	S
Special Sizes Available Built on 1/8" Increments	O
FRAMES	
Nail Fin Only	O
Nail Fin with J-Channel	O
3-1/4" Block	S
Integral 5/8" Flange	O
PERFORMANCE <sub>1</sub>	
Standard Performance	
Meets or Exceeds AAMA/WDMA Ratings	R-PG20 – R-PG35 Hallmark Certified
Air Infiltration (cfm/ft <sup>2</sup> of frame @ 1.57 psf wind pressure) <sub>2</sub>	0.19
Design Pressure	20 – 35 psf
Water Penetration Resistance	3.14 – 5.43 psf
Performance Upgrade <sub>3</sub>	
Meets or Exceeds AAMA/WDMA Ratings	R-PG50 Hallmark Certified
Air Infiltration (cfm/ft <sup>2</sup> of frame @ 1.57 psf wind pressure) <sub>2</sub>	0.19
Design Pressure	50 psf
Water Penetration Resistance	7.52 psf
Other Performance Criteria	
Forced Entry Resistance (Minimum Security Grade) <sub>4</sub>	10
Maximum Operating Force (lbs) (Maintain Motion)	35

### Sound Transmission Class and Outdoor-Indoor Transmission Class

Frame Size Tested <sub>5</sub>	Glazing System				STC Rating	OITC Rating
	Overall Glazing Thickness	Exterior Glass Thickness	Interior Glass Thickness	Third Pane Thickness		
DOUBLE-HUNG - DUAL PANE INSULATING GLASS						
48" x 60"	11/16"	2.2mm	2.2mm	–	26	22
DOUBLE-HUNG - TRIPLE-PANE INSULATING GLASS						
48" x 60"	1"	3mm	3mm	3mm	28	24

S = Standard; O = Optional;

(1) Published performance data is for single unit only. See Design Data pages in this section for specific product performance class and grade values.

(2) Published performance data for air infiltration is determined by testing a minimum of four (4) products of NFRC model size. Testing is conducted in accordance with ASTM E283. Air infiltration ratings for products will differ by size. The performance data does not apply to combination assemblies unless noted. Actual product performance may vary for a number of reasons including installation and product care.

(3) The sash members may have metal reinforcement in the cavities of the extrusion to achieve the stated Performance Grade. The exterior appearance of the unit is unchanged.

(4) The higher the level, the greater the product's ability to resist forced entry.

(5) ASTM E 1425 defines standard sizes for acoustical testing. Ratings achieved at that size are representative of all sizes of the same configuration.

The presence of low-e or argon have negligible effect on sound attenuation characteristics.



DOUBLE-HUNG

## PRODUCT SELECTION GUIDE

### Features and Options



#### GLAZING (INSULATING GLASS)

##### Glazing Type

Dual-pane insulating glass	S
Triple-pane insulating glass	O

##### Insulated Glass Options / Low-E Types

Advanced Low-E	S
NaturalSun Low-E	O
Bronze-tinted Advanced Low-E <sub>1</sub>	O

##### Additional Glazing Options

Annealed glass	S
Tempered glass	O
Obscure glass <sub>2</sub>	O

##### Gas Fill / High Altitude

Argon	O
High altitude	O
High altitude with argon <sub>1</sub>	O

#### SASH

Foam insulation	O
Performance upgrade	O

#### INTERIOR / EXTERIOR COLOR

White	S
Almond	O

#### HARDWARE

Color matched hardware	S
------------------------	---

##### Sash Locks

Standard Cam Lock	S
Autolock	O

##### Tilt-Wash Cleaning

Tilt to interior on both sashes	S
---------------------------------	---

#### SCREENS

Conventional black fiberglass - flat	S
--------------------------------------	---

#### GRILLES

##### Grilles-Between-the-Glass

Traditional, Prairie, Top Row, Custom - Equally Divided	O
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##### Simulated-Divided-Light Grilles<sub>1</sub> (without spacer)

Traditional, Prairie, Top Row, Custom - Equally Divided	O
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S = Standard; O = Optional

(1) Not available with triple-pane glazing.

(2) Contact your local Pella sales representative for current offering.



DOUBLE-HUNG

GLAZING PERFORMANCE - TOTAL UNIT

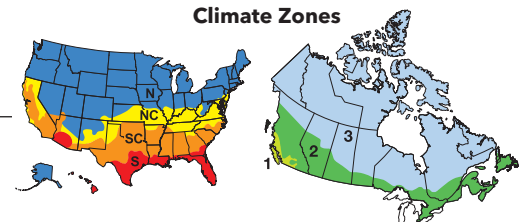
Vent  
Tinted Glass



Glass Thickness	Type of Glazing	NFRC Certified Product #	Glass (mm)		Gap Fill	Performance Values <sub>1</sub>				Shaded Areas Meet ENERGY STAR® Performance Criteria in Zones Shown							
			Ext.	Int.		U-Factor	SHGC	VLT %	CR	U.S.				Canada <sub>2</sub>			
										Zone				ER	Zone		
										N	NC	SC	S				
<b>VENT</b>											<b>N NC SC S 1 2 3</b>						
3/4"	Advanced Low-E IG	PEL-N-211-00003-00010	3	3	air	0.33	0.28	0.53	54								
	with SDL or grilles-between-the-glass	PEL-N-211-00003-00011				0.33	0.25	0.47	54								
3/4"	Advanced Low-E IG	PEL-N-211-00008-00010	3	3	argon	0.29	0.28	0.53	57								
	with SDL or grilles-between-the-glass	PEL-N-211-00008-00011				0.29	0.25	0.47	57								
3/4"	NaturalSun Low-E IG	PEL-N-211-00001-00013	3	3	air	0.33	0.49	0.59	53					25			
	with SDL or grilles-between-the-glass	PEL-N-211-00001-00014				0.33	0.44	0.53	53								
3/4"	NaturalSun Low-E IG	PEL-N-211-00006-00013	3	3	argon	0.30	0.49	0.59	56					29			
	with SDL or grilles-between-the-glass	PEL-N-211-00006-00014				0.30	0.44	0.53	56					26			
3/4"	SunDefense™ Low-E IG	PEL-N-211-00004-00007	3	3	air	0.32	0.21	0.49	54								
	with SDL or grilles-between-the-glass	PEL-N-211-00004-00008				0.32	0.19	0.43	54								
3/4"	SunDefense Low-E IG	PEL-N-211-00009-00007	3	3	argon	0.29	0.21	0.49	57								
	with SDL or grilles-between-the-glass	PEL-N-211-00009-00008				0.29	0.19	0.43	57								
<b>VENT – WITH FOAM INSULATION</b>																	
3/4"	Advanced Low-E IG	PEL-N-211-00020-00010	3	3	air	0.31	0.28	0.53	54								
	with SDL or grilles-between-the-glass	PEL-N-211-00020-00011				0.31	0.25	0.47	54								
3/4"	Advanced Low-E IG	PEL-N-211-00025-00010	3	3	argon	0.27	0.28	0.53	57					21			
	with SDL or grilles-between-the-glass	PEL-N-211-00025-00011				0.27	0.25	0.47	57					19			
3/4"	NaturalSun Low-E IG	PEL-N-211-00018-00013	3	3	air	0.32	0.49	0.59	53					27			
	with SDL or grilles-between-the-glass	PEL-N-211-00018-00014				0.32	0.44	0.53	53								
3/4"	NaturalSun Low-E IG	PEL-N-211-00023-00013	3	3	argon	0.28	0.49	0.59	57					32			
	with SDL or grilles-between-the-glass	PEL-N-211-00023-00014				0.28	0.44	0.53	57					29			
3/4"	SunDefense™ Low-E IG	PEL-N-211-00021-00007	3	3	air	0.30	0.21	0.49	54								
	with SDL or grilles-between-the-glass	PEL-N-211-00021-00008				0.30	0.19	0.43	54								
3/4"	SunDefense Low-E IG	PEL-N-211-00026-00007	3	3	argon	0.27	0.21	0.49	58					17			
	with SDL or grilles-between-the-glass	PEL-N-211-00026-00008				0.27	0.19	0.43	58								
<b>TINTED GLAZING</b>																	
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00003-00013	3	3	air	0.33	0.28	0.39	54								
	with SDL or grilles-between-the-glass	PEL-N-211-00003-00014	3	3		0.33	0.25	0.35	54								
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00008-00013	3	3	argon	0.29	0.27	0.39	57								
	with SDL or grilles-between-the-glass	PEL-N-211-00008-00014	3	3		0.29	0.25	0.35	57								
<b>TINTED GLAZING – WITH FOAM INSULATION</b>																	
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00020-00013	3	3	air	0.31	0.28	0.39	54								
	with SDL or grilles-between-the-glass	PEL-N-211-00020-00014	3	3		0.31	0.25	0.35	54								
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00025-00013	3	3	argon	0.27	0.27	0.39	57					20			
	with SDL or grilles-between-the-glass	PEL-N-211-00025-00014	3	3		0.27	0.25	0.35	57					19			

R-Value = 1/U-Factor  
 SHGC = Solar Heat Gain Coefficient  
 VLT % = Visible Light Transmission  
 CR = Condensation Resistance  
 ER = Canadian Energy Rating

(1) Glazing performance values are calculated based on NFRC 100, NFRC 200 and NFRC 500. ENERGY STAR® values are updated to 2015 (Version 6) criteria.  
 (2) The values shown are based on Canada's updated ENERGY STAR® 2015 initiative. Based on unit size, some products will use 2.5mm glass that may have improved glazing performance from what is shown. See the Product Performance section for more detailed information or visit [www.energystar.gov](http://www.energystar.gov) for Energy Star guidelines.





DOUBLE-HUNG

**GLAZING PERFORMANCE - TOTAL UNIT**

Triple-Pane IG

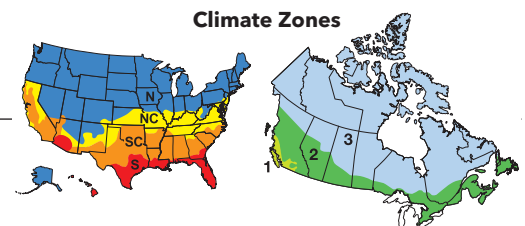
Triple-Pane Insulating Glass with Structural Reinforcement



Glass Thickness	Type of Glazing	NFRC Certified Product #	Glass (mm)			Gap Fill	Performance Values <sub>1</sub>				Shaded Areas Meet ENERGY STAR® Performance Criteria in Zones Shown									
			Ext.	Mid.	Int.		U-Factor	SHGC	VLT %	CR	U. S.				Canada <sub>2</sub>					
											Zone				ER	Zone				
											N	NC	SC	S				1	2	3
<b>VENT</b>																				
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00010-00001	3	3	3	air	0.26	0.24	0.41	63					21					
	with Grilles-between-the-glass	PEL-N-211-00014-00001					0.27	0.21	0.36	63					19					
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00012-00001	3	3	3	argon	0.23	0.24	0.41	65					25					
	with Grilles-between-the-glass	PEL-N-211-00016-00001					0.23	0.21	0.36	65					22					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00011-00001	3	3	3	air	0.27	0.42	0.52	62					31					
	with Grilles-between-the-glass	PEL-N-211-00015-00001					0.27	0.38	0.47	62					29					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00013-00001	3	3	3	argon	0.24	0.42	0.52	65					36					
	with Grilles-between-the-glass	PEL-N-211-00017-00001					0.24	0.38	0.47	65					33					
<b>VENT – WITH FOAM INSULATION</b>																				
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00027-00001	3	3	3	air	0.24	0.24	0.41	63					23					
	with Grilles-between-the-glass	PEL-N-211-00031-00001					0.25	0.21	0.36	63					21					
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00029-00001	3	3	3	argon	0.21	0.24	0.41	67					28					
	with Grilles-between-the-glass	PEL-N-211-00033-00001					0.21	0.21	0.36	67					25					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00028-00001	3	3	3	air	0.25	0.42	0.52	63					34					
	with Grilles-between-the-glass	PEL-N-211-00032-00001					0.25	0.38	0.47	63					30					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00030-00001	3	3	3	argon	0.22	0.42	0.52	66					37					
	with Grilles-between-the-glass	PEL-N-211-00034-00001					0.22	0.38	0.47	66					35					
<b>VENT – WITH STRUCTURAL REINFORCEMENT</b>																				
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00010-00001	3	3	3	air	0.26	0.24	0.41	63					20					
	with Grilles-between-the-glass	PEL-N-211-00014-00001					0.27	0.21	0.36	63					17					
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00012-00001	3	3	3	argon	0.23	0.24	0.41	65					23					
	with Grilles-between-the-glass	PEL-N-211-00016-00001					0.23	0.21	0.36	65					22					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00011-00001	3	3	3	air	0.27	0.42	0.52	62					29					
	with Grilles-between-the-glass	PEL-N-211-00015-00001					0.27	0.38	0.47	62					26					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00013-00001	3	3	3	argon	0.24	0.42	0.52	65					32					
	with Grilles-between-the-glass	PEL-N-211-00017-00001					0.24	0.38	0.47	65					30					
<b>VENT – WITH FOAM INSULATION – WITH STRUCTURAL REINFORCEMENT</b>																				
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00044-00001	3	3	3	air	0.26	0.24	0.41	63					20					
	with Grilles-between-the-glass	PEL-N-211-00048-00001					0.26	0.21	0.36	63					18					
1"	Advanced Low-E Triple-pane IG	PEL-N-211-00046-00001	3	3	3	argon	0.22	0.24	0.41	66					25					
	with Grilles-between-the-glass	PEL-N-211-00050-00001					0.23	0.21	0.36	66					22					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00045-00001	3	3	3	air	0.26	0.42	0.52	62					30					
	with Grilles-between-the-glass	PEL-N-211-00049-00001					0.27	0.38	0.47	62					26					
1"	NaturalSun Low-E Triple-pane IG	PEL-N-211-00047-00001	3	3	3	argon	0.23	0.42	0.52	66					34					
	with Grilles-between-the-glass	PEL-N-211-00051-00001					0.23	0.38	0.47	66					31					

R-Value = 1/U-Factor  
 SHGC = Solar Heat Gain Coefficient  
 VLT % = Visible Light Transmission  
 CR = Condensation Resistance  
 ER = Canadian Energy Rating

(1) Glazing performance values are calculated based on NFRC 100, NFRC 200 and NFRC 500. ENERGY STAR® values are updated to 2015 (Version 6) criteria.  
 (2) The values shown are based on Canada's updated ENERGY STAR® 2015 initiative. Based on unit size, some products will use 2.5mm glass that may have improved glazing performance from what is shown. See the Product Performance section for more detailed information or visit [www.energystar.gov](http://www.energystar.gov) for Energy Star guidelines.





DOUBLE-HUNG

### GLAZING PERFORMANCE - TOTAL UNIT

With Structural Reinforcement

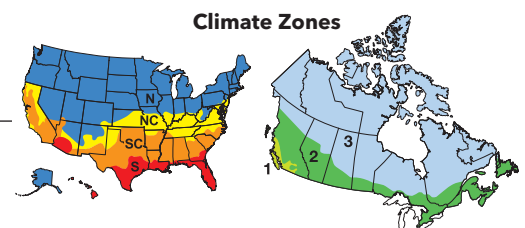
Tinted Glass with Structural Reinforcement



Glass Thickness	Type of Glazing	NFRC Certified Product #	Glass (mm)		Gap Fill	Performance Values <sub>1</sub>				Shaded Areas Meet ENERGY STAR® Performance Criteria in Zones Shown									
			Ext.	Int.		U-Factor	SHGC	VLT %	CR	U. S.		Canada <sub>2</sub>							
										Zone	ER	Zone	1	2	3				
<b>VENT- WITH STRUCTURAL REINFORCEMENT</b>										<b>N</b>	<b>NC</b>	<b>SC</b>	<b>S</b>						
3/4"	Advanced Low-E IG	PEL-N-211-00003-00010	3	3	air	0.33	0.28	0.53	54										
	with SDL or grilles-between-the-glass	PEL-N-211-00003-00011				0.33	0.25	0.47	54										
3/4"	Advanced Low-E IG	PEL-N-211-00008-00010	3	3	argon	0.29	0.28	0.53	57										
	with SDL or grilles-between-the-glass	PEL-N-211-00008-00011				0.29	0.25	0.47	57										
3/4"	NaturalSun Low-E IG	PEL-N-211-00001-00013	3	3	air	0.33	0.49	0.59	53						25				
	with SDL or grilles-between-the-glass	PEL-N-211-00001-00014				0.33	0.44	0.53	53										
3/4"	NaturalSun Low-E IG	PEL-N-211-00006-00013	3	3	argon	0.30	0.49	0.59	56						29				
	with SDL or grilles-between-the-glass	PEL-N-211-00006-00014				0.30	0.44	0.53	56						26				
3/4"	SunDefense™ Low-E IG	PEL-N-211-00004-00007	3	3	air	0.32	0.21	0.49	54										
	with SDL or grilles-between-the-glass	PEL-N-211-00004-00008				0.32	0.19	0.43	54										
3/4"	SunDefense Low-E IG	PEL-N-211-00009-00007	3	3	argon	0.29	0.21	0.49	57										
	with SDL or grilles-between-the-glass	PEL-N-211-00009-00008				0.29	0.19	0.43	57										
<b>VENT - WITH FOAM INSULATION - WITH STRUCTURAL REINFORCEMENT</b>																			
3/4"	Advanced Low-E IG	PEL-N-211-00037-00010	3	3	air	0.32	0.28	0.53	54										
	with SDL or grilles-between-the-glass	PEL-N-211-00037-00011				0.32	0.25	0.47	54										
3/4"	Advanced Low-E IG	PEL-N-211-00042-00010	3	3	argon	0.29	0.28	0.53	57										
	with SDL or grilles-between-the-glass	PEL-N-211-00042-00011				0.29	0.25	0.47	57										
3/4"	NaturalSun Low-E IG	PEL-N-211-00035-00013	3	3	air	0.33	0.49	0.59	53						25				
	with SDL or grilles-between-the-glass	PEL-N-211-00035-00014				0.33	0.44	0.53	53										
3/4"	NaturalSun Low-E IG	PEL-N-211-00040-00013	3	3	argon	0.30	0.49	0.59	56						29				
	with SDL or grilles-between-the-glass	PEL-N-211-00040-00014				0.30	0.44	0.53	56						26				
3/4"	SunDefense™ Low-E IG	PEL-N-211-00038-00007	3	3	air	0.32	0.21	0.49	54										
	with SDL or grilles-between-the-glass	PEL-N-211-00038-00008				0.32	0.19	0.43	54										
3/4"	SunDefense Low-E IG	PEL-N-211-00043-00007	3	3	argon	0.28	0.21	0.49	57										
	with SDL or grilles-between-the-glass	PEL-N-211-00043-00008				0.28	0.19	0.43	57										
<b>TINTED GLAZING - WITH STRUCTURAL REINFORCEMENT</b>																			
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00003-00013	3	3	air	0.33	0.28	0.39	54										
	with SDL or grilles-between-the-glass	PEL-N-211-00003-00014	3	3		0.33	0.25	0.35	54										
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00008-00013	3	3	argon	0.29	0.27	0.39	57										
	with SDL or grilles-between-the-glass	PEL-N-211-00008-00014	3	3		0.29	0.25	0.35	57										
<b>TINTED GLAZING - WITH FOAM INSULATION - WITH STRUCTURAL REINFORCEMENT</b>																			
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00020-00013	3	3	air	0.31	0.28	0.39	54										
	with SDL or grilles-between-the-glass	PEL-N-211-00020-00014	3	3		0.31	0.25	0.35	54										
3/4"	Bronze Advanced Low-E IG	PEL-N-211-00025-00013	3	3	argon	0.27	0.27	0.39	57						20				
	with SDL or grilles-between-the-glass	PEL-N-211-00025-00014	3	3		0.27	0.25	0.35	57						19				

R-Value = 1/U-Factor  
 SHGC = Solar Heat Gain Coefficient  
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 CR = Condensation Resistance  
 ER = Canadian Energy Rating

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 (2) The values shown are based on Canada's updated ENERGY STAR® 2015 initiative. Based on unit size, some products will use 2.5mm glass that may have improved glazing performance from what is shown. See the Product Performance section for more detailed information or visit [www.energystar.gov](http://www.energystar.gov) for Energy Star guidelines.





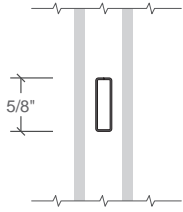
DOUBLE-HUNG

GRILLE TYPES

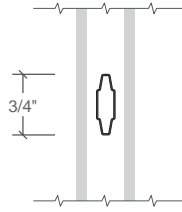


Grille Profiles

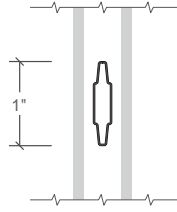
GRILLES-BETWEEN-THE-GLASS



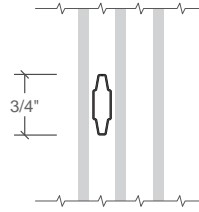
5/8" Flat Grille



3/4" Contour

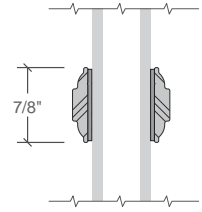


1" Contour



3/4" Contour - Triple

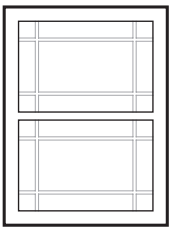
SIMULATED-DIVIDED-LIGHT GRILLES WITHOUT SPACER



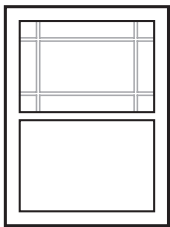
7/8" Contour

Grille Patterns

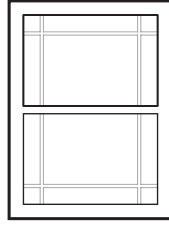
PRAIRIE LITE PATTERNS



9-Lite Prairie



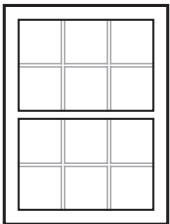
6-Lite Prairie



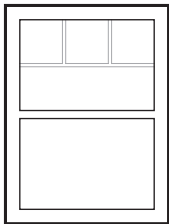
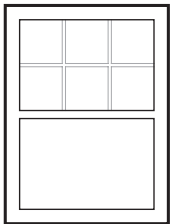
**Prairie**

- Specify upper or both sash
- Approximately 4" from edge of sash to center of bar
- Minimum actual glass is 13"

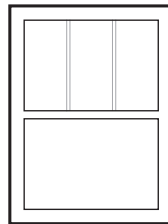
OTHER AVAILABLE PATTERNS



Traditional



Top Row



Custom – Equally Divided

**Traditional**

- Specify upper or both sash
- Specify number of lites
- Grilles must be equally divided on visible glass
- Minimum 6" x 6" center-to-center

**Top Row**

- Standard visible glass to separator bar must be  $\leq 1/2$  upper actual glass





DOUBLE-HUNG

**SPECIAL SIZE FRAME DIMENSIONS**

Miscellaneous Formulas



1-WIDE VENT UNIT	2-WIDE VENT UNIT COMPOSITE	3-WIDE VENT UNIT COMPOSITE
<b>MINIMUM</b>	<b>MINIMUM</b>	<b>MINIMUM</b>
14-1/2" W x 23-1/2" H (368 x 597) 28-1/2" H (724) Cottage and Contemporary	29-1/2" W x 23-1/2" H (749 x 597) 28-1/2" H (724) Cottage and Contemporary	44-1/2" W x 23-1/2" H (1 130 x 597) 28-1/2" H (724) Cottage and Contemporary
<b>EQUAL SASH MAXIMUM</b>	<b>EQUAL SASH MAXIMUM</b>	<b>EQUAL SASH MAXIMUM</b>
48 Ft <sup>2</sup> (4.46m <sup>2</sup> )	70 Ft <sup>2</sup> (6.5m <sup>2</sup> )	70 Ft <sup>2</sup> (6.5m <sup>2</sup> )
53-1/2" W x 77-1/2" H (1 359 x 1 969) <b>COTTAGE SASH MAXIMUM</b> 53-1/2" W x 65-1/2" H (1 359 x 1 664) <b>CONTEMPORARY SASH MAXIMUM</b> 53-1/2" W x 65-1/2" H (1 359 x 1 664)	95-1/2" W x 77-1/2" H (2 426 x 1 969) <b>COTTAGE SASH MAXIMUM</b> 95-1/2" W x 65-1/2" H (2 426 x 1 664) <b>CONTEMPORARY SASH MAXIMUM</b> 95-1/2" W x 65-1/2" H (2 426 x 1 664)	107-1/2" W x 77-1/2" H (2 731 x 1 969) <b>COTTAGE SASH MAXIMUM</b> 107-1/2" W x 65-1/2" H (2 731 x 1 664) <b>CONTEMPORARY SASH MAXIMUM</b> 107-1/2" W x 65-1/2" H (2 731 x 1 664)

**General Notes:**

- Rough Opening–Frame Dimension + 1/2"
- Keep frame dimensions to the nearest 1/8" increment
- 2-Wide and 3-Wide units are composites with multiple windows in one frame with integral mullions

Miscellaneous Formulas

		Standard Performance	Actual Glass Height		Standard Performance	Performance Upgrade	Visible Glass Height
		Actual Glass Width	Lower Glass	Upper Glass	Visible Glass Width	Visible Glass Width	
1-WIDE	Vent-equal		$(FH - 6) / 2$	$(FH - 6) / 2$			
	Cottage	FW - 5-1/4"	$(FH - 6) \times .6$	$(FH - 6) \times .4$	AGW - 1-1/8"	FW - 3-15/16"	AGH - 1-1/8"
	Contemporary		$(FH - 6) \times .4$	$(FH - 6) \times .6$			
2-WIDE	Vent-equal		$(FH - 6) / 2$	$(FH - 6) / 2$			
	Cottage	$(FW / 2) - 5-1/2"$	$(FH - 6) \times .6$	$(FH - 6) \times .4$	AGW - 1-1/8"		AGW - 1-1/8"
	Contemporary		$(FH - 6) \times .4$	$(FH - 6) \times .6$			
3-WIDE	Vent-equal		$(FH - 6) / 2$	$(FH - 6) / 2$			
	Cottage	$(FW / 3) - 5-19/32"$	$(FH - 6) \times .6$	$(FH - 6) \times .4$	AGW - 1-1/8"		AGW - 1-1/8"
	Contemporary		$(FH - 6) \times .4$	$(FH - 6) \times .6$			

Clear Opening Formulas

	COW	COH Equal Vent	COH Cottage Vent	COH Contemporary Vent
<b>CLEAR OPENING WITH CAM LOCK</b>	Frame Width - 5.046	$(FH / 2) - 5.411$	FH - ALGH - 8.411	FH - AUGH - 8.518
<b>CLEAR OPENING WITH AUTO LOCK</b>		$(FH / 2) - 5.411$	FH - ALGH - 8.411	FH - AUGH - 8.518

**KEY:**

AGW = Actual Glass Width  
 AGH = Actual Glass Height  
 ALGH = Actual Lower Glass Height  
 AUGH = Actual Upper Glass Height  
 FW = Frame Width

FH = Frame Height  
 VGW = Visible Glass Width  
 VGH = Visible Glass Height  
 COW = Clear opening width  
 COH = Clear opening height

Clear Opening Area (ft<sup>2</sup>) = (COW x COH) / 144  
 Frame Area (ft<sup>2</sup>) = (Frame Width x Frame Height) / 144



DOUBLE-HUNG

## SIZE TABLES

### Single Units - Equal Sash



1-Wide Vent	(610) (597)	(710) (699)	(762) (749)	(813) (800)	(914) (902)	(965) (953)	(1 067) (1 054)	(1 219) (1 207)	(1 372) (1 359)
Opening	2' 0"	2' 4"	2' 6"	2' 8"	3' 0"	3' 2"	3' 6"	4' 0"	4' 6"
Frame	23 1/2"	27 1/2"	29 1/2"	31 1/2"	35 1/2"	37 1/2"	41 1/2"	47 1/2"	53 1/2"
(914) (902)	3' 0"	35 1/2"							
(965) (953)	3' 2"	37 1/2"							
(1 067) (1 054)	3' 6"	41 1/2"							
(1 168) (1 156)	3' 10"	45 1/2"							
(1 219) (1 207)	4' 0"	47 1/2"							
(1 321) (1 308)	4' 4"	51 1/2"							
(1 372) (1 359)	4' 6"	53 1/2"							
(1 524) (1 511)	5' 0"	59 1/2"							
(1 575) (1 562)	5' 2"	61 1/2"							
(1 676) (1 664)	5' 6"	65 1/2"							
(1 829) (1 816)	6' 0"	71 1/2"							
(1 981) (1 969)	6' 6"	77 1/2"							

**Egress Notes:**  
 Check all applicable local codes for emergency egress requirements.  
 E = Window meets minimum clear opening of 24" height, 20" width, and 5.7 ft<sup>2</sup>.  
 E1 = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft<sup>2</sup>.  
 See Design Data pages in this section for clear opening dimensions.

Not to scale.



DOUBLE-HUNG

SIZE TABLES

2-Wide Composites with Integral Mullion - Equal Sash



2-Wide Vent		(1 219)	(1 422)	(1 524)	(1 626)	(1 829)	(1 930)	(2 134)	(2 438)
		(1 207)	(1 410)	(1 511)	(1 613)	(1 816)	(1 918)	(2 121)	(2 426)
Opening		4' 0"	4' 8"	5' 0"	5' 4"	6' 0"	6' 4"	7' 0"	8' 0"
	Frame	47 1/2"	55 1/2"	59 1/2"	63 1/2"	71 1/2"	75 1/2"	83 1/2"	95 1/2"
(914)	3' 0"	4-0/3-0	4-8/3-0	5-0/3-0	5-4/3-0	6-0/3-0	6-4/3-0	7-0/3-0	8-0/3-0
(902)	3' 0"	4-0/3-0	4-8/3-0	5-0/3-0	5-4/3-0	6-0/3-0	6-4/3-0	7-0/3-0	8-0/3-0
(965)	3' 2"	4-0/3-2	4-8/3-2	5-0/3-2	5-4/3-2	6-0/3-2	6-4/3-2	7-0/3-2	8-0/3-2
(953)	3' 2"	4-0/3-2	4-8/3-2	5-0/3-2	5-4/3-2	6-0/3-2	6-4/3-2	7-0/3-2	8-0/3-2
(1 067)	3' 6"	4-0/3-6	4-8/3-6	5-0/3-6	5-4/3-6	6-0/3-6	6-4/3-6	7-0/3-6	8-0/3-6
(1 054)	3' 6"	4-0/3-6	4-8/3-6	5-0/3-6	5-4/3-6	6-0/3-6	6-4/3-6	7-0/3-6	8-0/3-6
(1 168)	3' 10"	4-0/3-10	4-8/3-10	5-0/3-10	5-4/3-10	6-0/3-10	6-4/3-10	7-0/3-10	8-0/3-10
(1 156)	3' 10"	4-0/3-10	4-8/3-10	5-0/3-10	5-4/3-10	6-0/3-10	6-4/3-10	7-0/3-10	8-0/3-10
(1 219)	4' 0"	4-0/4-0	4-8/4-0	5-0/4-0	5-4/4-0	6-0/4-0	6-4/4-0	7-0/4-0	8-0/4-0
(1 207)	4' 0"	4-0/4-0	4-8/4-0	5-0/4-0	5-4/4-0	6-0/4-0	6-4/4-0	7-0/4-0	8-0/4-0
(1 321)	4' 4"	4-0/4-4	4-8/4-4	5-0/4-4	5-4/4-4	6-0/4-4	6-4/4-4	7-0/4-4	8-0/4-4
(1 308)	4' 4"	4-0/4-4	4-8/4-4	5-0/4-4	5-4/4-4	6-0/4-4	6-4/4-4	7-0/4-4	8-0/4-4
(1 372)	4' 6"	4-0/4-6	4-8/4-6	5-0/4-6	5-4/4-6	6-0/4-6	6-4/4-6	7-0/4-6	8-0/4-6
(1 359)	4' 6"	4-0/4-6	4-8/4-6	5-0/4-6	5-4/4-6	6-0/4-6	6-4/4-6	7-0/4-6	8-0/4-6
(1 524)	5' 0"	4-0/5-0	4-8/5-0	5-0/5-0	5-4/5-0	6-0/5-0	6-4/5-0	7-0/5-0	8-0/5-0
(1 511)	5' 0"	4-0/5-0	4-8/5-0	5-0/5-0	5-4/5-0	6-0/5-0	6-4/5-0	7-0/5-0	8-0/5-0
(1 575)	5' 2"	4-0/5-2	4-8/5-2	5-0/5-2	5-4/5-2	6-0/5-2	6-4/5-2	7-0/5-2	8-0/5-2
(1 562)	5' 2"	4-0/5-2	4-8/5-2	5-0/5-2	5-4/5-2	6-0/5-2	6-4/5-2	7-0/5-2	8-0/5-2
(1 676)	5' 6"	4-0/5-6	4-8/5-6	5-0/5-6	5-4/5-6	6-0/5-6	6-4/5-6	7-0/5-6	8-0/5-6
(1 664)	5' 6"	4-0/5-6	4-8/5-6	5-0/5-6	5-4/5-6	6-0/5-6	6-4/5-6	7-0/5-6	8-0/5-6
(1 829)	6' 0"	4-0/6-0	4-8/6-0	5-0/6-0	5-4/6-0	6-0/6-0	6-4/6-0	7-0/6-0	8-0/6-0
(1 816)	6' 0"	4-0/6-0	4-8/6-0	5-0/6-0	5-4/6-0	6-0/6-0	6-4/6-0	7-0/6-0	8-0/6-0
(1 981)	6' 6"	4-0/6-6	4-8/6-6	5-0/6-6	5-4/6-6	6-0/6-6	6-4/6-6	7-0/6-6	8-0/6-6
(1 969)	6' 6"	4-0/6-6	4-8/6-6	5-0/6-6	5-4/6-6	6-0/6-6	6-4/6-6	7-0/6-6	8-0/6-6

Egress Notes:

Check all applicable local codes for emergency egress requirements.

E = Window meets minimum clear opening of 24" height, 20" width, and 5.7 ft<sup>2</sup>.

E1 = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft<sup>2</sup>.

See Design Data pages in this section for clear opening dimensions.

Not to scale.



DOUBLE-HUNG

SIZE TABLES

3-Wide Composites with Integral Mullion - Equal Sash



3-Wide Vent		(1 829) (1 816)	(2 134) (2 121)	(2 438) (2 426)	(2 438) (2 426)	(2 743) (2 731)	
Opening	6' 0"	7' 0"	7' 6"	8' 0"	9' 0"		
Frame	71 1/2"	83 1/2"	89 1/2"	95 1/2"	107 1/2"		
(914) (902)	3' 0"	35 1/2"					
(965) (953)	3' 2"	37 1/2"					
(1 067) (1 054)	3' 6"	41 1/2"					
(1 168) (1 156)	3' 10"	45 1/2"					
(1 219) (1 207)	4' 0"	47 1/2"					
(1 321) (1 308)	4' 4"	51 1/2"					
(1 372) (1 359)	4' 6"	53 1/2"					
(1 524) (1 511)	5' 0"	59 1/2"					E <sub>1</sub>
(1 575) (1 562)	5' 2"	61 1/2"					E <sub>1</sub>
(1 676) (1 664)	5' 6"	65 1/2"				E <sub>1</sub>	
(1 829) (1 816)	6' 0"	71 1/2"					E <sub>1</sub>
(1 981) (1 969)	6' 6"	77 1/2"					E <sub>1</sub>

**Egress Notes:**  
 Check all applicable local codes for emergency egress requirements.  
 E = Window meets minimum clear opening of 24" height, 20" width, and 5.7 ft<sup>2</sup>.  
 E<sub>1</sub> = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft<sup>2</sup>.  
 See Design Data pages in this section for clear opening dimensions.

Not to scale.



DOUBLE-HUNG

SIZE TABLES

Single Units - Cottage Sash



1-Wide Vent		(610) (597)	(710) (699)	(762) (749)	(813) (800)	(914) (902)	(965) (953)	(1 067) (1 054)	(1 219) (1 207)	(1 372) (1 359)
Opening		2' 0"	2' 4"	2' 6"	2' 8"	3' 0"	3' 2"	3' 6"	4' 0"	4' 6"
Frame		23 1/2"	27 1/2"	29 1/2"	31 1/2"	35 1/2"	37 1/2"	41 1/2"	47 1/2"	53 1/2"
(914) (902)	3' 0"									
(965) (953)	3' 2"									
(1 067) (1 054)	3' 6"									
(1 1168) (1 1156)	3' 10"									
(1 219) (1 207)	4' 0"									
(1 321) (1 308)	4' 4"									
(1 372) (1 359)	4' 6"									
(1 524) (1 511)	5' 0"									
(1 575) (1 562)	5' 2"									
(1 676) (1 664)	5' 6"									

Not to scale.



DOUBLE-HUNG

SIZE TABLES

Single Units - Contemporary Sash



1-Wide Vent		(610) (597)	(710) (699)	(762) (749)	(813) (800)	(914) (902)	(965) (953)	(1 067) (1 054)	(1 219) (1 207)	(1 372) (1 359)	
Opening		2' 0"	2' 4"	2' 6"	2' 8"	3' 0"	3' 2"	3' 6"	4' 0"	4' 6"	
Frame		23 1/2"	27 1/2"	29 1/2"	31 1/2"	35 1/2"	37 1/2"	41 1/2"	47 1/2"	53 1/2"	
(914) (902)	3' 0"	35 1/2"									
(965) (953)	3' 2"	37 1/2"									
(1 067) (1 054)	3' 6"	41 1/2"									
(1 168) (1 156)	3' 10"	45 1/2"									
(1 219) (1 207)	4' 0"	47 1/2"									
(1 321) (1 308)	4' 4"	51 1/2"									
(1 372) (1 359)	4' 6"	53 1/2"									
(1 524) (1 511)	5' 0"	59 1/2"									
(1 575) (1 562)	5' 2"	61 1/2"									
(1 676) (1 664)	5' 6"	65 1/2"									

Not to scale.



DOUBLE-HUNG

## DESIGN DATA

Equal Sash

1-Wide Vent Units - Equal Sash



## 1-WIDE VENT UNITS – EQUAL SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
2-0/3-0		23-1/2	35-1/2	18-7/16	12-5/16	1.5	3.3	2.5	3.0	R35	R50
2-0/3-2		23-1/2	37-1/2	18-7/16	13-5/16	1.7	3.5	2.5	3.0	R35	R50
2-0/3-6		23-1/2	41-1/2	18-7/16	15-5/16	1.9	4.0	2.5	3.0	R35	R50
2-0/3-10		23-1/2	45-1/2	18-7/16	17-5/16	2.2	4.5	2.5	3.0	R35	R50
2-0/4-0		23-1/2	47-1/2	18-7/16	18-5/16	2.3	4.7	2.5	3.0	R35	R50
2-0/4-4		23-1/2	51-1/2	18-7/16	20-5/16	2.6	5.2	2.5	3.0	R35	R50
2-0/4-6		23-1/2	53-1/2	18-7/16	21-5/16	2.7	5.5	2.5	3.0	R35	R50
2-0/5-0		23-1/2	59-1/2	18-7/16	24-5/16	3.1	6.2	2.5	3.0	R35	R50
2-0/5-2		23-1/2	61-1/2	18-7/16	25-5/16	3.2	6.4	2.5	3.0	R35	R50
2-0/5-6		23-1/2	65-1/2	18-7/16	27-5/16	3.5	6.9	2.5	3.0	R30	R50
2-0/6-0		23-1/2	71-1/2	18-7/16	30-5/16	3.8	7.6	2.5	3.0	R30	R50
2-0/6-6		23-1/2	77-1/2	18-7/16	33-5/16	4.2	8.3	2.5	3.0	R20	-
2-4/3-0		27-1/2	35-1/2	22-7/16	12-5/16	1.9	4.1	2.5	3.0	R35	R50
2-4/3-2		27-1/2	37-1/2	22-7/16	13-5/16	2.0	4.4	2.5	3.0	R35	R50
2-4/3-6		27-1/2	41-1/2	22-7/16	15-5/16	2.3	4.9	2.5	3.0	R35	R50
2-4/3-10		27-1/2	45-1/2	22-7/16	17-5/16	2.7	5.5	2.5	3.0	R35	R50
2-4/4-0		27-1/2	47-1/2	22-7/16	18-5/16	2.8	5.8	2.5	3.0	R35	R50
2-4/4-4		27-1/2	51-1/2	22-7/16	20-5/16	3.1	6.4	2.5	3.0	R35	R50
2-4/4-6		27-1/2	53-1/2	22-7/16	21-5/16	3.3	6.7	2.5	3.0	R35	R50
2-4/5-0		27-1/2	59-1/2	22-7/16	24-5/16	3.7	7.6	2.5	3.0	R35	R50
2-4/5-2		27-1/2	61-1/2	22-7/16	25-5/16	3.9	7.9	2.5	3.0	R35	R50
2-4/5-6		27-1/2	65-1/2	22-7/16	27-5/16	4.2	8.5	2.5	3.0	R30	R50
2-4/6-0		27-1/2	71-1/2	22-7/16	30-5/16	4.7	9.4	2.5	3.0	R30	R50
2-4/6-6	E1	27-1/2	77-1/2	22-7/16	33-5/16	5.1	10.3	2.5	3.0	R20	-
2-6/3-0		29-1/2	35-1/2	24-1/4	12-5/16	2.0	4.4	2.5	3.0	R35	R50
2-6/3-2		29-1/2	37-1/2	24-1/4	13-5/16	2.2	4.8	2.5	3.0	R35	R50
2-6/3-6		29-1/2	41-1/2	24-1/4	15-5/16	2.6	5.4	2.5	3.0	R35	R50
2-6/3-10		29-1/2	45-1/2	24-1/4	17-5/16	2.9	6.1	2.5	3.0	R35	R50
2-6/4-0		29-1/2	47-1/2	24-1/4	18-5/16	3.1	6.4	2.5	3.0	R35	R50
2-6/4-4		29-1/2	51-1/2	24-1/4	20-5/16	3.4	7.0	2.5	3.0	R35	R50
2-6/4-6		29-1/2	53-1/2	24-1/4	21-5/16	3.6	7.3	2.5	3.0	R35	R50
2-6/5-0		29-1/2	59-1/2	24-1/4	24-5/16	4.1	8.3	2.5	3.0	R35	R50
2-6/5-2		29-1/2	61-1/2	24-1/4	25-5/16	4.3	8.6	2.5	3.0	R35	R50
2-6/5-6		29-1/2	65-1/2	24-1/4	27-5/16	4.6	9.3	2.5	3.0	R30	R50
2-6/6-0	E1	29-1/2	71-1/2	24-1/4	30-5/16	5.1	10.3	2.5	3.0	R30	R50
2-6/6-6	E1	29-1/2	77-1/2	24-1/4	33-5/16	5.6	11.2	2.5	3.0	R20	-
2-8/3-0		31-1/2	35-1/2	26-7/16	12-5/16	2.2	4.8	2.5	3.0	R35	R50
2-8/3-2		31-1/2	37-1/2	26-7/16	13-5/16	2.4	5.2	2.5	3.0	R35	R50
2-8/3-6		31-1/2	41-1/2	26-7/16	15-5/16	2.8	5.9	2.5	3.0	R35	R50
2-8/3-10		31-1/2	45-1/2	26-7/16	17-5/16	3.1	6.6	2.5	3.0	R35	R50
2-8/4-0		31-1/2	47-1/2	26-7/16	18-5/16	3.3	6.9	2.5	3.0	R35	R50
2-8/4-4		31-1/2	51-1/2	26-7/16	20-5/16	3.7	7.6	2.5	3.0	R35	R50
2-8/4-6		31-1/2	53-1/2	26-7/16	21-5/16	3.9	8.0	2.5	3.0	R35	R50
2-8/5-0		31-1/2	59-1/2	26-7/16	24-5/16	4.4	9.0	2.5	3.0	R35	R50
2-8/5-2		31-1/2	61-1/2	26-7/16	25-5/16	4.6	9.4	2.5	3.0	R35	R50
2-8/5-6	E1	31-1/2	65-1/2	26-7/16	27-5/16	5.0	10.1	2.5	3.0	R30	R50
2-8/6-0	E1	31-1/2	71-1/2	26-7/16	30-5/16	5.5	11.1	2.5	3.0	R30	R50
2-8/6-6	E	31-1/2	77-1/2	26-7/16	33-5/16	6.1	12.2	2.5	3.0	R20	-

Page 1 of 2

**Egress Notes:**

Check all applicable local codes for emergency egress requirements.

E = Window meets minimum clear opening of 24" height, 20" width, and 5.7 ft<sup>2</sup>.E1 = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft<sup>2</sup>.To convert areas to square meters (m<sup>2</sup>), multiply square feet by 0.0929.

(-) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.







DOUBLE-HUNG

**DESIGN DATA**  
 Equal Sash  
 2-Wide Vent Units



**2-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – EQUAL SASH**

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sub>1</sub>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
4-0/3-0		47-1/2	35-1/2	18-7/16	12-5/16	1.5	6.6	2.5	3.0	R35	R50
4-0/3-2		47-1/2	37-1/2	18-7/16	13-5/16	1.7	7.1	2.5	3.0	R35	R50
4-0/3-6		47-1/2	41-1/2	18-7/16	15-5/16	1.9	8.0	2.5	3.0	R35	R50
4-0/3-10		47-1/2	45-1/2	18-7/16	17-5/16	2.2	9.0	2.5	3.0	R35	R50
4-0/4-0		47-1/2	47-1/2	18-7/16	18-5/16	2.3	9.5	2.5	3.0	R35	R50
4-0/4-4		47-1/2	51-1/2	18-7/16	20-5/16	2.6	10.4	2.5	3.0	R35	R50
4-0/4-6		47-1/2	53-1/2	18-7/16	21-5/16	2.7	10.9	2.5	3.0	R35	R50
4-0/5-0		47-1/2	59-1/2	18-7/16	24-5/16	3.1	12.3	2.5	3.0	R35	R50
4-0/5-2		47-1/2	61-1/2	18-7/16	25-5/16	3.2	12.8	2.5	3.0	R35	R50
4-0/5-6		47-1/2	65-1/2	18-7/16	27-5/16	3.5	13.8	2.5	3.0	R30	R50
4-0/6-0		47-1/2	71-1/2	18-7/16	30-5/16	3.8	15.2	2.5	3.0	R30	R50
4-0/6-6		47-1/2	77-1/2	18-7/16	33-5/16	4.2	16.7	2.5	3.0	R20	-
4-8/3-0		55-1/2	35-1/2	22-7/16	12-5/16	1.9	8.1	2.5	3.0	R35	R50
4-8/3-2		55-1/2	37-1/2	22-7/16	13-5/16	2.0	8.7	2.5	3.0	R35	R50
4-8/3-6		55-1/2	41-1/2	22-7/16	15-5/16	2.3	9.9	2.5	3.0	R35	R50
4-8/3-10		55-1/2	45-1/2	22-7/16	17-5/16	2.7	11.1	2.5	3.0	R35	R50
4-8/4-0		55-1/2	47-1/2	22-7/16	18-5/16	2.8	11.7	2.5	3.0	R35	R50
4-8/4-4		55-1/2	51-1/2	22-7/16	20-5/16	3.1	12.8	2.5	3.0	R35	R50
4-8/4-6		55-1/2	53-1/2	22-7/16	21-5/16	3.3	13.4	2.5	3.0	R35	R50
4-8/5-0		55-1/2	59-1/2	22-7/16	24-5/16	3.7	15.2	2.5	3.0	R35	R50
4-8/5-2		55-1/2	61-1/2	22-7/16	25-5/16	3.9	15.8	2.5	3.0	R35	R50
4-8/5-6		55-1/2	65-1/2	22-7/16	27-5/16	4.2	17.0	2.5	3.0	R30	R50
4-8/6-0		55-1/2	71-1/2	22-7/16	30-5/16	4.7	18.7	2.5	3.0	R30	R50
4-8/6-6	E <sub>1</sub>	55-1/2	77-1/2	22-7/16	33-5/16	5.1	20.5	2.5	3.0	R20	-
5-0/3-0		59-1/2	35-1/2	24-7/16	12-5/16	2.0	8.9	2.5	3.0	R35	R50
5-0/3-2		59-1/2	37-1/2	24-7/16	13-5/16	2.2	9.5	2.5	3.0	R35	R50
5-0/3-6		59-1/2	41-1/2	24-7/16	15-5/16	2.6	10.8	2.5	3.0	R35	R50
5-0/3-10		59-1/2	45-1/2	24-7/16	17-5/16	2.9	12.1	2.5	3.0	R35	R50
5-0/4-0		59-1/2	47-1/2	24-7/16	18-5/16	3.1	12.8	2.5	3.0	R35	R50
5-0/4-4		59-1/2	51-1/2	24-7/16	20-5/16	3.4	14.0	2.5	3.0	R35	R50
5-0/4-6		59-1/2	53-1/2	24-7/16	21-5/16	3.6	14.7	2.5	3.0	R35	R50
5-0/5-0		59-1/2	59-1/2	24-7/16	24-5/16	4.1	16.6	2.5	3.0	R35	R50
5-0/5-2		59-1/2	61-1/2	24-7/16	25-5/16	4.3	17.3	2.5	3.0	R35	R50
5-0/5-6		59-1/2	65-1/2	24-7/16	27-5/16	4.6	18.6	2.5	3.0	R30	R50
5-0/6-0	E <sub>1</sub>	59-1/2	71-1/2	24-7/16	30-5/16	5.1	20.5	2.5	3.0	R30	R50
5-0/6-6	E <sub>1</sub>	59-1/2	77-1/2	24-7/16	33-5/16	5.6	22.4	2.5	3.0	R20	-
5-4/3-0		63-1/2	35-1/2	26-7/16	12-5/16	2.2	9.6	2.5	3.0	R35	R50
5-4/3-2		63-1/2	37-1/2	26-7/16	13-5/16	2.4	10.3	2.5	3.0	R35	R50
5-4/3-6		63-1/2	41-1/2	26-7/16	15-5/16	2.8	11.7	2.5	3.0	R35	R50
5-4/3-10		63-1/2	45-1/2	26-7/16	17-5/16	3.1	13.2	2.5	3.0	R35	R50
5-4/4-0		63-1/2	47-1/2	26-7/16	18-5/16	3.3	13.9	2.5	3.0	R35	R50
5-4/4-4		63-1/2	51-1/2	26-7/16	20-5/16	3.7	15.3	2.5	3.0	R35	R50
5-4/4-6		63-1/2	53-1/2	26-7/16	21-5/16	3.9	16.0	2.5	3.0	R35	R50
5-4/5-0		63-1/2	59-1/2	26-7/16	24-5/16	4.4	18.1	2.5	3.0	R35	R50
5-4/5-2		63-1/2	61-1/2	26-7/16	25-5/16	4.6	18.8	2.5	3.0	R35	R50
5-4/5-6	E <sub>1</sub>	63-1/2	65-1/2	26-7/16	27-5/16	5.0	20.2	2.5	3.0	R30	R50
5-4/6-0	E <sub>1</sub>	63-1/2	71-1/2	26-7/16	30-5/16	5.5	22.3	2.5	3.0	R30	R50
5-4/6-6	E	63-1/2	77-1/2	26-7/16	33-5/16	6.1	24.4	2.5	3.0	R20	-

**Egress Notes:**

Check all applicable local codes for emergency egress requirements.  
 E = Window meets minimum clear opening of 24" height, 20" width, and 5.7 ft<sup>2</sup>.  
 E<sub>1</sub> = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft<sup>2</sup>.  
 To convert areas to square meters (m<sup>2</sup>), multiply square feet by 0.0929.



DOUBLE-HUNG

**DESIGN DATA**  
 Equal Sash  
 2-Wide Vent Units



**2-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – EQUAL SASH**

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sub>1</sub>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
6-0/3-0		71-1/2	35-1/2	30-7/16	12-5/16	2.6	11.2	2.5	3.0	R35	R50
6-0/3-2		71-1/2	37-1/2	30-7/16	13-5/16	2.8	12.0	2.5	3.0	R35	R50
6-0/3-6		71-1/2	41-1/2	30-7/16	15-5/16	3.2	13.6	2.5	3.0	R35	R50
6-0/3-10		71-1/2	45-1/2	30-7/16	17-5/16	3.6	15.2	2.5	3.0	R35	R50
6-0/4-0		71-1/2	47-1/2	30-7/16	18-5/16	3.8	16.0	2.5	3.0	R35	R50
6-0/4-4		71-1/2	51-1/2	30-7/16	20-5/16	4.3	17.7	2.5	3.0	R35	R50
6-0/4-6		71-1/2	53-1/2	30-7/16	21-5/16	4.5	18.5	2.5	3.0	R35	R50
6-0/5-0	E1	71-1/2	59-1/2	30-7/16	24-5/16	5.1	20.9	2.5	3.0	R35	R50
6-0/5-2	E1	71-1/2	61-1/2	30-7/16	25-5/16	5.3	21.7	2.5	3.0	R35	R50
6-0/5-6	E	71-1/2	65-1/2	30-7/16	27-5/16	5.7	23.4	2.5	3.0	R30	R50
6-0/6-0	E	71-1/2	71-1/2	30-7/16	30-5/16	6.4	25.8	2.5	3.0	R30	R50
6-0/6-6	E	71-1/2	77-1/2	30-7/16	33-5/16	7.0	28.2	2.5	3.0	R20	-
6-4/3-0		75-1/2	35-1/2	32-7/16	12-5/16	2.7	11.9	2.5	3.0	R30	-
6-4/3-2		75-1/2	37-1/2	32-7/16	13-5/16	3.0	12.8	2.5	3.0	R30	-
6-4/3-6		75-1/2	41-1/2	32-7/16	15-5/16	3.4	14.5	2.5	3.0	R30	-
6-4/3-10		75-1/2	45-1/2	32-7/16	17-5/16	3.9	16.3	2.5	3.0	R30	-
6-4/4-0		75-1/2	47-1/2	32-7/16	18-5/16	4.1	17.1	2.5	3.0	R30	-
6-4/4-4		75-1/2	51-1/2	32-7/16	20-5/16	4.5	18.9	2.5	3.0	R30	-
6-4/4-6		75-1/2	53-1/2	32-7/16	21-5/16	4.8	19.7	2.5	3.0	R30	-
6-4/5-0	E1	75-1/2	59-1/2	32-7/16	24-5/16	5.4	22.4	2.5	3.0	R30	-
6-4/5-2	E	75-1/2	61-1/2	32-7/16	25-5/16	5.7	23.2	2.5	3.0	R30	-
6-4/5-6	E	75-1/2	65-1/2	32-7/16	27-5/16	6.1	25.0	2.5	3.0	R20	-
6-4/6-0	E	75-1/2	71-1/2	32-7/16	30-5/16	6.8	27.6	2.5	3.0	R20	-
6-4/6-6	E	75-1/2	77-1/2	32-7/16	33-5/16	7.5	30.2	2.5	3.0	R20	-
7-0/3-0		83-1/2	35-1/2	42-7/16	12-5/16	3.1	13.5	2.5	3.0	R30	-
7-0/3-2		83-1/2	37-1/2	42-7/16	13-5/16	3.3	14.4	2.5	3.0	R30	-
7-0/3-6		83-1/2	41-1/2	42-7/16	15-5/16	3.8	16.4	2.5	3.0	R30	-
7-0/3-10		83-1/2	45-1/2	42-7/16	17-5/16	4.3	18.4	2.5	3.0	R30	-
7-0/4-0		83-1/2	47-1/2	42-7/16	18-5/16	4.6	19.3	2.5	3.0	R30	-
7-0/4-4		83-1/2	51-1/2	42-7/16	20-5/16	5.1	21.3	2.5	3.0	R30	-
7-0/4-6		83-1/2	53-1/2	42-7/16	21-5/16	5.4	22.3	2.5	3.0	R30	-
7-0/5-0	E	83-1/2	59-1/2	42-7/16	24-5/16	6.1	25.2	2.5	3.0	R30	-
7-0/5-2	E	83-1/2	61-1/2	42-7/16	25-5/16	6.4	26.2	2.5	3.0	R30	-
7-0/5-6	E	83-1/2	65-1/2	42-7/16	27-5/16	6.9	28.2	2.5	3.0	R20	-
7-0/6-0	E	83-1/2	71-1/2	42-7/16	30-5/16	7.6	31.1	2.5	3.0	R20	-
7-0/6-6	E	83-1/2	77-1/2	42-7/16	33-5/16	8.4	34.0	2.5	3.0	R20	-
8-0/3-0		95-1/2	35-1/2	48-7/16	12-5/16	3.6	15.8	2.5	3.0	R30	-
8-0/3-2		95-1/2	37-1/2	48-7/16	13-5/16	3.9	16.9	2.5	3.0	R30	-
8-0/3-6		95-1/2	41-1/2	48-7/16	15-5/16	4.5	19.2	2.5	3.0	R30	-
8-0/3-10		95-1/2	45-1/2	48-7/16	17-5/16	5.1	21.5	2.5	3.0	R30	-
8-0/4-0		95-1/2	47-1/2	48-7/16	18-5/16	5.4	22.6	2.5	3.0	R30	-
8-0/4-4		95-1/2	51-1/2	48-7/16	20-5/16	5.9	24.9	2.5	3.0	R30	-
8-0/4-6		95-1/2	53-1/2	48-7/16	21-5/16	6.2	26.1	2.5	3.0	R30	-
8-0/5-0	E	95-1/2	59-1/2	48-7/16	24-5/16	7.1	29.5	2.5	3.0	R30	-
8-0/5-2	E	95-1/2	61-1/2	48-7/16	25-5/16	7.4	30.7	2.5	3.0	R30	-
8-0/5-6	E	95-1/2	65-1/2	48-7/16	27-5/16	8.0	32.9	2.5	3.0	R20	-
8-0/6-0	E	95-1/2	71-1/2	48-7/16	30-5/16	8.9	36.4	2.5	3.0	R20	-

**Egress Notes:**

Check all applicable local codes for emergency egress requirements.

E = Window meets minimum clear opening of 24" height, 20" width, and 5.7 ft<sup>2</sup>.

E1 = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft<sup>2</sup>.

To convert areas to square meters (m<sup>2</sup>), multiply square feet by 0.0929.

(-) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

DESIGN DATA

Equal Sash  
3-Wide Vent Units



3-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – EQUAL SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
6-0/3-0		71-1/2	35-1/2	18-7/16	12-5/16	1.5	9.9	2.5	3.0	R35	-
6-0/3-2		71-1/2	37-1/2	18-7/16	13-5/16	1.7	10.6	2.5	3.0	R35	-
6-0/3-6		71-1/2	41-1/2	18-7/16	15-5/16	1.9	12.0	2.5	3.0	R35	-
6-0/3-10		71-1/2	45-1/2	18-7/16	17-5/16	2.2	13.5	2.5	3.0	R35	-
6-0/4-0		71-1/2	47-1/2	18-7/16	18-5/16	2.3	14.2	2.5	3.0	R35	-
6-0/4-3		71-1/2	51-1/2	18-7/16	20-5/16	2.6	15.6	2.5	3.0	R35	-
6-0/4-6		71-1/2	53-1/2	18-7/16	21-5/16	2.7	16.4	2.5	3.0	R35	-
6-0/5-0		71-1/2	59-1/2	18-7/16	24-5/16	3.1	18.5	2.5	3.0	R35	-
6-0/5-2		71-1/2	61-1/2	18-7/16	25-5/16	3.2	19.2	2.5	3.0	R35	-
6-0/5-6		71-1/2	65-1/2	18-7/16	27-5/16	3.5	20.7	2.5	3.0	R30	-
6-0/6-0		71-1/2	71-1/2	18-7/16	30-5/16	3.8	22.8	2.5	3.0	R30	-
6-0/6-6		71-1/2	77-1/2	18-7/16	33-5/16	4.2	25.0	2.5	3.0	R20	-
7-0/3-0		83-1/2	35-1/2	22-7/16	12-5/16	1.9	12.2	2.5	3.0	R35	-
7-0/3-2		83-1/2	37-1/2	22-7/16	13-5/16	2.0	13.1	2.5	3.0	R35	-
7-0/3-6		83-1/2	41-1/2	22-7/16	15-5/16	2.3	14.8	2.5	3.0	R35	-
7-0/3-10		83-1/2	45-1/2	22-7/16	17-5/16	2.7	16.6	2.5	3.0	R35	-
7-0/4-0		83-1/2	47-1/2	22-7/16	18-5/16	2.8	17.5	2.5	3.0	R35	-
7-0/4-3		83-1/2	51-1/2	22-7/16	20-5/16	3.1	19.3	2.5	3.0	R35	-
7-0/4-6		83-1/2	53-1/2	22-7/16	21-5/16	3.3	20.1	2.5	3.0	R35	-
7-0/5-0		83-1/2	59-1/2	22-7/16	24-5/16	3.7	22.8	2.5	3.0	R35	-
7-0/5-2		83-1/2	61-1/2	22-7/16	25-5/16	3.9	23.7	2.5	3.0	R35	-
7-0/5-6		83-1/2	65-1/2	22-7/16	27-5/16	4.2	25.5	2.5	3.0	R30	-
7-0/6-0		83-1/2	71-1/2	22-7/16	30-5/16	4.7	28.1	2.5	3.0	R30	-
7-0/6-6	E1	83-1/2	77-1/2	22-7/16	33-5/16	5.1	30.8	2.5	3.0	R20	-
7-6/3-0		89-1/2	35-1/2	24-7/16	12-5/16	2.0	13.3	2.5	3.0	R35	-
7-6/3-2		89-1/2	37-1/2	24-7/16	13-5/16	2.2	14.3	2.5	3.0	R35	-
7-6/3-6		89-1/2	41-1/2	24-7/16	15-5/16	2.6	16.2	2.5	3.0	R35	-
7-6/3-10		89-1/2	45-1/2	24-7/16	17-5/16	2.9	18.2	2.5	3.0	R35	-
7-6/4-0		89-1/2	47-1/2	24-7/16	18-5/16	3.1	19.1	2.5	3.0	R35	-
7-6/4-3		89-1/2	51-1/2	24-7/16	20-5/16	3.4	21.1	2.5	3.0	R35	-
7-6/4-6		89-1/2	53-1/2	24-7/16	21-5/16	3.6	22.0	2.5	3.0	R35	-
7-6/5-0		89-1/2	59-1/2	24-7/16	24-5/16	4.1	24.9	2.5	3.0	R35	-
7-6/5-2		89-1/2	61-1/2	24-7/16	25-5/16	4.3	25.9	2.5	3.0	R35	-
7-6/5-6		89-1/2	65-1/2	24-7/16	27-5/16	4.6	27.9	2.5	3.0	R30	-
7-6/6-0	E1	89-1/2	71-1/2	24-7/16	30-5/16	5.1	30.8	2.5	3.0	R30	-
7-6/6-6	E1	89-1/2	77-1/2	24-7/16	33-5/16	5.6	33.7	2.5	3.0	R20	-
8-0/3-0		95-1/2	35-1/2	26-7/16	12-5/16	2.2	14.5	2.5	3.0	R35	-
8-0/3-2		95-1/2	37-1/2	26-7/16	13-5/16	2.4	15.5	2.5	3.0	R35	-
8-0/3-6		95-1/2	41-1/2	26-7/16	15-5/16	2.8	17.6	2.5	3.0	R35	-
8-0/3-10		95-1/2	45-1/2	26-7/16	17-5/16	3.1	19.7	2.5	3.0	R35	-
8-0/4-0		95-1/2	47-1/2	26-7/16	18-5/16	3.3	20.8	2.5	3.0	R35	-
8-0/4-3		95-1/2	51-1/2	26-7/16	20-5/16	3.7	22.9	2.5	3.0	R35	-
8-0/4-6		95-1/2	53-1/2	26-7/16	21-5/16	3.9	23.9	2.5	3.0	R35	-
8-0/5-0		95-1/2	59-1/2	26-7/16	24-5/16	4.4	27.1	2.5	3.0	R35	-
8-0/5-2		95-1/2	61-1/2	26-7/16	25-5/16	4.6	28.1	2.5	3.0	R35	-
8-0/5-6	E1	95-1/2	65-1/2	26-7/16	27-5/16	5.0	30.2	2.5	3.0	R30	-
9-0/3-0		107-1/2	35-1/2	30-7/16	12-5/16	2.6	16.8	2.5	3.0	R35	-
9-0/3-2		107-1/2	37-1/2	30-7/16	13-5/16	2.8	18.0	2.5	3.0	R35	-
9-0/3-6		107-1/2	41-1/2	30-7/16	15-5/16	3.2	20.4	2.5	3.0	R35	-
9-0/3-10		107-1/2	45-1/2	30-7/16	17-5/16	3.6	22.9	2.5	3.0	R35	-
9-0/4-0		107-1/2	47-1/2	30-7/16	18-5/16	3.8	24.1	2.5	3.0	R35	-
9-0/4-3		107-1/2	51-1/2	30-7/16	20-5/16	4.3	26.5	2.5	3.0	R20	-
9-0/4-6		107-1/2	53-1/2	30-7/16	21-5/16	4.5	27.7	2.5	3.0	R20	-
9-0/5-0	E1	107-1/2	59-1/2	30-7/16	24-5/16	5.1	31.4	2.5	3.0	R20	-
9-0/5-2	E1	107-1/2	61-1/2	30-7/16	25-5/16	5.3	32.6	2.5	3.0	R20	-

**Egress Notes:**  
 Check all applicable local codes for emergency egress requirements.  
 E = Window meets minimum clear opening of 24" height, 20" width, and 5.7 ft<sup>2</sup>.  
 E1 = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft<sup>2</sup>.  
 To convert areas to square meters (m<sup>2</sup>), multiply square feet by 0.0929.

(-) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

**DESIGN DATA**  
Cottage Sash  
Single Vent Units



**1-WIDE VENT UNITS – COTTAGE SASH**

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
2-0/3-0		23-1/2	35-1/2	18-7/16	9-3/8	1.2	3.3	2.5	3.0	R35	R50
2-0/3-2		23-1/2	37-1/2	18-7/16	10-3/16	1.3	3.5	2.5	3.0	R35	R50
2-0/3-6		23-1/2	41-1/2	18-7/16	11-3/4	1.5	4.0	2.5	3.0	R35	R50
2-0/3-10		23-1/2	45-1/2	18-7/16	13-3/8	1.7	4.5	2.5	3.0	R35	R50
2-0/4-0		23-1/2	47-1/2	18-7/16	14-3/16	1.8	4.7	2.5	3.0	R35	R50
2-0/4-4		23-1/2	51-1/2	18-7/16	15-3/4	2.0	5.2	2.5	3.0	R35	R50
2-0/4-6		23-1/2	53-1/2	18-7/16	16-9/16	2.1	5.5	2.5	3.0	R35	R50
2-0/5-0		23-1/2	59-1/2	18-7/16	18-15/16	2.4	6.2	2.5	3.0	R35	R50
2-0/5-2		23-1/2	61-1/2	18-7/16	19-3/4	2.5	6.4	2.5	3.0	R35	R50
2-0/5-6		23-1/2	65-1/2	18-7/16	21-3/8	2.7	6.9	2.5	3.0	R30	R50
2-4/3-0		27-1/2	35-1/2	22-7/16	9-3/8	1.4	4.1	2.5	3.0	R35	R50
2-4/3-2		27-1/2	37-1/2	22-7/16	10-3/16	1.5	4.4	2.5	3.0	R35	R50
2-4/3-6		27-1/2	41-1/2	22-7/16	11-3/4	1.8	4.9	2.5	3.0	R35	R50
2-4/3-10		27-1/2	45-1/2	22-7/16	13-3/8	2.0	5.5	2.5	3.0	R35	R50
2-4/4-0		27-1/2	47-1/2	22-7/16	14-3/16	2.2	5.8	2.5	3.0	R35	R50
2-4/4-4		27-1/2	51-1/2	22-7/16	15-3/4	2.4	6.4	2.5	3.0	R35	R50
2-4/4-6		27-1/2	53-1/2	22-7/16	16-9/16	2.5	6.7	2.5	3.0	R35	R50
2-4/5-0		27-1/2	59-1/2	22-7/16	18-15/16	2.9	7.6	2.5	3.0	R35	R50
2-4/5-2		27-1/2	61-1/2	22-7/16	19-3/4	3.0	7.9	2.5	3.0	R35	R50
2-4/5-6		27-1/2	65-1/2	22-7/16	21-3/8	3.3	8.5	2.5	3.0	R30	R50
2-6/3-0		29-1/2	35-1/2	24-7/16	9-3/8	1.5	4.4	2.5	3.0	R35	R50
2-6/3-2		29-1/2	37-1/2	24-7/16	10-3/16	1.7	4.8	2.5	3.0	R35	R50
2-6/3-6		29-1/2	41-1/2	24-7/16	11-3/4	2.0	5.4	2.5	3.0	R35	R50
2-6/3-10		29-1/2	45-1/2	24-7/16	13-3/8	2.2	6.1	2.5	3.0	R35	R50
2-6/4-0		29-1/2	47-1/2	24-7/16	14-3/16	2.4	6.4	2.5	3.0	R35	R50
2-6/4-4		29-1/2	51-1/2	24-7/16	15-3/4	2.6	7.0	2.5	3.0	R35	R50
2-6/4-6		29-1/2	53-1/2	24-7/16	16-9/16	2.8	7.3	2.5	3.0	R35	R50
2-6/5-0		29-1/2	59-1/2	24-7/16	18-15/16	3.2	8.3	2.5	3.0	R35	R50
2-6/5-2		29-1/2	61-1/2	24-7/16	19-3/4	3.3	8.6	2.5	3.0	R35	R50
2-6/5-6		29-1/2	65-1/2	24-7/16	21-3/8	3.6	9.3	2.5	3.0	R30	R50
2-8/3-0		31-1/2	35-1/2	26-7/16	9-3/8	1.7	4.8	2.5	3.0	R35	R50
2-8/3-2		31-1/2	37-1/2	26-7/16	10-3/16	1.8	5.2	2.5	3.0	R35	R50
2-8/3-6		31-1/2	41-1/2	26-7/16	11-3/4	2.1	5.9	2.5	3.0	R35	R50
2-8/3-10		31-1/2	45-1/2	26-7/16	13-3/8	2.4	6.6	2.5	3.0	R35	R50
2-8/4-0		31-1/2	47-1/2	26-7/16	14-3/16	2.6	6.9	2.5	3.0	R35	R50
2-8/4-4		31-1/2	51-1/2	26-7/16	15-3/4	2.9	7.6	2.5	3.0	R35	R50
2-8/4-6		31-1/2	53-1/2	26-7/16	16-9/16	3.0	8.0	2.5	3.0	R35	R50
2-8/5-0		31-1/2	59-1/2	26-7/16	18-15/16	3.4	9.0	2.5	3.0	R35	R50
2-8/5-2		31-1/2	61-1/2	26-7/16	19-3/4	3.6	9.4	2.5	3.0	R35	R50
2-8/5-6		31-1/2	65-1/2	26-7/16	21-3/8	3.9	10.1	2.5	3.0	R30	R50
3-0/3-0		35-1/2	35-1/2	30-7/16	9-3/8	1.9	5.6	2.5	3.0	R35	R50
3-0/3-2		35-1/2	37-1/2	30-7/16	10-3/16	2.1	6.0	2.5	3.0	R35	R50
3-0/3-6		35-1/2	41-1/2	30-7/16	11-3/4	2.4	6.8	2.5	3.0	R35	R50
3-0/3-10		35-1/2	45-1/2	30-7/16	13-3/8	2.8	7.6	2.5	3.0	R35	R50
3-0/4-0		35-1/2	47-1/2	30-7/16	14-3/16	3.0	8.0	2.5	3.0	R35	R50
3-0/4-4		35-1/2	51-1/2	30-7/16	15-3/4	3.3	8.8	2.5	3.0	R35	R50
3-0/4-6		35-1/2	53-1/2	30-7/16	16-9/16	3.5	9.2	2.5	3.0	R35	R50
3-0/5-0		35-1/2	59-1/2	30-7/16	18-15/16	4.0	10.5	2.5	3.0	R35	R50
3-0/5-2		35-1/2	61-1/2	30-7/16	19-3/4	4.1	10.9	2.5	3.0	R35	R50
3-0/5-6		35-1/2	65-1/2	30-7/16	21-3/8	4.5	11.7	2.5	3.0	R30	R50

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

## DESIGN DATA

### Cottage Sash Single Vent Units



## 1-WIDE VENT UNITS – COTTAGE SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
3-2/3-0		37-1/2	35-1/2	32-7/16	9-3/8	2.1	6.0	2.5	3.0	R30	R50
3-2/3-2		37-1/2	37-1/2	32-7/16	10-3/16	2.2	6.4	2.5	3.0	R30	R50
3-2/3-6		37-1/2	41-1/2	32-7/16	11-3/4	2.6	7.3	2.5	3.0	R30	R50
3-2/3-10		37-1/2	45-1/2	32-7/16	13-3/8	3.0	8.1	2.5	3.0	R30	R50
3-2/4-0		37-1/2	47-1/2	32-7/16	14-3/16	3.1	8.6	2.5	3.0	R30	R50
3-2/4-4		37-1/2	51-1/2	32-7/16	15-3/4	3.5	9.4	2.5	3.0	R30	R50
3-2/4-6		37-1/2	53-1/2	32-7/16	16-9/16	3.7	9.9	2.5	3.0	R30	R50
3-2/5-0		37-1/2	59-1/2	32-7/16	18-15/16	4.2	11.2	2.5	3.0	R30	R50
3-2/5-2		37-1/2	61-1/2	32-7/16	19-3/4	4.4	11.6	2.5	3.0	R30	R50
3-2/5-6		37-1/2	65-1/2	32-7/16	21-3/8	4.8	12.5	2.5	3.0	R30	R50
3-6/3-0		41-1/2	35-1/2	36-7/16	9-3/8	2.3	6.7	2.5	3.0	R30	R50
3-6/3-2		41-1/2	37-1/2	36-7/16	10-3/16	2.5	7.2	2.5	3.0	R30	R50
3-6/3-6		41-1/2	41-1/2	36-7/16	11-3/4	2.9	8.2	2.5	3.0	R30	R50
3-6/3-10		41-1/2	45-1/2	36-7/16	13-3/8	3.3	9.2	2.5	3.0	R30	R50
3-6/4-0		41-1/2	47-1/2	36-7/16	14-3/16	3.5	9.7	2.5	3.0	R30	R50
3-6/4-4		41-1/2	51-1/2	36-7/16	15-3/4	3.9	10.6	2.5	3.0	R30	R50
3-6/4-6		41-1/2	53-1/2	36-7/16	16-9/16	4.1	11.1	2.5	3.0	R30	R50
3-6/5-0		41-1/2	59-1/2	36-7/16	18-15/16	4.8	12.6	2.5	3.0	R30	R50
3-6/5-2		41-1/2	61-1/2	36-7/16	19-3/4	5.0	13.1	2.5	3.0	R30	R50
3-6/5-6		41-1/2	65-1/2	36-7/16	21-3/8	5.4	14.1	2.5	3.0	R20	R50
4-0/3-0		47-1/2	35-1/2	42-7/16	9-3/8	2.7	7.9	2.5	3.0	R30	R50
4-0/3-2		47-1/2	37-1/2	42-7/16	10-3/16	3.0	8.5	2.5	3.0	R30	R50
4-0/3-6		47-1/2	41-1/2	42-7/16	11-3/4	3.4	9.6	2.5	3.0	R30	R50
4-0/3-10		47-1/2	45-1/2	42-7/16	13-3/8	3.9	10.7	2.5	3.0	R30	R50
4-0/4-0		47-1/2	47-1/2	42-7/16	14-3/16	4.1	11.3	2.5	3.0	R30	R50
4-0/4-4		47-1/2	51-1/2	42-7/16	15-3/4	4.6	12.5	2.5	3.0	R30	R50
4-0/4-6		47-1/2	53-1/2	42-7/16	16-9/16	4.8	13.0	2.5	3.0	R30	R50
4-0/5-0		47-1/2	59-1/2	42-7/16	18-15/16	5.5	14.8	2.5	3.0	R30	R50
4-0/5-2		47-1/2	61-1/2	42-7/16	19-3/4	5.8	15.3	2.5	3.0	R30	R50
4-0/5-6		47-1/2	65-1/2	42-7/16	21-3/8	6.3	16.5	2.5	3.0	R20	R50
4-6/3-0		53-1/2	35-1/2	48-7/16	9-3/8	3.1	9.0	2.5	3.0	R20	–
4-6/3-2		53-1/2	37-1/2	48-7/16	10-3/16	3.4	9.7	2.5	3.0	R20	–
4-6/3-6		53-1/2	41-1/2	48-7/16	11-3/4	3.9	11.0	2.5	3.0	R20	–
4-6/3-10		53-1/2	45-1/2	48-7/16	13-3/8	4.5	12.3	2.5	3.0	R20	–
4-6/4-0		53-1/2	47-1/2	48-7/16	14-3/16	4.7	13.0	2.5	3.0	R20	–
4-6/4-4		53-1/2	51-1/2	48-7/16	15-3/4	5.3	14.3	2.5	3.0	R20	–
4-6/4-6		53-1/2	53-1/2	48-7/16	16-9/16	5.5	14.9	2.5	3.0	R20	–
4-6/5-0		53-1/2	59-1/2	48-7/16	18-15/16	6.3	16.9	2.5	3.0	R20	–
4-6/5-2		53-1/2	61-1/2	48-7/16	19-3/4	6.6	17.6	2.5	3.0	R20	–
4-6/5-6		53-1/2	65-1/2	48-7/16	21-3/8	7.1	18.9	2.5	3.0	R20	–

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(–) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

## DESIGN DATA

### Cottage Sash 2-Wide Vent Units



#### 2-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – COTTAGE SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
4-0/3-0		47-1/2	35-1/2	18-7/16	9-3/8	1.2	6.6	2.5	3.0	R35	R50
4-0/3-2		47-1/2	37-1/2	18-7/16	10-3/16	1.3	7.1	2.5	3.0	R35	R50
4-0/3-6		47-1/2	41-1/2	18-7/16	11-3/4	1.5	8.0	2.5	3.0	R35	R50
4-0/3-10		47-1/2	45-1/2	18-7/16	13-3/8	1.7	9.0	2.5	3.0	R35	R50
4-0/4-0		47-1/2	47-1/2	18-7/16	14-3/16	1.8	9.5	2.5	3.0	R35	R50
4-0/4-4		47-1/2	51-1/2	18-7/16	15-3/4	2.0	10.4	2.5	3.0	R35	R50
4-0/4-6		47-1/2	53-1/2	18-7/16	16-9/16	2.1	10.9	2.5	3.0	R35	R50
4-0/5-0		47-1/2	59-1/2	18-7/16	18-15/16	2.4	12.3	2.5	3.0	R35	R50
4-0/5-2		47-1/2	61-1/2	18-7/16	19-3/4	2.5	12.8	2.5	3.0	R35	R50
4-0/5-6		47-1/2	65-1/2	18-7/16	21-3/8	2.7	13.8	2.5	3.0	R30	R50
4-8/3-0		55-1/2	35-1/2	22-7/16	9-3/8	1.4	8.1	2.5	3.0	R35	R50
4-8/3-2		55-1/2	37-1/2	22-7/16	10-3/16	1.5	8.7	2.5	3.0	R35	R50
4-8/3-6		55-1/2	41-1/2	22-7/16	11-3/4	1.8	9.9	2.5	3.0	R35	R50
4-8/3-10		55-1/2	45-1/2	22-7/16	13-3/8	2.0	11.1	2.5	3.0	R35	R50
4-8/4-0		55-1/2	47-1/2	22-7/16	14-3/16	2.2	11.7	2.5	3.0	R35	R50
4-8/4-4		55-1/2	51-1/2	22-7/16	15-3/4	2.4	12.8	2.5	3.0	R35	R50
4-8/4-6		55-1/2	53-1/2	22-7/16	16-9/16	2.5	13.4	2.5	3.0	R35	R50
4-8/5-0		55-1/2	59-1/2	22-7/16	18-15/16	2.9	15.2	2.5	3.0	R35	R50
4-8/5-2		55-1/2	61-1/2	22-7/16	19-3/4	3.0	15.8	2.5	3.0	R35	R50
4-8/5-6		55-1/2	65-1/2	22-7/16	21-3/8	3.3	17.0	2.5	3.0	R30	R50
5-0/3-0		59-1/2	35-1/2	24-7/16	9-3/8	1.5	8.9	2.5	3.0	R35	R50
5-0/3-2		59-1/2	37-1/2	24-7/16	10-3/16	1.7	9.5	2.5	3.0	R35	R50
5-0/3-6		59-1/2	41-1/2	24-7/16	11-3/4	2.0	10.8	2.5	3.0	R35	R50
5-0/3-10		59-1/2	45-1/2	24-7/16	13-3/8	2.2	12.1	2.5	3.0	R35	R50
5-0/4-0		59-1/2	47-1/2	24-7/16	14-3/16	2.4	12.8	2.5	3.0	R35	R50
4-1/4-4		59-1/2	51-1/2	24-7/16	15-3/4	2.6	14.0	2.5	3.0	R35	R50
5-0/4-6		59-1/2	53-1/2	24-7/16	16-9/16	2.8	14.7	2.5	3.0	R35	R50
5-0/5-0		59-1/2	59-1/2	24-7/16	18-15/16	3.2	16.6	2.5	3.0	R35	R50
5-0/5-2		59-1/2	61-1/2	24-7/16	19-3/4	3.3	17.3	2.5	3.0	R35	R50
5-0/5-6		59-1/2	65-1/2	24-7/16	21-3/8	3.6	18.6	2.5	3.0	R30	R50
5-4/3-0		63-1/2	35-1/2	26-7/16	9-3/8	1.7	9.6	2.5	3.0	R35	R50
5-4/3-2		63-1/2	37-1/2	26-7/16	10-3/16	1.8	10.3	2.5	3.0	R35	R50
5-4/3-6		63-1/2	41-1/2	26-7/16	11-3/4	2.1	11.7	2.5	3.0	R35	R50
5-4/3-10		63-1/2	45-1/2	26-7/16	13-3/8	2.4	13.2	2.5	3.0	R35	R50
5-4/4-0		63-1/2	47-1/2	26-7/16	14-3/16	2.6	13.9	2.5	3.0	R35	R50
5-4/4-4		63-1/2	51-1/2	26-7/16	15-3/4	2.9	15.3	2.5	3.0	R35	R50
5-4/4-6		63-1/2	53-1/2	26-7/16	16-9/16	3.0	16.0	2.5	3.0	R35	R50
5-4/5-0		63-1/2	59-1/2	26-7/16	18-15/16	3.4	18.1	2.5	3.0	R35	R50
5-4/5-2		63-1/2	61-1/2	26-7/16	19-3/4	3.6	18.8	2.5	3.0	R35	R50
5-4/5-6		63-1/2	65-1/2	26-7/16	21-3/8	3.9	20.2	2.5	3.0	R30	R50
6-0/3-0		71-1/2	35-1/2	30-7/16	9-3/8	1.9	11.2	2.5	3.0	R35	R50
6-0/3-2		71-1/2	37-1/2	30-7/16	10-3/16	2.1	12.0	2.5	3.0	R35	R50
6-0/3-6		71-1/2	41-1/2	30-7/16	11-3/4	2.4	13.6	2.5	3.0	R35	R50
6-0/3-10		71-1/2	45-1/2	30-7/16	13-3/8	2.8	15.2	2.5	3.0	R35	R50
6-0/4-0		71-1/2	47-1/2	30-7/16	14-3/16	3.0	16.0	2.5	3.0	R35	R50
6-0/4-4		71-1/2	51-1/2	30-7/16	15-3/4	3.3	17.7	2.5	3.0	R35	R50
6-0/4-6		71-1/2	53-1/2	30-7/16	16-9/16	3.5	18.5	2.5	3.0	R35	R50
6-0/5-0		71-1/2	59-1/2	30-7/16	18-15/16	4.0	20.9	2.5	3.0	R35	R50
6-0/5-2		71-1/2	61-1/2	30-7/16	19-3/4	4.1	21.7	2.5	3.0	R35	R50
6-0/5-6		71-1/2	65-1/2	30-7/16	21-3/8	4.5	23.4	2.5	3.0	R30	R50

(-) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

## DESIGN DATA

### Cottage Sash 2-Wide Vent Units



#### 2-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – COTTAGE SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sub>1</sub>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
6-4/3-0		75-1/2	35-1/2	32-7/16	9-3/8	2.1	11.9	2.5	3.0	R30	–
6-4/3-2		75-1/2	37-1/2	32-7/16	10-3/16	2.2	12.8	2.5	3.0	R30	–
6-4/3-6		75-1/2	41-1/2	32-7/16	11-3/4	2.6	14.5	2.5	3.0	R30	–
6-4/3-10		75-1/2	45-1/2	32-7/16	13-3/8	3.0	16.3	2.5	3.0	R30	–
6-4/4-0		75-1/2	47-1/2	32-7/16	14-3/16	3.1	17.1	2.5	3.0	R30	–
6-4/4-4		75-1/2	51-1/2	32-7/16	15-3/4	3.5	18.9	2.5	3.0	R30	–
6-4/4-6		75-1/2	53-1/2	32-7/16	16-9/16	3.7	19.7	2.5	3.0	R30	–
6-4/5-0		75-1/2	59-1/2	32-7/16	18-15/16	4.2	22.4	2.5	3.0	R30	–
6-4/5-2		75-1/2	61-1/2	32-7/16	19-3/4	4.4	23.2	2.5	3.0	R30	–
6-4/5-6		75-1/2	65-1/2	32-7/16	21-3/8	4.8	25.0	2.5	3.0	R30	–
7-0/3-0		83-1/2	35-1/2	42-7/16	9-3/8	2.3	13.5	2.5	3.0	R30	–
7-0/3-2		83-1/2	37-1/2	42-7/16	10-3/16	2.5	14.4	2.5	3.0	R30	–
7-0/3-6		83-1/2	41-1/2	42-7/16	11-3/4	2.9	16.4	2.5	3.0	R30	–
7-0/3-10		83-1/2	45-1/2	42-7/16	13-3/8	3.3	18.4	2.5	3.0	R30	–
7-0/4-0		83-1/2	47-1/2	42-7/16	14-3/16	3.5	19.3	2.5	3.0	R30	–
7-0/4-4		83-1/2	51-1/2	42-7/16	15-3/4	3.9	21.3	2.5	3.0	R30	–
7-0/4-6		83-1/2	53-1/2	42-7/16	16-9/16	4.1	22.3	2.5	3.0	R30	–
7-0/5-0		83-1/2	59-1/2	42-7/16	18-15/16	4.8	25.2	2.5	3.0	R30	–
7-0/5-2		83-1/2	61-1/2	42-7/16	19-3/4	5.0	26.2	2.5	3.0	R30	–
7-0/5-6		83-1/2	65-1/2	42-7/16	21-3/8	5.4	28.2	2.5	3.0	R30	–
8-0/3-0		95-1/2	35-1/2	48-7/16	9-3/8	2.7	15.8	2.5	3.0	R30	–
8-0/3-2		95-1/2	37-1/2	48-7/16	10-3/16	3.0	16.9	2.5	3.0	R30	–
8-0/3-6		95-1/2	41-1/2	48-7/16	11-3/4	3.4	19.2	2.5	3.0	R30	–
8-0/3-10		95-1/2	45-1/2	48-7/16	13-3/8	3.9	21.5	2.5	3.0	R30	–
8-0/4-0		95-1/2	47-1/2	48-7/16	14-3/16	4.1	22.6	2.5	3.0	R30	–
8-0/4-4		95-1/2	51-1/2	48-7/16	15-3/4	4.6	24.9	2.5	3.0	R30	–
8-0/4-6		95-1/2	53-1/2	48-7/16	16-9/16	4.8	26.1	2.5	3.0	R30	–
8-0/5-0		95-1/2	59-1/2	48-7/16	18-15/16	5.5	29.5	2.5	3.0	R30	–
8-0/5-2		95-1/2	61-1/2	48-7/16	19-3/4	5.8	30.7	2.5	3.0	R30	–
8-0/5-6		95-1/2	65-1/2	48-7/16	21-3/8	6.3	32.9	2.5	3.0	R30	–

Page 2 of 2

(–) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

**DESIGN DATA**  
Cottage Sash  
3-Wide Vent Units



**3-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – COTTAGE SASH**

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft²	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft²		Annealed	Tempered	Standard	Upgrade
6-0/3-0		71-1/2	35-1/2	18-7/16	9-3/8	1.2	9.9	2.5	3.0	R35	–
6-0/3-2		71-1/2	37-1/2	18-7/16	10-3/16	1.3	10.6	2.5	3.0	R35	–
6-0/3-6		71-1/2	41-1/2	18-7/16	11-3/4	1.5	12.0	2.5	3.0	R35	–
6-0/3-10		71-1/2	45-1/2	18-7/16	13-3/8	1.7	13.5	2.5	3.0	R35	–
6-0/4-0		71-1/2	47-1/2	18-7/16	14-3/16	1.8	14.2	2.5	3.0	R35	–
6-0/4-3		71-1/2	51-1/2	18-7/16	15-3/4	2.0	15.6	2.5	3.0	R35	–
6-0/4-6		71-1/2	53-1/2	18-7/16	16-9/16	2.1	16.4	2.5	3.0	R35	–
6-0/5-0		71-1/2	59-1/2	18-7/16	18-15/16	2.4	18.5	2.5	3.0	R35	–
6-0/5-2		71-1/2	61-1/2	18-7/16	19-3/4	2.5	19.2	2.5	3.0	R35	–
6-0/5-6		71-1/2	65-1/2	18-7/16	21-3/8	2.7	20.7	2.5	3.0	R30	–
7-0/3-0		83-1/2	35-1/2	22-7/16	9-3/8	1.4	12.2	2.5	3.0	R35	–
7-0/3-2		83-1/2	37-1/2	22-7/16	10-3/16	1.5	13.1	2.5	3.0	R35	–
7-0/3-6		83-1/2	41-1/2	22-7/16	11-3/4	1.8	14.8	2.5	3.0	R35	–
7-0/3-10		83-1/2	45-1/2	22-7/16	13-3/8	2.0	16.6	2.5	3.0	R35	–
7-0/4-0		83-1/2	47-1/2	22-7/16	14-3/16	2.2	17.5	2.5	3.0	R35	–
7-0/4-3		83-1/2	51-1/2	22-7/16	15-3/4	2.4	19.3	2.5	3.0	R35	–
7-0/4-6		83-1/2	53-1/2	22-7/16	16-9/16	2.5	20.1	2.5	3.0	R35	–
7-0/5-0		83-1/2	59-1/2	22-7/16	18-15/16	2.9	22.8	2.5	3.0	R35	–
7-0/5-2		83-1/2	61-1/2	22-7/16	19-3/4	3.0	23.7	2.5	3.0	R35	–
7-0/5-6		83-1/2	65-1/2	22-7/16	21-3/8	3.3	25.5	2.5	3.0	R30	–
7-6/3-0		89-1/2	35-1/2	24-7/16	9-3/8	1.5	13.3	2.5	3.0	R35	–
7-6/3-2		89-1/2	37-1/2	24-7/16	10-3/16	1.7	14.3	2.5	3.0	R35	–
7-6/3-6		89-1/2	41-1/2	24-7/16	11-3/4	2.0	16.2	2.5	3.0	R35	–
7-6/3-10		89-1/2	45-1/2	24-7/16	13-3/8	2.2	18.2	2.5	3.0	R35	–
7-6/4-0		89-1/2	47-1/2	24-7/16	14-3/16	2.4	19.1	2.5	3.0	R35	–
7-6/4-3		89-1/2	51-1/2	24-7/16	15-3/4	2.6	21.1	2.5	3.0	R35	–
7-6/4-6		89-1/2	53-1/2	24-7/16	16-9/16	2.8	22.0	2.5	3.0	R35	–
7-6/5-0		89-1/2	59-1/2	24-7/16	18-15/16	3.2	24.9	2.5	3.0	R35	–
7-6/5-2		89-1/2	61-1/2	24-7/16	19-3/4	3.3	25.9	2.5	3.0	R35	–
7-6/5-6		89-1/2	65-1/2	24-7/16	21-3/8	3.6	27.9	2.5	3.0	R30	–
8-0/3-0		95-1/2	35-1/2	26-7/16	9-3/8	1.7	14.5	2.5	3.0	R35	–
8-0/3-2		95-1/2	37-1/2	26-7/16	10-3/16	1.8	15.5	2.5	3.0	R35	–
8-0/3-6		95-1/2	41-1/2	26-7/16	11-3/4	2.1	17.6	2.5	3.0	R35	–
8-0/3-10		95-1/2	45-1/2	26-7/16	13-3/8	2.4	19.7	2.5	3.0	R35	–
8-0/4-0		95-1/2	47-1/2	26-7/16	14-3/16	2.6	20.8	2.5	3.0	R35	–
8-0/4-3		95-1/2	51-1/2	26-7/16	15-3/4	2.9	22.9	2.5	3.0	R35	–
8-0/4-6		95-1/2	53-1/2	26-7/16	16-9/16	3.0	23.9	2.5	3.0	R35	–
8-0/5-0		95-1/2	59-1/2	26-7/16	18-15/16	3.4	27.1	2.5	3.0	R35	–
8-0/5-2		95-1/2	61-1/2	26-7/16	19-3/4	3.6	28.1	2.5	3.0	R35	–
8-0/5-6		95-1/2	65-1/2	26-7/16	21-3/8	3.9	30.2	2.5	3.0	R30	–
9-0/3-0		107-1/2	35-1/2	30-7/16	9-3/8	1.9	16.8	2.5	3.0	R35	–
9-0/3-2		107-1/2	37-1/2	30-7/16	10-3/16	2.1	18.0	2.5	3.0	R35	–
9-0/3-6		107-1/2	41-1/2	30-7/16	11-3/4	2.4	20.4	2.5	3.0	R35	–
9-0/3-10		107-1/2	45-1/2	30-7/16	13-3/8	2.8	22.9	2.5	3.0	R35	–
9-0/4-0		107-1/2	47-1/2	30-7/16	14-3/16	3.0	24.1	2.5	3.0	R35	–
9-0/4-3		107-1/2	51-1/2	30-7/16	15-3/4	3.3	26.5	2.5	3.0	R35	–
9-0/4-6		107-1/2	53-1/2	30-7/16	16-9/16	3.5	27.7	2.5	3.0	R35	–
9-0/5-0		107-1/2	59-1/2	30-7/16	18-15/16	4.0	31.4	2.5	3.0	R35	–
9-0/5-2		107-1/2	61-1/2	30-7/16	19-3/4	4.1	32.6	2.5	3.0	R35	–

(-) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.





DOUBLE-HUNG

## DESIGN DATA

### Contemporary Sash Single Vent Units



#### 1-WIDE VENT UNITS – CONTEMPORARY SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
2-0/3-0		23-1/2	35-1/2	18-7/16	9-1/4	1.1	3.3	2.5	3.0	R35	R50
2-0/3-2		23-1/2	37-1/2	18-7/16	10-1/16	1.2	3.5	2.5	3.0	R35	R50
2-0/3-6		23-1/2	41-1/2	18-7/16	11-11/16	1.4	4.0	2.5	3.0	R35	R50
2-0/3-10		23-1/2	45-1/2	18-7/16	13-1/4	1.7	4.5	2.5	3.0	R35	R50
2-0/4-0		23-1/2	47-1/2	18-7/16	14-1/16	1.8	4.7	2.5	3.0	R35	R50
2-0/4-4		23-1/2	51-1/2	18-7/16	15-11/16	2.0	5.2	2.5	3.0	R35	R50
2-0/4-6		23-1/2	53-1/2	18-7/16	16-7/16	2.1	5.5	2.5	3.0	R35	R50
2-0/5-0		23-1/2	59-1/2	18-7/16	18-7/8	2.4	6.2	2.5	3.0	R35	R50
2-0/5-2		23-1/2	61-1/2	18-7/16	19-11/16	2.5	6.4	2.5	3.0	R35	R50
2-0/5-6		23-1/2	65-1/2	18-7/16	21-1/4	2.7	6.9	2.5	3.0	R30	R50
2-4/3-0		27-1/2	35-1/2	22-7/16	9-1/4	1.4	4.1	2.5	3.0	R35	R50
2-4/3-2		27-1/2	37-1/2	22-7/16	10-1/16	1.5	4.4	2.5	3.0	R35	R50
2-4/3-6		27-1/2	41-1/2	22-7/16	11-11/16	1.8	4.9	2.5	3.0	R35	R50
2-4/3-10		27-1/2	45-1/2	22-7/16	13-1/4	2.0	5.5	2.5	3.0	R35	R50
2-4/4-0		27-1/2	47-1/2	22-7/16	14-1/16	2.1	5.8	2.5	3.0	R35	R50
2-4/4-4		27-1/2	51-1/2	22-7/16	15-11/16	2.4	6.4	2.5	3.0	R35	R50
2-4/4-6		27-1/2	53-1/2	22-7/16	16-7/16	2.5	6.7	2.5	3.0	R35	R50
2-4/5-0		27-1/2	59-1/2	22-7/16	18-7/8	2.9	7.6	2.5	3.0	R35	R50
2-4/5-2		27-1/2	61-1/2	22-7/16	19-11/16	3.0	7.9	2.5	3.0	R35	R50
2-4/5-6		27-1/2	65-1/2	22-7/16	21-1/4	3.3	8.5	2.5	3.0	R30	R50
2-6/3-0		29-1/2	35-1/2	24-7/16	9-1/4	1.5	4.4	2.5	3.0	R35	R50
2-6/3-2		29-1/2	37-1/2	24-7/16	10-1/16	1.7	4.8	2.5	3.0	R35	R50
2-6/3-6		29-1/2	41-1/2	24-7/16	11-11/16	1.9	5.4	2.5	3.0	R35	R50
2-6/3-10		29-1/2	45-1/2	24-7/16	13-1/4	2.2	6.1	2.5	3.0	R35	R50
2-6/4-0		29-1/2	47-1/2	24-7/16	14-1/16	2.3	6.4	2.5	3.0	R35	R50
2-6/4-4		29-1/2	51-1/2	24-7/16	15-11/16	2.6	7.0	2.5	3.0	R35	R50
2-6/4-6		29-1/2	53-1/2	24-7/16	16-7/16	2.7	7.3	2.5	3.0	R35	R50
2-6/5-0		29-1/2	59-1/2	24-7/16	18-7/8	3.2	8.3	2.5	3.0	R35	R50
2-6/5-2		29-1/2	61-1/2	24-7/16	19-11/16	3.3	8.6	2.5	3.0	R35	R50
2-6/5-6		29-1/2	65-1/2	24-7/16	21-1/4	3.6	9.3	2.5	3.0	R30	R50
2-8/3-0		31-1/2	35-1/2	26-7/16	9-1/4	1.7	4.8	2.5	3.0	R35	R50
2-8/3-2		31-1/2	37-1/2	26-7/16	10-1/16	1.8	5.2	2.5	3.0	R35	R50
2-8/3-6		31-1/2	41-1/2	26-7/16	11-11/16	2.1	5.9	2.5	3.0	R35	R50
2-8/3-10		31-1/2	45-1/2	26-7/16	13-1/4	2.4	6.6	2.5	3.0	R35	R50
2-8/4-0		31-1/2	47-1/2	26-7/16	14-1/16	2.5	6.9	2.5	3.0	R35	R50
2-8/4-4		31-1/2	51-1/2	26-7/16	15-11/16	2.8	7.6	2.5	3.0	R35	R50
2-8/4-6		31-1/2	53-1/2	26-7/16	16-7/16	3.0	8.0	2.5	3.0	R35	R50
2-8/5-0		31-1/2	59-1/2	26-7/16	18-7/8	3.4	9.0	2.5	3.0	R35	R50
2-8/5-2		31-1/2	61-1/2	26-7/16	19-11/16	3.6	9.4	2.5	3.0	R35	R50
2-8/5-6		31-1/2	65-1/2	26-7/16	21-1/4	3.9	10.1	2.5	3.0	R30	R50
3-0/3-0		35-1/2	35-1/2	30-7/16	9-1/4	1.9	5.6	2.5	3.0	R35	R50
3-0/3-2		35-1/2	37-1/2	30-7/16	10-1/16	2.1	6.0	2.5	3.0	R35	R50
3-0/3-6		35-1/2	41-1/2	30-7/16	11-11/16	2.4	6.8	2.5	3.0	R35	R50
3-0/3-10		35-1/2	45-1/2	30-7/16	13-1/4	2.8	7.6	2.5	3.0	R35	R50
3-0/4-0		35-1/2	47-1/2	30-7/16	14-1/16	2.9	8.0	2.5	3.0	R35	R50
3-0/4-4		35-1/2	51-1/2	30-7/16	15-11/16	3.3	8.8	2.5	3.0	R35	R50
3-0/4-6		35-1/2	53-1/2	30-7/16	16-7/16	3.4	9.2	2.5	3.0	R35	R50
3-0/5-0		35-1/2	59-1/2	30-7/16	18-7/8	3.9	10.5	2.5	3.0	R35	R50
3-0/5-2		35-1/2	61-1/2	30-7/16	19-11/16	4.1	10.9	2.5	3.0	R35	R50
3-0/5-6		35-1/2	65-1/2	30-7/16	21-1/4	4.5	11.7	2.5	3.0	R30	R50
3-2/3-0		37-1/2	35-1/2	32-7/16	9-1/4	2.0	6.0	2.5	3.0	R30	R50

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

**DESIGN DATA**  
Contemporary Sash  
Single Vent Units



**1-WIDE VENT UNITS – CONTEMPORARY SASH**

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
3-2/3-2		37-1/2	37-1/2	32-7/16	10-1/16	2.2	6.4	2.5	3.0	R30	R50
3-2/3-6		37-1/2	41-1/2	32-7/16	11-11/16	2.6	7.3	2.5	3.0	R30	R50
3-2/3-10		37-1/2	45-1/2	32-7/16	13-1/4	2.9	8.1	2.5	3.0	R30	R50
3-2/4-0		37-1/2	47-1/2	32-7/16	14-1/16	3.1	8.6	2.5	3.0	R30	R50
3-2/4-4		37-1/2	51-1/2	32-7/16	15-11/16	3.5	9.4	2.5	3.0	R30	R50
3-2/4-6		37-1/2	53-1/2	32-7/16	16-7/16	3.7	9.9	2.5	3.0	R30	R50
3-2/5-0		37-1/2	59-1/2	32-7/16	18-7/8	4.2	11.2	2.5	3.0	R30	R50
3-2/5-2		37-1/2	61-1/2	32-7/16	19-11/16	4.4	11.6	2.5	3.0	R30	R50
3-2/5-6		37-1/2	65-1/2	32-7/16	21-1/4	4.7	12.5	2.5	3.0	R30	R50
3-6/3-0		41-1/2	35-1/2	36-7/16	9-1/4	2.3	6.7	2.5	3.0	R30	R50
3-6/3-2		41-1/2	37-1/2	36-7/16	10-1/16	2.5	7.2	2.5	3.0	R30	R50
3-6/3-6		41-1/2	41-1/2	36-7/16	11-11/16	2.9	8.2	2.5	3.0	R30	R50
3-6/3-10		41-1/2	45-1/2	36-7/16	13-1/4	3.3	9.2	2.5	3.0	R30	R50
3-6/4-0		41-1/2	47-1/2	36-7/16	14-1/16	3.5	9.7	2.5	3.0	R30	R50
3-6/4-4		41-1/2	51-1/2	36-7/16	15-11/16	3.9	10.6	2.5	3.0	R30	R50
3-6/4-6		41-1/2	53-1/2	36-7/16	16-7/16	4.1	11.1	2.5	3.0	R30	R50
3-6/5-0		41-1/2	59-1/2	36-7/16	18-7/8	4.7	12.6	2.5	3.0	R30	R50
3-6/5-2		41-1/2	61-1/2	36-7/16	19-11/16	4.9	13.1	2.5	3.0	R30	R50
3-6/5-6		41-1/2	65-1/2	36-7/16	21-1/4	5.3	14.1	2.5	3.0	R20	R50
4-0/3-0		47-1/2	35-1/2	42-7/16	9-1/4	2.7	7.9	2.5	3.0	R30	R50
4-0/3-2		47-1/2	37-1/2	42-7/16	10-1/16	2.9	8.5	2.5	3.0	R30	R50
4-0/3-6		47-1/2	41-1/2	42-7/16	11-11/16	3.4	9.6	2.5	3.0	R30	R50
4-0/3-10		47-1/2	45-1/2	42-7/16	13-1/4	3.9	10.7	2.5	3.0	R30	R50
4-0/4-0		47-1/2	47-1/2	42-7/16	14-1/16	4.1	11.3	2.5	3.0	R30	R50
4-0/4-4		47-1/2	51-1/2	42-7/16	15-11/16	4.6	12.5	2.5	3.0	R30	R50
4-0/4-6		47-1/2	53-1/2	42-7/16	16-7/16	4.8	13.0	2.5	3.0	R30	R50
4-0/5-0		47-1/2	59-1/2	42-7/16	18-7/8	5.5	14.8	2.5	3.0	R30	R50
4-0/5-2		47-1/2	61-1/2	42-7/16	19-11/16	5.8	15.3	2.5	3.0	R30	R50
4-0/5-6		47-1/2	65-1/2	42-7/16	21-1/4	6.2	16.5	2.5	3.0	R20	R50
4-6/3-0		53-1/2	35-1/2	48-7/16	9-1/4	3.1	9.0	2.5	3.0	R20	–
4-6/3-2		53-1/2	37-1/2	48-7/16	10-1/16	3.3	9.7	2.5	3.0	R20	–
4-6/3-6		53-1/2	41-1/2	48-7/16	11-11/16	3.9	11.0	2.5	3.0	R20	–
4-6/3-10		53-1/2	45-1/2	48-7/16	13-1/4	4.4	12.3	2.5	3.0	R20	–
4-6/4-0		53-1/2	47-1/2	48-7/16	14-1/16	4.7	13.0	2.5	3.0	R20	–
4-6/4-4		53-1/2	51-1/2	48-7/16	15-11/16	5.2	14.3	2.5	3.0	R20	–
4-6/4-6		53-1/2	53-1/2	48-7/16	16-7/16	5.5	14.9	2.5	3.0	R20	–
4-6/5-0		53-1/2	59-1/2	48-7/16	18-7/8	6.3	16.9	2.5	3.0	R20	–
4-6/5-2		53-1/2	61-1/2	48-7/16	19-11/16	6.6	17.6	2.5	3.0	R20	–
4-6/5-6		53-1/2	65-1/2	48-7/16	21-1/4	7.1	18.9	2.5	3.0	R20	–

(–) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

## DESIGN DATA

### Contemporary Sash 2-Wide Vent Units



#### 2-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – CONTEMPORARY SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
4-0/3-0		47-1/2	35-1/2	18-7/16	9-1/4	1.1	6.6	2.5	3.0	R35	R50
4-0/3-2		47-1/2	37-1/2	18-7/16	10-1/16	1.2	16.9	2.5	3.0	R35	R50
4-0/3-6		47-1/2	41-1/2	18-7/16	11-11/16	1.4	19.2	2.5	3.0	R35	R50
4-0/3-10		47-1/2	45-1/2	18-7/16	13-1/4	1.7	21.5	2.5	3.0	R35	R50
4-0/4-0		47-1/2	47-1/2	18-7/16	14-1/16	1.8	22.6	2.5	3.0	R35	R50
4-0/4-4		47-1/2	51-1/2	18-7/16	15-11/16	2.0	24.9	2.5	3.0	R35	R50
4-0/4-6		47-1/2	53-1/2	18-7/16	16-7/16	2.1	26.1	2.5	3.0	R35	R50
4-0/5-0		47-1/2	59-1/2	18-7/16	18-7/8	2.4	29.5	2.5	3.0	R35	R50
4-0/5-2		47-1/2	61-1/2	18-7/16	19-11/16	2.5	30.7	2.5	3.0	R35	R50
4-0/5-6		47-1/2	65-1/2	18-7/16	21-1/4	2.7	32.9	2.5	3.0	R30	R50
4-8/3-0		55-1/2	35-1/2	22-7/16	9-1/4	1.4	18.8	2.5	3.0	R35	R50
4-8/3-2		55-1/2	37-1/2	22-7/16	10-1/16	1.5	20.2	2.5	3.0	R35	R50
4-8/3-6		55-1/2	41-1/2	22-7/16	11-11/16	1.8	22.9	2.5	3.0	R35	R50
4-8/3-10		55-1/2	45-1/2	22-7/16	13-1/4	2.0	25.7	2.5	3.0	R35	R50
4-8/4-0		55-1/2	47-1/2	22-7/16	14-1/16	2.1	27.0	2.5	3.0	R35	R50
4-8/4-4		55-1/2	51-1/2	22-7/16	15-11/16	2.4	29.8	2.5	3.0	R35	R50
4-8/4-6		55-1/2	53-1/2	22-7/16	16-7/16	2.5	31.1	2.5	3.0	R35	R50
4-8/5-0		55-1/2	59-1/2	22-7/16	18-7/8	2.9	35.2	2.5	3.0	R35	R50
4-8/5-2		55-1/2	61-1/2	22-7/16	19-11/16	3.0	36.6	2.5	3.0	R35	R50
4-8/5-6		55-1/2	65-1/2	22-7/16	21-1/4	3.3	39.3	2.5	3.0	R30	R50
5-0/3-0		59-1/2	35-1/2	24-7/16	9-1/4	1.5	20.3	2.5	3.0	R35	R50
5-0/3-2		59-1/2	37-1/2	24-7/16	10-1/16	1.7	21.8	2.5	3.0	R35	R50
5-0/3-6		59-1/2	41-1/2	24-7/16	11-11/16	1.9	24.8	2.5	3.0	R35	R50
5-0/3-10		59-1/2	45-1/2	24-7/16	13-1/4	2.2	27.7	2.5	3.0	R35	R50
5-0/4-0		59-1/2	47-1/2	24-7/16	14-1/16	2.3	29.2	2.5	3.0	R35	R50
4-1/4-4		59-1/2	51-1/2	24-7/16	15-11/16	2.6	32.2	2.5	3.0	R35	R50
5-0/4-6		59-1/2	53-1/2	24-7/16	16-7/16	2.7	33.7	2.5	3.0	R35	R50
5-0/5-0		59-1/2	59-1/2	24-7/16	18-7/8	3.2	38.1	2.5	3.0	R35	R50
5-0/5-2		59-1/2	61-1/2	24-7/16	19-11/16	3.3	39.6	2.5	3.0	R35	R50
5-0/5-6		59-1/2	65-1/2	24-7/16	21-1/4	3.6	42.5	2.5	3.0	R30	R50
5-4/3-0		63-1/2	35-1/2	26-7/16	9-1/4	1.7	21.9	2.5	3.0	R35	R50
5-4/3-2		63-1/2	37-1/2	26-7/16	10-1/16	1.8	23.5	2.5	3.0	R35	R50
5-4/3-6		63-1/2	41-1/2	26-7/16	11-11/16	2.1	26.6	2.5	3.0	R35	R50
5-4/3-10		63-1/2	45-1/2	26-7/16	13-1/4	2.4	29.8	2.5	3.0	R35	R50
5-4/4-0		63-1/2	47-1/2	26-7/16	14-1/16	2.5	31.4	2.5	3.0	R35	R50
5-4/4-4		63-1/2	51-1/2	26-7/16	15-11/16	2.8	34.6	2.5	3.0	R35	R50
5-4/4-6		63-1/2	53-1/2	26-7/16	16-7/16	3.0	36.2	2.5	3.0	R35	R50
5-4/5-0		63-1/2	59-1/2	26-7/16	18-7/8	3.4	40.9	2.5	3.0	R35	R50
5-4/5-2		63-1/2	61-1/2	26-7/16	19-11/16	3.6	42.5	2.5	3.0	R35	R50
5-4/5-6		63-1/2	65-1/2	26-7/16	21-1/4	3.9	45.7	2.5	3.0	R30	R50
6-0/3-0		71-1/2	35-1/2	30-7/16	9-1/4	1.9	24.9	2.5	3.0	R35	R50
6-0/3-2		71-1/2	37-1/2	30-7/16	10-1/16	2.1	26.7	2.5	3.0	R35	R50
6-0/3-6		71-1/2	41-1/2	30-7/16	11-11/16	2.4	30.4	2.5	3.0	R35	R50
6-0/3-10		71-1/2	45-1/2	30-7/16	13-1/4	2.8	34.0	2.5	3.0	R35	R50
6-0/4-0		71-1/2	47-1/2	30-7/16	14-1/16	2.9	35.8	2.5	3.0	R35	R50
6-0/4-4		71-1/2	51-1/2	30-7/16	15-11/16	3.3	39.4	2.5	3.0	R35	R50
6-0/4-6		71-1/2	53-1/2	30-7/16	16-7/16	3.4	41.2	2.5	3.0	R35	R50
6-0/5-0		71-1/2	59-1/2	30-7/16	18-7/8	3.9	46.7	2.5	3.0	R35	R50
6-0/5-2		71-1/2	61-1/2	30-7/16	19-11/16	4.1	48.5	2.5	3.0	R35	R50
6-0/5-6		71-1/2	65-1/2	30-7/16	21-1/4	4.5	52.1	2.5	3.0	R30	R50

(-) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

## DESIGN DATA

### Contemporary Sash 2-Wide Vent Units



#### 2-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – CONTEMPORARY SASH

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft <sup>2</sup>	Glass Thickness (mm)		Performance Class & Grade <sup>(1)</sup>	
		Width	Height	Width	Height	Ft <sup>2</sup>		Annealed	Tempered	Standard	Upgrade
6-4/3-0		75-1/2	35-1/2	32-7/16	9-1/4	2.0	26.4	2.5	3.0	R30	–
6-4/3-2		75-1/2	37-1/2	32-7/16	10-1/16	2.2	28.4	2.5	3.0	R30	–
6-4/3-6		75-1/2	41-1/2	32-7/16	11-11/16	2.6	32.2	2.5	3.0	R30	–
6-4/3-10		75-1/2	45-1/2	32-7/16	13-1/4	2.9	36.1	2.5	3.0	R30	–
6-4/4-0		75-1/2	47-1/2	32-7/16	14-1/16	3.1	38.0	2.5	3.0	R30	–
6-4/4-4		75-1/2	51-1/2	32-7/16	15-11/16	3.5	41.8	2.5	3.0	R30	–
6-4/4-6		75-1/2	53-1/2	32-7/16	16-7/16	3.7	43.8	2.5	3.0	R30	–
6-4/5-0		75-1/2	59-1/2	32-7/16	18-7/8	4.2	49.5	2.5	3.0	R30	–
6-4/5-2		75-1/2	61-1/2	32-7/16	19-11/16	4.4	51.5	2.5	3.0	R30	–
6-4/5-6		75-1/2	65-1/2	32-7/16	21-1/4	4.7	55.3	2.5	3.0	R20	–
7-0/3-0		83-1/2	35-1/2	42-7/16	9-1/4	2.3	29.5	2.5	3.0	R30	–
7-0/3-2		83-1/2	37-1/2	42-7/16	10-1/16	2.5	31.7	2.5	3.0	R30	–
7-0/3-6		83-1/2	41-1/2	42-7/16	11-11/16	2.9	35.9	2.5	3.0	R30	–
7-0/3-10		83-1/2	45-1/2	42-7/16	13-1/4	3.3	40.2	2.5	3.0	R30	–
7-0/4-0		83-1/2	47-1/2	42-7/16	14-1/16	3.5	42.4	2.5	3.0	R30	–
7-0/4-4		83-1/2	51-1/2	42-7/16	15-11/16	3.9	46.7	2.5	3.0	R30	–
7-0/4-6		83-1/2	53-1/2	42-7/16	16-7/16	4.1	48.8	2.5	3.0	R30	–
7-0/5-0		83-1/2	59-1/2	42-7/16	18-7/8	4.7	55.3	2.5	3.0	R30	–
7-0/5-2		83-1/2	61-1/2	42-7/16	19-11/16	4.9	57.4	2.5	3.0	R30	–
7-0/5-6		83-1/2	65-1/2	42-7/16	21-1/4	5.3	61.7	2.5	3.0	R20	–
8-0/3-0		95-1/2	35-1/2	48-7/16	9-1/4	2.7	34.1	2.5	3.0	R30	–
8-0/3-2		95-1/2	37-1/2	48-7/16	10-1/16	2.9	36.6	2.5	3.0	R30	–
8-0/3-6		95-1/2	41-1/2	48-7/16	11-11/16	3.4	41.5	2.5	3.0	R30	–
8-0/3-10		95-1/2	45-1/2	48-7/16	13-1/4	3.9	46.5	2.5	3.0	R30	–
8-0/4-0		95-1/2	47-1/2	48-7/16	14-1/16	4.1	49.0	2.5	3.0	R30	–
8-0/4-4		95-1/2	51-1/2	48-7/16	15-11/16	4.6	53.9	2.5	3.0	R30	–
8-0/4-6		95-1/2	53-1/2	48-7/16	16-7/16	4.8	56.4	2.5	3.0	R30	–
8-0/5-0		95-1/2	59-1/2	48-7/16	18-7/8	5.5	63.8	2.5	3.0	R30	–
8-0/5-2		95-1/2	61-1/2	48-7/16	19-11/16	5.8	66.3	2.5	3.0	R30	–
8-0/5-6		95-1/2	65-1/2	48-7/16	21-1/4	6.2	71.3	2.5	3.0	R20	–
4-0/3-0		95-1/2	35-1/2	48-7/16	9-1/4	2.7	34.1	2.5	3.0	R30	–
4-0/3-2		95-1/2	37-1/2	48-7/16	10-1/16	2.9	36.6	2.5	3.0	R30	–
4-0/3-6		95-1/2	41-1/2	48-7/16	11-11/16	3.4	41.5	2.5	3.0	R30	–
4-0/3-10		95-1/2	45-1/2	48-7/16	13-1/4	3.9	46.5	2.5	3.0	R30	–
4-0/4-0		95-1/2	47-1/2	48-7/16	14-1/16	4.1	49.0	2.5	3.0	R30	–
4-0/4-4		95-1/2	51-1/2	48-7/16	15-11/16	4.6	53.9	2.5	3.0	R30	–
4-0/4-6		95-1/2	53-1/2	48-7/16	16-7/16	4.8	56.4	2.5	3.0	R30	–
4-0/5-0		95-1/2	59-1/2	48-7/16	18-7/8	5.5	63.8	2.5	3.0	R30	–
4-0/5-2		95-1/2	61-1/2	48-7/16	19-11/16	5.8	66.3	2.5	3.0	R30	–
4-0/5-6		95-1/2	65-1/2	48-7/16	21-1/4	6.2	71.3	2.5	3.0	R20	–

(–) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

**DESIGN DATA**  
 Contemporary Sash  
 3-Wide Vent Units



**3-WIDE VENT UNIT COMPOSITES WITH INTEGRAL MULLION – CONTEMPORARY SASH**

Unit	Egress	Frame (Inches)		Clear Opening (Vent Units Only) (Inches)			Visible Glass Ft²	Glass Thickness (mm)		Performance Class & Grade <sup>1</sup>	
		Width	Height	Width	Height	Ft²		Annealed	Tempered	Standard	Upgrade
6-0/3-0		71-1/2	35-1/2	18-7/16	9-1/4	1.1	9.9	2.5	3.0	R35	–
6-0/3-2		71-1/2	37-1/2	18-7/16	10-1/16	1.2	10.6	2.5	3.0	R35	–
6-0/3-6		71-1/2	41-1/2	18-7/16	11-11/16	1.4	12.0	2.5	3.0	R35	–
6-0/3-10		71-1/2	45-1/2	18-7/16	13-1/4	1.7	13.5	2.5	3.0	R35	–
6-0/4-0		71-1/2	47-1/2	18-7/16	14-1/16	1.8	14.2	2.5	3.0	R35	–
6-0/4-3		71-1/2	51-1/2	18-7/16	15-11/16	2.0	15.6	2.5	3.0	R35	–
6-0/4-6		71-1/2	53-1/2	18-7/16	16-7/16	2.1	16.4	2.5	3.0	R35	–
6-0/5-0		71-1/2	59-1/2	18-7/16	18-7/8	2.4	18.5	2.5	3.0	R35	–
6-0/5-2		71-1/2	61-1/2	18-7/16	19-11/16	2.5	19.2	2.5	3.0	R35	–
6-0/5-6		71-1/2	65-1/2	18-7/16	21-1/4	2.7	20.7	2.5	3.0	R30	–
7-0/3-0		83-1/2	35-1/2	22-7/16	9-1/4	1.4	12.2	2.5	3.0	R35	–
7-0/3-2		83-1/2	37-1/2	22-7/16	10-1/16	1.5	13.1	2.5	3.0	R35	–
7-0/3-6		83-1/2	41-1/2	22-7/16	11-11/16	1.8	14.8	2.5	3.0	R35	–
7-0/3-10		83-1/2	45-1/2	22-7/16	13-1/4	2.0	16.6	2.5	3.0	R35	–
7-0/4-0		83-1/2	47-1/2	22-7/16	14-1/16	2.1	17.5	2.5	3.0	R35	–
7-0/4-3		83-1/2	51-1/2	22-7/16	15-11/16	2.4	19.3	2.5	3.0	R35	–
7-0/4-6		83-1/2	53-1/2	22-7/16	16-7/16	2.5	20.1	2.5	3.0	R35	–
7-0/5-0		83-1/2	59-1/2	22-7/16	18-7/8	2.9	22.8	2.5	3.0	R35	–
7-0/5-2		83-1/2	61-1/2	22-7/16	19-11/16	3.0	23.7	2.5	3.0	R35	–
7-0/5-6		83-1/2	65-1/2	22-7/16	21-1/4	3.3	25.5	2.5	3.0	R30	–
7-6/3-0		89-1/2	35-1/2	24-7/16	9-1/4	1.5	13.3	2.5	3.0	R35	-
7-6/3-2		89-1/2	37-1/2	24-7/16	10-1/16	1.7	14.3	2.5	3.0	R35	-
7-6/3-6		89-1/2	41-1/2	24-7/16	11-11/16	1.9	16.2	2.5	3.0	R35	-
7-6/3-10		89-1/2	45-1/2	24-7/16	13-1/4	2.2	18.2	2.5	3.0	R35	-
7-6/4-0		89-1/2	47-1/2	24-7/16	14-1/16	2.3	19.1	2.5	3.0	R35	-
7-6/4-3		89-1/2	51-1/2	24-7/16	15-11/16	2.6	21.1	2.5	3.0	R35	-
7-6/4-6		89-1/2	53-1/2	24-7/16	16-7/16	2.7	22.0	2.5	3.0	R35	-
7-6/5-0		89-1/2	59-1/2	24-7/16	18-7/8	3.2	24.9	2.5	3.0	R35	-
7-6/5-2		89-1/2	61-1/2	24-7/16	19-11/16	3.3	25.9	2.5	3.0	R35	-
7-6/5-6		89-1/2	65-1/2	24-7/16	21-1/4	3.6	27.9	2.5	3.0	R30	-
8-0/3-0		95-1/2	35-1/2	26-7/16	9-1/4	1.7	14.5	2.5	3.0	R35	–
8-0/3-2		95-1/2	37-1/2	26-7/16	10-1/16	1.8	15.5	2.5	3.0	R35	–
8-0/3-6		95-1/2	41-1/2	26-7/16	11-11/16	2.1	17.6	2.5	3.0	R35	–
8-0/3-10		95-1/2	45-1/2	26-7/16	13-1/4	2.4	19.7	2.5	3.0	R35	–
8-0/4-0		95-1/2	47-1/2	26-7/16	14-1/16	2.5	20.8	2.5	3.0	R35	–
8-0/4-3		95-1/2	51-1/2	26-7/16	15-11/16	2.8	22.9	2.5	3.0	R35	–
8-0/4-6		95-1/2	53-1/2	26-7/16	16-7/16	3.0	23.9	2.5	3.0	R35	–
8-0/5-0		95-1/2	59-1/2	26-7/16	18-7/8	3.4	27.1	2.5	3.0	R35	–
8-0/5-2		95-1/2	61-1/2	26-7/16	19-11/16	3.6	28.1	2.5	3.0	R35	–
8-0/5-6		95-1/2	65-1/2	26-7/16	21-1/4	3.9	30.2	2.5	3.0	R30	–
9-0/3-0		107-1/2	35-1/2	30-7/16	9-1/4	1.9	16.8	2.5	3.0	R35	–
9-0/3-2		107-1/2	37-1/2	30-7/16	10-1/16	2.1	18.0	2.5	3.0	R35	–
9-0/3-6		107-1/2	41-1/2	30-7/16	11-11/16	2.4	20.4	2.5	3.0	R35	–
9-0/3-10		107-1/2	45-1/2	30-7/16	13-1/4	2.8	22.9	2.5	3.0	R35	–
9-0/4-0		107-1/2	47-1/2	30-7/16	14-1/16	2.9	24.1	2.5	3.0	R35	–
9-0/4-3		107-1/2	51-1/2	30-7/16	15-11/16	3.3	26.5	2.5	3.0	R35	–
9-0/4-6		107-1/2	53-1/2	30-7/16	16-7/16	3.4	27.7	2.5	3.0	R35	–
9-0/5-0		107-1/2	59-1/2	30-7/16	18-7/8	3.9	31.4	2.5	3.0	R35	–
9-0/5-2		107-1/2	61-1/2	30-7/16	19-11/16	4.1	32.6	2.5	3.0	R35	–

**Egress Notes:**

Check all applicable local codes for emergency egress requirements.

E1 = Window meets minimum clear opening of 24" height, 20" width, and 5.0 ft².  
 To convert areas to square meters (m²), multiply square feet by 0.0929.

(–) = Not Available

(1) Maximum performance when glazed with the appropriate glass thickness.



DOUBLE-HUNG

## DETAILED PRODUCT DESCRIPTIONS



## FRAME

- Overall frame depth: 3-1/4" on all frame types.
- Frame members are mitered and heat fused to provide a fully welded corner assembly. Sill is fitted with weeps.
- Frame: [1-1/8" setback nail fin for 2-1/8" wall depth] [Block frame for 3-1/4" wall depth] [Integral 5/8" flange for 3" wall depth].
- Interior and exterior frame surfaces are extruded ridged PVC.

## SASH

- Sash members are extruded, rigid PVC [with optional foam insulation<sup>1</sup>].
- Sash members are mitered and heat-fused to provide a fully welded corner assembly.
- Includes an integral extruded sash lift as standard.
- Contains sealed insulating glass.

## WEATHERSTRIPPING

- Sash is weatherstripped around the sash perimeter with a fin-type, pile weatherstripping and vinyl wrapped foam weatherstrip.

## GLAZING SYSTEM

- Quality float glass complying with ASTM C 1036.
- Exterior face-glazed sealed insulating glass.
- [11/16"] [1"] Dual-Pane [[annealed] [tempered]] [[Advanced] [NaturalSun] [SunDefense™] [Bronze, Advanced] Low-E coated [, with Argon]] [Obscure<sup>3</sup>] [High Altitude<sup>2</sup>].
- or-
- 1" Triple-Pane [[annealed] [tempered]] [[Advanced] [NaturalSun] Low-E coated [with Argon]] [Obscure<sup>3</sup>] [High Altitude<sup>2</sup>].

## INTERIOR / EXTERIOR

- All window frame members have an integral color extruded throughout the profiles.
- All exposed PVC surfaces are smooth, glossy and uniform in appearance.
- Standard finishes are [White] [Almond].

## HARDWARE

- Constant force balances connected to sash with spring steel and concealed within the frame.
- Upper and lower sashes are fully operable for ventilation.
- All fasteners are corrosion-resistant material compatible with PVC.
- Locks are factory-installed, zinc die cast, self-aligning, [cam action locks] [AutoLock] located on the check rail. Two sash locks are installed on units with 29-1/2" or greater frame width.
- Tilt latches are factory installed, [zinc die cast] [PVC] and are located on the check rail of the lower sash and the top rail of the upper sash.
- Hardware finish is [White] [Almond].

## SCREENS

- [Full-size] [Half-screen] Set in aluminum frame and fitted to exterior of window.
- Screen frame finish is baked enamel, color to match exterior
- Screens for windows with frame width >39" or frame height > 53-1/2" have a screen spreader bar.
- Conventional Black Fiberglass
  - Black vinyl coated 18/16 mesh fiberglass screen cloth complying with ASTM D 3656 and SMA 1201.

## OPTIONAL PRODUCTS

## Grilles

- Grilles-Between-the-Glass
  - [Dual-Pane Insulating glass contains [[3/4"] [1"] contoured] [5/8" flat] aluminum grilles permanently installed between two panes of glass] [Triple-Pane Insulating glass contains 3/4" contoured aluminum grilles permanently installed between three panes of glass].
  - Patterns are [Traditional] [6-Lite Prairie] [9-Lite Prairie] [Top Row].
  - Grilles match color of interior and exterior frame.
- Simulated-Divided-Light grilles without spacer
  - 7/8" grilles permanently bonded to the interior and exterior of glass.
  - Patterns are [Traditional] [6-Lite Prairie] [9-Lite Prairie] [Top Row].
  - Grilles match color of interior and exterior frame
  - Available only on units glazed with dual-pane insulated glass.

## Hardware

- Optional limited opening hardware available for vent units in [White] [Almond] extruded vinyl to match the unit; nominal 3-3/4" opening.
- Optional window opening control device available for factory or field installation. Device allows window to open less than 4" with normal operation, with a release mechanism that allows the sash to open completely. Complies with ASTM F2090-10.

(1) Not available with performance upgrade.

(2) Dual-Pane IG High Altitude glazings are available with or without Argon. Triple-Pane IG High Altitude glazings are only available without Argon.

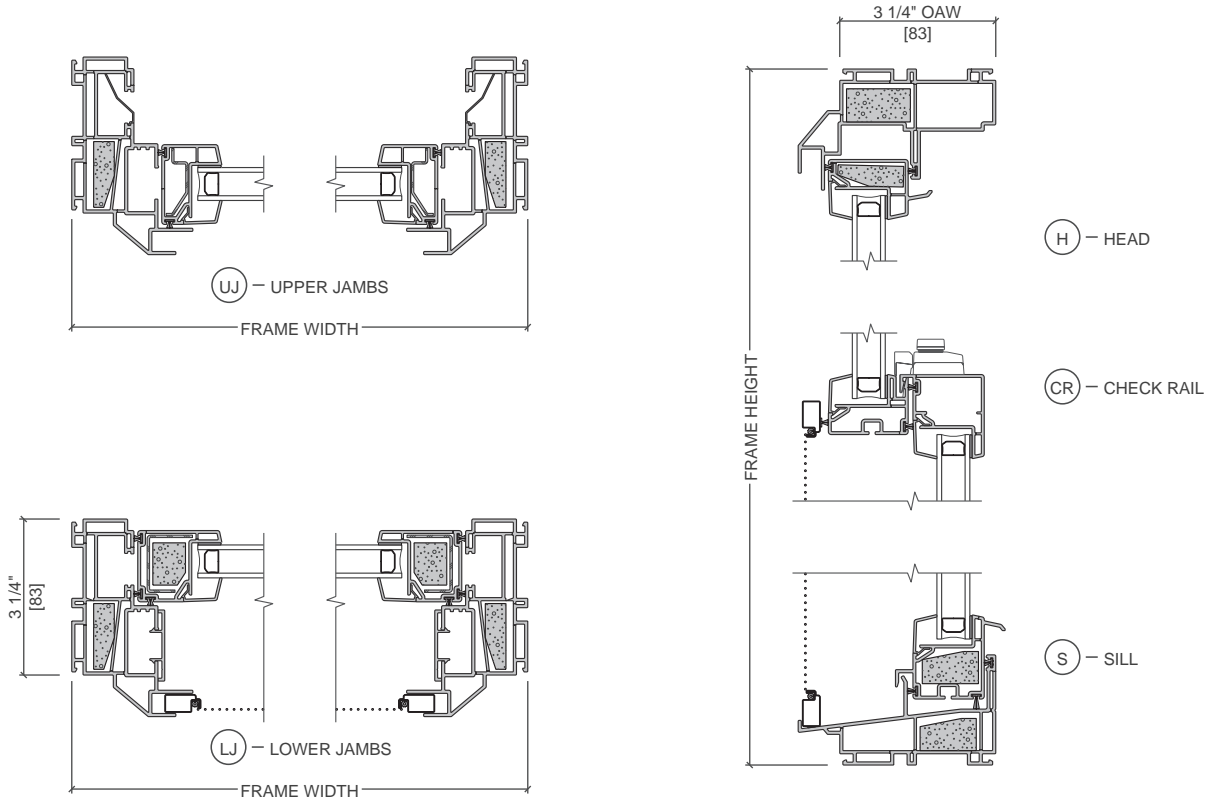
(3) Obscure glass not available with Bronze Advanced Low-E.



DOUBLE-HUNG

### UNIT SECTIONS

Optional Foam Insulation



Scale 3" = 1' 0"  
All dimensions are approximate.



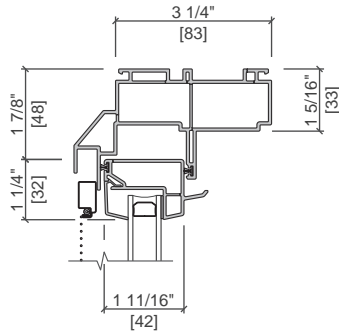
DOUBLE-HUNG

## UNIT SECTIONS

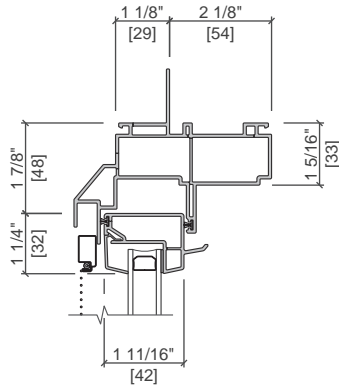
### Installation Types



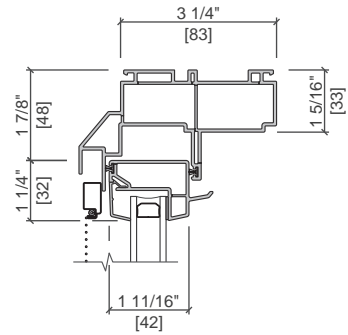
BLOCK FRAME



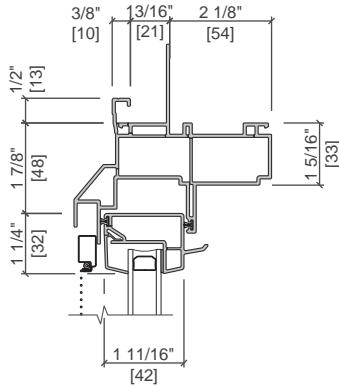
STANDARD NAIL FIN



3/4" IG

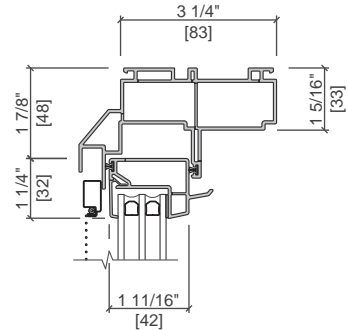


NAIL FIN with J-CHANNEL

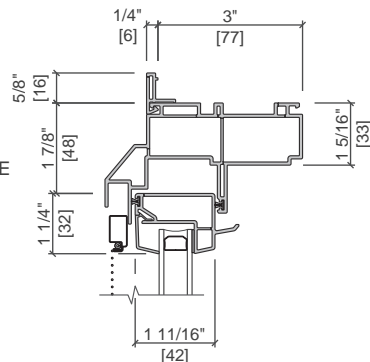


### Additional Glazing Options

1" TRIPLE PANE IG



BLOCK FRAME with 5/8" INTEGRAL FLANGE



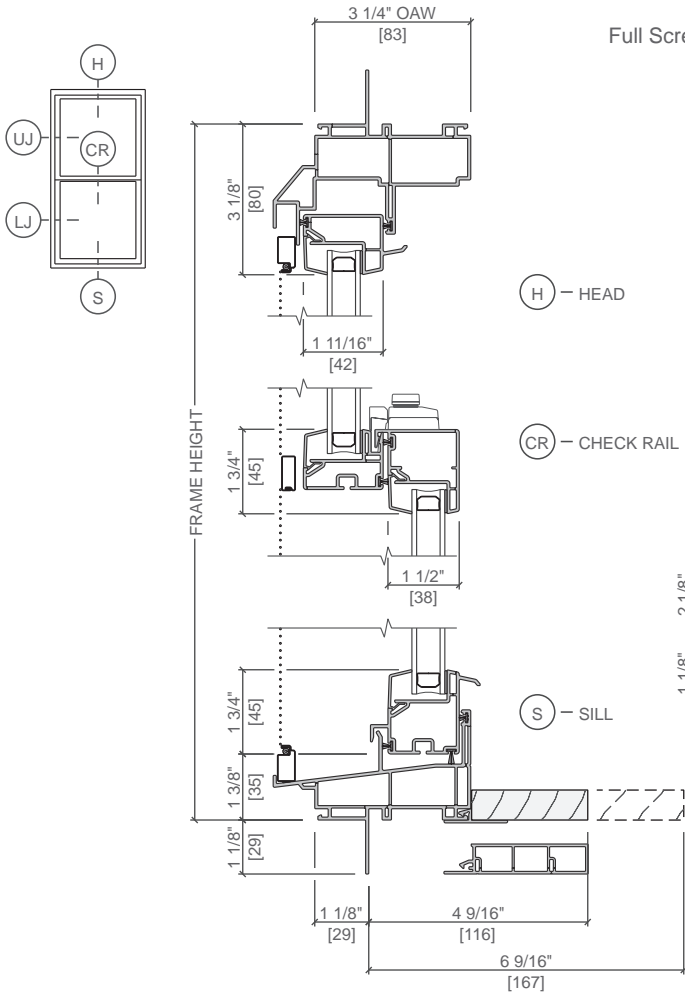
Scale 3" = 1' 0"  
All dimensions are approximate.



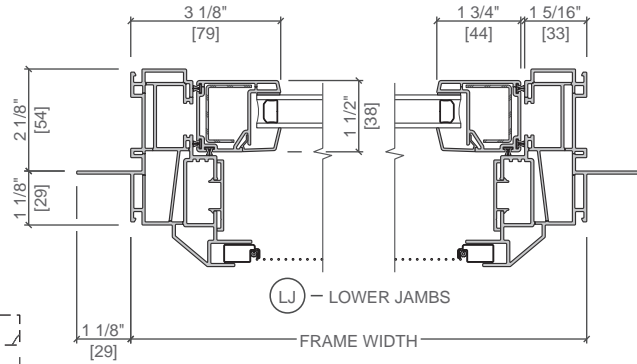
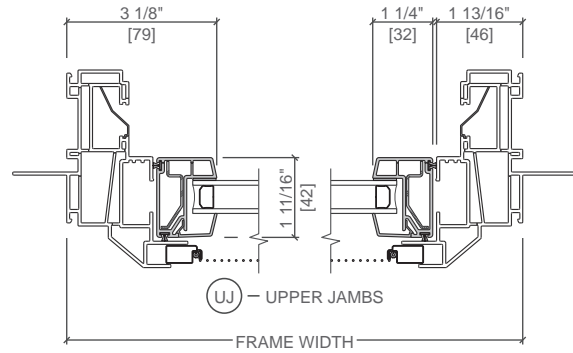


DOUBLE-HUNG

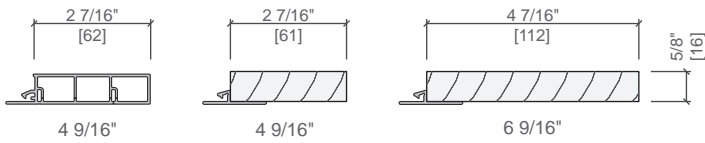
UNIT SECTIONS  
Standard Nail Fin



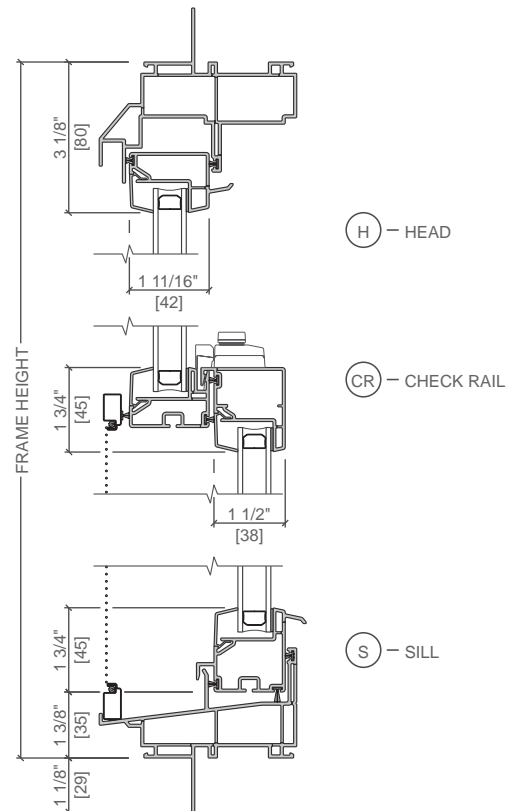
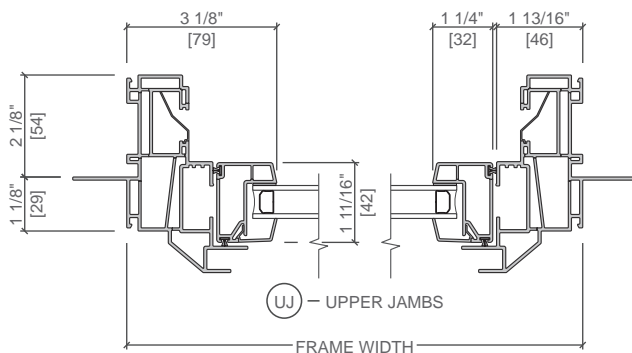
Full Screen



Optional Factory Applied Jamb Extensions



Half Screen



Scale 3" = 1' 0"  
All dimensions are approximate.

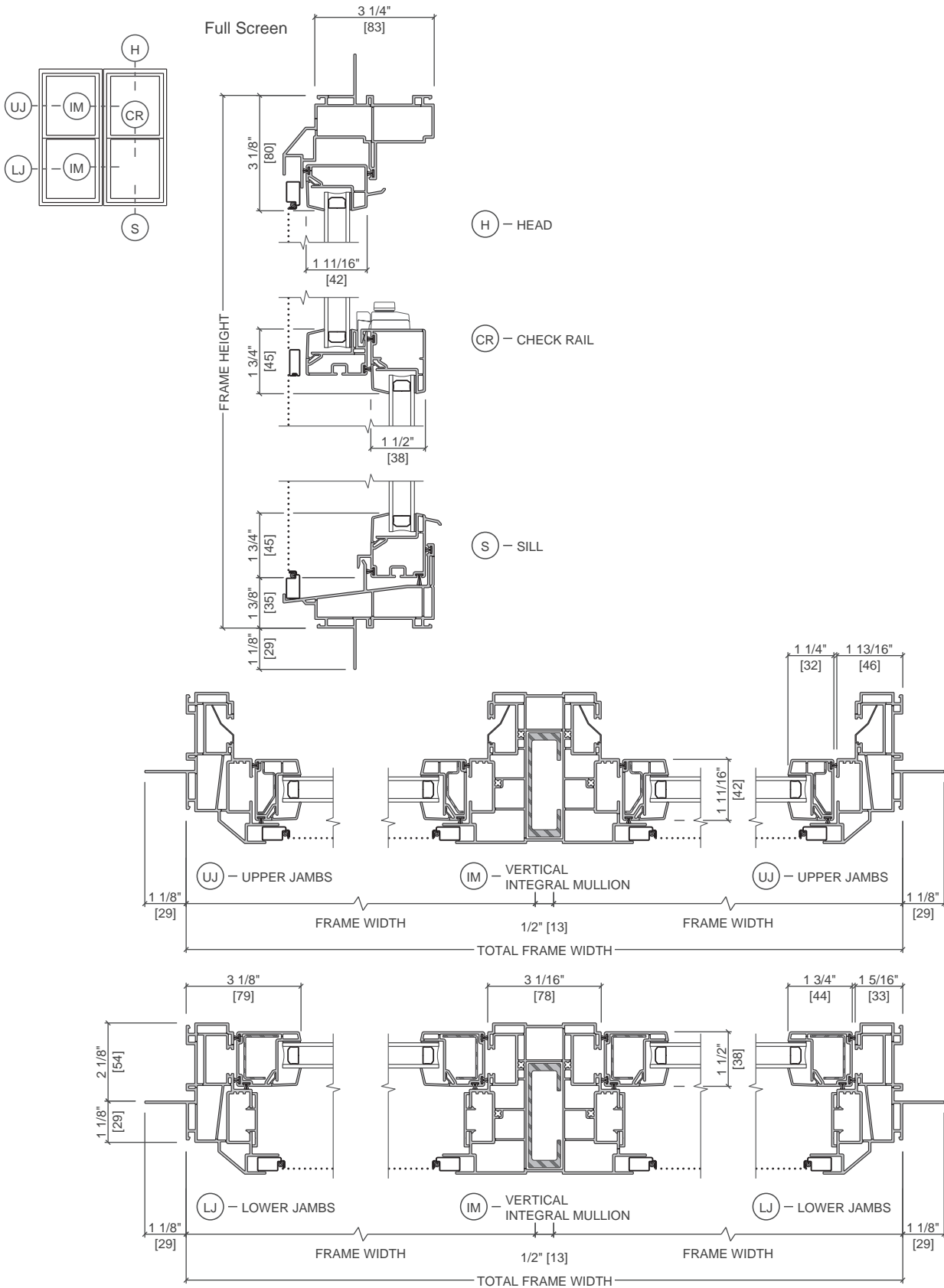


DOUBLE-HUNG

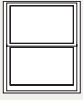
UNIT SECTIONS

Standard Nail Fin

Composite with Integral Mullion



Scale 3" = 1' 0"  
All dimensions are approximate.

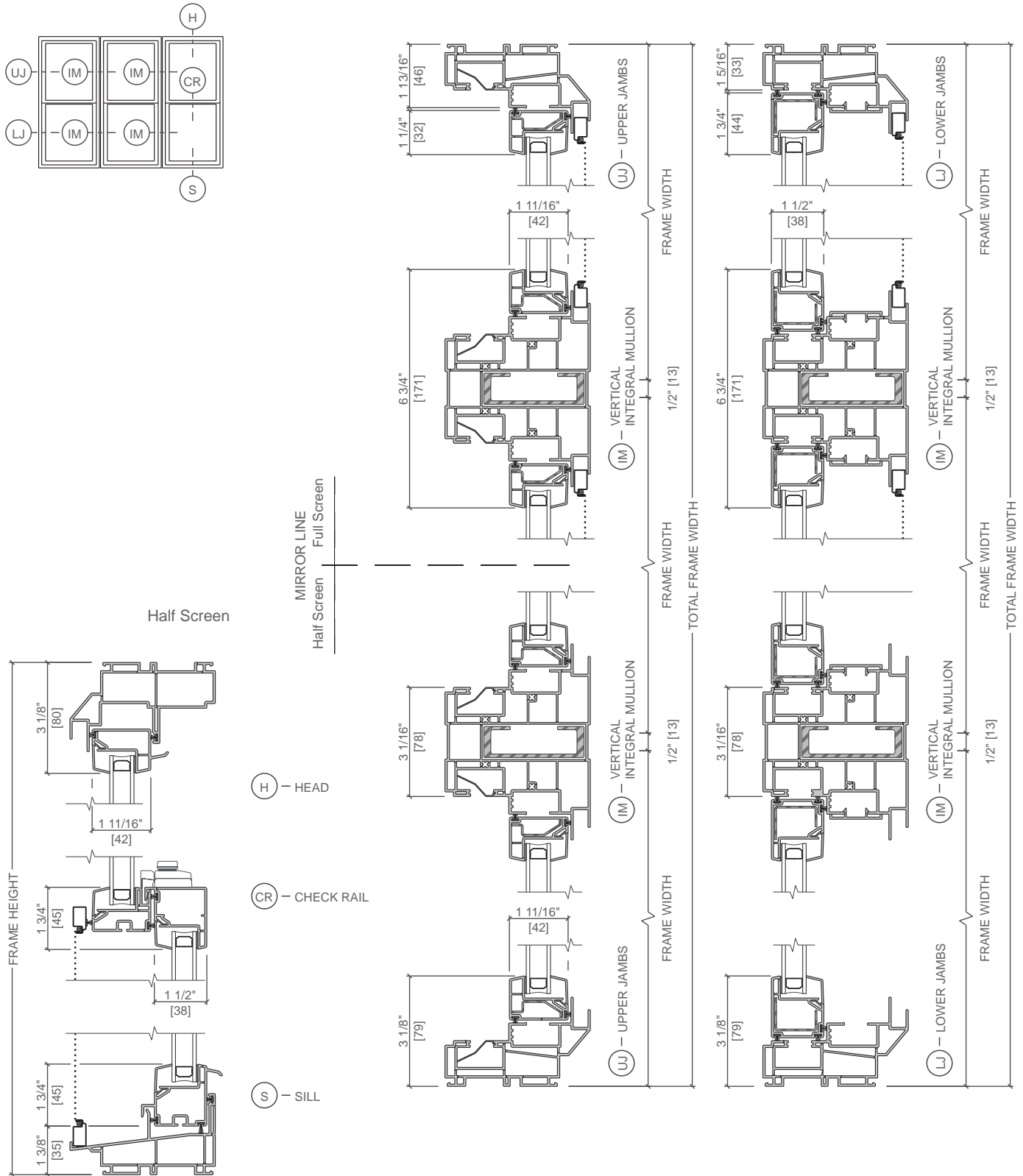


DOUBLE-HUNG

UNIT SECTIONS

Block Frame

Composite with Integral Mullion



Scale 3" = 1' 0"  
 All dimensions are approximate.

# 700 Series Wall Base

MADE IN THE USA

PRODUCT QUICK SPEC



# ROPPE

Proven. Flooring. Experiences.

## 1. MANUFACTURER

### Roppe Corporation

1602 N. Union Street

P.O. Box 1158

Fostoria, Ohio USA 44830-1158

t: (419) 435.8546 | tf: (800) 537.9527

f: (419) 435.1056

E-mail: [sales@roppe.com](mailto:sales@roppe.com) | Internet: [www.roppe.com](http://www.roppe.com)

## 2. PRODUCT DESCRIPTION

Roppe 700 Series Wall Base is designed for use in both commercial and residential wall base applications. Easier to work with and providing more flexibility than vinyl base products, Roppe's unique blend of thermoplastic rubber and vinyl makes the 700 Series an attractive and economical choice for a variety of applications.

### Available Styles (All Dimensions Nominal)



**Profile:** Standard Cove

**Gauge:** 1/8" (3.2 mm)

**Heights:** 2 1/2" (63.5 mm), 4" (101.6 mm) or 6" (152.4 mm)

**Lengths:** 48" (1.22 m) Pieces & 120' (36.58 m) Coils

**Factory Corners:** Inside & Outside Corners in 2 1/2" (63.5 mm), 4" (101.6 mm), 6" (152.4 mm) heights with 3" (76.2 mm) returns



**Profile:** Standard No Toe

**Gauge:** 1/8" (3.2 mm)

**Heights:** 2 1/2" (63.5 mm), 4" (101.6 mm) or 6" (152.4 mm)

**Lengths:** 48" (1.22 m) Pieces & 120' (36.58 m) Coils

**Factory Corners:** Outside Corners in 2 1/2" (63.5 mm) or 4" (101.6 mm) heights with 3" (76.2 mm) returns

## 3. TECHNICAL DATA

**ASTM F 1861** - Type TP, Group 2, Styles A & B

**ASTM E 648, Critical Radiant Flux** - Class 1 >.45 W/cm<sup>2</sup>

**ASTM E 662, Smoke Density** - Passes <450

**ASTM E 84, Surface Burning** - Class B

According to the BOCA (Building Officials & Code Administrators International Inc.) codes and the NFPA (National Fire Protection Agency), Accessories are considered incidental trim. According to these sections, any incidental trim not in excess of 10% of the aggregate wall and ceiling area of any room or space may be Class C material in occupancies where interior finish of Class A or Class B is required.

## 4. LIMITATIONS

Roppe 700 Series Wall Base is for indoor use only. Do not install on any surface exposed to moisture or extreme temperature changes. Do not install in areas subject to vegetable or petroleum based oils & greases. Fading can

occur from extensive exposure to heavy direct or glass-filtered sunlight, or unfiltered ultra-violet rays.

## 5. INSTALLATION

### General Preparation and Conditioning

Allow all trades to complete work prior to installation of 700 Series Wall Base. Deliver all materials to the installation location in its original packaging with labels intact. Maintain the installation area, material, and adhesive between 65° F (18° C) and 85° F (30° C) for at least 48 hours before installation, during installation, and after the installation.

### Wall Surface Inspection

Use only on structurally sound interior wall surfaces such as dry plaster, cured drywall, exterior grade plywood (Group 1, CC type), concrete and masonry that is clean, smooth, dry and structurally sound. All surfaces must be free from moisture, alkali, old adhesive, dust dirt, wax, oil, grease, loose paint or plaster, nonporous wall coverings or paints and other extraneous coatings or materials that could prevent a successful bond. Any rough or uneven surfaces may telegraph through the wall base. Follow the manufacturer's recommendations for any patching materials.

### Adhesive for Porous Substrates

**1100 Wall Base Adhesive** is a premium solvent free Acrylic adhesive with aggressive wet suction grip for all Roppe Wall Base products. Coverages are described on the 1100 Wall Base Adhesive quick spec.

### Adhesive for Non-Porous Substrates

Use a premium contact adhesive for installation over all non-porous substrates such as metal, FRP panels, etc.

## 6. MAINTENANCE

Do not clean, rub or apply lateral or vertical pressure to the 700 Series Wall Base for at least 72 hours after the installation is complete to allow the adhesive to properly cure. 700 Series Wall Base can be routinely cleaned by wiping with a soft cloth slightly dampened with warm water or by using a properly diluted neutral pH cleaner. Some disinfectants, cleaning agents, floor maintenance products and pesticides may stain or damage the surface of the 700 Series Wall Base. If applying finish to flooring, take necessary precautions to keep finish from the 700 Series Wall Base. If applying finish to the 700 Series Wall Base, test inconspicuous area first for compatibility.

## 7. AVAILABILITY AND COST

Products are available through Roppe distributors. Contact Roppe Customer Service (800) 537-9527 or visit [www.roppe.com](http://www.roppe.com).

## 8. TECHNICAL ASSISTANCE

Technical service information and assistance may be obtained by calling Roppe Customer Service at 1-800-537-9527, or by visiting [www.roppe.com](http://www.roppe.com).

*700 Series Wall Base*  
**MADE IN THE USA**  
PRODUCT QUICK SPEC



**9. SAMPLES**

Obtain samples by calling Roppe Customer Service at 1-800-537-9527, or by visiting [www.roppe.com](http://www.roppe.com).

**10. LIMITED WARRANTY**

Limited two (2) Year Manufacturer's Warranty

For complete substrate preparation, installation and/or maintenance instructions please visit [www.roppe.com](http://www.roppe.com)





**TAP Plastics Polyester Bond Coat Resin** (with Catalyst Indicator Dye)

**Type** • This product is a wide specification general purpose laminating resin with less than 35% styrene content. This resin contains a catalyst indicator dye. The blue resin changes to a neutral color with the addition of catalyst.

**Recommended Use** • This resin is intended for use in general purpose laminating applications that do not require strict tolerances for in-process liquid properties or finished part physical properties.

**Typical Inspection of Liquid Resin**

Color	Blue
Monomer Content, %	< 35%
Viscosity, Brookfield, @ 77° F, cps	575-675
Thix Index, minimum	3.0-5.0
Pounds/Gallon	8-10
Storage Stability @ 75° F, months	6

**Typical Reactivity - 100 gram (3.53 oz) casting @ 77° F**

Catalyst	1.0% MEKP-9%
Gel Time, minutes	18-22
Peak Exotherm, °F	300-360°F
Gel to peak, minutes	8-17

Properties are typical values, based on target values. Sample results vary from batch to batch. Typical values should not be construed as a guaranteed analysis of any specific lot or as specification items.

The manufacturing and quality control of TAP Bond Coat complies with one or more of the following programs or standards. Responsible Care, ISO 14001 and OHSAS 18001 by BVQI.

Rev. 22511

**Disclaimer and Limitation of Liability**

Since Seller exercises no control over Buyer's application or use of the products sold and since materials used with the products may vary, it is understood that :

1. There are no warranties expressed or implied, including any warranty of merchantability or fitness for any particular purpose.
2. While all data presented in Seller's technical data sheet is based on the best information available to the Seller and is believed to be correct, such data is not to be construed as a warranty that the products will conform to such specifications. Such technical data sheets are subject to change without notice.
3. The liability of the Seller shall not exceed the purchase price of the products and buyer shall not be entitled to nor shall be liable for any consequential, incidental, indirect or special damages resulting in any manner from the furnishing of the product or for any damages of any kind arising from the use of the products.
4. This product is a wide spec product. Shifts in liquid properties are not covered by the warranty.

Visit our website: [tapplastics.com](http://tapplastics.com)

<b>Description:</b>	Patent-Pending* Premium Engineered COREtec Plus® Luxury Vinyl Plank & Tile Floating Floor with Attached Cork Underlayment
<b>Warranty:</b>	Lifetime Limited Residential Wear Warranty Lifetime Limited Structural Warranty Lifetime Limited Waterproof Warranty 10 Year Limited Commercial Wear Warranty
<b>Installation:</b>	Float, Glue Down
<b>Size/Packaging:</b>	5" x 48" x 8 mm Planks 26.68 sq. ft./carton, 16 planks per carton, 36.4 lbs. each carton, 42 ctns per pallet  7-1/8" x 48" x 8 mm Planks 38.24 sq. ft./carton, 16 planks per carton, 52 lbs. each carton, 35 ctns per pallet  12" x 24" x 8 mm Tiles 32.04 sq. ft./carton, 16 tiles per carton, 43.6 lbs. each carton, 42 ctns per pallet  18.5" x 24" x 8 mm Tiles 30.86 sq. ft./carton, 10 tiles per carton, 50.7 lbs. each carton, 40 ctns per pallet
<b>Construction:</b>	1.5 mm virgin PVC (0.5 mm/20 mil wear surface) 5.0 mm core (Limestone, virgin PVC, wood and bamboo dust). 1.5 mm cork underlayment
<b>Wear Finish:</b>	2 coats UV-cured acrylic
<b>Gloss Level:</b>	8% - 10%

**TEST DATA**

<b>ASTM-E648 Critical Radiant Flux:</b>	Meets or exceeds, Class 1
<b>ASTM E492-09 Impact Sound Conduction:</b>	IIC 62 db
<b>ASTM E90-09 Airborne Sound Conduction:</b>	STC 62 db
<b>ASTM C518 Thermal Resistance:</b>	R Value – 0.57
<b>NALFA 3.2 Thickness Swell:</b>	Class 4, Heavy Commercial
<b>NALFA 3.3 Xenon Light Resistance:</b>	Class 4, Heavy Commercial
<b>NALFA 3.4 Cleanability-Stain Resistance:</b>	Class 4, Heavy Commercial
<b>NALFA 3.5 Large Ball Impact Resistance:</b>	Class 4, Heavy Commercial
<b>NALFA 3.6 Small Ball Impact Resistance:</b>	Class 4, Heavy Commercial
<b>NALFA 3.8 Dimensional Tolerance:</b>	Class 4, Heavy Commercial
<b>NALFA 3.9 Caster Chair:</b>	Class 3, Commercial
<b>NALFA 3.10 Surface Bonding:</b>	1.31 N/mm – Exceeds Class 3 Commercial Requirement
<b>ASTM C 1028-96 Static Coefficient of Friction:</b>	0.68 (slip resistance) Passes ADA/OSHA standard
<b>ASTM F-970-07 Static Load Limit:</b>	0.004 inch – Passes at 250 psi
<b>ASTM-F2753 Rolling Load Over Resilient FC:</b>	0.024 inch
<b>ASTM F 1514 Color Resistance to Heat:</b>	Meets <8.0 Delta E Requirement
<b>ASTM F 1515 Color Resistance to Light:</b>	Meets <8.0 Delta E Requirement

**Certifications:** CARB Compliant  
GREENGUARD GOLD Certified

**Environmental Statement:** USFloors' commitment is to provide consumers and specifiers with beautiful and durable floors at a good value, while minimizing our impact on the environment and enhancing and improving it whenever possible. USFloors is a member of the USGBC.

**Country of Origin:** Manufactured in China

*\*COREtec Plus<sup>®</sup> is a patent-pending product exclusively from USFloors Inc.*





# Haiku 52

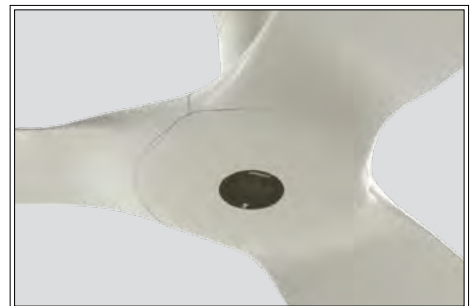
## The ceiling fan, reinvented

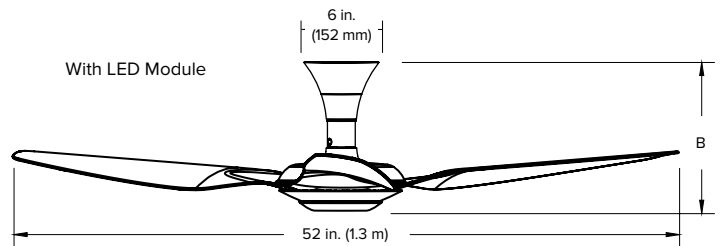
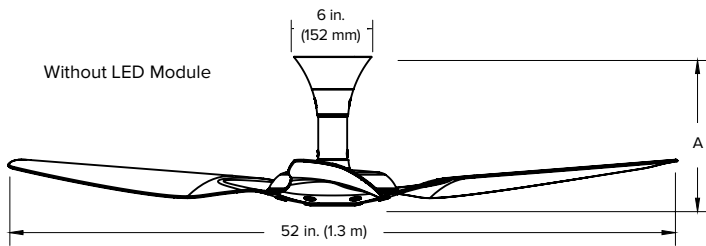
Offering unprecedented energy efficiency and silent, wobble-free operation, the 52-inch (1.3-m) Haiku® is designed to fit bedrooms and other smaller residential spaces. Sophisticated control options include up to seven speeds and special settings, such as Whoosh® mode, a proprietary feature that simulates natural breezes for better cooling.

Winner of more than 25 international design and technology awards, Haiku is handcrafted with premium materials, including sustainable Moso bamboo or a durable glass-infused matrix composite. The 52-inch (1.3-m) Haiku is everything you expect from Big Ass Fans® in a smaller package.

### Features and Benefits

- 10 unique control settings, including sleep and timer
- Hand balanced for wobble-free operation at all speeds
- Optional patented LED module
- Comes with slender remote control; also available with optional wall control
- Caramel bamboo, cocoa bamboo, black matrix composite and white matrix composite finishes
- Available with SenseME™ technology that keeps you comfortable automatically





### Technical Specifications

<b>Model</b>	Haiku Bamboo Short Mount
<b>Model number</b>	S3127-S0-XX-XX-03-C
<b>Fan diameter</b>	52 in. (1.3 m)
<b>Fan height (A)</b>	11.8 in. (299.7 mm); drop tube included
<b>Fan height (B)</b>	12.3 in. (312.4 mm); drop tube included
<b>Hanging weight</b>	14 lb (6 kg)*
<b>Motor and assembly finishes</b>	Caramel: white or black Cocoa: black
<b>Airfoil material</b>	Bamboo
<b>Airfoil finishes</b>	Caramel or Cocoa
<b>Number of airfoils</b>	3
<b>Motor type</b>	EC motor with digital inverter drive
<b>Power factor</b>	>0.92
<b>Number of fan speeds</b>	6
<b>Operating voltage and frequency</b>	100–125 VAC / 200–240 VAC, 1 $\Phi$ , 50–60 Hz
<b>IP rating</b>	X2
<b>RPM (min/max)</b>	49/178 RPM
<b>Amps (min/max)</b>	0.039/0.2414 A
<b>Watts (min/max)</b>	1.49/14.81 W
<b>Remote control</b>	Included
<b>Wireless wall control</b>	Optional
<b>Controller features</b>	<p><b>FAN:</b> On/off Whoosh® mode Sleep mode Timer Speed</p> <p><b>LIGHT:</b> On/off 16 dimmable light settings</p>
<b>Climate rating</b>	T
<b>Environment</b>	For indoor use only
<b>Fan mode indicator</b>	LED display
<b>Warranty</b>	Limited lifetime**

### Accessories

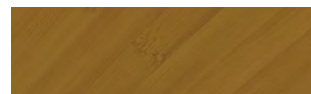
#### Standard Controller



#### Optional Wireless Wall Control



#### Airfoil Finishes



Caramel



Cocoa

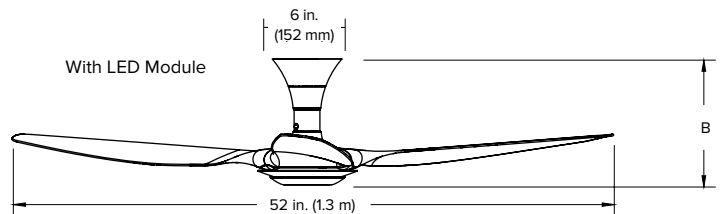
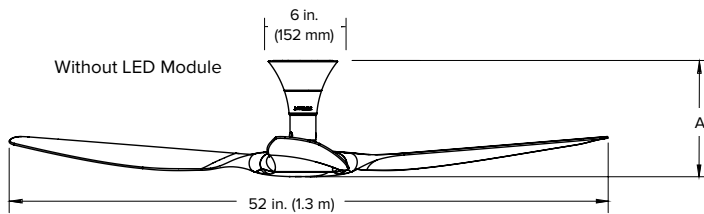
#### Optional LED Module



\*The actual, precise fan weight will vary based on actual individual component weights and finishing.

\*\*Limited lifetime warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.





### Technical Specifications

<b>Model</b>	Haiku Matrix Composite Short Mount
<b>Model number</b>	K3127-S0-XX-XX-03-C
<b>Fan diameter</b>	52 in. (1.3 m)
<b>Fan height (A)</b>	11.3 in. (287.0 mm); drop tube included
<b>Fan height (B)</b>	11.8 in. (299.7 mm); drop tube included
<b>Hanging weight</b>	14 lb (6 kg)*
<b>Motor and assembly finishes</b>	Black or white
<b>Airfoil material</b>	Matrix Composite
<b>Airfoil finishes</b>	Black or white
<b>Number of airfoils</b>	3
<b>Motor type</b>	EC motor with digital inverter drive
<b>Power factor</b>	>0.92
<b>Number of fan speeds</b>	6
<b>Operating voltage and frequency</b>	100–125 VAC / 200–240 VAC, 1 $\phi$ , 50–60 Hz
<b>IP rating</b>	X2
<b>RPM (min/max)</b>	49/179 RPM
<b>Amps (min/max)</b>	0.0409/0.3459 A
<b>Watts (min/max)</b>	1.66/22.61 W
<b>Remote control</b>	Included
<b>Wireless wall control</b>	Optional
<b>Controller features</b>	<p><b>FAN:</b> On/off Whoosh® mode Sleep mode Timer Speed</p> <p><b>LIGHT:</b> On/off 16 dimmable light settings</p>
<b>Climate rating</b>	T
<b>Environment</b>	Indoor or covered outdoor use
<b>Fan mode indicator</b>	LED display
<b>Warranty</b>	Limited lifetime**

### Accessories

#### Standard Controller



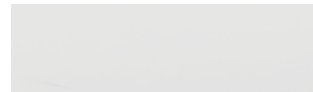
#### Optional Wireless Wall Control



#### Airfoil Finishes



Black



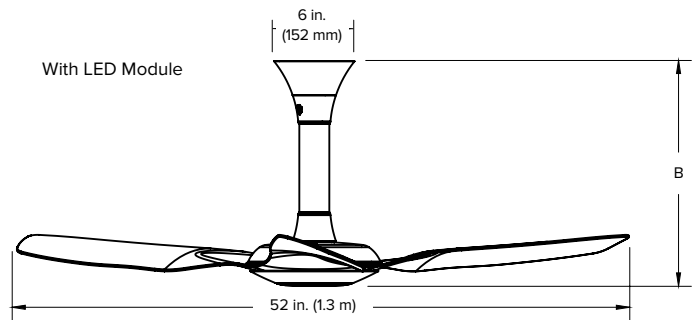
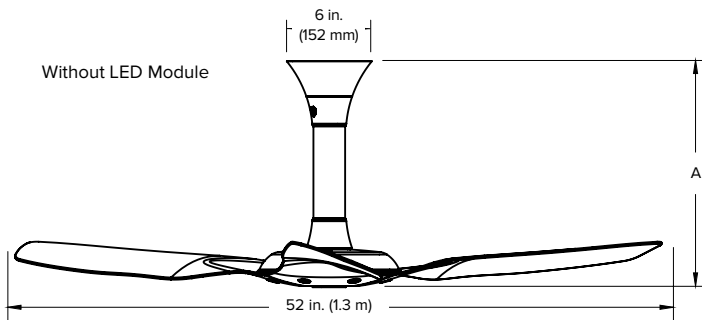
White

#### Optional LED Module



\*The actual, precise fan weight will vary based on actual individual component weights and finishing.  
 \*\*Limited lifetime warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.





### Technical Specifications

<b>Model</b>	Haiku Bamboo Standard Mount
<b>Model number</b>	S3127-A2-XX-XX-03-C
<b>Fan diameter</b>	52 in. (1.3 m)
<b>Fan height (A)</b>	16.4 in. (416.6 mm); drop tube included
<b>Fan height (B)</b>	16.9 in. (429.3 mm); drop tube included
<b>Hanging weight</b>	14 lb (6 kg)*
<b>Motor and assembly finishes</b>	Caramel: white or black Cocoa: black
<b>Airfoil material</b>	Bamboo
<b>Airfoil finishes</b>	Caramel or Cocoa
<b>Number of airfoils</b>	3
<b>Motor type</b>	EC motor with digital inverter drive
<b>Power factor</b>	>0.92
<b>Number of fan speeds</b>	7
<b>Operating voltage and frequency</b>	100–125 VAC / 200–240 VAC, 1 Φ, 50–60 Hz
<b>IP rating</b>	X2
<b>RPM (min/max)</b>	49/201 RPM
<b>Amps (min/max)</b>	0.0374/0.1737 A
<b>Watts (min/max)</b>	1.71/20.13 W
<b>Remote control</b>	Included
<b>Wireless wall control</b>	Optional
<b>Controller features</b>	<p><b>FAN:</b> On/off Whoosh® mode Sleep mode Timer Speed</p> <p><b>LIGHT:</b> On/off 16 dimmable light settings</p>
<b>Climate rating</b>	T
<b>Environment</b>	For indoor use only
<b>Fan mode indicator</b>	LED display
<b>Warranty</b>	Limited lifetime**

### Accessories

#### Standard Controller



#### Optional Wireless Wall Control



#### Airfoil Finishes



Caramel



Cocoa

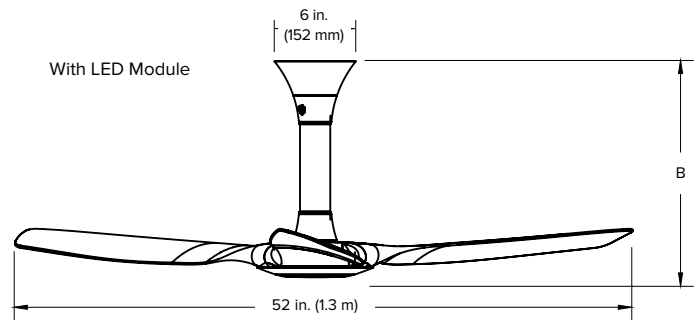
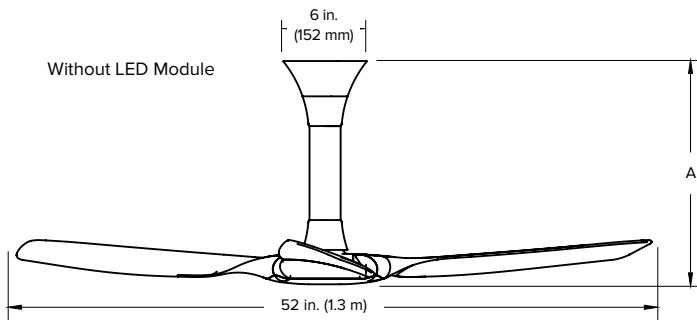
#### Optional LED Module



\*The actual, precise fan weight will vary based on actual individual component weights and finishing.

\*\*Limited lifetime warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.





### Technical Specifications

<b>Model</b>	Haiku Matrix Composite Standard Mount
<b>Model number</b>	K3127-A2-XX-XX-03-C
<b>Fan diameter</b>	52 in. (1.3 m)
<b>Fan height (A)</b>	16.2 in. (411.5 mm); drop tube included
<b>Fan height (B)</b>	16.6 in. (421.6 mm); drop tube included
<b>Hanging weight</b>	14 lb (6 kg)*
<b>Motor and assembly finishes</b>	Black or white
<b>Airfoil material</b>	Matrix Composite
<b>Airfoil finishes</b>	Black or white
<b>Number of airfoils</b>	3
<b>Motor type</b>	EC motor with digital inverter drive
<b>Power factor</b>	>0.92
<b>Number of fan speeds</b>	7
<b>Operating voltage and frequency</b>	100–125 VAC / 200–240 VAC, 1 Φ, 50–60 Hz
<b>IP rating</b>	X2
<b>RPM (min/max)</b>	49/202 RPM
<b>Amps (min/max)</b>	0.0384/0.2649 A
<b>Watts (min/max)</b>	1.84/31.32 W
<b>Remote control</b>	Included
<b>Wireless wall control</b>	Optional
<b>Controller features</b>	<p><b>FAN:</b> On/off Whoosh® mode Sleep mode Timer Speed</p> <p><b>LIGHT:</b> On/off 16 dimmable light settings</p>
<b>Climate rating</b>	T
<b>Environment</b>	Indoor or covered outdoor use
<b>Fan mode indicator</b>	LED display
<b>Warranty</b>	Limited lifetime**

### Accessories

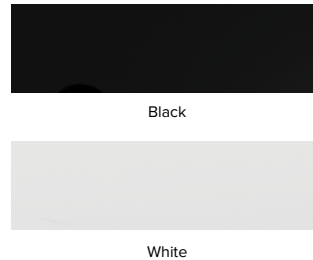
#### Standard Controller



#### Optional Wireless Wall Control



#### Airfoil Finishes

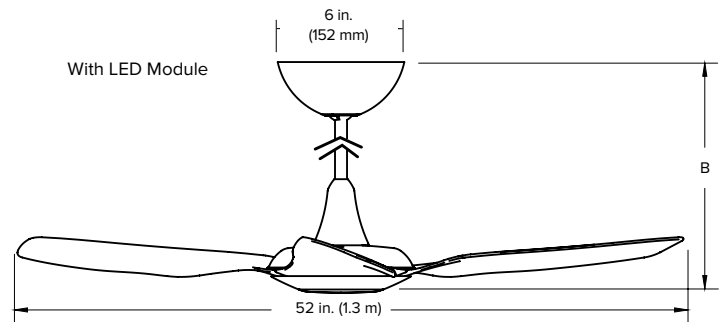
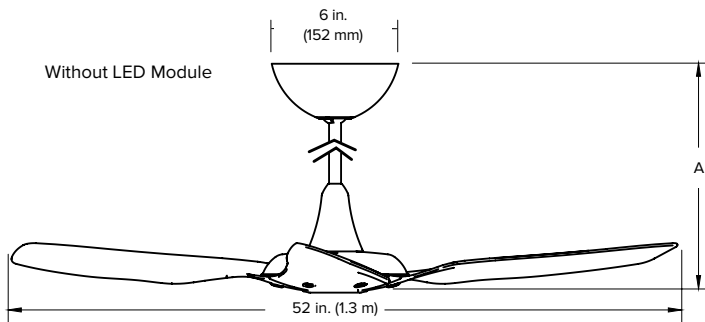


#### Optional LED Module



\*The actual, precise fan weight will vary based on actual individual component weights and finishing.  
 \*\*Limited lifetime warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.





### Technical Specifications

<b>Model</b>	Haiku Bamboo Extended Mount	
<b>Model number</b>	S3127-X2-XX-XX-03-C	
<b>Extension Length</b>	7 in. (177.8 mm)	20 in (508 mm)
<b>Fan diameter</b>	52 in. (1.3 m)	
<b>Fan height (A)</b>	15.4 in. (392 mm)	28.5 (724 mm)
<b>Fan height (B)</b>	15.9 in. (404 mm)	29 in. (736 mm)
<b>Hanging weight</b>	13 lb (5.9 kg)*	
<b>Motor and assembly finishes</b>	Caramel: white or black Cocoa: black	
<b>Airfoil material</b>	Bamboo	
<b>Airfoil finishes</b>	Caramel or Cocoa	
<b>Number of airfoils</b>	3	
<b>Motor type</b>	EC motor with digital inverter drive	
<b>Power factor</b>	>0.92	
<b>Number of fan speeds</b>	7	
<b>Operating voltage and frequency</b>	100–125 VAC / 200–240 VAC, 1 $\Phi$ , 50–60 Hz	
<b>IP rating</b>	X2	
<b>RPM (min/max)</b>	49/202 RPM	
<b>Amps (min/max)</b>	0.0352/0.1718 A	
<b>Watts (min/max)</b>	1.69/19.99 W	
<b>Remote control</b>	Included	
<b>Wireless wall control</b>	Optional	
<b>Controller features</b>	<b>FAN:</b> On/off Whoosh® mode Sleep mode Timer Speed <b>LIGHT:</b> On/off 16 dimmable light settings	
<b>Climate rating</b>	T	
<b>Environment</b>	For indoor use only	
<b>Fan mode indicator</b>	LED display	
<b>Warranty</b>	Limited lifetime**	

### Accessories

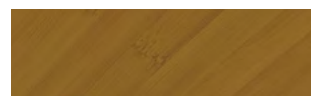
#### Standard Controller



#### Optional Wireless Wall Control



#### Airfoil Finishes



Caramel



Cocoa

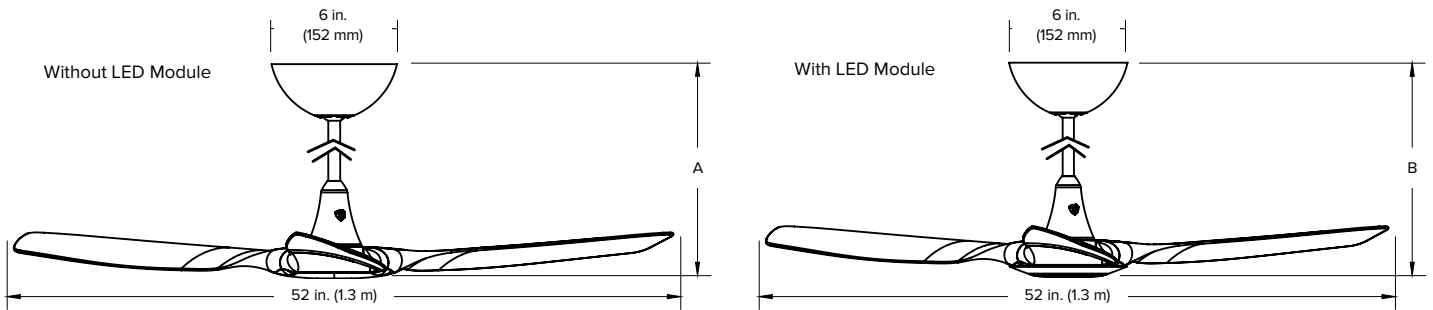
#### Optional LED Module



\*The actual, precise fan weight will vary based on actual individual component weights and finishing.

\*\*Limited lifetime warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.





### Technical Specifications

Model	Haiku Matrix Composite Extended Mount	
Model number	K3127-X2-XX-XX-03-C	
Extension Length	7 in. (177.8 mm)	20 in (508 mm)
Fan diameter	52 in. (1.3 m)	
Fan height (A)	15 in. (381 mm)	28 in. (711 mm)
Fan height (B)	15.4 in. (392.3 mm)	28.4 in. (722.3 mm)
Hanging weight	13 lb (5.9 kg)*	
Motor and assembly finishes	Black or white	
Airfoil material	Matrix Composite	
Airfoil finishes	Black or white	
Number of airfoils	3	
Motor type	EC motor with digital inverter drive	
Power factor	>0.92	
Number of fan speeds	7	
Operating voltage and frequency	100–125 VAC / 200–240 VAC, 1 $\Phi$ , 50–60 Hz	
IP rating	X2	
RPM (min/max)	49/200 RPM	
Amps (min/max)	0.0039/0.259 A	
Watts (min/max)	1.82/30.67 W	
Remote control	Included	
Wireless wall control	Optional	
Controller features	<b>FAN:</b> On/off Whoosh® mode Sleep mode Timer Speed	
	<b>LIGHT:</b> On/off 16 dimmable light settings	
Climate rating	T	
Environment	Indoor or covered outdoor use	
Fan mode indicator	LED display	
Warranty	Limited lifetime**	

### Accessories

#### Standard Controller



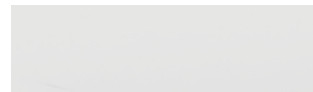
#### Optional Wireless Wall Control



#### Airfoil Finishes



Black



White

#### Optional LED Module



\*The actual, precise fan weight will vary based on actual individual component weights and finishing.

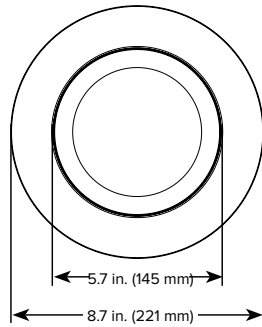
\*\*Limited lifetime warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.



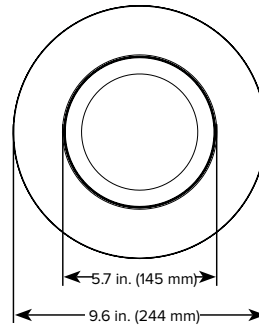
Optional Accessory:

# Haiku 52 LED Kit

## TECHNICAL SPECIFICATIONS



**Composite LED**



**Bamboo LED**



### Technical Specifications

Model number	K-LED-B	K-LED-W	S-LED-B	S-LED-W
Operating voltage	1.2V+/-0.5V			
Operating current	1.6 Adc (100% PWM)			
Nominal input power	20 W			
Operating temperature	32 to 104°F (0 to 40°C)			
Lens diameter	5.7 in. (145 mm)			
Nominal lumen output	832 lm			
Typical CR	79			
Corresponding color temperature	3000K			
Dimming range	0-100%			
Operating life expectancy	50,000 hours			
Lens color	Clear and smoky options included			
Controller	On/off control Digital dimmer			
Warranty	1 year in the US and Canada*			

\*1 year warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.

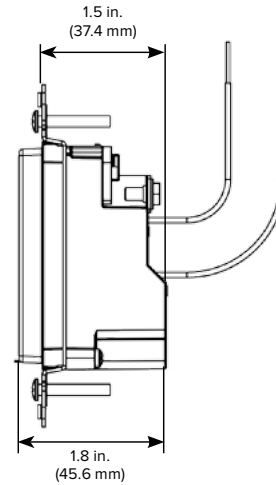
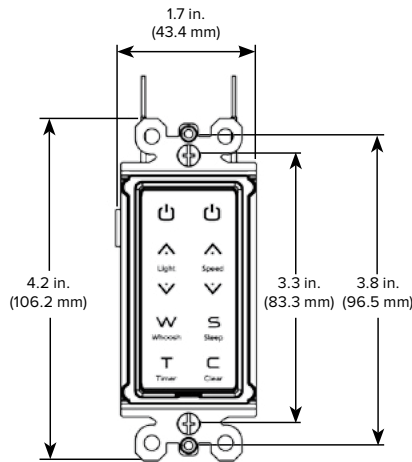




Optional Accessory:

# Haiku 52 Wall Controller

## TECHNICAL SPECIFICATIONS



### Technical Specifications







<b>Model</b>	Wireless Wall Control	
<b>Compatible model number</b>	K3127-SO	S3127-SO
<b>Color</b>	White	
<b>RF frequency</b>	900 Mhz	
<b>Operating range</b>	20 ft (6.1 m) from controller to fan; successive fans must be within 20 ft (6.1 m) of each other	
<b>Multiple fan operation*</b>	Control up to four fans with a single controller	
<b>Nominal input power</b>	100–240V	
<b>Wall control features</b>	<b>FAN:</b> Whoosh® mode On/off Fan speeds: 6 or 7 (model dependent) Sleep mode Off timer Reverse	
	<b>LIGHT:</b> Light on/off 16 dimmable light settings	
<b>User interface</b>	Capacitive touch interface	
<b>Status indicator</b>	White LEDs indicate user-entered values Blue LEDs indicate fan speed and lighting level LEDs turn off after 5 seconds of inactivity	
<b>Parts included</b>	Wireless wall control and mounting screws RF board and antenna retainer	
<b>Wallplate</b>	Not included; Decora® wallplate recommended	
<b>Dimension</b>	Fits standard junction box	
<b>Warranty</b>	1 year warranty in the US and Canada*	

\*1 year warranty available in the US and Canada; certain exclusions apply. Warranties vary by country. See full warranty for details.

### Wall Controller



### Controller Settings

-  **LED module** with 16 settings provides the perfect level of light for any need.
-  **Speed options** from gentle heat recirculation to a cooling breeze.
-  The exclusive **Whoosh® mode** simulates the variations in natural airflow.
-  **Sleep mode** reduces the fan speed by one increment every hour until the lowest speed is reached.
-  In **Timer mode**, the fan runs at a set speed until the programmed time period ends.
-  The **Clear button** returns the fan to default settings.



# 24" Recessed Handle Special Application

Stainless Steel SGE63E15UC



**SGE63E15UC**  
Stainless Steel

Also available in:  
Black SGE63E06UC

**Bosch dishwashers incorporate 18 unique sound-reducing technologies, to make Bosch the quietest dishwasher brand in the US.**

## Features & Benefits

49 dBA: Quietest dishwasher brand.

Water softener ensures optimally spot-free and shiny dishes.

AquaStop® Plus 4-Part leak protection prevents water damage 24/7.

24h Delay Start Timer lets you run your dishwasher at off-peak times.

## General Properties

Number of wash cycles	6
Number of options	5
dBA	49
Third rack	
Rack adjustability	Manual
Tub material	Stainless steel
Control type	Buttons
Concealed heating element	Yes
Leak protection system	24/7 AquaStop® Plus
Water softener	Yes
Five-level wash	Yes
ChildLock	Yes
Special features	Made in Germany

## Efficiency

Water usage per cycle	2.2
Energy efficiency class	Tier 1
ENERGY STAR® qualified	Yes
Total annual energy consumption (kWh)	234
Total annual water consumption (g)	477

## Capacity

Number of place settings	14
--------------------------	----

## Technical Details

Watts (W)	1300 W
Current (A)	12 Amps
Volts (V)	120 V
Frequency (Hz)	60 Hz
Power cord length	68 7/8"
Minimum water pressure (lb/sin)	7
Length inlet hose (in)	65"
Length outlet hose (in)	74 7/8"

## Dimensions & Weight

Overall appliance dimensions (HxWxD) (in)	32 1/16" x 23 9/16" x 22 9/16"
Required cutout size (HxWxD) (in)	32 1/8" x 24" x 24"
Adjustable feet	Yes
Net weight (lbs)	83 lbs

## Accessories—Optional

Dishwasher Softener Salt (4.4 lbs)	SGZ9091UC
Dishwasher Supply and Drainage Hose Extension 76 3/4"	SGZ1010UC
Dishwasher Accessory Kit	SMZ5000
Anti-tarnish Silverware Cassette	SMZ5002



For help and assistance with Bosch accessories please visit: [www.bosch-eshop.com/eshop/bosch/us](http://www.bosch-eshop.com/eshop/bosch/us) or call 1-800-944-2904 Mon-Fri 5am to 6pm PST Sat 6am to 3pm PST

Notes: All height, width and depth dimensions are shown in inches. Please refer to installation instructions prior to making cutout. BSH reserves the absolute and unrestricted right to change product materials and specifications, at any time, without notice. Consult the product's installation instructions for final dimensional data and other details. Applicable product warranty can be found in accompanying product literature or you may contact your account manager for further details.

Warranties: Bosch warrants that the Product is free from defects in materials and workmanship for a period of three hundred and sixty-five (365) days from the date of purchase. The foregoing timeline begins to run upon the date of purchase, and shall not be stalled, tolled, extended, or suspended, for any reason whatsoever. This Product is also warranted to be free from cosmetic defects in material and workmanship (such as scratches of stainless steel, paint/porcelain blemishes, chip, dents, or other damage to the finish of the Product, for a period of thirty (30) days from the date of purchase or closing date for new construction. This cosmetic warranty excludes slight color variations due to inherent differences in painted and porcelain parts, as well as differences caused by kitchen lighting, product location, or other similar factors. This cosmetic warranty specifically excludes any display, floor, "As Is", or "B" stock appliances.

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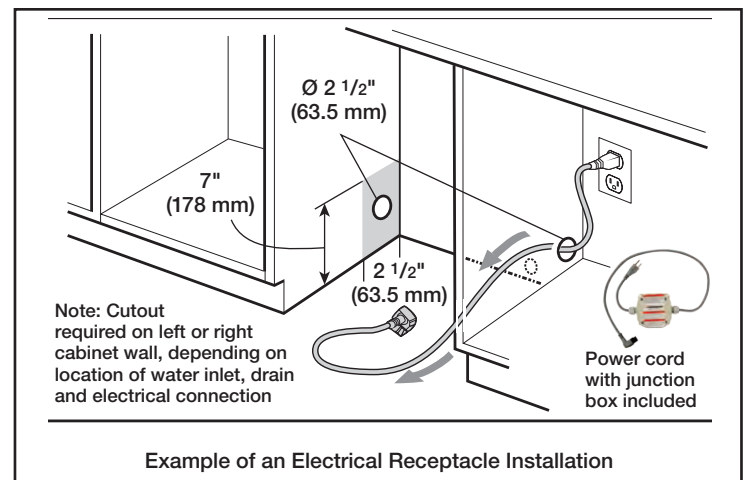
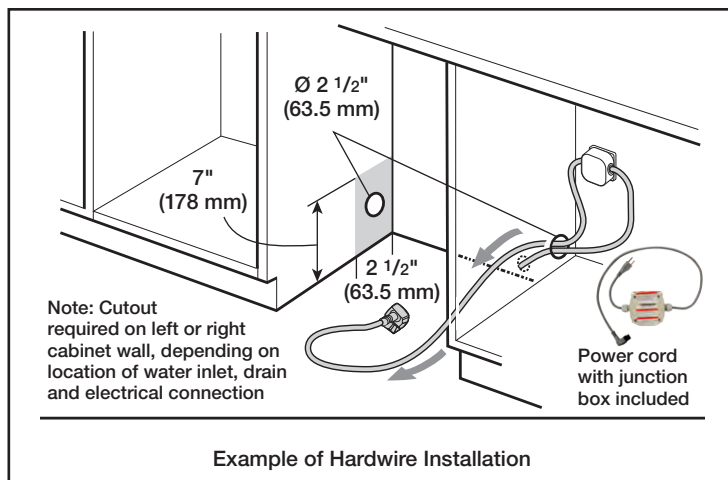
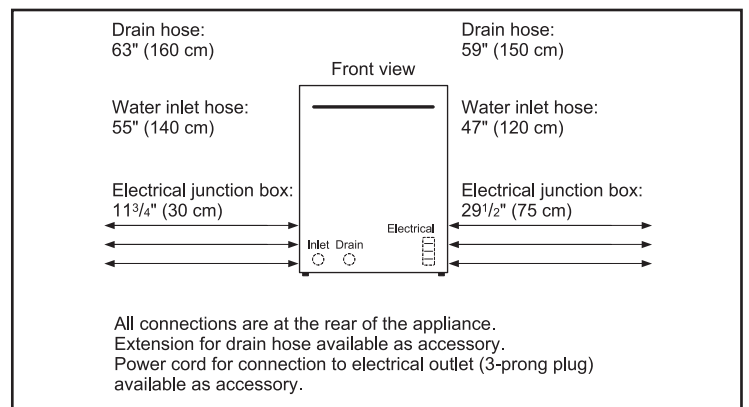
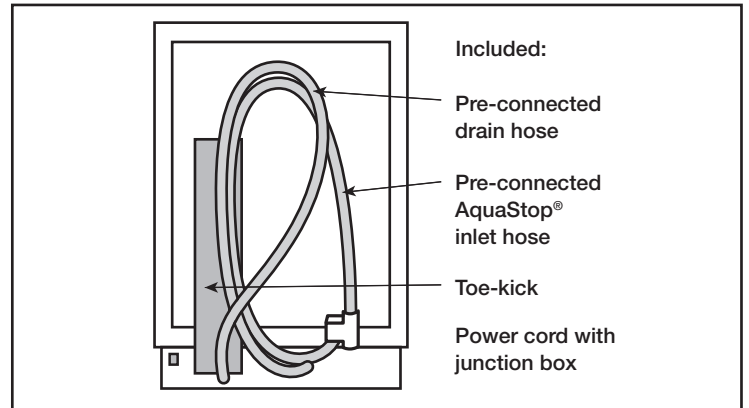
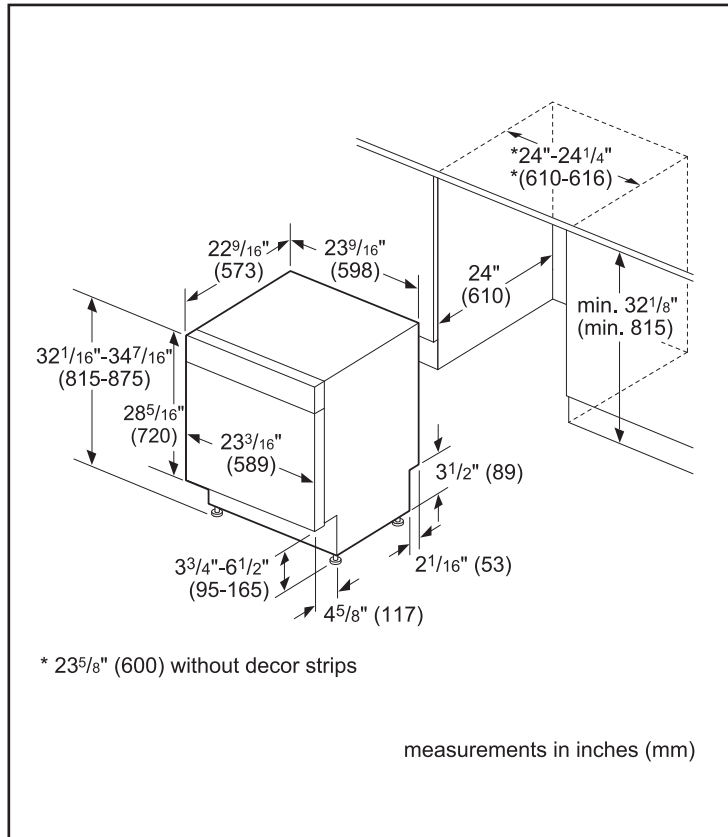
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# 24" Recessed Handle Special Application

Stainless Steel SGE63E15UC



## Installation Details



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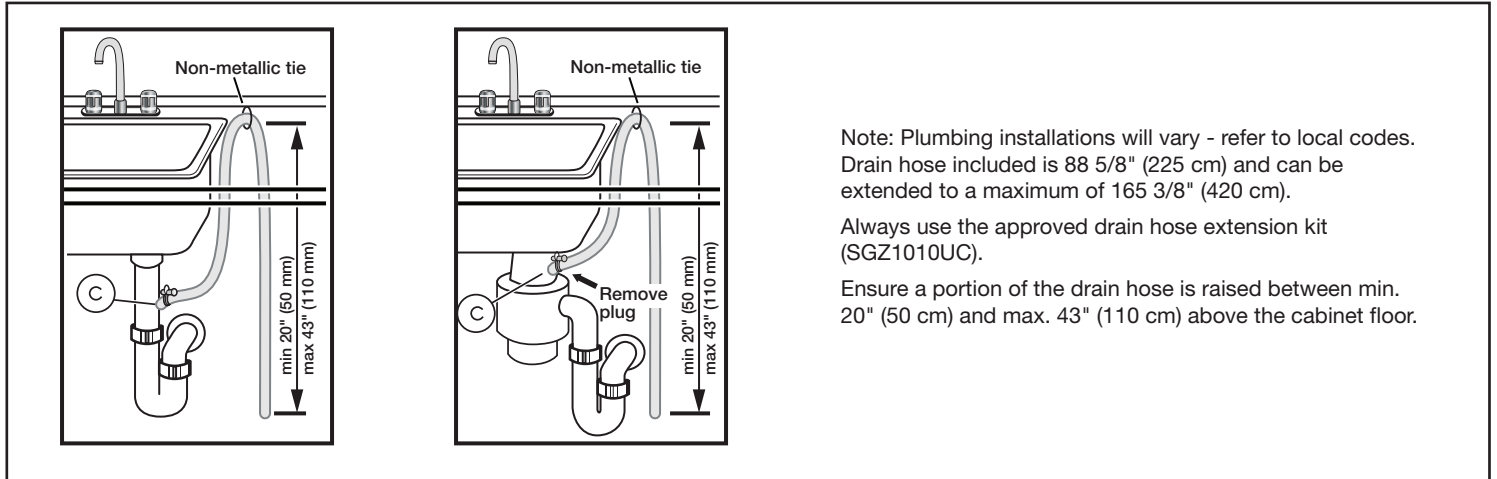
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# 24" Recessed Handle Special Application

Stainless Steel SGE63E15UC



## Installation Details



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# Power Max

## Electric Vehicle Charging Station



**BOSCH**

Invented for life



### Standards Compliances:

- ▶ cUL and UL listed
- ▶ SAE J1772
- ▶ NEC 625
- ▶ NEMA 3R

**Designed to work with all electric vehicles, Power Max features focus on driver and vehicle safety and convenience. Available in 16 Amp or 30 Amp configurations with multiple cable length options, there is a Power Max to meet any EV driver's needs.**

### Features and Benefits:

- ▶ The NEMA 3R enclosure allows for indoor and outdoor installations
- ▶ convenient on/off switch allows for power to be completely shut off to the charging station, resulting in zero energy consumption.
- ▶ LEDs illuminate while the charging station is powered on and actively charging
- ▶ Intuitive connector dock conveniently keeps the connector off of the ground while the cord easily wraps around the charging station
- ▶ Safety features protect the driver and vehicle
- ▶ Wall mounted application

EL-51245/EL-51253/EL-51254

Power Max Electric Vehicle Charging Station

Specifications			
Part No.	EL-51245	EL-51253	EL-51254
Amperage	16 Amps	30 Amps	30 Amps
Voltage	208 VAC- 240 VAC	208 VAC- 240 VAC	208 VAC- 240 VAC
Cable Length	12 ft	18 ft	25 ft
Weight	11 lbs	14 lbs	17 lbs
Dimensions	16 x 14 x 5	16 x 14 x 5	16 x 14 x 5
Input/Output Power	3.3 kW	7.2 kW	7.2 kW
Enclosure	NEMA Type 3R; indoor/ outdoor	NEMA Type 3R; indoor/ outdoor	NEMA Type 3R; indoor/ outdoor
Price*	\$449.00	\$593.00	\$749.00

\*Price does not include applicable taxes, shipping, or installation, and is subject to change without notice

# 30" Over-the-Range Microwave

500 Series – Stainless Steel HMV5052U



**HMV5052U**  
Stainless Steel

The precisely designed OTR microwave is a perfect match for the Bosch slide-in range or cooktop.

## Features & Benefits

A large cooking interior gives you flexibility to cook various dishes.

The OTR microwave is designed to install with a Bosch slide-in range or cooktop.

A multi-speed vent efficiently removes steam, smoke, grease and odors - 385 CFM.

A sensor detects when food is finished and automatically turns off.

The LCD display features easy-to-read white led lettering.

## General Properties

Cavity color	White
Max. microwave power (W)	1,100 W
Max. extraction rate (CFM)	385 CFM
Ducted	Yes
Ductless	Yes
Duct size	3 1/4" x 10"

## Capacity

Cavity capacity (cu. ft.)	2.1 cu. ft.
Turntable diameter (in.)	14 3/16"

## Technical Details

Watts (W)	1,550 W
Circuit breaker (A)	15 A
Volts (V)	120 V
Frequency (Hz)	60 Hz
Power cord length (in)	39"
Plug type	120V-3 prong

## Dimensions & Weight

Overall appliance dimensions (HxWxD) (in)	17 1/2" x 29 7/8" x 15 7/8"
Required cutout size (HxWxD) (in)	16 1/2" Min x 30" x 12" Min - 14" Max
Net weight (lbs)	54 lbs



For help and assistance with Bosch accessories please visit: [www.bosch-eshop.com/eshop/bosch/us](http://www.bosch-eshop.com/eshop/bosch/us) or call 1-800-944-2904 Mon-Fri 5am to 6pm PST Sat 6am to 3pm PST

Notes: All height, width and depth dimensions are shown in inches. Please refer to installation instructions prior to making cutout. BSH reserves the absolute and unrestricted right to change product materials and specifications, at any time, without notice. Consult the product's installation instructions for final dimensional data and other details. Applicable product warranty can be found in accompanying product literature or you may contact your account manager for further details.

Warranties: Bosch warrants that the Product is free from defects in materials and workmanship for a period of three hundred and sixty-five (365) days from the date of purchase. The foregoing timeline begins to run upon the date of purchase, and shall not be stalled, tolled, extended, or suspended, for any reason whatsoever. This Product is also warranted to be free from cosmetic defects in material and workmanship (such as scratches of stainless steel, paint/porcelain blemishes, chip, dents, or other damage to the finish of the Product, for a period of thirty (30) days from the date of purchase or closing date for new construction. This cosmetic warranty excludes slight color variations due to inherent differences in painted and porcelain parts, as well as differences caused by kitchen lighting, product location, or other similar factors. This cosmetic warranty specifically excludes any display, floor, "As Is", or "B" stock appliances.

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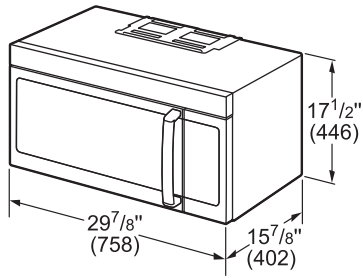
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# 30" Over-the-Range Microwave

500 Series – Stainless Steel HMV5052U

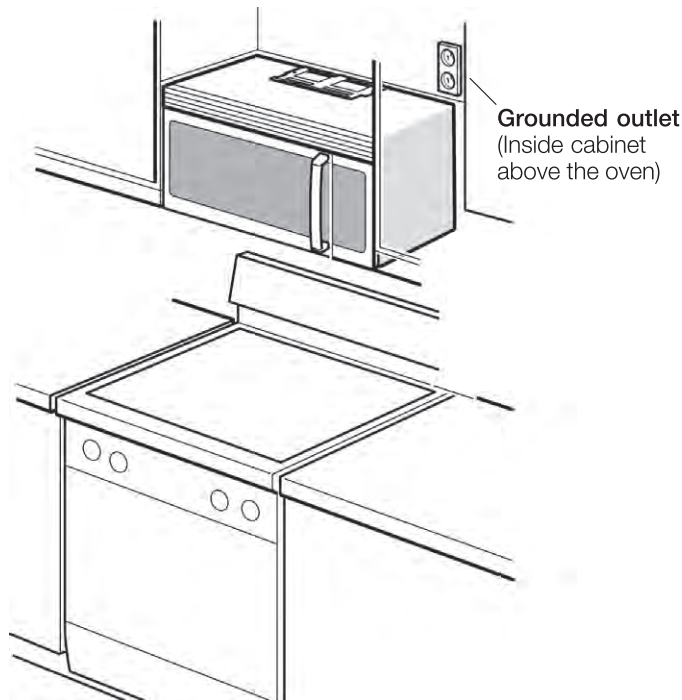


## Installation Details

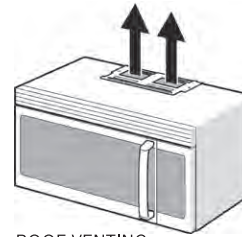


measurements in inches (mm)

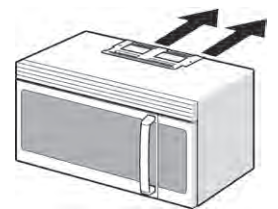
### Electrical Connection



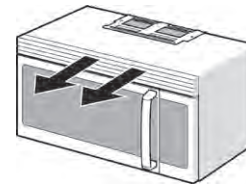
### Venting Options



ROOF VENTING

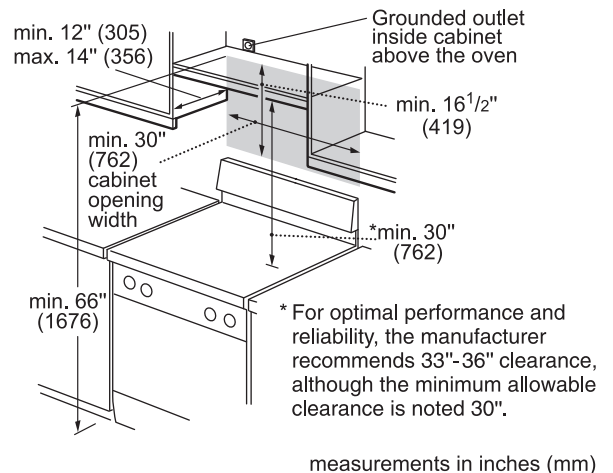


WALL VENTING



ROOM VENTING

### Clearance Above Cooktop



measurements in inches (mm)

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# Electric Ovens

## Quick Reference Guide

Built-in wall ovens, range ovens



**BOSCH**  
Invented for life

**IMPORTANT:** This reference guide is not a substitute for the Use & Care manual. **Read and consult the appliance Use & Care manual for important safety messages** and additional information regarding the use of your new appliance.

### Prepare the Oven for Use

#### Set the Clock

See detailed instructions in your appliance's Use and Care manual. Procedure varies by appliance.

#### Perform a before-first-use cleaning

- Wipe the oven interior with a clean, damp cloth using a mild dish detergent and wipe dry.
- To further reduce first-use odor, run a 30 minute bake cycle at 350° F.

#### User Settings

Consult the Use & Care manual "User Settings" to set 12/24 hour clock mode, Fahrenheit/Celsius temperature display, touchpad sound, show clock, oven temperature offset, and auto convection (select models only).

### Oven Racks

Do not handle the rack when it is hot. Make sure the oven rack is in the desired position before preheating the oven.



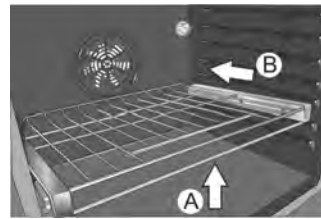
The oven has six rack position guides numbered 1 to 6 starting from the bottom. Refer to the table below or the cooking charts in your appliance's Use & Care manual for rack position to use when baking.

#### Rack Position Usage

Position	Best For
6	hamburgers, steaks
5	toasting bread, broiling most meats, melting cheese
4	thicker meats
3	broiling poultry, most baked goods on cooking sheet or baking pan, one rack, frozen convenience foods, cakes, casseroles, frozen pizza
2	small roasts/poultry, bundt cakes, pies, breads
1	large roasts, turkey, angel food cake

**Avoid Potential Damage to Oven Racks:** Do not attempt to clean an oven rack using the oven's Self-Clean feature. The intense heat will damage the rack's finish and performance.

#### Inserting the Telescopic Rack



Hold the rack by both sides. Slide it in above the position guide until the back of the rack is about 2 inches from the back of the oven. Tilt the front of the rack up slightly (A) and finish pushing the rack back (B).

The back of the rack drops into place. Pull the rack forward to seat the back onto the rack position guide.

Lower the front of the rack to finish seating it on the guide. The rack should be level and flat when properly inserted. Slide the moveable part of the rack in and out a few times to make sure the rack is securely anchored.

### Oven Mode and Temperature

#### Setting the cooking mode and temperature

- Select the cooking mode you wish to use (see the cooking mode chart on the next page for mode descriptions).
- Accept or change the default temperature (See detailed instructions in your appliance's Use and Care manual. The procedure used to change the oven temperature varies by appliance).













#### Allowed Temperature Range by Mode

Mode	Lowest °F	Highest °F	Default °F
Bake	100	550	350
Roast	100	550	325
Broil (low 450°; high 550°)	450	550	High
Warm	140	225	170
Proof*	85	125	100
Convection Bake*	100	550	325
Convection Multi-Rack*	100	550	325
Convection Roast*	100	550	325
Pizza*	100	550	400
Convection Broil* (Low, High)	450	550	High
Frozen Foods*	100	550	400
EcoChef*	100	550	325

\* some models only



## Mode Description and Usage

Oven Mode	Symbol	Description	Recommended Foods	Usage Tips
<b>Bake</b>		Cooks with dry, heated air	Variety of foods, such as cakes, cookies, pastries, quick breads, quiche and casseroles	Best used with a single rack
<b>Roast</b>		Uses more intense heat from upper element, more browning of exterior	Best suited for meats, poultry, less tender cuts of meats and roasting vegetables	Preheat not necessary. Use for cooking bags and covered bakeware
<b>Broil</b>		Uses intense heat radiated from the upper element	Tender cuts of meat (1" or less), poultry, browning bread & casseroles	Preheat oven 3 - 4 minutes. Use with rack in pan to drain fat away. Turn meat once
<b>Warm</b>		Maintains a low temperature in order to keep food hot	Keeping cooked foods at serving temperature	To keep food moist, cover with lid or foil. To keep food dry, do not cover
<b>Proof*</b>		Maintains a low temperature for proofing bread or other yeast doughs.	Rising of bread dough containing yeast	Loosely cover dough with a cloth for rising
<b>Convection Bake*</b>		Similar to Bake, but air is circulated by a fan at the back of the oven	Best for baked goods such as cakes, cornbread, pies, quick breads, tarts, and yeast breads	Reduce temperature 25°F from recipe. Use for <b>1 or 2 racks</b> of food
<b>Convection Multi-Rack*</b>		Circulates heat uniformly using fan and heating element in the back	Use for biscuits, cookies, cream puffs, cupcakes, dinner rolls, and muffins	Reduce temperature 25°F from recipe. Use for <b>2 and 3 racks</b> of food
<b>Convection Roast*</b>		Uses lower and more intense heat from upper element than Convection Bake with air circulated by a fan	Tender cuts of meat and poultry. Roasting vegetables. Meats are more juicy and moist than results with Roast mode	Preheat not necessary. Use recipe/cooking chart temperature. Use open roasting pan with rack
<b>Pizza*</b>		Similar to Bake, but air is circulated from a fan at the back of the oven that cycles on and off	All types of pizza - fresh, frozen, prebaked crust, ready-to-bake	Preheat baking stone while preheating. Crispy crust use oven rack. Best browning use dark coated pizza pan
<b>Convection Broil*</b>		Combines intense heat from upper element with fan circulation	Tender cuts of meat (more than 1"), poultry and fish. Not for browning	Preheat oven 3 - 4 minutes. Use with rack in pan to drain fat away. Turn meat once
<b>Frozen Foods*</b>		Uses all the heating elements as well as the convection fan to evenly distribute heat	Frozen convenience foods such as fish sticks, chicken nuggets and french fries.	No preheating required
<b>Eco Chef*</b>		Uses residual heat to reduce energy consumption during cooking	Tender cuts of meat and poultry	Requires use of probe. Allow 5 - 10 minute stand time outside the oven
 <b>CAUTION</b>	Do not use the Warm mode to warm cold food. Maintain proper food temperature (USDA recommends 140°F or higher). <b>DO NOT</b> keep food warm for longer than 1 hour.			

\* available in some models

### Pan Placement

Baking results are better if pans are placed in the center of the oven.

- Place a single pan in the center of the oven rack
- Allow 1" to 1 1/2" around pans
- Stagger pans if used on two racks so one pan is not above another

### Baking Pans and Dishes

Use light anodized or shiny metal bakeware for tender, light, golden brown crusts.

Dark, rough or dull pans absorb heat and will result in a browner, crisper crust. Follow the manufacturer's recommendations in selecting baking temperatures.

Insulated cookie sheets or bakeware will increase the length of cooking time.

Use low-sided, uncovered pans for convection modes.

### For Best Cooking Results

- Open the oven door as briefly as possible to avoid reducing the oven temperature.
- Use the interior oven light to view the food through the oven window rather than opening the door frequently.
- When using Convection baking modes (including Multi-Rack), set the oven temperature 25° lower than indicated in conventional baking recipes or package directions.
- Preheat oven for baked goods and pizza.

# Cooking Charts

## Baked Goods

Type	Food	Recommended Mode		Oven Temp. (in °F)	No. of Racks	Rack Position(s)	Cooking Time (minutes)
		Non-Conv	Convection				
Cakes	Cupcakes	Bake		350	1	4	17 - 24
		Conv Multi Rack*		325	2	2 & 5	17 - 23
		Conv Multi Rack*		325	3	1, 3 & 5	17 - 23
Cakes	Cakes	Bake		350	1	3	23 - 31
		Convection Bake*		325	2	2 & 5	23 - 30
Cookies	Brownies	Bake		350	1	3	33 - 41
		Conv Bake		325	1	3	33 - 40
Cookies	Cookies	Bake		350	1	3	
		Conv Multi Rack*		325	2	2 & 5	8 - 17
		Conv Multi Rack*		325	3	1, 3 & 5	8 - 17
Breads	Biscuits/Muffins	Bake		350	1	3 or 2	12 - 20
		Conv Multi Rack*		325	2	2 & 5	10 - 20
		Conv Multi Rack*		325	3	1, 3 & 5	10 - 20
Breads	Quick Bread	Conv Bake		350	1	2	48 - 60
	Yeast Bread	Conv Bake		400	1	2	22 - 35
Pie	Fruit, Fresh	Bake		400	1	2	35 - 50
	Pumpkin	Bake		425	1	2	15
Pizza	Frozen, thin crust	Bake		350	1	2	35 - 45
		Bake		425	1	3	recipe time
		Plizza*		425	1	3	recipe time
		Bake		425	1	3	recipe time
		Plizza		425	1	3	recipe time
		Bake		425	1	2	recipe time
Entrees	Casseroles	Bake		350 - 400	1	3	per recipe
		Bake		per package	1	3	per package
		Frozen Foods*		per package	1	3	per package
	Garlic Bread	Broil		Low			
		Bake		425	1	2	
	Vegetables, roasted	Bake		375	1	3	
Roast			400 - 500	1	3	15 - 30	
		Conv Roast *		400 - 500	1	3	15 - 30

\* In models with convection. The convection temperatures have been reduced 25°F from the recipe's or package's directions.

## Meat, Poultry, Fish

Type	Food	Recommended Mode		Oven Temp. (in °F)	Rack Position(s)	Final Internal Temperature	Cooking Time (minutes)
		Non-Conv	Convection				
Beef	Chuck Roast (2-3 lbs)	Roast	Roast	350	2	Well, 170°	1 1/2 - 2 hr
	Beef roast boneless 3 - 5.5 lbs	Roast	Conv Roast	325	2 & 5	Med-rare, 145°	18-33 min/lb
	Beef roast boneless 3 - 5.5 lbs	Roast	Conv Roast	325	2 & 5	Medium, 160°	30-35 min/lb
	Steaks, 1 inch thick	Broil	Broil	High	6	Med-rare, 145°	side 1 - 5-8 min. side 2 - 14-6 min.
	Steaks, 1 inch thick	Broil	Broil	High	6	Medium, 160°F	side 1 - 8-9 min. side 2 - 5-7 min.
Pork	Meatloaf, 1 - 2 lbs.	Roast	Roast	350°	2	160° F	50 - 60 min.
	Pork Loin Roast, 1.5 - 3 lbs.	Roast	Conv. Roast	350°	2	Medium, 160°F	19 - 36 min/lb
	Pork Loin Roast, 3 - 6 lbs.	Roast	Conv. Roast	350°	2	Medium, 160°F	19 - 36 min/lb
	Tenderloin, 1.5 - 3 lbs.	Roast	Conv. Roast	425°	2	Medium rare, 145°F	15 - 28 min/lb
Poultry	Chicken breasts, bone-in	Broil	Conv. Broil	Low	3	170° F	side 1 - 18-22min. side 2 - 12-13 min.
	Chicken thighs, bone-in	Broil	Broil	Low	3	180° F in thigh	side 1 - 14-15min. side 2 - 17-20 min.
	Chicken, whole 3.5 - 8 lbs.	Roast	Conv. Roast	375° F	2	180° F in thigh	13 - 20 min/lb
	Turkey, unstuffed, 12 - 19 lbs.	Roast	Conv. Roast	325° F	2	180° F in thigh	9 - 14 min/lb
	Turkey, unstuffed, 20 - 25 lbs.	Roast	Conv. Roast	325° F	2	180° F in thigh	6 - 12 min/lb
Fish	Fish Filets, 3/4" to 1" thick	Broil	Broil	Low	3	145° F	11 - 15 min.

Note: Roast times are approximate and may vary depending on the shape of the meat.

## Troubleshooting

Before calling customer service, consult this troubleshooting guide. Customer education issues are not covered by the appliance warranty. Refer to the Use and Care manual for additional information.

Problem	Possible Cause	Suggested Solution
Oven door is locked and will not open, even after cooling	Circuit breaker tripped	Reset circuit breaker (turn off, wait five minutes, turn back on)
Oven is not heating	Power not reaching oven. Temperature not set.	Restore power to oven. Select oven temperature.
Baking results not as expected	Rack position incorrect. Oven calibration needed for temperature offset. See cooking tips in Use & Care manual.	Refer to cooking chart for correct rack position. Adjust oven calibration if necessary, see "Oven Temperature Offset" in Custom Settings.
Food takes longer to cook than expected or is overcooked	Oven temperature offset needed	Adjust oven calibration if necessary, see "Oven Temperature Offset" in Custom Settings.
Convection Bake or Conv. Multi-Rack (some models) results are not as expected	Oven temperature needs to be reduced by 25° F. Incorrect rack position, cooking time, pan selection. Oven calibration needed.	Refer to cooking chart for correct rack position. Adjust oven calibration if necessary, see "Oven Temperature Offset" in Custom Settings.
Oven temperature too hot or too cool	Oven thermostat adjustment needed.	Adjust oven calibration if necessary, see "Oven Temperature Offset" in Custom Settings.
Oven light not working properly	Bulb loose or defective	Reinsert or replace the bulb (avoid touching bulb glass with fingers to avoid premature burnout due to oil deposits.)
Can not remove light lens cover	Soil buildup around lens cover. Lens catch not released.	Wipe lens cover area with a clean, dry towel prior to removing. Consult Use & Care manual for lens removal technique.
Oven is not self-cleaning properly	Oven was not cooled down prior to starting self clean.	Allow oven to cool down before running self clean. Wipe out loose soiling or spills before running self clean. If oven is badly soiled, set oven for the maximum self clean time.
"E" and a number appears in the display and the control panel emits a beep	This is a Fault Code.	Press any key or turn selection dial to cancel beeping. To clear Fault Code: (500 Series) turn control knob to "Off" position, (800 Series) Press the oven On/Off button to turn the oven Off. If the fault code remains displayed, reset oven (turn off circuit breaker for 20 seconds). If still displayed, contact Customer Service.
Odor detected on new oven use	This is normal with a new oven.	Will disappear after a few uses. Wiping oven cavity out when cool and then running a self-clean cycle may help reduce the odor more quickly.
Control panel does not respond to key press	Center of key not pressed with flat part of fingertip.	Touch the center part of the touch key using the flat pad of a fingertip. Be sure the panel surface is clean and dry.
Conv. fan runs during modes that do not use convection	This is normal in some modes while the oven is preheating.	No action required if the fan runs during preheating in certain non-convection modes.
Warm air or steam is seen escaping from the oven vent	This is normal to see or feel steam or warm air coming from the oven vent.	No action required, do not block the vent.
Cooking fan runs after the oven is turned "Off"	This is normal. The fan aids in oven cooling.	No action required. The cooling fan will continue to run until the oven has cooled sufficiently.

## Customer Service

Please check the troubleshooting pages in this guide before calling Customer Service. Commonly asked questions are addressed there and may resolve your issue the fastest. In the event you still need to contact Customer Service, there is some information you can have ready to speed up the process: 1) model & serial number 2) date of purchase.

Don't forget to register your oven so you will receive notices, updates and offers as they become available. This also will help provide quick and efficient support for your specific unit.

Data plate shows model and serial number. It is visible with the oven door open. Consult your oven's user manual for the specific label location.

### To contact customer service:

US: 800-944-2904

Web: [www.bosch-home.com.us](http://www.bosch-home.com.us)

Parts & Accessories: [www.bosch-eshop.us](http://www.bosch-eshop.us)

# 24" Counter-Depth Bottom-Freezer

500 Series – Stainless Steel B11CB50SSS



**B11CB50SSS**  
Stainless Steel

The specifically engineered hidden hinge and reversible doors allow for a next-to-wall placement and nearly flush installation.

## Features & Benefits

The LED lighting shines exceptionally bright and saves energy.

Ideal for compact kitchen layouts in metropolitan areas.

The HydroFresh drawer keeps fruit and vegetables fresh longer.

ENERGY STAR® qualified for energy efficiency.

Use the wine rack to store your favorite wine bottles.

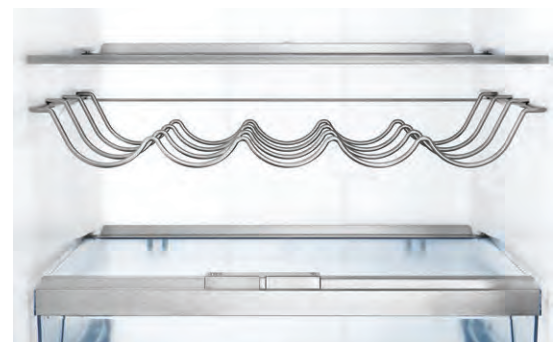
General Properties	
Reversible door hinge	Yes
Water filter	No
Lighting	LED
Defrost process refrigerator section	Frost-free
Number of shelves - refrigerator	3
Adjustable shelves - refrigerator	2
Shelf material - refrigerator	Tempered glass
Type of shelves - refrigerator	Spill-proof glass
Gallon storage bins	0
Humidity control drawer	1
Defrost process freezer section	Automatic
Number of drawers - freezer	3
Adjustable shelves - freezer	N/A
Shelf material - freezer	Metal
Type of shelves - freezer	Wire
Ice maker	No
Quick ice	N/A
Capacity	
Total unit gross capacity (cu. ft.) - AHAM	11 cu. ft.
Refrigerator gross capacity (cu. ft.)	7.7 cu. ft.
Freezer gross capacity (cu. ft.)	3.3 cu. ft.

Technical Details	
Current (A)	15 A
Volts (V)	120 V
Frequency (Hz)	60 Hz
Power cord length (in.)	94"
Plug type	120V-3 prong

Dimensions & Weight	
Appliance dimensions (H x W x D) (in.)	78 7/8" x 23 1/2" x 23 7/8"
Required cutout size (H x W x D) (in.)	79 1/2" x 24" x 24"
Net weight (lbs)	181 lbs

Efficiency	
ENERGY STAR® qualified	Yes
Energy consumption (kWh/yr)	357 kWh

Accessories—Included	
Included	Wine rack, ice tray, egg tray, bottle holder



For help and assistance with Bosch accessories please visit: [www.bosch-eshop.com/eshop/bosch/us](http://www.bosch-eshop.com/eshop/bosch/us) or call 1-800-944-2904 Mon-Fri 5am to 6pm PST Sat 6am to 3pm PST

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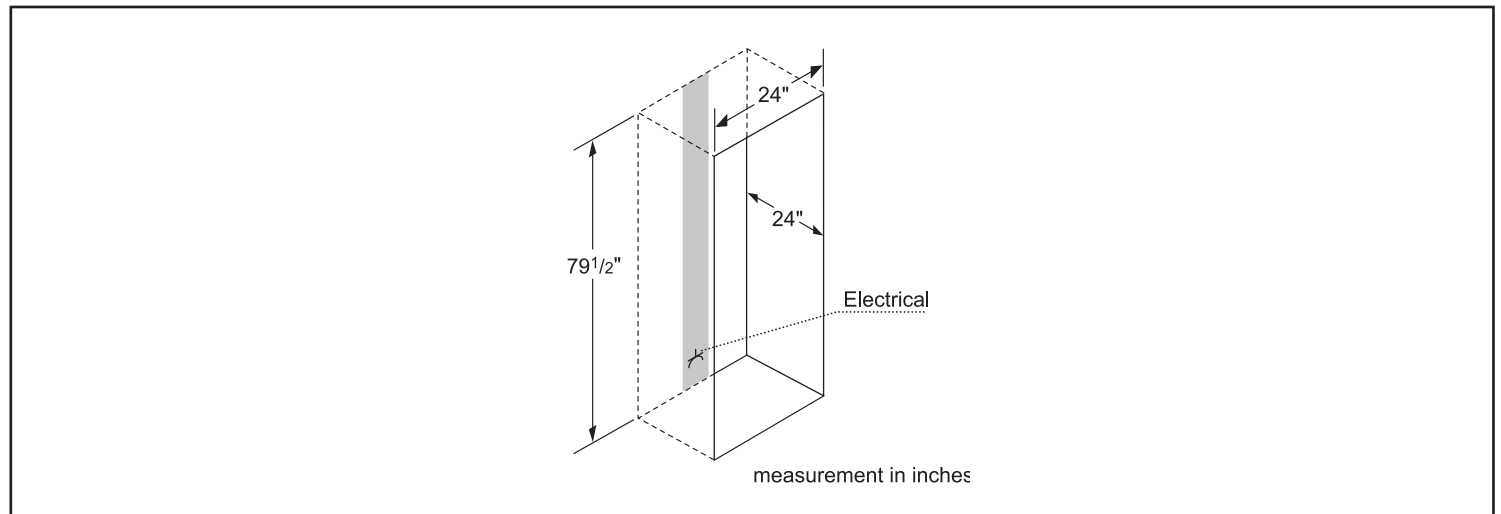
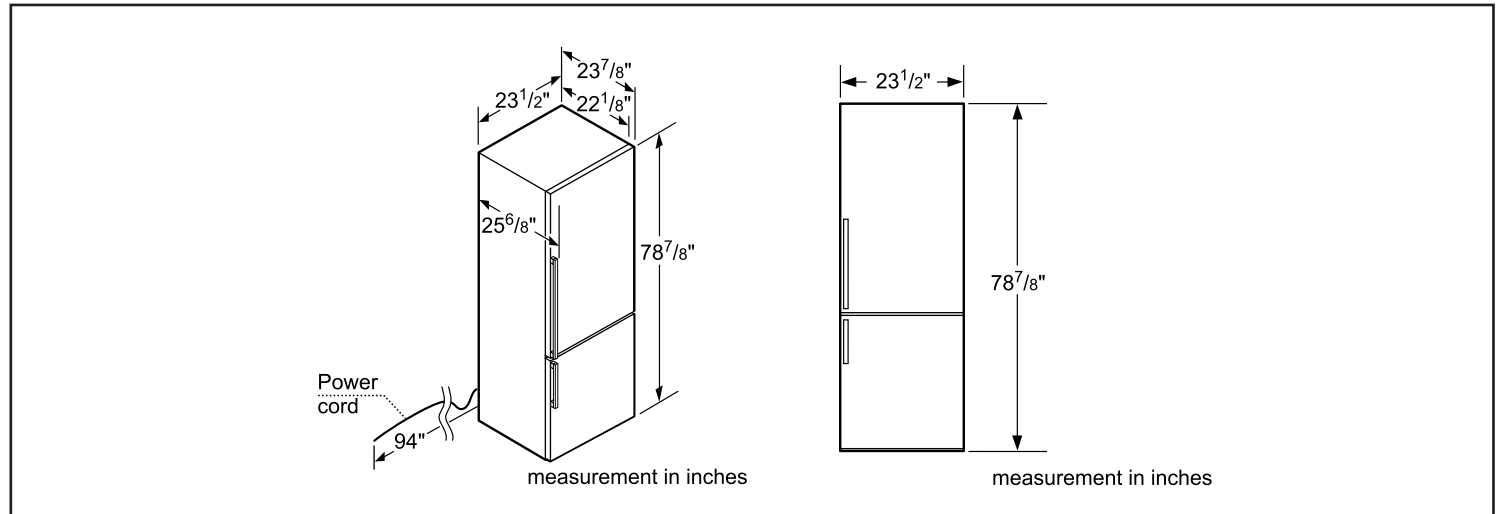
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# 24" Counter-Depth Bottom-Freezer

500 Series – Stainless Steel B11CB50SSS



## Installation Details



For help and assistance with Bosch accessories please visit: [www.bosch-eshop.com/eshop/bosch/us](http://www.bosch-eshop.com/eshop/bosch/us) or call 1-800-944-2904 Mon-Fri 5am to 6pm PST Sat 6am to 3pm PST

Notes: All height, width and depth dimensions are shown in inches. Please refer to installation instructions prior to making cutout. BSH reserves the absolute and unrestricted right to change product materials and specifications, at any time, without notice. Consult the product's installation instructions for final dimensional data and other details. Applicable product warranty can be found in accompanying product literature or you may contact your account manager for further details.

Warranties: Bosch warrants that the Product is free from defects in materials and workmanship for a period of three hundred and sixty-five (365) days from the date of purchase. The foregoing timeline begins to run upon the date of purchase, and shall not be stalled, tolled, extended, or suspended, for any reason whatsoever. This Product is also warranted to be free from cosmetic defects in material and workmanship (such as scratches of stainless steel, paint/porcelain blemishes, chip, dents, or other damage to the finish of the Product, for a period of thirty (30) days from the date of purchase or closing date for new construction. This cosmetic warranty excludes slight color variations due to inherent differences in painted and porcelain parts, as well as differences caused by kitchen lighting, product location, or other similar factors. This cosmetic warranty specifically excludes any display, floor, "As Is", or "B" stock appliances.

For more information on our entire line of products, go to [www.bosch-home.com/us](http://www.bosch-home.com/us) or call 1-800-944-2904

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# Fit speed and style just about anywhere

2014 24" Compact Laundry Brochure



**BOSCH**

Invented for life



## 24" Compact Laundry



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**Commitment to quality.** That's the thinking behind Bosch's German-engineered compact 24" washer and dryer. The matching laundry units are the optimal luxury upgrade to any home. As the European market leader for washing machines\*, our laundry products offer the perfect combination of function and style.

## Design

### Design options

The Bosch compact laundry pairs feature matching washer and dryer designs across the different series. The series specific design accents include white, silver or chrome control knobs, buttons and door ring.



Axxis+ Washer  
WAP24202UC



Axxis+ Dryer  
WTB86202UC

### LED Control Panel

The sleek design is apparent in the larger LED control panel which is easier to read and operate.



### Bosch Magneto

The compact laundry units feature the iconic Bosch Magneto\*.



\*On Axxis and Axxis+ models only.

## Design step up features



Ascenta Washer  
WAP24200UC



Ascenta Dryer  
WTB86200UC



Axxis® Washer  
WAP24201UC



Axxis® Dryer  
WTB86201UC



Axxis+ Washer  
WAP24202UC



Axxis+ Dryer  
WTB86202UC

Ascenta Series	Axxis	Axxis+
White design accents	+ Silver design accents	+ Chrome design accents
Stainless steel structured drum for washer	+ Stainless steel structured drum for washer and dryer	+ Interior light for dryer
Large LED display	+ Bosch Magneto on the door	
	+ Reversible dryer door	



## Installation

### Flexible and easy installation

Combining simple installation with a compact form, Bosch gives you the flexibility to place the washer in an area that's most convenient for the home. You can install your laundry appliances stacked, side by side, on 16" pedestals, in a closet or under a counter.



### Reversible Door

Selected Bosch dryers offer the option of a reversible door to enhance ease of use and multiple installation choices.



### Ventless Installation

Offering the latest technology on the market, condensation drying condenses the moisture in the hot air and releases it through the water drain via an internal pump. This way, no ducting and no blower or venting are necessary to help expel hot air. With no ducting to be installed, this makes installation easy, fast and cost-effective.

### Flexible Accessories

- WTZ20410 – Stationary Stacking Kit
- WTZ11400 – Stacking Kit with Pull Out Tray
- WMZ20490 – Washer Pedestal
- WMZ20500 – Dryer Pedestal

---

## Installation cost savings

Bosch compact washers and dryers not only offer space savings due to their size and the way they are installed, but they also offer cost savings.

- No additional power cord needed** \$  
Additional savings for the need of a power cord.
  
- No additional plugs needed** \$\$  
With the washer plugging into the dryer and only requiring one outlet, the installation of a second plug or wall mount kit is no longer needed.
  
- No ducting needed** \$\$  
Condensation drying provides the flexibility of installation options without installing ducting.
  
- No leak risk** \$\$\$  
With the AquaStop® and AquaShield® water leak protection systems, cost savings on the need of a smitty pan and potential floor damage.



---

## Quality

### Dirty to dry in 30 minutes

With a 15 minute wash and 15 minute dry cycle, Bosch laundry offers the fastest combined wash and dry time in the industry. Can be used on any small, lightly soiled load, such as 5 dress shirts.

### Large capacity

Even with a small footprint, our washer features a larger capacity and holds more than most. At 2.16 cubic feet the units have the capability to wash and dry 18 large bath towels. An expansive viewing window and lightweight door make loading and unloading a snap.



### ENERGY STAR® compliant

All Bosch compact washers are ultra-efficient. In fact, they exceed ENERGY STAR® requirements by up to 20%.

### AquaShield®

The AquaShield System consists of a special double-walled feed hose and safety valve which provides protection against water damage.

### AquaStop®

The AquaStop System consists of the AquaShield double-walled feed hose, a safety valve and a floor tank with float switch to provide extensive protection against water damage. A smitty pan is no longer required to protect floors from water damage.

### Quiet operation

The Anti-Vibration system encompasses 3D sensors in Bosch washers that monitor the load weight and movement of the drum in three dimensions to eliminate imbalances. Additionally, the circular tub design reinforces the structure of the sidewall and increases the stability of the washer. This structure combined with enhanced insulation regulate noise levels and reduce vibration up to 30%\*, making Bosch washers very quiet throughout the entire wash cycle.

### Raindrop structured drum

Bosch washers feature an innovative raindrop drum pattern that delivers a tailored solution for all fabric types, for powerful cleaning that protects your clothes. Depending on the cycle, the washer adjusts the direction of the drum rotation, using the steeper edges for heavy duty or shallow edges for delicate fabrics that require gentler care.



---

## Compact washers

**WAP24200UC**



### Ascenta

- 2.16 cu.ft. (15.4 lbs) capacity
- Stainless steel raindrop structured drum
- Anti-vibration system
- ENERGY STAR® qualified

**WAP24201UC**



### Axxis®

- + 2.16 cu.ft. (17.6 lbs) capacity
- + Silver design highlights: Dial, buttons, door trim
- + AquaShield® Water Safety System
- + Premium window design: Bosch Magneto

**WAP24202UC**



### Axxis+

- + Chrome design highlights: Dial, buttons, door trim
- + Super Quick 15 minute cycle
- + AquaStop® Exclusive Water Safety System
- + Mixed load cycle

---

## Compact dryers

**WTB86200UC**



### Ascenta

- 4.0 cu.ft. (15.4 lbs) capacity
- Washer plugs into the dryer
- 15 Programs / 6 Options
- Rigid anti-vibration circular side walls

**WTB86201UC**



### Axxis®

- + 4.0 cu.ft. (17.6 lbs) capacity
- + Silver design highlights: Dial, buttons, door trim
- + Premium window design: Bosch Magneto
- + Reversible door

**WTB86202UC**



### Axxis+

- + Chrome design highlights: Dial, buttons, door trim
- + Interior drum light
- + Super Quick 15 minute program

# Compact Washer Technical Details

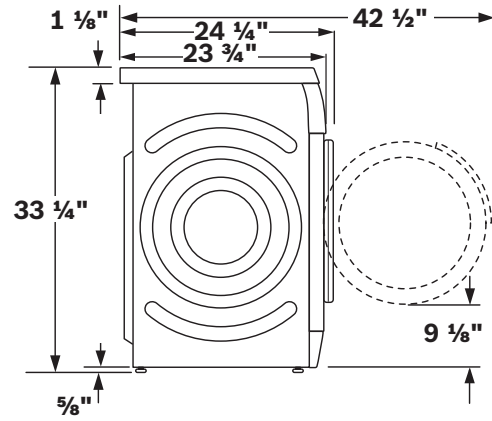
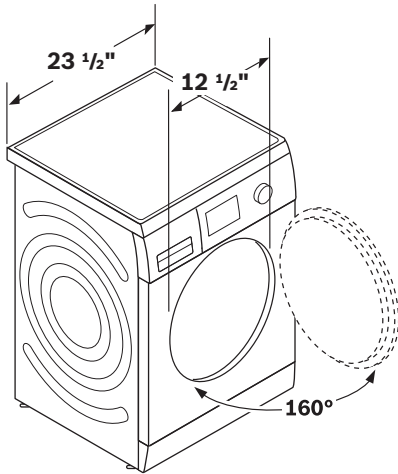
Series	Ascenta Washer	Axxis® Washer	Axxis® Plus Washer
<b>Color</b>			
White	WAP24200UC	WAP24201UC	WAP24202UC
<b>Core Features</b>			
Capacity DOE(cu ft)	2.16 cu ft	2.16 cu ft	2.16 cu ft
Washing Capability	16 towels	18 towels	18 towels
Spin Speed	1,200 rpm	1,200 rpm	1,200 rpm
Silence Rating – Washing	59 dBA	59 dBA	59 dBA
Number of Wash Cycles	15	15	15
Number of Wash Options	6	6	6
<b>Efficiency</b>			
ENERGY STAR® Qualified	■	■	■
Energy Use	135 kWh/y	135 kWh/y	135 kWh/y
CEE Tier	II	II	II
Modified Energy Factor (MEF)	2.3	2.3	2.3
Water Factor (WF)	4.3	4.3	4.3
Annual Water Consumption (gallons/year)	3,640	3,640	3,640
<b>Design Elements</b>			
Display	Large LED Display	Large LED Display	Large LED Display
Cabinet	White	White	White
Dial and Buttons	White	Silver	Chrome
Door	White	Silver	Chrome
Bosch Magneto	■	■	■
Drum	Stainless Steel, Structured Drum	Stainless Steel, Structured Drum	Stainless Steel, Structured Drum
<b>Cycles</b>	15	15	15
Cotton Normal	■	■	■
Cotton Heavy Soil	■	■	■
Cotton Light Soil	■	■	■
Permanent Press	■	■	■
Permanent Press Heavy Soil	■	■	■
Permanent Press Light Soil	■	■	■
Sanitary	■	■	■
Jeans	■	■	■
Quick Wash 30 min	■	■	■
Heavy Duty	■	■	■
Delicates	■	■	■
Woolens/Hand wash	■	■	■
Active Wear	■	■	■
Anti-shrink	■	■	■
Towels	■	■	■
Super Quick 15 min	■	■	■
Mixed	■	■	■
Whitest Whites	■	■	■
Maintenance	■	■	■
Spin/Drain	■	■	■
Rinse	■	■	■
<b>Options</b>	6	6	6
Easy Iron	■	■	■
Extra Rinse	■	■	■
Prewash	■	■	■
Temperature Selection	■	■	■
Spin Speed Selection	■	■	■
Delay Start	■	■	■
<b>Advanced Features</b>			
AquaStop® Leak Protection	■	■	■
AquaShield® Leak Protection	■	■	■
Reinforced Water Supply Hoses	■	■	■
Anti-vibration Design	■	■	■
3D Sensor	■	■	■
Control Types	Electronic	Electronic	Electronic
Raindrop Structured Drum	■	■	■
Internal Water Heater	■	■	■
Self-cleaning Detergent Drawer	■	■	■
Sensor Controlled Washing	■	■	■
Adjustable Signal	■	■	■
<b>Dimensions</b>			
Product HxWxD	33 ¼" x 23 ½" x 24 ¼"	33 ¼" x 23 ½" x 25"	33 ¼" x 23 ½" x 25"
Packaging HxWxD	34 ¼" x 25 ¼" x 26 ¾"	34 ¼" x 25 ¼" x 26 ¾"	34 ¼" x 25 ¼" x 26 ¾"
Minimum Staking Height	67 ¾"	67 ¾"	67 ¾"
Leveling Legs/Height Adjustment Range	Yes, ½"	Yes, ½"	Yes, ½"
Weight	170 lb	170 lb	170 lb
Shipping Weight	173 lb	173 lb	173 lb
Door Opening (Angle)	160°	180°	180°
<b>Technical Information</b>			
Supply Voltage	208/240 V	208/240 V	208/240 V
Frequency	60 Hz	60 Hz	60 Hz
Amperage	12 A	12 A	12 A
Required Circuit Amperage when Washer	30 A	30 A	30 A
Connected Load	2,300 W	2,300 W	2,300 W
Plug Included	240V 3-prong	240V 3-prong	240V 3-prong
Plug into Dryer	■	■	■
Plug Type	NEMA 6-15 (3 prong)	NEMA 6-15 (3 prong)	NEMA 6-15 (3 prong)
Power Cord Included	Yes	Yes	Yes
Power Cord Length	61"	61"	61"
Drain Hose Length	57"	57"	57"
Inlet Hose Length	47"	59"	59"

# Compact Dryer Technical Details

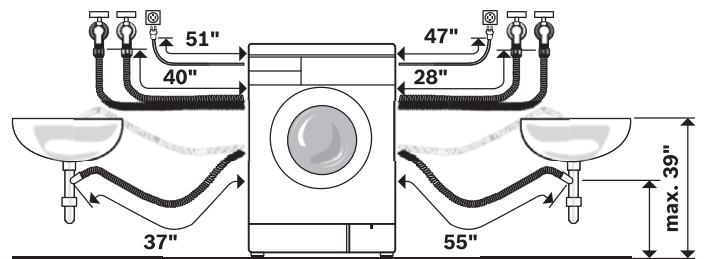
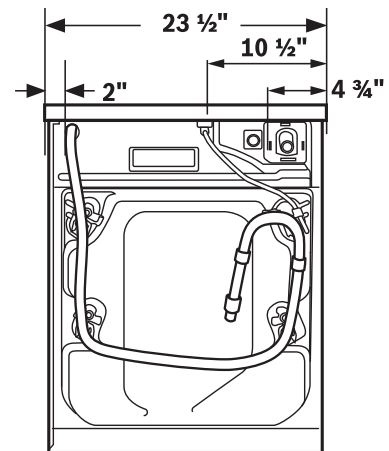
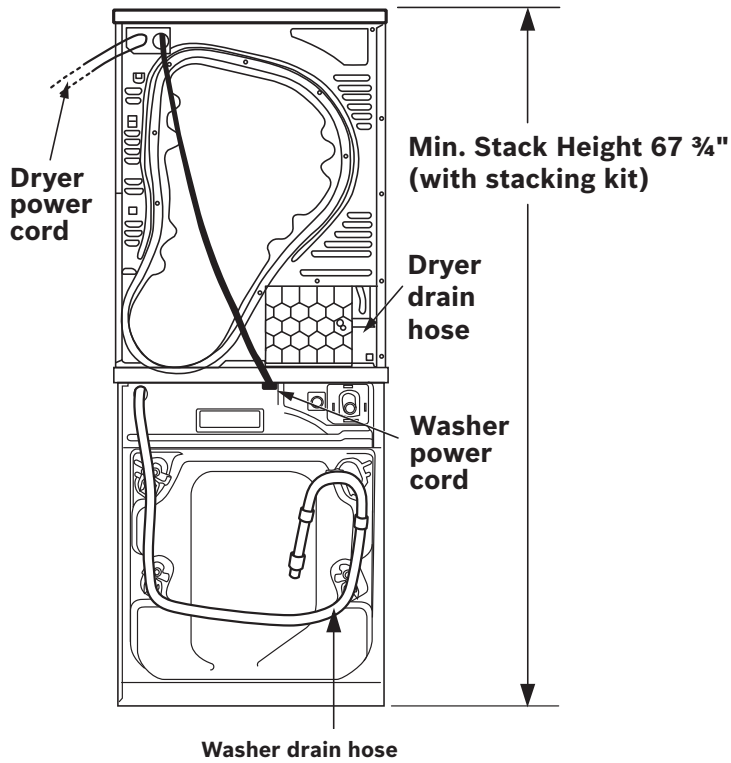
Series	Ascenta Condensation Dryer	Axxis® Condensation Dryer	Axxis® Plus Condensation Dryer
<b>Color</b>			
White	WTB86200UC	WTB86201UC	WTB86202UC
<b>Core Features</b>			
Capacity (cu ft)	4.0 cu ft	4.0 cu ft	4.0 cu ft
Drying Capability	16 towels	18 towels	18 towels
Silence Rating	65 dBA	65 dBA	65 dBA
Number of Drying Programs	15	15	15
Number of Drying Options	6	6	6
<b>Design Elements</b>			
Display	Large LED Display	Large LED Display	Large LED Display
Cabinet	White	White	White
Dial and Buttons	White	Silver	Chrome
Door	White	Silver	Chrome
Bosch Magneto	■	■	■
See-thru Door	■	■	■
Drum	Galvalume Drum	One Piece Stainless Steel, Structured Drum	One Piece Stainless Steel, Structured Drum
<b>Programs</b>	15	15	15
Cotton Extra Dry	■	■	■
Cotton Dry (Regular)	■	■	■
Cotton Damp	■	■	■
Permanent Press Extra Dry	■	■	■
Permanent Press Dry	■	■	■
Permanent Press Damp	■	■	■
Sanitary	■	■	■
Jeans	■	■	■
Quick Dry	■	■	■
Air Fluff/No Heat	■	■	■
Time Dry	■	■	■
Time Program 40 Hot	■	■	■
Delicates	■	■	■
Heavy Duty	■	■	■
Super Quick 15 min	■	■	■
Active Wear	■	■	■
Anti-shrink	■	■	■
Woolens	■	■	■
Towels	■	■	■
Iron Dry	■	■	■
Mixed	■	■	■
<b>Options</b>	6	6	6
Time Dry	■	■	■
Dry Level	■	■	■
Finished in	■	■	■
Low Heat	■	■	■
WrinkleBlock®	■	■	■
Signal	■	■	■
<b>Advanced Features</b>			
Control Types	Electronic	Electronic	Electronic
Unique Structured Drum	■	■	■
WrinkleBlock®	Up to 60 min	Up to 60 min	Up to 60 min
Fully Electronic Moisture Sensor	■	■	■
Reversible Door	■	■	■
Interior Light	■	■	■
Lint Filter Indicator	■	■	■
<b>Dimensions</b>			
Product HxWxD	33 ¼"x 23 ½"x 25"	33 ¼"x 23 ½"x 25"	33 ¼"x 23 ½"x 25"
Packaging HxWxD	34 ¼"x 25 ¼"x 26 ¾"	34 ¼"x 25 ¼"x 26 ¾"	34 ¼"x 25 ¼"x 26 ¾"
Minimum Staking Height	67 ¾"	67 ¾"	67 ¾"
Leveling Legs/Height Adjustment Range	Yes, ⅝"	Yes, ⅝"	Yes, ⅝"
Weight	99 lb	99 lb	99 lb
Shipping Weight	101 lb	101 lb	101 lb
Door Opening (Angle)	180°	180°	180°
<b>Technical Information</b>			
Supply Voltage	208/220-240 V	208-240 V	208-240 V
Frequency	60 Hz	60 Hz	60 Hz
Connected Load	2,800 W	2,800 W	2,800 W
Amperage	13 A	13 A	13 A
Required Circuit Amperage	30 A	30 A	30 A
Air-Flow-Intake	118 CFM (200 m³/h)	118 CFM (200 m³/h)	118 CFM (200 m³/h)
Plug Included	NEMA 14-30 (4-prong)	NEMA 14-30 (4-prong)	NEMA 14-30 (4-prong)
Type	Electric	Electric	Electric
Drain Pump and Hose	Yes, Dryer and Washer Drain Hoses Routed Together	Yes, Dryer and Washer Drain Hoses Routed Together	Yes, Dryer and Washer Drain Hoses Routed Together

## Dimensions and Installation

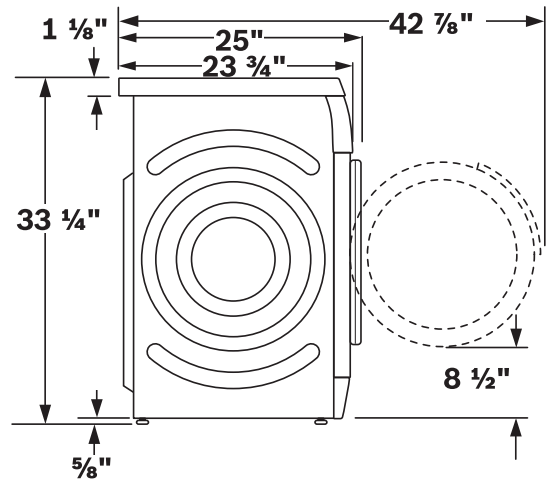
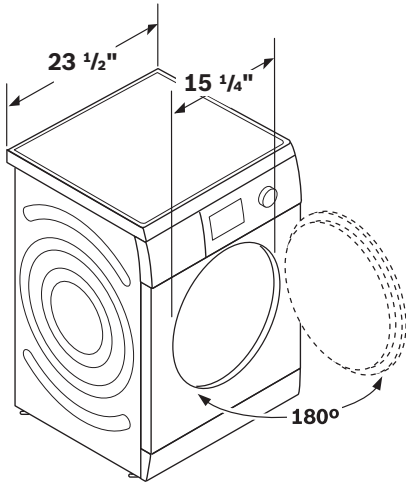
### Ascenta Washer - WAP24200UC



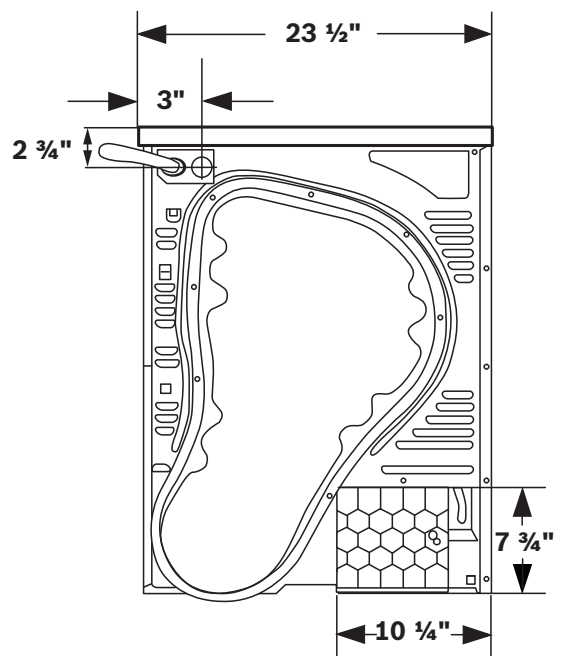
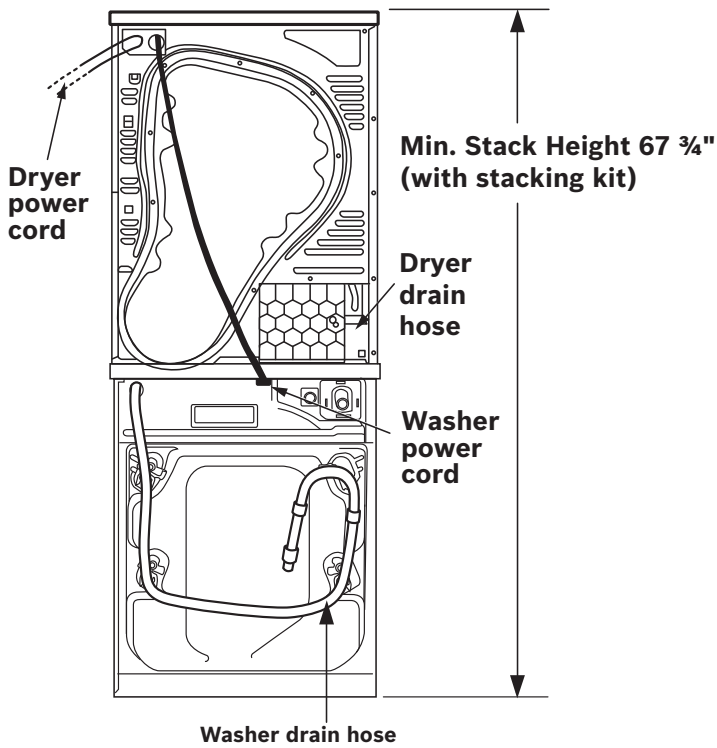
### Washer plugged into the dryer



Ascenta Dryer - WTB86200UC



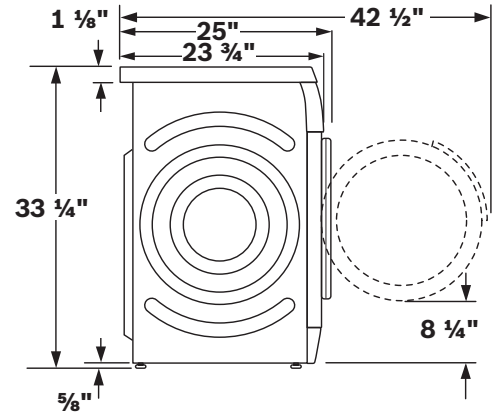
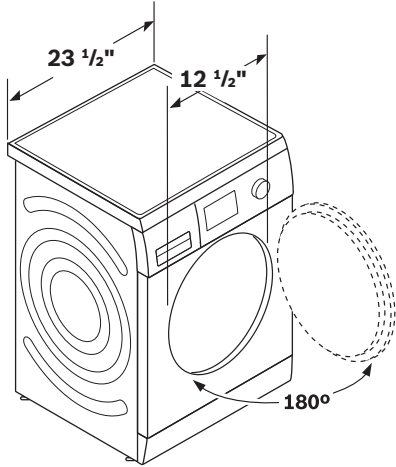
Washer plugged into the dryer



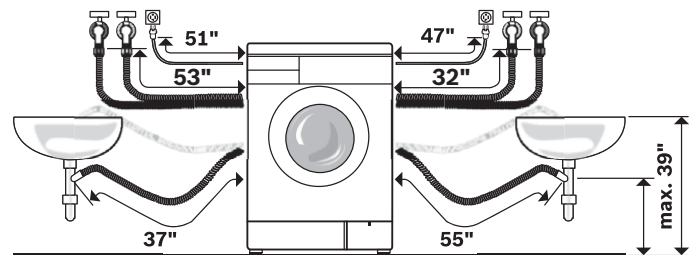
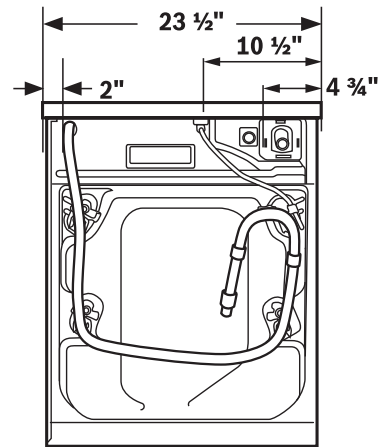
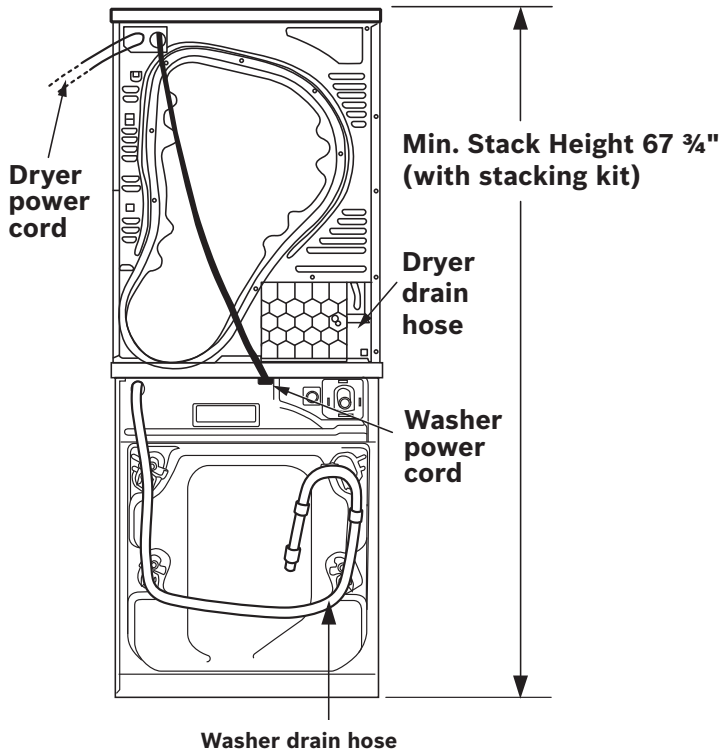


## Dimensions and Installation

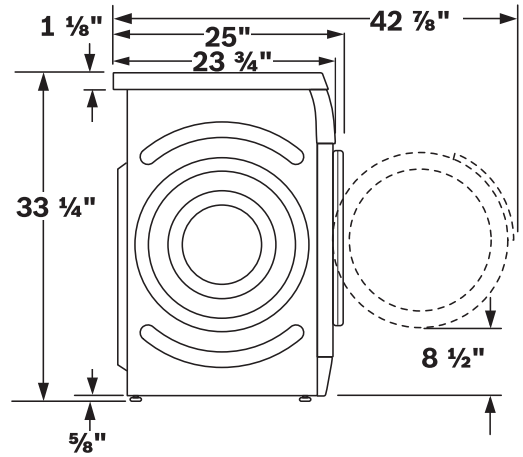
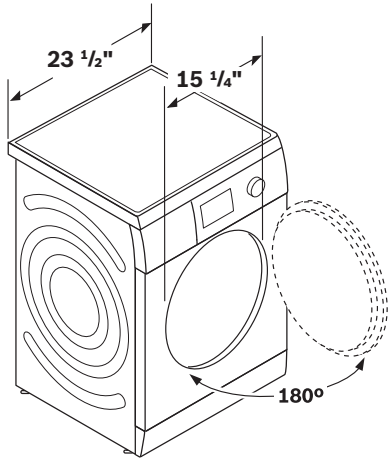
Axxis® (WAP24201UC ) and Axxis® + (WAP24202UC) Washer



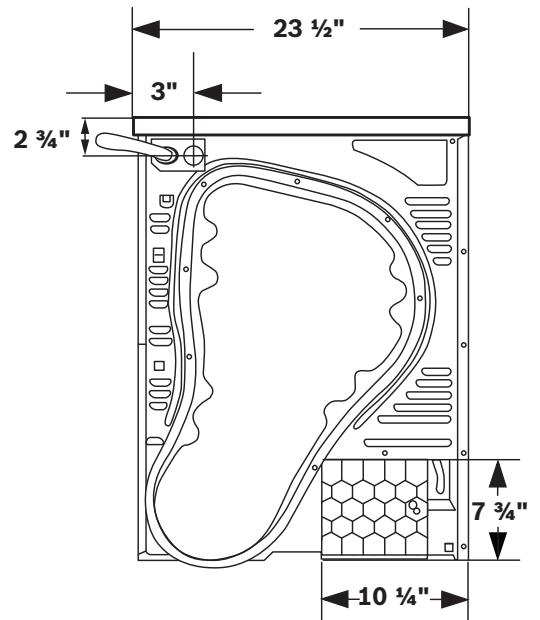
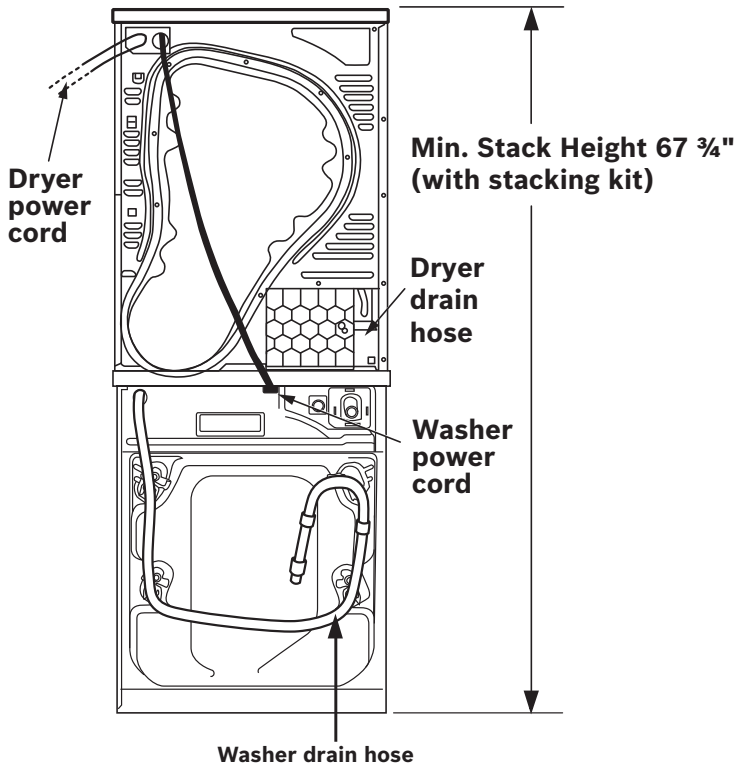
Washer plugged into the dryer



**Axxis® (WTB86201UC ) and Axxis® + (WTB86202UC) Dryer**

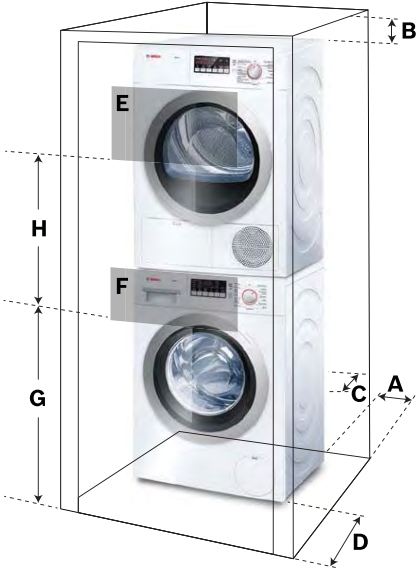


**Washer plugged into the dryer**

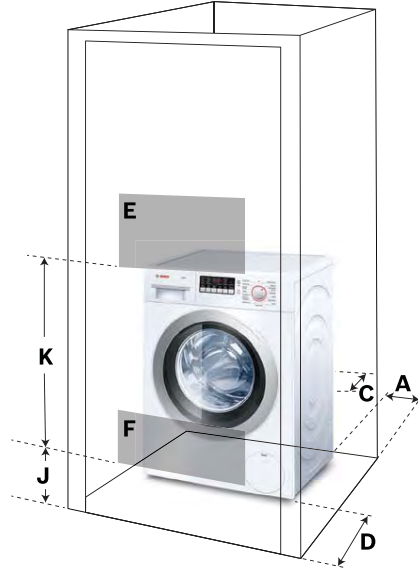


## Dimensions and Installation

### Closet: Stacked



### Closet: Stand Alone (shown) or Side by Side



#### Clearance requirements (Minimum)

A Both Sides	5/8 in.
B Top	6 1/4 in.
C Rear	3 1/4 in.
D Front	3 1/2 in.

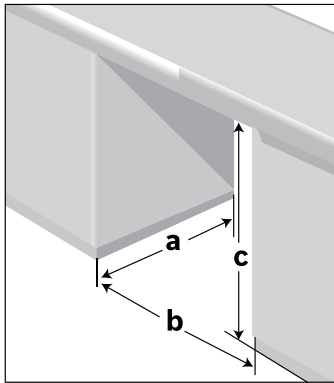
#### Ventilation Area (Minimum)

E Top	63 sq. in.
F Bottom	63 sq. in.

#### Vent Spacing

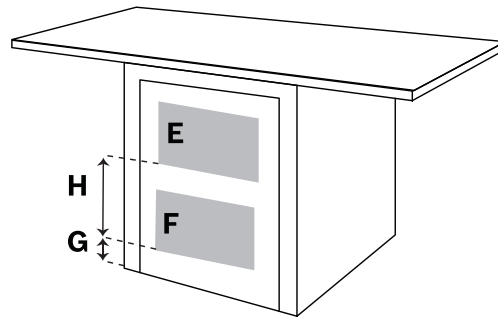
G	37 in.
H	26 in.
J	3 in.
K	29 in.

### Under Counter: (Preferred)



Front of the appliance fully open.  
No doors or coverings.

### Under Counter: (Less Preferred)



If front of the appliance is covered,  
ventilation openings must be installed.

#### Minimum opening dimensions

a	23 7/8 in.
b	23 7/8 in.
c	33 1/2 in.

#### E & F are minimum area sizes

E	63 sq. in.
F	63 sq. in.

#### G & H actual spacing dimensions for min. open area sizes

G	3 in.
H	14 in.

### ADA Compliant

Bosch washer and dryers are ADA compliant and offer easy to access doors when they are installed on pedestals.







**BOSCH**

Invented for life

**Bosch Home Appliances**

1901 Main Street, Suite 600

Irvine, CA 92614

1.800.944.2904

[www.bosch-home.com/us](http://www.bosch-home.com/us) (U.S.)

[www.bosch-home.ca](http://www.bosch-home.ca) (Canada)

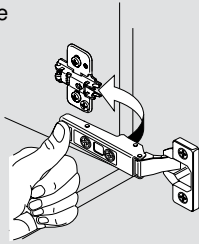
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BSH#14-BOS-0308 4/14 PF

# Euro hinge attachment and adjustment

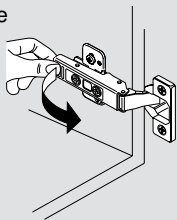
## Door installation

To install, place the hinge on the mounting plate and push the back of the hinge arm down with finger pressure. The "click" sound confirms a secure attachment.



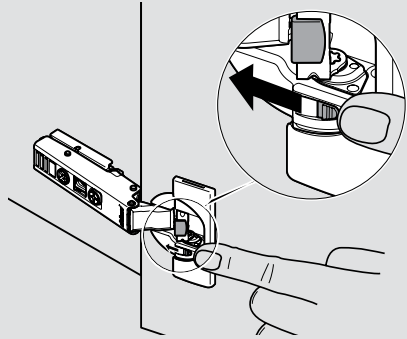
## Door removal

Release the lever under the hinge arm to remove.

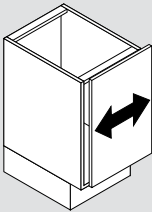


## CLIP top BLUMOTION deactivation

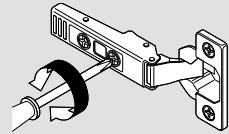
For small or light doors, the BLUMOTION can be deactivated on one of the hinges. Door must be closed once for the deactivation to be complete. To reactivate, move switch back to the original position.



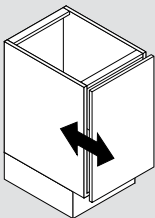
## Side adjustment



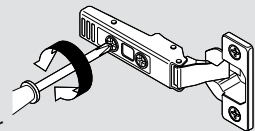
Rotate the front screw to increase or decrease the door overlay (+/- 2 mm).



## Depth adjustment



Rotate the rear spiral tech cam screw to adjust the door position (+ 3/- 2 mm).



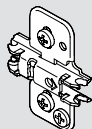
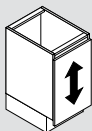
For CLIP hinges, loosen the rear screws on all hinges, adjust and retighten.

800-438-6788  
www.blum.com

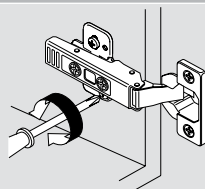
# CLIP mounting plate adjustments

## Height adjustment

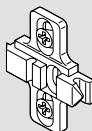
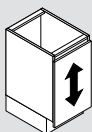
### Cam wing mounting plate



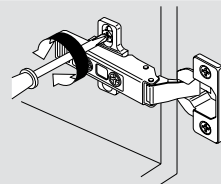
Rotate cam screw on the mounting plate to adjust door position (+/- 2 mm).



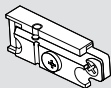
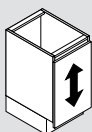
### One-piece wing plate



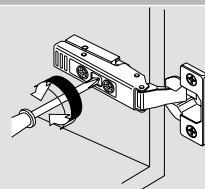
Loosen screws on the mounting plate. Adjust door to position and tighten screws (+/- 3 mm).



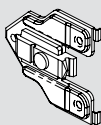
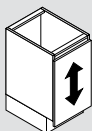
### Cam in-line mounting plate



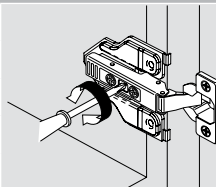
Rotate cam screw on the mounting plate to adjust door position (+/- 2 mm).



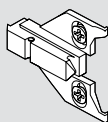
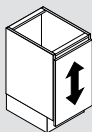
### Face frame cam adapter plate



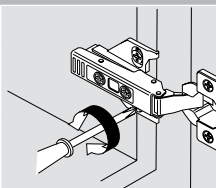
Rotate cam screw on the mounting plate to adjust door position (+/- 2 mm).



### Face frame adapter plate



Loosen screws on the mounting plate. Adjust door to position and tighten screws (+/- 2 mm).



# DuPont™ Corian® Commercial Care In Use

DuPont™ Corian® solid surfaces meet the demanding needs of today's commercial surfacing applications. As a solid, non-porous surface, Corian® can be maintained with minimum care to retain the original appearance. Because it can be repaired, Corian® will still look and perform like a new installation, while other surfacing materials will often need to be replaced. With proper care the Corian® surfaces in your commercial building will stay looking like new.

For more information, call 1-800-426-7426).

## Routine Care

There are three types of Corian® solid surface finishes: matte/satin, semigloss and high-gloss. Contact your Corian® sales expert if you are unsure of your finish. Most countertops and all sinks and lavatories are finished with a matte/satin finish. Soapy water, ammonia-based cleaners or commercially available solid surface cleaners will remove most dirt and residue from all types of finishes. Stubborn residue will require a little stronger cleaner. Follow the recommendations below to properly clean your Corian® solid surface application.

### Conventional Cleaning Techniques

- Washing with soap and water is usually sufficient to remove surface dirt or stains.
- Ammonia based liquid cleaner (not window cleaner) may also be used. Always rinse surface thoroughly and wipe dry.
- Drying is an important step, preventing a build-up of soap film or cleaning residue, which can create the appearance of light scratches over time.
- Stubborn soap film or cleaning residue build-up in Corian® is easily removed with abrasive cleanser and a white Scotch-Brite® pad or a sponge.
- For darker colors, a polish may be used to enhance the shine. For areas where there may be food contact, always use a polish formulated for food contact areas, such as Countertop Magic®. Where food contact is not a possibility, a simple furniture polish may be used. Always follow the manufacturer's instructions for using the polish and for safety concerns.

### Cleaning Agents

Corian® is unaffected by common household and commercial cleaners such as

- Powdered abrasive cleansers (like Comet®)
- Ammonia
- Strong detergents
- Oxalic acid solutions
- Dilute hydrochloric acid solutions
- Dilute trisodium phosphate solutions

***Acid drain cleaners may cause surface damage and should not be used on Corian® solid surfaces.***

### Cigarette Burns, Stubborn Stains

Unlike other surface materials stains or marks caused by cigarettes, alcohol, food, lipstick, hair dye, shoe polish, iodine, marking pens, etc. can be removed by using an abrasive cleanser and a Scotch-Brite® pad.

- If the surface has a **matte finish**, use a **green Scotch-Brite® pad**
- If the surface has a **gloss finish**, use a **white Scotch-Brite® pad**

This type of maintenance will not harm the Corian® surface, and will restore it to "like new" condition.



# DuPont™ Corian® Commercial Care In Use

## Repairs

Surfaces of Corian® can be repaired with no permanent damage. Tough to remove stains, fine scratches, and small cuts can be removed using standard repair techniques.

### Professional repair

Contact DuPont (800.426.7426), or your supplier, for information on how to have your Corian® surfaces professionally restored to their original finish

### Making your own repairs

- To restore a matte finish - use 220 grit sandpaper followed by hard buffing with a green Scotch-Brite® pad in a circular motion.
- To restore a semi-gloss - use the 220 grit sandpaper, followed by 320 grit, followed by 400 grit. Then blend the finish in by using abrasive cleanser and a sponge or rag.
- A high gloss finish is best restored by a professional. Contact your supplier or DuPont.
- If the damage is particularly deep, use a random orbital sander equipped with vacuum dust collection. Start with 120 grit sandpaper first, followed by 180-220 grit. After sanding, a uniform matte finish can be obtained by buffing with a green Scotch-Brite® buffing pad. For a semi-gloss, continue sanding with 320 followed by 400 grit. Then buff with a gray Scotch-Brite® pad.

The impact resistance of Corian® allows it to withstand harsh use without chipping, breaking, or cracking. However, if damaged due to extreme abuse, satisfactory repairs can often be made. Contact DuPont for guidance.

## Preventing Damage

### Avoid Strong Chemicals

Some chemicals are not compatible with Corian®. Avoid surface contact with:

- Strong chlorinated solvents
- Chloroform
- Ketones
- Methylene chloride (paint removers)
- Very strong acids such as concentrated sulfuric and hydrochloric acids
- Acid drain cleaners should not be used.

Surfaces exposed to these agents should be promptly flushed with water. Contact for even a short period of time can cause surface damage, spots, or staining. Follow the recommended repair procedures described above as needed to repair and/or restore the surface to its original condition. Severe damage caused by incompatible chemical contact will require professional repair. Again, contact DuPont, or your supplier for assistance.

### Use Care with Hot Pans and Appliances

While Corian® withstands heat better than most surface materials, do not place hot cookware directly on a Corian® surface. To avoid damage caused by excessive heat:

- Always use a trivet or hot pad under hot cookware
- Always use a trivet with minimum ¼" legs under small electrical appliances such as fryers and cookers

### Use a Cutting Board

A Corian® surface can be scratched or gouged if used as a cutting or chopping surface for food preparation. Scratches can be repaired, but to avoid the problem, use of a cutting board is highly recommended.

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DuPont™  
**CORIAN®**  
SOLID SURFACES



*The miracles of science™*



## Installation Instructions

Watch the installation video →

Instructions for Prepping an Opening for SOSS Invisible Hinges

### IMPORTANT

Use only Porter-Cable Template Guide Bushing #42024 (Lock Face Routing) and #42237 (Lock Nut) to assure the following guide bushing dimensions: 21/32" I.D., 3/4" O.D., 9/16" distance past base.

To avoid installation problems, we recommend you do a practice installation on the same type of wood before using the template on your application. This practice will help ensure proper installation, and reveal any potential difficulties with the routing equipment and/or tools before using the template on your finished project.

### SAFETY

Protective eyewear should be worn by anyone operating equipment used in the installation of SOSS Invisible Hinges, as should those in the area where the work is being performed. For safety, if you are not using the recommended Amana Tool Router Bits as described in Table B, use router bits with 1/2" diameter shanks only.

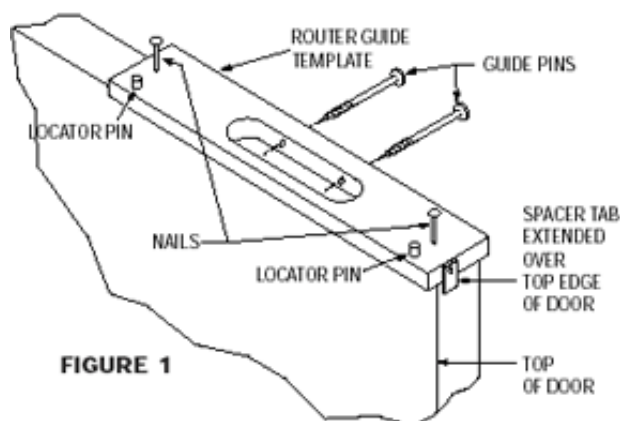
**To Mount SOSS Invisible Hinges using the hinge router guide template, you will need the following:**

- |  |  |
|--|--|
| 1 Extra long router bits (See table "B") | 4 Measuring scale, ruler or spacing sticks |
| 2 Template guide bushing and locknut     | 5 Electric drill or brace                  |
| 3 Hinge installation template package    | 6 Selection of spade drills or wood bits   |

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FIGURE 1

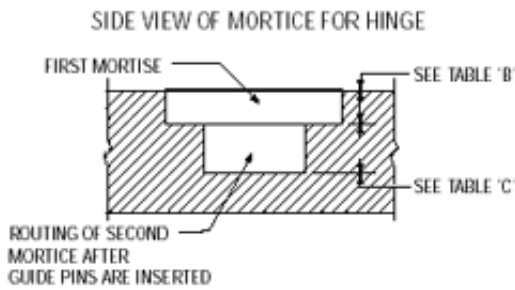
References the various components of the hinge router guide template. Become familiar with this terminology as it will be used throughout these instructions.



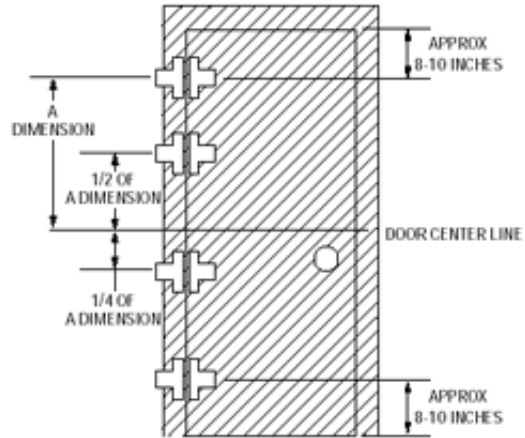
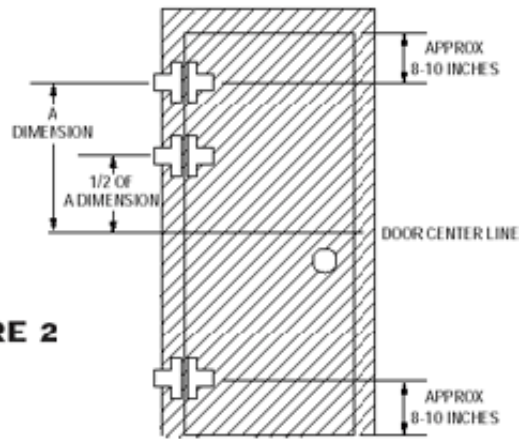
Recommended Spacing of SOSS Invisible Hinges (Refer to Figure 2)

Notice that the "center" hinge is not shown in the usual location near the middle of the door. The "center" hinge should be located one-half the distance from the center of the door to the center of the top hinge. This is to fortify the door against extra leverage extended on the top hinge.

On applications requiring more than four SOSS Invisible Hinges, a good rule of thumb is to place more SOSS Invisible Hinges in the upper half of the door than in the lower.



**FIGURE 2**



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To determine your path and clearance, [click here](#).

Instructions for Mounting SOSS Invisible Hinges  
Using the Hinge Router Guide Template (continued)

FIGURE 3 illustrates a typical door/jamb where SOSS Invisible Hinges will be mounted. Become familiar with the terminology as it will be used throughout these instructions.

6 The chart in TABLE "B" lists the maximum depths for which the hinge outlines should be routed. It is advisable to check the depth of the cut you are making, prior to removing a significant amount of wood. If desired, the required depth may be cut in multiple passes.

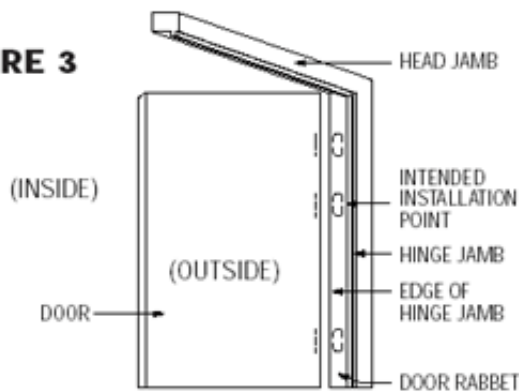
7 Recalling the measurements you made to determine the hinge spacing on the jamb, use those identical measurements to position the template for the next hinge mortise on the door.

8 Remove the template from the top of the door and move it to the new location repeating steps 3 through 7 for the number of hinges requiring installation.

At this point, the routing of the outline portions of the hinge mortises is complete. The next step is to rout the deep mortises.

Place the guide pins into their proper

**FIGURE 3**



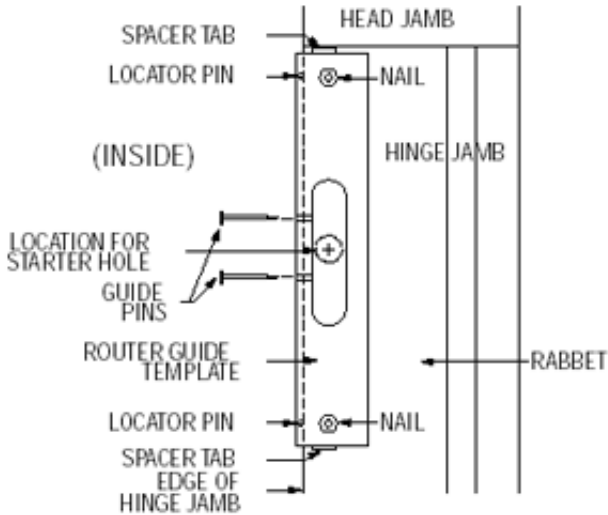
**Jamb Preparation (Refer to Figure 4)**

1 Remove the guide pins from the router guide template.

2 Place the Router Guide Template on the hinge jamb so the locator pins rest flush against the pull side jamb face, and are on the inside of the intended door swing. The spacer tab should be flush against the head jamb, and positioned in line with the template (i.e. tab positioned as packaged).

3 Once the desired position is established, the nails can be tapped-in the door rabbet to secure the template in place.

**FIGURE 4**



4 REFER TO TABLE "A" to obtain the proper size drill or spade bit and starter hole depth.

TABLE A: Starter Hole Depth

SOSS Hinge Model	Drill Size	Starter Hole Depth*
#101	1/4"	37/64"
#103	3/8"	23/32"
#203	3/8"	27/32"
#204	3/8"	27/32"
#208	1/2"	1-1/32"
#212	3/8"	1-13/64"
#216/#416	1/2"	1-9/16"
#218/#418	3/4"	1-23/32"
#220	1/2"	2-1/8"

\*The depth of the starter hole should be at least the values listed. Depths exceeding those tabulated will not adversely affect hinge operation.

5 Being careful not to nick or gouge the template, drill the starter hole for the router to the proper depth in the center of the hinge outline of the template.

**Routing the Hinge Outline**

6 The chart in TABLE "B" lists the maximum depths to which the hinge outlines should be routed. It is advisable to check the depth of the cut you are making prior to removing a significant amount of wood. If desired, the required depth may be obtained by making multiple router passes.

TABLE B Shallow Mortise

SOSS Hinge Model	Router Bit Size	Depth	Recommended Amana Tool Router Bit
#101	1/4"x 2-7/8"	7/32"	43838
#103	3/8"x 3-1/4"	7/32"	46259S
#203	3/8"x 3-1/4"	3/16"	46259S
#204	3/8"x 3-1/4"	1/4"	46259S
#208	3/8"x 3-1/4"	9/32"	46259S
#212	3/8"x 3-1/4"	3/8"	46259S
#216/#416	1/2"x 4-1/2"	15/32"	51310
#218/#418	1/2"x 4-1/2"	13/32"	51310
#220	1/2"x 4-1/2"	15/32"	51310

holes on the template. The guide pins are threaded and must not be hammered or otherwise forced into position. Care must also be taken that the threaded guide pins are not overtightened, as this may distort the templates.

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**Completion of the Jamb Mortises (Refer to Figure1)**

1 Starting at the top hinge mortise, position the template so the nails fit into the holes left in the jamb from the previous rout. The locator pins should be toward the inside of the door swing as before.

2 Once the proper position is reestablished, the nails can be tapped in to secure the template in place.

3 To complete the routing of the hinge mortise, it will be necessary to remove wood to the depth listed in TABLE "C". It is recommended that multiple passes be made, as opposed to removing all of the wood at once.

#101	33/64"
#103	21/32"
#203	25/32"
#204	25/32"
#208	31/32"
#212	1-9/64"
#216/#416	1-1/2"
#218/#418	1-21/32"
#220	2-1/16"

CAUTION: Rout only the area between the guide pins. Do not remove any more material from the circular outline or any outside the guide pins.

4 After the deep mortise has been routed, remove the template.

5 Place a SOSS Invisible Hinge into the mortise you have completed and inspect the following:

**A** Does the hinge fit "snugly" into the mortise.

**B** Does any portion of the hinge extend beyond the rabbet of the jamb?

The body of the hinge should fit snugly into the mortise. If the hinge body extends above the jamb after the hinge has been pushed into the mortise as far as possible, verify that the mortises have been routed to the proper depths. Correct as required.

6 Position the template at the next

CAUTION: Do not exceed the listed depths when routing the hinge outline, as binding of the hinges will occur.

**7** Using whatever means of measurement best suited to you, determine the location of the next hinge to be mounted on the jamb. Mark or measure that distance so as not to damage the door.

NOTE: Remember the distances you have selected, as you will need to recall those measurements when mounting the templates on the door.

**8** Remove the template from the jamb and move it to the new location you have chosen, repeating steps 2 through 7 for the number of hinges requiring installation.

### Door Preparation (Refer to Figure 3)

**1** Prior to mounting the template on the door, make certain that the door is properly oriented.

**2** The clearance between the head jamb and the door is set with the spacer tab. It should be positioned one quarter turn so the template will hang from the top of the door.

**3** Place the Router Guide Template on the door so the locator pins rest flush against the pull side face of the door, and are on the inside of the desired direction of the door swing.

**4** Once the desired position is established, the nails can be tapped in to secure the template in place.

**5** Again, being careful not to nick or gouge the template, drill the starter hole for the router to the depth listed in TABLE "A" in the center of the hinge outline of the template.

location on the jamb. Repeat steps 1 through 5 for the number of hinges requiring installation.

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### Completion of the Jamb Mortises (Refer to Figure 1)

**1** Position the template so the nails fit into the holes left in the door from the previous rout. The locator pins should be toward the inside of the door swing as before.

**2** Once the proper position is reestablished, the nails can be tapped in to secure the template in place.

**3** To complete the routing of the hinge mortise, it will be necessary to remove wood from the door to the depths listed in TABLE "C". Again, it is recommended that the wood be removed by making multiple router passes.

**4** After the deep mortise has been routed, remove the template from the door and position it at the next hinge location on the door.

**5** Repeat steps 1 through 4 for each hinge requiring installation.

### Mounting the Door to the Jamb

Having completed the routing of the hinge mortises, notice that the hinge mortise is not centered within the thickness of the door. The "thin" section corresponds to the inside surface of the door.

**1** Place the SOSS Invisible Hinges into the mortises so the hinge bodies straddle the thin section of the door. Using the wood screws supplied with the hinges, secure the hinges to the door.

**2** The door can then be moved into a position where the remaining hinge bodies can be placed into their respective mortises in the jamb.

**3** Secure the jamb side of the hinges with the remaining wood screws.

**4** Exercise the door to see that it opens and closes freely throughout the required amount of opening.

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**1** Place the routed side of the wood router guide (refer to illustration below) into a slotted aluminum channel rail. Slide the guide to the end of the channel so the wood is flush with the aluminum.

**2** Place small washer on wood screw. Slip screw through the slot in the channel and screw it into the wood hole closest to the flush end. Tighten.

**3** Turn the steel clip on the flush end of the guide one quarter turn.

**4** Put screws and washers into any two remaining router guide holes and tighten.

**5** Slide a second router guide into the other end of the above channel/guide assembly. Slide the guide about two inches into the channel.

**6** Place a small washer on a wood screw. Slip the screw through the slot in the channel. Turn it into the hole in the wood. Do not tighten.

**7** Place another channel on the guide and insert two washers and screws as before. Do not tighten them.

**8** Turn a machine screw in each tapped hole in the angle rail so that screw head is inside the rail's corner.

**9** Place the angle rail into the end of the channel so one screw extends into the slot in the channel and the angle extends 6" beyond the channel.

**10** Place a large washer over the screw, turn on a wing nut. Do not tighten.

**11** Place the third channel over the angle and secure with machine screw washer and wing nut but do not tighten.

**12** Put the remaining router guide into the channel and secure with three screws and washers. Do not tighten.

**13** Put nails into the holes in each end of the guide

**14** Hang the assembly from the top of the door, using the steel clip in step 3. Rotate clip a half turn if required. The two locator pins in each guide should be against the pull side face of the door. Lay the door on its side as shown in the illustration below.

**15** Slide each router guide to the desired location and tighten all loose screws. See attached "Instructions for Mounting Soss Invisible Hinges Using The Hinge Guide Template" to determine each guide's location.

**16** Partially drive the nails into the door, only far enough to secure the location of each router guide.

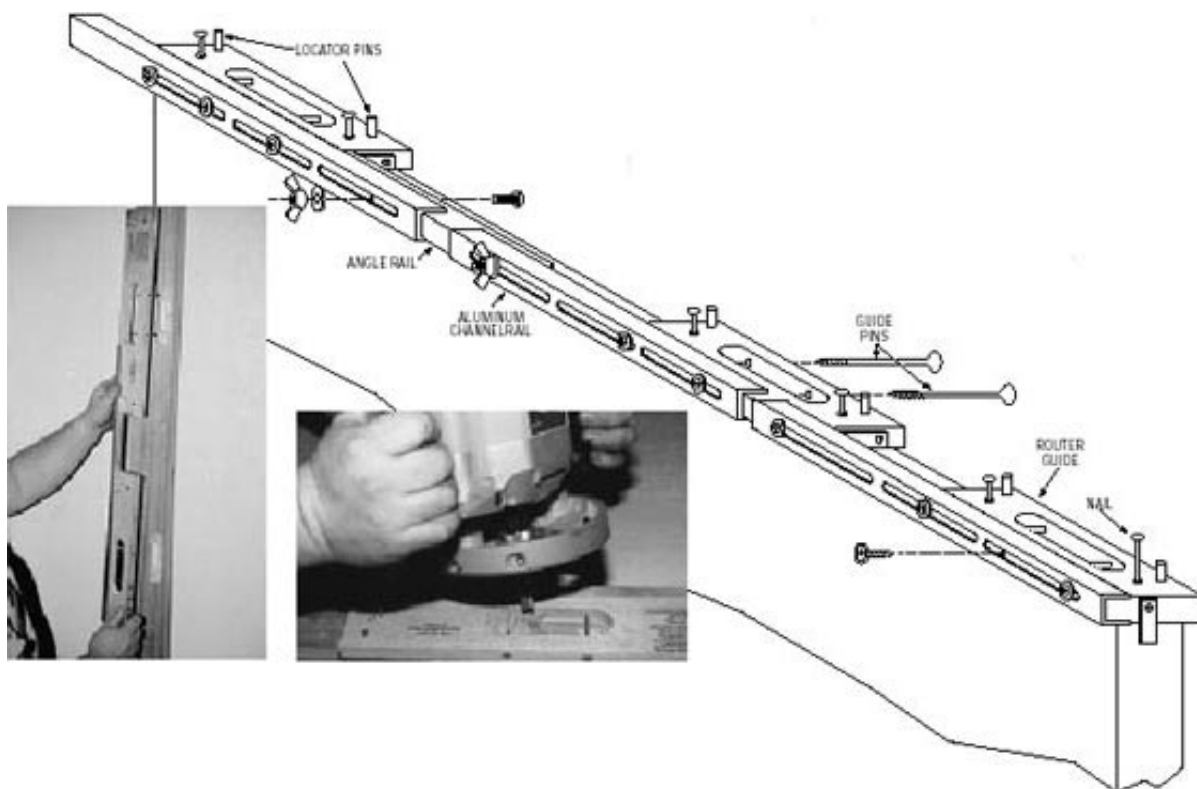
**17** To rout the mortise, follow the procedure on "Instructions for Mounting SOSS Invisible Hinges Using the Router Guide Template".

**18** After routing the door, pull the nails out of the door. It is not necessary to pull the nails out of the pre-drilled holes in the guide.

**19** Rotate the steel clip back to the original position. Place the entire assembly against the hinge jamb with the steel clip snug against the head jamb. The locator pins should be against the pull side face of the jamb.

**20** Drive nails into jamb just far enough to secure the position.

**21** Rout the jamb mortises in the same manner as used on the door.



SOSS  
Invisible Spring Closer Installation Instructions  
**SAFETY**

Protective eyewear should be worn by anyone operating equipment used in the installation of SOSS Invisible Hinges, as should those in the area where the work is being performed.

**IMPORTANT!** Read these instructions prior to undertaking the installation of the SOSS Invisible Spring Closer. These instructions pertain only to the installation of the SOSS Invisible Spring Closer. Instructions for the installation of standard (non selfclosing) hinges are enclosed in the package containing the hinges.

**Recommended Equipment:**

Hinge drilling template (supplied)	Spade drills or wood bits as follows:	
Sharp chisel	for #216: 3/4" drill for drilling spring clearance hole	1" drill for drilling hinge body mortices
Drill or Brace	for #218: 1" drill for drilling spring clearance hole	1-7/8" drill for drilling hinge body mortices
Suitable extension shaft for spade bits	for #220: 1" drill for drilling spring clearance hole	1-3/8" drill for drilling hinge body mortices

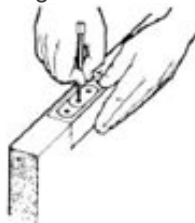
**INSTALLATION USING THE DRILLING TEMPLATE**

**1** Make the required measurements on both the door and jamb where the hinges and closer shall be mounted. Make certain that clearance is provided between the top of the door and the jamb to permit free movement of the door after installation,

**NOTE** *It is recommended that the SOSS invisible Closer be mounted such that the spring-bearing portion of the hinge is situated in the door if possible.*

**2** Fold the mounting template card along the scored line on the template.

**3** Using a punch or similar object, punch holes into the door at the locations marked by the drill-point indicators (crosshairs). Note the drill-point indicator marked with an X. This is the point where the clearance hole for the spring must be drilled.



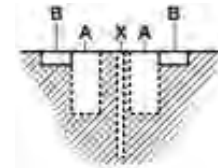
**4** Remove the template from the door prior to doing any drilling.

**WARNING**

**It is imperative that all drilling be done with the utmost precision and care. Special attention must be directed to the the drilling of the spring clearance hole. You will be required to drill a relatively large diameter hole over 7" deep (in the case of a solid-core door). Special precautions should be taken to assure that the holes you will be drilling are perpendicular to the mounting surface.**

**5** At the punch point corresponding to the X, a small diameter hole (approximately 1/8" diameter or less)

**7** At the punch point marked with B, drill the required size hole according to the following chart



CLOSER MODEL	DRILL SIZE	DEPTH OF HOLES
#216	1"	1/2" DEEP
#218	1-1/8"	7/16" DEEP
#220	1-3/8"	1/2" DEEP

**8** Using a chisel or router, remove the wood protruding into the hinge outline to form a smooth morticed surface.

**9** Locate the spring clearance starter hole, and remove any excess wood preventing the drill from entering the starter hole.

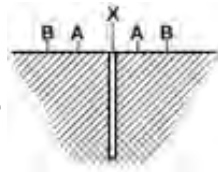
**10** Make sure that the proper size drill bit is being used for the spring clearance hole!

**The spring clearance hole must be drilled centered in the starting hole, and must be drilled perpendicular to the edge (thickness) of the door.**

**11** In drilling the spring clearance hole in hollow-core doors, you will drill into the cavity of the door, thus completing the drilling on the door side of the SOSS Invisible Spring Closer. Solid-core doors will require drilling the spring clearance hole 7" deeper than the hinge-body mortice.

**12** To create the hinge-body mortice for the jamb side of the closer, repeat this sequence of instructions ignoring everything pertaining to the

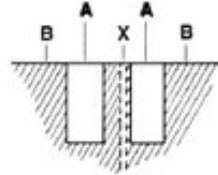
should be drilled at least 23/4" deep.



**NOTE:** This is the start point for the eventual drilling of the spring clearance hole. The spring clearance hole will be drilled after the hinge mortise has been formed. Do not drill through it, or you will have to visually ascertain its location at a later time.

**DRILLING OF HINGE BODY MORTICES**

**6** At the punch points marked with A, drill the required size holes to the depths listed below by hinge size.



CLOSER MODEL	DRILL SIZE	DEPTH OF HOLES
#216	1"	2" DEEP
#218	1-1/8"	2-1/8" DEEP
#220	1-3/8"	2-1/2" DEEP

drilling of the spring clearance hole. Ignore that indicator on the template.

**13** Once the hinges are installed and the door swing found to be satisfactory, the door closure speed may be set by adjusting the socket-head fastener (requires 5/32" hex wrench). Turning the fastener in a clockwise direction increases spring tension and door closing speed. The spring tension should be adjusted gradually until the desired closing speed is achieved.

**14** If all tension is removed, it can not be added once installed. The hinge will have to be removed to add spring tension, then reinstalled.

**15** Lubrication may be used.

**WARNING:**

**Self-closing doors are potentially dangerous to animals, children and the handicapped! Suitable measures should be taken to prevent anything from being caught between the door and the jamb!**

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## **RAPID RESPONSE Series LFII Residential Sprinklers 4.9 K-factor Flat-Plate Concealed Pendent Wet Pipe and Dry Pipe Systems**

### **General Description**

The TYCO RAPID RESPONSE Series LFII Residential Flat-Plate Concealed Pendent Sprinklers (TY2524) are decorative, fast response, fusible solder sprinklers designed for use in residential occupancies such as homes, apartments, dormitories, and hotels.

The Cover Plate/Retainer Assembly conceals the sprinkler operating components above the ceiling. The flat profile of the Cover Plate provides the optimum aesthetically appealing sprinkler design. Additionally, the concealed design of the Series LFII Residential Flat-Plate Concealed Pendent Sprinklers provides 1/2 inch (12,7 mm) vertical adjustment. This adjustment provides a measure of flexibility when cutting fixed sprinkler drops.

The Series LFII Residential Flat-Plate Concealed Pendent Sprinklers are intended for use in the following systems:

- wet and dry pipe residential sprinkler systems for one- and two-family dwellings and mobile homes per NFPA 13D
- wet and dry pipe residential sprinkler systems for residential occupancies up to and including four stories in height per NFPA 13R
- wet and dry pipe sprinkler systems for the residential portions of any occupancy per NFPA 13

The Series LFII Residential Sprinklers have been designed with heat sensitivity and water distribution characteristics

proven to help in the control of residential fires and to improve the chance for occupants to escape or be evacuated.

The Series LFII Residential Flat-Plate Concealed Pendent Sprinklers are shipped with a Disposable Protective Cap. The Protective Cap protects the sprinkler during ceiling installation or finish. After ceiling installation is complete, the Protective Cap is removed and the Cover Plate/Retainer Assembly is installed. Removing the Protective Cap is required for proper sprinkler performance.

#### **Dry Pipe System Application**

The Series LFII Residential Flat-Plate Concealed Pendent Sprinkler offers a laboratory approved option for designing dry pipe residential sprinkler systems, whereas, most residential sprinklers are laboratory approved for wet systems only.

Through extensive testing, it has been determined that the number of design sprinklers (hydraulic design area) for the Series LFII Residential Flat-Plate Concealed Sprinklers (TY2524) need not be increased over the number of design sprinklers (hydraulic design area) specified for wet pipe sprinkler systems, as is customary for density/area sprinkler systems designed per NFPA 13, 13D, or 13R.

Consequently, the Series LFII Residential Flat-Plate Concealed Sprinklers (TY2524) offer the features of non-water filled pipe in addition to not having to increase the number of design sprinklers (hydraulic design area) for systems designed to NFPA 13, 13D, or 13R.

#### **NOTICE**

*The Series LFII Residential Flat-Plate Concealed Pendent Sprinklers (TY2524) described herein must be installed and maintained in compliance with this document and the applicable standards of the National Fire Protection Association, in addition to the standards of any authorities having jurisdiction. Failure to do so may impair the performance of these devices.*



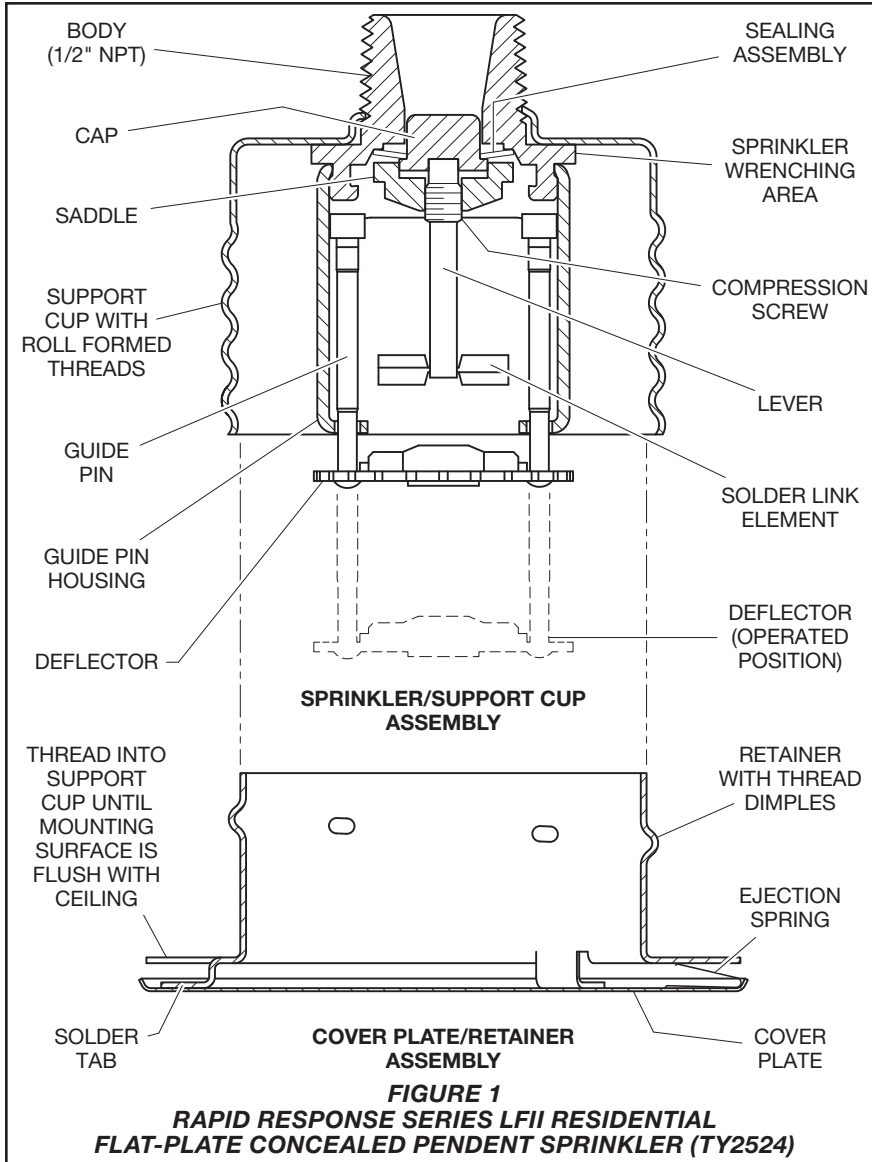
*The owner is responsible for maintaining their fire protection system and devices in proper operating condition. Contact the installing contractor or sprinkler manufacturer with any questions.*

### **Sprinkler Identification Number (SIN)**

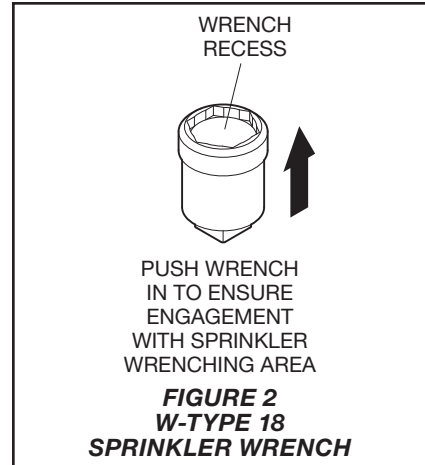
TY2524

#### **IMPORTANT**

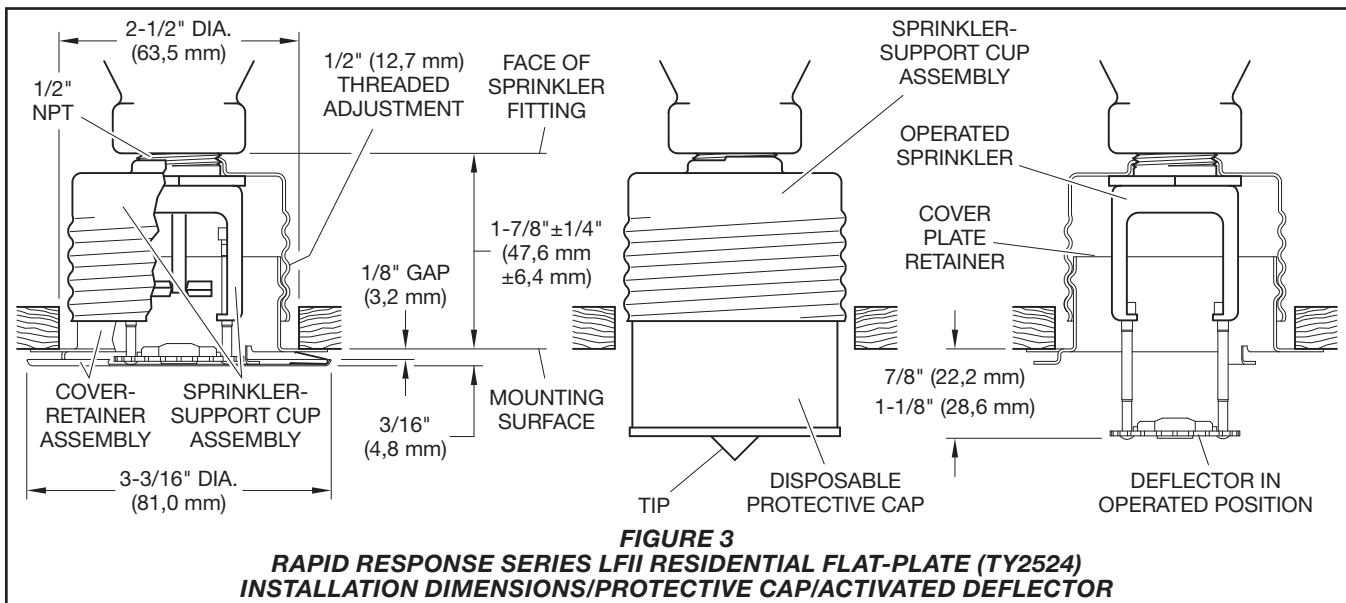
*Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.*



**FIGURE 1**  
**RAPID RESPONSE SERIES LFI RESIDENTIAL**  
**FLAT-PLATE CONCEALED PENDENT SPRINKLER (TY2524)**



**FIGURE 2**  
**W-TYPE 18**  
**SPRINKLER WRENCH**



**FIGURE 3**  
**RAPID RESPONSE SERIES LFI RESIDENTIAL FLAT-PLATE (TY2524)**  
**INSTALLATION DIMENSIONS/PROTECTIVE CAP/ACTIVATED DEFLECTOR**

## Technical Data

### Approvals

UL and C-UL Listed

The TYCO RAPID RESPONSE Series LFII Residential Flat-Plate Concealed Pendent Sprinklers are only listed with the Series LFII Concealed Cover Plates having a factory-applied finish.

These Cover Plates and their part numbers can be found in the Ordering Procedure section at the end of this data sheet.

For details on approvals, refer to the Design Criteria section.

### Maximum Working Pressure

175 psi (12,1 bar)

### Discharge Coefficient

$K = 4.9 \text{ GPM/psi}^{1/2} (70,6 \text{ LPM/bar}^{1/2})$

### Temperature Rating

Sprinkler: 160°F (71°C)

Cover Plate: 139°F (59°C)

### Vertical Adjustment

1/2 inch (12,7 mm)

### Finishes

Refer to the Ordering Procedure section.

### Physical Characteristics

Cover Plate/Retainer Assembly:

Cover Plate . . . . . Copper  
Ejection Spring . . . . . Stainless Steel  
Retainer . . . . . Brass

Sprinkler/Support Cup Assembly:

Body . . . . . Brass  
Cap . . . . . Bronze  
Saddle . . . . . Brass  
Sealing Assembly . . . . . Beryllium  
Nickel w/ TEFLON

Soldered Link Halves . . . . . Nickel  
Lever . . . . . Bronze  
Compression Screw . . . . . Brass  
Deflector . . . . . Bronze  
Guide Pin Housing . . . . . Bronze  
Guide Pins . . . . . Bronze  
Support Cup . . . . . Steel

## Operation

When exposed to heat from a fire, the Cover Plate, which is normally soldered to the Retainer at three points, falls away to expose the Sprinkler/Support Cup Assembly. At this point, the Deflector, supported by the Guide Pins, drops down to its operated position.

The Solder Link Element of the Sprinkler/Support Cup Assembly is comprised of two link halves that are soldered together with a thin layer of solder. When the rated temperature is reached, the solder melts and the two link halves separate, allowing the sprinkler to activate and flow water.

## Design Criteria

The TYCO RAPID RESPONSE Series LFII Residential Flat-Plate Concealed Pendent Sprinklers (TY2524) are UL and C-UL Listed for installation in accordance with this section:

### Residential Sprinkler Design Guide

When conditions exist that are outside the scope of the provided criteria, refer to the Residential Sprinkler Design Guide TFP490 for the manufacturer's recommendations that may be acceptable to the authority having jurisdiction.

### System Type

Per the UL Listing, wet pipe and dry pipe systems may be utilized. Per the C-UL Listing, only wet pipe systems may be utilized.

Refer to Technical Data Sheet TFP485 about the use of Residential Sprinklers in residential dry pipe systems.

### Ceiling Types

Smooth flat horizontal, or beamed, or sloped, in accordance with the 2013 Edition of NFPA 13D, 13R or 13 as applicable.

### Hydraulic Design (NFPA 13D and 13R)

For systems designed to NFPA 13D or NFPA 13R, the minimum required sprinkler flow rate are given in Tables A and B as a function of temperature rating and the maximum allowable coverage areas. The sprinkler flow rate is the minimum required discharge from each of the total number of "design sprinklers" as specified in NFPA 13D or NFPA 13R. The number of "design sprinklers" specified in NFPA 13D and 13R for wet pipe systems is to be applied when designing dry pipe systems.

### Hydraulic Design (NFPA 13)

For systems designed to NFPA 13, the number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in Tables A and B as a function of temperature rating and the maximum allowable coverage area
- A minimum discharge of 0.1 gpm/ft<sup>2</sup> over the "design area" comprised of the four most hydraulically demanding sprinklers for the actual coverage areas being protected by the four sprinklers

The number of "design sprinklers" specified in NFPA 13 for wet pipe systems is to be applied when designing dry pipe systems.

### Dry Pipe System Water Delivery

When using the Series LFII Residential Flat-Plate Concealed Pendent Sprinklers (TY2524) in dry pipe sprinkler systems, the time for water delivery must not exceed 15 seconds for the most remote operating sprinkler.

### Obstruction to Water Distribution

Sprinklers are to be located in accordance with the obstruction rules of NFPA 13D, 13R, and 13 as applicable for residential sprinklers as well as with the obstruction criteria described within the Technical Data Sheet TFP490.

### Operational Sensitivity

Install sprinklers relative to the ceiling mounting surface as shown in Figure 3.

The Series LFII Residential Flat-Plate Concealed Pendent Sprinklers must not be used in applications where the air pressure above the ceiling is greater than that below. Down drafts through the Support Cup can delay sprinkler operation in a fire situation.

### Sprinkler Spacing

The minimum spacing between sprinklers is 8 feet (2,4 m). The maximum spacing between sprinklers cannot exceed the length of the coverage area (Table A) being hydraulically calculated (e.g., a maximum of 12 feet for a 12 ft. x 12 ft. coverage area or 20 feet for a 20 ft. x 20 ft. coverage area.)

Maximum Coverage Area <sup>(a)</sup> Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	WET PIPE SYSTEM Minimum Flow and Residual Pressure <sup>(b, c)</sup>				
		Ordinary Temp Rating 160°F (71°C)		Deflector to Ceiling	Installation Type	Minimum Spacing Ft. (m)
		Flow GPM (L/min)	Pressure PSI (bar)			
12 x 12 (3,7 x 3,7)	12 (3,7)	13 (49,2)	7.0 (0,48)	Smooth Ceilings 7/8 to 1-1/8 inches.  Beamed Ceilings per NFPA 13D 13R, or 13 Installed in beam 7/8 to 1-1/8 inches below bottom of beam	Concealed	8 (2,4)
14 x 14 (4,3 x 4,3)	14 (4,3)	13 (49,2)	7.0 (0,48)			
16 x 16 (4,9 x 4,9)	16 (4,9)	13 (49,2)	7.0 (0,48)			
18 x 18 (5,5 x 5,5)	18 (5,5)	17 (64,3)	12.0 (0,83)			
20 x 20 (6,1 x 6,1)	20 (6,1)	20 (75,7)	16.7 (1,15)			

- (a) For coverage area dimensions less than or between those indicated, use the minimum required flow for the next highest coverage area for which Hydraulic Design section under the Design Criteria are stated.
- (b) The Minimum Flow requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to "Hydraulic Design" in the Design Criteria section for details.
- (c) For NFPA 13 residential applications, the greater of 0.1 gpm/ft.<sup>2</sup> over the design area or the flow in accordance with the criteria in this table must be used.

**TABLE A**  
**WET PIPE SYSTEM**  
**SERIES LFII RESIDENTIAL FLAT-PLATE CONCEALED PENDENT SPRINKLER (TY2524)**  
**NFPA 13D, 13R, AND 13 HYDRAULIC DESIGN CRITERIA**

Maximum Coverage Area <sup>(a)</sup> Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	DRY PIPE SYSTEM Minimum Flow and Residual Pressure <sup>(b)</sup>				
		Ordinary Temp Rating 160°F (71°C)		Deflector to Ceiling	Installation Type	Minimum Spacing Ft. (m)
		Flow GPM (L/min)	Pressure PSI (bar)			
12 x 12 (3,7 x 3,7)	12 (3,7)	15 (56,8)	9.4 (0,65)	Smooth Ceilings 7/8 to 1-1/8 inches.  Beamed Ceilings per NFPA 13D 13R, or 13 Installed in beam 7/8 to 1-1/8 inches below bottom of beam	Concealed	8 (2,4)
14 x 14 (4,3 x 4,3)	14 (4,3)	15 (56,8)	9.4 (0,65)			
16 x 16 (4,9 x 4,9)	16 (4,9)	16 (60,6)	10,7 (0,74)			
18 x 18 (5,5 x 5,5)	18 (5,5)	17 (64,3)	12.0 (0,83)			
20 x 20 (6,1 x 6,1)	20 (6,1)	21 (79,5)	18,4 (1,27)			

- (a) For coverage area dimensions less than or between those indicated, use the minimum required flow for the next highest coverage area for which Hydraulic Design section under the Design Criteria are stated.
- (b) The Minimum Flow requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to "Hydraulic Design" in the Design Criteria section for details.
- (c) For NFPA 13 residential applications, the greater of 0.1 gpm/ft.<sup>2</sup> over the design area or the flow in accordance with the criteria in this table must be used.

**TABLE B**  
**DRY PIPE SYSTEM**  
**SERIES LFII RESIDENTIAL FLAT-PLATE CONCEALED PENDENT SPRINKLER (TY2524)**  
**NFPA 13D, 13R, AND 13 HYDRAULIC DESIGN CRITERIA**

## Installation

The TYCO RAPID RESPONSE Series LFII Residential Flat-Plate Concealed Pendent Sprinklers must be installed in accordance with this section:

### General Instructions

Damage to the Solder Link Element during installation can be avoided by handling the sprinkler by the Support Cup only; that is, do not apply pressure to the Solder Link Element (Figure 1).

A leak-tight 1/2 inch NPT sprinkler joint should be obtained by applying a minimum-to-maximum torque of 7 to 14 ft.-lbs. (9,5 to 19,0 Nm). Higher levels of torque can distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in the Cover Plate/Retainer Assembly by under- or over-tightening the sprinkler. Re-adjust the position of the sprinkler fitting to suit.

**Step 1.** Install pendent sprinklers in the pendent position, with the centerline of the sprinkler perpendicular to the mounting surface.

**Step 2.** Remove the Protective Cap.

**Step 3.** With pipe-thread sealant applied to the pipe threads, and using the W-Type 18 Wrench shown in Figure 2, install and tighten the Sprinkler/Support Cup Assembly into the fitting. The W-Type 18 Wrench accepts a 1/2 inch ratchet drive.

**Step 4.** Replace the Protective Cap by pushing it upwards until it bottoms out against the Support Cup. The Protective Cap helps prevent damage to the Deflector and Guide Pins during ceiling installation and/or during application of the finish coating of the ceiling.

### NOTICE

*As long as the protective Cap remains in place, the system is considered "Out Of Service".*

**Step 5.** After the ceiling has been completed with the 2-1/2 inch (63 mm) diameter hole and in preparation for installing the Cover Plate/Retainer Assembly, remove and discard the Protective Cap, and verify that the Deflector moves up and down freely.

If the sprinkler has been damaged and the deflector does not move up and down freely, replace the entire sprinkler assembly. Do not attempt to modify or repair a damaged sprinkler.

**Step 6.** Screw on the Cover Plate/Retainer Assembly until its flange contacts the ceiling. Do not continue to screw on the Cover Plate/Retainer Assembly such that it lifts a ceiling panel out of its normal position.

If the Cover Plate/Retainer Assembly cannot be engaged with the Mounting Cup or the Cover Plate/Retainer Assembly cannot be engaged sufficiently to contact the ceiling, the Sprinkler Fitting must be repositioned.

## Care and Maintenance

The TYCO RAPID RESPONSE Series LFII Residential Flat-Plate Concealed Pendent Sprinkler (TY2524) must be maintained and serviced in accordance with this section:

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, obtain permission to shut down the affected fire protection system from the proper authorities and notify all personnel who may be affected by this action.

Absence of a Cover Plate may delay the sprinkler operation in a fire situation.

The owner must assure that the sprinklers are not used for hanging any objects and that the sprinklers are only cleaned by means of gently dusting with a feather duster; otherwise, non-operation in the event of a fire or inadvertent operation may result.

When properly installed, there is a nominal 1/8 inch (3,2 mm) air gap between the lip of the Cover Plate and the ceiling, as shown in Figure 3. This air gap is necessary for proper operation of the sprinkler by allowing heat flow from a fire to pass below and above the Cover Plate to help assure appropriate release of the Cover Plate in a fire situation. If the ceiling needs repainting after sprinkler installation, exercise care to ensure that the new paint does not seal off any of the air gap. Failure to do so may impair sprinkler operation.

Factory painted Cover Plates must not be repainted. They should be replaced, if necessary, by factory painted units. Non-factory applied paint may adversely delay or prevent sprinkler operation in the event of a fire.

Do not pull the Cover Plate relative to the Retainer. Separation may result.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified or overheated sprinklers must be replaced.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. Contact the installing contractor or sprinkler manufacturer regarding any questions.

Automatic sprinkler systems are recommended to be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

## **Limited Warranty**

For warranty terms and conditions, visit  
[www.tyco-fire.com](http://www.tyco-fire.com).

## **Ordering Procedure**

Contact your local distributor for availability. When placing an order, indicate the full product description and Part Number (P/N).

### **Sprinkler/Support Cup Assembly**

Specify: Series LFII (TY2524), K = 4.9 (70,6), Residential Flat-Plate Concealed Pendent Sprinkler without Cover Plate/Retainer Assembly, P/N 51-114-1-160

### **Cover Plate/Retainer Assembly**

Specify: Series LFII (TY2524), K = 4.9 (70,6), Residential Flat-Plate Concealed Pendent Sprinkler Cover Plate/Retainer Assembly with (specify) finish, P/N (specify):

Ivory (RAL 1015) . . . . . P/N 56-202-0-135  
Beige (RAL 1001) . . . . . P/N 56-202-2-135  
Pure White (b) (RAL 9010) . . . . . P/N 56-202-3-135  
Signal White (a) (RAL 9003) . . . . . P/N 56-202-4-135  
Grey White (RAL 9002) . . . . . P/N 56-202-5-135  
Brown (RAL 8028) . . . . . P/N 56-202-6-135  
Black (RAL 9005) . . . . . P/N 56-202-7-135  
Brushed Brass . . . . . P/N 56-202-8-135  
Brushed Chrome . . . . . P/N 56-202-9-135  
Custom Paint . . . . . P/N 56-202-X-135  
(a) Previously known as Bright White.  
(b) Eastern Hemisphere sales only.

**Note:** All Custom Cover Plates are painted using Sherwin Williams Interior Latex Paint. Contact TYCO Customer Service with any questions related to custom orders.

### **Sprinkler Wrench**

Specify: W-Type 18 Sprinkler Wrench, P/N 56-000-1-265

# Bourdon Tube Pressure Gauges Standard Series Type 111.10SP

WIKA Datasheet 111.10SP

## Applications

- Fire sprinkler systems
- Suitable for all media that will not obstruct the pressure system or attack copper alloy parts

## Special Features

- UL-listed (UL-393), United States and Canada
- Factory Mutual (FM) approved
- Reliable and economical



Bourdon Tube Pressure Gauge Type 111.10SP

## Standard Features

### Design

EN 837-1 & ASME B40.100

### Sizes

4" (100 mm)

### Accuracy class

± 3/2/3% of span (ASME B40.100 Grade B)

### Ranges

0/80 psi, retard to 250 psi (air)

0/300 psi (water)

### Working pressure

Steady: 3/4 of full scale value

Fluctuating: 2/3 of full scale value

Short time: full scale value

### Operating temperature

Ambient: -40°F to 140°F (-40°C to 60°C)

Media: 140°F (+60°C) maximum

### Temperature error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

### Bourdon tube

Material: copper alloy

C-type

### Pressure connection

Material: copper alloy

1/4" NPT lower mount (LM)

### Movement

Copper alloy

### Dial

White aluminum with stop pin; black and red lettering

### Pointer

Black aluminum

### Case

Black polycarbonate

### Window

Snap-in clear polycarbonate

### Approvals

UL listed (UL-393)

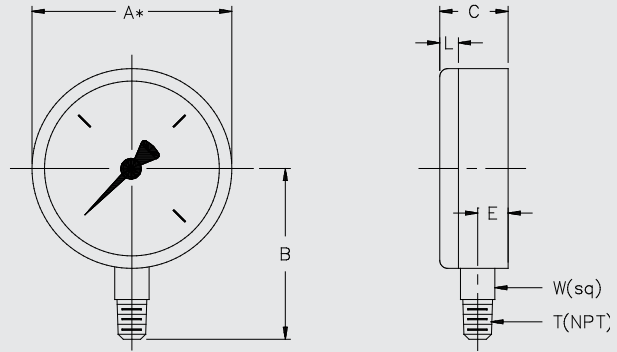
Factory Mutual

## Optional Extras

(not all options are UL or FM approved)

- Brass restrictor
- Black-painted steel case
- Custom dial layout
- Other dual scales in combination with psi are available:  
bar, kPa, MPa, kg/cm<sup>2</sup>

## Dimensions



Size		A	B	C	E	L	T	W	Weight
4"	mm	100	71	30	11.5	3.75		14	
	in	4.0	2.79	1.18	0.45	0.15	1/4"	0.55	0.35 lb.

### Ordering information

Pressure gauge model / Nominal size / Scale range / Size of connection / Optional extras required  
 Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing.  
 Modifications may take place and materials specified may be replaced by others without prior notice.



**WIKA Instrument Corporation**  
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 Lawrenceville, GA 30043-5868  
 Tel: 888-WIKA-USA • 770-513-8200  
 Fax: 770-338-5118  
 E-Mail: info@wika.com  
 www.wika.com



# 6030CTS – A<sup>2</sup> COMPOSITE TUB/SHOWER

inches (mm)

60 x 30 x 76 (1525 x 760 x 1930) • Fax on Demand #1357

## A<sup>2</sup> COMPOSITE

Lightweight and durable, our A<sup>2</sup> Composite is an engineered compound of resin, glass and special fillers formed into sheets. These sheets are then placed under high pressure and heat to liquify the compound, allowing it to flow and take the shape of almost any form imaginable. The results are simple, stylish and a snap to install.



## FEATURES

- Durable high gloss finish
- Smooth wall, 4 piece molded sectionals
- Pre-Levelled base
- Caulkless Installation
- Leakproof right angle joint flanges
- Easy Wedge & Lock Installation
- Multiple integral soap shelves
- Left, right drain
- Slip resistant, textured bottom
- Available in White and Biscuit
- 15 year residential limited warranty

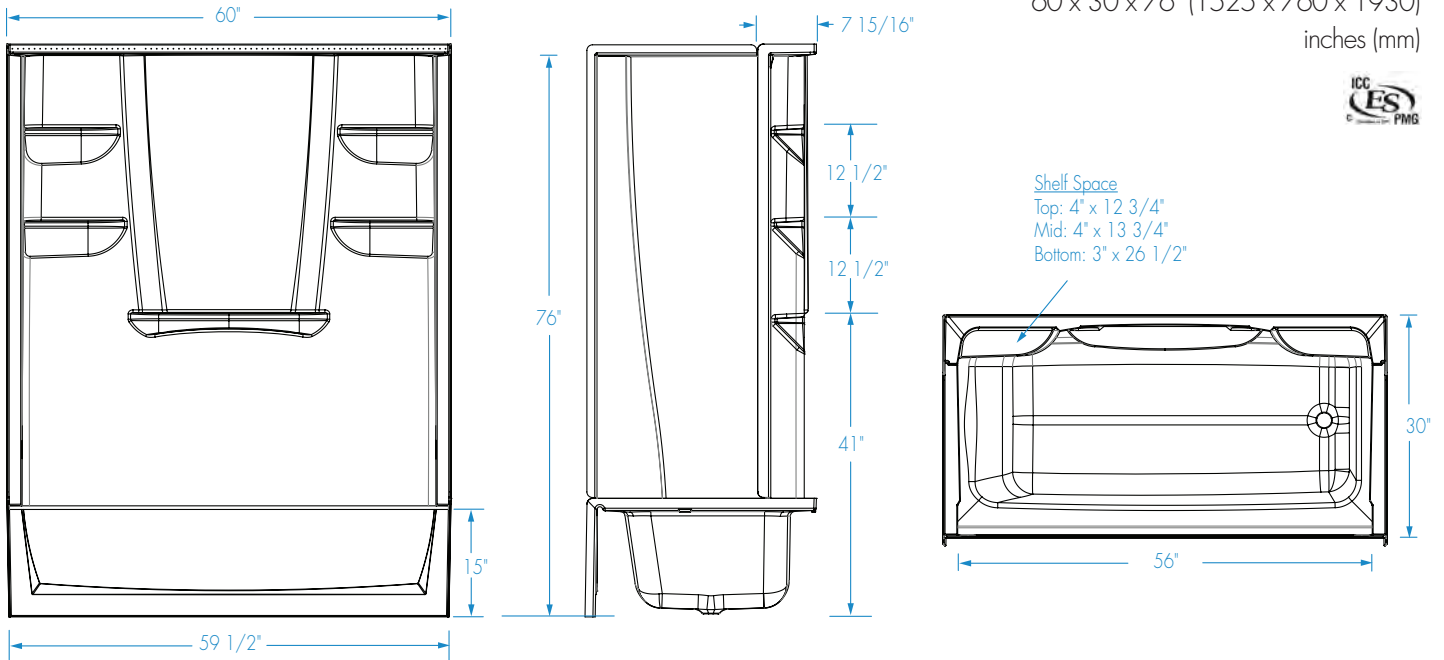
## AQUATIC ADVANTAGE

- National distribution
- 6 manufacturing facilities
- Private fleet
- Centralized customer service
- Field support
- 24-hour fax-on-demand



# 6030CTS

60 x 30 x 76 (1525 x 760 x 1930)  
inches (mm)



**FEATURES** lbs (kg) Dimensional Tolerance  $\pm \frac{3}{16}$ ". Dimensions needed for site preparation should be measured from the unit. Aquatic assumes no responsibility for preparatory work.

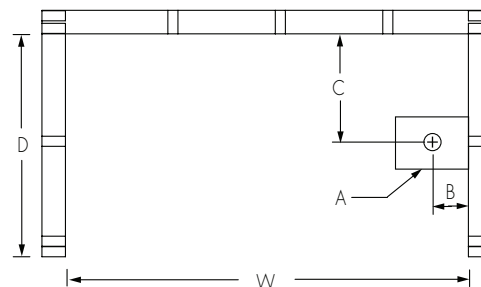
Model #	Material	Jets	Motor	Controls	Drain	Net Wt.	Pkg. Wt.
Tub-Shower #6030CTS	Composite	-	-	-	LH or RH	120 (54)	128 (58)

## DIMENSIONS

Specifications	inches (mm)
Width: Overall / Net	60 (1525)
Depth: Overall / Net	31 1/4 (795) / 30 (760)
Height: Overall / Net	77 3/8 (1965) / 76 (1930)
Enclosure Opening	56 (1420)
Skirt Height	15 (380)
Drain Rough-In (from Back Wall)	14 1/4 (360)
Drain Rough-In (from Side Wall)	2 7/8 (75)
Drain: Diameter / Clearance	2 (50) / 1/2 (15)

## FRAMING DIMENSIONS inches (mm)

Type	D Depth	W Width	H Height	A	B	C
Alcove	31 1/4 (795)	60 (1525)	77 3/8 (1965)	Box Out	2 7/8 (75)	14 1/2 (370)



## SUMP DATA

Top of Drain to Bottom of Overflow	Capacity to Overflow gal (litr)	WIDTH @ centerline		DEPTH @ centerline	
		Top	Bottom	Top	Bottom
9 7/8 (250)	37 (940)	51 1/2 (1310)	45 1/2 (1155)	22 1/4 (540)	20 1/2 (520)



## World's Most Advanced Complete Units

### Major System Components:

- 1 DC Power from Solar Array
- 2 Glass Lined Solar Storage Water Heater
- 3 Proprietary *Intellement™* Control
- 4 *Intellement™* PV Disconnect
- 5 Mandatory Mixing Valve



- **Factory Installed Automatic Controls** - Fast acting surface-mount thermostats for automatic control and safety.

- **Direct Heat Transfer With Immersed Heating Elements** - Transfers heat directly and efficiently to the water. Screw-in style.

- **Factory Installed Cold Water Delivery Dip Tube** - Reduces sediment build up.

- **1600°F Fused Glass Tank Lining**

- **2" Non-CFC Foam Insulation** - Sides and top.

- **Water Connections** - 3/4" NPT Factory installed true dielectric fittings.

- **Factory Installed Heat Traps** - Design incorporates a flexible disk that reduces heat loss.

- **Protective Magnesium Anode Rod** - Provides added protection against corrosion for a long service life.

- **Automatic Solar Power Point Tracking** - Delivers highest percentage of solar energy.

- **Simultaneous Operation** - Of AC & Solar when demand is high during the day.

- **Operating Voltages** - 0-250V DC, 208-240V AC.

- **Factory Installed T&P Relief Valve**

- **Low Restriction Brass Drain Valve**

- **Minimum Energy Factor of 2.0**

### System Operation

Solar generated electricity is connected by wires to the DC PV Disconnect. From here, it is connected to the *Intellement™* Control. The Control manages DC power to the element to optimize heating. Heat energy is low in the morning, peaks at solar noon, then decreases until the sun no longer strikes the panels. At day's end, *Intellement™* goes into sleep mode until the next morning. Water heated is stored in the tank for use. In days of low or no sun, AC power provides electricity to the backup element near the top of the tank.

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F: 904.693.6999  
M: 904.424.0180

<http://www.energylabsinc.com>

All Components Proudly



"Energy for a changing world"



Part Number	Control	Tank Size(Gal)
INT SWPV-50	INT-C-200	50
INT SWPV-65	INT-C-200	65
INT SWPV-80	INT-C-200	80



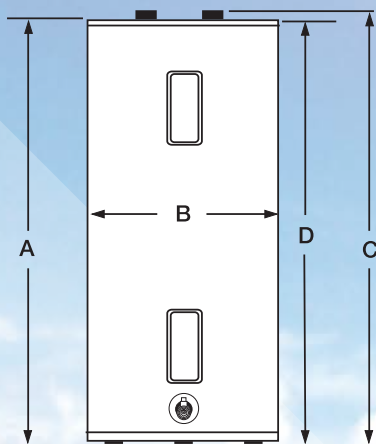
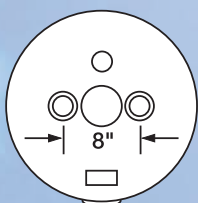
## Submittal Information

The solar water heating system shall be a Hybrid Solar Electric type as offered by Solar Energy Labs, Inc., 5191 Shawland Road, Jacksonville, Florida 32254. The system model shall be of the INT-SWPV series, system model number \_\_\_\_\_ having a \_\_\_\_ gallon glass-lined water heater storage tank employing the Intellement<sup>®</sup> control system and have \_\_\_\_ of the SolarWorld USA brand, Sunmodule+™ 285 watt, mono-crystalline photovoltaic panels, or equivalent. It shall exclusively employ the Schletter™ racking system as produced and provided by Schletter USA. The system shall be fitted with a mixing valve set to safely deliver water at \_\_\_\_ degrees F. The system shall be fitted with a DC fused safety disconnect as provided by Solar Energy Labs, Inc.

## THERMALUX™ Standard Models

C.E.C. Listed

Model Number	Capacity		Recovery 90°F Rise		A Floor to Heater Top	B Jacket Dia.	C Floor to Water Conn.	D Floor to T&P Conn.	Approx. Shipping Weight
	U.S. Gal.	Imp. Gal.	U.S. GPH*	Imp. GPH*	in.	in.	in.	in.	lbs.
M-2-HE50S6DS	50	42	21	18	47½	22	48½	47½	131
M-2-HE65R6DS	65	54	21	18	60¼	22	61¼	60¼	160
M-2-HE80R6DS	80	67	21	18	60¼	24	61¼	60¼	191



**Warning:** Installation should be in accordance with all national and/or local codes. In the absence of local codes, refer to NFPA 54 or ANSI Z21.10.1.

**Caution:** The recommended maximum hot water temperature setting for normal residential use is 120°F. Manufacturer recommends a tempering valve or anti-scald valve be installed and used according to the manufacturer's directions to prevent scalding. THERMALUX™ Hybrid Water Heaters include a mixing valve that will prevent scalding when installed properly.

**Pressures (all):** Working pressure, 150 psi; testing pressure, 300 psi

### Electrical Ratings:

AC - Upper Only, Single 4500W Fixed Resistance Element  
208-240V AC, Single Phase Power from Grid  
20 Amps on Dedicated Breaker

DC - Single Variable Wattage DC Lower Element, 0-2400W  
Power In: 1140 to 1195 Watts @ 1000W/M<sup>2</sup> SOLAR  
0-250V DC - Solar Maximum Power Point  
0-10A DC - Solar Maximum Power Point

- AC & DC Circuits are completely isolated
- Tank and Control Housings tied to Earth Ground



Listings Pending

### COUNTERTOP BATHROOM SINK K-2196

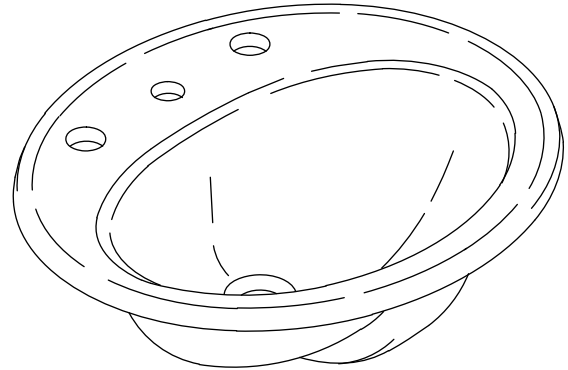
ADA

CSA B651

OBC

#### Features

- Vitreous china
- Drop-in
- Single-hole
- ADA compliant when installed in a 21" (533 mm) minimum depth countertop
- Optional soap dispenser hole on left (-L) or right (-R)
- With or without overflow
- 20-1/4" (514 mm) x 17-1/2" (445 mm)



#### Codes/Standards Applicable

Specified model meets or exceeds the following:

- ADA
- ICC/ANSI A117.1
- CSA B651
- OBC
- ASME A112.19.2/CSA B45.1

#### Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

#### Accessories

- CP: Polished Chrome

#### Specified Model

Model	Description	Colors/Finishes	
K-2196-1N	Single-hole drilling; less overflow	<input type="checkbox"/> 0	<input type="checkbox"/> Other _____
K-2196-1K	Single-hole drilling; less overflow; with soap dispenser hole on right	<input type="checkbox"/> 0	<input type="checkbox"/> Other _____
K-2196-1F	Single-hole drilling; less overflow; with soap dispenser hole on left	<input type="checkbox"/> 0	<input type="checkbox"/> Other _____
K-2196-1	Single-hole drilling; with overflow; less soap dispenser hole	<input type="checkbox"/> 0	<input type="checkbox"/> Other _____
K-2196-1L	Single-hole drilling; with overflow; with soap dispenser hole on left	<input type="checkbox"/> 0	<input type="checkbox"/> Other _____
K-2196-1R	Single-hole drilling; with overflow; with soap dispenser hole on right	<input type="checkbox"/> 0	<input type="checkbox"/> Other _____

Recommended Accessories		
K-8998	P-Trap	<input type="checkbox"/> CP

#### Product Specification

The drop-in bathroom sink shall be made of vitreous china. Bathroom sink shall be 20-1/4" (514 mm) in length, and 17-1/2" (445 mm) in width. Bathroom sink shall have single-hole drilling (-1). Bathroom sink shall be ADA compliant when installed in a 21" (533 mm) minimum depth countertop. Bathroom sink shall feature optional soap dispenser hole (-L, left or -R, right). Bathroom sink shall be Kohler Model K-2196-\_\_\_\_\_-\_\_\_\_\_.

# PENNINGTON®

## Technical Information

Fixture*:	
Basin area	16" (406 mm) x 11" (279 mm)
Water depth	4" (102 mm)
Drain hole	Ø 1-3/4" (44 mm)
*Approximate measurements for comparison only.	
Holes	
Spout	Ø 1-3/8" (35 mm)
Soap dispenser	Ø 1-1/4" (32 mm)
Included components:	
Cut-out template	1002970-7

## Installation Notes

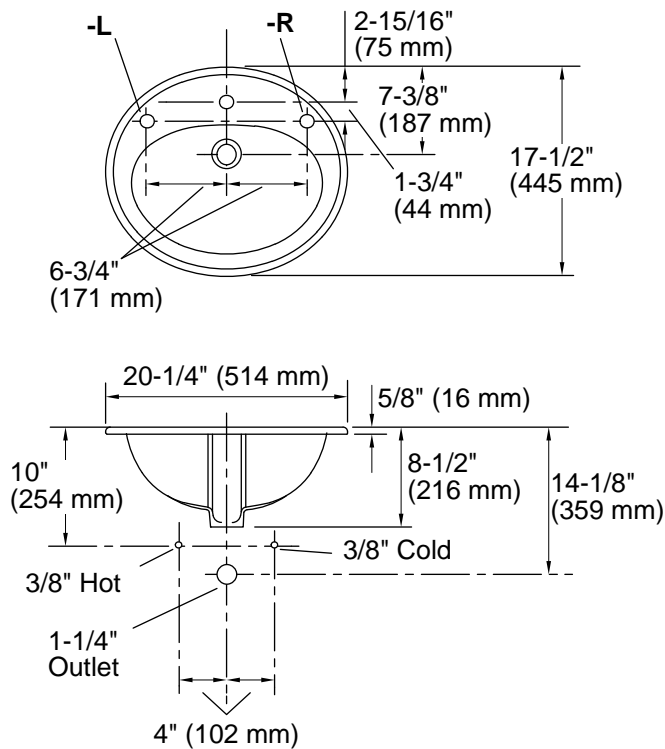
Install this product according to the installation guide.

**NOTICE:** Countertop manufacturer or cutter **must** use the cutout template provided with the product, or a current one provided by Kohler Co. (call 1-800-4KOHLER). Kohler Co. is not responsible for cutout errors when the incorrect cutout template is used.

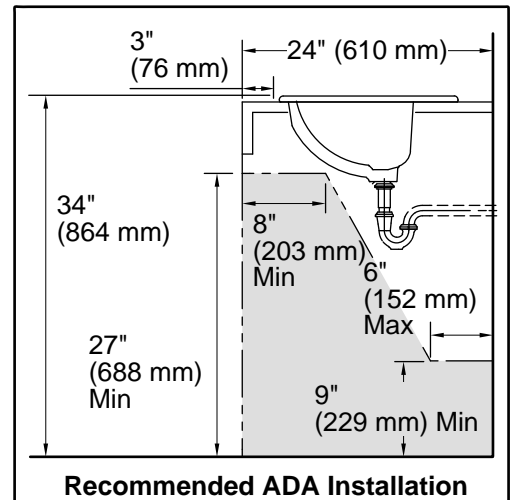
Will comply with **ADA** when installed per Section 606 Lavatories of the Act.

Will comply with **CSA B651** when installed per Clause 4.3.3 of the standard.

Will comply with **OBC** when installed per Clause 3.8.3.11.



Standard Installation



Recommended ADA Installation

## Product Diagram

**CABLE DRAIN  
K-7213  
ALSO K-7214**

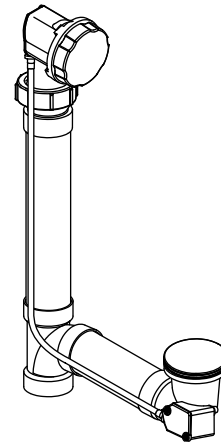
**Features**

- For baths 17" (432 mm) to 22" (559 mm) deep from the center of the bath overflow outlet to the center of the bath drain outlet
- 27" (686 mm) length cable
- Adjustable rotating connection for easy installation
- Metal construction control handle and stopper
- Includes PVC tee

**Codes/Standards Applicable**

Specified model meets or exceeds the following:

- ASME A112.18.2
- ASME A112.18.1/CSA B125.1
- IAPMO/UPC



**Colors/Finishes**

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

**Specified Model:**

Model	Description	Colors/Finishes	
K-7213	Cable drain with PVC tubing	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____
K-7214	Cable drain without PVC tubing	<input type="checkbox"/> CP	<input type="checkbox"/> Other _____

**PRODUCT SPECIFICATION**

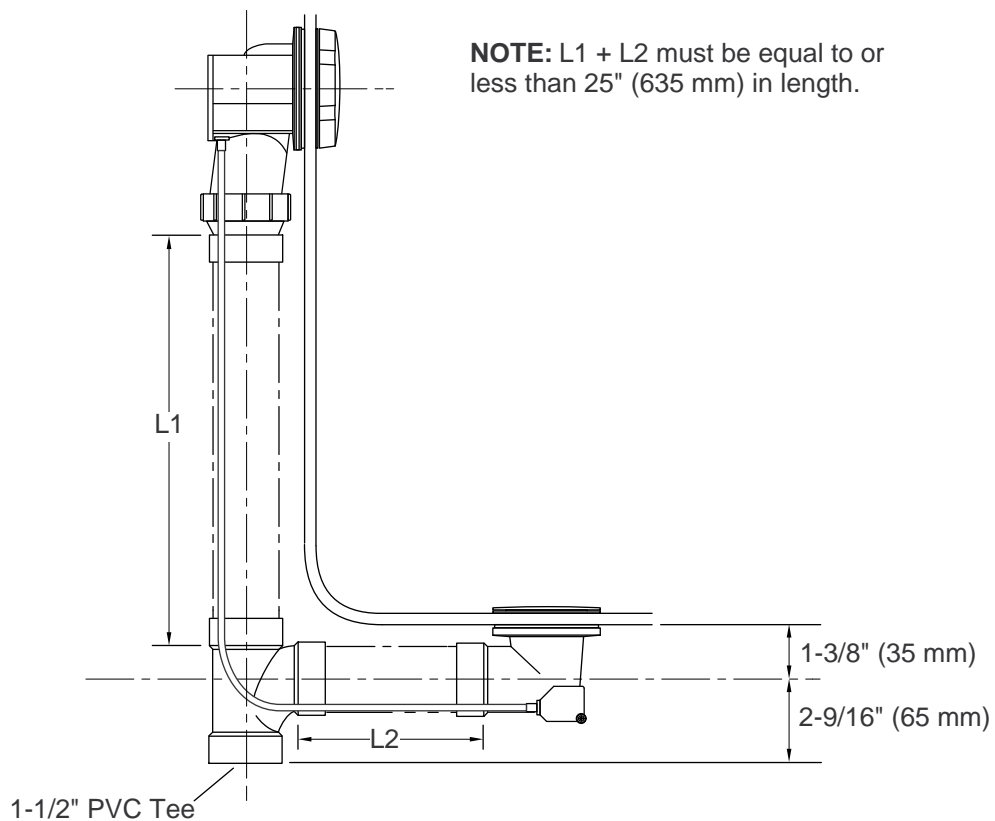
Cable drain shall be for baths 17" (432 mm) to 22" (559 mm) deep from the center of the bath overflow to the center of the bath drain outlet. Product shall feature a 27" (686 mm) length cable. Product shall feature a metal constructed control handle and stopper. Product shall feature an adjustable rotating connection for easy installation. Product shall include a PVC tee. Product shall be Kohler Model K-\_\_\_\_-\_\_\_\_.

# CLEARFLO

## Installation Notes

Install this product according to the installation guide.

The combined length of the PVC tubing (noted as L1 and L2 in the Product Diagram) must be equal to or less than 25" (635 mm).



## Product Diagram



**Features**

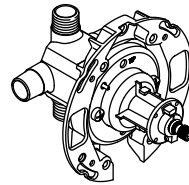
- Brass valve bodies
- High-temperature limit setting for added safety
- Mixing valve cycles from "cold" to "hot"
- Rite-Temp pressure-balancing diaphragm design valve
- One-piece diaphragm cartridge design for ease of maintenance
- Available with or without screwdriver stops

**Codes/Standards Applicable**

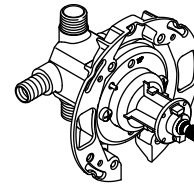
Specified model meets or exceeds the following:

- ASME A112.18.1/CSA B125.1
- ASSE 1016

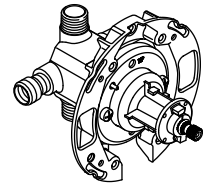
**PRESSURE-BALANCING VALVE  
K-304**



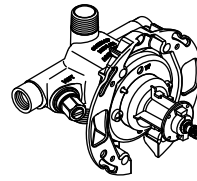
**K-304-K**



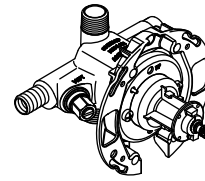
**K-304-PX**



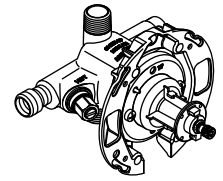
**K-304-UX**



**K-304-KS**



**K-304-PS**



**K-304-US**

**Colors/Finishes**

- NA: None applicable

**Specified Model**

Model	Description	Colors/Finishes
K-304-K	Pressure-balancing valve without screwdriver stops – universal inlets	<input type="checkbox"/> NA
K-304-KS	Pressure-balancing valve with screwdriver stops – universal inlets	<input type="checkbox"/> NA
K-304-PX	Pressure-balancing valve without screwdriver stops – PEX inlets (crimp)	<input type="checkbox"/> NA
K-304-PS	Pressure-balancing valve with screwdriver stops – PEX inlets (crimp)	<input type="checkbox"/> NA
K-304-UX	Pressure-balancing valve without screwdriver stops – PEX inlets (cold expansion)	<input type="checkbox"/> NA
K-304-US	Pressure-balancing valve with screwdriver stops – PEX inlets (cold expansion)	<input type="checkbox"/> NA
K-304-CX	Pressure-balancing valve without screwdriver stops – 1/2" CPVC inlets	<input type="checkbox"/> NA
K-304-CS	Pressure-balancing valve with screwdriver stops – 1/2" CPVC inlets	<input type="checkbox"/> NA

The K-304-CX and K-304-CS are K-304-K and K-304-KS with CPVC adapters installed on the inlets.

**Optional Accessories**

Deep rough-in kits are available (refer to the trim set Specification Sheet).

**Product Specification**

Rite-Temp pressure-balancing single-control valve shall have a brass valve body. Valve shall include a Rite-Temp pressure-balancing diaphragm design valve with a one-piece diaphragm cartridge design for ease of maintenance. Valve shall have mixing valve cycles from "cold" to "hot" and a high-temperature limit stop for added safety. Valve shall be available without or with screwdriver stops. Rite-Temp pressure-balancing valve shall be Kohler Model K-304-\_\_\_\_-NA.

# RITE-TEMP®

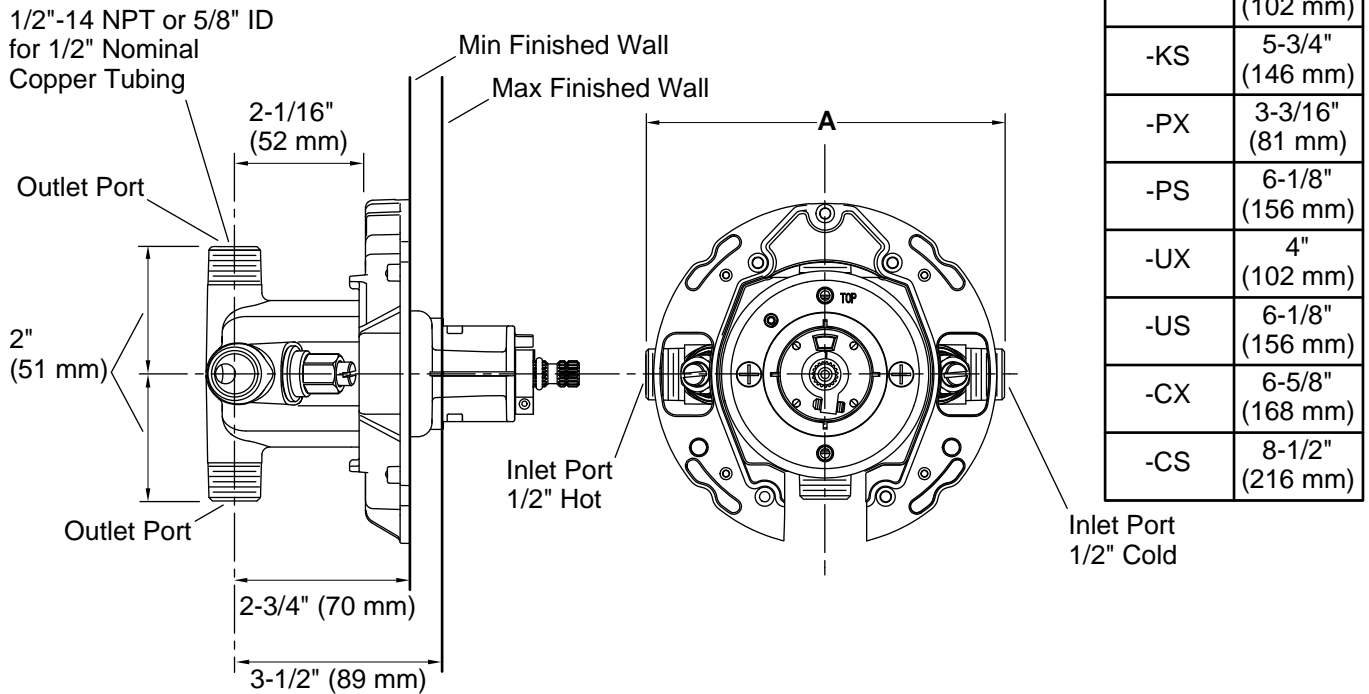
## Installation Notes

Install this product according to the installation guide.

Avoid cross-flow conditions. Do not install a shut-off device on either valve outlet.

Cap the shower outlet if a deck-mount spout, diverter, or handshower is connected to a spout outlet.

Install straight pipe or tube drop of 7" (178 mm) to 18" (457 mm) with single elbow between valve and wall-mount spout. Refer to the installation instructions for proper configuration of the connection between the valve and bath spout.



## Product Diagram

### BATH & SHOWER TRIM SET K-T15601

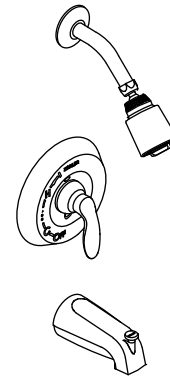
#### Features

- Metal construction
- 2.5 gallon (9.5 L) per minute flow rate
- Available with 4-7/8" (124 mm) diverter bath spout with NPT or slip-fit connection
- Includes showerhead with arm and flange
- Includes faceplate and lever handle

#### Codes/Standards Applicable

Specified model meets or exceeds the following:

- ASME A112.18.1/CSA B125.1
- ASSE 1016



#### Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

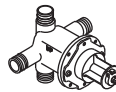

#### Accessories

- NA: None applicable
- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

#### Specified Model

Model	Description	Colors/Finishes	
K-T15601-4	Bath & shower trim set – NPT spout	<input type="checkbox"/> CP	<input type="checkbox"/> Other_____
K-T15601-4S	Bath & shower trim set – slip-fit spout	<input type="checkbox"/> CP	<input type="checkbox"/> Other_____

#### Required Accessories

			
K-304-*	Rite-Temp® valve OR	<input type="checkbox"/> NA	
K-2971-KS	HiFlow Rite-Temp valve with stops		<input type="checkbox"/> NA

\* For a complete listing of all the Rite-Temp valves, refer to the K-304-\* Specification Sheet or Roughing-In sheet.

#### Optional Accessories

88526	HiFlow Rite-Temp® thin wall installation kit	<input type="checkbox"/> CP	<input type="checkbox"/> Other_____
-------	--	-----------------------------	-------------------------------------

### Product Specification

The single-handle bath & shower trim set shall be made of metal construction. Product shall include showerhead with arm and flange, faceplate with lever handle, and 4-7/8" (124 mm) diverter bath spout with NPT or slip-fit connection. Faucet trim shall be 2.5 gallon (9.5 L) per minute flow rate. Faucet trim shall be Kohler Model K-T15601-\_\_\_\_\_-\_\_\_\_\_ and mixing valve shall be Kohler Model K-\_\_\_\_\_-\_\_\_\_\_-NA.

# CORALAIS®

## Installation Notes

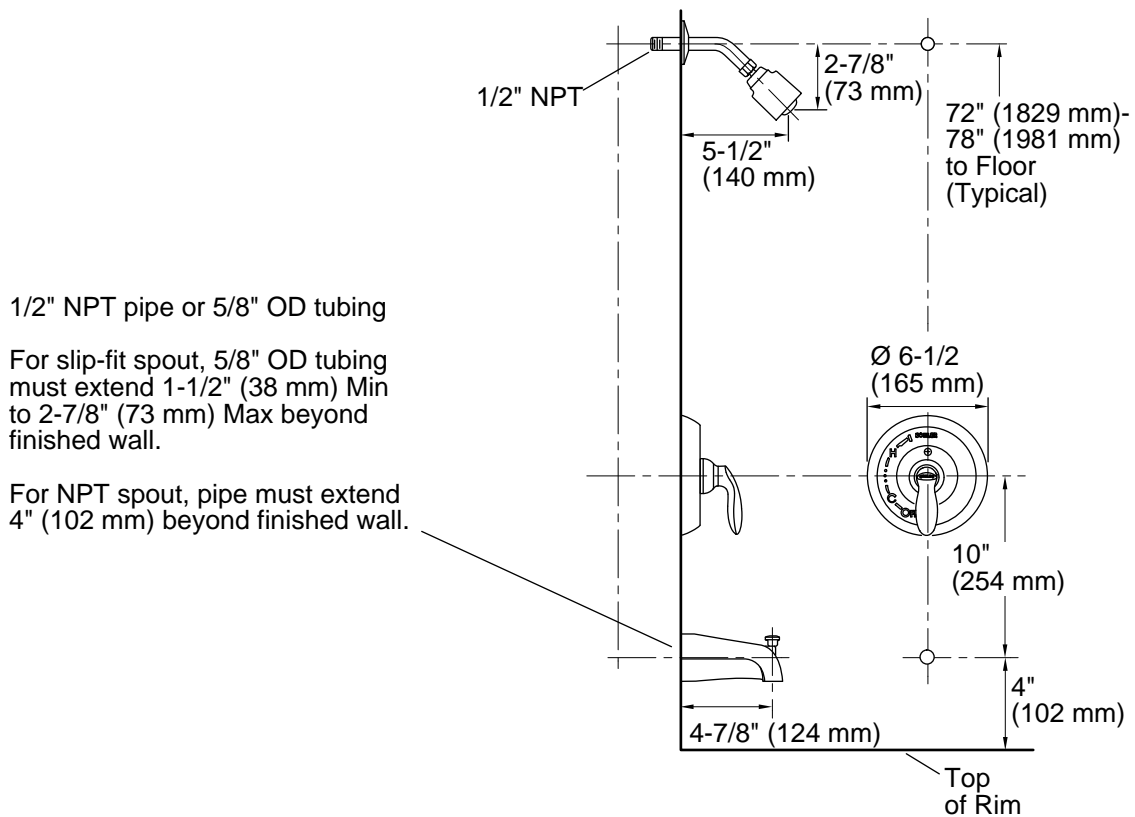
Install this product according to the installation guide.

**NOTICE: Risk of product damage.** Long screws, for installing trim, can damage the K-2971-KS valve. Consult the trim installation guide to verify if the thin wall installation kit (88526) is needed.

Avoid cross-flow conditions. Do not install shut-off device on either valve outlet.

Cap shower outlet if deck-mount spout, diverter, or handshower is connected to spout outlet.

Install straight pipe or tube drop of 7" (178 mm) to 18" (457 mm) with single elbow between valve and wall-mount spout.



## Product Diagram

### THE COMPLETE SOLUTION® TOILET K-11464



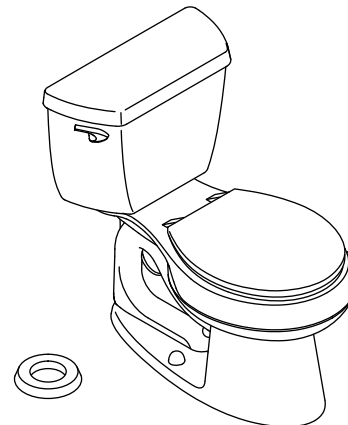
#### Features

- Vitreous china
- Round bowl
- Class Five® flushing system
- Includes seat, cover, wax ring, polished chrome trip lever and floor hardware
- Less supply
- 12" (305 mm) rough-in
- 1.28 gpf (4.8 lpf)
- 2-1/8" (54 mm) glazed trapway
- 10-1/2" (267 mm) x 7-3/4" (197 mm) water area
- 27-1/2" (699 mm) x 19-5/8" (498 mm) x 28-1/4" (718 mm)

#### Codes/Standards Applicable

Specified model meets or exceeds the following:

- ASME A112.19.2/CSA B45.1
- EPA WaterSense®



#### Colors/Finishes

- 0: White

#### Accessories

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

#### Specified Model

Model	Description	Trip Lever	Colors/Finishes
K-11464	The Complete Solution toilet	left-hand	<input type="checkbox"/> 0

Recommended Accessories			
K-7637	Angle supply with stop – 3/8" NPT	<input type="checkbox"/> CP	<input type="checkbox"/> Other_____

#### Product Specification

The round bowl toilet shall be made of vitreous china. Toilet shall be 27-1/2" (699 mm) in length, 19-5/8" (498 mm) in width, and 28-1/4" (718 mm) in height with a 10-1/2" (267 mm) x 7-3/4" (197 mm) water area. Product shall be for 12" (305 mm) rough-in. Product shall feature a 1.28 gpf (4.8 lpf) and Class Five flushing system. Product shall include a seat, cover, wax ring, polished chrome trip lever, and floor hardware. Product shall include a polished chrome trip lever. Product shall be less supply. Product shall have a 2-1/8" (54 mm) glazed trapway. Toilet shall be Kohler Model K-11464-\_\_\_\_\_.

# WELLWORTH®

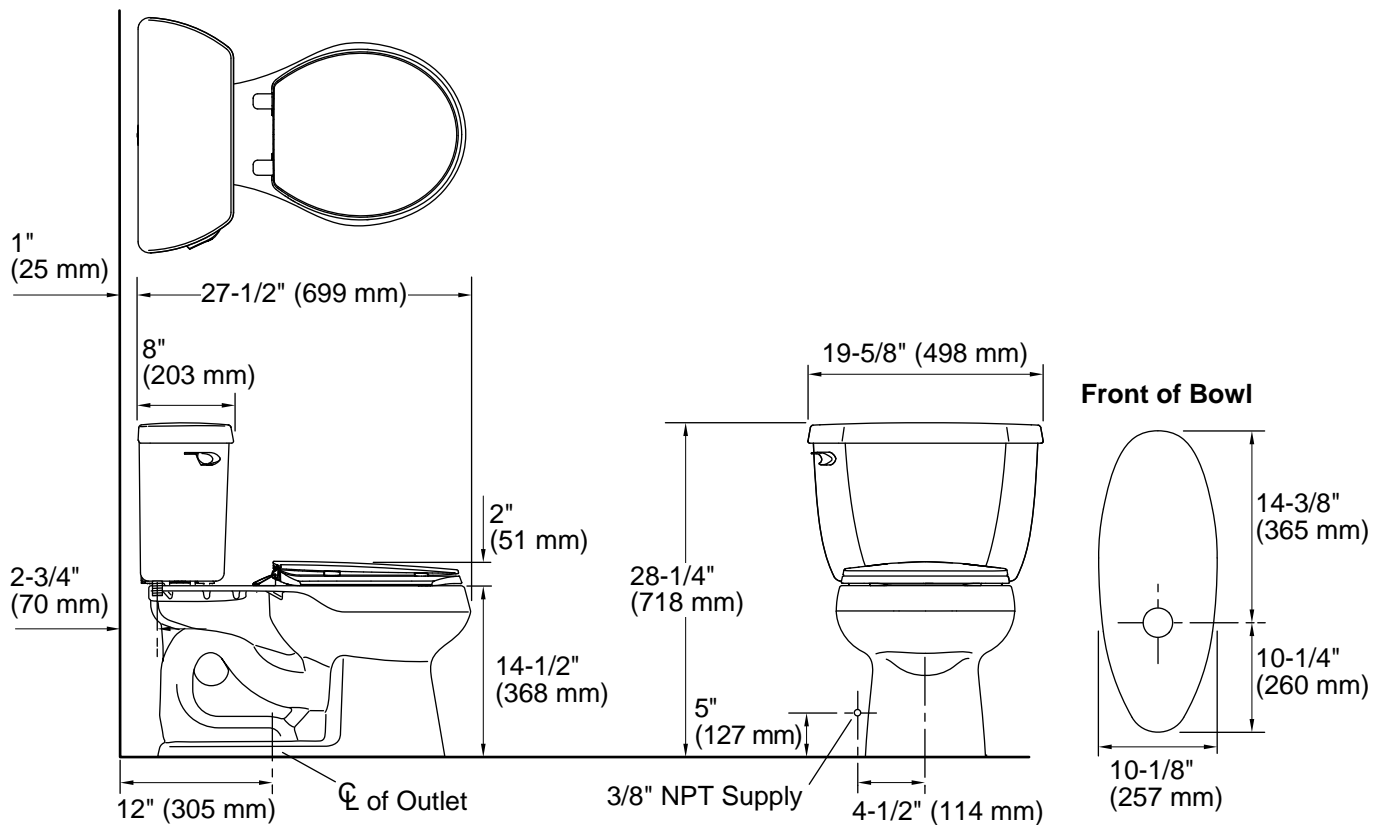
## Technical Information

Fixture:	
Configuration	two-piece, round
Water per flush	1.28 gal (4.8 L)
Passageway	2-1/8" (54 mm)
Water area	10-1/2" (267 mm) x 7-3/4" (197 mm)
Water depth from rim	5-1/4" (133 mm)
Seat post hole centers	5-1/2" (140 mm)

Included components:	
Bowl	K-4197
Tank	K-4436
Tank cover	84591
Trip lever	K-9386-L
Toilet seat	K-4658
Bolt cap accessory pack	1013092
Wax ring and hardware installation kit	1023457

## Installation Notes

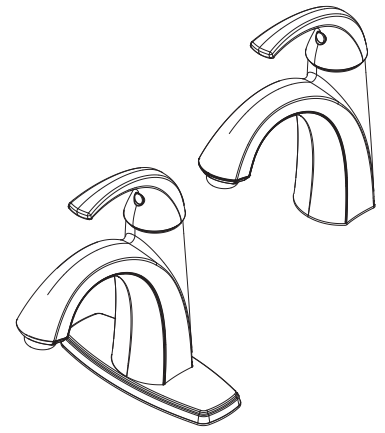
Install this product according to the installation guide.



## Product Diagram

### Single Control Lavatory Faucet

- F-042-SLCC Finish(CC)
- F-042-SLKK Finish(KK)
- F-042-SLYY Finish(Y)



## Specifications

### Features

- 1 or 3-Hole Installation; Deck Plate or Single Hole Mounting Option
- Pforever Seal Ceramic Disc Valves
- Push & Seal™ Pop-Up
- Pforever Warranty®

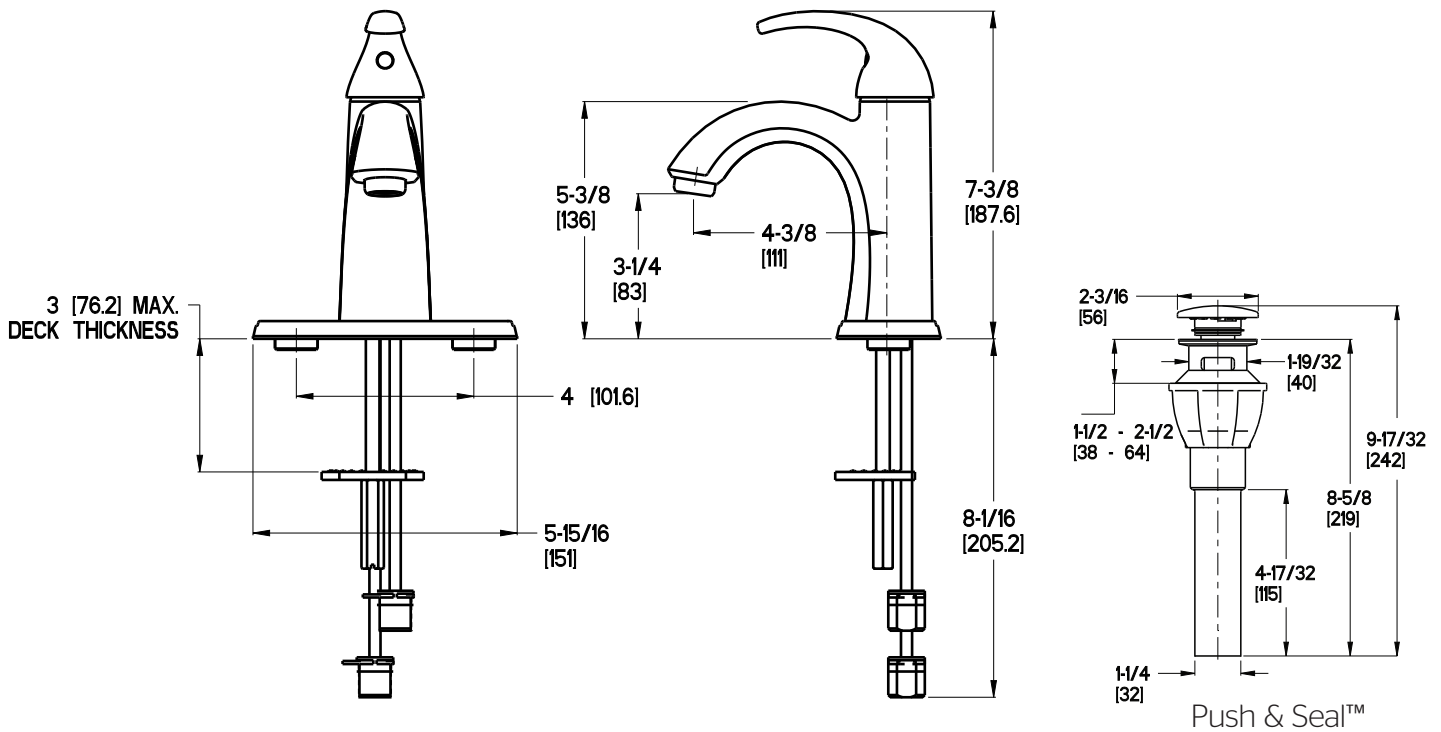
### Code Compliance

Pfister products are designed and manufactured in compliance with the following standards and codes:

- IAPMO Certified
- CSA B125 Certified
- ASME A112.18.1
- NSF 61/9 Annex G (Low lead)
- Cal Green Compliant
- EPA WaterSense Certification 1.5 gpm, 5.7L/Min
- ADA Compliant-ANSI A117.1 (Lever handles only)



## Dimensions



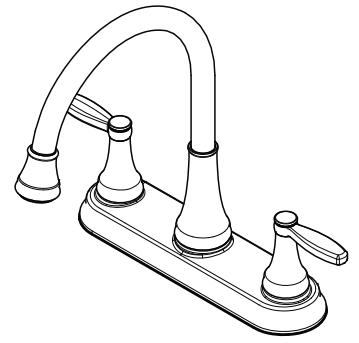
Ø1 Min to Ø1-1/2 Max. Deck Hole Openings

F-036-3GFS Finish(SS)\*

F-036-4GFS Finish(SS)

F-036-4GFY Finish(Y)

\*International Only



## Specifications

### Features

- 3 or 4-Hole Installation
- High Arc Spout
- Installs With or Without Side Spray
- 360° Swivel Spout
- TiteSeal™ Deck Plate
- Tri-Flow™ with Eco Option
- Pforever Seal Ceramic Disc Valves
- Pforever Warranty®

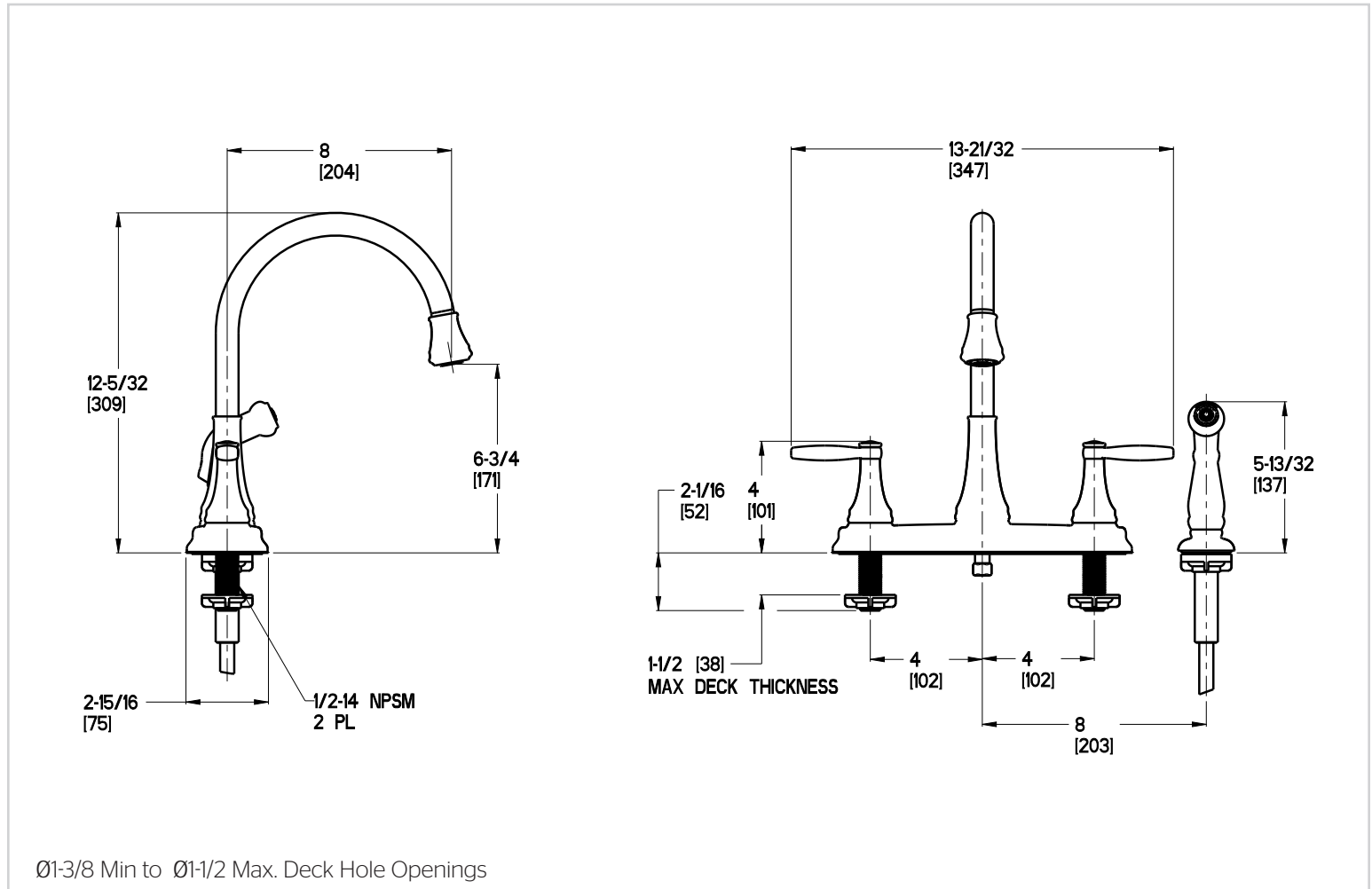
### Code Compliance

Pfister products are designed and manufactured in compliance with the following standards and codes:

- IAPMO Certified
- CSA B125 Certified
- ASME A112.18.1
- NSF 61/9 Annex G (Low lead)
- Cal Green Compliant
- ADA Compliant-ANSI A117.1 (Lever handles only)



## Dimensions







# SHARKBITE® PUSH-FIT CONNECTION SYSTEM



**Push To Connect Fittings for Copper, PEX and CPVC**  
**Specification Submittal Package for Potable Water**  
**and Hydronic Heating**

[www.sharkbite.com](http://www.sharkbite.com)



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## SYSTEM DATA SHEET

### System Description

The SharkBite Push-Fit quick-connect plumbing system is the easiest and most dependable way to join copper, CPVC or PEX pipe in any combination—with no soldering, clamps, unions or glue. Available in an assortment of over 200 fittings and sizes ranging from 1/4" to 2" copper tube size (CTS).

### Applications

Tubing: Hard drawn copper pipe Type K, L and M and annealed Type M not to exceed 3/8 nominal complying with ASTM B 88, PEX tubing complying with ASTM F 876 or CSA B137.5, or CVPC tubing complying with ASTM D 2846 or CSA B137.6. SharkBite fittings are approved for installations above and below ground applications. Please consult with local code for final approval. Failure to comply with the above types of pipe or application could result in connection failures.

### Operating Parameters

Operating Pressure: 200 PSI Max  
Operating Temperature: 200°F Max

### Approved Applications

- Potable Water
- Hydronic Heating (w/ Glycol concentration up to 100%)

### System Benefits

- Instant push-fit connection for increased ease of use
- No soldering, clamps, unions or glue needed
- Reduces installation time with no tightening of nuts, clamps and unions.
- Connects three types of pipe in any combination
- No mapping of system
- Can be installed wet or dry
- Rotatable after installation
- Approved for behind the wall and underground applications.
- Removable after installation
- Clean, professional installation

### Fittings

SharkBite push-fit fittings are available in 200+ configurations including: Couplings, Elbows, Tees, Reducers, Threaded Adapters, Caps, Stops, Stub Outs, Ball Valves, Slips, Water Heater Hoses and Valves with SharkBite Connections. Made from Lead Free Dezincification Resistant (DZR) brass and available in sizes 1/4" – 2" CTS.

### Push-Fit Technology

The SharkBite fitting works via a two stage process that ensures a quick, easy connection.

- The tubing passes through the release collar and then through the stainless steel grab ring.
- The tube is pushed through an o-ring protector that aligns the tube. It then passes through a specially formulated o-ring that compresses between the pipe and the wall of the fitting before it reaches the tube stop.

### How to Make a Connection

1. Cut the pipe. Make sure the cut is square and even.
2. Deburr the end of the pipe to remove any sharp edges. Sharp edges can cut the o-ring and lead to leaks.
3. Mark the pipe with the proper insertion depth (see below for reference).
4. Push the pipe into the fitting. The mark made on the pipe should rest against the collar of the fitting, ensuring a proper seal.

FITTING SIZE	INSERTION DEPTH
1/4"	0.813"
3/8"	0.875"
1/2"	0.938"
5/8"	1.125"
3/4"	1.125"
1"	1.313"
1-1/4"	2.000"
1-1/2"	2.250"
2"	2.500"

### Tube Liner

SharkBite fittings ranging in sizes 3/8" to 1" come with an integral tube liner preinstalled for use with PEX pipe. SharkBite sizes 1-1/4" to 2" do not come with tube liners preinstalled and are sold separately. The tube liner must be used when PEX piping is utilized.

### Tools

Tools are available to make the installation process easier.

- SharkBite depth & deburring tool for 1/4" to 1" CTS
- SharkBite depth & deburring tool for 1-1/4" to 2" CTS
- SharkBite disconnect clip (1 size per tubing)
- SharkBite disconnect tongs (1 size per tubing)

### History

SharkBite was launched in the Australian market in 1999 and in the North America market in 2004, ushering in a new way to do plumbing. Reliance Worldwide, an ISO 9001 organization, is one of the world's largest manufacturers of thermostatic water control valves and has been a major world supplier of hot water safety valves for over 50 years.

### Warranty

SharkBite fittings carry a 25 year warranty against any manufacturer's defect as long as the item has been installed per installation instructions and comply with local code. Please contact Customer Service for more information.

### IAPMO

<http://pld.iapmo.org/default.asp>

(Select Listee Name and enter "Reliance Worldwide")

### For more information on SharkBite products, contact:

Reliance Worldwide Corporation  
2727 Paces Ferry Road  
Building 2, Suite 1800  
Atlanta, GA 30339  
United States: 1-877-700-4242  
Canada: 1-888-820-0120  
Web: [www.sharkbite.com](http://www.sharkbite.com)

## ENGINEERING SPECIFICATIONS

The push-fit fitting shall be installed on hard drawn copper type K, L and M complying with ASTM B88, cross-linked polyethylene pipe (PEX) complying with ASTM F 876 or CSA B137.5 or CPVC piping complying with ASTM D 2846 or CSA B137.6. The fitting shall be made of lead free dezincification brass and compliant with ASSE 1061, NSF/ANSI 61 and NSF/ANSI 372. The fitting shall consist of an EPDM O-ring, a grade 316 stainless steel grab ring, and contain a polysulfone tube liner for PEX applications. The fitting shall be used in a potable water system or a hydronic heating water distribution up to 200 psi and 200°F. The fitting shall be a SharkBite fitting.

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Push-Fit Connection System for Potable Water Distribution and Hydronic Heating Water Distribution

#### 1.2 DEFINITIONS

- A. ASME: American Society of Mechanical Engineers
- B. ASSE: American Society of Safety Engineers
- C. ASTM: American Society for Testing and Materials
- D. CSA: Canadian Standards Association
- E. EPDM: Ethylene Propylene Diene Monomer
- F. IAPMO: International Association of Plumbing and Mechanical Officials
- G. NSF: National Sanitation Foundation

#### 1.3 REFERENCES

- A. ASSE 1061: Performance Requirements for Push-Fit Fittings
- B. NSF/ANSI Standard 61: Certification for Drinking Water System Components – Health Effects
- C. NSF/ANSI Standard 14: Plastics Piping System Components and Related Materials
- D. NSF/ANSI Standard 372: Lead Content Certification
- E. ASTM B 88: Standard Specifications for Seamless Copper Water Tube
- F. ASTM F 876: Standard Specification for Cross-linked Polyethylene (PEX) Tubing
- G. CSA B137.5: Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications
- H. CSA B137.6
- I. ASTM D 2846: Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot-and Cold-Water Distribution Systems.
- J. IAPMO: Uniform Plumbing Code
- K. IAPMO: National Plumbing Code of Canada
- L. IAPMO: International Plumbing Code
- M. AWWA C904: Cross-Linked Polyethylene (PEX) Pressure Pipe, ½ In. (12mm) Through 3 In. (.76 mm) for Water Service.

#### 1.4 QUALITY ASSURANCE

- A. Installer shall be well informed on installation instructions prior to installing.
- B. The installation of tubing and fittings for hot and cold water distribution systems shall conform to the requirements of the ICC International Plumbing Code or IAPMO Uniform Plumbing Code.
- C. The piping shall be cut square, even and have no rough edges.



## 1.5 WARRANTY

- A. SharkBite Push-Fit Fittings have a 25 year limited warranty from point of sale.
- B. All products must be installed in accordance with all applicable codes and in accordance with any local, state, provincial or federal requirements.
- C. The installing contractor must use construction techniques compliant with applicable codes to install the range of products and use the product(s) within the design parameters specified in any installation guidelines and technical notes for the applicable system. This shall include field pressure testing prior to concealing with concrete or by other means.
- D. Products must not be installed in a system that may operate at temperatures or at pressures that exceed the printed rating on the product, packaging or installation instructions.
- E. Evidence of tampering, mishandling, neglect, accidental damage, freeze damage or unauthorized modifications or repairs that cause damage to RWC warranted products void any warranty coverage of those particular products. It is expressly understood that failure as a result of any freezing fluids within the pipes does not constitute a defect in material or workmanship and shall not be covered by this warranty.
- F. Although RWC provides a plumbing system to facilitate a complete installation, other manufacturers tubing and/or fittings may be installed in any given installation provided manufacturing of the tubing and/or fittings demonstrates compliance with the applicable ASTM standards, and the product has been certified by a recognized third-party testing agency. The RWC product in the given installation will continue to be covered under this warranty. **NOTE:** RWC will be responsible only for proven defects in material or workmanship in RWC products. Problems in products manufactured by another company should be reported to that manufacturer.
- G. For full warranty information, please see page 30.

## PART 2: PRODUCTS

### 2.1 MANUFACTURERS

- A. RWC, 2727 Paces Ferry Road, Building 2, Suite 1800, Atlanta, GA 30339  
Telephone: 1-877-700-4242, Website: [www.sharkbite.com](http://www.sharkbite.com)

### 2.2 MATERIAL

- A. Tubing Standard: Copper tubing shall be hard drawn Type K, L, or M and annealed Type M copper complying with ASTM B 88.
- B. Tubing Standard: Cross-linked polyethylene pipe (PEX) shall conform to ASTM F 876 or CSA B137.5.
- C. Tubing Standard: CPVC tubing shall conform to ASTM D 2846 or CSA B137.6.
- D. O-ring shall be made from EPDM.
- E. Grab ring shall be made from Grade 316 Stainless Steel.
- F. Push-fitting: Brass fitting shall comply with ASSE 1061 and NSF/ANSI 61.

### 2.3 SOURCE QUALITY

- A. All fittings in contact with drinking water shall be listed by a third party agency to NSF 61.



## PART 3: EXECUTION

### 3.1 EXAMINATION

- A. If installing PEX pipe, ensure that the tube liner has been installed.
- B. Ensure the fitting is free from any damage, including but not limited to damaged or missing O-ring, cracked brass forging or deformed grab ring.

### 3.2 PREPARATION

- A. The tubing shall be cut square to ensure a proper connection.
- B. The tubing shall be free of dirt, debris or scale buildup. Any burrs shall be removed using a deburring tool.
- C. Mark the piping to use as verification of proper insertion into the fitting.

### 3.3 INSTALLATION

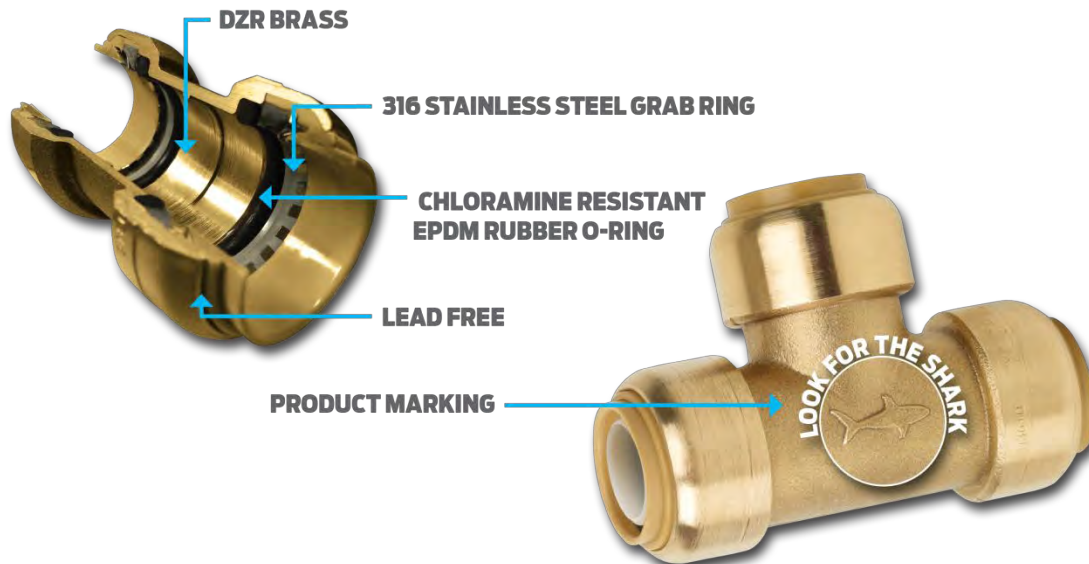
- A. Push-fit fitting shall be installed in accordance with the manufacturer's installation instructions.
- B. Pressure Rating: Install components having a pressure rating equal to or less than the system operating pressure.
- C. Threaded Joints: Threaded joints shall have thread seal tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
- D. Pipe Protection: Provide protection against abrasion where tubing/fitting is in contact with other building materials (including burial) by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
- E. Hydronic Heating: Glycol mixture for hydronic heating application is acceptable up to and including 100%.
- F. Behind the wall installation: Pressure test system for no less than 24 hours to ensure no leakage.
- G. Removal and reuse of push-fit fitting is allowed when executed in accordance with manufacturer's installation instructions.

### 3.4 FIELD QUALITY CONTROL

- A. Water Testing: The copper tubing system shall be water tested for joint tightness. The piping system shall be filled with water. The system shall be pressurized to the maximum pressure and length of time required by the code or standard. The system shall have no leaks at the rated pressure.

## THE SHARKBITE DESIGN (1/4" – 1")

The SharkBite Fitting incorporates a number of unique and patented features.



## WHY SHARKBITE?

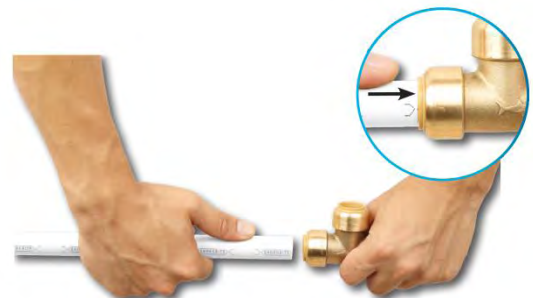
- **Instant push-fit connection for increased ease-of-use:**
  - No soldering, clamps, unions, or glue required.
- **Fittings certified to 200 PSI and 200°F (93°C):**
  - Proven durability and quality.
- **Fits copper tubing, and CTS CPVC and PEX:**
  - Connects all three types in any combination.
- **Integral tube liner for PEX installations:**
  - Integrated design means no loose components, ensures secure, reliable connection.
- **Design certified and agency listed:**
  - Inspector friendly, peace of mind!
- **Compact, robust DZR brass body:**
  - Foundation of a strong, corrosion resistant, durable fitting.
- **Design certified to ANSI/NSF-61 and ASSE 1061 product standard for use in potable water and hydronic heating water distribution:**
  - Quality engineered and manufactured.
- **Approved to be used underground and behind walls without access panels.**
  - Designed for hydronic heating as well as potable water distribution.

## CONNECTING A SHARKBITE FITTING

1. Cut the desired length of pipe.
  - Make sure cuts are square and even.
2. Deburr the end of the pipe to remove any sharp edges.
  - This will ensure that the o-ring will not be damaged upon insertion of the pipe.
3. Using a depth gauge, mark the pipe.
  - A 1" mark on the pipe can be used as a guideline. Proper insertion depths are listed below.
  - This will let you know if your connection is successful.

Pipe Size	Insertion Depth
1/4"	0.813"
3/8"	0.875"
1/2"	0.938"
5/8"	1.125"
3/4"	1.125"
1"	1.313"

4. Push the pipe into the fitting.
  - The mark you made on the pipe should rest against the edge of the fitting.





## DISCONNECTING A FITTING

### With the Disconnect Clip

1. Place the SharkBite disconnect clip around the tube with the non-branded side against the release collar.
2. Push the clip against the release collar and pull the tube with a twisting action to release the tube.



### With Disconnect Tongs

1. Place the teeth around the fitting assembly. The fork end with the SharkBite brand logo should be positioned around the tube and the other end around the neck of the fitting.
2. Squeeze the tool with one hand and pull the tube with a twisting action with the other hand to release the tube.



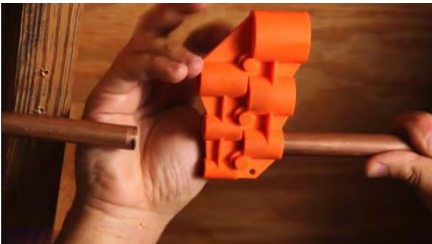
Check the fitting and tube end for damage. The fitting and tubing should be free of damage, foreign objects and marks on the outside diameter. If the tubing is damaged or marked, then cut and use a new section of tubing.

## SHARKBITE SLIP PRODUCTS

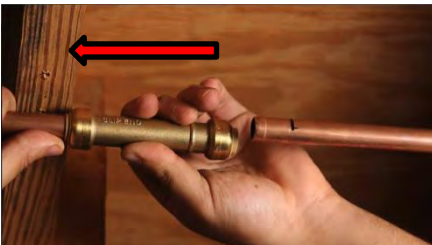
Slip fittings simplify repair by doing the job that two couplings and extra pipe would do. Only one end of the coupling has a stop, allowing the other end to slide freely over the end of a pipe. The fitting can be released with a disconnect tool and slid back onto the other end of the pipe for successful leak repair.



Cut out the section of the pipe needing repair (no more than 2" in length).



Using the SharkBite Deburring & Depth Gauge, clean the edges of the copper pipe. Use the gauge to mark the proper insertion depth on the pipe.



On the side of the fitting marked "SLIP END," slide the copper pipe into the fitting until it bottoms out.



Place the SharkBite Disconnect Clip on the copper pipe, on the same side as the "SLIP END." As you are pressing the clip to release the fitting, slide the SharkBite fitting to meet the other copper pipe.



Continue to slide the fitting until the non-slip end bottoms out. Ensure the fitting lines up with the mark you made. Also ensure the Slip End of the fitting has not proceeded past the depth mark you originally made.

## SHARKBITE SLIP PRODUCTS

In addition to slip coupling and tees, we also have slip ball valves and slip pressure regulators available to ease installation woes.



To see an installation video on installing a slip fitting, please visit:

<http://www.youtube.com/watch?v=lgdBv5BK5dQ&list=PL0ABAD0AF076CFA60&feature=c4-overview-vl>

## SHARKBITE FOR CONCEALED AREAS

SharkBite fittings can be utilized in underground applications and as manufactured joints without access panels, per IAPMO Certificate of Listing File No. 4630.

If burying SharkBite, it is recommended:

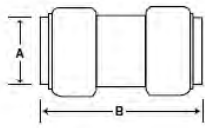
Fitting should be wrapped with an impervious material, chloride-free tape or tightly wrapped and sealed insulation works well to prevent direct contact with the backfill. Backfill should be free of rocks, debris or any sharp objects that may cause damage through impact or abrasion.

It is also recommended to pressure test the system for 24 hours before closing up any inaccessible location.

# SHARKBITE PUSH-FIT CONNECTION SYSTEM

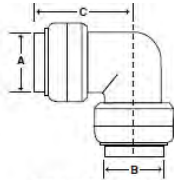


## DIMENSIONS



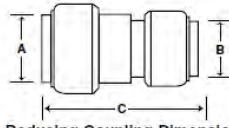
**Straight Coupling Dimensions**

P/N	A	B
U004	1/4"	1.59"
U006	3/8"	1.84"
U008	1/2"	2"
U016	3/4"	2.36"
U020	1"	2.72"



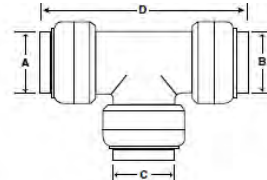
**Elbow Dimensions**

P/N	A	B	C
U244	1/4"	1/4"	1.16"
U276	1/4"	3/8" MIP	1.16"
U246	3/8"	3/8"	1.28"
U272	1/2"	3/8"	1.43"
U248	1/2"	1/2"	1.36"
U256	3/4"	3/4"	1.64"
U260	1"	1"	1.933"
U274	3/4"	1/2"	1.373"
U280	1/2"	1/2" MNPT	1.21"
U308	1/2"	1/2" FNPT	1.21"



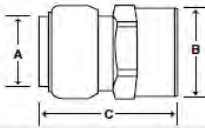
**Reducing Coupling Dimensions**

P/N	A	B	C
U009	3/8"	1/2"	2.0"
U058	3/4"	1/2"	2.2"
U060	1"	3/4"	2.51"



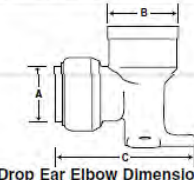
**Tee Dimensions**

P/N	A	B	C	D
U358	1/4"	1/4"	1/4"	2.30"
U360	3/8"	3/8"	3/8"	2.77"
U362	1/2"	1/2"	1/2"	2.72"
U363	1/2"	1/2"	3/8"	2.85"
U364	3/8"	3/8"	1/2"	2.77"
U370	3/4"	3/4"	3/4"	3.24"
U374	1"	1"	1"	3.84"
U412	3/4"	3/4"	1/2"	3.04"
U416	1"	1"	3/4"	3.63"
U444	3/4"	1/2"	3/4"	3.08"
U454	3/4"	1/2"	1/2"	2.92"



**Connector Dimensions**

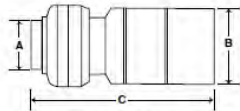
P/N	A	B	C
U066	1/4"	1/2" FNPT	1.61"
U068	1/2"	3/4" FNPT	1.75"
U070	3/8"	1/2" FNPT	1.73"
U072	1/2"	1/2" FNPT	1.64"
U092	3/4"	1/2" FNPT	1.83"
U088	3/4"	3/4" FNPT	1.88"
U094	1"	1" FNPT	2.17"
U110	1/4"	1/2" MNPT	1.64"
U118	3/8"	1/2" MNPT	1.77"
U120	1/2"	1/2" MNPT	1.64"
U116	1/2"	3/4" MNPT	1.75"
U134	3/4"	3/4" MNPT	1.89"
U138	3/4"	1/2" MNPT	1.90"
U140	1"	1" MNPT	2.48"
U142	1"	3/4" MNPT	2.11"



**Drop Ear Elbow Dimensions**

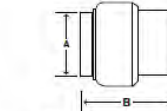
P/N	A	B	C
U249	1/2"	1/2"	2.20"
U332	3/8"	1/2" FNPT	1.83"
U334	1/2"	1/2" FNPT	1.77"
U335*	1/2"	1/2" FNPT	2.0"
U340	3/4"	3/4" FNPT	2.5"

\*Hy-Ear Elbow



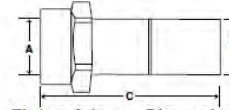
**Fitting Reducer Dimensions**

P/N	A	B	C
U719	3/8"	1/2"	2.08"
U721	3/8"	3/4"	2.27"
U722	1/2"	1"	3"
U724	3/4"	1"	2.5"



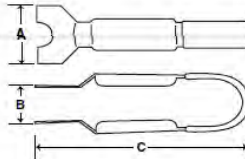
**End Stop Dimensions**

P/N	A	B
U512	3/8"	1.11"
U514	1/2"	1.08"
U518	3/4"	1.32"
U520	1"	1.52"



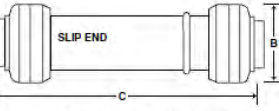
**Fitting Adapter Dimensions**

P/N	A	B	C
U766	3/4" FNPT	3/4"	2.83"
U772	1" FNPT	1"	2.83"



**Disconnect Tong Dimensions**

P/N	Fits SharkBite	A	B	C
U711	1/2"	1.7"	2"	6.5"
U713	3/4"	1.7"	2"	6.5"
U715	1"	1.7"	2"	6.5"



**Slip Coupling\* Dimensions**

P/N	A	B	C
U3008	1/2"	1.075"	4.46"
U3016	3/4"	1.355"	4.42"
U3020	1"	1.64"	4.5"

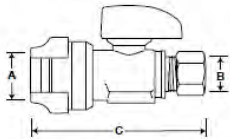
\*For use with copper only.



**Disconnect Clip Dimensions**

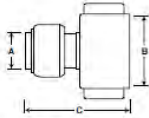
P/N	Size	A	B
U706	1/4"	1.19"	0.3"
U708	3/8"	1.22"	0.3"
U710	1/2"	1.22"	0.3"
U712	3/4"	1.72"	0.4"
U714	1"	2"	0.4"

Note: Disconnect Clips sold separately



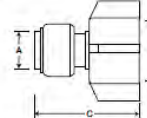
**Straight Stop (Chrome Plated) Dimensions**

P/N	A	B	C
23037-0000	1/2"	3/8" compression	2.68"



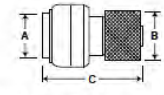
**Ballcock Connector Dimensions (Chrome Plated)**

P/N	A	B	C
U3531	1/4"	7/8" ballcock	1.58"



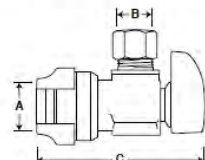
**Faucet Connector Dimensions (Chrome Plated)**

P/N	A	B	C
U3525	1/4"	1/2" NPS	1.58"



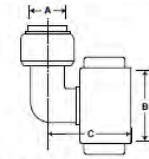
**Stop Connector Dimensions (Chrome Plated)**

P/N	A	B	C
U3523	1/4"	9/16" X 24 UNEF	1.61"



**Angle Stop (Chrome Plated) Dimensions**

P/N	A	B	C
23036-0000	1/2"	3/8" compression	2.58"

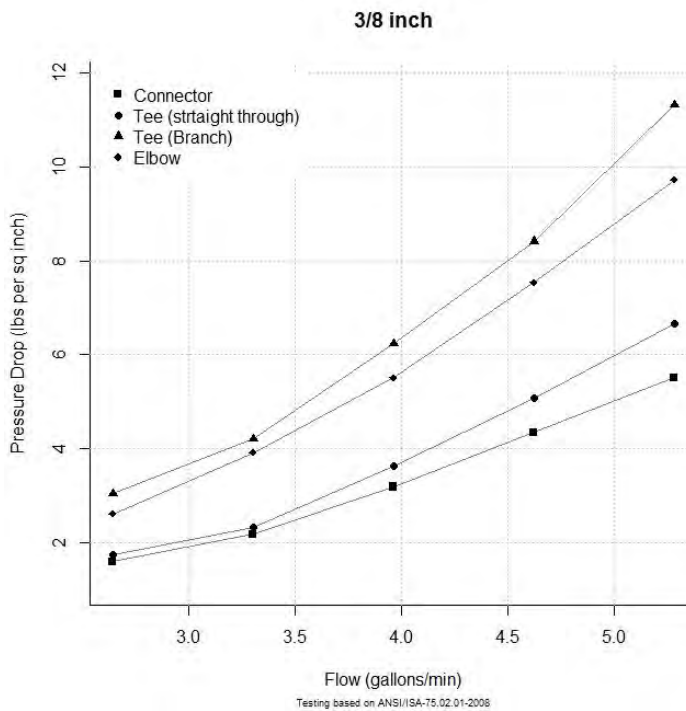
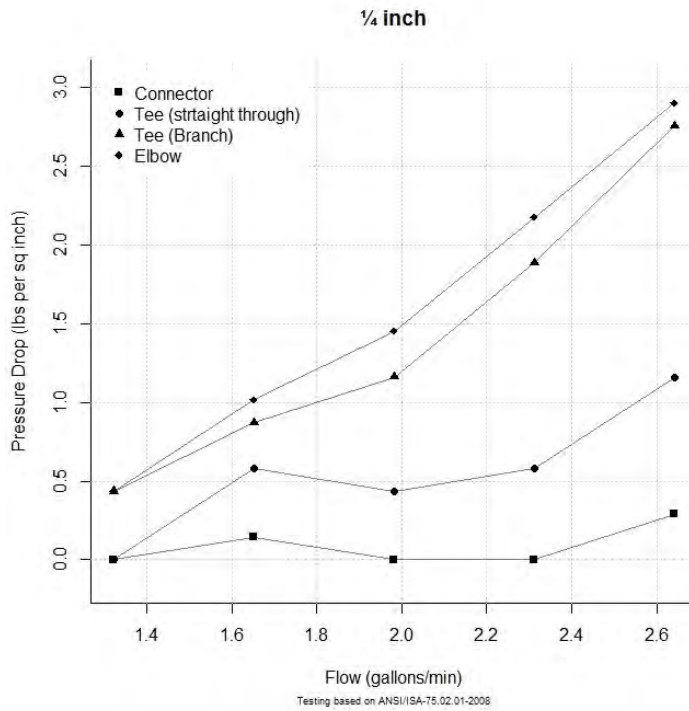


**Ballcock Elbow Dimensions (Chrome Plated)**

P/N	A	B	C
U3537	1/4"	7/8" ballcock	1.05"



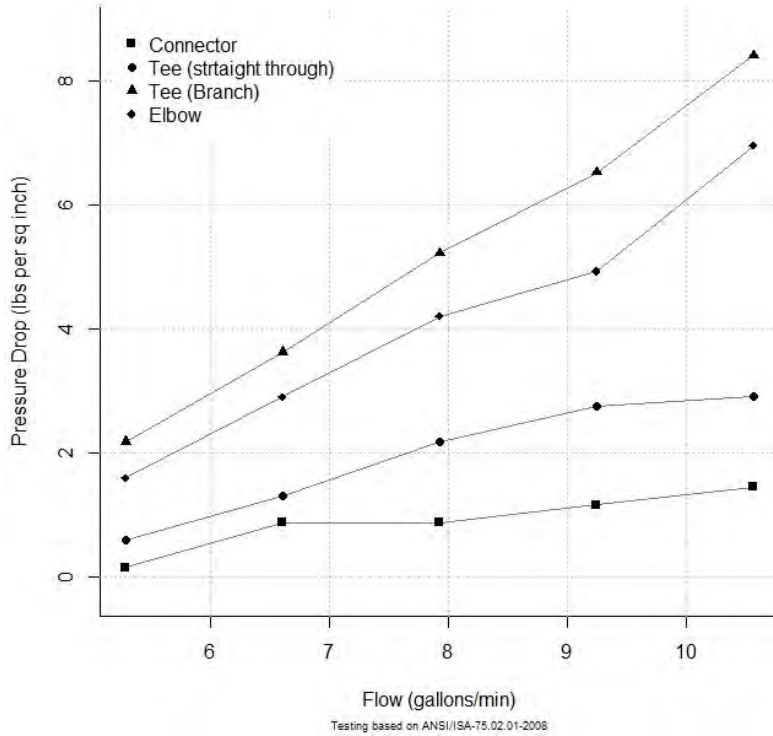
## PRESSURE LOSS AND FLOW RATES



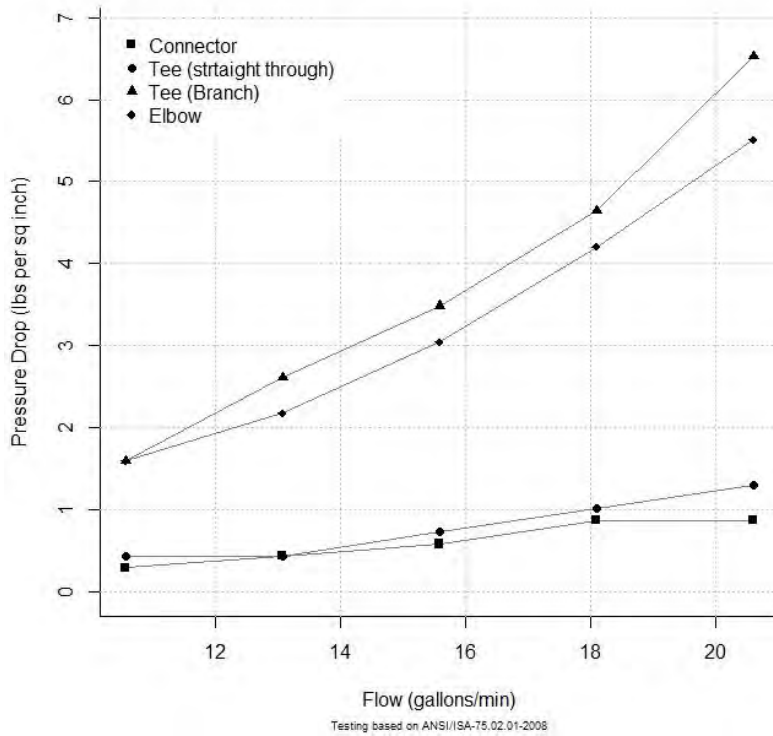
# SHARKBITE PUSH-FIT CONNECTION SYSTEM



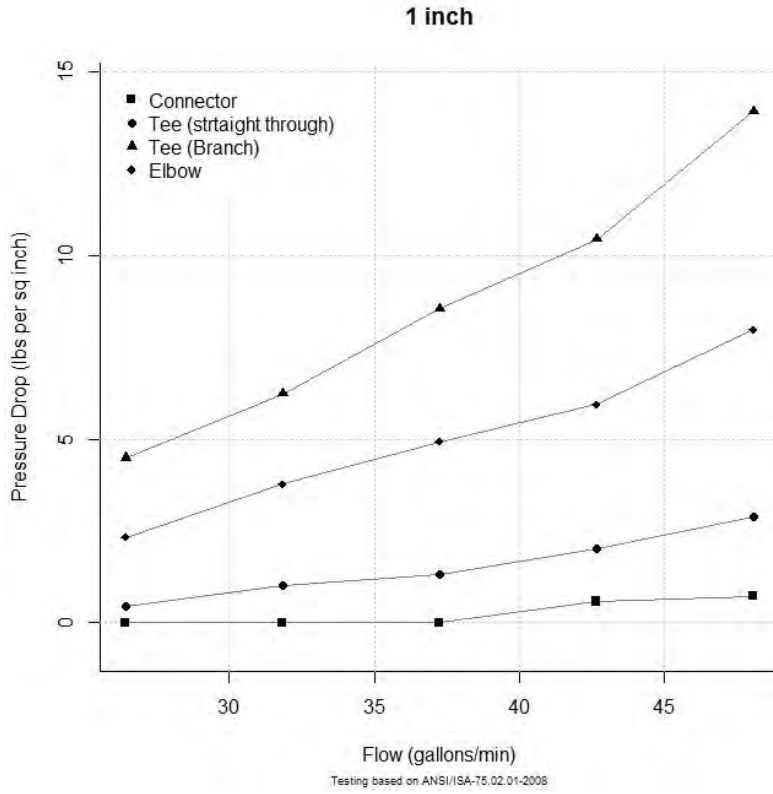
## 1/2 inch



## 3/4 inch

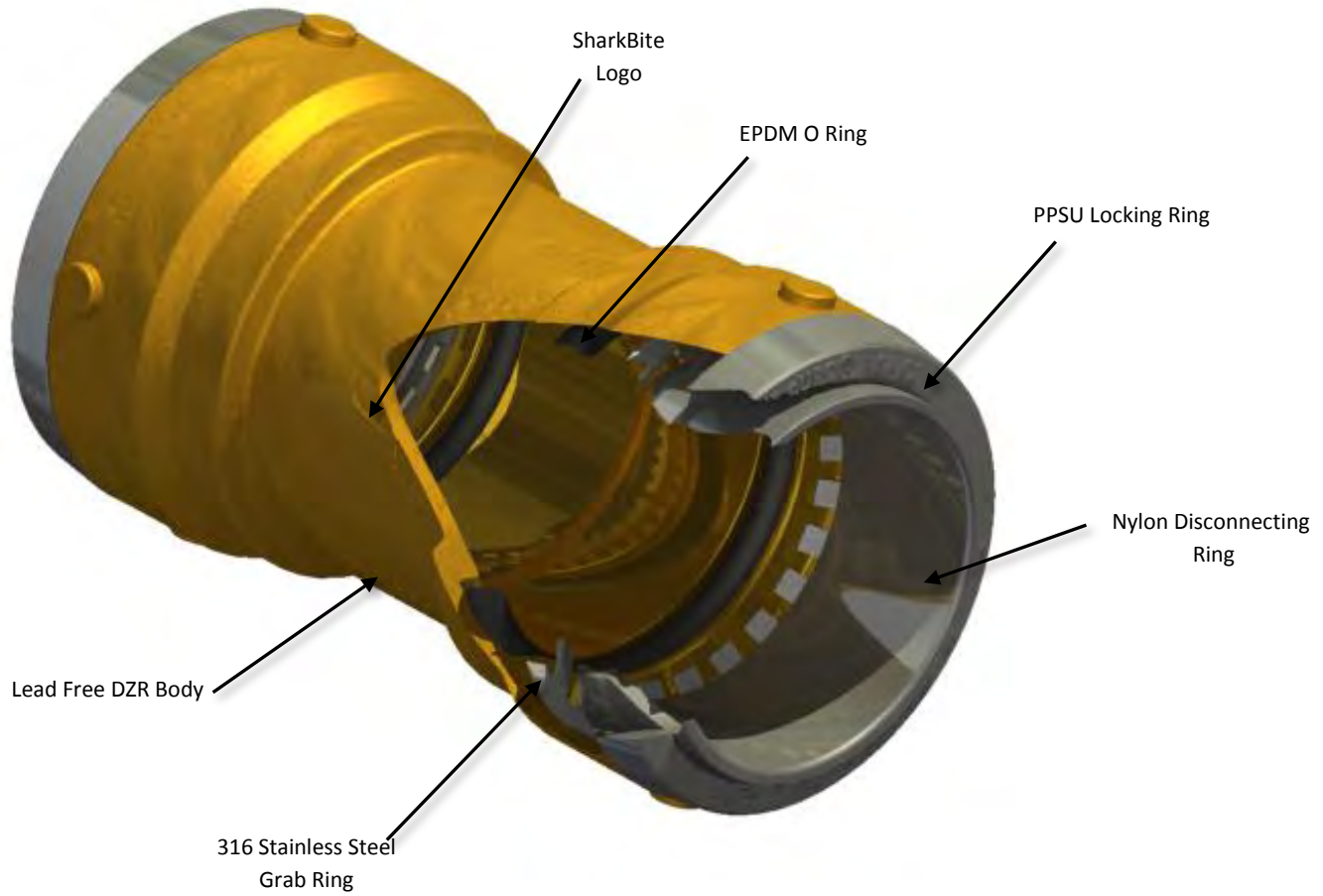


# SHARKBITE PUSH-FIT CONNECTION SYSTEM





## THE SHARKBITE 2XL DESIGN (1-1/4" – 2")





## WHY SHARKBITE 2XL?

- **Quick Connect:**
  - No tools, soldering, clamps, unions or glue required. Cut pipe square, de-burr to remove rough edges/debris, mark the pipe for correct depth and push to get a pressure ready connection every time.
- **Quick Disconnect:**
  - Disconnect in seconds by sliding the De-Mount Tool down the pipe to engage the demount lugs and rotate clockwise to lock the open position leaving both hands free, you can now remove the pipe.
- **SAFE-Recessed Release Collar:**
  - Commercial SharkBite require a special Demount Tool and cannot be accidentally disconnected/released.
- **Extensive Range Including Slip Feature on Couplings and Tee's:**
  - When repairing or tapping into existing pipe with "Push-Fittings" you must be able to either move the fitting or the pipe to ensure the pipe is engaged fully into the fitting. With rigid pipe like copper the only way with "Push-Fittings" is to have a SLIP feature to allow easy installation when tapping into existing pipe.
- **Easy Installation:**
  - Unlike the tool intensive connection methods there is NO need to send multiple fitters to a job, SharkBite 2XL has been designed to be installed or removed by one person. All fittings are lubricated for easy connection and by fitting the De-Mount Tool before engaging the pipe the force required can be reduced further. With the De-Mount Tool locked on you also have hands free disconnection. WET OR DRY: No waiting for copper tube to dry before soldering or glue to cure, SharkBite makes an instant connection in seconds.
- **No Tools:**
  - Unlike alternative tool intensive connections systems, SharkBite has no special tooling required for installation.
- **No Time:**
  - Fastest connection - CUT-PUSH-DONE.
  - Easy access to small or tight places.
  - No Flame - Does not require fire permit or fire marshal.
- **No Waste:**
  - Should you make an error or simply want to change your installation, no problem for SharkBite. Simply remove and re-use. (Fittings used for repeated testing must not be used in any permanent application).
- **Fittings Cannot be Disassembled:**
  - SharkBite 2XL Fittings are factory assembled and components cannot be removed.
- **Long Pipe Engagement:**
  - Provides pipe support against lateral pipe forces.
- **Lead Free (LF) Dezincification Resistance (DZR) Brass:**
  - Exceeds current no lead legislation - AB1953 or NSF372. Suitable for underground installation subject to local code authorities/inspectors. Dezincification properties (DZR) exceed ISO6509 and NSF-14.
- **Environmentally Friendly:**
  - Remove and re-use fittings, no need to be scrapped. No heat is required for installation.

## HOW TO MAKE A SHARKBITE 2XL CONNECTION

1. Cut copper, CPVC or PEX using a quality tuber or pipe cutter with a sharp blade.
2. Remove burrs and ensure pipe surface is free of scratches and any debris. It is critical that pipe be marked with the correct insertion depth as listed below:
  - 1-1/4" Pipe Insertion Depth = 2"
  - 1-1/2" Pipe Insertion Depth = 2-1/4"
  - 2" Pipe Insertion Depth = 2-1/2"



3. Align pipe with the fitting, insert pipe while rotating either pipe or fitting.



4. SharkBite 2XL PEX Stiffener must be inserted into PEX pipe prior to fitting.



Connection is complete when pipe is fully inserted with depth insertion marked on pipe is still visible at the head of the fitting



## DISCONNECTING A SHARKBITE 2XL CONNECTION

1. Place the Shark Shifter De-Mount Tool on the pipe just above the connection. Then slide the tool down to engage lugs on the head of the fitting.



2. Rotate the Shark Shifter De-Mount Tool clockwise to lock onto the lugs. This will lock the Shark Shifter De-Mount Tool in place.



3. Rotate the Shark Shifter De-Mount Tool clockwise to lock onto the lugs. This will lock the Shark Shifter De-Mount Tool in place.

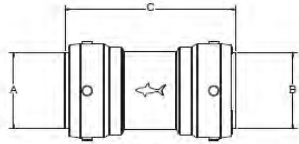


With the Shark Shifter De-Mount Tool Withdraw locked in place, pull the pipe from the fitting. Rotate the Shark Shifter De-Mount Tool counter-clockwise to remove the fitting.

# SHARKBITE PUSH-FIT CONNECTION SYSTEM

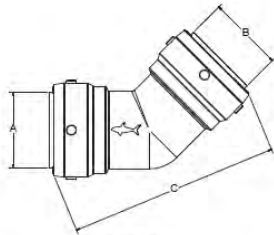


## SHARKBITE 2XL DIMENSIONS



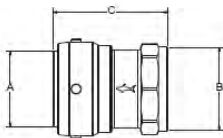
Coupling

P/N	A	B	C	Weight
SB0135	1 1/4"	1 1/4"	3.26"	0.84
SB0141	1 1/2"	1 1/2"	4.37"	1.15
SB0154	2"	2"	4.80"	1.56
SB013528	1 1/4"	1"	3.26"	0.69
SB014135	1 1/2"	1 1/4"	4.37"	1.02
SB015441	2"	1 1/2"	4.80"	1.42



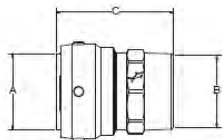
45° Elbow

P/N	A	B	C	Weight
SB0535	1 1/4"	1 1/4"	5.15"	0.97
SB0541	1 1/2"	1 1/2"	5.77"	1.35
SB0554	2"	2"	6.50"	1.91



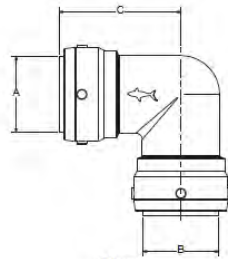
Female Connector

P/N	A	B	C	Weight
SB113532F	1 1/4"	1 1/4" FNPT	2.98"	0.72
SB114140F	1 1/2"	1 1/2" FNPT	3.21"	0.92
SB115450F	2"	2" FNPT	3.42"	1.23



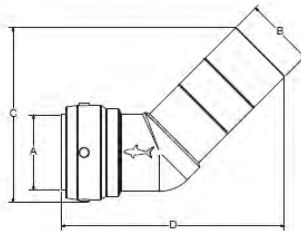
Male Connector

P/N	A	B	C	Weight
SB113532M	1 1/4"	1 1/4" MNPT	3.03"	0.71
SB114140M	1 1/2"	1 1/2" MNPT	3.20"	0.89
SB115450M	2"	2" MNPT	3.43"	1.20



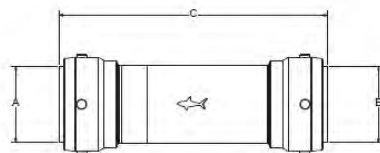
Elbow

P/N	A	B	C	Weight
SB0235	1 1/4"	1 1/4"	2.80"	1.07
SB0241	1 1/2"	1 1/2"	3.16"	1.52
SB0254	2"	2"	3.60"	2.18



Street 45° Elbow

P/N	A	B	C	D	Weight
SB0735	1 1/4"	1 1/4"	4.24"	5.45"	0.97
SB0741	1 1/2"	1 1/2"	4.70"	6.05"	1.35
SB0754	2"	2"	5.30"	6.74"	1.91



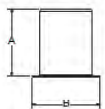
Slip Coupling

P/N	A	B	C	Weight
SB0635	1 1/4"	1 1/4"	6.69"	1.20
SB0641	1 1/2"	1 1/2"	7.40"	1.71
SB0654	2"	2"	7.98"	2.33



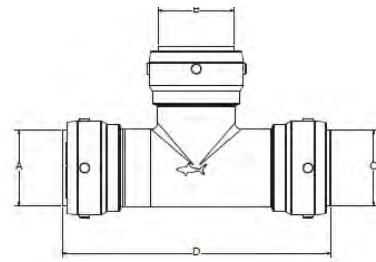
Demount Clip

P/N	Size	A	Weight
SBDC35	1 1/4"	2.70"	0.07
SBDC41	1 1/2"	2.94"	0.08
SBDC54	2"	2.45"	0.09



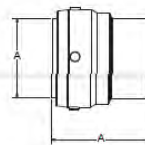
Pex Stiffener

P/N	Size	A	B	Weight
SBLT35	1 1/4"	1.65"	1.34"	0.08
SBLT41	1 1/2"	1.89"	1.59"	0.10
SBLT54	2"	2.09"	2.09"	0.15



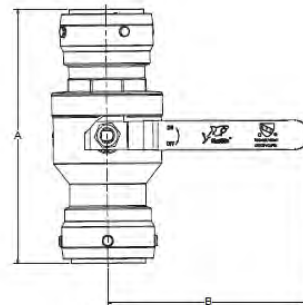
Tee

P/N	A	B	C	D	Weight
SB0335	1 1/4"	1 1/4"	1 1/4"	6.50"	1.61
SB0341	1 1/2"	1 1/2"	1 1/2"	6.70"	2.26
SB0354	2"	2"	2"	7.99"	3.07
SB03353516	1 1/4"	1/2"	1 1/4"	6.70"	1.25
SB03353522	1 1/4"	3/4"	1 1/4"	6.70"	1.28
SB03353528	1 1/4"	1"	1 1/4"	6.70"	1.42
SB03414122	1 1/2"	3/4"	1 1/2"	7.39"	1.78
SB03414128	1 1/2"	1"	1 1/2"	7.39"	1.92
SB03414135	1 1/2"	1 1/4"	1 1/2"	7.39"	2.08
SB03545428	2"	1"	2"	7.99"	2.55
SB03545435	2"	1 1/4"	2"	7.99"	2.72
SB03545441	2"	1 1/2"	2"	7.99"	2.86



End Stop

P/N	Size	A	Weight
SB0435	1 1/4"	2.35"	0.57
SB0441	1 1/2"	2.62"	0.82
SB0554	2"	2.89"	1.25



Ball Valve

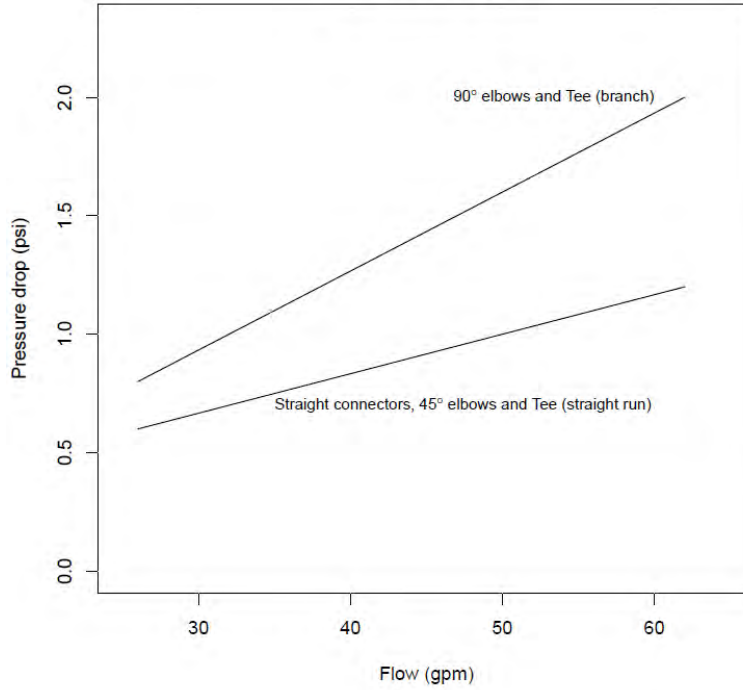
P/N	Size	A	B	Weight
SBBV435	1 1/4"	6.08"	5.10"	2.06
SBBV441	1 1/2"	6.79"	6.10"	2.99
SBBV454	2"	7.58"	6.16"	4.45

\* All weights are in pounds

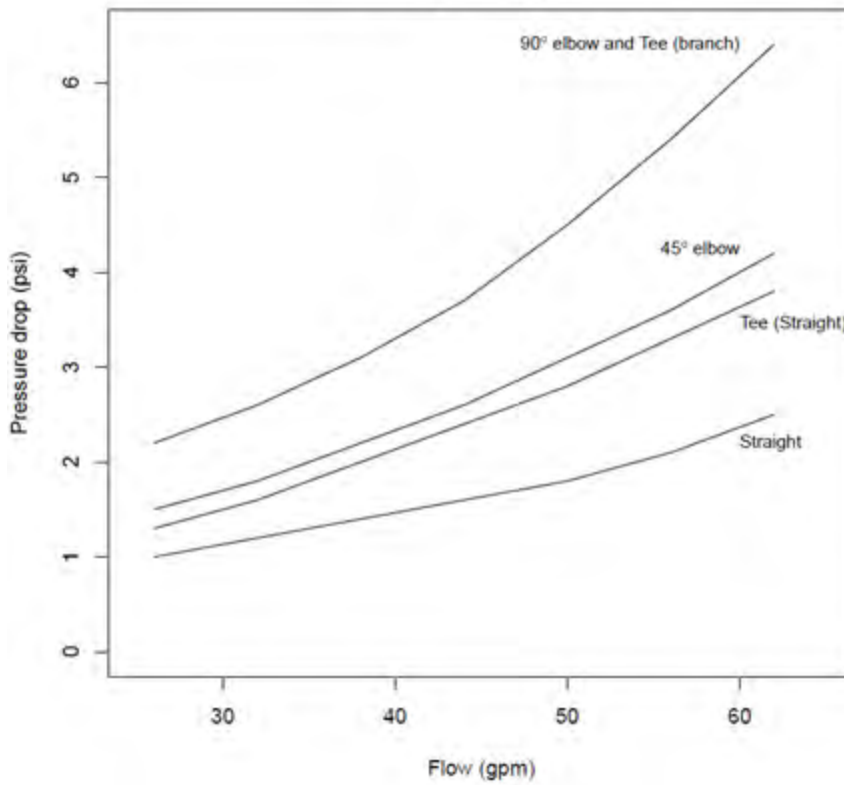


## SHARKBITE 2XL PRESSURE LOSS AND FLOW RATES

**Sharkbite 1/4" Connectors  
using Copper pipe**

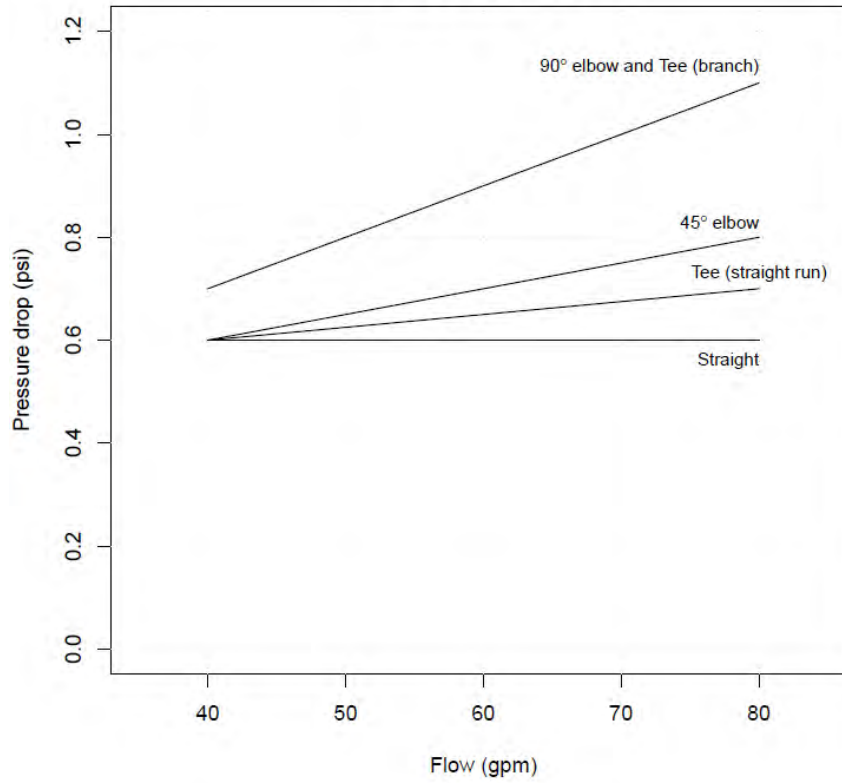


**Sharkbite 1/4" Connectors  
using PEX pipe**

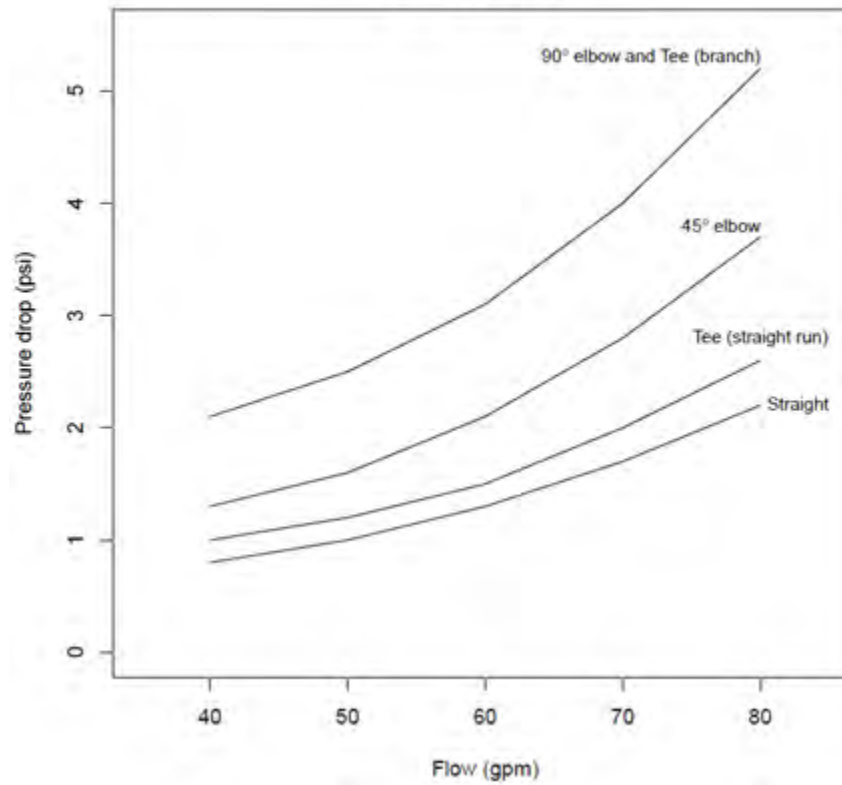




## Sharkbite 1½" Connectors using Copper pipe

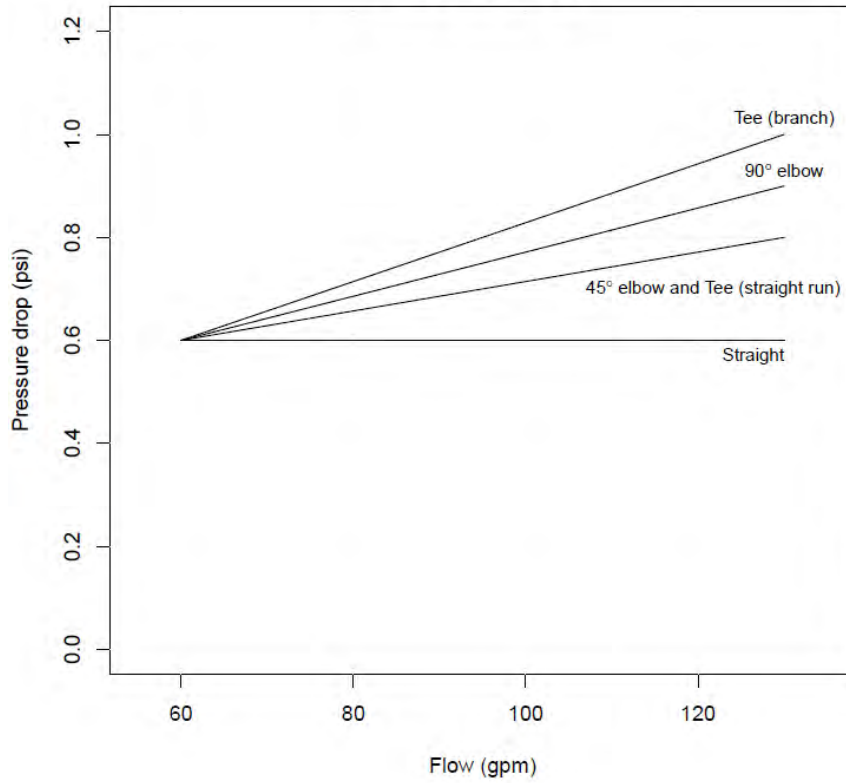


## Sharkbite 1½" Connectors using PEX pipe

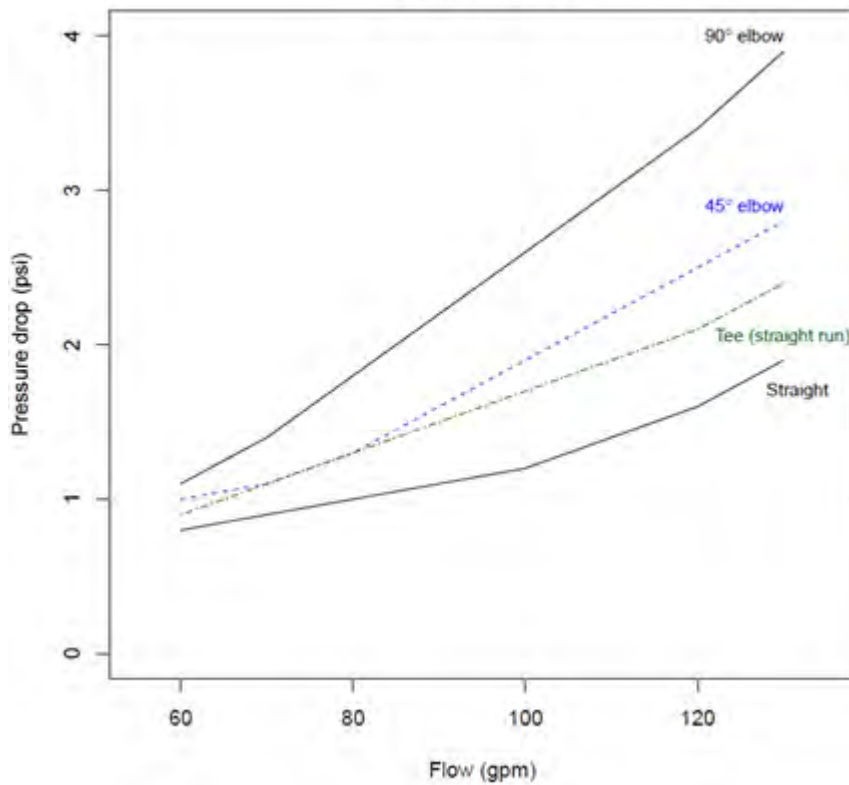




**Sharkbite 2" Connectors  
using Copper pipe**



**Sharkbite 2" Connectors  
using PEX pipe**



## SHARKBITE PEX TUBING

SharkBite PEX tubing is a cross-linked polyethylene tubing for a wide range of residential and commercial plumbing applications. Manufactured without an oxygen barrier for potable water systems (available in white, blue, and red) and with an oxygen barrier for radiant floor and hydronic heating applications (available in orange). The oxygen diffusion barrier applied to the exterior limits oxygen permeation through the tubing wall in hydronic heating applications which prevents corrosion of ferrous metal parts in the heating system.



### FEATURES AND BENEFITS

- Flexible: Easy to install and service.
- Quieter: Minimizes noise caused by water hammer.
- Resists corrosion and scale buildup: Improves the performance of the plumbing system.
- Fewer fittings required: Reduces total installation cost.
- Fewer joints: Reduces the chances of call backs.
- Pressure test immediately: No waiting for glue to dry or joints to cool

A repeating SharkBite imprint pattern provides a visual aid to determine if the tube has been inserted all the way into the SharkBite Push-Fit Fitting. This feature only works if the tubing is cut between the SharkBite imprint pattern.



### CERTIFICATIONS

The SharkBite tubing with and without oxygen barrier is approved for use in all model codes in the US and Canada for use in hydronic and potable water systems and is certified to the following standards:

- NSF 14/61,
- NSF P171,
- ASTM F 876,
- ASTM F 877,
- CSA B137.5
- AWWA C904.





## PEX PIPE SPECS AND DIMENSIONS

Model	Nominal Tubing Size				Length		Bend Radius		Fluid Capacity Per 100'		Package Weight	
	ID		OD		FT	M	in	mm	gal	ltrs	lbs	kgs
	in	mm	in	mm								
Blue PEX (Coil)												
U860B100	1/2	13	5/8	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860B300	1/2	13	5/8	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860B500	1/2	13	5/8	16	500	152.4	5	127	0.96	3.63	24	10.9
U870B100	3/4	19	7/8	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870B300	3/4	19	7/8	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870B500	3/4	19	7/8	22	500	152.4	7	178	1.9	7.19	45	20.4
U880B100	1	25	1-1/8	29	100	30.48	10	254	3.1	11.73	18	8.2
U880B300	1	25	1-1/8	29	300	91.44	10	254	3.1	11.73	54	24.6
U880B500	1	25	1-1/8	29	500	152.4	10	254	3.1	11.73	90	40.8
Red PEX (Coil)												
U860R100	1/2	13	5/8	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860R300	1/2	13	5/8	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860R500	1/2	13	5/8	16	500	152.4	5	127	0.96	3.63	24	10.9
U870R100	3/4	19	7/8	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870R300	3/4	19	7/8	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870R500	3/4	19	7/8	22	500	152.4	7	178	1.9	7.19	45	20.4
U880R100	1	25	1-1/8	29	100	30.48	10	254	3.1	11.73	18	8.2
U880R300	1	25	1-1/8	29	300	91.44	10	254	3.1	11.73	54	24.6
U880R500	1	25	1-1/8	29	500	152.4	10	254	3.1	11.73	90	40.8
White PEX (Coil)												
U860W100	1/2	13	5/8	16	100	30.48	5	127	0.96	3.63	5.5	2.5
U860W300	1/2	13	5/8	16	300	91.44	5	127	0.96	3.63	14.5	6.6
U860W500	1/2	13	5/8	16	500	152.4	5	127	0.96	3.63	24	10.9
U870W100	3/4	19	7/8	22	100	30.48	7	178	1.9	7.19	10.5	4.8
U870W300	3/4	19	7/8	22	300	91.44	7	178	1.9	7.19	31.5	14.4
U870W500	3/4	19	7/8	22	500	152.4	7	178	1.9	7.19	45	20.4
U880W100	1	25	1-1/8	29	100	30.48	10	254	3.1	11.73	18	8.2

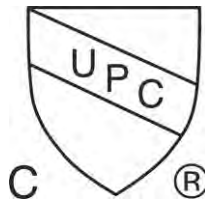
# SHARKBITE PUSH-FIT CONNECTION SYSTEM



Model	Nominal Tubing Size				Length		Bend Radius		Fluid Capacity Per 100'		Package Weight	
	ID		OD		FT	M	in	mm	gal	ltrs	lbs	kgs
	in	mm	in	mm								
White PEX (Coil)												
U880W300	1	25	1-1/8	29	300	91.44	10	254	3.1	11.73	54	24.6
U880W500	1	25	1-1/8	29	500	152.4	10	254	3.1	11.73	90	40.8
U885W100	1-1/4	31.75	1-3/8	35	100	30.48	7	175	4.67	17.68	25	11.34
U890W100	1-1/2	38.1	1-5/8	41	100	30.48	8	206	6.5	24.61	35	15.88
U895W100	2	50.8	2-1/4	54	100	30.48	11	270	11.4	43.15	60	27.22
Blue PEX (Straight Lengths)												
U860B5	1/2	13	5/8	16	5	1.52	5	127	0.96	3.63	3	1.4
U860B10	1/2	13	5/8	16	10	3.04	5	127	0.96	3.63	6	2.7
U860B20	1/2	13	5/8	16	20	6.09	5	127	0.96	3.63	12	5.5
U870B5	3/4	19	7/8	22	5	1.52	7	178	1.9	7.19	5.25	2.5
U870B10	3/4	19	7/8	22	10	3.04	7	178	1.9	7.19	10.5	4.8
U870B20	3/4	19	7/8	22	20	6.09	7	178	1.9	7.19	21	9.5
U880B5	1	25	1-1/8	29	5	1.52	10	254	3.1	11.73	4.5	2
U880B10	1	25	1-1/8	29	10	3.04	10	254	3.1	11.73	8.8	4
U880B20	1	25	1-1/8	29	20	6.09	10	254	3.1	11.73	17.4	7.9
Red PEX (Straight Lengths)												
U860R5	1/2	13	5/8	16	5	1.52	5	127	0.96	3.63	3	1.4
U860R10	1/2	13	5/8	16	10	3.04	5	127	0.96	3.63	6	2.7
U860R20	1/2	13	5/8	16	20	6.09	5	127	0.96	3.63	12	5.5
U870R5	3/4	19	7/8	22	5	1.52	7	178	1.9	7.19	5.25	2.5
U870R10	3/4	19	7/8	22	10	3.04	7	178	1.9	7.19	10.5	4.8
U870R20	3/4	19	7/8	22	20	6.09	7	178	1.9	7.19	21	9.5
U880R5	1	25	1-1/8	29	5	1.52	10	254	3.1	11.73	4.5	2
U880R10	1	25	1-1/8	29	10	3.04	10	254	3.1	11.73	8.8	4
U880R20	1"	25	1-1/8	29	20	6.09	10	254	3.1	11.73	17.4	7.9
White PEX (Straight Lengths)												
U860W10	1/2	13	5/8	16	10	3.04	5	127	0.96	3.63	6	2.7
U860W20	1/2	13	5/8	16	20	6.09	5	127	0.96	3.63	12	5.5
U870W5	3/4	19	7/8	22	5	1.52	7	178	1.9	7.19	5.25	2.5
U870W10	3/4	19	7/8	22	10	3.04	7	178	1.9	7.19	10.5	4.8
U870W20	3/4	19	7/8	22	20	6.09	7	178	1.9	7.19	21	9.5
U880W5	1	25	1-1/8	29	5	1.52	10	254	3.1	11.73	4.5	2
U880W10	1	25	1-1/8	29	10	3.04	10	254	3.1	11.73	8.8	4
U880W20	1	25	1-1/8	29	20	6.09	10	254	3.1	11.73	17.4	7.9
U885W20	1-1/4	31.75	1-3/8	35	20	6.10	7	175	4.76	7.68	25	11.34
U890W20	1-1/2	38.1	1-5/8	41	20	6.10	8	206	6.5	24.61	35	15.88
U895W20	2	50.8	2-1/4	54	20	6.10	11	270	11.4	43.15	36	16.33

## IAPMO RESEARCH AND TESTING, INC.

5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 •  
[www.iapmort.org](http://www.iapmort.org)



## CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date: July 2013 -Rev. 1/8/2014- Void After: July 2014

Product: Push Fit Fittings File No. 4630

Issued To: Cash Acme/Reliance Worldwide  
2400 7TH AVE SW  
CULLMAN, AL 35055

Identification: Each fitting shall have the following information marked on it where it will be visible after it has been installed:  
Name of manufacturer or trademark.  
When a fitting is not suitable for all four (4) materials, it shall be marked as follows for the materials for which they are suitable:  
Copper or Cu  
CPVC  
PEX  
PE-RT  
When push-fit connectors are used on plumbing devices, the markings are permitted to be on the plumbing device.

Fittings CTS or smaller are permitted to use a permanent label complying with the requirements of UL 969 or CSA C22.2 N. 0.15 to display the required markings.

The markings shall be permanent.

The product shall also bear the CUPC mark.

# SHARKBITE PUSH-FIT CONNECTION SYSTEM



**Characteristics:** Push fit fittings that have a quick assembly push fit mechanism that can be used with Copper, PEX and CPVC tubing and pipes. Fittings for use in domestic and commercial application for both potable water distribution systems and hydronic heating systems. Push fit fittings can be utilized in underground applications and as manufactured joints without access panels. To be installed in accordance with the manufacturer's instructions and the latest edition of the Uniform Plumbing Code and the National Plumbing Code of Canada.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following code(s):

Uniform Plumbing Code (UPC)  
National Plumbing Code of Canada  
International Plumbing Code (IPC)

Products are in compliance with the following standard(s):

ASSE 1061-2011

## MODELS:

Note: The requirements of Section 609.3.2 in the Uniform Plumbing Code are satisfied for push fit fittings by section 301.4.1 of the same Uniform Plumbing Code when installed in accordance with the manufacturer's installation guides.

Note: All 1/2" through 1" models comply with ANSI/NSF 14.

For a complete list of compliant models and the most up to date listing, please visit

[http://pld.iapmo.org/file\\_info.asp?file\\_no=0004630](http://pld.iapmo.org/file_info.asp?file_no=0004630)

# SHARKBITE PUSH-FIT CONNECTION SYSTEM



5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 •  
www.iapmort.org



## CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date: October 2013 -Rev. 12/4/2013- Void After: October 2014

Product: Lead Free Plumbing Products File No. 6544

Issued To: CASH ACME/RELIANCE WORLDWIDE  
2400 7TH AVE SW  
CULLMAN, AL 35055

Identification: Each product shall bear permanent and legible markings to identify the manufacturer. This marking shall be the trade name, trademark, or other mark known to identify the manufacturer. The product and/or product packaging may also bear the term "Lead Plumbing Law", "Complies with Lead Plumbing Law", or either "Lead Free" or "Low Lead" above or in close proximity to the appropriate IAPMO R&T certification mark, or the term "Certified by IAPMO R&T". The product packaging may also bear a grey dot, a check mark with circle, or any other home centers marking requirements.

Characteristics: Products may include any pipe, pipe fitting, solder, flux, or other plumbing products providing water for human consumption. Products listed below are to be installed in accordance with the manufacturer's instruction. These products have been verified with weighted average lead content  $\leq 0.25\%$ ; Solder and flux lead content  $\leq 0.2\%$ .

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following standard(s):

Section 1417(d) of the Safe Drinking Water Act  
The lead content requirements of Section 116875 of the California Health & Safety Code  
NSF/ANSI 372-2010

For a complete list of compliant models and the most up to date listing, please visit

[http://pld.iapmo.org/file\\_info.asp?file\\_no=0006544](http://pld.iapmo.org/file_info.asp?file_no=0006544)

## IAPMO RESEARCH AND TESTING, INC.

5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 • [www.iapmort.org](http://www.iapmort.org)



NSF/ANSI 61

### CERTIFICATE OF LISTING

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Effective Date: December 2013 -Rev. 2/20/2014- Void After: December 2014

Product: Drinking Water System Components - Health Effects File No. N-4630

Issued To: Cash Acme/Reliance Worldwide  
2400 7TH AVE SW  
CULLMAN, AL 35055

Identification: Each product shall be permanently and legibly marked with the manufacturer's name or trademark. The product may also be marked with the standard designation "NSF/ANSI 61".

Characteristics: Materials or products that come into contact with drinking water and/or drinking water treatment chemicals. Products and materials may include process media, protective materials, joining and sealing materials, pipes and related products, mechanical devices used with treatment/transmission/distribution systems, and mechanical plumbing devices. To be installed in accordance with the manufacturer's instruction.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following standard(s):

NSF/ANSI 61-2011

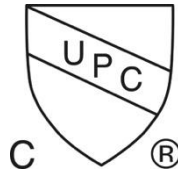
For a complete list of compliant models and the most up to date listing, please visit

[http://pld.iapmo.org/file\\_info.asp?file\\_no=N4630](http://pld.iapmo.org/file_info.asp?file_no=N4630)

# SHARKBITE PUSH-FIT CONNECTION SYSTEM



5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 •  
www.iapmort.org



## CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date: October 2013 -Rev. 11/6/2013- Void After: October 2014

Product: Crosslinked Polyethylene Water Distribution System (PEX) File No. 7143

Issued To: CASH ACME/RELIANCE WORLDWIDE  
2400 7TH AVE SW  
CULLMAN, AL 35055

Identification: The tubing shall be marked with the manufacturer's name or trademark, ASTM F876 and ASTM F877 PEX, pressure rating at 180° F, nominal size, standard dimension ratio and a code number identifying the compound and the date of manufacture. The fittings shall be marked with the manufacturer's name or trademark, and ASTM F877. Both tubing and fittings shall be marked with the cUPC® certification mark.

Characteristics: Crosslinked polyethylene plastic hot and cold water distribution systems made in one standard dimension ratio and intended for a maximum of 100 psi water service up to and including a maximum working temperature of 180° F. Components are comprised of tubing and/or fittings. To be installed in accordance with the manufacturer's instructions and the requirements of the latest edition of the Uniform Plumbing Code.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

Products are in compliance with the following code(s):

Uniform Plumbing Code (UPC®)  
National Plumbing Code of Canada  
International Plumbing Code (IPC®)

Products are in compliance with the following standard(s):  
ASTM F877-2011a and CSA B137.5-2009

For a complete list of compliant models and the most up to date listing, please visit

[http://pld.iapmo.org/file\\_info.asp?file\\_no=0007143](http://pld.iapmo.org/file_info.asp?file_no=0007143)



## WARRANTY

### Limited Warranty – SharkBite® and Cash Acme® Products

#### What Does This Warranty Cover?

Subject to conditions outlined in this statement, RWC (in the USA, Reliance Worldwide Corporation and in Canada, Reliance Worldwide Canada Inc.) warrants SharkBite® and Cash Acme® products, when used and installed in accordance with the requirements set forth below, to be free from defects in material and workmanship for the applicable warranty period.

#### How Long Does The Warranty Coverage Last?

Product(s)	Warranty Period (from the date of sale)
SharkBite® PEX Tubing	Twenty-Five (25) years
SharkBite® Push-Fit Fittings	Twenty-Five (25) years
SharkBite® Brass PEX Barbed-Fittings	Five (5) years
SharkBite® Copper PEX Manifolds	Five (5) years
All other SharkBite® products	Two (2) years
All Cash Acme® products	One (1) year

Proof of purchase is required to validate the warranty period. If proof of purchase is not available, the warranty period shall default to the date of manufacture for each product. **NOTE:** Warranty is applicable to product installed in the country it was purchased.

#### What Are The Conditions Of This Warranty?

1. All products must be installed in accordance with all applicable codes and in accordance with any local, state, provincial or federal requirements.
2. The installing contractor must use construction techniques compliant with applicable codes to install the range of products and use the product(s) within the design parameters specified in any installation guidelines and technical notes for the applicable system. This shall include field pressure testing prior to concealing with concrete or by other means.
3. Products must not be installed in a system that may operate at temperatures or at pressures that exceed the printed rating on the product, packaging or installation instructions.
4. Evidence of tampering, mishandling, neglect, accidental damage, freeze damage or unauthorized modifications or repairs that cause damage to RWC warranted products void any warranty coverage of those particular products. It is expressly understood that failure as a result of any freezing fluids within the pipes does not constitute a defect in material or workmanship and shall not be covered by this warranty.
5. Although RWC provides a plumbing system to facilitate a complete installation, other manufacturers tubing and/or fittings may be installed in any given installation provided manufacturing of the tubing and/or fittings demonstrates compliance with the applicable ASTM standards, and the product has been certified by a recognized third-party testing agency. The RWC product in the given installation will continue to be covered under this warranty. **NOTE:** RWC will be responsible only for proven defects in material or workmanship in RWC products. Problems in products manufactured by another company should be reported to that manufacturer.



## How Do You Get Service?

In order to be eligible for service under this warranty you must return the defective product (with shipping charges prepaid) to the original place of purchase. You also must include the model number of the product, the original date of purchase, proof of purchase and the nature of the problem. Products returned without shipping charges prepaid will be refused. For questions or inquiries to the Manufacturer, in the U.S. call 1-877-700-4242 and in Canada 1-888-820-0120.

## What Will RWC Do?

If, after inspection, we find that a product covered by this limited warranty has failed due to a defect in material or workmanship during the specified warranty period, we will repair or replace, at our sole option, free of charge, the defective product during normal working hours and through a place of business as determined by RWC. This shall constitute the sole and exclusive remedy for any defective product.

## What Does This Warranty Not Cover?

RWC shall not be responsible for any incidental, indirect, contingent, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if these warranted products do not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, adverse chemical environments, or any other circumstances over which has no control. This limitation applies even if RWC could have foreseen or has been advised of the possibility of these damages. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product.

## How Does State/Provincial Law Apply?

Some States/Provinces do not allow limitations on how long an implied warranty lasts, and some States/Provinces do not allow the exclusion or limitation of incidental or consequential damages. Therefore, the above limitations may not apply to you. This Limited Warranty gives you the specific legal rights, and you may have other rights that vary from State/Province to State/Province. You should consult applicable State/Provincial laws to determine your rights.

**SO FAR AS IS CONSISTENT WITH APPLICABLE STATE/PROVINCIAL/FEDERAL LAW, THE EXPRESS WARRANTY SET FORTH HEREIN IS THE ONLY WARRANTY GIVEN BY RWC WITH RESPECT TO THE SHARKBITE® AND CASH ACME® PRODUCTS AND RWC MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**



Reliance Worldwide Corporation

## Reliance Worldwide USA

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[www.sharkbite.com](http://www.sharkbite.com)

## PureFlow® MANABLOC® Parallel Water Distribution System For ViegaPEX™, ViegaPEX™ Ultra and FostaPEX® SDR-9 Cross-linked Polyethylene (PEX)

### Scope

This specification designates requirements for the PureFlow MANABLOC parallel water distribution system which supplies water to individual plumbing fixtures through dedicated ports and distribution lines. Each port (outlet) is equipped with a built-in shut-off valve to provide control for each fixture from a central location. The MANABLOC has separate hot and cold water inlets and ports to manage the entire plumbing system. A variety of standard and Zero Lead<sup>1</sup> fitting options are available for the MANABLOC distribution ports, including PEX Compression, Bronze PEX Press, Brass PEX Crimp and PolyAlloy PEX Crimp fittings. These distribution connections come complete with the MANABLOC when ordered. However, supply connections and fixture transition fittings are not included with the unit but are available separately.

### Materials

The modular MANABLOC sections are molded from polysulfone (PLS) plastic. This material is used extensively in the medical industry and is highly resistant to hot water, chlorine and other chemicals typically found in potable water systems. The other components making up the MANABLOC consist of corrosion-resistant metals and engineered plastics that have been chosen specifically for each purpose. The stiffener used in the compression port fitting assembly is manufactured from 304 stainless steel.

### Marking and Certification

MANABLOC units are marked with the product name, unit part number, material designation, production date and marks of third-party certifications by NSF International (NSF-pw) to ASTM F877, ANSI/NSF standards 14 and 61 CSA B137.5 and are listed with IAPMO as meeting the requirements of the Uniform Plumbing Code.

### Recommended Uses

The MANABLOC is recommended for use in hot and cold potable water distribution systems in single and multifamily dwellings, as well as multiple-unit structures (apartments, condos, hotels, motels, etc.). Maximum pressure/temperature rating is 100 psi @ 180°F. The MANABLOC is not to be used directly in line with hot water domestic recirculation loops. PureFlow MANABLOC system components are not interchangeable with components and tubing from other suppliers. For information on other hot and cold applications not listed here, consult with your Viega representative.

### Handling and Installation

The MANABLOC must be protected from UV exposure and petroleum products that can damage them. Use of these materials in hot and cold water distribution systems must be in accordance with good plumbing practices, applicable code requirements, and current installation practices available from Viega. Contact a Viega representative or the applicable code enforcement bureau for information about approvals for specific applications.

### Capacities and K-Factor

Specifications	English Units	SI
Main Waterway (each side)	1-1/4"	31.8mm
Main Inlet/Outlet Connection	1" Male NPSM	-
Fixture Ports	3/8" CTS and 1/2" CTS	9.5mm and 12.7mm
Fixture Port Rating (each)	3/8" - 2.5 GPM	3/8" - 9.5 LPM
(@ 8 FPS tubing velocity)	1/2" - 4 GPM	1/2" - 15.1 LPM
Fixture Port K-Factor	3/8" - .35	3/8" - 1.66 x 10 <sup>-3</sup>
	1/2" - .21	1/2" - 9.997 x 10 <sup>-4</sup>
	(PSI=KxGPM <sup>2</sup> )	(BAR=KxLPM <sup>2</sup> )
Main Bore Flow Capacity (each side) (2006 IPC Table 604.10.1)	31 GPM	117.3 LPM
Main Bore Through Feed K Factor	0.012	56.98x10 <sup>-6</sup>
(36 Ports with "Y" Block)	(PSI=KxGPM <sup>2</sup> )	(BAR=KxLPM <sup>2</sup> )
WSFU Capacity (each side) (2006 IPC, table E103.3)	60	-

1. "Zero Lead" identifies Viega products meeting the lead free requirements of California and Vermont law, effective January 1, 2010, as tested and listed against NSF- 61, Annex G

**Viega... The global leader in plumbing and heating systems.**

301 N. Main, 9th Floor • Wichita, KS 67202 • Ph: 800-976-9819 • Fax: 800-976-9817 • E-Mail: insidesales@viega.com • www.viega.com

# TechData

**viega**

## Quality Assurance

When the product is marked with the ASTM F877 designation, it affirms that all MANABLOC manifold control units are factory-assembled and pretested prior to delivery to the field. Viega utilizes protective packaging to reduce risk of damage during shipping and storage. MANABLOC manifolds are not intended to be fabricated or disassembled in the field. MANABLOC manifolds are intended for potable water use only.

## Certification

### cNSF@us pw-G

- Zero lead listing meeting California AB 1953 and Vermont ACT 193
- NSF International Performance and Health Effects (Standards 14 & 61)
- NSF certified to CSA B137.5 (Canadian Standards Association)



- IAPMO Certified

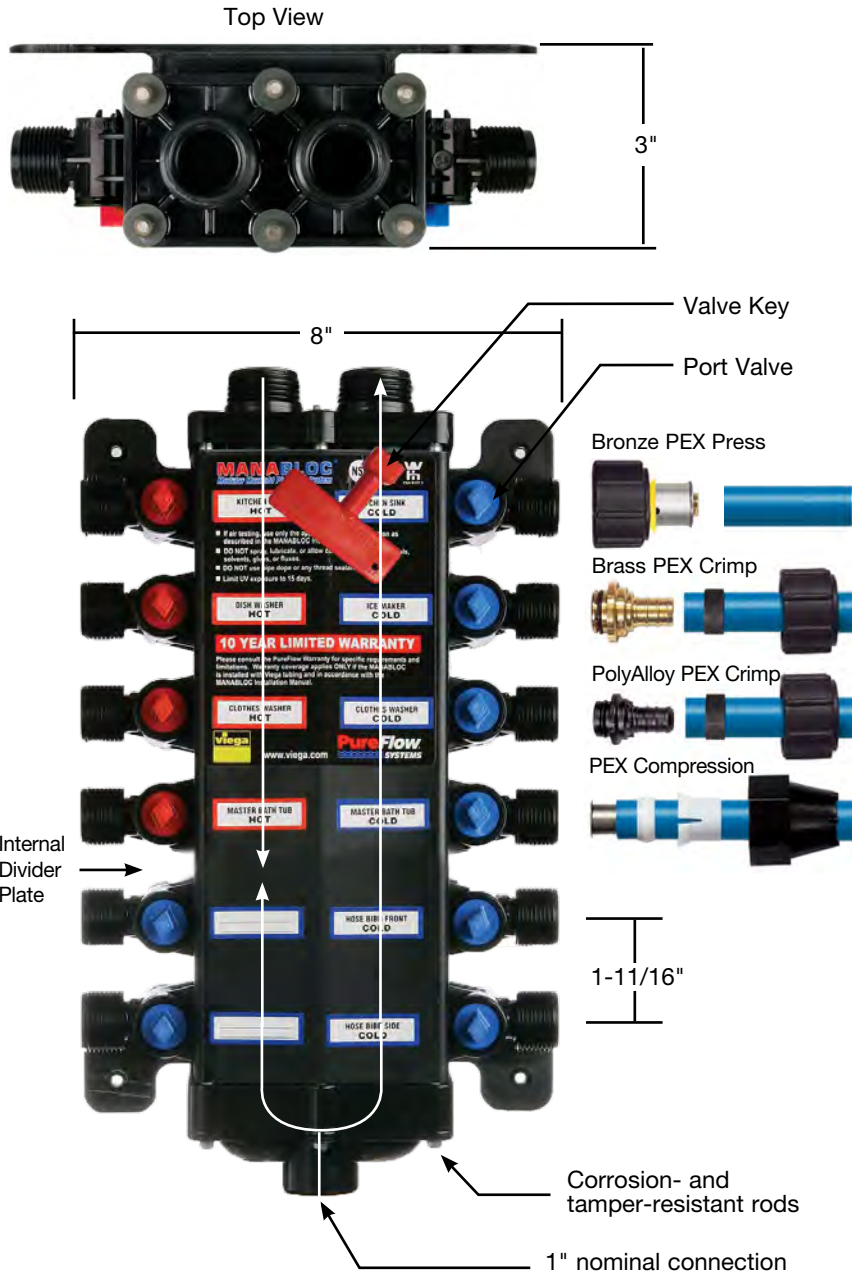
### MANABLOC Dimensions

Total Ports	Length
14	15 - 15/16"
18	19 - 3/8"
24	24 - 3/8"
30	29 - 1/2"
36	34 - 3/8"

Dimensions reflect stock MANABLOC sizes.

### MANABLOC Pressure Drop Table Expressed as PSI Drop Through Port

Port Size	Rated Flow	PSI Drop
3/8"	2.5 gpm	2 psi
1/2"	4 gpm	3.4 psi



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# TQ Series 60Hz Electronic Control Pump

ISO 9001



### Applications

The TQ series pumps are designed for water supply and pressure boosting in residential, commercial and light industrial applications where low or inadequate water pressure exists. It is suitable for boosting pressure from underground or surface water supplies.

### Suitable Liquids

Potable water or other clean or non-corrosive liquids.

### Operation Conditions

1. Ambient temperature: Max. +104°F (40°C)
2. Liquid temperature: +39°F(4°C) ~ +104°F (40°C)
3. System Pressure : Max. 85 PSI
4. Relative humidity: Max. 85% (RH)
5. Under normal operation, it is not necessary to adjust the pressure unless the cut in pressure is higher than preset activation point (refer to specification).

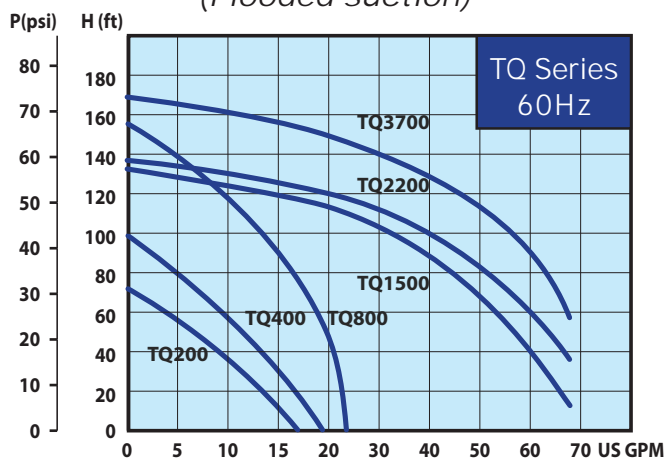
### Product Code



### Product Features

1. The TQ is a complete, all-in-one unit, consisting of pump, motor, pressure tank, and electronic controller. The built-in electronic controller provides constant pressure which ensures that the pump starts automatically when water is consumed and operates continuously until water is not required.
2. Compact design and quiet operation make the TQ series suitable for many applications.
3. The TQ is constructed from the top quality corrosion resistant materials.
4. Pump has built in dry-run shut off with automatic reset function.
5. The motor has built-in thermal overload to protect against high operating temperatures and over current. (Single phase motor only)
6. The TQ has an anti-cycling feature which prevents the pump from continuous starting and stopping when you have a dripping tap or minor leak in the system.
7. The pumps will lift water up to 25 ft. with foot valve and pump suction piping filled with water.

Hydraulic performance curve  
(Flooded suction)

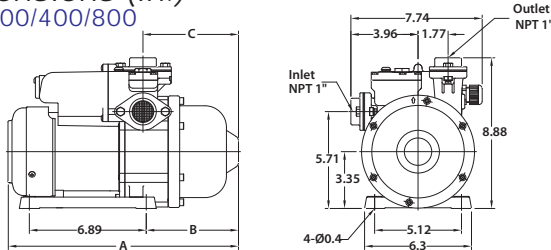


### Materials

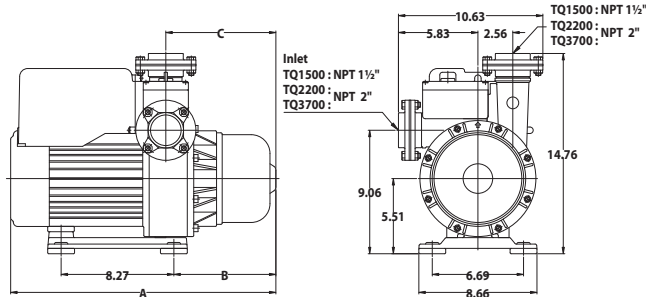
Part name	TQ200/400	TQ800	TQ1500/2200/3700
Pump casing	Glass filled noryl		
Filling plug	NyLon		
Outlet & Inlet	SUS 304		
Intermediate chamber	Glass filled polycarbonate	SUS 304	
Impeller	Glass filled noryl	SUS 304	
Mechanical seal	Ceramic+Carbon+NBR	Carbon+SiC+Viton	
Shaft	SUS 316		
Motor shell	Coating steel	Aluminum alloy	

### Dimensions (in.)

TQ200/400/800



TQ1500/2200/3700



Model	A (in.)	B (in.)	C (in.)
TQ 200	13.23	5.08	5.28
TQ 400	13.56	5.43	5.63
TQ 800	16.42	6.46	6.65
TQ1500~3700	19.72	7.76	8.35

### Specification

Model	Power (HP)	Cycle (Hz)	Phase (Ø)	Voltage (V)	Amp's (A)	Inlet (NPT)	Outlet (NPT)	Preset activation pressure (psi)	Max discharge pressure (psi)	Q max. (GPM)	Faucet	N.W. (lbs)
TQ200	¼	60	1	115 or 230	4.0 or 2.0	1"	1"	20	31	16.9	3	16.3
TQ400	½	60	1	115 or 230	6.0 or 3.0	1"	1"	28	40	18.5	5	19.6
TQ800	1	60	1	115 or 230	11.0 or 5.5	1"	1"	36	67	23.8	10	25.6
TQ1500	2	60	1 or 3	230	9.5 or 6.5	1½"	1½"	43	58	66.0	15	62.8
TQ2200	3	60	3	230	9.5	2"	2"	43	60	71.3	15	68.3
TQ3700	5	60	3	230	12	2"	2"	43	72	71.3	15	74.4

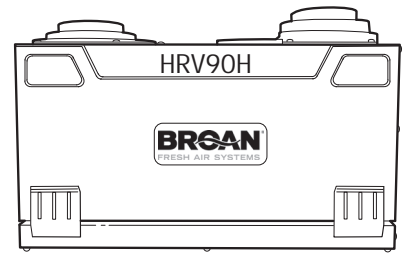
⚙️ - Assuming an average delivery of 2 GPM per minute per tap and a 20 psi discharge pressure.

### Suction Lift Performance Table

Model	Discharge pressure in psi	Capacity in US gallons per minute					
		Suction lift in feet					
		0	5	10	15	20	25
TQ200	10	12.6	11.4	10.2	9.2	8.2	7.1
	20	7.7	6.4	5.2	3.8	2.4	0.5
TQ400	10	16.6	15.6	14.6	13.6	12.7	11.7
	20	12.0	11.0	10.0	9.0	7.8	6.6
	30	7.1	5.8	4.5	3.2	2.0	0.6
	40	14.7	13.8	12.9	12.1	11.1	10.2
TQ800	10	22.4	22.1	21.7	21.3	20.8	20.5
	20	20.7	20.2	19.8	19.2	18.8	18.2
	30	18.3	17.8	17.1	16.2	15.3	14.2
	40	14.7	13.8	12.9	12.1	11.1	10.2
	50	10.5	9.3	8.1	6.9	5.6	4.3
TQ1500	10	66.2	65.0	63.7	62.0	60.2	58.1
	20	58.2	57.0	55.3	53.7	51.7	49.0
	30	50.0	47.3	44.3	41.8	39.7	37.2
	40	38.2	35.7	32.5	29.0	24.8	20.0
TQ2200	10	69.0	69.0	68.7	67.8	66.7	65.3
	20	65.8	64.4	62.8	61.2	59.3	57.2
	30	58.0	55.9	53.3	50.5	47.2	43.5
	40	45.0	41.2	37.6	34.1	30.0	24.6
TQ3700	10	70.9	70.4	70.0	69.5	69.2	68.7
	20	68.9	68.5	68.2	67.9	67.3	66.2
	30	66.7	65.5	64.2	62.8	61.3	59.8
	40	60.4	58.5	56.5	54.3	51.9	48.8
	50	50.0	46.6	42.8	39.0	35.8	32.6
60	34.0	30.4	25.8	20.0	12.7	5.7	

Note - The total system pressure is "the inlet supply pressure + max pump boost pressure."

# HRV90H FRESH AIR SYSTEM



### FEATURES

- 20% smaller than comparable units / Designed for applications where space is critical, such as closet and utility rooms in condominiums, apartments, and pre-fabricated homes. Also has compact footprint design for an easy fit in mechanical rooms, closets, and other tight-fit applications. A versatile solution for the most demanding applications.
- State-of-the-art ventilation technology / Performance sized for new ventilation standards and will not over-dry the house. The most flexible Heat Recovery Ventilator (HRV) on the market.
- Bottom door opening / Design allows easy access from any angle.
- Side (HRV90HS) and top (HRV90HT) port configuration / Versatile design allows for vertical or horizontal configuration, facilitating installation and maintenance (factory-configured).
- Removable electric drawer / Easy maintenance of major sub-components.
- Interchangeable core / Allows unit to be changed from HRV to ERV in the summer.
- Convenient three-mode wall control (VT4W) (Optional) (Min/Max Intermittent: 20-min. On / 40-min. Off).



### GENERAL SPECIFICATIONS

- For houses up to 3,000 sq. ft.
- 45 to 96 cfm (0.4 in. w.g.)
- Voltage: 120 VAC
- Frequency: 60 Hz
- Dimensions: 12.81" x 22.56" x 19.81"
- Weight: 39 lbs
- Shipping Weight: 42 lbs
- Warranty: 2 years on parts - 10 years on core
- HVI Rated of air flow: 106 cfm
- Power Consumed (max): 150 Watts
- Supply air duct connections: 5" diameter
- Exhaust air duct connections: 5" diameter
- Filter: 30 ppi washable reticulated foam
- Cabinet: 20 ga. Pre-painted steel
- Mounting: Suspension by chains and springs
- Wall control modes: Low/High Speeds
- Power: 150 Watts
- Current: 1.3 Amps
- Continuous duty, permanently lubricated motors
- 36" power cord

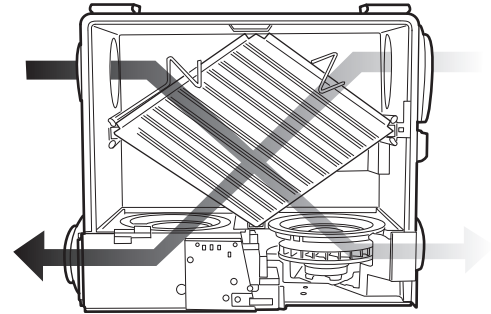
Broan-NuTone LLC Hartford, Wisconsin www.broan.com 800-558-1711

REFERENCE	QTY.	REMARKS	Project
			Location
			Architect
			Engineer
			Contractor
			Submitted by <span style="float: right;">Date</span>

# MODEL HRV90H

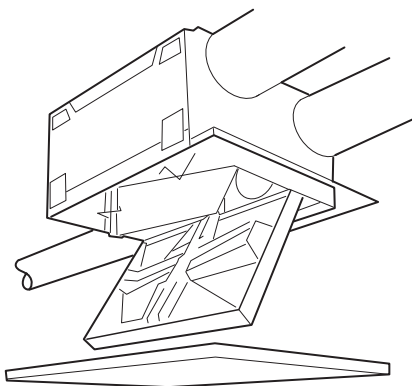
## PERFORMANCE SPECIFICATIONS

Ventilation Performance							
External Static Pressure		Net Supply Airflow		Gross Airflow			
				Supply		Exhaust	
Pa	In. W.g.	L/s	cfm	L/s	cfm	L/s	cfm
25	0.1	52	110	52	110	57	122
50	0.2	50	106	50	106	55	116
75	0.3	48	101	48	102	53	113
100	0.4	45	96	46	97	50	107
125	0.5	43	92	43	92	48	103
150	0.6	41	87	41	87	45	96
175	0.7	38	81	38	81	43	91

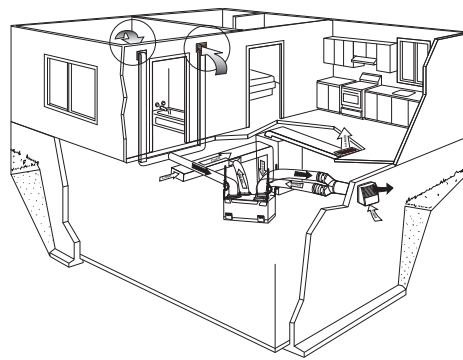


Energy Performance								
	Supply Temperature		Net Airflow		Average Power	Sensible Recovery Efficiency	Apparent Sensible Effectiveness	Latent Recovery Moisture Transfer
	C	F	L/s	cfm				
Heating	0	32	23	48	68	66	78	0.07
	0	32	30	63	82	65	76	0.04
	0	32	44	93	116	59	68	0.04
	-25	-13	30	63	110	55	81	0.08
						Total Recovery Efficiency		
Cooling	35	95			Not Tested			

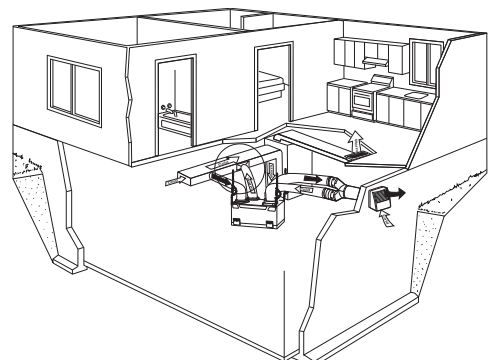
## INSTALLATION OPTIONS



**Bulkhead Installation  
(Mechanical Room)**



**Direct Exhaust  
- Return Connection**



**Return-Return  
Connection**





Project Name: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Engineer: \_\_\_\_\_  
 Submitted to: \_\_\_\_\_  
 Submitted by: \_\_\_\_\_  
 Reference: \_\_\_\_\_

Approval: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Construction: \_\_\_\_\_  
 Unit #: \_\_\_\_\_  
 Drawing #: \_\_\_\_\_

## Performance

*Indoor Unit Model No:* FBQ18PVJU  
*Outdoor Unit Model No:* RZQ18PVJU9  
*Rated Cooling Capacity (Btu/hr):* 18000  
*Sensible Capacity (Btu/hr):* 14800  
*Max/Min Cooling Capacity (Btu/hr / kW):* tabook/databook  
*Cooling Input Power (kW):* 2.12  
*SEER:* 17.5  
*Rated Heating Capacity (Btu/hr):* 20000  
*Max/Min Heating Capacity (Btu/hr / kW):* tabook/databook  
*Heating Input Power (kW):* 2.12  
*Heating COP (Btu/hr / Btu/hr):* N/A  
*HSPF:* 10.6

*Indoor Unit Type:* DC Duct Mounted  
*Condensing Unit Type:* SkyAir Heat Pump  
*Rated Cooling Conditions*  
 Indoor: 80°F DB/67°F WB  
 Outdoor: 95°F DB/75°F WB  
*Rated Heating Conditions*  
 Indoor: 70°F DB/60°F WB  
 Outdoor: 47°F DB/43°F WB  
*Rated Piping Length(ft)* 25  
*Rated Height Separation(ft)* 0

## Indoor Unit Details

*Power Supply (V/Hz/Ph):* 208-230/60/1ph  
*Power Supply Connections:* L1, L2, Ground  
*Min Circuit Amps MCA (A):* 1.6  
*Max Overcurrent Amps MFA (A):* 15  
*Dimensions (HxWxD):* 11-13/16x39-3/8x27-9/16  
*Panel (HxWxD):* N/AxN/AxN/A  
*Net Weight (lbs):* 80  
*Weight with Panel (lbs):* N/A

*Airflow Rate (CFM wet coil)* 635/582/529  
*Moisture Removal (pt/h):*  
*Gas Pipe Connection (inch):* 1/2  
*Liquid Pipe Connection (inch):* 1/4  
*Condensate Connection (inch):* 1  
*Sound Pressure Level (dBA):* 41  
*Sound Power Level (dBA):* 37  
*Static Pressure Rated/Max (inWg)* 0.4 / 0.8/0.8

## Condensing Unit Details

*Power Supply (V/Hz/Ph):* 208-230/60/1ph  
*Power Supply Connections:* L1, L2, Ground  
*Min. Circuit Amps MCA (A):* 16.5  
*Max. Overcurrent Amps MFA (A):* 20  
*Max. Starting Current MSC(A):*  
*Rated Load Amps RLA (A):* 7.1  
*Dimensions (HxWxD):* 30-5/16x35-7/16x12-5/8  
*Net Weight (lbs):* 150

*Compressor Type:* Inverter  
*Capacity Control Range (%):* 35 - 100  
*Airflow Rate (CFM):* 1835  
*Gas Pipe Connection (inch):* 5/8  
*Liquid Pipe Connection (inch):* 3/8  
*Sound Pressure Level (dBA):* 49  
*Sound Power Level (dBA):*

## System Details

*Refrigerant Type:* R-410A  
*Holding Refrigerant Charge (lbs):* 5.1  
*Additional Charge (oz/ft):* 0.036lbs/ft  
*Pre-charge Piping (Length ft):* -  
*Max. Pipe Length (Total ft):* 164 ft

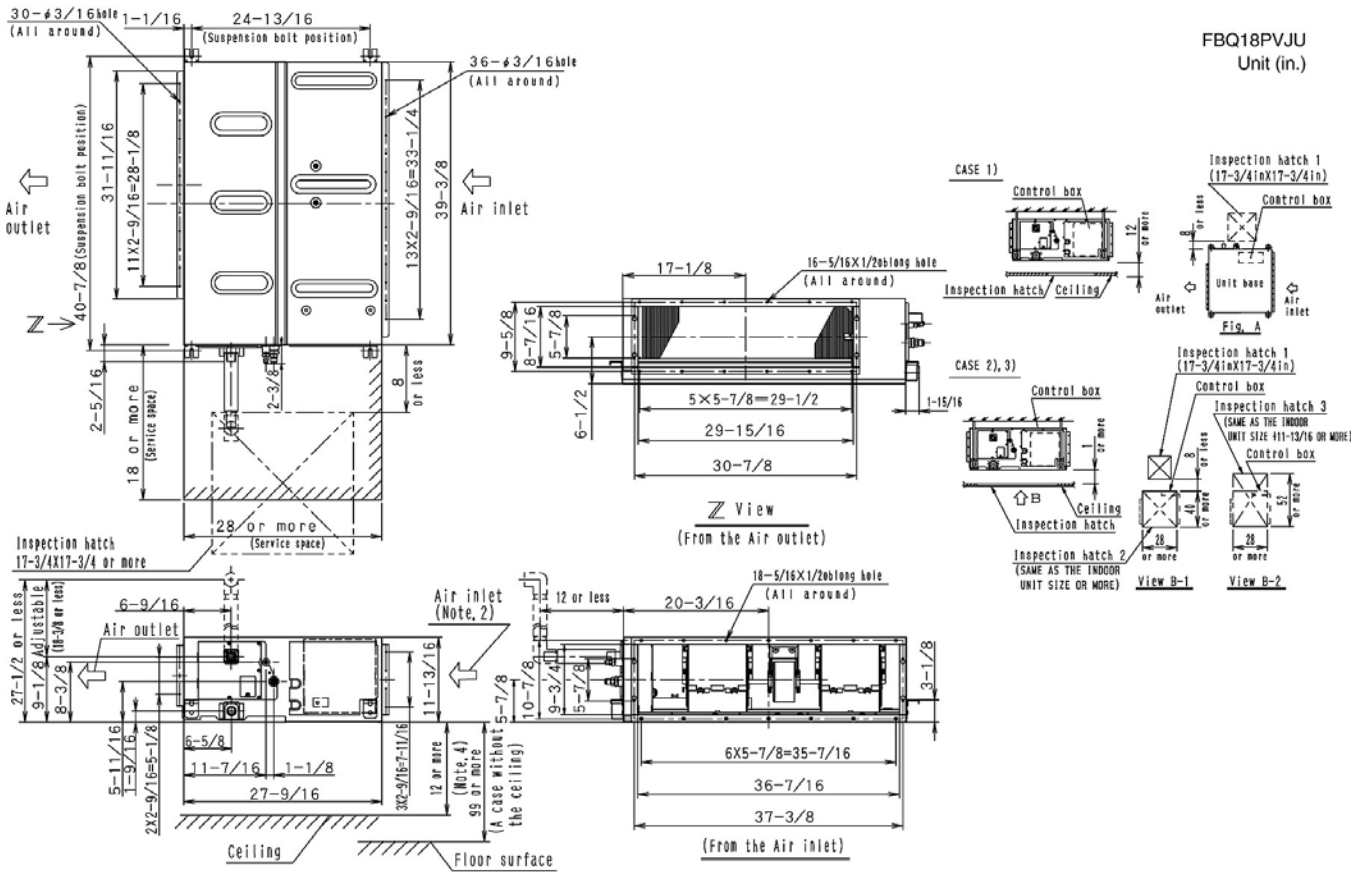
*Max. Pipe Length (Vertical ft):* 98 ft  
*Cooling Operation Range (°F):* 23 - 115  
*Cooling Range w/Baffle (°F):* 0 - 115  
*Heating Operation Range (°F):* 0 - 77  
*Heating Range w/Baffle (°F):* 0 - 77

Project Name: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Engineer: \_\_\_\_\_  
 Submitted to: \_\_\_\_\_  
 Submitted by: \_\_\_\_\_  
 Reference: \_\_\_\_\_

Approval: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Construction: \_\_\_\_\_  
 Unit #: \_\_\_\_\_  
 Drawing #: \_\_\_\_\_

## Dimensional Drawing - Indoor Unit

FBQ18PVJU

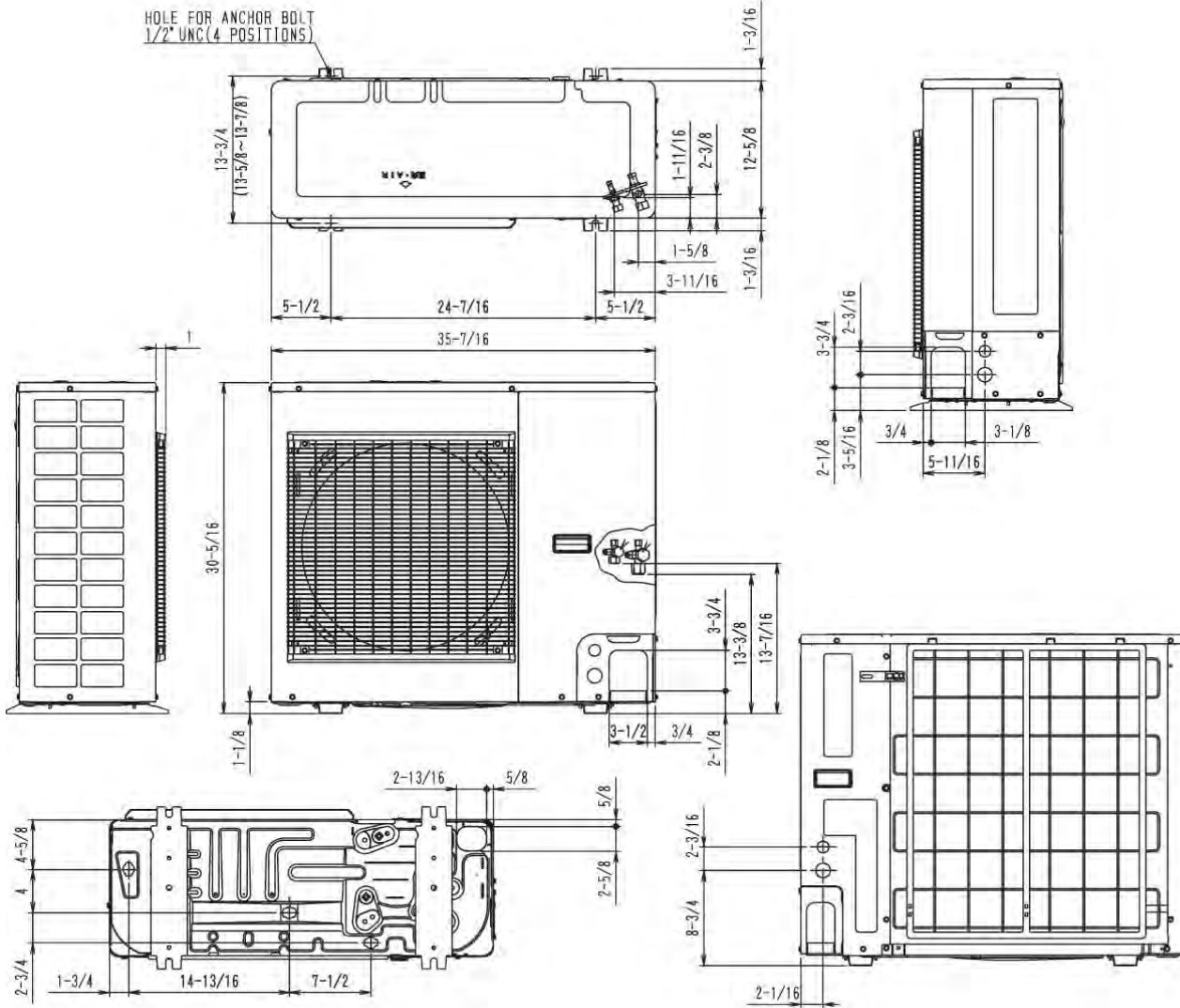


Project Name: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Engineer: \_\_\_\_\_  
 Submitted to: \_\_\_\_\_  
 Submitted by: \_\_\_\_\_  
 Reference: \_\_\_\_\_

Approval: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Construction: \_\_\_\_\_  
 Unit #: \_\_\_\_\_  
 Drawing #: \_\_\_\_\_

**Dimensional Drawing - Condensing Unit**

RZQ18PVJU9



Project Name: \_\_\_\_\_  
Location: \_\_\_\_\_  
Engineer: \_\_\_\_\_  
Submitted to: \_\_\_\_\_  
Submitted by: \_\_\_\_\_  
Reference: \_\_\_\_\_

Approval: \_\_\_\_\_  
Date: \_\_\_\_\_  
Construction: \_\_\_\_\_  
Unit #: \_\_\_\_\_  
Drawing #: \_\_\_\_\_

**FBQ18PVJU**



**RZQ18PVJU9**



**FBQ18PVJU**

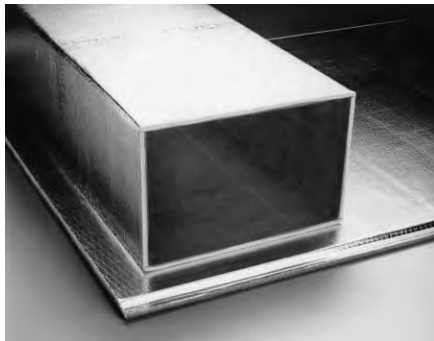
Std U.S. Warranty: 7yrs Compressor, 5yrs Parts

**RZQ18PVJU9**

Std U.S. Warranty: 7yrs Compressor, 5yrs Parts



## Product Data Sheet



### Description

Owens Corning™ QuietR<sup>®</sup> Duct Board is a rigid, resin bonded fibrous glass board with a tough, damage-resistant, flame retardant, reinforced aluminum foil (FRK) facing. When fabricated into duct systems, it combines excellent thermal and acoustical insulating properties with substantially airtight transmission of air when all joints are sealed with UL 181A listed closures.

QuietR<sup>®</sup> Duct Board features a durable mat air stream surface that isolates the glass fiber substrate from the airstream and inhibits penetration of the insulation by dirt, dust and other pollutants. This durable air stream surface makes it easy to clean the duct system using methods and equipment described in North American Insulation Manufacturers Association (NAIMA) Publication AH122, Cleaning Fibrous Glass Insulated Duct Systems, Recommended Practice.

### Key Features

- Absorbs noise and reduces popping noises caused by expansion, contraction and vibration.
- Assured thermal R-value performance.
- Bacterial and fungal growth resistant with an EPA registered biocide that protects the air stream surface from microbial growth.
- Thermal/acoustical insulation board plus jacket forms a single component duct system, thus reducing inspection time.
- Lightweight boards are easier to transport and handle than insulated sheet metal ducts.
- Virtually eliminates air leakage thus saving energy and removing the need for system overdesign.

### Product Applications

QuietR<sup>®</sup> Duct Board may be used to fabricate components for indoor commercial and residential heating, ventilating and air conditioning duct systems operating at static pressures to  $\pm 2$  in. w.g. (500 Pa), internal air temperatures 40°F (4°C) to 250°F (121°C), and air velocities to 6,000 fpm (30.5 m/s). Straight duct sections, elbows, tees, offsets and other system elements can quickly and easily be fabricated at the shop or on the job and assembled into a complete air transmission system using these lightweight, thermally efficient boards.

### UL Class I Air Duct

National Fire Protection Association Standards NFPA 90A and 90B for air conditioning and ventilating systems require air ducts to be Class 0 or I. The tests set stringent requirements on fire safety as well as ruggedness. To meet Class I air duct requirements, the system

### Typical Physical Properties

Property	Test Method	Value
Maximum Operating Temperature Limits	UL 181/ULC S110	Internal: 250°F (121°C) External: 150°F (66°C)
Maximum Air Velocity	UL 181/ULC S110 Erosion Test	6,000 fpm (30.5 m/s)
Static Pressure Limit	UL 181/ULC S110	$\pm 2$ in. w.g. (500 Pa)
Water Vapor Sorption	ASTM C1104	<3% by weight at 120°F (49°C), 95% R.H.
Mold Growth	UL 181/ULC S110	Meets requirements
Fungi Resistance	ASTM G21	Meets requirements
Bacteria Resistance	ASTM G22	Meets requirements
Surface Burning Characteristics <sup>1</sup>	UL 723/ULC S102	Flame Spread < 25 <sup>1</sup> Smoke Developed < 50
Fire Retardancy	UL 181/ULC S110	Flame Penetration 30 min.

1. The surface burning characteristics of these products have been determined in accordance with UL 723/ULC S102. This standard should be used to measure and describe the properties of materials, products or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use. Values are reported to the nearest 5 rating.



## Product Data Sheet

must withstand UL 181/ULC S110 tests such as erosion, pressure loss, impact, collapse, puncture, static load and fire retardancy (30 minute flame penetration test). Also, to qualify as a Class I Air Duct System, the following UL 723/ULC S102 fire testing requirements must be met: Flame spread, 25; Smoke developed, 50.

### Limitations

Fiber glass ducts should not be used in the following applications:

- A. Kitchen or fume exhaust ducts, or to convey solids or corrosive gases;
- B. In concrete or buried below grade;
- C. Outdoors;
- D. As casings and/or housings of built-up equipment;
- E. Immediately adjacent to high temperature electric heating coils without radiation protection;
- F. For vertical risers in air duct systems serving more than two stories in height;
- G. With coal or wood fueled equipment, or with equipment of any type which does not include automatic maximum temperature controls;
- H. In variable air volume systems on the high pressure side unless reinforced to withstand the full fan pressure;
- I. As penetrations in construction where fire dampers are required, unless the fire damper is installed in a

sheet metal sleeve extending through the fire wall; or

- J. When the duct system is located in non-conditioned space and is used for cooling only (when heating is from another source), unless all registers which would allow moist air into the duct system are vapor sealed during the heating season to prevent condensation from forming inside the duct.

### Technical Information

Fabrication and installation of fiber glass Duct Systems shall be in accordance with the UL listing and shall conform to Owens Corning's published methods and/or latest editions of

NAIMA (North American Insulation Manufacturers Association) Fibrous Glass Duct Construction Standards or SMACNA (Sheet Metal and Air Conditioning Contractors National Association) Fibrous Glass Duct Construction Standards. One of the following closure methods must be employed to meet the requirements of UL 181/ULC S110. USE OF A NON-LISTED CLOSURE SYSTEM VOIDS THE UL CLASS I AIR DUCT RATING.

#### I. Pressure-Sensitive Tape

Any tape listed and labeled under UL 181A, Part I (P).

- a. All longitudinal and

### Thermal Performance

	1" (25mm)	1½" (38mm)	2" (51mm)
R-value, hr•ft <sup>2</sup> •°F/Btu (RSI, m <sup>2</sup> •°C/W)	4.30 (0.76)	6.50 (1.15)	8.70 (1.53)
k-value, Btu•in/hr•ft <sup>2</sup> •°F (W/m•°C)	0.23 (0.033)	0.23 (0.033)	0.23 (0.033)
C-value, Btu/hr•ft <sup>2</sup> •°F (W/m <sup>2</sup> •°C)	0.23 (1.32)	0.16 (0.87)	0.12 (0.65)

Mean temperature is the average of two temperatures: that of the air inside the duct and that of the ambient air outside it.

Note: Specified design thickness should be adequate to prevent exterior surface condensation.

### Acoustical Performance

Sound absorption coefficients at octave band center frequencies, Hz.

Type	125	250	500	1000	2000	4000	NRC
Type 475, 1" (25mm)	0.08	0.19	0.69	0.94	0.99	0.98	0.70
Type 800, 1½" (38mm)	0.12	0.33	0.92	1.04	1.03	1.02	0.85
Type 1400, 2" (51mm)	0.14	0.72	1.15	1.12	1.06	1.07	1.00

These data were collected using a limited sample size and are not absolute values. Therefore, reasonable tolerances must be applied. Tests were conducted in accordance with ASTM C423, Mounting A (material placed against a solid backing).

### Product Availability

QuietR® Fiber Glass Duct Board is available in the following forms:

Type	Thickness	Density, pcf (kg/m <sup>3</sup> )
Type 475	1" (25mm)	4.4 (70)
Type 800	1½" (38mm)	3.8 (61)
Type 1400	2" (51mm)	3.8 (61)

Type designates board stiffness defined by flexural rigidity.

Type selection depends on duct size, pressure and reinforcement schedule. The 1½" (38mm) and 2" (51mm) thickness provides superior thermal value.



## Product Data Sheet

circumferential joints must be stapled with outward flaring ½" (13mm) (min.) staples, 2" (50mm) (approx.) O.C.

- b. Wipe surface where tape is to be applied to field joints with clean cloth. If surface has grease or oil, saturate cloth with approved solvent. Refer to tape manufacturer's recommendations.
- c. Center tape over edge of stapling flap and rub firmly in place immediately after application, using a squeegee or similar tool.
- d. A heat sealing iron must be used to assure a good bond when installed below 50°F (10°C).
- e. Tape should not be applied to surface of duct board when temperature is below 32°F (0°C) due to the possibility of entrapping ice crystals which will cause tape to loosen upon melting. Heat surface first to drive off moisture.

### 2. Heat-Activated Tape

Any tape listed and labeled under UL 181A, Part II (H).

- a. All longitudinal and circumferential joints must be stapled with outward flaring ½" (13mm) (min.) staples, 2" (50mm) (approx.) O.C.
- b. Wipe surface where tape is to be applied with clean cloth. If surface has grease or oil, saturate cloth with approved solvent. Refer to tape manufacturer's recommendations.

- c. Center tape over joint and seal down tape end with 500°F (260°C) iron. Do not use heat gun; heat and pressure are both required to effect a seal.
- d. Press down entire length of tape to hold in place using a smearing action to get good bond. Colored dots on tape surface darken when satisfactory bonding temperature is reached.
- e. Staples may be omitted when automatic closure machines such as Glass Master Closemasters are used. Iron temperature must be set at 650°F (343°C) minimum. Continuous production may require periodic pauses to allow sealing iron to recover to 650°F (343°C).
- f. Allow joint to cool before stressing.

### 3. Mastic and Glass Fabric

Any mastic and glass fabric closure system listed and labeled under UL 181, Part III (M).

- a. All longitudinal and circumferential joints must be stapled with outward flaring ½" (13mm) (min.) staples, 2" (50mm) (approx.) O.C.
- b. Brush mastic onto joint and embed glass fabric in mastic.
- c. Brush second coat of mastic over fabric until completely filled.

- d. Allow joints to dry in accordance with mastic manufacturer's recommendation before pressurizing system.

### Tips to Avoid Mold Growth in Ducts

- Mold in duct systems occurs when moisture comes into contact with dirt or dust collected on the duct system surfaces. Proper filters will minimize the collection of dust and dirt, but care needs to be exercised to prevent water formation in the duct. A properly sized and operated air conditioning unit will minimize the likelihood of water formation.
- The system must be maintained and operated to insure that sufficient dehumidification is occurring and that filters are installed and changed as recommended by the equipment manufacturer.

### Standards, Code Compliance

- Meets NFPA 90A/90B
- Meets ICC International Mechanical Code, Corps of Engineers Guide Spec., NYC MEA #186-69
- Supported by NAIMA and SMACNA industry standards
- Meets requirements of ASTM C1338, ASTM G21 (fungi test) and ASTM G22 (bacteria test)



## Product Data Sheet

### Certifications and Sustainable Features of QuietR® Duct Board

- Certified by Scientific Certification Systems to contain a minimum of 57% recycled glass content
- Certified to meet indoor air quality standards under the stringent GREENGUARD Indoor Air Quality Certification Program, and the GREENGUARD Gold Certification.\*

### Environmental and Sustainability

Owens Corning is a worldwide leader in building material systems, insulation and composite solutions, delivering a broad range of high-quality products and services. Owens Corning is committed to driving sustainability by delivering solutions, transforming markets and enhancing lives. More information can be found at <http://sustainability.owenscorning.com>.

\* Duct Board up to and including 1" is GREENGUARD Gold Certified.



#### Disclaimer of Liability

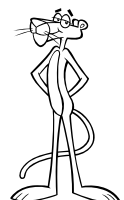
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GREENGUARD Certified products are certified to GREENGUARD standards for low chemical emissions into indoor air during product usage. For more information, visit [ul.com/gg](http://ul.com/gg).



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**1-800-GET-PINK®**  
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## *Air conditioner disconnects*

### PULLER TYPE AC DISCONNECTS

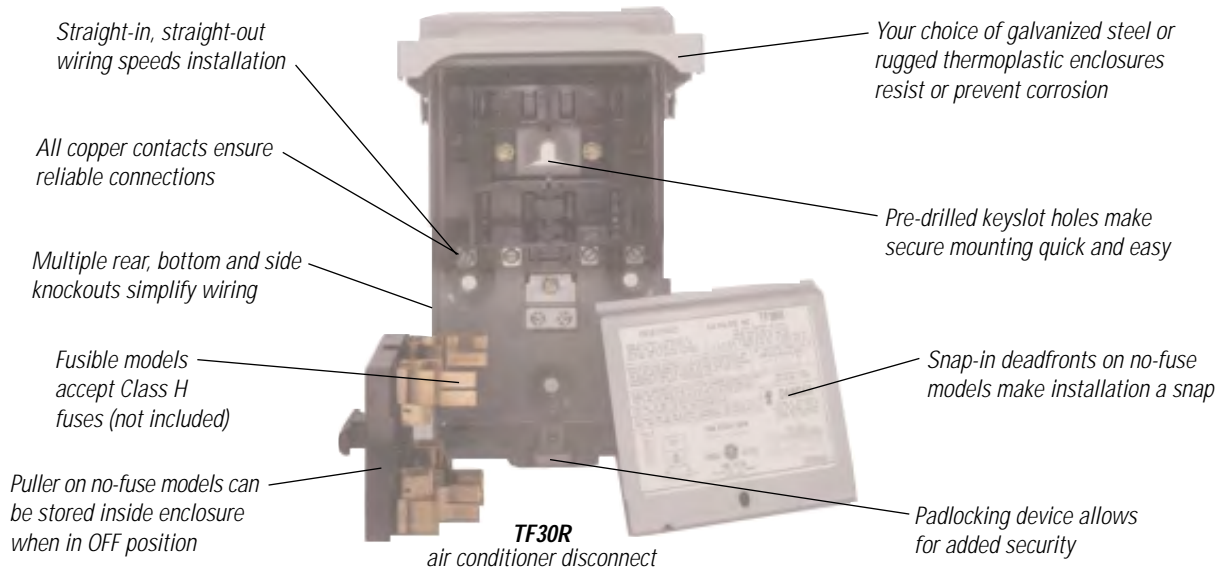


## **Cool operators**

Fusible and non-fusible in plastic and metal enclosures

**With GE air conditioner disconnects, you get:**

- Compact size
- Easy installation
- Fusible and non-fusible types
- Plastic and metal enclosures
- Puller and non-automatic switch type disconnects



Schematic Diagram	Puller Type	Maximum Ampere Rating	Volts	Outdoor, Type 3R Catalog Number	Horsepower Rating	Lug Wire Range AWG Cu/Al
<b>Thermoplastic-Enclosures — GE Noryl® Resin</b>						
	Fusible	30	120-240	TPF30R	3	14-3
		60	120-240	TPF60R	10	
	No Fuse	60	240	TPN60R1	10	14-3
	Non-Auto Switch	60	240	TPNA60R1	10	14-3
<b>Steel Enclosures</b>						
	Fusible	30	120-240	TF30R	3	14-3
		60	120-240	TF60R	10	
	No Fuse	60	240	TFN60R	10	14-3
	Non-Auto Switch	60	240	TNA60R1	10	14-3

**Application Information**

*UL Information*

Fusible: **UL Listed** — UL869 Service Entrance

No Fuse: **UL Listed** — UL1429 Enclosed Pull-out Switch

**cUL Listed** — TFN60R only

NEC: **440-14**

*Install Confidence. Install GE.*



**GE Industrial Systems**

General Electric Company  
 41 Woodford Avenue, Plainville, CT 06062  
 www.GEindustrial.com

## SmartlockPro® Outlet Branch Circuit AFCI Devices

### Advanced technology helps protect against electrical fires resulting from arc-faults.

The U.S. Fire Administration (USFA) National Fire Incident Reporting System reported that in 2011, an estimated 47,700 home structure fires reported to U.S. fire departments involved some type of electrical failure or malfunction as a factor contributing to ignition. And, according to the National Fire Protection Association (NFPA), arc-faults are “the principle electrical failure mode resulting in fire”.

Arc Fault Circuit Interrupters (AFCI) were developed to help combat the problems associated with arc-faults.

- AFCIs are designed to detect a wide range of arc-faults to help reduce the likelihood of the electrical system being an ignition source of a fire.
- AFCIs function by de-energizing the circuit downstream of the device upon which an arc-fault is detected; which could help prevent ignition and a resultant fire.
- AFCIs are now required by the National Electrical Code® in most areas throughout the home.

Often unseen, arc-faults can occur anywhere in the home's electrical system including within walls, at loose electrical connections or within damaged electrical cords. Leviton Outlet Branch Circuit (OBC) AFCI Devices are designed to identify arc-faults and to respond by interrupting power to help prevent arc-faults that may lead to a fire.

#### AFCI Devices

Whole house electrical safety is a tall order, but with the new line of SmartlockPro OBC AFCI Devices Leviton has developed a means to offer added protection from arc-faults. Previously, the only available option for providing the required AFCI protection against electrical fire hazards was through the use of AFCI breakers. And, even though there were some exceptions to the Code that would allow for the use of AFCI protection at the receptacle level with prescribed wiring techniques, there were no AFCI devices available on the market. That has recently changed.

#### AFCI Receptacle

OBC AFCI Receptacles address the dangers associated with both types of potentially hazardous arcing – parallel and series arcing. Similar to GFCIs, AFCI receptacles provide feed-through protection and are able to detect downstream parallel and series arc-faults as well as upstream series arc-faults. Utilizing an AFCI receptacle offers homeowners the benefit of localized TEST and RESET. Applications include installation in living rooms, dining rooms, family rooms, bedrooms, parlors, dens, libraries, sunrooms, recreation rooms, closets, hallways, dormitories or similar areas.



#### Blank Face AFCI

The Blank Face AFCI offers the ideal solution for outlet branch circuits where AFCI protection is desired but located where an outlet is not needed. This type of application could include installing a Blank Face AFCI in a location to make AFCI protection readily accessible per the 2014 National Electrical Code. A Blank Face AFCI may also be used on circuits feeding lighting loads and/or other loads such as smoke detectors where a receptacle is not used.

#### Combination AFCI/Switch

Our Combination AFCI/Switch provides AFCI protection plus the convenience of a single pole switch to control the lights. This combination is ideal for kitchens, family rooms, bedrooms, dining rooms and hallways. The AFCI Switch may be used for new circuits or modifications to existing circuits where a switch is the first outlet on a branch circuit.

# OBC Options for AFCI Requirements in the 2014 NEC

## New Branch Circuit

### NEC 210.12(A)

Covers new branch circuits originating from the panel. AFCI protection for all 15A and 20A, 125V branch circuits supplying outlets in designated locations. (Locations noted below)

#### What type of wiring is coming from the panel?

##### Type NM (i.e. Romex®)

- Install at first outlet
- Must be readily accessible
- First outlet box must be marked
- Wiring between panel and first outlet must be continuous and not more than 50' if 14 AWG, not more than 70' if 12 AWG
- OBC AFCI must have "System Combination" listing with the breaker\*

##### RMC, IMC, EMT, Type MC, Type AC

- Install at first outlet
- Must be readily accessible
- Any boxes between panel and first outlet must be metal

##### Note:

*It is not necessary to continue the metal cable/conduit or metal boxes past the first outlet (transition could be made to NM)*

## Modifications or extension to an existing branch circuit

### NEC 210.12(B)

AFCI protection needs to be added when modifying or extending existing branch circuits in locations designated in 210.12(A). Not required if extension of circuit is less than 6 ft. and does not include any additional outlets or devices.

- Install at first outlet
- Must be readily accessible

##### Notes:

- For circuit extensions of less than 6' it is not necessary to add AFCI protection
- OBC AFCI Outlet can be used for all wiring types

## Changing out an existing receptacle

### NEC 406.4(D)

Covers replacement of any receptacles in those locations designated in 210.12 that are not currently AFCI protected.

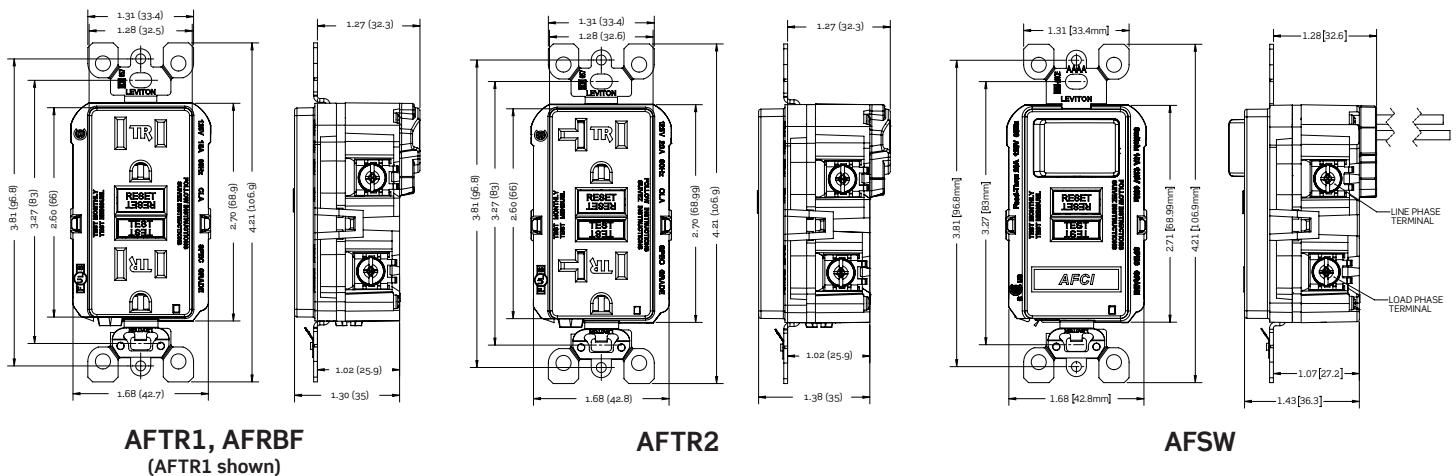
- Install OBC AFCI in place of receptacle being replaced **or**
- Install OBC AFCI at any outlet location "upstream" (closer to the panel) of receptacle being replaced
- Recommend the first outlet

##### Note:

*OBC AFCI Outlet can be used for all wiring types*

\*Requires listing Nationally Recognized Testing Laboratory (NRTL - i.e. UL). Standard for listing expected in 2014. Always check with your local inspector or AHJ (Authority Having Jurisdiction) for any questions on current local code requirements.

## Dimensional Drawings



## Features and Benefits

### General

- Use of TEST and RESET buttons is similar to traditional GFCI receptacles of which consumers have become familiar with. This translates into greater acceptance of the technology and a more user-friendly platform
- Meets or exceeds UL requirements for tripping time on both series and parallel arcs
- Device design reduces nuisance tripping
- Impact-resistant thermoplastic cover and body
- Superior resistance to electrical surges and over-voltages
- Expanded wiring options with nine back-wire holes (two for each line and load connection plus one for ground with an internal clamp)
- Silver alloy contacts
- Compatible with all Decora® devices and wallplates; available in select colors
- Packed with coordinating wallplate (except AFRBF)
- Backed by Leviton's Limited Two-Year Product Warranty

### Lockout Action

- As an additional safeguard, all Leviton AFCI Devices feature a lockout function which prevents the device from being reset if:
- it is not functioning properly
  - protection has been compromised
  - line and load wires were reversed during installation

### AFCI Receptacle

- Tamper-resistant to comply with the latest NEC® requirements for tamper-resistant receptacles in residences and childcare facilities

### Blank Face

- May be used for outlet branch circuits where AFCI protection is desired but is located where an outlet is not needed
- Ideal for installing in locations to make AFCI protection "readily accessible" per NEC requirements
- May be used on circuits feeding lighting loads as well as other loads such as smoke detectors where a receptacle is not used

### AFCI Switch

- Combination AFCI and single pole switch
- Use for new circuits or modifications to existing circuits where a switch is the first outlet in a branch circuit

## Key Specifications

- **Amperage:** Switch 15 Amp; Receptacle 15 Amp and 20 Amp
- **Voltage:** 125 Volt
- **Feed-through:** 20 Amp protection
- **NEMA:** 5-15R, 5-20R
- **Pole:** 2
- **Wire:** 3
- **Indicators:** Reverse wiring/power
- **Termination:** Back & Side
- **Strap Material:** Galvanized Steel
- **Warranty:** 2-Year Limited



## Specification Details

AC Horsepower Ratings	Electrical Specifications	Environmental Specifications	Material Specifications	Mechanical Specifications	Standards and Certifications
<b>At Rated Voltage:</b> 1 HP	<b>Dielectric Voltage:</b> Withstands 1250VAC per UL 1699A <b>Temperature Rise at terminals:</b> <b>AFTR1/AFTR2:</b> Max 30°C after 250 cycles OL at 200 percent rated current <b>AFRBF/AFSW1:</b> Max 35° C	<b>Flammability:</b> Rated V-2 per UL94 <b>Operating Temperature:</b> -35°C to +66°C	<b>Face Material:</b> Thermoplastic <b>Body Material:</b> Polycarbonate <b>Line Contacts:</b> Brass Double-Wipe .031 Thick* <b>Terminal Screws:</b> Plated Steel <b>Grounding:</b> Self-Ground Clip <b>Grounding Screw:</b> Plated Steel <b>Yoke:</b> Zinc-Plated Steel <b>Clamps:</b> Brass	<b>Terminal ID:</b> Brass-Hot, Green-Ground, Silver-Neutral <b>Terminal:</b> 14-10 AWG <b>Product ID:</b> Ratings are permanently marked on device <b>Wiring:</b> Use with copper or copper-clad wire. No aluminum wiring	<b>NEMA*:</b> WD-6 <b>ANSI*:</b> C-73 <b>UL498*</b> <b>NOM:</b> 003 <b>UL1699A:</b> File E342815 <b>UL Fed Spec WC-596*</b> <b>CSA Standard C22.2 No 42</b> <b>CSA Technical Information Letter No. M-02A</b>

\*Only AFTR1 and AFTR2

## Ordering Information

### SmartlockPro Outlet Branch Circuit AFCI Devices

Description	Rating	Cat. No.	Color
Tamper-Resistant Outlet Branch Circuit AFCI Receptacle with LED Indicator	15A-125V @ Receptacle, 20A-125V Feed-Through  NEMA 5-15R 	AFTR1-W AFTR1-I AFTR1-T AFTR1-GY AFTR1-E AFTR1	White Ivory Light Almond Gray Black Brown
Tamper-Resistant Outlet Branch Circuit AFCI Receptacle with LED Indicator	20A-125V @ Receptacle, 20A-125V Feed-Through  NEMA 5-20R 	AFTR2-W AFTR2-I AFTR2-T AFTR2-GY AFTR2-E AFTR2	White Ivory Light Almond Gray Black Brown
Outlet Branch Circuit Combination AFCI/Switch with LED Indicator	15A-120V Switch	AFSW1-W AFSW1-I AFSW1-T	White Ivory Light Almond
Blank Face Outlet Branch Circuit AFCI Receptacle with LED Indicator	20A-125V Feed-Through	AFRBF-W AFRBF-I AFRBF-T	White Ivory Light Almond

#### Leviton Manufacturing Co., Inc. World Headquarters

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 Telephone: 1-800-323-8920 FAX: 1-800-832-9538  
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Visit our Website at: [www.leviton.com/afci](http://www.leviton.com/afci)

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## Important 2008 NEC Code Change Mandates Tamper-Resistant Receptacles in all New Residential Construction

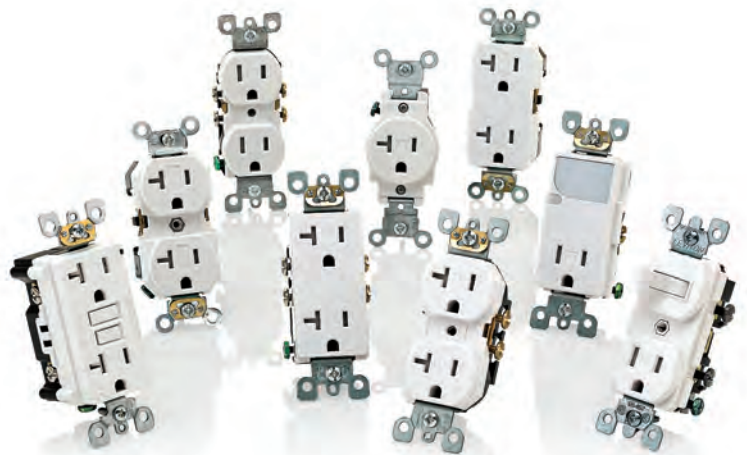


### Plug Into Safety with Leviton's Line of Tamper-Resistant (TR) Receptacles

Leviton makes it easy for you to comply with the 2008 NEC mandate for TR Receptacles in all new residential housing. This requirement resulted from a Consumer Product Safety Commission study<sup>†</sup> that reported alleged injuries in the home caused each year by children attempting to insert foreign objects into receptacles. TR receptacles have been mandated in pediatric care areas for over 20 years and have likely been successful in preventing electrical injuries. As a long-time manufacturer of tamper-resistant devices, we are pleased to be at the forefront of this safety measure with an expanded product line that encompasses a wide range of TR devices in Residential and Commercial Grades.

As more states and municipalities adopt the 2008 NEC code, we expect it to have a major impact on your market. Although there is an increase in cost per product, it is negligible compared to the priceless value of protecting children. To smooth the transition and help you meet your new construction needs, we provide a handy cross-reference of standard and TR catalog numbers on the following page.

*Section 406.11 requires that all 15- and 20-ampere receptacles installed in dwelling units in accordance with Section 210.52 to be listed tamper-resistant receptacles.*



<sup>†</sup> Ten-year study (1991-2001) of National Electronic Injury Surveillance System (NEISS) data. Over 24,000 children under 10 years old were treated in Emergency Rooms for incidents related to electrical receptacles; averaging 2,400 per year, 7 per day.



**Features and Benefits:**

- Shutter mechanism inside the receptacle blocks access to the contacts unless a two-prong plug is inserted, helping ensure hairpins, keys, etc., will be locked out
- TR symbol on residential receptacles assures they meet the 2008 NEC requirement
- TR selection includes Residential and Commercial Grade receptacles
- Heavy-duty construction offers long, trouble-free service life
- Limited Two-Year Warranty

**Applications:**

- New or renovated single- and multi-family housing
- Schools, libraries, childcare facilities

**Agency Standards:**

- UL Listed:** TR and Weather Resistant Receptacles TWR15 and TWR20 (File #E-13399)  
 TR Combination Devices (File #E-7458)  
 SmartlockPro® TR GFCI (File #E-48380)

**CSA Certified:** All TR Devices (File #152105)

**STANDARD AND TR RECEPTACLE CROSS-REFERENCE**

**RESIDENTIAL RECEPTACLES**  
**Duplex Receptacles**

**NEMA 5-15R and 5-20R**  

Description	Standard Receptacle Catalog Number	TR Receptacle Catalog Number	Rating	TR Color* (Basic Cat. No. denotes Brown)
Duplex Receptacle, Quickwire Push-in and Side Wired	5320	T5320	15A-125V	W, I, A, T, E
Duplex Receptacle, Side Wired	N/A	T5820	20A-125V	W, I, T, GY, E
Decora® Duplex, Quickwire Push-in and Side Wired	5325	T5325	15A-125V	W, I, A, T, E
Decora Duplex Receptacle, Side Wired	N/A	T5825	20A-125V	W, I, T, GY, E

**Combination Devices**

Decora LED Guide Light/Receptacle	N/A	T6525	15A-125V	W, I, A, T
Single Pole Switch/Receptacle with ground screw	5225	T5225	Switch: 15A-120V Receptacle: 15A-125V	W, I, A, T
Decora Single Pole Switch/Receptacle with ground screw	5625	T5625	Switch: 15A-120V Receptacle: 15A-125V	W, I, A, T, E

**SmartlockPro® GFCI - Back and Side Wired**

GFCI with LED Indicator Light	7599	T7599	15A-125V @ Receptacle, 20A-125V @ Feed-Through	W, I, A, T
GFCI with LED Indicator Light	7899	T7899	20A-125V @ Receptacle, 20A-125V @ Feed-Through	W, I, A, T

**COMMERCIAL GRADE RECEPTACLES**  
**Straight Blade Receptacles**

Description	Standard Receptacle Catalog Number	TR Receptacle Catalog Number	Rating	TR Color* (Basic Cat. No. denotes Brown)
Duplex Receptacle, Back and Side Wired	BR15	TBR15	15A-125V	W, I, T, GY, E
Duplex Receptacle, Back and Side Wired	BR20	TBR20	20A-125V	W, I, T, GY, E
Duplex Receptacle, Side Wired	CR15	CR15S	15A-125V	W, I, T, GY
Decora Plus Duplex Receptacle, Side Wired	16242	DR15S	15A-125V	W, I, T, GY, E
Decora Plus Duplex Receptacle, Back and Side Wired	16252	TDR15	15A-125V	W, I, GY, E
Decora Plus Duplex Receptacle, Back and Side Wired	16352	TDR20	20A-125V	W, I, T, GY, E
Single Receptacle, Side Wired	5015	T5015	15A-125V	W, I, T, GY, E
Single Receptacle, Side Wired	5801	T5020	20A-125V	W, I, T
Duplex Floor Box Receptacle, 2-Pole, 3-Wire, Self-Grounding with Brass Plate	N/A	25249-TFB	15A-125V	I
Duplex Floor Box Receptacle, 2-Pole, 3-Wire, Self-Grounding with Nickel Plate	N/A	25249-TFN	15A-125V	I

**Weather Resistant Receptacles**

Residential Grade: Duplex Receptacle, 2-Pole, 3-Wire, Self-Grounding	N/A	W5320-T	15A-125V	W, GY
Duplex Receptacle, 2-Pole, 3-Wire, Self-Grounding	WBR15 (Yellow only)	TWR15	15A-125V	W, GY (n/a in Brown)
Duplex Receptacle, 2-Pole, 3-Wire, Self-Grounding	WBR20 (Yellow only)	TWR20	20A-125V	W, GY (n/a in Brown)
Outdoor Grade SmartlockPro GFCI Receptacle, Back and Side Wired, with LED Indicator Light	N/A	W7599-T	15A-125V@ Receptacle, 20A-125V Feed-Through	W, I, E (n/a in Brown)
Outdoor Grade SmartlockPro GFCI Receptacle, Back and Side Wired, with LED Indicator Light	N/A	W7899-T	20A-125V @ Receptacle, 20A-125V Feed-Through	W, E (n/a in Brown)

\* TR Color: Basic Cat. Nos. denote Brown, unless otherwise noted. For color selection, add suffix to catalog number as follows: White (-W), Ivory (-I), Almond (-A), Light Almond (-T), Gray (-GY) and Black (-E).

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**Visit our Website at: [www.leviton.com](http://www.leviton.com)**

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B-1300D/G09-dp



# Sunmodule<sup>®</sup> Plus

## SW 285 MONO (33mm frame)



TUV Power controlled:  
Lowest measuring tolerance in industry



Every component is tested to meet  
3 times IEC requirements



Designed to withstand heavy  
accumulations of snow and ice



Sunmodule Plus:  
Positive performance tolerance



25-year linear performance warranty  
and 10-year product warranty



Glass with anti-reflective coating



### World-class quality

Fully-automated production lines and seamless monitoring of the process and material ensure the quality that the company sets as its benchmark for its sites worldwide.

### SolarWorld Plus-Sorting

Plus-Sorting guarantees highest system efficiency. SolarWorld only delivers modules that have greater than or equal to the nameplate rated power.

### 25-year linear performance guarantee and extension of product warranty to 10 years

SolarWorld guarantees a maximum performance digression of 0.7% p.a. in the course of 25 years, a significant added value compared to the two-phase warranties common in the industry, along with our industry-first 10-year product warranty.\*

\*in accordance with the applicable SolarWorld Limited Warranty at purchase.  
[www.solarworld.com/warranty](http://www.solarworld.com/warranty)



- Qualified, IEC 61215
- Safety tested, IEC 61730
- Blowing sand resistance, IEC 60068-2-68
- Ammonia resistance, IEC 62716
- Salt mist corrosion, IEC 61701
- Periodic inspection



- Periodic inspection
- Power controlled



# Sunmodule<sup>®</sup> Plus

## SW 285 MONO (33mm frame)



### PERFORMANCE UNDER STANDARD TEST CONDITIONS (STC)\*

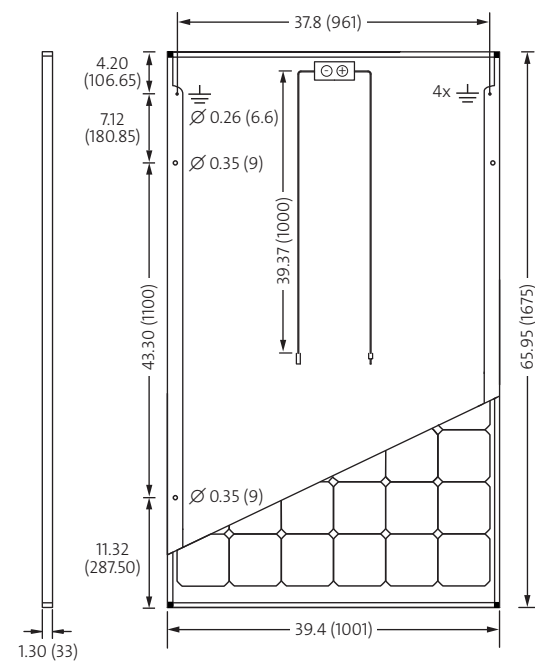
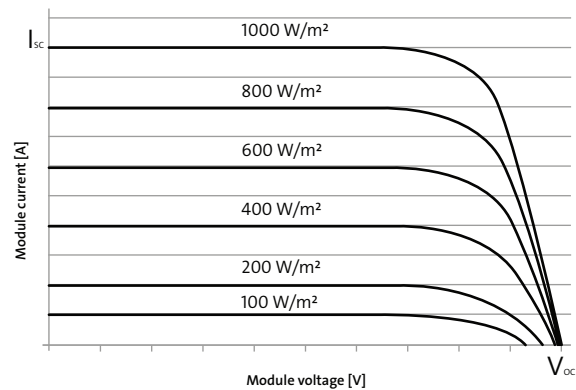
Maximum power	$P_{max}$	285 Wp
Open circuit voltage	$V_{oc}$	39.7 V
Maximum power point voltage	$V_{mpp}$	31.3 V
Short circuit current	$I_{sc}$	9.84 A
Maximum power point current	$I_{mpp}$	9.20 A
Module efficiency	$\eta_m$	17.0 %

\*STC: 1000 W/m<sup>2</sup>, 25°C, AM 1.5

1) Measuring tolerance ( $P_{max}$ ) traceable to TUV Rheinland: +/- 2% (TUV Power Controlled).

### THERMAL CHARACTERISTICS

NOCT	46 °C
TC $I_{sc}$	0.04 %/°C
TC $V_{oc}$	-0.30 %/°C
TC $P_{mpp}$	-0.41 %/°C
Operating temperature	-40°C to 85°C



All units provided are imperial. SI units provided in parentheses.  
SolarWorld AG reserves the right to make specification changes without notice.

### PERFORMANCE AT 800 W/m<sup>2</sup>, NOCT, AM 1.5

Maximum power	$P_{max}$	213.1 Wp
Open circuit voltage	$V_{oc}$	36.4 V
Maximum power point voltage	$V_{mpp}$	28.7 V
Short circuit current	$I_{sc}$	7.96 A
Maximum power point current	$I_{mpp}$	7.43 A

Minor reduction in efficiency under partial load conditions at 25°C: at 200 W/m<sup>2</sup>, 100% (+/-2%) of the STC efficiency (1000 W/m<sup>2</sup>) is achieved.

### COMPONENT MATERIALS

Cells per module	60
Cell type	Mono crystalline
Cell dimensions	6.17 in x 6.17 in (156.75 x 156.75 mm)
Front	Tempered glass (EN 12150)
Frame	Clear anodized aluminum
Weight	39.7 lbs (18.0 kg)

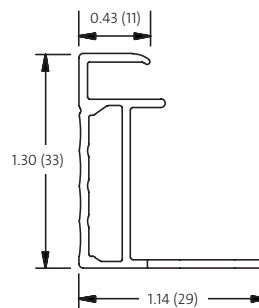
### SYSTEM INTEGRATION PARAMETERS

Maximum system voltage SC II / NEC	1000 V	
Maximum reverse current	25 A	
Number of bypass diodes	3	
Design Loads*	Two rail system	113 psf downward 64 psf upward
Design Loads*	Three rail system	178 psf downward 64 psf upward
Design Loads*	Edge mounting	178 psf downward 41 psf upward

\*Please refer to the Sunmodule installation instructions for the details associated with these load cases.

### ADDITIONAL DATA

Power sorting <sup>1</sup>	-0 Wp / +5 Wp
J-Box	IP65
Module leads	PV wire per UL4703 with H4 connectors
Module type (UL 1703)	1
Glass	Low iron tempered with ARC

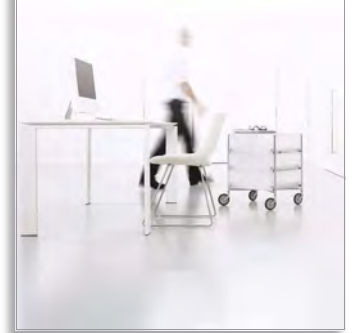


- Compatible with both "Top-Down" and "Bottom" mounting methods
- Grounding Locations:
  - 4 locations along the length of the module in the extended flange.

Philips myLiving  
Suspension light

Cinta  
aluminium  
LED

myLiving



41620/48/48



## Essence of purity

giving light a new experience

A clean Philips Ledino suspension light that hovers majestically in the air. A sweeping band of light, sleek and minimalist, constructed from brushed aluminium with semi-translucent panels for a creamy, diffuse glow.

### Advanced

- Pure natural, dimmable light
- Innovative LED technology with extremely long operating life

### Ease of use

- Maintenance free, no lamp replacement needed
- Integrated driver, directly connectable to main power supply

### Elegant design meets innovative technology

- Warm white light effect

### Sustainable light solutions

- Saves up to 80% energy

**PHILIPS**

Suspension light  
Cinta aluminium, LED

416204848

## Specifications

### Design and finishing

- Material: aluminium
- Color: aluminium

### Extra feature/accessory incl.

- Dimmable
- LED integrated

### Product dimensions & weight

- Height minimum: 1.1 inch
- Height maximum: 138 inch
- Length: 19.7 inch
- Width: 19.7 inch
- Net weight: 6.393 lb

### Technical specifications

- Mains power: 120 V, 60 Hz
- Bulb technology: LED, Safety Extra Low Voltage
- Number of bulbs: 3
- Wattage bulb included: 7.5 W

- Light color: warm white
- Lamp lifetime up to: 20,000 hrs
- Beam angle: 105°
- Fixture dimmable
- LED
- Light source equivalent to traditional bulb of: 34 W

### Service

- Warranty: 3 year(s)

### Packaging dimensions & weight

- Height: 21.2 inch
- Length: 21 inch
- Depth: 2.6 inch
- Weight: 9.480 lb

### Miscellaneous

- Especially designed for: Living- & Bedroom
- Style: Modern
- Type: Suspension light

## Highlights

### Innovative LED technology

Innovative LED technology with extremely long operating life

### Maintenance free

Maintenance free, no lamp replacement needed

### Saves up to 80% energy

The LED lighting technology used in Philips lighting fixtures is highly energy-efficient (7.5 W module produces 350 Lumen). As a result, every lighting fixture conserves energy, helping consumers to save money on their electricity bills and contribute to preserving the environment. For home lighting that's energy-efficient and provides great light in a range of contemporary designs, look for Philips LED products.



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Version: 1.0.1

12 NC: 9150 026 04401  
UPC: 0 46677 79440 8

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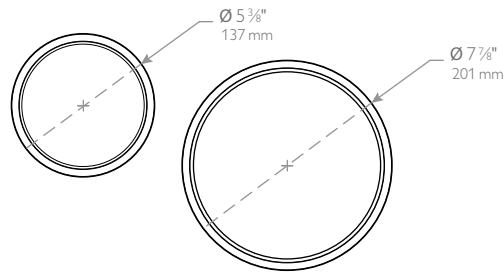
[www.philips.com](http://www.philips.com)

# PHILIPS LIGHTOLIER

## Downlighting

### SlimSurface LED

5" and 7" round aperture  
surface mount downlight



Project: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Cat.No: \_\_\_\_\_  
 Type: \_\_\_\_\_  
 Lamps: \_\_\_\_\_ Qty: \_\_\_\_\_  
 Notes: \_\_\_\_\_

Specifiers will enjoy the appearance and the accolades of selecting a product that meets and exceeds the needs of their customers. Contractors will have a positive experience working with a hassle-free downlight installation.

#### Round 5" aperture

Catalog No.	Size	CRI	CCT	Lms	Listed	Finish (painted)
S5R827K7	5-inch	80	2700K	650	Wet	White
S5R827K7AL	5-inch	80	2700K	650	Wet	Aluminum
S5R830K7	5-inch	80	3000K	650	Wet	White
S5R830K7AL	5-inch	80	3000K	650	Wet	Aluminum
S5R927K7	5-inch	90	2700K	650	Wet	White
S5R927K7AL	5-inch	90	2700K	650	Wet	Aluminum
S5R830K7-D	5-inch	80	3000K	650	Damp	White

#### Round 7" aperture

Catalog No.	Size	CRI	CCT	Lms	Listed	Finish (painted)
S7R827K10	7-inch	80	2700K	1000	Wet	White
S7R827K10AL	7-inch	80	2700K	1000	Wet	Aluminum
S7R830K10	7-inch	80	3000K	1000	Wet	White
S7R830K10AL	7-inch	80	3000K	1000	Wet	Aluminum
S7R927K10	7-inch	90	2700K	1000	Wet	White
S7R927K10AL	7-inch	90	2700K	1000	Wet	Aluminum
S7R830K10-D	7-inch	80	3000K	1000	Damp	White

#### Features

- Flange:** One piece plastic flange. Powder coated non yellowing white or aluminum.
- Lens:** High transmittance lens allowing for smooth, comfortable light pattern.
- Power supply:** Integral class 2 driver. Factory wired electronic LED driver (see Electrical section for specifications)
- LED Strip:** Utilizes Philips LEDs.
- Lifetime:** Expected lifetime 50,000 hours and backed by a 5-year warranty (see Philips.com/warranties for details).

#### Electrical

**Electronic power supply:** RoHS compliant. Class 2 power unit for use in a damp location. Unit tolerates sustained open circuit and short circuit output conditions without damage.

**Dimming:** All luminaires are intended for use with incandescent standard type dimmers (TRIAC). 10%-100% dimming range.

Lumen Output	Max. Input Current	Max. Input Power
630lm	0.08A	9.5W
980lm	0.13A	14.2W

Input Voltage 120V  
 Input Frequency 50/60Hz  
 Power Factor > 0.9  
 Max. THD < 15%  
 Minimum Operating Temperature - 20°C

#### Compatibility

Installs into standard J-box applications:

-  3 1/2" round (plastic)
-  4" square (plastic)  
Not compatible with S5R
-  4" octagonal (metal)
-  4" square (metal)  
Not compatible with S5R

#### Labels

cULus listed for damp locations (walls) and wet locations (ceilings). ENERGY STAR® certified.

Non-conductive fixture for shower light application. This product complies with the requirements of the California Energy Commission regulated under Title 24, and has been listed in the Title 20 database.

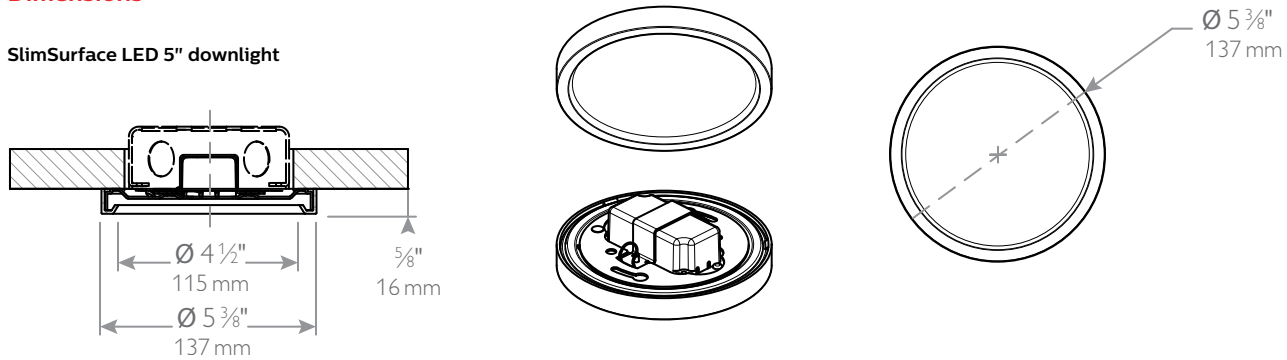


# S5R & S7R SlimSurface LED

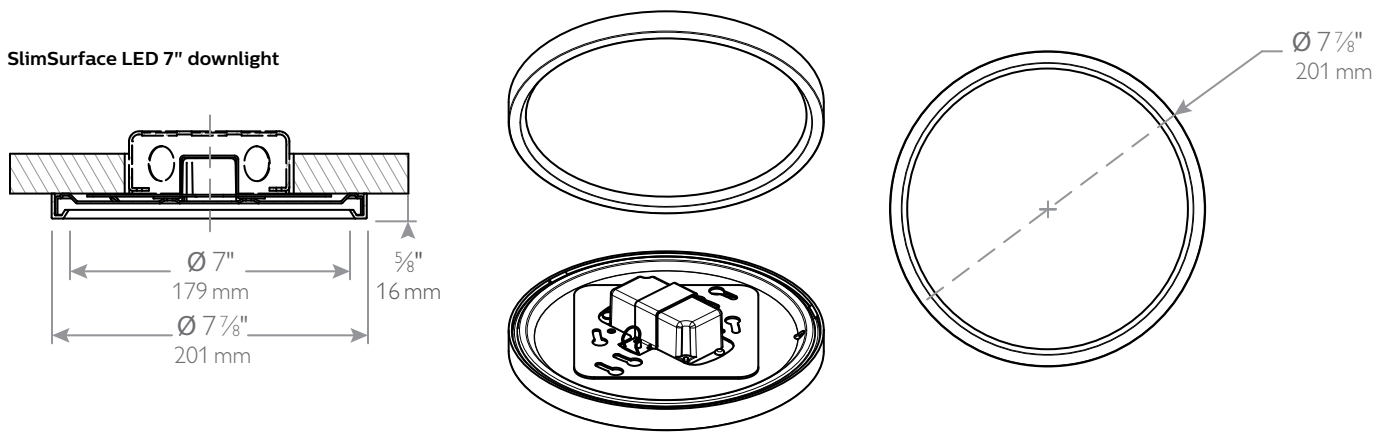
5" and 7" round aperture surface mount downlight

## Dimensions

SlimSurface LED 5" downlight



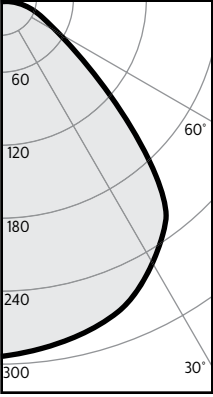
SlimSurface LED 7" downlight



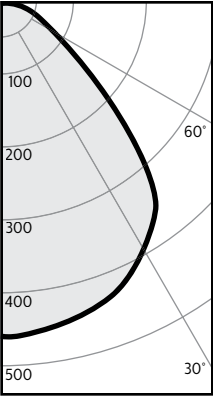
# S5R & S7R SlimSurface LED

5" and 7" round aperture surface mount downlight

## S5R830K7 • 10 W LED, 3000 K, 80 CRI, 650 lm

<b>Candela Curves</b> 	<table border="1"> <thead> <tr> <th>Angle</th> <th>Mean CP</th> <th>Lumens</th> </tr> </thead> <tbody> <tr><td>0</td><td>294</td><td></td></tr> <tr><td>5</td><td>291</td><td>28</td></tr> <tr><td>10</td><td>286</td><td></td></tr> <tr><td>15</td><td>282</td><td>80</td></tr> <tr><td>20</td><td>276</td><td></td></tr> <tr><td>25</td><td>265</td><td>122</td></tr> <tr><td>30</td><td>253</td><td></td></tr> <tr><td>35</td><td>236</td><td>147</td></tr> <tr><td>40</td><td>211</td><td></td></tr> <tr><td>45</td><td>157</td><td>121</td></tr> <tr><td>50</td><td>108</td><td></td></tr> <tr><td>55</td><td>74</td><td>68</td></tr> <tr><td>60</td><td>53</td><td></td></tr> <tr><td>65</td><td>39</td><td>40</td></tr> <tr><td>70</td><td>30</td><td></td></tr> <tr><td>75</td><td>22</td><td>23</td></tr> <tr><td>80</td><td>14</td><td></td></tr> <tr><td>85</td><td>5</td><td>6</td></tr> <tr><td>90</td><td>0</td><td></td></tr> </tbody> </table>	Angle	Mean CP	Lumens	0	294		5	291	28	10	286		15	282	80	20	276		25	265	122	30	253		35	236	147	40	211		45	157	121	50	108		55	74	68	60	53		65	39	40	70	30		75	22	23	80	14		85	5	6	90	0		<b>Single unit data</b> <table border="1"> <thead> <tr> <th>Height to Lighted Plane</th> <th>Initial center beam foot-candles</th> <th>Beam dia. (ft)*</th> </tr> </thead> <tbody> <tr><td>5'</td><td>12</td><td>6.5'</td></tr> <tr><td>6'</td><td>8</td><td>7.8'</td></tr> <tr><td>7'</td><td>6</td><td>9.1'</td></tr> <tr><td>8'</td><td>5</td><td>10.4'</td></tr> <tr><td>9'</td><td>4</td><td>11.7'</td></tr> </tbody> </table> <p>* Beam diameter is where foot-candles drop to 50% of maximum.</p>	Height to Lighted Plane	Initial center beam foot-candles	Beam dia. (ft)*	5'	12	6.5'	6'	8	7.8'	7'	6	9.1'	8'	5	10.4'	9'	4	11.7'	<b>Coefficients of utilization</b> <table border="1"> <thead> <tr> <th rowspan="2">Ceiling</th> <th colspan="4">80%</th> <th colspan="2">70%</th> <th colspan="2">50%</th> <th colspan="2">30%</th> <th>0%</th> </tr> <tr> <th>70</th><th>50</th><th>30</th><th>10</th> <th>50</th><th>10</th> <th>50</th><th>10</th> <th>50</th><th>10</th> <th>0</th> </tr> </thead> <tbody> <tr> <td>Wall</td> <td>70</td><td>50</td><td>30</td><td>10</td> <td>50</td><td>10</td> <td>50</td><td>10</td> <td>50</td><td>10</td> <td>0</td> </tr> </tbody> </table> <p>RCR Zonal cavity method - Effective floor reflectance = 20%</p> <table border="1"> <thead> <tr> <th rowspan="2">Room Cavity Ratio</th> <th colspan="2">0</th> <th colspan="2">1</th> <th colspan="2">2</th> <th colspan="2">3</th> <th colspan="2">4</th> <th colspan="2">5</th> <th colspan="2">6</th> <th colspan="2">7</th> <th colspan="2">8</th> <th colspan="2">9</th> <th colspan="2">10</th> </tr> </thead> <tbody> <tr> <td>0</td><td>119</td><td>119</td><td>119</td><td>119</td><td>116</td><td>116</td><td>111</td><td>111</td><td>106</td><td>106</td><td>100</td><td>106</td><td>106</td><td>100</td><td>96</td><td>92</td><td>87</td><td>80</td><td>76</td><td>66</td><td>58</td></tr> <tr> <td>1</td><td>111</td><td>107</td><td>103</td><td>100</td><td>104</td><td>98</td><td>100</td><td>95</td><td>96</td><td>92</td><td>87</td><td>80</td><td>76</td><td>66</td><td>58</td><td>52</td><td>46</td><td>41</td><td>37</td><td>34</td><td>31</td></tr> <tr> <td>2</td><td>102</td><td>95</td><td>89</td><td>84</td><td>93</td><td>83</td><td>90</td><td>81</td><td>87</td><td>80</td><td>76</td><td>66</td><td>58</td><td>52</td><td>46</td><td>41</td><td>37</td><td>34</td><td>31</td><td>28</td><td>25</td></tr> <tr> <td>3</td><td>94</td><td>85</td><td>78</td><td>72</td><td>84</td><td>72</td><td>81</td><td>71</td><td>78</td><td>69</td><td>66</td><td>64</td><td>54</td><td>52</td><td>46</td><td>41</td><td>37</td><td>34</td><td>31</td><td>28</td><td>25</td></tr> <tr> <td>4</td><td>87</td><td>77</td><td>69</td><td>63</td><td>75</td><td>63</td><td>73</td><td>62</td><td>71</td><td>61</td><td>58</td><td>52</td><td>46</td><td>41</td><td>37</td><td>34</td><td>31</td><td>28</td><td>25</td><td>22</td><td>20</td></tr> <tr> <td>5</td><td>81</td><td>69</td><td>61</td><td>55</td><td>68</td><td>55</td><td>66</td><td>55</td><td>64</td><td>54</td><td>52</td><td>46</td><td>41</td><td>37</td><td>34</td><td>31</td><td>28</td><td>25</td><td>22</td><td>20</td><td>18</td></tr> <tr> <td>6</td><td>75</td><td>63</td><td>55</td><td>49</td><td>62</td><td>49</td><td>61</td><td>49</td><td>59</td><td>48</td><td>46</td><td>41</td><td>37</td><td>34</td><td>31</td><td>28</td><td>25</td><td>22</td><td>20</td><td>18</td><td>16</td></tr> <tr> <td>7</td><td>70</td><td>58</td><td>50</td><td>44</td><td>57</td><td>44</td><td>55</td><td>44</td><td>54</td><td>43</td><td>41</td><td>37</td><td>34</td><td>31</td><td>28</td><td>25</td><td>22</td><td>20</td><td>18</td><td>16</td><td>14</td></tr> <tr> <td>8</td><td>65</td><td>53</td><td>45</td><td>40</td><td>52</td><td>40</td><td>51</td><td>39</td><td>50</td><td>39</td><td>37</td><td>34</td><td>31</td><td>28</td><td>25</td><td>22</td><td>20</td><td>18</td><td>16</td><td>14</td><td>12</td></tr> <tr> <td>9</td><td>61</td><td>49</td><td>41</td><td>36</td><td>48</td><td>36</td><td>47</td><td>36</td><td>46</td><td>36</td><td>34</td><td>31</td><td>28</td><td>25</td><td>22</td><td>20</td><td>18</td><td>16</td><td>14</td><td>12</td><td>10</td></tr> <tr> <td>10</td><td>58</td><td>45</td><td>38</td><td>33</td><td>45</td><td>33</td><td>44</td><td>33</td><td>43</td><td>33</td><td>31</td><td>28</td><td>25</td><td>22</td><td>20</td><td>18</td><td>16</td><td>14</td><td>12</td><td>10</td><td>8</td></tr> </tbody> </table>	Ceiling	80%				70%		50%		30%		0%	70	50	30	10	50	10	50	10	50	10	0	Wall	70	50	30	10	50	10	50	10	50	10	0	Room Cavity Ratio	0		1		2		3		4		5		6		7		8		9		10		0	119	119	119	119	116	116	111	111	106	106	100	106	106	100	96	92	87	80	76	66	58	1	111	107	103	100	104	98	100	95	96	92	87	80	76	66	58	52	46	41	37	34	31	2	102	95	89	84	93	83	90	81	87	80	76	66	58	52	46	41	37	34	31	28	25	3	94	85	78	72	84	72	81	71	78	69	66	64	54	52	46	41	37	34	31	28	25	4	87	77	69	63	75	63	73	62	71	61	58	52	46	41	37	34	31	28	25	22	20	5	81	69	61	55	68	55	66	55	64	54	52	46	41	37	34	31	28	25	22	20	18	6	75	63	55	49	62	49	61	49	59	48	46	41	37	34	31	28	25	22	20	18	16	7	70	58	50	44	57	44	55	44	54	43	41	37	34	31	28	25	22	20	18	16	14	8	65	53	45	40	52	40	51	39	50	39	37	34	31	28	25	22	20	18	16	14	12	9	61	49	41	36	48	36	47	36	46	36	34	31	28	25	22	20	18	16	14	12	10	10	58	45	38	33	45	33	44	33	43	33	31	28	25	22	20	18	16	14	12	10	8
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1. Tested using absolute photometry as specified in LM79: IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
2. Wattage: controlled to within 5%
3. Correlated Color Temperature: within specs as defined in ANSI\_NEMA\_ANSI C78.377-2008: Specifications for the Chromaticity of Solid State Lighting Products.

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Philips Lighting, North America Corporation  
 200 Franklin Square Drive, Somerset, NJ 08873  
 Tel. 855-486-2216

Imported by: Philips Lighting,  
 A division of Philips Electronics Ltd.  
 281 Hillmount Rd, Markham, ON, Canada L6C 2S3  
 Tel. 800-668-9008



# Kidde wireless system

Provide Advanced Fire Protection with the Kidde Wireless System

## Why Wireless?

- When one alarm sounds they all do.
- Ability to interconnect without wires.
- Install in minutes, anywhere in the home! Less cost, and less hassle than re-wiring.

### AC Powered Smoke Alarm

Makes it easy to expand the coverage of a current interconnected system.



#### Wireless AC Powered Smoke Alarm

The Kidde Wireless AC Powered Smoke Alarm makes it easy to expand the coverage of a current interconnected system. Simply replace one interconnected smoke alarm with the Kidde Wireless AC powered alarm. Kidde Wireless Battery Powered Smoke Alarms can be installed in additional rooms that need extra protection. This AC powered alarm bridges a home's current interconnected system to the newly installed alarms, so that when one alarm is triggered, all alarms will sound.

### Battery Powered Smoke Alarm

Enables quick and easy installation of an interconnected smoke alarm system without messy wiring or labor.



#### Wireless Battery Powered Smoke Alarm

The Kidde Wireless Battery Powered Smoke Alarm allows for quick and easy installation an interconnected smoke alarm system without messy wiring or labor. The battery-powered units are linked so that when one alarm is triggered, all alarms will sound. In addition to providing protection to any room of the home, this battery powered alarm also can be placed in a detached workshop or shed and linked into the home's interconnected system.

*Kidde wireless alarms use ionization sensing technology. Ionization sensing alarms may detect invisible fire particles (associated with flaming fires) sooner than photoelectric alarms. Photoelectric sensing alarms may detect visible particles (associated with smoldering fires) sooner than ionization alarms.*

Item	Part Number	Pack Qty	UPC	1 2 of 5	Dimensions w x d x h
<b>Battery Wireless Smoke Alarm</b> RF-SM-DC	0919-9999	3 piece PDQ	0 47871 05557 9	100 47871 05557 6	8.5" x 6.75" x 9.75"
<b>Hardwired AC Wireless Smoke Alarm</b> RF-SM-AC	1279-9999	3 piece PDQ	0 47871 05560 9	100 47871 05560 6	8.5" x 6.75" x 9.75"



# Kidde Wireless System: Architectural, Engineering, and Technical Specifications

## Architectural and Engineering Specifications for Wireless Model RF-SM-AC

The smoke alarm shall be Kidde Model RF-SM-AC or approved equal. It shall be powered by a 120VAC, 60Hz source along with a 9V battery backup. The unit shall incorporate an ionization sensor with nominal sensitivity of 0.60±0.1 percent/Ft. The temperature operation range shall be between 40F (4C) to 100F (38C) and the humidity operating range shall be up to 85% relative humidity.

The smoke alarm can be installed on any standard single gang electrical box, up to a 4" octagon junction box. The electrical connection (to the alarm) shall be made with a plug-in connector.

The smoke alarm shall work interconnected immediately out of the box without any user programming. A maximum of 24 Kidde devices can be interconnected in a multiple station arrangement. The interconnect system must not exceed the NFPA (National Fire Protection Association) limit of 18 initiation devices, of which 12 can be smoke alarms. With 18 initiating devices (smoke, heat, CO, etc.), interconnected, it is still possible to interconnect 6 strobe lights and/or relay modules.

The smoke alarm shall give fire alarm signals priority over all other signals. The smoke alarm shall incorporate a maximum allowable response delay from activation of an initiating device to receipt and alarm/display by the receiver/control unit of 30 seconds. The smoke alarm shall automatically repeat alarm transmission at intervals not exceeding 60 seconds until the initiating device is returned to its non-alarm condition (per NFPA 72, Chapter 6, Section 6.16.3.2).

The smoke alarm shall have remote hush and low battery hush capabilities. The unit shall have alarm memory to indicate which alarm in a system was the initiating alarm (per NFPA 72, Chapter 6, Section 6.16.3.5). The unit shall provide optional tamper resistance that deters removal of the unit from the wall or ceiling.

The alarm shall include a test button that will electronically simulate the presence of smoke and cause the unit to go into alarm. This sequence tests the unit's electronics, battery and horn to ensure proper operation.

The unit shall include a piezoelectric horn that is rated at 85 decibels at 10 feet. The smoke alarm shall produce an audible signal in the form of the "three pulse" temporal pattern. Each ON phase shall last 0.5-second +/-10 percent. After the third of these ON phases, there shall be an OFF phase that lasts 1.5 seconds +/-10 percent. This pattern should repeat continuously without interruption. The unit shall also include a low battery warning utilizing a brief alarm chirp every 30-40 seconds for a minimum of seven (7) days.

The unit shall incorporate one red LED to the alarm's current status and mode of operation. The red LED will flash in conjunction with the alarm beep, and flash during a smoke alarm, a low battery mode and a unit error. The unit shall incorporate one green LED to indicate the alarm's current status and mode of operation. The green LED will indicate one of five (5) conditions:

**Standby Condition** (powered by AC and battery backup)– The LED will be constant on

**Standby Condition** (powered by only battery backup) – The LED will flash approximately every 10 seconds.

**Initiating Alarm Indicator** – The LED will flash every second while sounding an alarm to signify that the alarm sensed a smoke hazard.

**Alarm Memory Condition** – The LED will flash every second signifying that the alarm sensed a smoke hazard. It will continue to flash every second until the test/reset button is pressed, thus resetting the alarm.

**Hush® Mode Condition** – The LED will flash every 2 seconds while the alarm is in Hush® Mode

The unit shall at a minimum meet the requirements of UL217, NFPA72. The State of California Fire Marshall, NFPA 101 (one and two family dwellings) Federal Housing Authority (FHA), Housing and Urban Development (HUD). It shall also include a 10-year manufacturer's limited warranty.

### Technical Specifications:

Power Source: 120VAC; 9V battery backup  
Audio Alarm: 85dB at 10ft  
Temperature Range: 40F (4.4C) to 100F (37.8C)  
Humidity Range: up to 85% relative humidity (RH)  
Sensor: Ionization  
Wiring: Quick connect plug with 8" pigtails  
Size: 5.75" in diameter x 1.25" depth  
Weight: .5lb  
Interconnects: Up to 24 devices (of which 18 can be initiating)

## Architectural and Engineering Specifications for Wireless Model RF-SM-DC

The smoke alarm shall be Kidde Model RF-SM-DC or approved equal. It shall be powered by three (3) AA batteries. The unit shall incorporate an ionization sensor with nominal sensitivity of 0.69±0.19%/ft. The temperature operation range shall be between 40F (4C) to 100F (38C) and the humidity operating range shall be up to 85% relative humidity.

The smoke alarm shall work interconnected immediately out of the box without any user programming. A maximum of 24 Kidde devices can be interconnected in a multiple station arrangement. The interconnect system must not exceed the NFPA (National Fire Protection Association) limit of 18 initiation devices, of which 12 can be smoke alarms. With 18 initiating devices (smoke, heat, CO, etc.), interconnected, it is still possible to interconnect 6 strobe lights and/or relay modules. The smoke alarm shall give fire alarm signals priority over all other signals. The smoke alarm shall incorporate a maximum allowable response delay from activation of an initiating device to receipt and alarm/display by the receiver/control unit of 30 seconds. The smoke alarm shall automatically repeat alarm transmission at intervals not exceeding 60 seconds until the initiating device is returned to its non-alarm condition (per NFPA 72, Chapter 6, Section 6.16.3.2).

The smoke alarm shall have remote hush and low battery hush capabilities. The unit shall have alarm memory to indicate which alarm in a system was the initiating alarm (per NFPA 72, Chapter 6, Section 6.16.3.5). The unit shall provide optional tamper resistance that deters removal of the unit from the wall or ceiling.

The alarm shall include a test button that will electronically simulate the presence of smoke and cause the unit to go into alarm. This sequence tests the unit's electronics, battery and horn to ensure proper operation.

The unit shall include a piezoelectric horn that is rated at 85 decibels at 10 feet. The smoke alarm shall produce an audible signal in the form of the "three pulse" temporal pattern. Each ON phase shall last 0.5-second +/-10 percent. After the third of these ON phases, there shall be an OFF phase that lasts 1.5 seconds +/-10 percent. This pattern should repeat continuously without interruption. The unit shall also include a low battery warning utilizing a brief alarm chirp every 30-40 seconds for a minimum of seven (7) days.

The unit shall incorporate one red LED to indicate the alarm's current status and mode of operation. The red LED will flash in conjunction with the alarm beep, and flash during a smoke alarm, a low battery mode and a unit error.

The unit shall incorporate one green LED to indicate the alarm's current status and mode of operation. The green LED will indicate one of four (4) conditions:

**Standby Condition** – The LED will flash approximately every 10 seconds.

**Initiating Alarm Indicator** – The LED will flash every second while sounding an alarm to signify that the alarm sensed a smoke hazard.

**Alarm Memory Condition** – The LED will flash every second signifying that the alarm sensed a smoke hazard. It will continue to flash every second until the test/reset button is pressed, thus resetting the alarm.

**Hush® Mode Condition** – The LED will flash every 2 seconds while the alarm is in Hush® Mode

The unit shall at a minimum meet the requirements of UL217, NFPA72 (chapter 11 2002 edition), The State of California Fire Marshall, NFPA 101 (one and two family dwellings) Federal Housing Authority (FHA), Housing and Urban Development (HUD). It shall also include a 10-year manufacturer's limited warranty.

### Technical Specifications:

Power Source: 3 AA batteries  
Audio Alarm: 85dB at 10ft  
Temperature Range: 40F (4.4C) to 100F (37.8C)  
Humidity Range: up to 85% relative humidity (RH)  
Sensor: Ionization  
Wiring: None  
Size: 5.75" in diameter x 1.25" depth  
Weight: .5lb  
Interconnects: Up to 24 devices ( of which 18 can be initiating)

KL-1279-9999DS 10K HP 1008



1016 Corporate Park Drive  
Mebane, NC 27302

# SolaDeck

FLASHED PV ROOF-MOUNT COMBINER/ENCLOSURE

## Basic Features

- Stamped Seamless Construction
- 18 Gauge Galvanized Steel
- Powder Coated Surfaces
- Flashes into the roof deck
- 3 Roof deck knockouts .5", .75", 1"
- 5 Centering dimples for entry/exit fittings or conduit
- 2 Position Ground lug installed
- Mounting Hardware Included



SolaDeck Model SD 0783



## SolaDeck UL50 Type 3R Enclosures

Available Models:

Model SD 0783 - (3" fixed Din Rail)

Model SD 0786 - (6" slotted Din Rail)



## SolaDeck UL 1741 Combiner/Enclosures

Models SD 0783-41 and SD 0786-41 are labeled and ETL listed UL STD 1741 according to the UL STD 1741 for photovoltaic combiner enclosures.

Max Rated - 600VDC, 120AMPS

**Model SD 0783-41** 3" Fixed Din Rail fastened using Norlock System

### \*\*Typical System Configuration

- 4- Din Rail Mounted Fuse Holders 600VDC 30 AMP
- 1- Power Distribution Block 600VDC 175AMP
- 1- Bus Bar with UL lug

**Model SD 0786-41** 6" Slotted Din Rail fastened using steel studs

### \*\*Typical System Configuration

- 4- Din Rail Mounted Fuse Holders 600VDC 30 AMP
- 4- Din Rail Mounted Terminal Blocks
- Bus Bars with UL lug

\*\*Fuse holders and terminal blocks added in the field must be UL listed or recognized and meet 600 VDC 30 AMP 110C for fuse holders, 600V 50 AMP 90C for rail mounted terminal blocks and 600 V 175 AMP 90C for Power Distribution Blocks. Use Copper Wire Conductors.



Cover is trimmed to allow conduit or fittings, base is center dimpled for fitting locations.



Model SD 0783-41, wired with Din Rail mounted fuse holders, bus bar and power distribution block.



Model SD 0786-41, wired with Din Rail mounted fuse holders, terminal blocks and bus bars.



**SHERWIN  
WILLIAMS.**

101.30a

**SUPERPAINT®**  
Interior Latex  
Semi-Gloss  
A88-1100 Series

As of 12/01/2012, Complies with:			
OTC	Yes	LEED® 09 CI	Yes
SCAQMD	Yes	LEED® 09 NC	Yes
CARB	Yes	LEED® 09 CS	Yes
CARB SCM 2007	Yes	LEED® H	Yes
MPI #	43, 140	NGBS	Yes

**CHARACTERISTICS**

**SuperPaint Interior Latex Semi-Gloss** is for use on previously painted, bare or primed wallboard and wood, and primed plaster, masonry, and metal. SuperPaint provides one coat hiding over any color on smooth surfaces and will provide a durable, scrubbable, and washable finish.

**Color:** Most colors  
To optimize hide and color development, always use the recommended P-Shadow primer

**Coverage:** 350 - 400 sq ft/gal  
@ 4 mils wet; 1.6 mils dry

**Drying Time, @ 77°F, 50% RH:**  
Touch: 1 hour  
Recoat: 4 hours

Drying and recoat times are temperature, humidity, and film thickness dependent

**Flash Point:** N/A

**Finish:** 25-35 units @ 60°

**Tinting with CCE:**

Base	oz/gal	Strength
Extra White	0-6	100%
Deep Base	4-12	100%
High Refl White	0-5	125%

**Vehicle Type:** Vinyl Acrylic

**A88W01151**

**VOC (less exempt solvents):**  
<50 g/L; 0.42 lb/gal  
As per 40 CFR 59.406 and SOR/2009-264, s.12

**Volume Solids:** 39 ± 2%

**Weight Solids:** 52 ± 2%

**Weight per Gallon:** 10.6 lb

**SPECIFICATIONS**

**SuperPaint Interior Latex can be used directly over existing coatings, or bare drywall, plaster (cured with a pH of less than 9), masonry (cured with a pH of less than 9) and non-bleeding wood.**

**Drywall**

Self-prime using 2 cts. of SuperPaint Interior Latex  
or

- 1 ct. Premium Wall & Wood Primer
- 2 cts. SuperPaint Interior Latex

**Masonry / Block**

(can be filled to provide a smooth surface or primed if it is a high pH substrate)

- 1 ct. Loxon Block Surfacer
- or
- 1 ct. Loxon Concrete & Masonry Primer
- 2 cts. SuperPaint Interior Latex

**Plaster**

Self-prime using 2 cts. of SuperPaint Interior Latex  
or

- 1 ct. Premium Wall & Wood Primer
- 2 cts. SuperPaint Interior Latex

**Wood**

Self-prime using 2 cts. of SuperPaint Interior Latex  
or

- 1 ct. Premium Wall & Wood Primer
  - 2 cts. SuperPaint Interior Latex
- If the wood has bleeding (such as tannin or knot-holes), prime with Multi-Surface Primer.

Other primers may be appropriate.

When repainting involves a drastic color change, a coat of primer will improve the hiding performance of the topcoat color.

**SURFACE PREPARATION**

**WARNING!** Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

Remove all surface contamination by washing with an appropriate cleaner, rinse thoroughly and allow to dry. Existing peeled or checked paint should be scraped and sanded to a sound surface. Glossy surfaces should be sanded dull. Stains from water, smoke, ink, pencil, grease, etc. should be sealed with the appropriate primer/sealer.

**Drywall**

Fill cracks and holes with patching paste/spackle and sand smooth. Joint compounds must be cured and sanded smooth. Remove all sanding dust.

**Masonry, Concrete, Cement, Block**

All new surfaces must be cured according to the supplier's recommendations—usually about 30 days. Remove all form release and curing agents. Rough surfaces can be filled to provide a smooth surface. If painting cannot wait 30 days, allow the surface to cure 7 days and prime the surface with Loxon Concrete & Masonry Primer.



**SHERWIN  
WILLIAMS.**

101.30a

# SUPERPAINT®

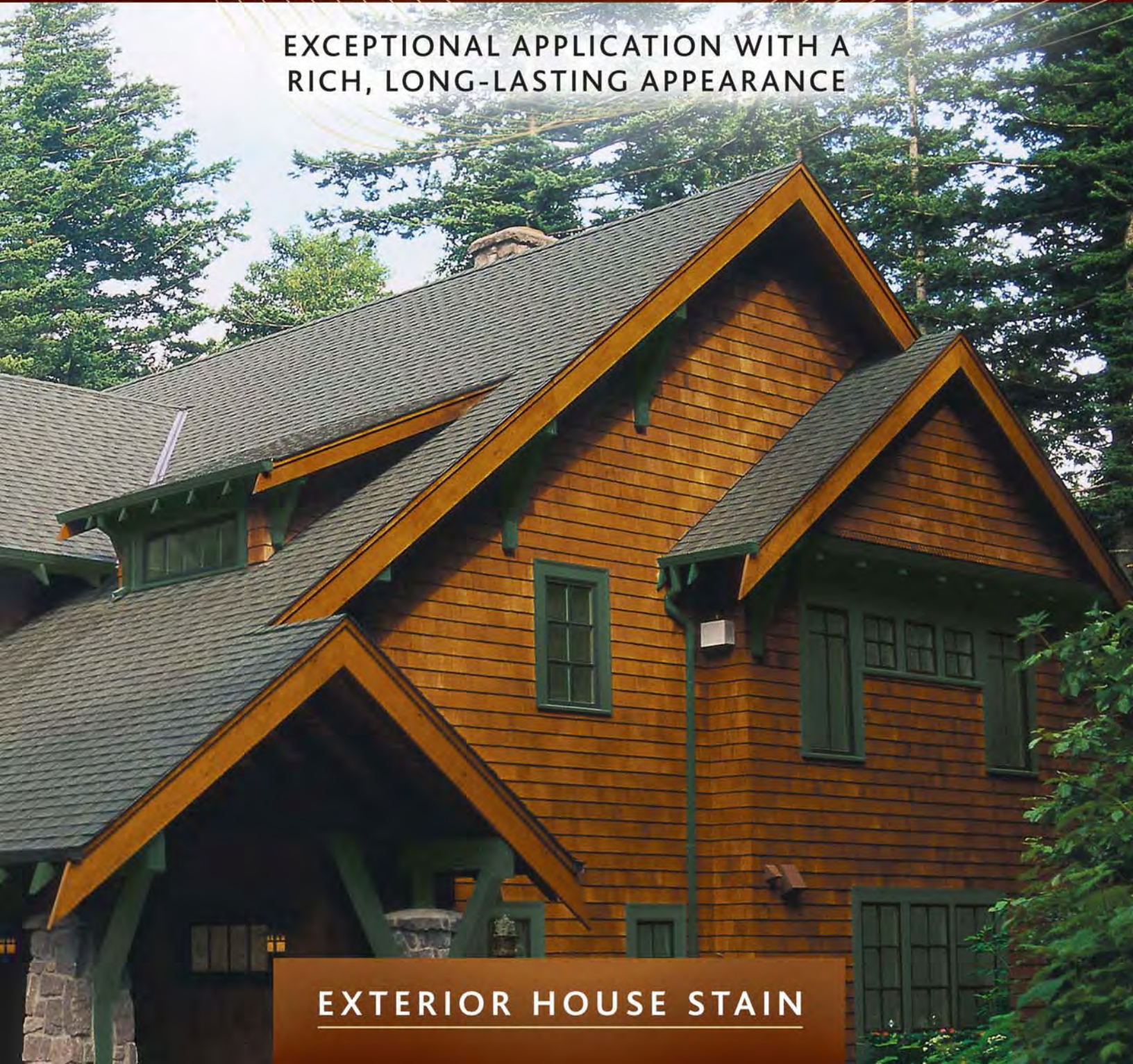
## Interior Latex Semi-Gloss A88-1100 Series

<u><b>SURFACE PREPARATION</b></u>	<u><b>APPLICATION</b></u>	<u><b>CAUTIONS</b></u>
<p><b>Plaster</b> Bare plaster must be cured and hard. Textured, soft, porous, or powdery plaster should be treated with a solution of 1 pint household vinegar to 1 gallon of water. Repeat until the surface is hard, rinse with clear water and allow to dry.</p> <p><b>Wood</b> Sand any exposed wood to a fresh surface. Patch all holes and imperfections with a wood filler or putty and sand smooth.</p> <p><b>Mildew</b> Remove before painting by washing with a solution of 1 part liquid bleach and 3 parts water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with water and allow the surface to dry before painting. Wear protective eyewear, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.</p> <p><b>Caulking</b> Gaps between walls, ceilings, crown moldings, and other interior trim can be filled with the appropriate caulk after priming the surface.</p>	<p>Apply at temperatures above 50°F. No reduction needed.</p> <p><b>Brush</b> Use a nylon/polyester brush.</p> <p><b>Roller</b> Use a 1/4" - 3/4" nap synthetic cover.</p> <p><b>Spray—Airless</b> Pressure..... 2000 psi Tip..... .017"-.021"</p> <p><u><b>CLEANUP INFORMATION</b></u></p> <p>Clean spills, spatters, hands and tools immediately after use with soap and warm water. After cleaning, flush spray equipment with mineral spirits to prevent rusting of the equipment. Follow manufacturer's safety recommendations when using mineral spirits.</p>	<p>For interior use only. Protect from freezing. Non-photochemically reactive.</p> <p><b>LABEL CAUTIONS</b> CAUTION contains CRYSTALLINE SILICA. Use only with adequate ventilation. To avoid overexposure, open windows and doors or use other means to ensure fresh air entry during application and drying. If you experience eye watering, headaches, or dizziness, increase fresh air, or wear respiratory protection (NIOSH approved) or leave the area. Adequate ventilation required when sanding or abrading the dried film. If adequate ventilation cannot be provided wear an approved particulate respirator (NIOSH approved). Follow respirator manufacturer's directions for respirator use. Avoid contact with eyes and skin. Wash hands after using. Keep container closed when not in use. Do not transfer contents to other containers for storage. <b>FIRST AID:</b> In case of eye contact, flush thoroughly with large amounts of water. Get medical attention if irritation persists. If swallowed, call Poison Control Center, hospital emergency room, or physician immediately. <b>DELAYED EFFECTS FROM LONG TERM OVEREXPOSURE.</b> Abrading or sanding of the dry film may release crystalline silica which has been shown to cause lung damage and cancer under long term exposure. <b>WARNING:</b> This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. <b>DO NOT TAKE INTERNALLY. KEEP OUT OF THE REACH OF CHILDREN.</b></p> <p>HOTW 03/25/2013 A88W01151 09 45</p> <p>The information and recommendations set forth in this Product Data Sheet are based upon tests conducted by or on behalf of The Sherwin-Williams Company. Such information and recommendations set forth herein are subject to change and pertain to the product offered at the time of publication. Consult your Sherwin-Williams representative to obtain the most recent Product Data Sheet.</p>



# WoodScapes®

EXCEPTIONAL APPLICATION WITH A  
RICH, LONG-LASTING APPEARANCE



EXTERIOR HOUSE STAIN



## BREAKTHROUGH STAIN TECHNOLOGY

WoodScapes® is warranted for twice as long as you would expect a traditional stain to last. And with its fast application and brush load, efficiency and productivity are optimized. The thick formula ensures a uniform finish with no lap marks and great coverage. WoodScapes is self-priming with easy water cleanup, saving time and money.



The acrylic solid color minimizes the spotty appearance and discoloration problems caused by knots and cedar bleeding, so you can minimize callbacks. When the job calls for a rich, beautiful appearance, top-quality performance, and time and material savings, WoodScapes Exterior House Stain is the ideal choice of professionals.

### WOODSCAPES KEY BENEFITS

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Enhances appearance and texture for great curb appeal.</li> </ul>           | <ul style="list-style-type: none"> <li>• Excellent color retention and mildew resistance.</li> </ul>              |
| <ul style="list-style-type: none"> <li>• Penetrates for exceptional protection and resistance to peeling.</li> </ul> | <ul style="list-style-type: none"> <li>• Exceptional prevention of tannin stains in cedar and redwood.</li> </ul> |
| <ul style="list-style-type: none"> <li>• Thick formula for a uniform finish with great coverage.</li> </ul>          | <ul style="list-style-type: none"> <li>• Low temperature application down to 35°F.</li> </ul>                     |



Leading Brand Oil Stain    WoodScapes®  
"after 5 years of exposure"

**Acrylic Solid Color is Warranted Against Fading and Discoloration for 8 Years and the Polyurethane Semi-Transparent for 5 Years\***

\*See product labels for complete warranty details.



Leading Brand Oil Stain    WoodScapes®  
"our thicker formula won't drip or run"

**WOODSCAPES® IS BROUGHT TO YOU BY A NAME YOU KNOW AND TRUST.**

For more than 145 years, Sherwin-Williams has provided contractors, builders, property managers, architects and designers with the trusted products they need to build their business and satisfy customers. WoodScapes is just one more way we bring you industry-leading paint technology – innovation you can pass on to your customers.

Plus, with more than 3,500 stores and 1,800 sales representatives across North America, personal service and expert advice is always available near jobsites. Find out more about WoodScapes Exterior House Stain at your nearest Sherwin-Williams store or to have a sales representative contact you, call **800-524-5979**.

