



GRoW Buffalo
University at Buffalo, The State University of New York

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U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2015
AS BUILT PROJECT MANUAL
8.17.2015





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Summary of Changes

Rules Compliance Checklist

The following rules have new compliance documents:

- Rule 4-5, Generators
- Rule 9-2, Team Provided Liquids
- Rule 9-4, Rainwater Collection
- Rule 9-8, Water Delivery,
- Rule 9-9, Water Removal

Quantity Takeoff

Interconnection Application Form

Number of panels, inverter model number

Specifications, DD Set

The following sections have had content altered:

- 05 12 00 Structural Steel Framing
- 06 12 00 Structural Insulated Panels
- 07 21 00 Thermal insulation
- 08 41 00 NanaWall® SL60, Thermally Broken Aluminum Framed Folding System

The following sections have been removed:

- 06 11 00 Wood Framing
- 06 20 13 Exterior Finish Carpentry
- 06 20 23 Interior Finish Carpentry
- 08 52 13 Aluminum-Clad Wood Windows

The following sections have been added:

- 06 10 00 Rough Carpentry
- 06 20 00 Finish Carpentry
- 08 80 00 Glazing
- 08 51 13 Steel Windows
- 26 50 00 Lighting

Specifications, CD Set

The following sections have had content altered:

- 00 01 15 List of Drawing Sheets
- 05 12 00 Structural Steel Framing
- 06 10 00 Rough Carpentry
- 06 15 33 Wood Deck
- 06 12 00 Structural Insulated Panels
- 06 20 00 Finish Carpentry
- 07 21 00 Thermal Insulation



07 54 23 Thermoplastic Polyolefin (TPO) Roofing
08 41 00 Folding Glass Wall System
08 70 00 Hardware
23 37 13 Diffusers, Registers and Grilles
26 50 00 Lighting

The following sections have been added:

06 41 13 Wood-Veneer-Faced Architectural Cabinets
06 81 00 Composite Railings
08 70 00 Hardware
22 13 63 Facility Grey Water Tank
22 15 53 Facility Septic Tank
23 57 19 Liquid-to-Liquid Heat Exchangers

Specifications, CD Set (Resubmission)

The following sections have been removed:

08 84 00 Plastic Glazing

The following sections have had content altered:

06 20 00 Finish Carpentry
07 54 23 Thermoplastic Polyolefin (TPO) Roofing
07 62 00 Sheet Metal Flashing and Trim
08 41 00 Folding Glass Wall System
08 51 23 Steel Windows
08 80 00 Glazing
09 64 00 Wood Flooring
11 31 00 Residential Appliances
13 34 13.16 Growlarium
22 13 53 Facility Septic Tank
26 05 26 Grounding and Bonding For Electrical Systems
26 05 33 Raceway and Boxes for Electrical Systems
32 93 00 Plants

The following sections have been added:

08 35 13 Mechanical Room Door

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 drawings
Rule 4-2	Construction Equipment	Specifications for heavy machinery	n/a
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	C-101, C-301, C-302, S-101
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	C-101
Rule 4-5	Generators	Specifications for generators (including sound rating)	41 65 16
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	H-101, P-101
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	H-001
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	Manual Pg. 14
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-506
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	A-101, G-201, G-202
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	n/a
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that will be stamped by the qualified, licensed design professional in the stamped structural submission; the stamped submission shall consist entirely of sheets that also appear in the drawings and project manual	
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	n/a

Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-103
Rule 7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	L-101
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	n/a
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	23 31 00 26 31 00
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	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	Manual Pg. 11
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	A-111, A-114 M-401 E-101, E-102, E-201
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	23 31 00 26 31 00
Rule 8-5	Village Grid	One-line electrical diagram	E-601
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-603
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	A-101, C-101, C-103
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-201
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	H-101
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. PDT or between 8 a.m. and 4 p.m. solar time on October 1	G-601
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	23 57 19

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	L-102
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-901
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	22 12 19
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	O-
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	22 13 53
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-103

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 JOB GROW SOLAR DECATHLON
 SUBJECT STRUCTURAL CALCULATIONS
 CALCULATED BY NJP DATE 7/7/2014
 CHECKED BY _____ DATE _____
 SHEET NO 2 OF 17
II). B) LIVE LOADS:
 $S_D = 0.98$

- $P_s = 2 K_z I R_{TS} \frac{C_e}{R_{TS}}$ $\frac{C_e}{R_{TS}} = 1.21$ $12.8 \times 1.21 = 15.48$ $I = 1.0, K_z = 1.0, \text{EXP. "C"}, h = 75'$
 1) WIND: $S \leq \text{MPL}$; EXPOSURE CAT. "C". $N_{MS} = 90 \text{ MPL: } 110 \times 7, 62, 120$
 2) SEISMIC: $VZC \cdot SBC \cdot D_2$: $ZIP \text{ CODE } 92618 \quad S_s = 1.47; S_1 = 0.52; F_a = 1.0; F_v = 1.3$
 3) INTERIOR FLOORS: 50 PSF . $SM_1 = F_v S_1 = 1.3(0.52) = 0.68$
 4) ROOF: 20 PSF . $SD_1 = \frac{2}{3} SM_1 = 0.45$
 5) SNOW: N_{MS} . GROUND SNOW LOAD: 50 PSF . $I_s = 1.0 \quad C_e = 1.0 \quad C_g = 1.0$
 $P_g = 0.7 C_e C_g I_s S_g$; C_e - PARTIALLY EXPOSED TOWER CATEGORY "C". $\therefore P_g = 35 \text{ PSF}$.

C) LOAD COMBINATIONS: ASCE 7

ALLOWABLE STRESS DESIGN: § 2.4.1.

- | | |
|-----------------------------------------------------|---------------------------------|
| 1.) D + L | D = DEAD LOAD |
| 2.) D + L _r | L = LIVE LOAD |
| 3.) D + S | L _r = LOOP LIVE LOAD |
| 4.) D + 0.75 L + 0.75 L _r | S = SNOW LOAD |
| 5.) D + 0.75 L + 0.75 S | W = WIND LOAD |
| 6.) D + W | E = EARTHQUAKE LOAD |
| 7.) D + 0.7 E | |
| 8.) D + 0.75 W + 0.75 L + 0.75 L _r | |
| 9.) D + 0.75 (0.7 E) + 0.75 L + 0.75 L _r | |
| 10.) D + 0.75 W + 0.75 L + 0.75 S | |
| 11.) D + 0.75 (0.7 E) + 0.75 L + 0.75 S | |
| 12.) 0.6 D + W | |
| 13.) 0.6 D + 0.7 E | |

D) SEISMIC LADING DETAILS:

MOMENT RESISTIVE FRAME SYSTEM: 4 - ORDINARY STEEL MOMENT FRAME.

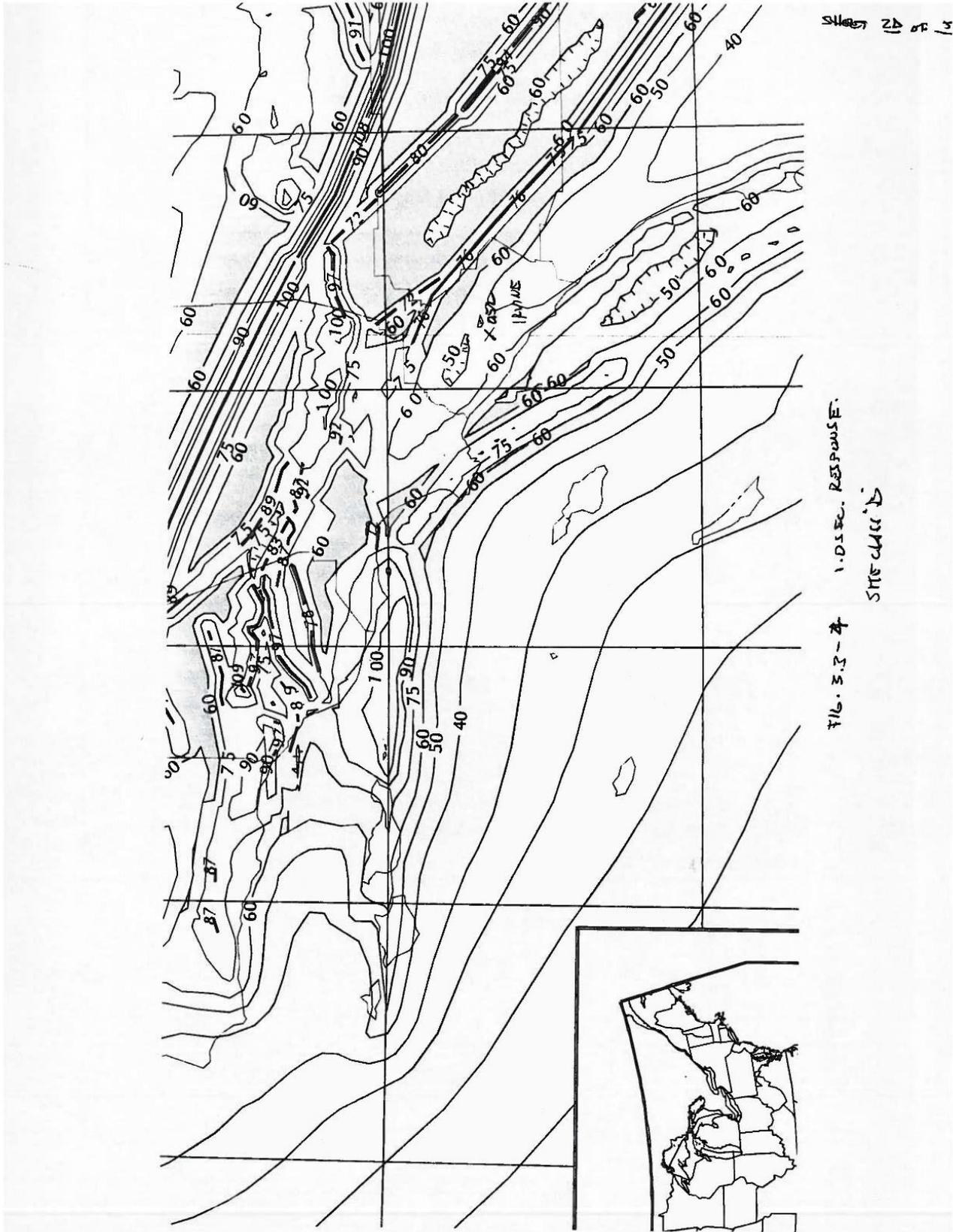
 RESPONSE MODIFICATION COEFFICIENT: $R = 3.5$

 SYSTEM OVERSTRENGTH FACTOR: $\beta_o = 3$

 DEFLECTION AMPLIFICATION FACTOR: $C_d = 3$

SEISMIC CATEGORY "C" - NO LIMIT ON BUILDING HEIGHT.

- $S_{D1} = 0.98$ \therefore SEISMIC DESIGN CATEGORY D_2 (TABLE R301.2.2.1.1)
- SECTION R301.2.2 STATES D_2 SHALL BE CONSTRUCTED IN ACCORDANCE WITH § R301.2.2.4.
- SECTION R301.2.2.4 STATES D_2 SHALL CONFORM TO SBC "C". (SEE ATTACHED)



3. For periods greater than T_S , and less than or equal to T_L , the design spectral response acceleration, S_a , shall be taken as given by Eq. 11.4-6:

$$S_a = \frac{S_{D1}}{T} \quad (11.4-6)$$

4. For periods greater than T_L , S_a shall be taken as given by Eq. 11.4-7:

$$S_a = \frac{S_{D1}T_L}{T^2} \quad (11.4-7)$$

where

S_{DS} = the design spectral response acceleration parameter at short periods

S_{D1} = the design spectral response acceleration parameter at 1-s period

T = the fundamental period of the structure, s

$$T_0 = 0.2 \frac{S_{D1}}{S_{DS}}$$

$$T_S = \frac{S_{D1}}{S_{DS}} \text{ and}$$

T_L = long-period transition period (s) shown in Fig. 22-15 (Conterminous United States), Fig. 22-16 (Region 1), Fig. 22-17 (Alaska), Fig. 22-18 (Hawaii), Fig. 22-19 (Puerto Rico, Culebra, Vieques, St. Thomas, St. John, and St. Croix), and Fig. 22-20 (Guam and Tutuila).

11.4.6 MCE Response Spectrum. Where a MCE response spectrum is required, it shall be determined by multiplying the design response spectrum by 1.5.

11.4.7 Site-Specific Ground Motion Procedures. The site-specific ground motion procedures set forth in Chapter 21 are permitted to be used to determine ground motions for any structure. A site response analysis shall be performed in accordance with Section 21.1 for structures on Site Class F sites, unless the exception to Section 20.3.1 is applicable. For seismically isolated structures and for structures with damping systems on sites with S_1 greater than or equal to 0.6, a ground motion hazard analysis shall be performed in accordance with Section 21.2.

11.5 IMPORTANCE FACTOR AND OCCUPANCY CATEGORY

11.5.1 Importance Factor. An importance factor, I , shall be assigned to each structure in accordance with Table 11.5-1 based on the Occupancy Category from Table 1-1.

11.5.2 Protected Access for Occupancy Category IV. Where operational access to an Occupancy Category IV structure is required through an adjacent structure, the adjacent structure shall conform to the requirements for Occupancy Category IV structures. Where operational access is less than 10 ft from an interior lot line or another structure on the same lot, protection from potential falling debris from adjacent structures shall be provided by the owner of the Occupancy Category IV structure.

TABLE 11.5-1 IMPORTANCE FACTORS

Occupancy Category	I
I or II	1.0
III	1.25
IV	1.5

TABLE 11.6-1 SEISMIC DESIGN CATEGORY BASED ON SHORT PERIOD RESPONSE ACCELERATION PARAMETER

Value of S_{DS}	Occupancy Category		
	I or II	III	IV
$S_{DS} < 0.167$	A	A	A
$0.167 \leq S_{DS} < 0.33$	B	B	C
$0.33 \leq S_{DS} < 0.50$	C	C	D
$0.50 \leq S_{DS}$	D	D	D

11.6 SEISMIC DESIGN CATEGORY

Structures shall be assigned a Seismic Design Category in accordance with Section 11.6.1.1.

Occupancy Category I, II, or III structures located where the mapped spectral response acceleration parameter at 1-s period, S_1 , is greater than or equal to 0.75 shall be assigned to Seismic Design Category E. Occupancy Category IV structures located where the mapped spectral response acceleration parameter at 1-s period, S_1 , is greater than or equal to 0.75 shall be assigned to Seismic Design Category F. All other structures shall be assigned to a Seismic Design Category based on their Occupancy Category and the design spectral response acceleration parameters, S_{DS} and S_{D1} , determined in accordance with Section 11.4.4. Each building and structure shall be assigned to the more severe Seismic Design Category in accordance with Table 11.6-1 or 11.6-2, irrespective of the fundamental period of vibration of the structure, T .

Where S_1 is less than 0.75, the Seismic Design Category is permitted to be determined from Table 11.6-1 alone where all of the following apply:

- In each of the two orthogonal directions, the approximate fundamental period of the structure, T_a , determined in accordance with Section 12.8.2.1 is less than $0.8T_s$, where T_s is determined in accordance with Section 11.4.5.
- In each of two orthogonal directions, the fundamental period of the structure used to calculate the story drift is less than T_s .
- Eq. 12.8-2 is used to determine the seismic response coefficient C_s .
- The diaphragms are rigid as defined in Section 12.3.1 or for diaphragms that are flexible, the distance between vertical elements of the seismic force-resisting system does not exceed 40 ft.

Where the alternate simplified design procedure of Section 12.14 is used, the Seismic Design Category is permitted to be determined from Table 11.6-1 alone, using the value of S_{DS} determined in Section 12.14.8.1.

11.7 DESIGN REQUIREMENTS FOR SEISMIC DESIGN CATEGORY A

11.7.1 Applicability of Seismic Requirements for Seismic Design Category A Structures. Structures assigned to Seismic Design Category A need only comply with the requirements of

TABLE 11.6-2 SEISMIC DESIGN CATEGORY BASED ON 1-S PERIOD RESPONSE ACCELERATION PARAMETER

Value of S_{D1}	OCCUPANCY CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067$	A	A	A
$0.067 \leq S_{D1} < 0.133$	B	B	C
$0.133 \leq S_{D1} < 0.20$	C	C	D
$0.20 \leq S_{D1}$	D	D	D

Poloo. 3B of 17

conform to the requirements of Section 12.5.2 for Seismic Design Category B and the requirements of this section. Structures that have horizontal structural irregularity Type 5 in Table 12.3-1 shall use one of the following procedures:

- a. **Orthogonal Combination Procedure.** The structure shall be analyzed using the equivalent lateral force analysis procedure of Section 12.8, the modal response spectrum analysis procedure of Section 12.9, or the linear response history procedure of Section 16.1, as permitted under Section 12.6, with the loading applied independently in any two orthogonal directions and the most critical load effect due to direction of application of seismic forces on the structure is permitted to be assumed to be satisfied if components and their foundations are designed for the following combination of prescribed loads: 100 percent of the forces for one direction plus 30 percent of the forces for the perpendicular direction; the combination requiring the maximum component strength shall be used.
- b. **Simultaneous Application of Orthogonal Ground Motion.** The structure shall be analyzed using the linear response history procedure of Section 16.1 or the nonlinear response history procedure of Section 16.2, as permitted by Section 12.6, with orthogonal pairs of ground motion acceleration histories applied simultaneously.

12.5.4 Seismic Design Categories D through F. Structures assigned to Seismic Design Category D, E, or F shall, as a minimum, conform to the requirements of Section 12.5.3. In addition, any column or wall that forms part of two or more intersecting seismic force-resisting systems and is subjected to axial load due to seismic forces acting along either principal plan axis equaling or exceeding 20 percent of the axial design strength of the column or wall shall be designed for the most critical load effect due to application of seismic forces in any direction. Either of the procedures of Section 12.5.3 a or b are permitted to be used to satisfy this requirement. Except as required by Section 12.7.3, 2-D analyses are permitted for structures with flexible diaphragms.

12.6 ANALYSIS PROCEDURE SELECTION

The structural analysis required by Chapter 12 shall consist of one of the types permitted in Table 12.6-1, based on the structure's seismic design category, structural system, dynamic properties, and regularity, or with the approval of the authority having jurisdiction, an alternative generally accepted procedure is permitted to be used. The analysis procedure selected shall be completed in accordance with the requirements of the corresponding section referenced in Table 12.6-1.

12.7 MODELING CRITERIA

12.7.1 Foundation Modeling. For purposes of determining seismic loads, it is permitted to consider the structure to be fixed at the base. Alternatively, where foundation flexibility is considered, it shall be in accordance with Section 12.13.3 or Chapter 19.

12.7.2 Effective Seismic Weight. The effective seismic weight, W , of a structure shall include the total dead load and other loads listed below:

1. In areas used for storage, a minimum of 25 percent of the floor live load (floor live load in public garages and open parking structures need not be included).
2. Where provision for partitions is required by Section 4.2.2 in the floor load design, the actual partition weight or a

TABLE 12.6-1 PERMITTED ANALYTICAL PROCEDURES

Seismic Design Category	Structural Characteristics	Equivalent Lateral Force Analysis Section 12.8	Modal Response Spectrum Analysis Section 12.9	Seismic Response History Procedures Chapter 16
B, C	Occupancy Category I or II buildings of light-framed construction not exceeding 3 stories in height	P	P	P
	Other Occupancy Category I or II buildings not exceeding 2 stories in height	P	P	P
	All other structures	P	P	P
D, E, F	Occupancy Category I or II buildings of light-framed construction not exceeding 3 stories in height	P	P	P
	Other Occupancy Category I or II buildings not exceeding 2 stories in height	P	P	P
	Regular structures with $T < 3.5T$; and all structures of light frame construction	P	P	P
	Irregular structures with $T < 3.5T$; and having only horizontal irregularities Type 2, 3, 4, or 5 of Table 12.2-1 or vertical irregularities Type 4, 5a, or 5b of Table 12.3-1	P	P	P
	All other structures	NP	P	P

NOTE: P: Permitted; NP: Not Permitted

minimum weight of 10 psf (0.48 kN/m²) of floor area, whichever is greater.

3. Total operating weight of permanent equipment.
4. Where the flat roof snow load, P_f , exceeds 30 psf (1.44 kN/m²), 20 percent of the uniform design snow load, regardless of actual roof slope.

12.7.3 Structural Modeling. A mathematical model of the structure shall be constructed for the purpose of determining member forces and structure displacements resulting from applied loads and any imposed displacements or P-Delta effects. The model shall include the stiffness and strength of elements that are significant to the distribution of forces and deformations in the structure and represent the spatial distribution of mass and stiffness throughout the structure.

Structures that have horizontal structural irregularity Type 1a, 1b, 4, or 5 of Table 12.3-1 shall be analyzed using a 3-D representation. Where a 3-D model is used, a minimum of three dynamic degrees of freedom consisting of translation in two orthogonal plan directions and torsional rotation about the vertical axis shall be included at each level of the structure. Where the diaphragms have not been classified as rigid or flexible in accordance with Section 12.3.1, the model shall include representation of the diaphragm's stiffness characteristics and such additional dynamic degrees of freedom as are required to account for the participation of the diaphragm in the structure's dynamic response. In addition, the model shall comply with the following:

- a. Stiffness properties of concrete and masonry elements shall consider the effects of cracked sections.
- b. For steel moment frame systems, the contribution of panel zone deformations to overall story drift shall be included.

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 JOB GROW SOLAR DECATHLON

 SUBJECT STRUCTURAL CALCULATIONS

 CALCULATED BY MRP DATE 7/30/14

CHECKED BY _____ DATE _____

 SHEET NO 4 OF 5

II.) D.) 1. (cont.)

$$W = 16237^{\#}$$

$$C_s = 0.28$$

$$V = C_s W = 0.28 (16237) = 4546^{\#}$$

$$\text{DIVIDE BY AREA: } 460 \text{ SF} = \frac{4546^{\#}}{460 \text{ SF}} = 9.9 \text{ PLF. APPLY IN Z DIRECTION}$$

b) FOR "X" DIRECTION:

NON BEARING WALL SO NO ROOF LOAD:

 APPLY ALL WALL LOAD TO
 FRONT (LEFT) FACE.

$$\text{AREA: } 11.33 (11) = 125 \text{ FT}^2$$

$$\text{@ 4 WALLS: } 500 \text{ FT}^2$$

"X" SEISMIC FORCES:

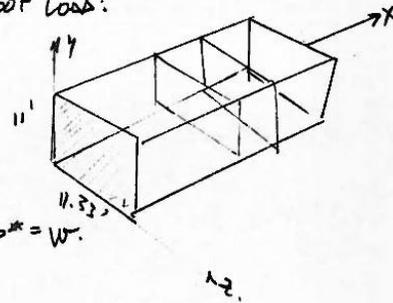
$$\text{WEIGHT} = 500 \text{ SF @ } 12 \text{ PLF} = 6000^{\#} = W$$

$$C_s = 0.28$$

$$V_x = C_s W$$

$$V_x = 0.28 (6000^{\#}) = 1680^{\#}$$

$$\text{APPLY TO END OF STRUCTURE: AREA LOAD } 1680^{\#} / 125 \text{ FT}^2 = 13.4 \text{ PLF.}$$



c.) APPLY LINE LOAD TO FLOOR EDGE FOR FLOOR WEIGHT DISTRIBUTION:

$$\text{FLOOR AREA: } 412 \text{ SF.}$$

$$\text{FLOOR WEIGHT: } 412 \text{ SF (28 PLF)} = 13216^{\#} = W$$

$$\text{UNIFORM LOAD TO EDGE BEAM: } 41.83 \text{ PLF ("Z")}$$

$$\text{"Z" DIRECTION: } V = C_s W$$

$$V_z = 0.28 (13216^{\#}) = 3700 \text{ LBS.}$$

$$\text{@ } 41.83' : V_z = 3700 / 41.83 = 88.5 \text{ PLF.}$$

$$\text{d) "X" DIRECTION: } V_x = 0.28 (13216^{\#}) = 3700 \text{ LBS.}$$

$$\text{@ } 11.33' : V_x = 3700 / 11.33 = 326 \text{ PLF.}$$

e) MEMBERS:

$$\text{Z UNI } 0.088 \text{ PLF: } \boxed{1} \quad \boxed{2} \quad \boxed{3} \quad \boxed{4}$$

$$\text{X UNI } 0.326 \text{ PLF: } \boxed{5} \quad \boxed{6} \quad \boxed{7} \quad \boxed{8}$$

MEMB

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 JOB 1417A GROW SOLAR DECATHLON
 SUBJECT STRUCTURAL CALCULATIONS
 CALCULATED BY MB DATE 7.20.2014
 CHECKED BY _____ DATE _____
 SHEET NO 5 OF 5

Below. ALL CORNER JOINTS.
 W8X13 FILL.
 1/2" W8X15. $F_y = 50 \text{ ksi}$.

TRUSS: 32 TO 34 40 TO 42 47 B5 86 96 120 TO 123

MEMBER 28 FILL. W8X13. ROOF 3 TO 90' NO:
 43 {44.
 27 {28 {26
 39 {38 {37
 MAKE W8X19.

III) REDESIGN USING STRUCTURAL INSULATED PANELS: (SIP's)

A) FLOOR SIP'S: CHECK $10\frac{1}{4}"$ SPANNING $12' \pm$
 DEAD LOADS: CEMENTITE ON $\frac{1}{2}"$ WASTER BLDG = 16 PSF.
 LIVE LOAD: 50 PSF:
 $\Sigma = 66 \text{ PSF}$.
 LOAD CHART #3 - "R-CORNER SIP'S" DOUBLE 2X SPLINE DETAILS.
 SIP 102 & SIP 108: @ $\frac{1}{360}$, 12' SAW, $10\frac{1}{4}"$ DEPTH: 111 PSF ALLOWED (OK)

B) ROOF: CHECK $10\frac{1}{4}"$ SIP w/ $\frac{1}{2}"$ GYPSUM WALL BOARD, RAFTING, CEILING, INSULATION:
 DEAD LOAD IMPACT: SIP 10 PSF.
 LIVE LOAD: SNOW: 35 PSF.
 $\Sigma = 45 \text{ PSF}$.
 LOAD DESIGN CHART #1 SPLINE DETAIL
 SIP 102, SIP 102g; SIP-102m.
 FOR $\frac{1}{360}$ @ 12' SAW: $10\frac{1}{4}"$ @ 12' - 46 PSF. (OK)

C) WALLS: WIND LOAD: 12.8 PSF NET WIND
 WALL HEIGHT $9' \pm$; USING $10\frac{1}{4}"$ SIP 101-C CHART #4 @ $\frac{1}{360}$
 ALLOW. LOAD: $10' - 47 \text{ PSF}$. $8' - 56 \text{ PSF}$. $\therefore 9' - 50 \text{ PSF}$. (OK)

D) CHECK WIND UPLIFT: $11' - 9" \text{ SAW}$: D.L. 20 PSF, SNOW = 35 PSF. $\therefore \text{STAFF @ } C = 330 \text{ PSF}$.
 $M_o = w \frac{L^2}{8} = 330 \text{ PSF} \frac{(11.75)^2}{8} = 5.7 \text{ K-FT}$. $w/F_y = 2.9 \text{ ksi}$. $S_x \text{ ALLOW} = \frac{M_o}{F_y} = \frac{5.7(12,000)}{2.9} = 23,600$
 $S_x = 1.75 \times 9\frac{1}{4} = 16\frac{1}{8} = 1.75(9.25) \frac{1}{8} = 2.0 \text{ IN}^3$ (OK) IF DOUBLE LVL. @ 2700

LOAD DESIGN CHARTS



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STRUCTURAL INSULATED PANELS



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LOAD DESIGN CHARTS

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R-Control SIPs are manufactured by a network of licensed manufacturers throughout North America and the world. R-Control SIP licensed facilities adhere to strict, consistent standards to ensure high-quality custom-made R-Control SIPs.

This network allows us to offer architects, engineers and builders the best of both worlds: the resources of the country's largest provider of SIP products and systems, and the superior attention and customer service of a local supplier.

R-Control SIPs are structural components for use in load bearing wall, roof, ceiling, or floor assemblies. An R-Control SIP Construction Manual, technical bulletins, and a building techniques video are available with additional information. These documents should be reviewed in detail prior to design and installation of R-Control SIPs. You can download these documents from www.r-control.com.

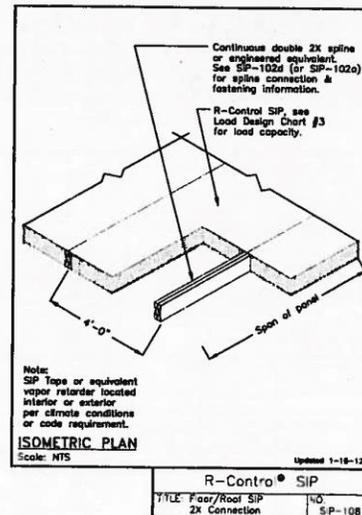
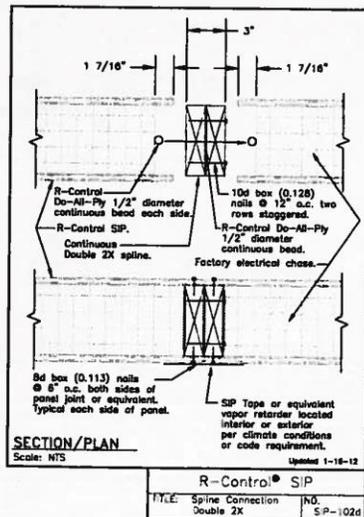
SC of 17

SIPs Load Design Charts

Roof/Floor - Transverse Loads - PSF LOAD DESIGN CHART #3 DOUBLE 2X SPLINE DETAILS SIP-102d and SIP-108									
SIP THICKNESS	DEFLECTION LIMIT	SIP SPAN (feet)							
		10	12	14	16	18	20	22	24
6-1/2"	L/360	53	40	30	24	19	15		
	L/240	79	59	45	35	28	22		
	L/180	105	79	60	47	37	30		
8-1/4"	L/360	89	65	48	37	28	22		
	L/240	109	91	72	55	42	33		
	L/180	109	91	78	68	57	44		
10-1/4"	L/360	150	111	84	65	51	41	33	27
	L/240	174	145	124	98	77	61	49	40
	L/180	174	145	124	109	97	82	66	54
12-1/4"	L/360	177	148	115	89	70	56	45	37
	L/240	177	148	127	111	99	84	68	55
	L/180	177	148	127	111	99	89	81	74

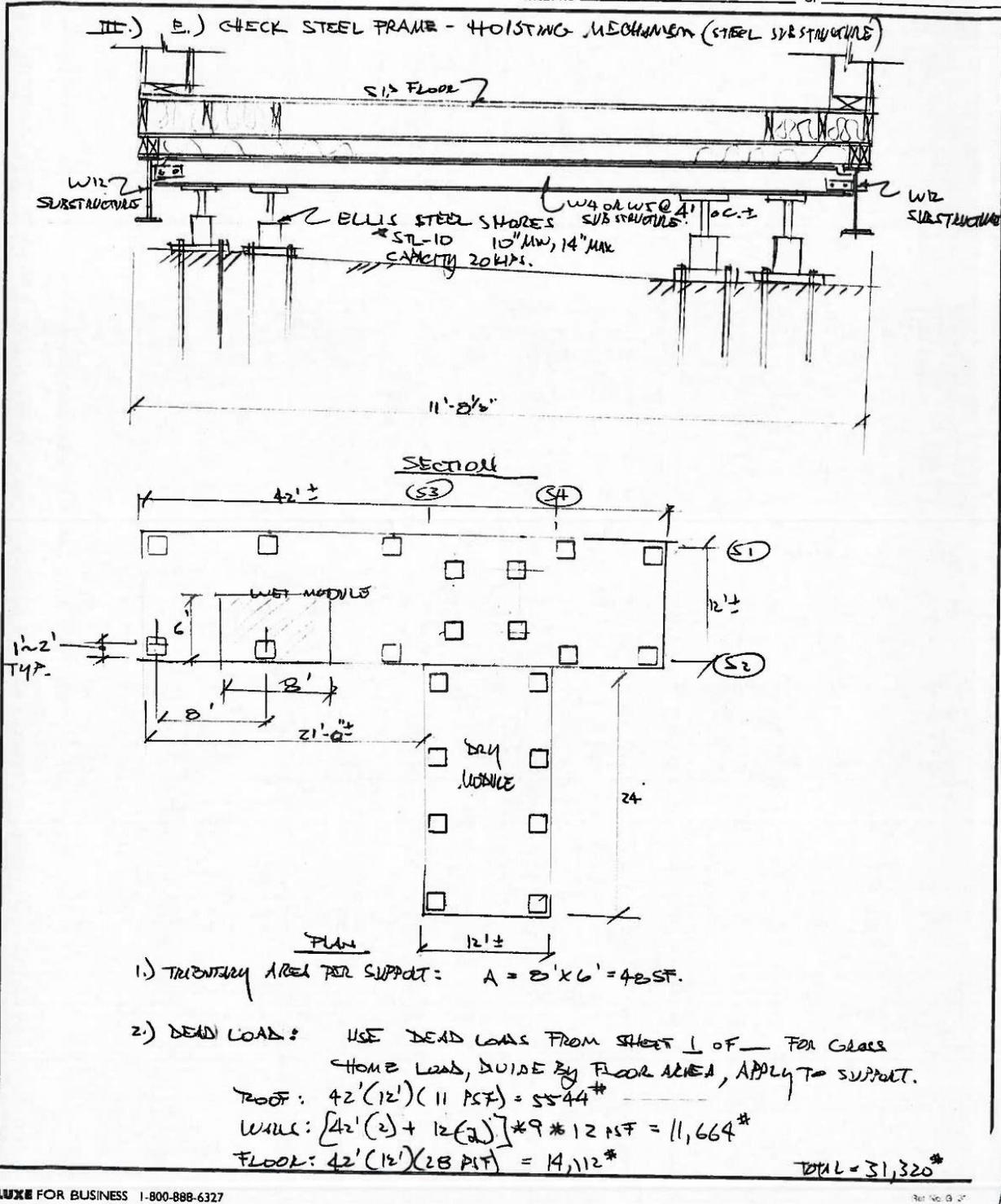
GENERAL NOTES:

- CHART VALUES ARE POUNDS PER SQUARE FOOT.
- DOUBLE 2X SPLINE MUST BE CONTINUOUS, SPACED 4' O.C., AND CONNECTED TO SIP FACING WITH 8d BOX (0.113) NAILS 6" O.C.
- CONTINUOUS SUPPORT WITH A MINIMUM DOUBLE 2X SPLINE BEARING OF 1-1/2" AT EACH END REQUIRED.
- CHART IS BASED UPON UNIFORM LOADS.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- FLOORS MUST HAVE A MINIMUM 7/16" THICK OSB OR EQUIVALENT OVERLAY.
- FOR SPANS GREATER THAN 22' AND FOR ALL 12-1/4" SIPs, DOUBLE 2X SPLINE IS REQUIRED TO BE #2 DOUGLAS FIR OR BETTER.
- FOR SLOPED SIPs, THE LOADING CONDITIONS AND SIP CAPACITIES SHOULD BE REVIEWED BASED UPON THE INCLINED SIP LENGTH. REFER TO R-CONTROL SIP TECHNICAL BULLETIN SIP NO. 2042.
- VALUES ARE FOR TOTAL LOAD (DEAD LOAD + LIVE LOAD).
- DEFLECTION BASED UPON $K_c = 1.0$. FOR LONG TERM DEFLECTION UNDER SUSTAINED LOAD (CREEP), ADDITIONAL DEFLECTION MUST BE EVALUATED.



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 SUBJECT STRUCTURAL CALCULATIONS
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 CHECKED BY _____ DATE _____
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III) E.) 2.) (CONT.)

$$\text{MODULE WT.} = 31,320\#$$

$$\text{AREA} = 42' (12') = 504 \text{ SF.}$$

$$\text{D.L./SF} = 62 \text{ PSF.}$$

$$\text{LOAD TO AVE. SUPPORT: } 42 \text{ SF} @ 62 \text{ PSF} = 2976\# \sim 3\text{K.}$$

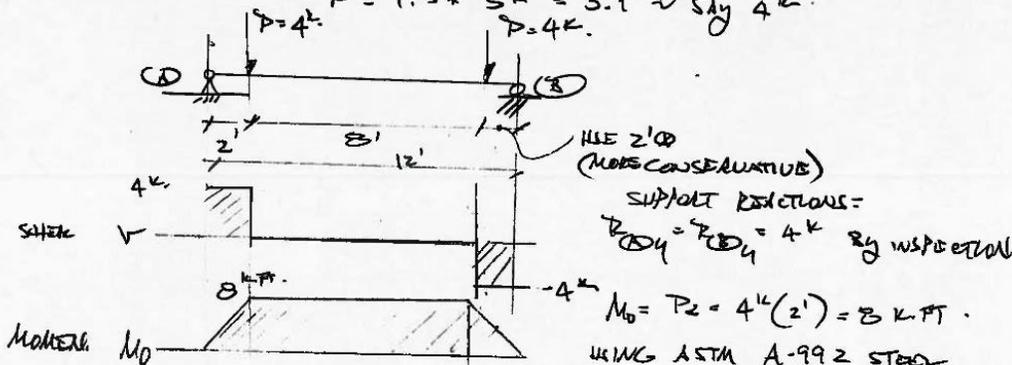
3.) DESIGN W4 OR W5 SUPPORT BEAM USING SUPPORT LOADS IMPOSED ON BEAM & CONNECTION @ W/2' & 1' SUPPORT NBR. (INVERT LOADS)

a.) APPLY IMPACT FACTOR TO SUPPORT LOAD FOR INSTALLATION

USE 1.3 IMPACT FACTOR:

$$\therefore P = 1.3 * (\text{SUPPORT LOAD})$$

$$P = 1.3 * 3\text{K} = 3.9\text{K} \text{ say } 4\text{K.}$$



USE 2' O.D.
(MORE CONSERVATIVE)

SUPPORT REACTIONS =

$$R_{BY} = R_{BY} = 4\text{K} \text{ by inspection}$$

$$M_0 = P/2 = 4\text{K} (2') = 8\text{K-FT.}$$

USE ASTM A-992 STEEL.

$$F_y = 50 \text{ ksi.}$$

FIND S_x REQ'D:

$$\text{IF } F_b = 0.6 F_y \quad F_b = 30 \text{ ksi.}$$

$$S_x = \frac{M_0}{F_b} = \frac{8\text{K-FT.} (12\text{ FT})}{30 \text{ ksi}} = 3.2 \text{ in}^3.$$

$$\text{W4X13} \quad S_x = 5.46 \text{ in}^3 > 3.2 \text{ in}^3 \text{ (OK)}$$

$$\text{W5X16} \quad S_x = 8.55 \text{ in}^3 > 3.2 \text{ in}^3 \text{ (OK)}$$

4.) DESIGN W12 PERIMETER BEAM:

a.) LOADING = USE 6' WIDE CONTRIBUTION WIDTH & 62 PSF DEAD LOAD.

$$W = 6' (62 \text{ PSF}) = 372 \text{ LBF.}$$

AS 8' SIMPLE SPAN: $M_0 = Wl^2/8$

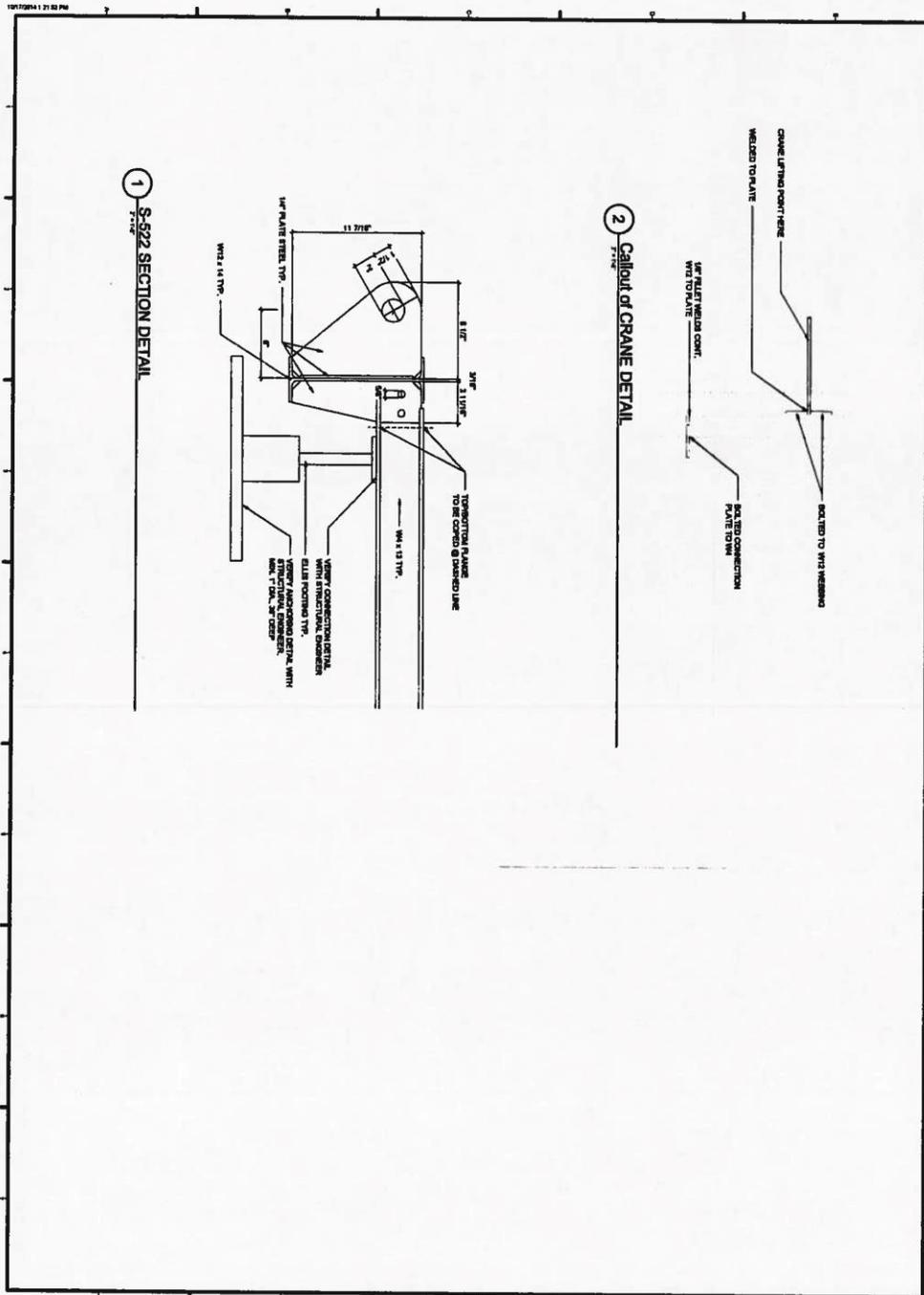
$$M_0 = 372 (8')^2 / 8 = 2.98 \text{ K-FT.}$$

FOR SELECTION USE ALSO TABLE 3-6

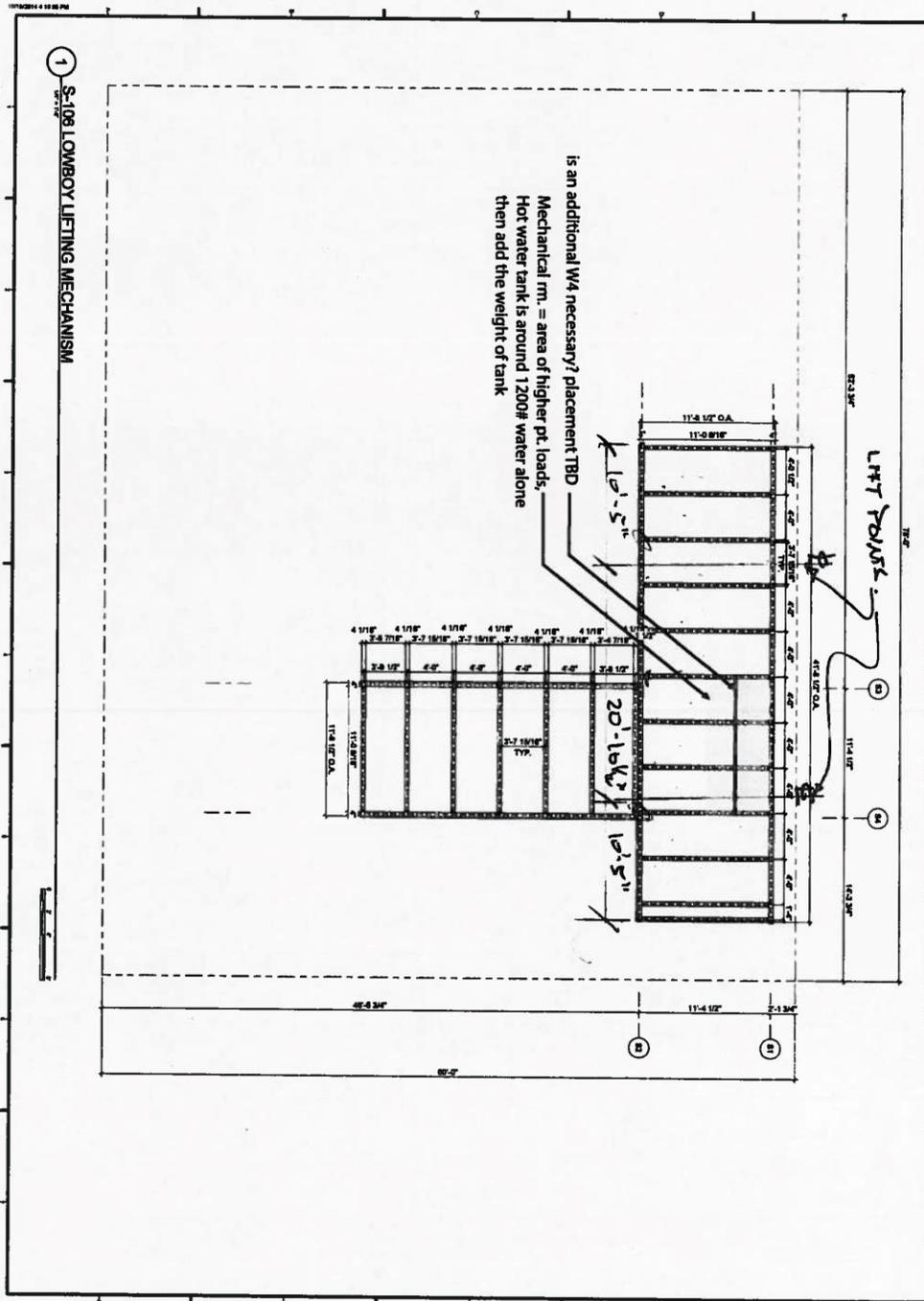
$$\text{W12X14} \quad M_p = 43.4 \text{ K-FT.} > 2.98 \text{ K-FT.} \quad L_p = 2.6'$$

$$\text{S2-6} \quad \text{TABLE 3-10 @ } 2': M_p = 24 \text{ K-FT.} \quad L_p = 7.73'$$

7A OF 12



TITLE: S-522 PROJECT: UNIVERSITY AT BUFFALO CONTRACT:	DATE:
DRAWN BY:	CHECKED BY:
DATE:	DATE:
DESCRIPTION:	DESCRIPTION:
CRANE LIFTING DETAIL	CRANE LIFTING DETAIL



1 S-106 LOWBOY LIFTING MECHANISM

c 14159
10-23-2014

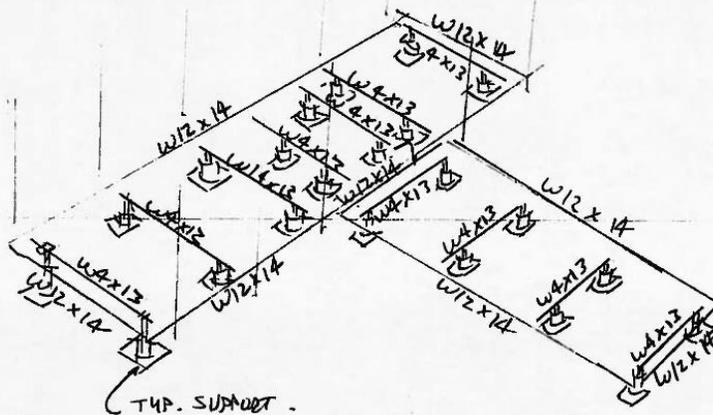
PROJECT S-106 LOWBOY LIFTING MECHANISM FRAMING PLAN	CLIENT U.S. DEPARTMENT OF ENERGY NATIONAL ENERGY TECHNOLOGY RESEARCH DEVELOPMENT CENTER
DESIGNER G. J. ARTHUR ARCHITECTS	DATE 10/23/14
SCALE 1/4" = 1'-0"	DESCRIPTION FRAMING PLAN
REVISIONS NO. DATE DESCRIPTION	APPROVED PROJECT MANAGER: G. J. ARTHUR ARCHITECTS

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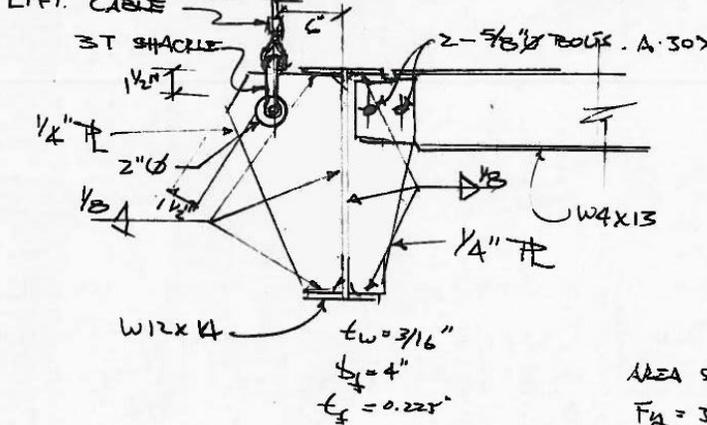
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III.) E.) T.) FRAMING ARRANGEMENT:



G.) DETAIL LIFT ATTACHMENT:



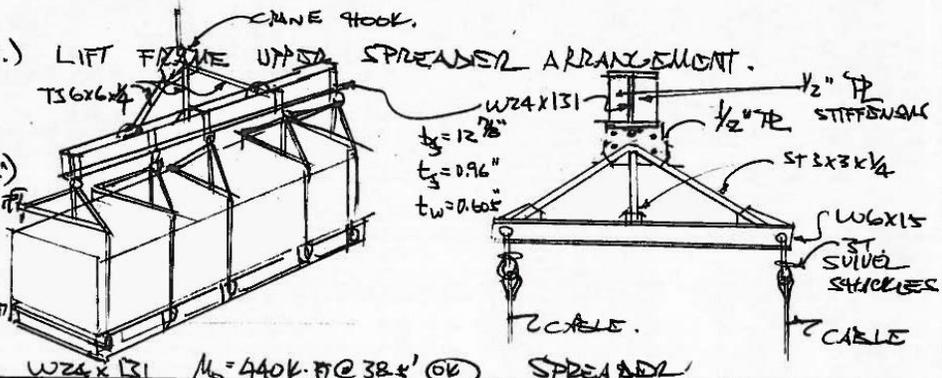
ALL TABLE 7-1
 SINGLE SHEAR $4.14 \frac{k}{root}$
 EZ CAPACITY 8.28K.

SHEAR IN PL.
 ALLC § 34-3
 $P_n = 0.6 F_y A_g$
 AREA SUBJECT TO SHEAR $= A_g v = 0.27 (1.5'') = 0.375 \text{ in}^2$
 $F_y = 36 \text{ ksi}$
 $P_n = 0.6 (36 \text{ ksi}) (0.375 \text{ in}^2) = 8.1 \text{ K} > 4 \text{ K}$
 (OK)

TYPICAL

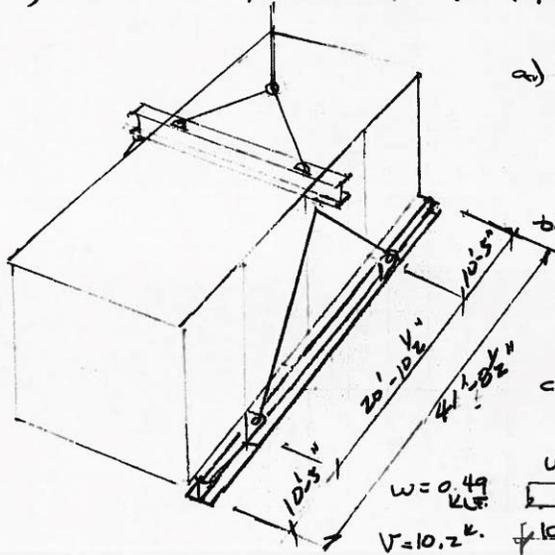
7.) LIFT FRAME UPPER SPREADER ARRANGEMENT.

LIFT BEAM LOAD:
 $5 \frac{k}{ft} \times 8' = 40 \text{ k}$
 $M_0 = 8 \text{ k}(20) + 8 \text{ k}(12) + 8 \text{ k}(4) = 288 \text{ k-ft}$
 W/IMPACT LOAD
 $M_0 = 1.3 M_0$
 $M_0 = 1.3(288) = 374 \text{ k-ft}$
 ALLC TABLE 3-10: $M_n = 440 \text{ k-ft} @ 38 \text{ k-ft}$ (OK)



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 SHEET NO 8A OF 17
III) E) B) REDESIGN LIFT ARRANGEMENT TO 4 POINTS:


a) WHAT LOAD TO EACH POINT? -

$$\text{MODULE WT.} = 31.3 \text{ k.}$$

$$P_{\text{LIFT}} = \frac{31.3 \text{ k}}{4} = 7.8 \text{ k.}$$

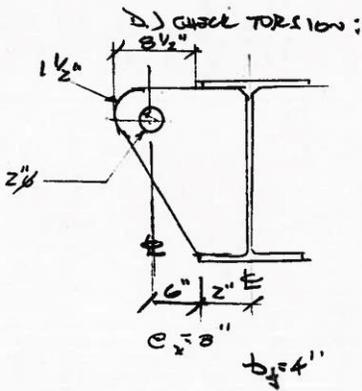
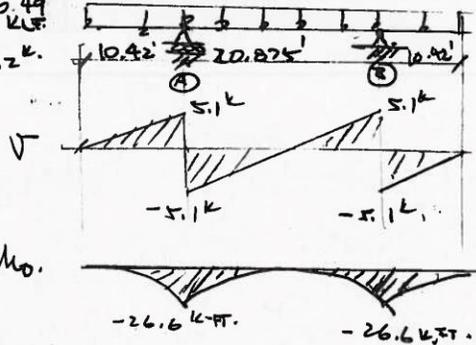
b) APPLY IMPACT FACTOR 1.3

FACTORED LIFT LOAD:

$$P_{\text{LIFT}} = 7.8 \text{ k} (1.3) = 10.2 \text{ k.}$$

c) DESIGN BEAM IN PURE FLXURE:

$$W = (5.1 \text{ k} / 2) + 41.71 = 46.81 \text{ k/ft.} \# 12 \times 0.4 \text{ ft}$$



TORSION MOMENT: $\frac{8''}{12} (10.2 \text{ k}) = 6.8 \text{ k-ft.}$
 $C_x = 0.67'$
 $P_y = 10.2 \text{ k.}$

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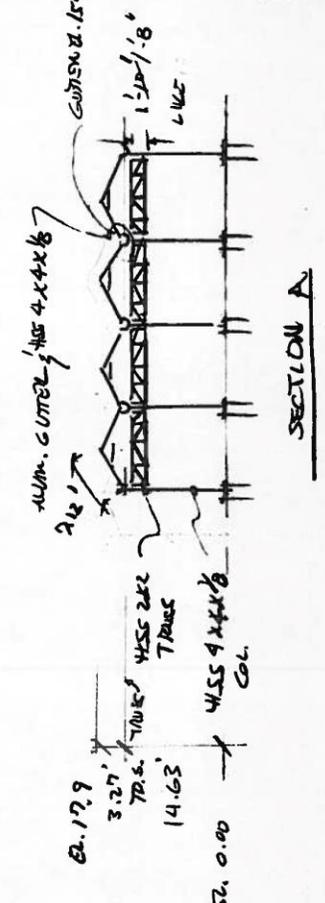
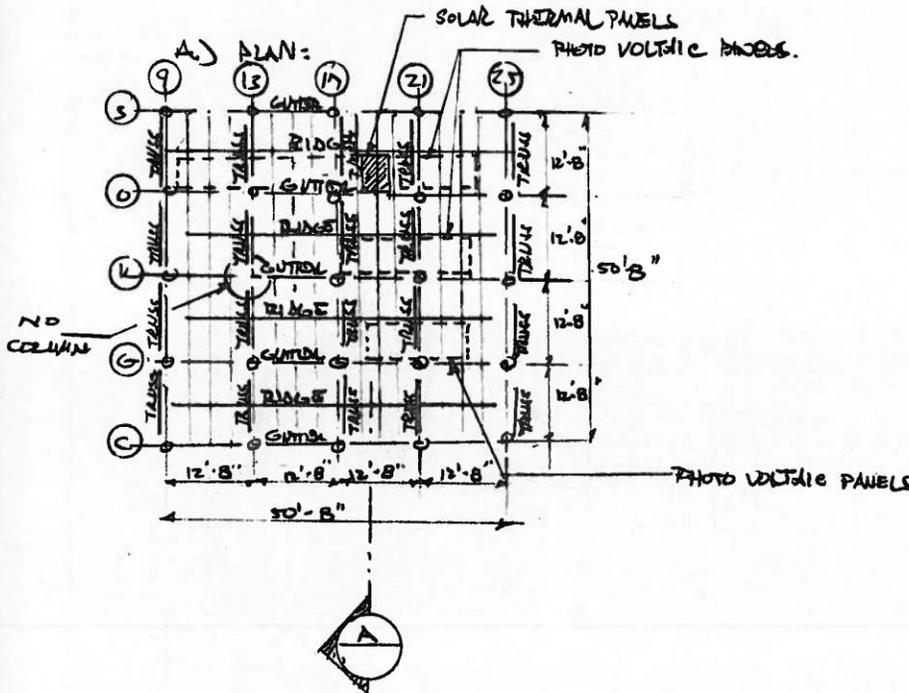
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DATE _____

 SHEET NO 9

 OF 17
IV) GREENHOUSE DESIGN:

B.) LOADING:

- 1.) DEAD LOADS:
 - FRAME - 2 PSF.
 - TRUSS - 0.9 PSF
 - SOLAR THERMAL PANEL - 4.5 PSF.
 - PHOTO VOLTIC PANEL - 4 PSF OR 2.3 PSF.

- 2.) LIVE LOADS:
 - SNOW: 35 PSF.
 - DEPT LOAD:
 - WIND: 15.5 PSF
 - SEISMIC: $S_s = 1.0$; $S_1 = 0.12$; $T_u = 10$; $T_p = 1.3$; $S_1 = 0.68$; $S_2 = 0.45$

C.) MEMBER DESIGN:

- 1.) CHECK PROPOSED COLUMN: HSS 4x4 x 1/2
 - AREA OF CONTRIBUTION = $A = 12.67' (12.67') = 161 \text{ FT}^2$
 - D.L. = $2 + 0.9 = 2.9 \text{ PSF}$.
 - D.L. = $2 + 0.9 + 4.5 \text{ PSF} = 7.4 \text{ PSF}$ (SOLAR THERMAL) 6'-4" WIDTH.
 - D.L. = $2 + 0.9 + 4 \text{ PSF} = 6.9 \text{ PSF}$ (PHOTO VOLTIC) 6'-4" WIDTH.
 - S.L. = 35 PSF BALANCE. - NO DEPT.
 - MAX LOAD: D.L. = $7.4 \text{ PSF} + 35 \text{ PSF (S.L.)} = 42.4 \text{ PSF}$ x 4 PSF

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 SHEET NO 10

 OF 17

II) c.) 1.) (CONT.)

 1st CHECK: DL + S: (NO DRIFT): $P = 161 \text{ FT}^2 (42 \text{ PSF}) = 6792 \text{ K}$

 say $K = 1.0$ (PINNED). $l = 14.63'$ $\therefore Kl = 14.63'$

 AISC TABLE 4-4: $P_{allow} = 20.3 \text{ K} (ASD)$ $- 15' = KL > 6.9 \text{ K}$ (OK)

2.) SNOW DRIFT. LOAD:

SLOPE OF ROOF: 31.7" RISE OVER 76" SPAN:

5:12 PITCH

USING BLDG. CODE II.

 $P_g = 50 \text{ PSF}$

 HALL ROOF LENGTH = 50.67' = L_H

 LOBBY ROOF LENGTH = 50.67' = L_L

 HORIZ. DIST. TO EAVE/RIDGE = 6.33' = W

GABLE ROOF (MULTIPLE)

 OBSTRUCTION HEIGHT: 3.27' = W_0

ROOF SLOPE 5:12 = 5

 EXPOSURE FACTOR: $C_e = 1.0$ (SEE PG. 5)

 * THERMAL FACTOR: $C_t = 1.2$ UNHEATED. AISC 7 TABLE 7-3

 ROOF ANGLE $\theta = 22.6^\circ$
 $I = 1.0$ IMPORTANCE

 SNOW DENSITY: $\rho = 0.13 p_g + 14 = 20.5 \text{ PCF}$

 FLAT SNOW LOAD: $A = 0.7 C_e C_t I \rho = 0.7 (1.0) (1.2) (1.0) (20)$
 $P_{flat} = 42 \text{ PSF}$

 BALANCED SNOW LOAD: $h_s = P_{flat} / \rho = 42 / 20.5 = 2.05'$

 UNBALANCED SNOW LOAD @ RIDGE: $= 0.5 P_{flat} = 0.5 (42) = 21 \text{ PSF}$

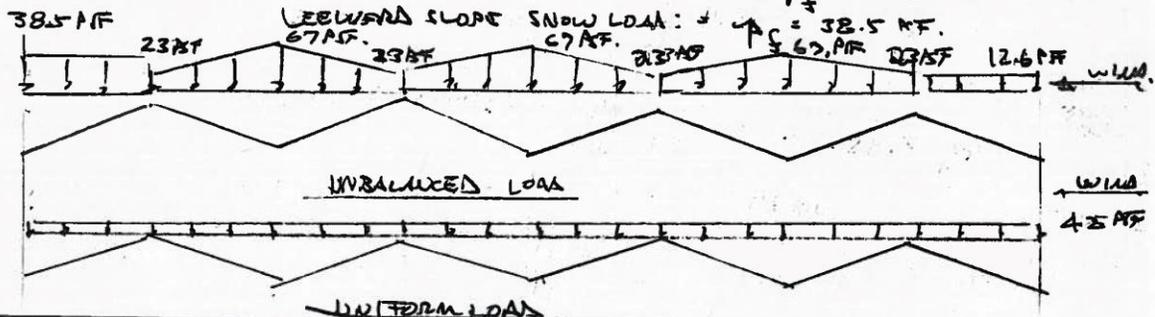
 AT VALLEY: $2 P_{flat} / C_e = 2 (42) / 1.0 = 84 \text{ PSF}$

CHECK TO SEE IF VALLEY SNOW DEPTH EXCEEDS RIDGE

 $h_{dv} = \frac{84 \text{ PSF}}{20.5 \text{ PCF}} = 4.1'$ EXCEEDS RIDGE. 3.27'

 $\therefore \text{MAX} = 3.27' (20.5 \text{ PCF}) = 67 \text{ PSF}$

 WINDWARD SLOPE SNOW LOAD: $= 0.3 P_{flat} = 0.3 (42.0) = 12.6 \text{ PSF}$

 LEeward SLOPE SNOW LOAD: $= P_{flat} = 38.5 \text{ PSF}$


133.

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 SHEET NO 11

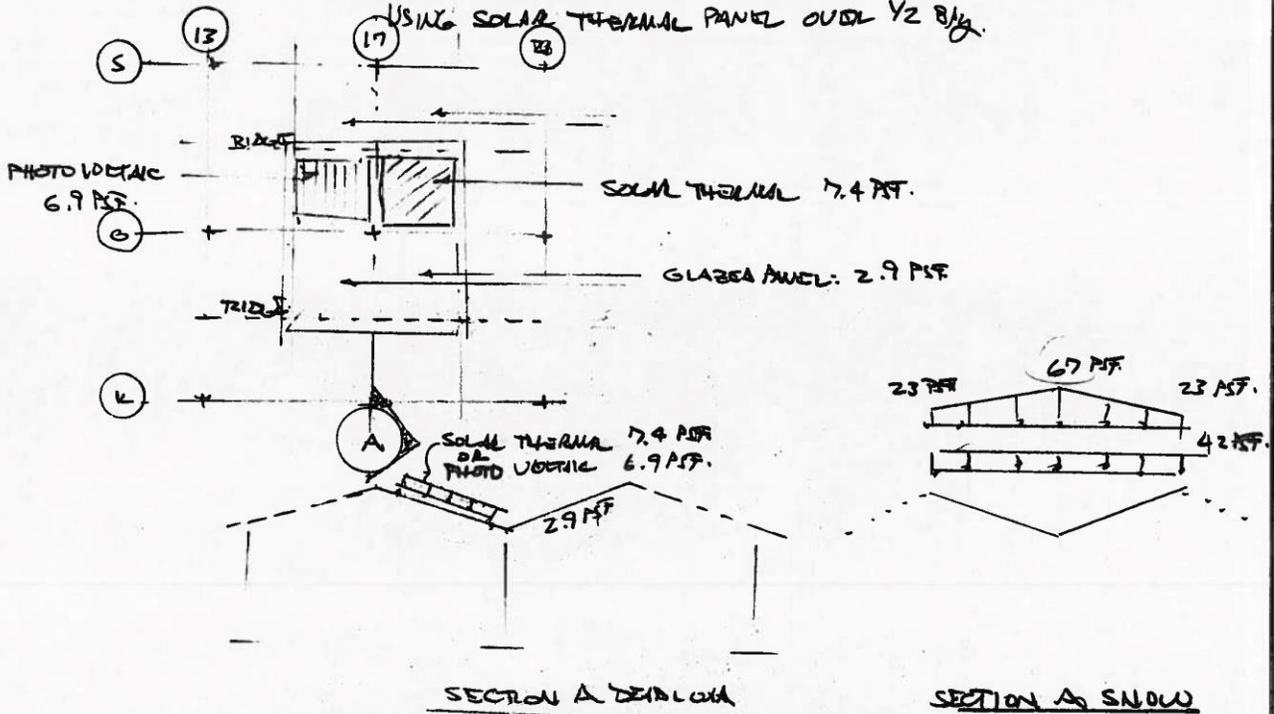
 OF 17

II .) c.) 2.) (CONT.)

 2nd CHECK:

MAXIMUM COLUMN LOAD:

USING SOLAR THERMAL PANEL OVER 1/2 BAY.



$$D.L. \rightarrow \left[\frac{12.67'}{2} (7.4 \text{ PSF}) + \frac{12.67'}{2} (6.9 \text{ PSF}) \right] 6.33' + \frac{12.67' (2.9 \text{ PSF}) (6.33')}{2} = 886 \text{ LBS}$$

$$\text{ADD TRUSS \& GUTTER: } 573 \text{ LBS} \quad \text{SNOW } 2.9 \text{ PSF @ } 161 \text{ FT}^2 = 322 \text{ LBS} \quad 886 + 322 = 1128 \text{ LBS}$$

SNOW:

$$\text{BALANCED: } \left[\frac{12.67'}{2} \right]^2 (42 \text{ PSF}) = 6742 \text{ LBS}$$

$$\text{UNBALANCED: } \left[\frac{67+23}{2} \right] 12.67' = 7223 \text{ LBS}$$

$$\text{MAXIMUM COLUMN LOAD} = D + S \text{ UNBALANCED} = 1128 \text{ LBS} + 7223 \text{ LBS} = 8351 \text{ LBS}$$

$$\text{USE } 4 \times 4 \times \frac{1}{8} \quad P = 20.3 \text{ K} > 8.4 \text{ K. (OK)}$$

ALLOW

 3.) CHECK COMBINED $D + 0.75 W + 0.75 S$.

 WIND RANGE FROM -15.5 PSF TO 8.1 PSF ; USE 15.5 PSF TO BE

$$W = 161 \text{ FT}^2 (-15.5 \text{ PSF}) = 2,496 \text{ LBS. CONSERVATIVE}$$

$$S = 7223 \text{ LBS.}$$

$$D = 1128 \text{ LBS.}$$

$$\therefore \text{COMBINED } D + 0.75 W + 0.75 S = 1128 + 0.75 (2496) + 0.75 (7223) = 8417 \text{ LBS}$$

$$P_{ALLOW} = 20.4 \text{ K} > 8.4 \text{ K. (OK)}$$

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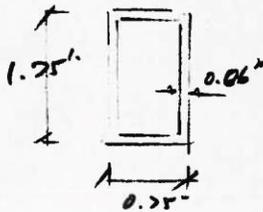
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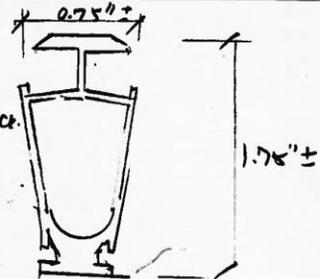
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 OF 17
IV.) C.) 4.) CHECK ALUMINUM RAFTER DESIGN:

SECTION PROPERTIES:

$$A = 0.29 \text{ in}^2 \text{ USING EQUIV. RFT. TUBES } 0.6' \text{ THICK.}$$

$$I_x = 0.104 \text{ in}^4 + 0.093 \text{ in}^4$$

$$S_x = 0.126 \text{ in}^3 + 0.113 \text{ in}^3$$


 a.) SPACING: $\text{TRG } 12.67/4 = 3.17' \text{ o.c.}$

MAX. LOAD: 7.4 PSF D.L.

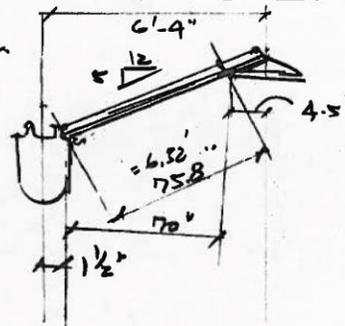
@ 3.17' (7.4 PSF) = 23.5 PLF.

SNOW LOAD: 67.7 PSF → 23 PSF.

A/S = 4.5 PSF.

@ 3.17' (4.5) = 143 PLF.

TOTAL: 167 PLF.



ALUMINUM 6063-T6

 $E = 10,100 \text{ ksi.}$
 $E_H = 30,000 \text{ psi.}$
 $F_{tL} = 28,000 \text{ psi.}$
 F_s TENSILE & COMPRESSIVE STRENGTH = 1.65.

FROM TABLE 3.3.2 ALLOW STRESS, BUILDING - 6063-T6 ALUMINUM ALN: TABLE 3.7.3

TENSION EXTREME FIBER - BEAMS: 15 ksi.

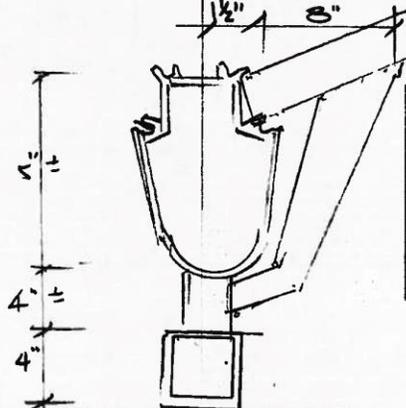
COMPRESS IN BEAMS EXTREME FIBER: 15 ksi

$$M_0 = wL^2/8 = 0.167 \text{ klf } (6.32')^2/8 = 0.83 \text{ k-ft.}$$

$$S_x \text{ REQD} = \frac{M_0}{F_b} = \frac{0.83 (12'')^2}{15 \text{ ksi}} = 0.66 \text{ in}^3 > 0.12 \text{ in}^3$$

(NO GOOD)

SHORTEN SPAN WITH GUTTER RAFTER KNEE BRACE.



RAFTER SPAN REDUCED FROM: 70" → 62" HORIZ.

$$\therefore \text{SPAN} = \frac{13}{12} (62'') = 67.2'' = 5.60'$$

SPACE @ 0.97' o.c.

$$w = 0.97 (7.4 \text{ PSF} + 4.5 \text{ PSF}) = 51 \text{ PLF.}$$

$$M_b = wL^2/8 = 51 (5.6')^2/8 = 0.20 \text{ k-ft.}$$

$$S_x = \frac{M_b}{F_b} = \frac{0.2 (12'')^2}{15 \text{ ksi}} = 0.16 \text{ in}^3 \text{ - NG!}$$

w

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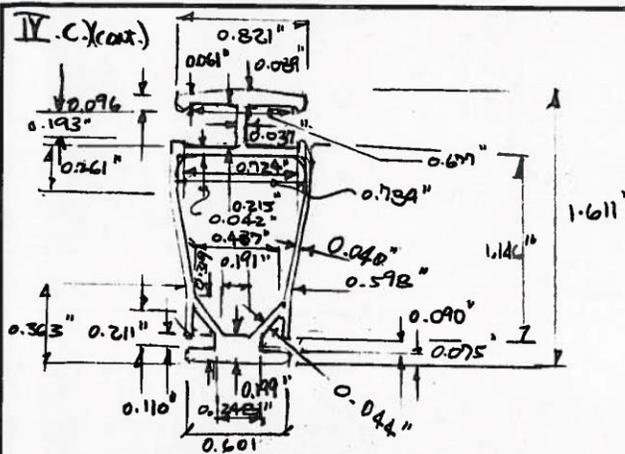
JOB GROW SOLAR DECKING

SUBJECT STRUCTURAL CALCULATIONS

CALCULATED BY MEP DATE 1.26.2014

CHECKED BY _____ DATE _____

SHEET NO 12 OF 17



MEASURED DIMENSIONS

$A = 0.285 \text{ in}^2$

$\bar{y} = 0.825$

$I_x = \frac{bd^3}{12} + Ad^2 = 0.093 \text{ in}^4$

SEE ATTACHED CALCULATIONS

$A_5 = 1.104(0.04)(2) = 0.088 \text{ in}^2$
 $d_5 = 0.759$

IF ADD 1" TO 5

$A_5 = (1.104 + 1)(0.04)(2) = 0.168$

$d_5 = 0.759 + 0.5 = 1.259$

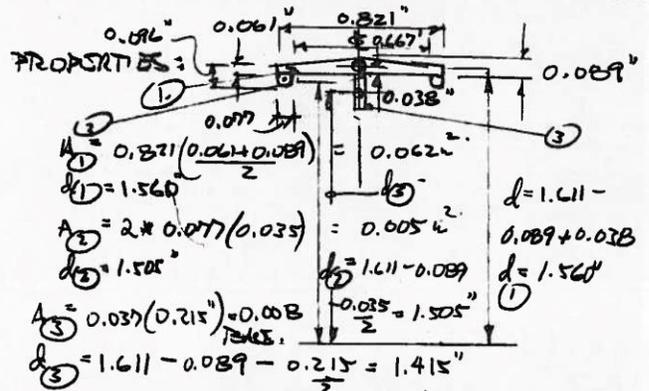
$A = 0.367 \text{ in}^2$

$I_x = 0.372 \text{ in}^4$

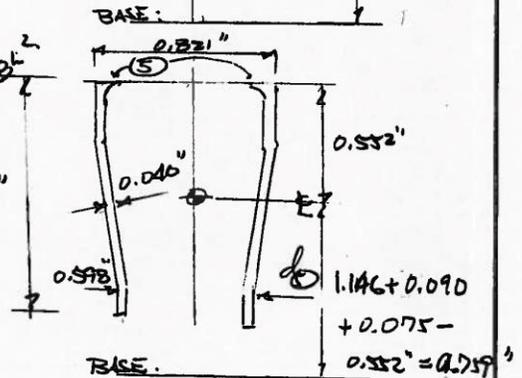
SPACING OF RIFTER: 2.2' O.C.

USING 3/8" LENGTH & DEPTH SECTION.

w



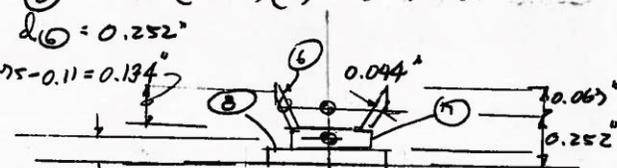
$A_4 = 0.821(0.042) = 0.034 \text{ in}^2$
 $d_4 = 1.611 - 0.089 - 0.215 - \frac{0.042}{2} = 1.286$



$A_6 = 0.044(0.134)(2) = 0.012 \text{ in}^2$

$d_6 = 0.252$

$0.319 - 0.075 - 0.11 = 0.134$



$0.199 - 0.075 = 0.124$

$A_7 = 0.124(0.248) = 0.031 \text{ in}^2$

$d_7 = 0.199 - \frac{0.124}{2} = 0.137$

$A_8 = 0.075(0.601) = 0.045 \text{ in}^2$

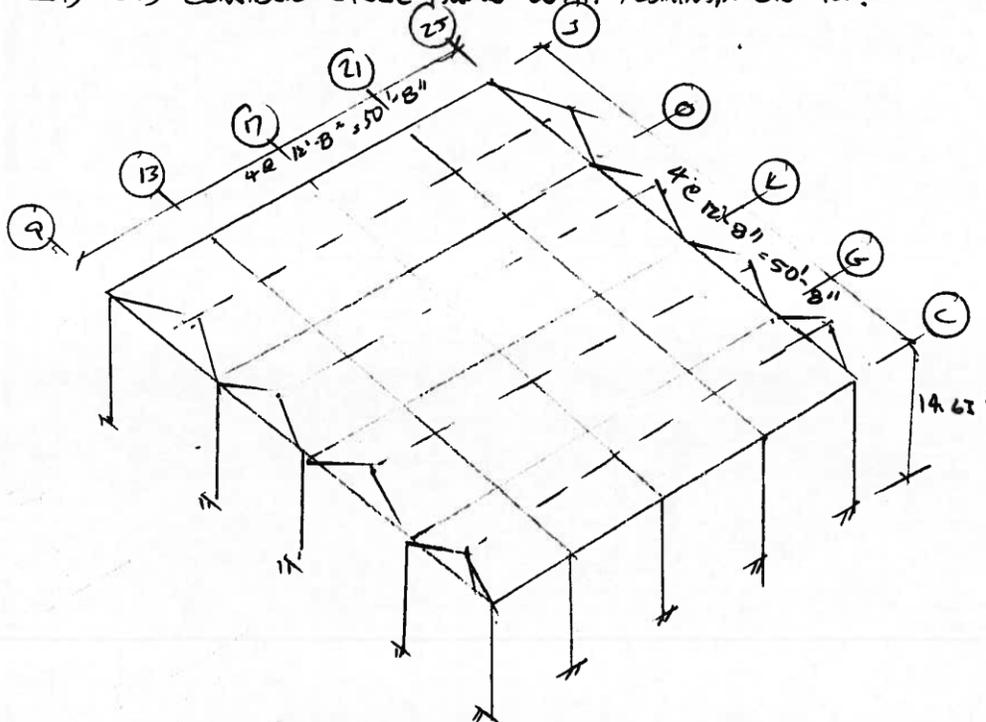
$d_8 = \frac{0.075}{2} = 0.038$

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 JOB CAROL SOLAR DECKING
 SUBJECT STRUCTURAL CALCULATIONS
 CALCULATED BY MEP DATE 1-27-2015
 CHECKED BY _____ DATE _____
 SHEET NO 14 OF 17

IV.) D.) CONSIDER STEEL FRAMES WITH ALUMINUM ON TOP:



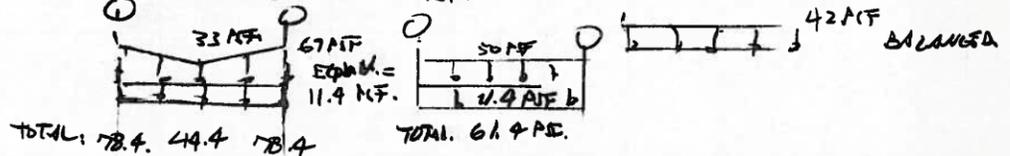
1.) HAND METHOD DESIGN:

a.) ASSUME GLAZING & ALUMINUM FRAME REST ON STEEL FRAMES. DESIGN BEAMS & COLUMNS ACCORDINGLY.

b.) DEAD LOAD: MAX. 7.4 K/FT.

SNOW LOAD: USE DIFF LOAD

D.L. STEEL FRAME LOAD: 4 K/FT.


 c.) BEAM DESIGN: CONTINUOUS MOMENT FRAME: $W = 61.4 (12.67) = 775 \text{ PLF}$

$$M_{O, \text{MAX}} @ \text{COL} = \frac{Wl^2}{10} = 0.775 (12.67)^2 / 10 = 12.5 \text{ K-FT}$$

 USING AISC: IF Φ -500 GR. B TUBE. $F_y = 46 \text{ ksi}$.

FROM AISC TABLE 3-13

$$M_{O, \text{MAX}} \Phi 564 \times 4 \times 5/16: \frac{M_{\text{req}}}{\phi} = 12.5 \text{ K-FT} > 12.5 \text{ K-FT. (OK)}$$

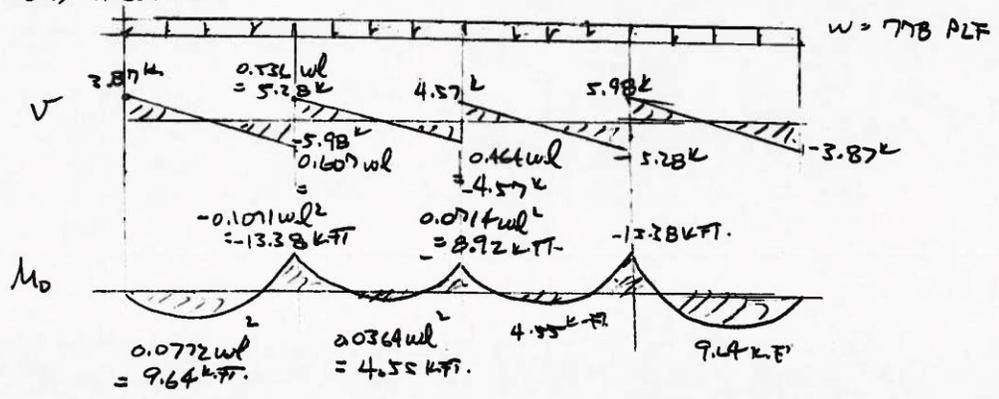
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 JOB GROW SOLAR ARCHITECTURE
 SUBJECT STRUCTURAL CALCULATIONS
 CALCULATED BY MRP DATE 1-29-2015
 CHECKED BY _____ DATE _____
 SHEET NO 15 OF 17

IV.) d.) 1.) d.) DIAGRAM.

$0.393 wl =$


 AISC TABLE 3-13: HSS 4x4x3/8 $\frac{M_u}{\phi_b} = 14.7 \text{ k.FT.}$

 e.) COLUMN: $V = 5.98 \text{ k.}$ $L = 14.63'$
 $K = 1.2$
 $KL = 17.6' \text{ N1D'}$
 ST 4x4x3/8
 $P_{allow} = 142 \text{ k.} > 6 \text{ k.}$

 f.) IF ELIMINATE 1 COLUMN:
 $M_{u, \text{MAX}} = \frac{wl^2}{8} = \frac{778(25.3')^2}{8} = 62.4 \text{ k.FT.}$

FROM AISC TABLE 3-13.

HSS	M_u / ϕ_b	WT./FT.
HSS 14x4x1/4	76.2 k.FT.	21.2
HSS 12x4x5/16	71.9 k.FT.	31.8
HSS 10x4x3/8	62.0 k.FT.	32.6
HSS 8x4x5/8	68.0 k.FT.	42.3
HSS 16x4x3/8	66.9 k.FT.	24.73

2.) MULTIFEMMS MODEL OF STRUCTURE:

- a) SNOW LOADS AS DESCRIBED, BALANCED & UNBALANCED
 - WIND 90 DEG = 132 PSF. 3 SECOND GUST > 85 MPH REFD(CA)
 - SELFWEIGHT: 1.0.
- b) RIFTS @ 3.17' O.C.: SNOW: 23 PSF @ 3.17' = 0.073 kLF.
 67 PSF @ 3.17' = 0.212 kLF.
 38.5 PSF @ 3.17' = 0.122 kLF

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 JOB GROW SOLAR DESCRIPTION
 SUBJECT STRUCTURAL CALCULATIONS
 CALCULATED BY WJS DATE 2-2-2015
 CHECKED BY _____ DATE _____
 SHEET NO 16 OF 17

IX.1 b.) 2.) (cont.)

$$-12.6 \text{ PSF} @ 3.17' = 0.040 \text{ KLF.}$$

$$\text{BALANCED: } 42 \text{ PSF} @ 3.17' = 0.133 \text{ KLF.}$$

b.) DEAD LOADS: GLAZING: $+14 \text{ PSF} @ 3.17' = 2.9 \text{ PLF.}$

PHOTO VOLTIC: $-2.3 \text{ PSF} @ 3.17' = .73 \text{ PLF.}$

THERMAL PANEL: $-4.5 \text{ PSF} @ 3.17' = 1.4 \text{ PLF.}$

c.) SEISMIC LOADS:

WEIGHT OF STRUCTURES: $W = 13,153^*$

APPLY SEISMIC EQUIVALENT LATERAL FORCE TO FRAMES

FUNDAMENTAL PERIOD:

HEIGHT OF STRUCTURES: $17.9'$

ASCE 7-05 TABLE 12.8-2. $C_E = 0.028$ (STEEL MOMENT FRAME)
 $\lambda = 0.8$ (" " " ")

$$T_I = C_E h_w^x$$

$$T_d = 0.028 (17.9')^{0.8} = 0.28 \text{ SEC. } T$$

 C_s NEED NOT EXCEED

$$C_s = S_{D1} = \frac{0.45}{\frac{T(1.25)}{1}} = \frac{0.45}{0.28(3.17)} = 0.46 \text{ GREATER THAN } C_E = 0.28$$

USE $C_s = 0.28$

$$\text{§ 12.8.1: } V = C_s W$$

 MASS OF STRUCTURES: $13,153 \text{ LBS:}$ (FROM MUCT FRAMES POINT OUT Pg. 52)

$$V = 0.28(13,152 \text{ LBS}) = 3683 \text{ LBS.}$$

 MASS OF COLUMNS: $24 (4 \text{ USE } 4 \times 4 \times 1/8 = 6.46 \text{ PLF}) @ 14.63' = 2268^*$

TOP OF STRUCTURES: $13,153^* - 2268^* = 10,885^*$

$$13,153^* \bar{y} = 10,885^* (15.71') + 2268^* (7.32')$$

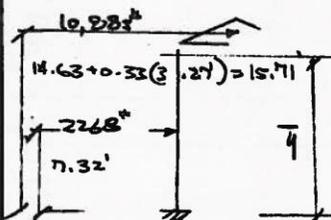
$$\bar{y} = 14.26' \sim \text{APPLY @ TOP OF COLUMN: } 14.63' \text{ CLOSE ENOUGH.}$$

APPLY TO COLUMNS IN X & Z DIRECTIONS.

$$E = 13,153^* / 24 \text{ COLUMNS} = 548^* \rightarrow X.$$

LOAD CASES.

$$0.75 E \quad 0.75(0.75)$$



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JOB GROW SOLAR DISCATHLON
 SUBJECT STRUCTURAL CALCULATIONS
 CALCULATED BY MS DATE 2-10-15
 CHECKED BY _____ DATE _____
 SHEET NO 17 OF 17

II.) D.) 3.) RE-RUN MODEL WITHOUT TRUSSES:

- RATED D.L. - 0.003 KLF. COLTRNG.
- RATED D.L. - 0.010 KLF. PHOTOVOLTAIC
- RATED D.L. - 0.014 KLF. THERMAL

- 4.) CHANGE BEAMS TO 4x5x5x1/2" POLYMERULAR TO RIGID.
 CHANGE COLUMNS TO 4x4x3/8"
 CHANGE: BEAM PIVOT TO RIGID 4"x4"x1/2"

REFER TO MULTIFAMILY PRINT OUT FOR DETAILS:

- 5.) FOR CONSTRUCTION SITE, SEISMIC, WIND, & DEAD LOAD CONDITIONS APPLY TO CONSTRUCTION.
- 6.) FOR BUFFALO, DEAD, SNOW, WIND, SEISMIC CONDITIONS CONSIDER.
 PERMANENT MOMENT RESISTING FORMATIONS WILL BE USED.

Detailed Water Budget

FUNCTION	WATER USE (GALLONS)	CALCULATIONS		NOTES
		GAL	EVENTS	
Hot Water Draws	240	15	16	Estimated draw for duration
Water Vaporization	6	1	6	Cooking contest
Dishwasher	40	5	8	5 gallons per load
Clothes Washer	160	20	8	20 gallons per load
Vegetation	350	5	70	5 Gallons per square foot of garden
Fire Protection	280	40	7	2 sprinklers * 20 gal. per min. * 7 min. suppression
Thermal Storage Tanks	0			n/a
Testing	110	110	1	Initial Priming and Testing
Initial Systems Fill	80	80	1	80 Gallon surplus factored in
Solar Thermal Collectors	50	50	1	
Aesthetic Purpose	0			n/a
Radiant Flooring	0			n/a
Safety Factor	131.6	131.6	1	10% Contingency
WATER REQUIRED	1447.6	gallons		



Summary of Unlisted Electrical Components

There are currently no unlisted electrical components.

Summary of Reconfigurable Features

1. The Growlarium contains significant operable shading devices in order to shade the space from the sun during hot and sunny weather. These shades are designed to open though to allow sunlight to heat the Growlarium space during colder weather.
2. The Growlarium contains large operable exterior glazed doors in order to perform in a variety of diverse climates (6'-4" wide x 7' high [2x] + 3'-2" wide x 7' high [2x]). In a cold climate, the doors can be closed and sealed in order to create an unconditioned thermal buffer between the conditioned space of the house and the outside. This is akin to a foyer, where winds may not blow directly into the most heated parts of a house. In a hot climate, these doors may open to allow passive airflow through the Growlarium and into the house.
3. The Growlarium utilizes moveable planter boxes in order to move plants grown inside in the winter to the outside during the swing and summer seasons. These planter boxes are made of wood with a steel frame and caster system in order to move about the space freely during operation, giving the plants optimal year round growing potential. Each planter box holds 9 cubic feet of soil, totaling 1000 lbs.
4. The Wet Module and Growlarium utilize moveable work tables in order to facilitate the movement of plants from the growing areas into the kitchen for processing, and cooked food from the kitchen to the Wet Module or Growlarium for eating. The Tables provide a flexibility to the work space beside the kitchen, which acts to expand the kitchen when it is being used. Upon the tables, one can move fresh picked fruit from the Growlarium to the kitchen, expand kitchen counter space while cooking, then move a meal into the appropriate place and consume it. The tables are steel framed with large caster wheels and a stone or concrete mass top.
5. The exterior deck to the East of the Dry Module is equipped with towel drying locations. This is an area proximal to the bathroom where towels are likely to be used, and is open air to the outdoors offering passively drying of towels and minimizing supplemental energy usage by the operator of the house.



Interconnection Application Form

NY-BUFF Lot 206

PV SYSTEMS

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
Silevo	Triex U280, Hybrid Monocrystalline / Amorphous Silicon Cells with Tunneling Junction Technology, 24 Panels, 2 String array with 12 modules each, 22 degree tilt	6.7 KW
SolarEdge	P400 Power Optimizer, 24 units, 1 per solar panel	400 W

Total DC power of all arrays is 6.7 kW (in tenths)

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (KVA or KW)	Quantity
Solar Edge	SE6000A-US	240V AC	6 KW	1

Total AC power of all inverters is 6 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
Electrical Distribution Plan	E101
PV Wiring	E102
Three Line Electrical Schematic	E602
One-Line Electrical Schematic	E601
Calculations of service/feeder net computed load and neutral load (NEC 220)	E603
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	E201

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

Masterformat Section	Category	Brief Description	Detailed Description	Manufacturer	Quantity	Units
Division 05						
Metals						
05 00 00	Foundation	Footings	18x18 seismic piers w/ STL-10	Ellis	18	ea
05 00 00	Foundation	Footings	12x12 seismic piers		25	ea
05 00 00	Foundation	Footings	6x6 seismic piers w/ STL-10	Ellis	29	ea
05 00 00	Floor Structure	Steel substructure framing	W4 and W12 Beam framing		2.9	tons
05 00 00	Canopy Superstructure	Canopy and Growlarium Structure	Galvanized Steel	Community Steel	9.5	tons
05 00 00	Roofing	Flashing	24-ga kynar (PVDF) coping with insect screen		156	lf
05 00 00	Exterior Decking	Ramp Construction	Diamond plate, ramp transition		36	sf
Division 06						
Wood						
06 00 00	Foundation	Footings	4x4 wood post over footing base; assumes 2' tall		48	lf
06 00 00	Floor Structure	Floor Build Up	2x6 floor framing		699	lf
06 00 00	Floor Structure	Floor Construction	1 3/4 9 1/2 LVL floor framing		83	lf
06 00 00	Floor Structure	Floor Construction	8.25" EPS SIP floor panels		768	sf
06 00 00	Floor Structure	Finish Floor Backer	1/2" plywood sheathing		768	sf
06 00 00	Roof Structure	Finish Ceiling Backer	1/2" plywood sheathing		772	sf
06 00 00	Roof Structure	Roof Construction	1 3/4 9 1/2 LVL roof framing		131	lf
06 00 00	Roof Structure	Roof Construction	10.25" SIP roof panel		772	sf
06 00 00	Roof Structure	Roof Drainage	2" x 5" tapered lumber		772	sf
06 00 00	Walls	Rain Screen	1x6 plank rain screen - larch		1326	sf
06 00 00	Walls	Exterior Wall Construction	10.25" R-40SIP wall panel		1060	sf
06 00 00	Walls	Exterior Wall Construction	1/2" plywood sheathing		1060	sf
06 00 00	Roof Structure	Roof Drainage	Roof Curb Buldup (stacked 2x3, 2x4, and 2x8)		156	lf
06 00 00	Walls	Interior Framing	Interior 2x6 framing		297	sf
06 00 00	Walls	Interior Framing	1/2" plywood		594	sf
06 00 00	Walls	Interior Framing	Interior 2x8 framing, furred wet wall		74	sf
06 00 00	Walls	Interior Framing	3/4" plywood, one side		74	sf
06 00 00	Exterior Decking	Deck Module Structure	2x8 deck framing		1913	sf
06 00 00	Exterior Decking	Decking	Decking 2x8-5/4 decking		794	sf
06 00 00	Exterior Decking	Ramp Decking	Decking 2x8-5/4 decking, ramp		408	sf
06 00 00	Exterior Decking	Ramp Construction	Railing, deck		86	lf
06 00 00	Exterior Decking	Ramp Construction	Railing, ramp		143	lf
Division 07						
Thermal and Moisture Protection						
07 00 00	Floor	Floor Construction	5 1/2" batt insulation		768	sf
07 00 00	Floor	Floor Construction	Vapor Barrier		772	sf
07 00 00	Walls	Exterior Wall Construction	Rainvent Battens	DuPont	1	ls
07 00 00	Walls	Exterior Wall Construction	TYVEK housewrap	TYVEK	1060	sf
07 00 00	Roofing	Roof Construction	TYVEK housewrap	TYVEK	809	sf
07 00 00	Roofing	Roof Construction	60mm TPO white		809	sf
Division 08						
Openings						
08 00 00	Windows	Fized Window	26x61" vented window		77	sf
08 00 00	Windows	Egress Window	26x61" vented window		11	sf
08 00 00	Doors	Large Folding Door	11'-9"x7'-0"	Eurowall	2	ea
08 00 00	Doors	Bathroom Exterior Door	3'-0"x7'-0" door		1	ea
08 00 00	Doors	Mechanical Room Door	9'-0"x7'-0" bi-fold door		1	ea
08 00 00	Doors	Bathroom Door	3'-2"x7'-0" pocket door		1	ea
08 00 00	Doors	Bedroom Door	2'-6"x7'-0" door		2	ea
08 00 00	Growlarium Construction	Growlarium Walls	single pane glazing	BC Greenhouses	471	sf
08 00 00	Doors	Growlarium Door	single pane glazing	BC Greenhouses	2	ea
08 00 00	Growlarium Construction	Growlarium Roof	single pane glazing	BC Greenhouses	371	sf
Division 09						
Finishes						
09 00 00	Interior Finish	Gypsum Board	1/2" Gypsum Board		1844	sf
09 00 00	Interior Finish	Wall Reveals	FRY Reglet (DCS-625-50) Reveal Strips		257	lf
09 00 00	Interior Finish	Wall Reveals	FRY Reglet (DCS-625-75) Reveal Strips		102	lf
09 00 00	Interior Finish	Wall Reveals	FRY Reglet (DCS-625-100) Reveal Strips		57	lf
09 00 00	Interior Finish	Wall Bathroom	Bathroom Laminate		477	sf
09 00 00	Interior Finish	Floor Wet Module	Ceramic Tile		280	sf
09 00 00	Interior Finish	Floor Dry Module	White Oak 3/4" x 5"		301	sf
09 00 00	Interior Finish	Ceiling	1/2" gypsum w/1" furring painted		1234	sf
Division 11						
Equipment						
11 00 00	Appliances	Vanity Mirror	3x2 mirror (assumed)		6	sf
11 00 00	Appliances	Refrigerator	Refrigerator		1	ea
11 00 00	Appliances	Dishwasher	Dishwasher		1	ea
11 00 00	Appliances	TV	VIZIO E-Series 28" Class Full-Array LED Smart TV	Sony	1	ea
11 00 00	Appliances	Laptop	Laptop		1	ea
11 00 00	Appliances	Washer	Washer		1	ea
11 00 00	Appliances	Cooktop/Range	Cooktop/Range		1	ea
11 00 00	Appliances	Range Hood	Range Hood		1	ea
11 00 00	Appliances	Oven	Wall Oven		1	ea
11 00 00	Appliances	Blue-ray	BDPS1500 Blu-ray Player (2015 Model)	Sony	1	ea
11 00 00	Appliances	Speakers	Speakers		1	ea
11 00 00	Appliances	Router	Internet Router		1	ea
11 00 00	Appliances	Dryer	Dryer		1	ea

Masterformat Section	Category	Brief Description	Detailed Description	Manufacturer	Quantity	Units
Division 12						
Furnishings						
12 00 00	Fittings	Kitchen Base Cabinet	33" Base Corner Cabinet		2	If
12 00 00	Fittings	Kitchen Base Cabinet	36" Sink Base Cabinet		1	If
12 00 00	Fittings	Kitchen Base Cabinet	12" Base Cabinet		2	ea
12 00 00	Fittings	Kitchen Base Cabinet	8" Base Pull Out Cabinet		2	ea
12 00 00	Fittings	Kitchen Wall Cabinet	24" w x 18" h x 24" deep Wall Cabinet		1	ea
12 00 00	Fittings	Kitchen Shelving	Glass Shelving (1'x5.5' 1/2" glass with necessary hardware)		2	ea
12 00 00	Fittings	Kitchen Countertop	Corian Countertop		30	SF
12 00 00	Fittings	Bathroom Countertop	Corian Countertop		1	ea
12 00 00	Fittings	Interior Wall	Frosted glass shower divider		1	ea
12 00 00	Fittings	Custom Fitting	Built-in entertainment center, living room & bedroom		1	ea
Division 21						
Fire Suppression						
21 00 00	Fire Protection	Detectors	Sprinkler head		7	ea
21 00 00	Fire Protection	System	Fitting-elbow		10	ea
21 00 00	Fire Protection	System	Fitting-tee		6	ea
21 00 00	Fire Protection	System	Pipe-straight 1/2" PEX		100	If
21 00 00	Fire Protection	System	Valve assembly		1	ea
21 00 00	Fire Protection	System	Pressure release valve		1	ea
21 00 00	Fire Protection	System	Pump station & controller		1	ea
Division 22						
Plumbing						
22 00 00	Plumbing	Toilet	Toilet		1	ea
22 00 00	Plumbing	Bathroom Sink	Bathroom Sink		1	ea
22 00 00	Plumbing	Bathroom Sink Drain	Bathroom Sink Drain		1	ea
22 00 00	Plumbing	Bathroom Sink Fixtures	Bathroom Sink Fixtures		1	ea
22 00 00	Plumbing	Shower Fixtures	Shower Fixtures		1	ea
22 00 00	Plumbing	Kitchen Sink	Kitchen Sink		1	ea
22 00 00	Plumbing	Kitchen Fixtures	Kitchen Sink Fixtures		1	ea
22 00 00	Plumbing	Shower Fixtures	Shower Drain		1	ea
22 00 00	Plumbing	Water Supply	Domestic water pump station		2	ea
22 00 00	Plumbing	Water Supply	Hot water tank - 80 gal		1	ea
22 00 00	Plumbing	Water Supply	Expansion tank		4	ea
22 00 00	Plumbing	Water Supply	Blackwater Tank - 500g		2	ea
22 00 00	Plumbing	Water Supply	1500-gallon tank		1	ls
22 00 00	Plumbing	Water Supply	Exterior Hose Bibb		2	ea
22 00 00	Plumbing	Water Supply	Plumbing supply pipe; PEX		220	If
22 00 00	Plumbing	Water Supply	Misc valves & fittings		1	ls
22 00 00	Plumbing	Sewage	Waste & vent piping; PVC		110	If
22 00 00	Plumbing	Solar Thermal	Apricus AP-30 Solar Collector System		1	ls
Division 23						
HVAC						
23 00 00	HVAC	Duct 1	13" x 5.5" duct		30	If
23 00 00	HVAC	Duct 2	8" x 5.5" duct		55	If
23 00 00	HVAC	Duct 3	6" x 5.5" duct		30	If
23 00 00	HVAC	Flex Duct	6" Flex duct		30	If
23 00 00	HVAC	Duct fittings	Duct fittings		1	ls
23 00 00	HVAC	Diffusers	Dampers		3	ea
23 00 00	HVAC	Diffusers	Indoor Underfloor Air Diffusers		7	ea
23 00 00	HVAC	Air Supply	2 Ton, Variable Speed, XV200 Condensing Heat Pump	Trane	1	ea
23 00 00	HVAC	Air Supply	2 Ton, Variable Speed Air Handler	Hyperion	1	ea
23 00 00	HVAC	Air Supply	5 Kw Electric Heater		1	ea
23 00 00	HVAC	Air Supply	XL950 Thermostat		1	ea
23 00 00	HVAC	Air Supply	Wired Remote Outdoor Air Sensor		1	ea
23 00 00	HVAC	Air Supply	GRD's		8	ea
23 00 00	HVAC	Air Supply	Energy Recovery ventilator		1	ea
23 00 00	HVAC	Air Supply	Outside grille for intake/exhaust		2	ea
23 00 00	HVAC	Air Supply	Temperature controls		1	ls
Division 26						
Electrical						
26 00 00	Electrical	Electrical Control	200A Panel, including AFCI circuit breakers		1	ea
26 00 00	Electrical	Electrical Control	Electrical meter		1	ea
26 00 00	Electrical	Electrical Control	Service entrance conductors (3) 2/0 THHN (1) #4 ground		15	If
26 00 00	Electrical	Electrical Distribution	200A SE Cable		50	If
26 00 00	Electrical	Electrical Distribution	Grounding Allowance		1	ls
26 00 00	Electrical	Electrical Distribution	Duplex		11	ea
26 00 00	Electrical	Electrical Distribution	Ground fault interrupter		9	ea
26 00 00	Electrical	Electrical Distribution	Weatherproof ground fault interrupter		4	ea
26 00 00	Electrical	Electrical Distribution	Floor box duplex		3	ea
26 00 00	Electrical	Electrical Distribution	30A Dryer outlet		2	ea
26 00 00	Electrical	Electrical Distribution	50A Range outlet		1	ea
26 00 00	Electrical	Electrical Distribution	30A Vehicle charging station		1	ea
26 00 00	Electrical	Electrical Distribution	Single pole switch, 1-gang		6	ea
26 00 00	Electrical	Electrical Distribution	3-way switch, 1-gang		8	ea
26 00 00	Electrical	Electrical Distribution	4-way, 1-gang		1	ea
26 00 00	Electrical	Electrical Distribution	14-2 NM Cable		1300	If
26 00 00	Electrical	Electrical Distribution	14-3 NM Cable		180	If
26 00 00	Electrical	Electrical Distribution	12-2 NM Cable		260	If

Masterformat Section	Category	Brief Description	Detailed Description	Manufacturer	Quantity	Units
Division 26	Electrical					
26 00 00	Electrical	Electrical Distribution	10-3 NM Cable		120	If
26 00 00	Electrical	Electrical Distribution	6-3 NM Cable		50	If
26 00 00	Electrical	Lighting	Track Head Light Fixtures (Aloyon LED LLAV11)		1	Is
26 00 00	Electrical	Lighting	Track Head Light Fixtures (Aloyon LED LLAV11)		14	ea
26 00 00	Electrical	Lighting	Track Head Light Fixtures (Smaller Beam Spread)		3	ea
26 00 00	Electrical	Lighting	Surface Mounted Spot Lights (Eureka4526-CHR-SA-BLKA)		7	ea
26 00 00	Electrical	Lighting	Vanity Light (Fluorescent Tube)		1	ea
26 00 00	Electrical	Lighting	Headboard Light Fixtures		2	ea
26 00 00	Electrical	Lighting	LED Strip Lighting		237	If
26 00 00	Electrical	Electrical Service	Domestic water pump station		2	ea
26 00 00	Electrical	Electrical Service	Domestic hot water tank; 80 gallon		1	ea
26 00 00	Electrical	Electrical Service	Domestic hot water buffer tank; 30 gallon		1	ea
26 00 00	Electrical	Electrical Service	Dishwasher connection		1	ea
26 00 00	Electrical	Electrical Service	Water-to-air heat pump		1	ea
26 00 00	Electrical	Electrical Service	Energy recovery ventilator		1	ea
26 00 00	Electrical	Cable	12-3 NM Cable		120	If
26 00 00	Electrical	Cable	10-3 NM Cable		200	If
26 00 00	Electrical	Control	Voice Opening		5	ea
26 00 00	Electrical	Control	Data Opening		5	ea
26 00 00	Electrical	Control	TV Opening		5	ea
26 00 00	Electrical	Electrical Service	Smoke Detector		5	ea
26 00 00	Electrical	PV System	PV Panels		24	ea
26 00 00	Electrical	PV System	PV Connections		60	ea
26 00 00	Electrical	PV System	PV Controller		1	ea
26 00 00	Electrical	PV System	Power Optimizers		26	1
26 00 00	Electrical	PV System	PV Disconnects		1	ea
26 00 00	Electrical	PV System	Central Inverter		1	ea
26 00 00	Electrical	PV System	Data Acquisition System DAS		1	ea
26 00 00	Electrical	PV System	Feeder, 3/4" PVC, #6, 3 wire		150	If

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Construction Specifications

Division 00 – Procurement and Contracting Requirements

00 01 01 Project Title Page

Title:

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GRoW Home

Completion Date:

October 2015

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Division 01 – General Requirements

01 12 00 Summary

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Documents.
 - 2. Specification formats and conventions.
- B. This set of documents, including the Drawings, Specifications, and other data provided, is an incomplete representation of the project. Pricing the project using these documents will result in an estimate that may be more or less than the price for the project when the documents are complete. Commencing or pursuing construction activities using these documents, including ordering of materials or systems, is not permitted.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: GRoW, a project of the University at Buffalo.
- B. Owner: Research Foundation, University at Buffalo.
- C. The Work consists of the following:
 - 1. The Work includes a single-family home, newly-constructed on a portable frame, designed for highway transport in 2 main sections, and for reassembly on another site. Work includes structure, interior and exterior finishes, fixtures, appliances, and electrical, mechanical, and plumbing systems. Work also includes some exterior work that is also transportable, and which serves to complete the utility systems and provide access to the home.

1.03 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI's "MasterFormat 2014 Update" numbering system.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 12 00



Division 05 – Metals

05 12 00 Structural Steel Framing

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Comply with applicable provisions of the following:
 - 1. AISC 360.
 - 2. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

PART 2 – PRODUCTS

2.1 COMPONENTS

- A. Adjustable Footings and Base Plates
- B. Steel Substructure
- C. Steel Canopy framework

2.2 STRUCTURAL STEEL

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 572/A 572M, Grade 50.
- C. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- F. Tube Steel: ASTM A 53/A 53M, Type E or S, Grade B.

2.3 ACCESSORIES

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325
- B. Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 and AISC 360.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
- C. Painting: Prepare surfaces clean and free of foreign materials or films of any kind. Where applicable, coat with Benjamin-Moore "Super Spec" alkyd based DTM paint.
- D. Galvanizing: shall be hot-dip galvanized steel complying with ASTM A 123/A 123M. Minimum Average Coating Thickness Grade by Material Category (From ASTM A123), the finish shall be continuous, smooth, and uniform. The appearance shall be free from uncoated areas, blisters, flux deposits and gross dross inclusions as well as having no heavy zinc deposits that interfere with intended use. The entire coating should have a strong adherence throughout the service life of galvanized steel.

PART 3 – EXECUTION

3.1 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated in SC- drawings and according to AISC 303 and AISC 360.
- B. Baseplates: Bearing Plates and Leveling Plates: Clean concrete and masonry surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate.
- C. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- D. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
 - 2. All bolts, lag screws, washers, and nuts shall be hot dipped galvanized.
 - 3. Refer to SC- drawings for sizes.
- E. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

END OF SECTION 05 12 00

05 50 00 Metal Fabrications

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Shop Drawings.

PART 2 - PRODUCTS

2.1 METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- C. Wire Rod for Bar Grating Crossbars: ASTM A 510 (ASTM A 510M).
- D. Rolled Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Steel Tubing: ASTM A 500/A 500M.
- F. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), black finish.
- G. Slotted Channel Framing: Cold-formed steel channels complying with MFMA-4
- H. Cast Iron: ASTM A 48/A 48M or ASTM A 47/A 47M.
- I. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 240/A 240M or ASTM A 666, Type 304.
- J. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- K. Zinc-Coated Steel Wire Rope: ASTM A 741.
 - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- L. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- M. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- N. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- O. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- P. Extruded-Bronze Shapes: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).

- Q. Bronze Castings: ASTM B 62, Alloy UNS No. C83600 (85-5-5-5 or No. 1 composition commercial red brass) or ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze).

2.2 FASTENERS

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

2.3 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107; recommended by manufacturer for exterior applications.

2.4 FABRICATION

- A. General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges. Form bent-metal corners to smallest radius possible without impairing work.
- B. Welding: Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. At exposed connections, finish welds and surfaces smooth, with contour of welded surface matching those adjacent.
- C. Comply with AWS for recommended practices in shop brazing. Braze behind finished surfaces without distorting or discoloring exposed side. Clean exposed brazed joints of flux, and dress exposed and contact surfaces.
- E. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
- F. Fabricate steel pipe columns with 1/2-inch steel base plates and 1/4-inch steel top plates welded to pipe with continuous fillet weld same size as pipe wall thickness. Drill top plates for connection bolts and base plates for 5/8-inch anchor bolts.
- G. Fabricate loose lintels from steel angles and shapes. Size to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches.

2.5 STEEL AND IRON FINISHES

- A. Hot-dip galvanize steel fabrications at exterior locations.
- B. Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 and paint with a fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

PART 3 - EXECUTION

3.1 INSTALLATION



- A. Provide anchorage devices and fasteners where needed to secure items to in-place construction.
- B. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack.
- C. Fit exposed connections accurately together to form hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers.

END OF SECTION 05 50 00

Division 06 – Wood, Plastics, and Composites

06 10 00 Rough Carpentry

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Wood blocking and nailers.
 - 3. Laminated Veneer Lumber (LVL)
 - 3. Plywood panels.

1.2 SECTION REQUIREMENTS

- A. Submittals: ICC-ES evaluation reports for engineered wood products.
- B. Related Sections include the following:
 - 1. 06 05 23 Wood Fasteners
 - 2. 06 12 00 Structural Insulated Panels
 - 3. 06 15 33 Wood Deck
 - 4. 06 20 00 Finish Carpentry
 - 5. 07 54 23 Thermoplastic Polyolefin (TPO) Roofing

PART 2 – PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Engineered wood products shall have allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

2.2 TREATED MATERIALS

- A. Preservative-Treated Materials: AWP A U1; Use Category UC3b for exterior construction not in contact with the ground.
 - 1. Use treatment containing no arsenic or chromium.
 - 2. Kiln-dry lumber after treatment to a maximum moisture content of 15 percent.
 - 3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- B. Provide preservative-treated materials for items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood framing members that are less than 18 inches above the ground.

2.3 FRAMING

A. Dimension Lumber:

1. Maximum Moisture Content: 15 percent
2. Non-Load-Bearing Interior Partitions: No. 2, Hem-fir (north): NLGA
3. Framing Other Than Non-Load-Bearing Interior Partitions: No. 2, Hem-fir (north): NLGA

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

1. Manufacturers:

- a. Georgia-Pacific Building Products
4 Treadeasy Avenue
Batavia, NY
Telephone: (585) 343-3800
Website: <http://www.buildgp.com/contact-us>
 - b. 84 lumber
2286 Military Road
Tonawanda, NY
Telephone: (716) 695-3784
Website: www.84lumber.com
 - c. Genesee Lumber Co
76 Franklin Street
Batavia, NY 14020
Telephone: (585) 343-0777
Website: www.geneseelumber.com
 - d. Gui's lumber and home center
4695 Shisler Road
Grand Island, NY 14072
Telephone: (716) 773-9060
Website: www.guislumber.com
 - e. Other: Equal approved by the architect in advance of bid submittal.
2. Extreme Fiber Stress in Bending, Edgewise: 2700 psi for **9.25" nominal**- depth members.
 3. Modulus of Elasticity, Edgewise: **2,000,000 psi**

C. Plywood:

1. Smooth faced, water-resistant 1/2 inch OSB plywood for SIP's roof splines.
2. Smooth faced, water-resistant 3/4 inch, 1/4 inch, 1/2 inch birch plywood.
3. Smooth faced, water-resistant 1/2 inch plywood for subfloor.

2.4 MISCELLANEOUS LUMBER



- A. Miscellaneous Dimension Lumber: No. 2 grade with 15 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.
- B. Concealed Boards: No. 2 Hem-fir with 15 percent maximum moisture content.

2.5 MISCELLANEOUS PRODUCTS

- A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel according to the drawings.
 - 1. Power-Driven Fasteners: CABO NER-272.
 - 2. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Structural capacity, type, and size indicated.
 - 1. Manufacturer: Simpson StrongTie
 - 2. Use 'Import' stainless steel 8D common nails, 2.5 inch long with bright finish and flat head @ 3" on center or equivalent.
 - 3. Use anchors made from hot-dip galvanized steel complying with ASTM A 653/A 653M, G60 coating designation for interior locations where stainless steel is not indicated.
 - 4. Use anchors made from stainless steel complying with ASTM A 666, Type 304 for exterior locations and where indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Securely attach rough carpentry to substrates, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Table 2304.9.1, "Fastening Schedule," in the IBC, Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

END OF SECTION 06 10 00

06 12 00 Structural Insulated Panels

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Structural Insulated Panels (SIPs).
- B. Related Sections: Section(s) related to this section include:
 - 1. Section 06 10 00 Rough Carpentry
 - 2. Section 06 09 00 Wood and Plastics Fastenings

1.2 SYSTEM DESCRIPTION

- A. Structural Insulated Panels (SIPs) consist of oriented strand board (OSB) laminated with structural adhesives to a termite resistant EPS insulation core, a EPA registered treatment for mold, mildew, and termites, and SIP Manufacturer supplied connecting splines, sealants, and SIP screws.

1.3 REFERENCES

- A. ACSE 7 - Minimum Loads for Buildings and other Structures.
- B. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- C. DOC PS2 – Performance Standard for Wood-based Structural-Use Panels.
- D. ICC ES AC04 – Acceptance Criteria for Sandwich Panels.
- E. ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives.
- F. ICC ES AC12 – Acceptance Criteria for Foam Plastic Insulation.
- G. ICC ES AC239 – Acceptance Criteria for Termite-Resistant Foam Plastics.
- H. AWPA E1 - Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites.
- I. AWPA E12- Standard Method of Determining Corrosion of Metal in Contact with Treated Wood.
- J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- K. EPA - Registered products listing.

1.4 DESIGN REQUIREMENTS



- A. Provide SIPs which have been manufactured, fabricated and installed to withstand loads as stated in the U.S. Department of Energy Solar Decathlon 2015 Building Code and to maintain performance criteria stated by SIP manufacturer without defects, damage or failure.

1.5 SUBMITTALS

- A. Product Data: Submit product data for specified products.
 - 1. SIP Code Compliance: Provide ICC ES code report for SIP with evidence of compliance with code requirements as an alternate method of construction. Submit current compliance report number from ICC ES showing conformance to the 2012 International Building Code (IBC) and International Residential Code (IRC). Code report shall include compliance with ICC ES AC04 (Sandwich Panels) dated February 2012.
 - 2. EPS Code Compliance: Provide ICC ES code report for EPS foam with evidence of compliance with code. Submit current compliance report numbers from ICC ES with conformance to the 2012 International Building Code (IBC) and International Residential Code (IRC). Code report shall include compliance with ICC ES AC12 (Foam Plastic) dated February 2011 and ICC ES AC239 (Termite-Resistance) dated October 2008.
 - 3. Manufacturer's Instructions: SIP Manufacturer's Construction Manual and load design charts.
- B. Calculations: Provide structural calculations by a registered architect or professional engineer in the state of New York qualified to perform such work.
- C. Shop Drawings: Submit shop drawings for SIPs showing layout, elevations, product components and accessories.
- D. Warranty: Warranty documents specified herein.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Installer should be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.
- B. Source Limitations: Obtain all SIPs through one source. All accessories to be as furnished or recommended by the SIP manufacturer.

1.6 REGULATORY REQUIREMENTS:

- A. SIPs shall be recognized for compliance with the International Building Code in a current ICC ES evaluation report
- B. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, SIP manufacturer installation instructions and SIP manufacturer warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.

PART 2 – PRODUCTS

2.1 Manufacturers/Suppliers:

- A. Thermal Foams, Inc., 2101 Kenmore Avenue, Buffalo, NY 14207

2.2 MATERIALS

- A. SIPs consisting of the following:
1. UL certified EPS core with Perform Guard treatment, minimum of 0.95 pcf complying with ASTM C578 Type I and having ICC ES recognition of termite resistance. Insulation manufacturer shall provide Third Party UL certificate. ICC ES report shall be provided for recognition of termite resistance in compliance with ICC AC239.
 2. OSB identified with APA or TECO performance mark with Exposure I durability rating and performance in accordance with DOC PS-2 span rating 24/16 or greater.
 3. Adhesives shall be in conformance with ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives
 4. FrameGuard treatment for mold, mildew, and termite resistance meeting the following requirements:
 - a. Registered with EPA.
 - b. Mold growth: 0 rating, tested to ASTM D3273 for 8 weeks at 77 degrees F and 100 percent relative humidity.
 - c. Termite resistance: Minimum rating of 7.0, tested to AWWA E-1.
 - d. Corrosion potential for metals in contact with treated wood: Maximum 2 mils per year, tested to AWWA E12 for minimum of 60 days on aluminum 2024, carbon steel, hot-dip galvanized steel, and G90 galvanized steel.
 - e. Equivalent lateral resistance and tooth holding capacity as untreated wood.

2.3 ACCESSORIES

- A. Splines: OSB (WALLS), or I-beam (ROOF + FLOOR) for use in joining SIPs shall be supplied by SIPs manufacturer.
- B. Fasteners: corrosion resistant SIP screws compatible with SIP system shall be provided by the SIPs manufacturer.
1. Wood Screws for attachment to wood members
 2. Heavy Duty Metal Screws for attachment to metal members (16 gauge to 3/16")
 3. Light Duty Metal Screws for attachment to metal decks (18 gauge or thinner)
- C. SIP Sealant: Shall be specifically designed for use with SIPs. Sealant must be compatible with all components of the SIP. Sealant shall be provided by the SIP manufacturer. VOC content of SIP sealant shall be less than 10 g/L.
- D. Dimensional Lumber: SPF, #2 or better, or engineered equivalent unless otherwise required by structural drawings.
1. 2x10 caps
 2. 1.75" x 9.25" Actual LVL Beams
 3. 1.75" x 7.25" Actual LVL Beams
- E. Vapor Barrier SIP Tape: woven and coated polyolefin membrane with synthetic adhesive suitable for indoor use, min. 4 inch wide for use on SIP joints as specified by designer. SIP Tape shall be supplied by the SIP manufacturer.

2.4 FABRICATION

- A. Sizes: SIPs shall be fabricated in accordance with approved Shop Drawings

- B. Thermal Resistance, R-value
 1. 8 ¼" thick SIP with R-value of 29 at 75oF (32 at 40oF) [FLOOR]
 2. 10 ¼" thick SIP with R-value of 37 at 75oF (40 at 40oF) [ROOF + WALLS]

2.5 PRODUCT SUBSTITUTIONS

- A. Substitutions: No substitutions permitted without fourteen day (14) prior approval.

2.6 RELATED MATERIALS

- A. Related Materials: Refer to other sections for related materials as follows:
 1. Dimensional Lumber: SPF #2 or better or pre-engineered equivalent: Refer to Division 6 Carpentry Sections.
 2. Laminated-Veneer Lumber: Refer to Division 6 Carpentry Sections.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's ICC ES report, Load Design Charts, Construction Manual, Shop Drawings, and product data, including product technical bulletins, for installation.
- B. Plans shall be reviewed by a qualified architect/engineer and shall be signed and/or sealed. Deviations from standard detail and load design values shall be calculated and signed and/or sealed by a qualified architect/engineer.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.
 1. Verify conditions of foundation/structural system/substrate and other conditions which affect installation of SIPs. Any adverse conditions shall be reported in writing. Do not proceed with installation until adverse conditions are corrected.

3.3 INSTALLATION

- A. SIP Installation:
 1. SIP Supports: Provide level and square foundation/structural system/substrate that support wall and/or roof SIPs. For wall SIPs, hold sill plate back from edge of rim board 7/16" to allow full bearing of OSB skins. Provide 1 1/2" diameter access holes in plating to align with electrical wire chases in SIPs. Provide adequate bracing of SIPs during erection. Remove debris from plate area prior to SIP placement.
 2. SIP Fastening: Connect SIPs by nails as shown on drawings. SIP sealant must be used together with each fastening techniques. Where SIP Screw Fasteners are used, provide a minimum of 1" penetration into support. Join SIPs using plates and splines. Secure attachment with nails, staples, or screws, and SIP sealant. Apply SIP sealant following SIP manufacturer recommendations.
 3. SIP Tape: Provide SIP Tape at joints between SIP panels and at intersection of SIP roof and wall.
 4. Vapor Retarders: Provide vapor retarders mandated by building code or climate conditions.



5. Thermal Barriers: Interior surfaces of SIPs shall be finished with a minimum 15-minute thermal barrier, such as 1/2" gypsum wallboard, nominal 1" wood paneling, or other approved materials. Apply code approved thermal barriers according to SIP manufacturer's recommendations.
6. Restrictions: Do not install SIPs directly on concrete. Do not put plumbing in SIPs without consulting SIP manufacturer. Do not overcut skins for field-cut openings and do not cut skins for electrical chases. SIPs shall be protected from exposure to solvents and their vapors that damage the EPS foam core.
7. Remove and replace insulated wall or roof SIPs which have become excessively wet or damaged before proceeding with installation of additional SIPs or other work.

3.4 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction.
 1. Roof SIPs: Protect roof SIPs from weather. Provide temporary protection at the end of the day or when rain or snow is imminent.
 2. After installation, cover SIPs to prevent contact with water on each exposed SIP edges and faces.

END OF SECTION 06 12 00



06 15 33 Wood Deck

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: ICC-ES evaluation reports for preservative-treated wood metal framing anchors, and decking fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.
- B. Maximum Moisture Content:
 - 1. Boards: 15 percent.
 - 2. Dimension Lumber: 15 percent

2.2 WOOD MATERIALS

- A. Wood Decking:
 - 1. Dimension Lumber Decking: No. 1 grade and the following species:
 - a. Mixed southern pine; SPIB.
 - 2. Board Decking: 1-1/4-inch-thick, radius-edged decking of the following species and grades:
 - a. Southern pine, Standard; SPIB.
- B. Railings: Provide material hand selected for freedom from characteristics that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.
 - 1. Dimension Lumber Railing Members: Construction or No. 2 grade and the following species:
 - a. Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; NLGA, WCLIB, or WWPA.
 - 3. Railing Boards
 - a. Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; NLGA, WCLIB, or WWPA.
- C. Dimension Lumber Framing
 - 1. Deck Framing: No. 1 grade and the following species:
 - b. Southern pine; SPIB.
 - 2. Dimension Lumber Posts: No. 2 grade and the following species:
 - c. Mixed southern pine; SPIB.

2.3 TREATED MATERIALS

- A. Preservative-Treated Boards and Dimension Lumber: AWPA U1; Use Category UC3b.
- B. Preservative-Treated Timber and Poles: AWPA U1; Use Category UC4a, waterborne preservative.
 - 1. Use treatment containing no arsenic or chromium.

- C. After treatment, redry boards and dimension lumber to 19 percent maximum moisture content.
- D. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
- E. Provide preservative-treated materials for all exterior rough carpentry unless otherwise indicated.
 - 1. Framing members.
 - 2. Posts.
 - 3. Decking.

2.5 MISCELLANEOUS PRODUCTS

- A. Fasteners: Use stainless steel unless otherwise indicated.
 - 1. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
 - 2. Power-Driven Fasteners: ICC-ES AC70.
- B. Metal Framing Anchors: Structural capacity, type, and size indicated, made from hot-dip galvanized steel complying with ASTM A 653/A 653M, G60 (Z180) coating.
 - 1. Simpson StrongTie

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.
- C. Securely attach work to substrates, complying with the following:
 - 1. ICC-ES AC70 for power-driven fasteners.
 - 2. "Fastening Schedule" in ICC's International Building Code.
 - 3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.
- D. Secure decking to framing with screws.
- F. Railing Installation: Countersink fastener heads, fill flush, and sand filler.
 - 1. Fit balusters to railings, glue, and screw in place.
 - 2. Secure posts to stringers with steel brackets and through bolts.

END OF SECTION 061533

06 16 00 Sheathing

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: ICC-ES evaluation reports for preservative-treated plywood.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: DOC PS 1.
- B. Oriented Strand Board: DOC PS 2.

2.2 WALL SHEATHING

- A. Cementitious Backer Units: ASTM C 1325, Type A.
 - 1. USG Durock[®]

2.3 ROOF SHEATHING

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

2.5 SUBFLOORING AND UNDERLAYMENT

- A. Subflooring:
 - 1. Oriented-Strand-Board Subflooring: Exposure 1 single-floor panels or sheathing.
- C. Underlayment:
 - 1. Hardboard Underlayment: AHA A135.4, Class 4 (Service), Surface S1S; with back side sanded.

2.6 MISCELLANEOUS PRODUCTS

- A. Fasteners: Size and type indicated.
 - 1. Power-Driven Fasteners: CABO NER-272.
- B. Adhesives for Field Gluing Panels to Framing: APA AFG-01.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely attach to substrates, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.



- B. Fastening Methods:
 - 1. Subflooring:
 - a. Glue and nail to wood framing.
 - 2. Roof Sheathing:
 - a. Nail to wood framing.
 - 3. Underlayment:
 - a. Thin-set and screw to subflooring.

- D. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

END OF SECTION 061600



06 20 00 Finish Carpentry

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Samples for siding, hardboard paneling, moldings and trim.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.
- B. Softwood Plywood: DOC PS 1.
- C. Baltic Birch Plywood

2.2 EXTERIOR FINISH CARPENTRY

- A. Lumber Siding: Kiln-dried, Grade 1 Larch, 5 3/4-inch by 1-inch, tongue and groove.
 - 1. Maximum Moisture Content: 15 percent.

2.3 INTERIOR FINISH CARPENTRY

- A. Interior Entertainment Center: 3/4-inch Baltic Birch Plywood with interlocking radiused joints.
- B. Mechanical Room Wall: : 3/4-inch Baltic Birch Plywood
- C. Fixed Window Trim: : Baltic Birch Plywood
- D. Vent operable door: Baltic Birch Plywood, painted to match adjacent walls.

2.4 RAILINGS

- A. Exterior Railings: Kiln-dried, Grade 1 Larch.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Stainless-steel.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer.
 - 1. Wood glue shall have a VOC content of 30 g/L or less.
 - 2. Use waterproof resorcinol glue for exterior applications.



- C. Insect Screening for Soffit Vents: PVC-coated glass-fiber fabric.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Condition interior finish carpentry in installation areas for 24 hours before installing.
- B. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.
- C. Install to tolerance of **1/8 inch in 96 inches** for level and plumb. Install adjoining exterior finish carpentry with **1/32-inch** maximum offset for flush installation and **1/16-inch** maximum offset for reveal installation.
- E. Subparagraph below is based on NFPA 101 requirements.
- F. Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than **24 inches** long except where necessary. Stagger joints in adjacent and related trim. Cope at returns and inside corners and miter at outside corners.
- G. Select and arrange paneling for best match of adjacent units. Install with uniform tight joints.

END OF SECTION 06 20 00

06 41 13 Wood-Veneer-Faced Architectural Cabinets

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Section Includes Bedroom Casework
- B. Submittals: Shop Drawings.
- C. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is completed, and HVAC system is operating.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINETS

- A. Quality Standard: AWI, AWMAC, and WI's "Architectural Woodwork Standards."
- B. Wood Cabinets for Transparent Finish: Custom grade.
 - 1. Type of Construction: Frameless.
 - 2. Cabinet Door and Drawer Style: Flush overlay.
 - 3. Wood Species for Exposed Surfaces: Baltic Birch Plywood.
 - 4. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.

2.2 MATERIALS

- A. Wood Moisture Content: 5 to 10 percent.
- B. Particleboard Faced with White Melamine: ANSI A208.1, Grade M-2
- C. Baltic Birch Plywood

2.3 CABINET HARDWARE AND ACCESSORY MATERIALS

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- B. Edge Pulls: Back mounted, solid aluminum, 4 inches long.
- C. Shelf Rests: BHMA A156.9, B04013; metal on drilled holes.
- G. Drawer Slides: BHMA A156.9, B05091.
 - 1. Box Drawer Slides: Grade 1.
- I. Furring, Blocking, Shims, and Hanging Strips: Softwood lumber, kiln dried to 15 percent moisture content.

2.4 FABRICATION

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

2.5 SHOP FINISHING OF WOOD CABINETS

- A. Finishes: Same grades as items to be finished.
- B. Finish cabinets at the fabrication shop; defer only final touchup until after installation.
 - 1. Apply one coat of sealer or primer to concealed surfaces of cabinets. Apply two coats to end-grain surfaces.
 - 2. Apply a wash coat sealer to woodwork made from closed-grain wood before staining and finishing.
 - 3. After staining, if any, apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
- C. Transparent Finish:
 - 1. Product: Minwax® Polycrylic®.
 - 2. Sheen: Clear Satin.
 - 3. Application: Brushed on.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Install cabinets to comply with referenced quality standard for grade specified.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built into or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Use finishing screws for exposed nailing, countersunk and filled flush.
- F. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
 - 1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into SIP wall.

END OF SECTION 064113



06 41 16 Plastic-Laminate Faced Architectural Cabinet

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Section includes:
 - 1. Wood and laminate finish used for the kitchen cabinets.
 - 2. Wood and laminate finish used for bathroom cabinets
- B. Submittals: Shop Drawings.
- C. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is completed, and HVAC system is operating.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINETS

- A. Quality Standard: AWI, AWMAC, and WI's "Architectural Woodwork Standards."
- B. Plastic-Laminate Cabinets: Custom grade.
 - 1. Type of Construction: Frameless.
 - 2. Cabinet Door and Drawer Style: Flush overlay.
 - 3. Laminate Cladding: Thermoset Decorative panels.
 - 4. Drawer Sides and Backs: Solid hardwood.
 - 5. Drawer Bottoms: Hardwood plywood.

2.2 MATERIALS

- A. Wood Moisture Content: 5 to 10 percent.
- B. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
- C. Particleboard Faced with White Melamine.
- E. High-Pressure Decorative Laminate: NEMA LD 3.

2.3 CABINET HARDWARE AND ACCESSORY MATERIALS

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- B. Edge Pulls: Back mounted, solid aluminum, 4 inches long.
- C. Shelf Rests: BHMA A156.9, B04013; metal on drilled holes.



- G. Drawer Slides: BHMA A156.9, B05091.
 - 1. Box Drawer Slides: Grade 1.

- I. Furring, Blocking, Shims, and Hanging Strips: Softwood lumber, kiln dried to 15 percent moisture content.

2.4 FABRICATION

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Install cabinets to comply with referenced quality standard for grade specified.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built into or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing.
- F. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
 - 1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into SIP wall.

END OF SECTION 064116



Division 07 – Thermal and Moisture Protection

07 21 00 Thermal Insulation

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Batt insulation.
 - 2. Auxiliary Insulating Materials
- B. Related Work specified elsewhere includes:
 - 1. Division 07 roofing Sections for insulation installed as part of the roofing system.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Schedule: Indicate where each type of product is to be applied. Provide drawings if necessary to show where insulation is to be installed.

PART 2 - PRODUCTS

2.1 BATT INSULATION

- A. Mineral-Fiber-Blanket Insulation: ASTM C 665, Type I, unfaced, with flame-spread index of 25 or less.

2.2 AUXILIARY INSULATING MATERIALS

- A. Insulation for Small Voids: Foamed in-place plastic

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.



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

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- D. Electrical Boxes: Install sheet caulking at each electrical switch and outlet box and at cavity spaces where required to prevent air infiltration through boxes in framed and cavity walls.

END OF SECTION 07 21 00

07 25 00 Weather Barriers

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: ICC-ES evaluation reports for water-resistive barrier.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIERS

- A. Building Wrap: ASTM E 1677, Type I air barrier; with water-vapor permeance not less than 23 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A); flame-spread and smoke-developed indexes not greater than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. DUPONT™ TYVEK® COMMERCIALWRAP®

2.2 ACCESSORIES

- A. Flexible Flashing: Adhesive butyl rubber compound, bonded to plastic film or spunbonded polyolefin, with an overall thickness of 0.030 inch (0.8 mm).
 - 1. Butyl Rubber:
 - a. DUPONT™ FLEXWRAP NF®
 - b. DUPONT™ STRAIGHTFLASH®
- B. Building Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.
- B. Rainscreen Battens
 - 1. DUPONT™ RAINVENT® BATTEN

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Building Wrap Installation:
 - 1. Apply building wrap immediately after sheathing is installed.
 - 2. Seal seams, edges, fasteners, and penetrations with building wrap tape.
 - 3. Extend into jambs of openings and seal corners with building wrap tape.
- B. Flexible Flashing Installation:
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least 3 inches (75 mm), except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.



4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller.

C. Rainscreen Batten Installation:

1. Place the battens over DuPont™ Tyvek® at 16" on center and align with the wall studs. Secure DuPont™ RainVent™ Battens in place with 1" crown, 1-1/4" long staples at 16" on center or other approved fasteners capable of penetrating the studs by 1/2"

END OF SECTION 072500

07 54 23 Thermoplastic Polyolefin (TPO) Roofing

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Engineered Thermoplastic Polyolefin (TPO) single ply mechanically fastened membrane roofing system, including Thermoplastic Polyolefin (TPO), cover board, coping/fascia system, metal flashing, fixing hardware; designed to provide a closed roof system, with sizes and configurations as shown on drawings and specified herein.
- B. Basis of design shall be the Thermoplastic Polyolefin (TPO) with 10 feet wide and 45 mils thick minimum.
- C. Warranties: Manufacturer's standard form or customized, without monetary limitation, signed by roofing manufacturer agreeing to repair leaks due to defects in materials or workmanship for period of 10 years.
- D. Related Sections include the following:
 - 1. 06 10 00 Rough Carpentry
 - 2. 06 12 00 Structural Insulated Panels
 - 3. 07 62 00 Sheet Metal Flashing and Trim

1.2 REFERENCES

- A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:
 - 1. ASTM D 1079 "Terminology Relating to Roofing and Waterproofing."
 - 2. Glossary of NRCA's "The NRCA Roofing and Waterproofing Manual."
 - 3. Roof Consultants Institute "Glossary of Roofing Terms."
 - 4. Sheet Metal Terminology and Techniques: SMACNA Architectural Sheet Metal Manual.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets for each product to be provided.
- B. Detail Drawings: Review roofing system plans, elevations, sections, details, and details of attachment to other Work, as included in the attached bid set and approve prior to submittal of bid:
 - 1. Base metal flashings, cants, and membrane terminations.
 - 2. Any crickets, saddles, and tapered edge strips, including slopes.
- C. Verification Samples: Provide for each product specified.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" and "Guarantees" Article.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's guarantee.
- B. Manufacturer Qualifications: Qualified manufacturer that has UL listing or FMG approval for roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 SITE CONDITIONS, DELIVERY, STORAGE AND HANDLING

- A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- B. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- C. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.6 WARRANTY

- A. Provide manufacturer's standard warranty against defects in materials and workmanship. Warranty to be issued by the original manufacturer. No third party or other sub-supplier warranties will be accepted.
- B. Warranty Period: Ten years for TPO roof membrane and for all other components from the date of final completion.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS



- A. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
- B. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- C. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980.
- D. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- E. Energy Performance: Three-year, aged, solar reflectance not less than 0.55 and emissivity not less than 0.75 or aged, Solar Reflectance Index of not less than 64.
- E. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class B; Roof assembly material shall be tested in accordance with ASTM E 108 or UL 790.
 - 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

2.2 SUPPLIER

- A. Carlisle Syntec
P.O. Box 7000, Carlisle, PA 17013
(800) 479-6832
- B. Johns Manville Corporate Offices,
P. O. Box 5108, Denver, CO 80217-5108
Toll Free: (800) 922-5922
Telephone: (303) 978-2000
Website: www.jm.com
- C. Firestone Building Products
250 West 96th Street, Indianapolis, IN 46260
Toll Free: (800) 428-4442
Telephone: (317) 575-7000 phone
Fax: (317) 575-7100
Website: www.firestonebpco.com
- D. Other: Approved equal approved by the architect in advance of bid submittal.

2.3 MATERIALS

- A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible, TPO sheet.
 - 1. Thickness: 45 mils, minimum.
 - 2. Exposed Face Color: White.

3. Tensile Strength: Minimum of 300 lbs as tested using ASTM D751
4. Tearing Strength: Minimum of 85 lbs as tested using ASTM D751

B. Cover Board:

1. Smooth faced, water-resistant 3/4 inch Plywood.

C. Auxiliary Materials:

1. Sheet Flashing: Unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.
2. Bonding Adhesive: LVOC.
3. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
4. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors.
5. Metal Flashing Sheet: Provide 26 gauge thick SS Metal flashing sheet specified in Section 1.2 "REFERENCES"
 - A. 4 - Sheet Metal Terminology and Techniques.
6. Any Miscellaneous Accessories.

2.4 TAPERED ROOF STRUCTURE

- A. Examine and verify already constructed tapered structure using plywood blocks with slope of 1/4 inch per 12 inches unless otherwise indicated.

2.5 VAPOR RETARDER/BARRIER

- A. Apply Dupont™ Tyvek® COMMERCIALWRAP® air barrier as per manufacturer's instructions; tested according to ASTM E2357. Verify with Joe

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide two skilled people to assist our construction team members with TPO roof installation on site in Buffalo for a period of at least two days.
- B. Examine substrates, areas, and conditions for compliance with requirements affecting performance of roofing system:
 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
- C. Clean and remove sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation.
- D. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.



- E. Proceed with installation only after unsatisfactory conditions have been corrected.
- F. Install TPO sheet according to roofing system as per instructions:
 - 1. Examine and check tapered wood structure created and completed prior to TPO roof installation to maintain the roof's slopes.
 - 2. Mechanically Fastened Sheet Installation: Secure one edge of sheet using fastening plates centered within the membrane splice, and mechanically fasten sheet to roof deck over the tapered wood structure.
- G. Spread sealant bed over deck drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.
- H. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- I. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- J. Terminate and seal top of sheet flashings.

END OF SECTION 07 54 23

07 62 00 Sheet Metal Flashing and Trim

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings, and color Samples.
- B. Coordinate installation of sheet metal flashing and trim with adjoining roofing and wall materials, joints, and seams to provide a leakproof, secure, and noncorrosive installation.
- C. Fabricator Qualifications: For copings and low-slope roof edge flashings that are SPRI ES-1 tested and/or FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standard: Comply with NRCA's "The NRCA Roofing Manual unless otherwise indicated. Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- B. FM Approvals' Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification. Identify materials with name of fabricator and design approved by FM Approvals.
- C. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the design pressure as noted in drawings

2.2 SHEET METAL

- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, not less than 0.032 inch (0.8 mm) thick; finished as follows:
 - 1. Finish: Manufacturer's standard two-coat fluoropolymer system with color coat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

2.3 ACCESSORIES

- A. Self-Adhering, High-Temperature Sheet Underlayment: Butyl or SBS-modified asphalt; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F (116 deg C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
- B. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.
- C. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners.

1. Exposed Fasteners: Heads matching color of sheet metal roofing using plastic caps or factory-applied coating.
2. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
3. Fasteners for Copper: Copper, hardware bronze, or Series 300 stainless steel.
4. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
5. Fasteners for Zinc-Tin Alloy-Coated Stainless-Steel Sheet: Series 300 stainless steel.
6. Fasteners for Metallic-Coated Steel Sheet: Hot-dip galvanized steel or Series 300 stainless steel.

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

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

- A. Fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to the design, dimensions, geometry, metal thickness, and other characteristics of item indicated.
- B. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that are capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with cited sheet metal standards. Allow for thermal expansion; set true to line and level. Install Work with laps, joints, and seams permanently watertight and weatherproof; conceal fasteners where possible.
- B. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- C. Seams: Fabricate nonmoving seams with flat-lock seams.[For aluminum, form seams and seal with epoxy seam sealer. Rivet joints for additional strength.]
- D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to a width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
 1. Do not solder [metallic-coated steel] [and] [aluminum] sheet.
 2. Do not pretin zinc-tin alloy-coated stainless steel.
 3. Do not use torches for soldering.
 4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.



- E. Metal Protection: Where dissimilar metals contact each other, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating.
 - 1. Coat concealed side of aluminum with bituminous coating where it contacts wood, ferrous metal, or cementitious construction.

END OF SECTION 07 62 00

07 71 00 Roof Specialties

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings, and color Samples.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. SPRI Wind Design Standard: Manufacture and install copings roof-edge specialties tested according to SPRI ES-1 and capable of resisting the design pressure as noted on drawings.

2.2 ROOF SPECIALTIES

- A. Copings: Formed metal coping system consisting of formed-metal coping cap, concealed anchorage, corner units, end cap units, and concealed splice plates.

- 1. Formed Aluminum: 0.040 inch thick.

- D. Scuppers:

- 1. Scupper: Fabricated in uniform section lengths, with matching corner units, ends, outlet tubes, and other accessories. Furnish expansion joints and expansion-joint covers.
 - a. Scupper Style: Two piece rectangular box with drainage hole.
 - b. Aluminum: 0.040 inch.

2.3 MATERIALS

- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required.
- B. Aluminum Finish: Two-coat fluoropolymer system with color coat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
- C. Self-Adhering Sheet Underlayment, High Temperature: Butyl or SBS-modified asphalt; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F (116 deg C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
- D. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements.
 - 1. Exposed Penetrating Fasteners: Gasketed screws with heads matching color of metal.
 - 2. Fasteners for Copper Sheet: Copper, hardware bronze, or Series 300 stainless steel.
 - 3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
 - 4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 - 5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel.

- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant.
- F. Butyl Sealant: ASTM C 1311, solvent-release butyl rubber sealant.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement.
- B. Coat back side of [aluminum] [stainless-steel] roof specialties with bituminous coating where they will contact wood or ferrous metal construction.
- C. Separate dissimilar metals with a bituminous coating or polymer-modified, bituminous sheet underlayment.
- D. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- E. Space movement joints at a maximum of [12 feet (3.6 m)] <Insert dimension> with no joints within [18 inches (450 mm)] <Insert dimension> of corners or intersections unless indicated.
- F. Fastener Sizes: Use fasteners of sizes that will penetrate [wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws] [substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance] <Insert size requirement>.
- H. Scuppers: Allow for thermal expansion. Attach scupper to firmly anchored scupper supports.

END OF SECTION 077100

07 92 00 Joint Sealants

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and color Samples.
- B. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

- A. Low-Emitting Materials: Sealants shall comply with the following limits for VOC content:
 - 1. Architectural Sealants: 250 g/L.
 - 2. Nonmembrane Roof Sealants: 300 g/L.
 - 3. Single-Ply Roof Membrane Sealants: 450 g/L.
 - 4. Other Sealants: 420 g/L.
 - 5. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 6. Sealant Primers for Porous Substrates: 775 g/L.
 - 7. Modified Bituminous Sealant Primers: 500 g/L.
 - 8. Other Sealant Primers: 750 g/L.
- B. Low-Emitting Materials:
 - 1. Exterior reactive sealants shall have a VOC content of not more than 50 g/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.
 - 3. Interior sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.
- D. Sealant for Use in Building Expansion Joints[, One of the Following]:
 - 1. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 50.
- E. Sealant for General Exterior Use Where Another Type Is Not Specified[, One of the Following]:
 - 1. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 25.
- F. Sealant for Exterior Traffic-Bearing Joints, Where Slope Precludes Use of Pourable Sealant:
 - 1. Single-component, nonsag urethane sealant, ASTM C 920, Type S; Grade NS; Class 25.

- G. Sealant for Exterior Traffic-Bearing Joints, Where Slope Allows Use of Pourable Sealant:
 - 1. Single-component, pourable urethane sealant, ASTM C 920, Type S; Grade P; Class 25.
- H. Sealant for Use in Interior Joints in Ceramic Tile and Other Hard Surfaces in Kitchens and Toilet Rooms and around Plumbing Fixtures:
 - 1. Single-component, mildew-resistant silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; formulated with fungicide.
- I. Sealant for Interior Use at Perimeters of Door and Window Frames:
 - 1. Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
- J. Acoustical Sealant:
 - 1. Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission as demonstrated by testing according to ASTM E 90.

2.2 MISCELLANEOUS MATERIALS

- A. Provide sealant backings of materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.
- D. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 1193.
- B. Install sealant backings to support sealants during application and to produce cross-sectional shapes and depths of installed sealants that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.



- D. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal perimeters, control joints, openings, and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions. Comply with ASTM C 919.

END OF SECTION 079200

Division 08 – Openings

08 14 23 Out-Swing Entry Doors

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Factory-primed Wood French hinged doors.

1.2 RELATED SECTIONS

- A. Section 07 25 00 - Weather Barriers: Water-resistant barrier.
- B. Section 07 92 00 - Joint Sealants: Sealants and caulking.

1.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Doors.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM B 117 - Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM C 1036 - Flat Glass.
 - 3. ASTM C 1048 - Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass.
 - 4. ASTM D 1149 - Rubber Deterioration – Surface Ozone Cracking in a Chamber.
 - 5. ASTM D 2803 - Filiform Corrosion Resistance of Organic Coatings on Metal.
 - 6. ASTM D 3656 - Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
 - 7. ASTM D 4060 - Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - 8. ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
 - 9. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 - 10. ASTM E 547 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.
 - 11. ASTM G 85 - Modified Salt Spray (Fog) Testing.
- C. Screen Manufacturers Association (SMA):
 - 1. SMA 1201 - Specifications for Insect Screens for Windows, Sliding Doors and Swinging Doors.
- D. Window and Door Manufacturers Association (WDMA):
 - 1. ANSI/AAMA/NWDA 101/I.S.2 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
 - 2. ANSI/AAMA/NWDA 101/I.S.2/NAFS-02 - Voluntary Performance Specification for Windows, Skylights and Glass Doors.
 - 3. WDMA I.S.4 - Industry Standard for Water-Repellent Preservative Non-Pressure Treatment for Millwork.



1.4 PERFORMANCE REQUIREMENTS

- A. Door Unit Air Leakage, ASTM E 283, 1.57 psf (25 mph): 0.15 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 547, under static pressure of 0 psf (0 mph) after 4 cycles of 5 minutes each, with water being applied at a rate of 5 gallons per hour per square foot.

1.5 SUBMITTALS

- A. Comply with Division 1 requirements.
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Warranty: Submit manufacturer's standard warranty.

1.6 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.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Pella Corporation, 102 Main Street, Pella, Iowa 50219. Toll Free (800) 54-PELLA. Phone (641) 621-1000. Website www.pella.com.

2.2 WOOD FRENCH HINGED DOORS

- A. Factory-Primed Wood Out-swing French Door: Architect Series factory-assembled wood French doors with outward swing door panels installed in frame.
- B. Frame:
 - 1. Select wood, water-repellent, preservative-treated with EnduraGuard® in accordance with WDMA I.S.-4. EnduraGuard includes water-repellency, three active fungicides and an insecticide applied to the frame.
 - 2. Exposed Surfaces: Pine veneered and edge-banded with no visible fastener holes.
 - 3. Exterior Finish: Factory-Primed Morning Sky Grey.
 - 4. Sill: 1/2-inch low-profile extruded aluminum with mill finish.

5. Overall Frame Depth: 5-7/8 inches.

E. Weather Strip:

1. Panel-mounted, dual-durometer extruded polymer one-piece design with welded corner.

2.3 GLAZING

A. Glazing:

1. Float Glass: ASTM C 1036, Quality 1.

a. Tempered Glass: ASTM C 1048.

2. Type: Glass: Insulated Triple Tempered Obscure Low-E Obscure SunDefense™ Low-E Insulating Glass Air Filled High Altitude 1"

2.5 HARDWARE

A. Handles:

1. Solid brass on interior and exterior.

2. Interior thumb-turn.

3. Schlage configured "C-K" keyway pinlock cylinder on exterior.

4. Finish: Endura Hardware Collection satin nickel.

B. Locking System:

1. Mortised and keyed multi-point locking system.

2. 7/8-inch center dead bolt and shoot-bolts at head and sill shall engage simultaneously.

C. Hinges:

1. Corrosion-resistant leaves with wear-resistant hinge bushings, stainless steel pin and decorative cap.

2. Doors with frame heights greater than 6' 10": 4 hinges.

3. Finish:

a. Out-Swing Doors: Match exterior door cladding.

2.6 TOLERANCES

A. Doors shall accommodate the following opening tolerances:

1. Vertical Dimensions Between High and Low Points: Plus 1/8 inch, minus 0 inch.

2. Width Dimensions: Plus 1/8 inch, minus 0 inch.

3. Building Columns or Masonry Openings: Plus or minus 1/8 inch from plumb.

2.7 FINISH

A. Exterior Finish: Standard Enduraclad, Black.

B. Interior Finish: Unfinished, ready for site finishing.

2.8 INSTALLATION ACCESSORIES

- A. Flashing/Sealant Tape: Pella SmartFlash.
 - 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.
- B. Interior Insulating-Foam Sealant: Low-expansion, low-pressure polyurethane insulating window and door foam sealant.
- C. Exterior Perimeter Sealant: "Pella Window and Door Installation Sealant" or equivalent high quality, multi-purpose sealant as specified in the joints sealant section.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 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 water-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with water-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.

3.3 CLEANING

- A. Clean door frames and glass in accordance with Division 1 requirements.
- B. Do not use harsh cleaning materials or methods that would damage finish.



- C. Remove labels and visible markings.

3.4 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 13



08 35 13 Mechanical Room Door

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 FOLDING DOORS

- B. Panel-Folding Doors: Top-supported panels, continuous hinges on alternate sides of panels, and manufacturer's standard track and hardware.
 - 1. Panel: Baltic Birch Plywood, transparent.
 - 2. Track: Recessedmounted.
 - 5. Carriers: Four-wheel carriers at lead post and two-wheel intermediate carriers.
 - 7. Hardware Finish: Clear-anodized aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install track in one piece.
- B. Install folding doors with floor clearances of 1/4 to 3/4 inch.
- C. Adjust units as necessary to ensure smooth, quiet operation without warping or binding.

END OF SECTION 083513

41 00 Folding Glass Wall System

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Engineered sliding/folding aluminum and glass door system, including aluminum frame, threshold, panels, sliding/folding and locking hardware, weather stripping, glass and glazing; designed to provide an opening glass wall, with sizes and configurations as shown on drawings and specified herein.
- B. Basis of design shall be the Euro-Wall C5 Thermally Broken o3R and o3L.
- C. Related Sections:
 - 1. 06 10 00 Rough Carpentry
 - 2. 06 12 00 Structural Insulated Panels
 - 3. 06 20 00 Finish Carpentry
 - 4. 09 64 00 Wood Flooring

1.2 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2604, Voluntary Specifications, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 1304, Voluntary Specifications for Forced Entry Resistance of Side-Hinged Door Systems.
- B. American National Standards Institute (ANSI):
 - 1. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used In Buildings.
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM E 283, Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - 2. ASTM E 330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - 3. ASTM E 547, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
 - 4. ASTM E 331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- D. Consumer Product Safety Commission (CPSC):
 - 1. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials.
- E. National Fenestration Rating Council (NFRC):

1. NFRC 100, Procedure for Determining Fenestration Product Thermal Materials.
2. NFRC 200, Procedure for Determining Solar Heat Gain Coefficient.
3. NFRC 400, Procedure for Determining Fenestration Product Air Leakage

F. AAMA/WDMA/CSA 101/I.S.2/A440 Fenestration Standard

1.3 SUBMITTALS

- A. Detail Drawings: Indicate dimensioning, direction of swing, configuration, swing panels, typical head jamb, side jambs and sill details, type of glazing material and handle height.
- B. Product Data: Manufacturer's literature including independently tested data listing performance criteria and Owner's Manual with installation instructions.
- C. Contract Closeout Submittal: Submit Owner's Manual from manufacturer. Identify with project name (GRoW Home), location (Buffalo, NY) and completion date, type and size of unit installed.

1.4 QUALITY ASSURANCE

- A. Manufacturer:
 1. The manufacturer must have a quality management system registration to the ISO 9001: 2008 standard.
 2. The manufacturer must have an environmental management system registration to the ISO 14001: 2005 standard.
- B. Performance Requirements: Provide from manufacturer that has independently tested typical units per AAMA/NWDA 101/I.S.2 or later standard. Testing results to include air infiltration in accordance with ASTM E 283, water penetration in accordance with ASTM E 547, structural loading in accordance with ASTM E 330, and forced entry in accordance with CAWM 300-96.
- C. Thermal Performance U factor: Unit to be rated, certified and labeled in accordance with NF RC 100, shown in manufacturer's latest published data for the glazing, sill, and direction of opening specified.
- D. Solar Heat Gain Coefficient: Unit to be rated, certified and labeled in accordance with NFRC 200, shown in manufacturer's latest published data for the glazing, sill, and direction of opening specified.
- E. Select glazing which qualifies the product for Energy Star rating.

1.5 SITE CONDITIONS, DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job site in sealed, unopened cartons or crates. Protect units from damage. Store material under cover, protected from weather and construction activities.

1.6 WARRANTY



- A. Provide manufacturer's standard warranty against defects in materials and workmanship. Warranty to be issued by the original manufacturer. No third party or other sub-supplier warranties will be accepted.
- B. Warranty Period: Ten years.

PART 2 – PRODUCTS

2.1 SUPPLIER

- A. EURO-WALL
24100 Tiseo Blvd., Punta Gorda, FL 33980.
Toll Free: 888-989-EURO (3876).
Fax: 941-979-5317.
Web Site: www.euro-wall.com.
Email: engineering@euro-wall.com
- B. Other suppliers equal to the specified product must submit substitution request two weeks before bid for prior approval.

2.2 ALUMINUM SLIDING/FOLDING DOORS

- A. Provide BOTTOM MOUNTED sliding/folding glass doors to fit the openings and configurations indicated on the Drawings. Provide system complete with head, sill and jambs complete with weatherstripping, operating hardware and specified accessories as follows:
 - 1. System: Euro-Wall System LLC Euro-C5 Thermally Broken Aluminum Folding Systems as manufactured by Euro-Wall Systems LLC.
 - 2. Door Panel Size: Provide doors as a factory fabricated knock-down system.
 - a. As indicated on the Drawings.
 - 3. Operation:
 - a. Out-folding system.
 - 4. Glazing: Provide safety glazing materials complying with ANSI Z97.1 and with the requirements of Section 08800.
 - a. Glazing: 1 inch (24 mm) Sealed insulating glass. Low-E 366. Glass Tint: Clear. Air filled.
 - 5. Framing: Extruded aluminum with nominal thickness of .080 inches (2.0 mm) to .1562 (4mm).
 - 6. Weatherstripping:
 - a. Dual weatherstripping on head, jambs and between panels, and single weatherstripping on sill.
 - b. Hinge gaskets on specific hinges.
 - 10. Sill:
 - a. ADA Sill
 - 10. Accessories:
 - a. Moldings.
 - b. Sill Cover.
 - 11. Hardware: Folding door.

- a. Aluminum hinges, color as follows:
 - i. Black Powder Coat.
 - b. Stainless steel corrosion proof carriers with sealed, self-lubrication, ball bearing multi-rollers.
 - c. Twinpoint Handle and Gear Box with Stainless shoot bolts.
 - d. Multipoint stainless steel door lock system.
12. Door Handles:
- a. Brass Modern (15A1)
 - b. Flat Black finish (US19)

2.2 MATERIALS

- A. Aluminum: 6063-T5 alloy and temper. Other alloys and tempers may be used for non-structural members provided they do not void the required warranties. Indicate alloys and tempers clearly on shop drawings and in structural calculations.
- B. Glazing: Provide glazing type specified complying with ANSI Z97.1.
- C. Flashings: Sheet aluminum, same finish as for system components; secured with concealed fastening method or fastener with head finished to match; thickness as required for conditions encountered.
- D. Glazing Gaskets: Dry glazing system compression type design, replaceable; EPDM, complying with ASTM C 864, with solid strand cord to prevent shrinkage.
 1. Manufacturer's standard black color.
- E. Setting Blocks, Edge Blocks, and Spacers: As required by manufacturer and compatible with insulated glass where required.
- F. Anchors and Fasteners: Aluminum, zinc and stainless steel of type, which will not cause electrolytic action or corrosion.
- G. Accessories: Provide accessories as scheduled to achieve design intent and environmental control.
- H. Aluminum Finish: Standard mill finish with custom finish as follows:
 1. Custom Powder Coat finishes available D3000-AAMA 2605 (10 year Florida) 20 year manufacturer's warranty.
 - a. Black Powder Coated
 - b. Same finishes on inside and outside

2.3 FABRICATION

- A. Use extruded aluminum frame and panel profiles with male-female interlocking, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather stripping as specified herein to make a folding glass wall. Factory pre-assemble as is standard for manufacturer and ship with all components and installation instructions.

- B. Sizes and Configurations: See drawings for selected custom dimensions. See drawings for selected number of panels and configuration. Outward opening unit.

PART 3 – EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install system in accordance with approved shop drawings and manufacturer's instructions.
- C. Install components level, plumb and true to line with uniform joints. Do not use defective parts that are warped, twisted, bowed, dented or abraded.
- D. Separate dissimilar materials using nonconductive tape, paint, or other material not visible in finished work.
- E. Provide attachments and shims to permanently fasten system to building structure.
- F. Maintain dimensional tolerances and alignment with adjacent Work.
- G. Anchor securely in place, allowing for required movement, including expansion and contraction.
- H. Install glazing and sealants in accordance with manufacturer's instructions without exception, including surface preparations.
- I. Set sill members in bed of sealant. Set other members with internal sealants to provide weathertight construction.
- J. Install flashings, closures, corners, and other accessories as required or detailed.



- K. Clean surfaces and install sealant in accordance with sealant manufacturer's instructions and structure manufacturer's guidelines.

3.4 ADJUSTING AND CLEANING

- A. Adjust hinge sets, locksets, and other hardware for proper operation. Lubricate using a suitable lubricant compatible with door and frame coatings.
- B. Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions before owner's acceptance.
- C. Clean and maintain aluminum surfaces in accordance with AAMA 610.1.
- D. Remove from project site and legally dispose of construction debris associated with this work.

3.5 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION 08 41 00

08 52 00 Wood Windows

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of .167
- B. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.36

2.2 WOOD WINDOWS

- A. Window Types: As indicated on Drawings.
 - 1. Fixed.
- B. Provide weatherproofed wood windows.
- C. Reclaimed lumber
- D. Exterior Color: Natural
- F. Exterior Trim: Provide indicated trim, matching material and finish of frame members.
- G. Interior Trim: : Baltic Birch Plywood
- H. Glaze units with tinted, low-E-coated, argon-filled, sealed insulating glass, complying with Section 08 80 00 "Glazing."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set units level, plumb, and true to line, without warp or rack of frames and panels. Provide proper support, and anchor securely in place.
- B. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.



- E. Clean glass surfaces immediately after installing windows. Remove nonpermanent labels from glass surfaces.

END OF SECTION 085200

08 52 01 Wood Egress Window

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes aluminum-clad wood windows.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.
- C. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - d. Aluminum-Cladding Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Pella Corporation Architect Series® or comparable product by one of the following:
 - 1. Aluminum-Clad Wood Windows:
 - a. EAGLE Window & Door, Inc.; an Andersen Window & Door company.
 - b. Marvin Windows and Doors.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: WDMA Hallmark certified with label attached to each window.
- B. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of .19
- C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of .25
- D. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.

2.3 WOOD WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
 - 1. Casement: Project out.
- B. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.
 - 1. Exterior Finish: Aluminum-clad wood.
 - a. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight and complying with AAMA 2605.
 - b. Color: Morning Sky Grey.
 - 2. Interior Finish: Unfinished.
 - a. Exposed Unfinished Wood Surfaces: Pine.
 - c. Stain Color: Natural.
- C. Insulating-Glass Units: ASTM E 2190.
 - 1. Glass: ASTM C 1036, Type 1, Class 1, q3.
 - a. Tint or Pattern: Clear.
 - b. Kind: Fully tempered ASTM C 1048.
 - 2. Lites: Three.
 - 3. Filling: Fill space between glass lites with air.
 - 4. Low-E Coating: SunDefense
- D. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- E. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent

materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: Satin Nickel.

F. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens.
 - a. Type and Style: Side Pivot Hardware.
2. Hinges: Manufacturer's standard type for sash weight and size indicated.
3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one lock on sashes up to 29 inches (735 mm) tall and two locks on taller sashes.
4. Operator Stud Cover: Matching operator handle finish. Provide in locations where operator handle is removed for controlled access.

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
2. Finish for Interior Screens: Baked-on organic coating in Champagne

C. Glass-Fiber Mesh Fabric: InView Screen

2.6 FABRICATION

A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze wood windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action. (dissimilar materials, treated lumber, etc.) at the points of contact with other materials.
- D. For fin method of attachment, integrate window system installation with exterior water-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with water-resistant barrier using watershed principles in accordance with window manufacturer's instructions.
- E. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using insulating-foam sealant.
- F. Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.
- G. Leave windows closed and locked.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.



- B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 52 00

08 80 00 Glazing

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 – PRODUCTS

2.1 GLASS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- E. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic protection testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
 - 1. Large-Missile Test: For glazing located within **30 feet** of grade.

2.2 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT; Type I; Quality-Q3.
- C. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials.
- D. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

2.4 GLAZING SEALANTS

- A. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- B. Low-Emitting Materials: Sealants shall have a VOC content of not more than 250 g/L.
- C. Low-Emitting Materials: Sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are contained in GANA's "Glazing Manual."
- B. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- D. Remove nonpermanent labels, and clean surfaces immediately after installation.

3.2 MONOLITHIC-GLASS TYPES

- A. Glass Type: Tempered patterned glass.
 - 1. Thickness: 4 mm.
 - 2. Finish: Frosted (patterned one side).
 - 4. Safety glazing required.

3.3 LAMINATED-GLASS TYPES

- A. Glass Type : Low-E-coated, laminated glass with two plies of clear float glass.
 - 1. Thickness of Each Glass Ply: 3 mm.
 - 3. Visible Light Transmittance: 88 percent minimum.
 - 4. Solar Heat-Gain Coefficient: .81 maximum.
 - 5. Safety glazing required.

3.4 INSULATING-GLASS TYPES

- A. Glass Type: Low-E-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 1 1/4-inch
 - 2. Thickness of Each Glass Lite: 1/8 -inch
 - 3. Outdoor Lite: Float glass.
 - 4. Interspace Content: Argon filled.
 - 5. Indoor Lite: Float glass.



6. Visible Light Transmittance: 70%
7. U-Factor: 0.167.
8. Solar Heat-Gain Coefficient: 0.362

END OF SECTION 08 80 00



08 95 16 Wall Vent

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 WALL VENT

- A. Custom Wood Framed Wall Vents, 3/4-inch thick frame, with PVC-coated glass-fiber fabric insect screening on outside face, removable from interior.

2.2 MATERIALS

- A. 3/4-inch Baltic Birch Plywood. Used to construct frame, and interior operable vent door.
- B. 3/4-inch Southern pine, Standard; SPIB. Used to construct exterior trim.
- C. 3/4-inch Southern pine, Standard; SPIB. Used to construct exterior trim.

2.3 HARDWARE

- A. Adjustable 90° Drop Flap Hinge
 - 1. Grass - GRA-210-735-04-0015
- B. Duo Standard Lid/Flap Stay Arm
 - 1. Hafele - HAF-373-66-500
- C. 4" Cabinet Wire Pull
 - 1. Berenson Zurich - BER-6130-2SC-P
- D. Aluminum Casement Fastener
 - 1. Ives - IVE-066A14RSMS
- E. Kerf-in Weatherstrip for .125 Kerf
 - 1. THH-V9650SRBRZ81
- F. Single Magnetic Touch Latch White
 - 1. Epcos - EPC-507-WH-PWS

2.4 FINISHES

- A. Sealer: Waterproofed with Rain Guard Advanced Multi-Surface Masonry and Wood Waterproofer.



PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set units level, plumb, and true to line. Provide proper support, and anchor securely in place.
- B. For installation procedures and requirements comply with installation requirements in ASTM E 2112.
- C. Set frame in bed of sealant, as indicated in drawings, to provide weathertight construction.

END OF SECTION 08 95 16

Division 09 – Finishes

09 29 00 Gypsum Board

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

2.2 PANEL PRODUCTS

- A. Provide in maximum lengths available to minimize end-to-end butt joints.
- B. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Type X, as required for specific fire-resistance-rated assemblies
- C. Cementitious Backer Units: ANSI A118.9, ASTM C 1288, or ASTM C 1325.

2.3 ACCESSORIES

- A. Aluminum Accessories: Extruded-aluminum reveal strips indicated with Class II, clear anodic finish; AA-C12C22A31.
 - 1. Manufacturer:
 - Pittcon Industries
 - 6409 Rhode Island Ave.
 - Riverdale, MD 20737
 - Phone: (800) 637-7638
 - Fax: (301) 699-8690
 - 2. Products:
 - a. PCS7550-C
 - b. FPM7575-C
 - c. FPM75100-C
 - d. XPM7575-C
- B. Joint-Treatment Materials: ASTM C 475/C 475M.



1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.
2. Joint Compounds: Drying-type, ready-mixed, all-purpose compounds.
3. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
4. Cementitious Backer Unit Joint-Treatment Materials: Products recommended by cementitious backer unit manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gypsum board to comply with ASTM C 840, in conjunction with extruded aluminum reveal strips.
 1. Install reveals level, plumb, true, and straight according to drawings. Attach with fasteners through hidden flange every 12-inches o.c.
 2. Isolate gypsum board assemblies from abutting structural work. Provide edge trim.
 3. Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws.
- B. Install cementitious backer units to comply with ANSI A108.11.
- C. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.
- D. Finishing Gypsum Board: ASTM C 840.
 1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
 2. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
 3. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
 4. Where indicated, provide Level 5 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges. Apply skim coat to entire surface.
- F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

END OF SECTION 092900

9 30 13 Ceramic Tiling

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.
- B. Obtain tile of each type and color or finish from same production run for each contiguous area.

PART 2 - PRODUCTS

2.1 CERAMIC TILE

- A. Ceramic tile that complies with ANSI A137.1.
- E. Ceramic Tile Type: Unglazed porcelain tile.
 - 1. Olympia Tile
 - 2. Face Size: 12 by 24 inches.
 - 3. Face: Plain with square edges.
 - 4. Tile Color, Glaze, and Pattern: Black Concrete Matte Pei3, Staggered
 - 5. Grout Color: Dark Grey (matching tile).
 - 6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile and matching characteristics of adjoining flat tile.
 - a. Base: Coved
 - b. Wainscot Cap: Surface bullnose.
 - c. External Corners for Portland Cement Mortar Installations: Bead.
 - d. External Corners for Thinset Mortar Installations: Surface bullnose.
 - e. Internal Corners: Cove.
 - f. Internal Corners: Field-butted square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
- F. Ceramic Tile Type: Glazed wall tile.
 - 1. Olympia Tile
 - 2. Module Size: 3 by 3 inches.
 - 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 - 4. Finish: Bright, opaque.
 - 5. Color and Pattern: Arctic White, Staggered.
 - 6. Grout Color: White
 - 7. Mounting: PregROUTED sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.
 - 8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[and matching characteristics of adjoining flat tile]. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Portland Cement Mortar Installations: Coved.
 - b. Base for Thinset Mortar Installations: Straight.

- c. Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap.
 - d. Wainscot Cap for Thinset Mortar Installations: Surface bullnose.
 - e. External Corners for Portland Cement Mortar Installations: Bullnose shape with radius of at least 3/4 inch (19 mm) unless otherwise indicated.
 - f. External Corners for Thinset Mortar Installations: Surface bullnose.
 - g. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.
- F. Ceramic Tile Type: Glass wall tile.
1. Olympia Tile
 2. Module Size: 3 by 3 inches.
 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 4. Finish: Gloss Glass Cristallo
 5. Color and Pattern: Clear glass, Staggered.
 6. Grout Color: White.
 7. Mounting: Pregrouted sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.
 8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Portland Cement Mortar Installations: Coved.
 - b. Base for Thinset Mortar Installations: Straight.
 - c. Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap.
 - d. Wainscot Cap for Thinset Mortar Installations: Surface bullnose.
 - e. External Corners for Portland Cement Mortar Installations: Bullnose shape with radius of at least 3/4 inch (19 mm) unless otherwise indicated.
 - f. External Corners for Thinset Mortar Installations: Surface bullnose.
 - g. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

2.2 INSTALLATION MATERIALS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, 1/2 inch (12.7 mm) thick.
- B. Fiber-Cement Underlayment: ASTM C 1288, 1/2 inch (12.7 mm) thick.
- C. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall have a VOC content of 65 g/L or less.
- D. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall comply with Green Seal's GS-36 and with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Waterproofing Membranes for Thinset Installations: ANSI A118.10, unreinforced liquid-latex or elastomeric polymer product.

- F. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.
1. Thinset Mortar Type: Latex-portland] cement; white, unless otherwise indicated.
 2. Grout Type: High-performance tile grout, ANSI A118.7[, unless otherwise indicated].
 - a. Mapei Flexcolor CQ

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, are specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight, aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- C. Lay tile in staggered pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.
- D. Install fiber-cement underlayment, and treat joints according to ANSI A108.11.
- E. Install waterproofing to comply with ANSI A108.13.
- F. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
- G. Interior Floor Tile Installation Method(s):
1. Over Wood Subfloors: TCNA F144 (thinset mortar bonded on cementitious backer units or fiber-cement underlayment).
 2. Over Waterproof Membranes on Wood Subfloors: TCNA F121; cement mortar bed.
- H. Interior Wall Tile Installation Method(s):
1. Over Wood or Metal Studs or Furring: TCNA W242; organic adhesive on gypsum board.
 2. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring: TCNA B412; water-cleanable, tile-setting epoxy on cementitious backer units or fiber-cement underlayment.
 5. Shower Receptor and Wall Installations: TCNA B415; thinset mortar on cementitious backer units or fiber-cement underlayment.

END OF SECTION 093013



09 64 00 Wood Flooring

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.1 WOOD FLOORING, GENERAL

- A. Hardwood Flooring: Comply with NOFMA grading rules for species, grade, and cut.
 - 1. Certification: Provide flooring that carries NOFMA grade stamp on each bundle or piece.

2.3 FACTORY-FINISHED WOOD FLOORING

- A. Solid-Wood Plank Flooring: Kiln dried and as follows:
 - 1. Species: Oak
 - 4. Cut: Plain sawn.
 - 5. Thickness: 3/4 inch.
 - 6. Face Width: 5-inches.
 - 7. Lengths: Lengths required to form pattern indicated.
 - 8. Edge Style: Square.
 - 9. Finish: UV urethane system.

2.4 ACCESSORY MATERIALS

- A. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils (0.15 mm) thick.
- B. Asphalt-Saturated Felt: ASTM D 4869, Type II.
- C. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.
 - 1. Low-Emitting Materials: Adhesives shall have a VOC content of 100 g/L or less.
 - 2. Low-Emitting Materials: Adhesives shall comply with Green Seal's GS-36 and with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines: Wood Flooring."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."



- B. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 3/4 inch.
- C. Solid-Wood, Plank Flooring: Blind nail or staple flooring to substrate.
 - 1. Plank Flooring: For flooring of face width more than 3 inches (75 mm), install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring. Install not less than two countersunk nails at each end of each piece, spaced not more than 16 inches (406 mm) along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

END OF SECTION 09 64 00



09 91 23 Interior Painting

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data.

PART 2 - PRODUCTS

2.1 PAINT

- A. BEHR PREMIUM PLUS ULTRA Interior Eggshell Enamel
- B. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."
 - 1. Latex, Interior, (Gloss Level 3): MPI #52.
- C. Material Compatibility: Provide materials that are compatible with one another and with substrates.
 - 1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- D. Paints and coatings shall comply with the following limits for VOC content:
 - 1. Flat Paints and Coatings: 50
- E. Colors:
 - 1. Walls: Sculptors Grey
 - 2. Ceilings: Ultra Pure White

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.
- C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.2 APPLICATION



- A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Paint exposed surfaces, new and existing, unless otherwise indicated.
 - 1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
 - 2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint the back side of access panels.
 - 4. Color-code mechanical piping in accessible ceiling spaces.
 - 5. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.
- C. Apply paints according to manufacturer's written instructions.
 - 1. Use brushes only where the use of other applicators is not practical.
 - 2. Use rollers for finish coat on interior walls and ceilings.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - 1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

3.3 INTERIOR PAINT APPLICATION SCHEDULE

- A. Gypsum:
 - 1. Gloss Level 3 Latex: Two coats: MPI INT 6.3T.

END OF SECTION 099123



09 93 00 Staining and Transparent Finishing

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: Include printout of MPI's "MPI Approved Products List" with product highlighted.

PART 2 - PRODUCTS

2.1 STAIN AND TRANSPARENT FINISHES

A. Woodsman Wood UV Sealant & Protector, Acrylic, Amber.

B. Minwax® Polycrylic®.

C. Behr SEMI-TRANSPARENT WEATHERPROOFING ALL-IN-ONE WOOD STAIN & SEALER #5077

C. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."

1. Stain, 100% Acrylic for Exterior Wood Decks: MPI #33.
2. Varnish, Water Based, Clear, Satin (Gloss Level 4): MPI #128.

C. Material Compatibility: Provide materials that are compatible with one another and with substrates.

1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

D. Interior stains and clear finishes shall comply with the following limits for VOC content:

1. Clear Wood Finishes, Varnishes: .350 g/L.
2. Stains: 250 g/L.

E. Colors:

1. Deck: Padre Brown

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be finished. Mask items that cannot be removed. Reinstall items in each area after finishing is complete.

C. Clean and prepare surfaces in an area before beginning finishing in that area. Schedule finishing so cleaning operations will not damage newly finished surfaces.

3.2 APPLICATION



- A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Finish exposed surfaces unless otherwise indicated.
- C. Apply stains and transparent finishes according to manufacturer's written instructions.
- D. Apply stains and transparent finishes to produce surface films without color irregularity, cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other imperfections. Use multiple coats to produce a smooth surface film of even luster.

3.3 EXTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

- A. Wood, nontraffic surfaces, including rainscreen and windows.
 - 1. Varnish, with UV Inhibitor, Exterior, Semigloss : Two Coat : MPI EXT 6.2K.
- B. Wood, traffic surfaces, including wood decks.
 - 1. Deck Stain: Two coats: MPI EXT 6.5F.

3.4 INTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

- A. Wood substrates, nontraffic surfaces, including architectural woodwork, doors, and windows.
 - 1. Semigloss Alkyd Varnish: Two coats over sanding sealer: MPI INT 6.1C.

END OF SECTION 09 93 00

Division 10 – Specialties

10 28 19 Shower Door

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.
- B. Verify dimensions by field measurements before fabrication and indicate on Shop Drawings.

PART 2 - PRODUCTS

2.1 SHOWER DOORS

- A. Kohler Levity R706009-L-SH
- B. Semi-Frameless Units: Metal-framed units, with hardware-supported glass doors that do not have metal framing.
- C. Door Operation: Sliding on overhead track.
 - 1. Safety Clip System: Manufacturer's accessory designed to prevent door from falling off of sliding track.
- D. Operating Hardware: Included by Manufacturer
- G. Fasteners: Manufacturer's standard, stainless steel, or other noncorrosive fasteners.

2.2 MATERIALS

- A. Glass Doors: Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.
- B. Clear Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Kind FT.
- F. Glass Nominal Thickness: 1/4-inch
- G. Framing: Anodized aluminum.
- H. Hardware: Anodized aluminum.
- I. Aluminum Finish: Bright Silver.
- K. Installation Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Low-Emitting Materials: VOC content of sealants not more than 250 g/L.



2. Low-Emitting Materials: Sealants complying with testing and product requirements of California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare and install as recommended in manufacturer's written instructions, unless more stringent requirements are contained in GANA's "Glazing Manual."
- B. Set units level, plumb, and true to line, without warp or rack of frames and panels, and anchor securely in place.
- C. Install doors to produce smooth operation and tight fit at contact points.

END OF SECTION 102819



10 44 00 Fire Protection Specialties

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 – PRODUCTS

2.2 FIRE EXTINGUISHERS AND BRACKETS

- A. Portable Fire Extinguishers: NFPA 10, listed and labeled for the type, rating, and classification of extinguisher.
 - 1. Multipurpose Dry-Chemical Type: UL-rated 2-A:10-B:C, 5-lb nominal capacity, in enameled-aluminum container.
- B. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for fire extinguishers indicated, with plated or baked-enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cabinets at heights acceptable to authorities having jurisdiction.
- B. Fire-Rated Hose or Valve Cabinets: Install cabinet with not more than 1/16-inch (1.6-mm) tolerance between pipe OD and knockout OD. Seal through penetrations with firestopping sealant.
- C. Identification: Apply decals or vinyl lettering to cabinets at locations indicated.
- D. Install mounting brackets in locations indicated at heights acceptable to authorities having jurisdiction.
- E. Install fire extinguishers in mounting brackets where indicated.

END OF SECTION 104400

Division 11 – Equipment

11 31 00 Residential Appliances

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 – PRODUCTS

2.1 RESIDENTIAL APPLIANCES

- A. Regulatory Requirements: Comply with the following:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with ICC A117.1.
- C. Electric Induction Cooktop: 30-inch wide, drop-in range with 4 burners
 - 1. Manufacturer: Whirlpool
 - 2. Product Number: GCI3061XB
 - 3. Color: Black
- D. Electric Wall Oven: Built-in, single, electric, self-cleaning wall over with broiler unit.
 - 1. Manufacturer: Whirlpool
 - 2. Product Number: WOS51ECOAS02
 - 3. Color: Stainless Steel
- E. Exhaust Hood: 30-inch, wall-mounted exhaust hood with two-speed fan.
 - 1. Manufacturer: Whirlpool
 - 2. Product Number: GXW7330DXS
 - 3. Color: Stainless Steel
 - 4. Fan control: Hood-mounted switch, with separate light switch
 - 5. Weatherproof wall cap with backdraft damper and rodent-proof screening
- F. Refrigerator/Freezer: Freestanding, automatic defrost, two-door refrigerator with top-mounted freezer, interior cabinet liners.
 - 1. Manufacturer: Whirlpool
 - 2. Product Number: WRT111SFDM
 - 3. Color: Stainless Steel
 - 4. Fresh Food Compartment Volume: 7.74 cu. ft.



5. Freezer Compartment Volume: 2.94 cu. ft.
6. Shelf Area: One fixed full-width glass, two adjustable full-width glass

- G. Dishwasher: Built-in, undercounter, automatic dishwasher, sized to replace 24-inch-base cabinet, five wash cycles with hot-air and heat-off drying cycles, polypropylene tub and door liner, nylon-coated sliding dish racks.
 1. Manufacturer: Whirlpool
 2. Product Number: WDT720PADM
 3. Color: Stainless Steel

- H. Clothes Washer: Freestanding, front-loading, automatic clothes washer with 4.3-cu. ft. capacity, stainless-steel tub and twelve wash cycles including regular, delicate, and permanent press.
 1. Manufacturer: Whirlpool
 2. Product Number: WFW96HEAW
 3. Color: White
 4. Energy Performance: Qualifies for the EPA/DOE ENERGY STAR product labeling program.

- I. Electric Clothes Dryer: Freestanding, front-loading clothes dryer with 7.3-cu. ft. capacity with stainless-steel interior.
 1. Manufacturer: Whirlpool
 2. Product Number: WED99HEDW
 3. Color: White

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- B. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
- D. Verify that accessories required have been furnished and installed.

END OF SECTION 11 31 00



Division 12 – Furnishings

12 24 00 Shades

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.1 SHADING FABRIC

- A. Manufacturer: Gempler's
- B. Shadeband Materials:
 - 1. Light-Filtering Fabric: High-density knit polyethylene shade cloth
 - 2. Roll Width: 32 inches, 33 inches, 36 inches, 38 inches, 48 inches, 72 inches, 76 inches.
 - 3. Openness Factor: 30 percent.
 - 4. Color: Saddle Tan

2.2 OPERABLE GROWLARIUM SHADE ROLLER

- A. Manufacturer: Colvin Draperies
- B. Provide shadeband material passing flame-resistance testing according to NFPA 701.
- C. Fabrication: Comply with WCMA A 100.1. Fabricate shadebands without battens or seams to extent possible except as follows:
 - 1. Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length.
- D. Manually Operating Roller Shades: Chain-and-clutch with bead chains.
- E. Installation Accessories:
 - 1. Closure panel and wall clip.
 - 2. Color and: Black

2.3 CANOPY GROMMETED SHADING

- A. Manufacturer: Gempler's
- A. Grommet material: stainless-steel.



PART 3 - EXECUTION

3.1 INSTALLATION OF ROLLER SHADES

- A. Install roller shades aligned with adjacent units according to manufacturer's instructions.
- B. Adjust roller shades to operate smoothly and easily throughout entire operational range.

3.2 INSTALLATION OF GROMMETED SHADING

- A. Install grommeted shades aligned with adjacent units according to manufacturer's instructions.
- B. Grommets are placed through threaded rods welded to canopy rafters, secured snug by threaded nuts.

END OF SECTION 12 24 00



12 36 61 Simulated Stone Countertops

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Countertops: 1/2-inch- thick, solid surface material material laminated to 1-inch- thick particleboard.
 - 1. Edges: built up with solid surface material.
 - 2. Front: Straight, slightly eased at top
- B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. DuPont™ Corian® Solid Surfaces
 - a. Color: Concrete

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops according to manufacturer's written directions. Fasten to substrates with adhesive. Align adjacent surfaces. Seal seams and perimeter with mildew-resistant silicone sealant.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- B. Install level and plumb to a tolerance of 1/8 inch in 8 feet.

END OF SECTION 12 36 61

Division 13 – Special Construction

13 13 40 Growlarium (Greenhouse / Solarium)

PART 1 – GENERAL

A. Work Included:

1. Factory fabricated and installed aluminum clear span pre-engineered greenhouse / solarium structure with framework, glass and glazing, sill cap flashing and other required flashings, door, windows, attachments and other equipment as described herein for a complete watertight installation.
2. Applied finish to aluminum extrusions and flashings.

B. Work Not Included in Contract:

1. Shop Drawings shall be provided by the architect, reviewed and approved by the manufacturer prior to fabrication.
2. Engineering and drafting of production documents, including structural design calculations shall be by the architect and structural engineer.

C. Standards:

1. Comply with the standards that are applicable to the work of this Section except as otherwise indicated. Provide assembly that is weather tight, airtight.
2. Aluminum Association Incorporated (AA): SAS-30 Specifications for Aluminum Structures.
3. American Architectural Manufacturers Association (AAMA):
 - a. 501.1: Standard Test Method for Metal Curtain Walls for Water Penetration Using Dynamic Pressure.
 - b. 501.2: Field Check of Metal Curtain Walls for Water Leakage.
 - c. 501.3: Field Check of Water Penetration Through Installed Exterior Windows, Curtain Walls and Doors by Uniform Air Pressure Difference.
 - d. 605.2: Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
 - e. 606.1: Voluntary Guide Specification and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.
 - f. 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
1. American National Standards Institute (ANSI): Z 97.1 -1984- Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
2. American Society for Testing and Materials (ASTM):
 - a. A193: Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
 - b. A307: Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - c. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - d. B211: Specification for Aluminum-Alloy Bar, Rod and Wire.
 - e. B221: Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - f. B316: Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods.
 - g. C719: Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cycle Movement.
 - h. C794: Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
 - i. C1036: Specification for Flat Glass.

- j. C1048: Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
 - k. D395: Test Methods for Rubber Property -Compression Set.
 - l. D412: Test Methods for Rubber Properties in Tension.
 - m. D1171: Test Method for Rubber Deterioration -Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).
 - n. D2240: Test Method for Rubber Property -Durometer Hardness.
 - o. E283: Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors.
 - p. E330: Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 - q. E331: Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 - r. E773: Test Method for Seal Durability of Sealed Insulating Glass Units.
 - s. E774: Specification for Sealed Insulating Glass Units.
 - t. E783: Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors.
1. Consumer Product Safety Commission (CPSC): 16CFR 1202 - Architectural Glazing Standards and Related Material.
 2. Flat Glass Manufacturers Association (FGMA): Glazing Manual.
 3. Insulating Glass Certification Council (IGCC): Classification of Insulating Glass Units.

D. Submittals:

1. Prior to starting fabrication, submit manufacturers' product specifications, test results showing compliance with performance criteria described below, handling installation and protection instructions. Indicate pertinent dimensioning, general construction, component connections and locations, anchorage methods, locations and installation details.
2. Submit only if specifically requested:
 - a. Submit (2) 12-in. x 12-in. samples of each type of glazing.
 - b. Submit (2) manufacturer's samples of each type of sealant.
 - c. Submit (2) 6-in. long samples of extrusions (with appropriate finish).
 - d. Certification that insulating glass units will withstand specified design loads.
 - e. Submit structural calculations prepared in accordance with the Aluminum Association's Specifications for Aluminum Structures (SAS30) by a structural engineer qualified in the design of self-supporting sloped glazed systems and licensed to practice where the greenhouse / solarium is manufactured.

E. Quality Assurance:

1. The greenhouse / solarium installers must be permanent full-time employees of the greenhouse / solarium manufacturer.
2. Engage a single source manufacturer/installer for the metal-framed greenhouse / solarium. Greenhouse / solarium source will assume undivided responsibility for all components, including structural design, engineering, fabrication, finishing, preparation at the job site, erection and glazing of the greenhouse / solarium system and the weatherproof integrity of the system in place.
3. The manufacturer shall be regularly engaged in the preceding phases of construction of greenhouse / solarium and able to demonstrate that he has performed successfully on comparably sized projects and of comparable design complexity over at least the previous ten years.
4. Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this Section or referenced standards.

PART 2 – PRODUCTS

- A. Manufacturer:
 - 1. BC Greenhouses
A5-19327-94th Ave.
Surrey, B.C.
V4N 4E6
T: 1-888-391-4433

- A. Materials:
 - 1. Glazing
 - a. Laminated Glass (4mm + 4mm + Low-e coating)

- B. Accessories
 - 1. Hinged Roof Panels
 - 2. Doors

PART 3 – EXECUTION

- A. Delivery:
 - 1. Deliver fabricated units and component parts to the jobsite completely identified with labels corresponding to the erection drawings. Protect surfaces from damage during shipping. Inspect materials for damage upon delivery to the jobsite. Touch-up or replace items with minor defects or scratches with the appropriate material.

- B. Installation:

Installation shall be by, or under the direct supervision of, the manufacturer. Adjustable screw jacks shall be installed at column locations in preparation for the steel columns. Steel erection consists of structural steel columns, structural steel beams connecting column to column, and X-bracing at key locations. Custom Yokes will be placed periodically along beams to accept the aluminum gutter/beams. Aluminum rafters, connection details, and glazing shall be installed simultaneously. At locations where solar panels are mounted, special connection U-bolts will be installed for solar panel mounting. After roof panels and aluminum construction is complete, wall glazing and transitions to home will be installed as shown in architectural drawings by manufacturer.

- C. Site Tolerances:
 - 1. All supporting and adjacent construction will be held to within + ½” of theoretical.
 - 2. Tolerances for the installation of related products: Refer to the sections noted in the “Related Work Not Included” paragraph above for specified tolerances for adjoining construction.

- D. Cleaning:
 - 1. Remove any temporary greenhouse / solarium coverings and protection of adjacent work areas at the completion of greenhouse / solarium installation. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.



END OF SECTION 13 34 13.16

Division 21 – Fire Suppression

21 13 13 Wet-Pipe Sprinkler System

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data for valves, sprinklers, specialties, and alarms.
2. Submit sprinkler system drawings identified as "working plans" and calculations according to NFPA 13. Submit required number of sets to authorities having jurisdiction for review, comment, and approval. Include system hydraulic calculations.
3. Submit test reports and certificates as described in NFPA 13.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 442/F 442M, UL 1821, 175-psig (1207-kPa) rating, made in NPS ((DN)) for sprinkler service. Include "Listed" and "CPVC Sprinkler Pipe" marks on pipe.
- B. CPVC Plastic Pipe Fittings: ASTM F 438 for NPS 3/4 to NPS 1-1/2 (DN 20 to DN 40) and ASTM F 439 for NPS 2 (DN 50), UL listed, 175-psig (1207-kPa) rating, for sprinkler service. Include "Listed" and "CPVC Sprinkler Fitting" marks on fittings.
- K. Provide hangers, supports, and seismic restraints with UL listing and FM approval for fire-protection systems.

2.3 VALVES

A. Two-Piece Ball Valves with Indicators:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Description: UL 1091, and FM Global Class Number 1112, Forged brass or bronze, 175 psig (1200 kPa) working pressure.
3. End Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
4. End Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.4 SPRINKLERS

- A. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide" listing published by FM Global.
 - 1. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
- B. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Residential Applications: [UL 1626] <Insert standard>.
 - 2. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes: Painted White.
- E. Sprinkler Escutcheons (for Ceiling and Sidewall Mounted): Plastic, white finish, one piece, flat.

2.5 PIPING SPECIALTIES AND ALARM DEVICES

- A. Pressure Guages:
 - 1. Description: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with dial range of 0 to 250 psig (0 to 1725 kPa).

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATIONS

- A. Install piping free of sags and bends.
- B. Install fittings for changes in direction and branch connections.
- C. Install unions at final connection to each piece of equipment.

3.3 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.4 SPRINKLER PIPING INSTALLATION

- A. Protect piping from earthquake damage as required by NFPA 13.
- B. Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water supply connection. Install backflow preventers in potable-water supply sources.

- D. Install alarm check valves for proper direction of flow, including bypass check valve and retard chamber drain line connection.

3.5 SPRINKLER SCHEDULE

- A. Rooms with Suspended Ceilings: Pendent sprinklers
- B. Wall Mounting: Sidewall sprinklers.
- C. Sprinkler Finishes: White enamel in finished spaces and unfinished spaces. Provide escutcheons in finished and residential spaces.
- G. Install sprinklers in suspended ceilings in center of ceiling panels.

3.6 PIPING SCHEDULE

- A. Use CPVC plastic pipe and fittings and metal-to-plastic transition fittings with solvent-cemented joints.
- B. Install shutoff valve, check valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water service piping.

3.7 TESTING

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

END OF SECTION 211000

Division 22 – Plumbing

22 11 16 Domestic Water Piping

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For transition fittings and dielectric fittings.
2. Product for solvent cements and adhesive primers, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ###### A. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 PIPE AND FITTINGS

- ###### A. PEX Tube and Fittings: ASTM F 877, SDR 9 PEX tubing and ASTM F 1807, metal insert-type fittings with copper or stainless-steel crimp rings.

1. Manifold: ASTM F 877 plastic or corrosion-resistant-metal assembly, with a plastic or corrosion-resistant-metal valve for each outlet.

G. Special-Duty Valves:

1. Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
2. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
3. CPVC and Cast Iron and PEX Union Ball Valves: MSS SP-122, with full-port ball, socket detachable end connectors, and pressure rating not less than 125 psig (860 kPa) 73 deg F (23 deg C).

- ###### H. Transition Fittings: Manufactured piping coupling or specified piping system fitting. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.

1. Plastic-to-Metal Transition Fittings:

- a. Description:

- 1) One end with threaded brass insert and one solvent-cement-socket end.

2. Plastic-to-Metal Transition Unions:

- A. Description:

- 1) Brass or stainless-steel threaded end.
- 2) Solvent-cement-joint plastic end.
- 3) Rubber O-ring.
- 4) Union nut.

- I. Flexible Connectors: Stainless-steel, corrugated-metal tubing with wire-braid covering. Working-pressure rating a minimum of 100 psig.

2.3 PRESSURE GAGES AND TEST PLUGS

- A. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
 1. Standard: ASME B40.100.
 2. Case: Sealed Solid-front, pressure relief type
- B. Test Plug: Corrosion-resistant brass or stainless-steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating 500 psig at 200 deg F (3450 kPa at 93 deg C).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install piping free of sags and bends.
- B. Install fittings for changes in direction and branch connections.
- C. Install unions at final connection to each piece of equipment.
- D. Install domestic water piping with 0.25 percent slope downward toward drain for horizontal piping and plumb for vertical piping.
- E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
 1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
 - b. Install hangers for vertical PEX piping every 48 inches (1200 mm).
- K. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

3.2 INSPECTING AND CLEANING

- A. Inspect and test piping systems as follows:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

3.3 PIPING SCHEDULE

- A. Aboveground Distribution Piping: PEX piping.

3.4 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Install gate valves close to main on each branch and riser serving two or more plumbing fixtures or equipment connections and where indicated.
- C. Install gate or ball valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.
- D. Install swing check valve on discharge side of each pump and elsewhere as indicated.
- E. Install ball valves in each hot-water circulating loop and discharge side of each pump.

END OF SECTION 221116

22 11 19 Domestic Water Piping Specialties

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 1. Product Data: For each type of product.
 2. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with IRC.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 160 psi @ 73.4 F, 100 psi @ 180 F, 80 psi @ 200 F

2.3 MANUFACTURED UNITS

- A. Reduced-Pressure-Principle Backflow Preventers:
 1. Standard: ASSE 1013.
 2. Operation: Continuous-pressure applications.
 3. Size: 3/4-inch.
 4. Operating Pressure: 175 psi.
 5. End Connections: Threaded for NPS 2 (DN 50) and smaller
 6. Configuration: Designed for horizontal, straight-through flow.
 7. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
- B. Primary Thermostatic, Water Mixing Valves:
 1. Taco
 2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
 4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
 5. Body: Bronze with corrosion-resistant interior components.
 6. Connections: Threaded inlets and outlet.
 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Tempered-Water Setting: 150 deg F.
 9. Tempered-Water Design Flow Rate: 20 gpm.
 10. Valve Finish: Rough bronze.

- C. Clothes Washer Outlet Boxes:
1. Mounting: Exposed.
 2. Material and Finish: Plastic box and faceplate.
 3. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
 4. Supply Shutoff Fittings: NPS 1/2 (DN 15) ball valves and NPS 1/2 (DN 15) pex water tubing.
 5. Drain: NPS 2 (DN 50) standpipe and P-trap for direct waste connection to drainage piping.
 6. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
 7. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.
- D. Hose Bibbs :
1. Standard: ASME A112.18.1 for sediment faucets.
 2. Body: Bronze.
 3. Seat: Bronze, replaceable.
 4. Supply Connections: NPS 1/2 or NPS 3/4 DN 20 threaded.
 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 8. Finish for Equipment Rooms: Rough bronze.
 9. Finish for Service Areas: Rough bronze.
 11. Operation for Equipment Rooms: Wheel handle.
 12. Operation for Service Areas: Wheel handle.
 13. Operation for Finished Rooms: Wheel handle.
 14. Include operating key with each operating-key hose bibb.
 15. Include integral wall flange with each chrome- or nickel-plated hose bibb.
- E. Ball-Valve-Type, Hose-End Drain Valves :
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
 3. Size: NPS 3/4 (DN 20).
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- F. Stop-and-Waste Drain Valves:
1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
 2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
 3. Size: NPS 3/4 (DN 20).
 4. Body: ASTM B 62 bronze.
 5. Drain: NPS 1/8 (DN 6) side outlet with cap.
- G. Off-Floor Cartridge Filters:

1. Description: Simplex, wall-mounted housing with replaceable element for removing suspended particles from water.
 - a. Housing: Corrosion resistant; designed to separate feedwater from filtrate and to direct feedwater through water filter element; with element support.
 - 1) Pipe Connections: Threaded according to ASME B1.20.1.
 - b. Element: Replaceable; of shape to fit housing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
- B. Install water regulators with inlet and outlet shutoff valves[and bypass with memory-stop balancing valve]. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- G. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
 2. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
 3. Prepare test and inspection reports.

END OF SECTION 221119

22 11 23 Domestic Water Pumps

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data. For each type of product.
 - a. Include certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DOMESTIC WATER PUMPS

- A. Armstrong Series 4700-VMS-03:03-0.75 hp Pump
- B. Description: Factory-assembled and -tested, in-line, multi-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts vertically mounted. Rated for 125-psig (860-kPa) minimum working pressure and minimum continuous water temperature of 225 deg F (107 deg C).
 1. Casing: AISI 304 SS.
 2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 4. Shaft and Shaft Sleeve: AISI 316 SS.
 5. Seal: Mechanical; with carbon-steel rotating ring, stainless-steel spring, and rubber bellows and gasket.
 6. Bearings: Oil lubricated; bronze-journal or ball type.
 7. Motor: Resiliently mounted to pump casing.

2.3 MOTORS

- A. Comply with NEMA MG 1 unless otherwise indicated.
 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Motor Sizes: 0.75 hp
- C. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 262913 "Enclosed Controllers."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support pumps and piping so weight of piping is not supported by pump volute.
- D. Install electrical connections for power, controls, and devices.
- E. Suspend in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers. Fabricate brackets or supports as required for pumps.
- F. Connect piping with valves that are at least the same size as piping connecting to pumps.
- G. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- H. Install shutoff valve on suction side of pumps.
- I. Install nonslam check valve and throttling valve on discharge side of pumps.

END OF SECTION 221123



22 12 19 Facility Potable Water Storage Tanks

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Water tank for supply and storage of domestic water supply systems and fire sprinkler system, completed, including piping and all accessories.

1.2 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.3 COMPLIANCE

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 22-08: Water Tanks for Private Fire Protection
 - 2. NFPA 25-08: Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
- B. NSF INTERNATIONAL (NSF):
 - 1. NSF/ANSI 61 (2010) Drinking Water System Components -Health Effects

PART 2 – PRODUCTS

2.1 EXPANSION TANK

- A. Manufacturers:
 - 1. Watts
 - a. Model: ETX-30
 - a. Size: 4.5 gal
 - b. 75 PSI max working pressure
 - c. Max temp 220 degrees F
- A. Manufacturers:
 - 1. Watts
 - a. Model: PLT-12
 - a. Size: 4.5 gal
 - b. 150 PSI max working pressure
 - c. Max temp 200 degrees F

2.1 LOW PROFILE WATER TANK



- A. Roto-molding rectangular tank
 - 1. Material: Polyethylene
 - 2. Capacity: 500 gallons
 - 3. Weight: 185 lbs.

2.3 PIPING

- A. PVC, ASTM D 1785, Schedule 40
- B. Stainless Steel

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install tank in accordance with NFPA 22.
- B. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place.
- C. Fasten securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated.
- D. Correct deficiencies in or remove and reinstall products that do not comply with requirements.

END OF SECTION 22 12 19

22 13 16 Sanitary Waste and Vent Piping

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Minimum Pressure Requirement for Soil, Waste, and Vent: 10-foot head of water (30kPa).
- B. Comply with NSF 14, "Plastic Piping Components and Related Materials," for plastic piping components.

PART 2 – PRODUCTS

2.1 PIPES AND FITTINGS

- F. PVC Plastic, DWV Pipe and Fittings: ASTM D 2665, Schedule 40, plain ends with PVC socket-type, DWV pipe fittings.
 - 1. Adhesive Primer: ASTM F 656.
 - a. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent Cement: ASTM D 2564.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- A. PVC Pipe
 - 1. 2" pipe, ASTM D 1785, Schedule 40.
 - 2. 4" pipe, ASTM D 1785, Schedule 40.
- B. ASTM D 2466, Schedule 40, socket type and npt.

PART 3 – EXECUTION

3.1 PIPING INSTALLATION

- A. Install wall penetration system at each pipe penetration through wall. Make installation watertight.
- B. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- C. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (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. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.2 PIPE SCHEDULE

A. Aboveground Applications: PVC plastic, DWV pipe and fittings with solvent cemented joints.

END OF SECTION 22 13 16



22 15 53 Facility Septic Tank

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data

PART 2 - PRODUCTS

2.1 SEPTIC TANKS

- A. Roto-molding rectangular tank
 - 1. Material: Polyethylene
 - 2. Capacity: 500 gallons
 - 3. Weight: 185 lbs.

2.2 DISTRIBUTION PIPES AND FITTINGS

- A. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, non-perforated, for solvent-cement or elastomeric gasket joints.
- B. Solvent Cement: ASTM D 2564.
- C. Gaskets: ASTM F 477, elastomeric seal.

PART 3 – EXECUTION

3.1 SEPTIC TANK INSTALLATION

- A. Install septic tanks level.
- B. Layout PVC piping to proper slope to tank, verify connections are water-tight.

END OF SECTION 22 13 53



22 33 30 Solar Water Heating Equipment

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data: For each type and size of domestic-water heater.
 - 2. Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."
 - a. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
 - 3. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.
- C. Comply with performance efficiencies prescribed in ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings."

2.2 WATER HEATERS, GENERAL

- A. Insulation: Suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.
- B. Anode Rods: Factory installed, magnesium.
- C. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
- D. Drain Valve: Factory installed.

2.3 ELECTRIC WATER HEATERS

- A. Residential, Small-Capacity, Electric, Domestic-Water Heaters:
 - 1. Apricus PTK-SOLX-80



- B. Standard UL 174, 76-gal. capacity; steel with 150-psig (1035-kPa) working-pressure rating. One electric, screw-in, immersion-type heating elements with adjustable thermostat for each element and wiring arrangement for nonsimultaneous operation with maximum 30-A circuit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install temperature and pressure relief valves and extend to closest floor drain.
- B. Install shutoff valves and unions at hot- and cold-water piping connections.
- C. Make piping connections with dielectric fittings where dissimilar piping materials are joined.
- D. Electrically ground units according to authorities having jurisdiction.

END OF SECTION 223300

22 41 00 Residential Plumbing Fixtures

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data for each type of plumbing fixture, including trim, fittings, accessories, appliances, appurtenances, equipment, and supports.
 - 2. Documentation indicating flow and water consumption requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

2.2 WATER CLOSET

- A. Manufacturer:
 - 1. Gerber
 - a. Model: DF-21-318

2.3 TOILET SEATS

- A. Standard: IAPMO/ANSI Z124.5. Round front, solid plastic closed front with cover with bumpers and hardware, Residential class.

2.4 LAVATORY

- A. Bathroom Sink:
 - 1. Gerber
 - a. Model: 12-760 Logan Square Suite Undercounter
- B. Faucets:
 - 1. Apec Water
 - a. Model: Ceramic Disc Luxury Designer Faucet
 - b. Finish: Brushed Nickel

2.5 SHOWER

- A. Shower Head:
 - 1. Moen
 - a. Model: T3293
 - b. Finish: Brushed Nickel

2.6 KITCHEN SINK

- A. Stainless-Steel Sink and drains: Undermount, double-bowl.
 - 1. Ruvati
 - a. Model: RVH7350
 - b. Finish: Stainless Steel
- B. Faucet:
 - 1. Kraus
 - a. Model: KPF 1602
 - b. Finish: Chrome

2.7 DISHWASHER AIR-GAP FITTINGS

- A. Air Gap
 - 1. Danze
 - a. Model: D491342
 - b. Finish: Stainless Steel

PART 3 - EXECUTION

3.1 INSTALLATIONS

- A. Install fixtures with flanges and gasket seals.
- B. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- C. Fasten counter-mounting plumbing fixtures to casework.
- D. Secure supplies to supports or substrate within pipe space behind fixture.
- E. Set shower receptors and mop basins in leveling bed of cement grout.
- F. Install individual supply inlets, supply stops, supply risers, and tubular brass traps with cleanouts at fixture.
- G. Install water-supply stop valves in accessible locations.



- H. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes unless otherwise indicated.
- I. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.
- J. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew resistant, silicone sealant. Match sealant color to fixture color.
- K. Install piping connections between plumbing fixtures and piping systems and plumbing equipment. Install insulation on supplies and drains of fixtures for people with disabilities.
- L. Ground equipment.

END OF SECTION 22 41 00



Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC)

23 05 93 Testing, Adjusting, and Balancing for HVAC

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Certified TAB reports.
 - 2. Documentation of work performed per ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
 - 3. Documentation of work performed per ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."
- B. TAB Firm Qualifications: AABC, NEBB, or TABB certified.
- C. TAB Report Forms: Standard TAB contractor's forms approved by Architect.
- D. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- E. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- F. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- G. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.

3. Integrity of dampers and valves for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

H. Report deficiencies discovered before and during performance of test and balance procedures.

3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.3 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare schematic diagrams of systems' "as-built" duct layouts.
- B. For variable-air-volume systems, develop a plan to simulate diversity.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check for airflow blockages.
- F. Check condensate drains for proper connections and functioning.
- G. Check for proper sealing of air-handling unit components.
- H. Check for proper sealing of air duct system.

3.4 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data; number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Set system controls so automatic valves are wide open to heat exchangers.
 - 5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.5 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

END OF SECTION 230593

23 21 13 Hydronic Piping

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 3400 psig at 70 deg F.
 - 2. Condensate-Drain Piping: 150 deg F.
 - 3. Air-Vent Piping: 200 deg F.
 - 4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 PIPES, TUBES, AND FITTINGS

- A. Stainless Steel Flex Tubing: ASTM A 53, Schedule 40, plain ends with brass threaded fittings, Class 150.
- B. Unions: ASME B16.39, bronze, Class 150, compression fitting.

2.3 SPECIAL-DUTY VALVES

- A. Bronze, Calibrated-Orifice, Balancing Valves:
 - 2. Body: Bronze, ball or plug type with calibrated orifice.
 - 3. Pressure-Gage Connections: Integral seals for portable differential pressure meter.
 - 4. CWP Rating: Minimum 125 psig (860 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).
 - 6. Valve shall have integral pointer and calibrated scale to register degree of valve opening.

2.4 HYDRONIC SPECIALTIES

- A. Manual Air Vents:
 - 1. Watts
- B. Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure, 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.
- C. Diaphragm-Type Expansion Tanks:
 - 1. Watts EXT-30

- D. Welded carbon steel, 125-psig (860-kPa) working pressure, 375 deg F (190 deg C) maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a flexible diaphragm securely sealed into tank. Provide taps for pressure gage and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Tank, with taps and supports, shall be constructed, tested, and labeled according to ASME Pressure Vessel Code: Section VIII.

2.5 SLEEVES AND SLEEVE SEALS

- A. PVC Pipe: ASTM D 1785, Schedule 40.
- B. Modular rubber sealing-element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: Ethylene-propylene-diene-monomer-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2.7 TEST PLUGS

- A. Test Plug: Corrosion-resistant brass with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating of 500 psig at 200 deg F (3450 kPa at 93 deg C).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping free of sags and bends and install fittings for changes in direction and branch connections.
- E. Install piping at a uniform slope of 0.2 percent upward in the direction of flow.
- F. Make reductions in pipe sizes using eccentric reducer fitting installed with level side up.
- G. Install branch connections to mains using T-fittings in main with takeoff out the bottom of the main, except for up-feed risers, which shall have swing joint and takeoff out the top of the main line.
- H. Install unions in pipes adjacent to each valve, at final connections with each piece of equipment, and elsewhere as indicated.

- I. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.
- J. Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before soldering or brazing.
- K. Sleeve-Seal-System Installation:
 - 1. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand, and make a watertight seal.

3.2 VALVE INSTALLATIONS

- A. Shutoff Duty: Use ball valves.
- B. Throttling Duty: Use ball valves.
- C. Install shutoff-duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- D. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- E. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.
- F. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage, consisting of a T-fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple and cap.
- G. Install safety relief valves on hot-water generators and elsewhere as required by authorities having jurisdiction. Pipe discharge to floor drain without valves.
- H. Install manual air vents at high points in the system, at heat-transfer coils, and elsewhere as required for system air venting.
- I. Run piping from boiler air vent connection or air separator to compression tank with 1/4 inch per foot (1:50) upward slope towards tank. Connect boiler outlet piping.
- J. Install valves with stem up. Allow clearance above stem for check mechanism removal.

3.3 SPECIALTIES INSTALLATIONS

- A. Install diaphragm-type expansion tanks on wall. Vent and purge air from hydronic system; charge tank with proper air charge to suit system design requirements.



- B. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated.

3.4 TESTING, ADJUSTING, AND BALANCING

- A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens.
- B. Hydrostatically test completed piping at a pressure one and one-half times operating pressure. Isolate equipment before testing piping. Repair leaks and retest piping until there are no leaks.
- C. Balance water flow within distribution system, including submains, branches, and terminals, to indicated quantities.

3.5 PIPING SCHEDULE

- A. Hot and Chilled Water, NPS 2 (DN 50) and Smaller:
 - 1. Aboveground: Drawn-temper copper tubing with soldered joints, or steel pipe with threaded joints.
 - 2. Aboveground: Steel pipe with threaded joints.

END OF SECTION 232113

23 21 23 Hydronic Pumps

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data. For each type of pump including certified pump-performance curves, furnished specialties, motor horsepower and electrical characteristics.
 - 2. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with UL 778 for motor-operated water pumps.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Apricus APS-KIT-DOM-CL
- B. Factory-assembled and -tested, designed for installation with pump and motor shafts mounted horizontally or vertically. Rated for 125-psig (860-kPa) minimum working pressure and minimum continuous water temperature of 225 deg F (107 deg C).
 - 1. Casing: Radially split, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, and threaded union end connections.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
 - 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring. Include water slinger on shaft between motor and seal.

2.3 MOTORS

- A. Comply with NEMA MG 1 unless otherwise indicated
 - 1. 1/25 HP (87 W): Built-in thermal-overload protection.
 - 2. Motor shall be non-overloading within full range of pump performance.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- B. Support pumps and piping so weight of piping is not supported by pump volute.



- C. Install electrical connections for power, controls, and devices.
- D. Suspend in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers. Fabricate brackets or supports as required for pumps.
- E. Connect piping with valves that are at least the same size as piping connecting to pumps.
- F. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- G. Install shutoff valve and strainer on suction side of pumps.
- H. Install nonslam check valve and throttling valve on discharge side of pumps.

END OF SECTION 232123

23 23 00 Refrigerant Piping

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line-Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

B. Comply with ASME B31.5, "Refrigerant Piping," and with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

2.2 TUBES AND FITTINGS

A. Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B) and ASTM B 280, Type ACR.

B. Wrought-Copper Fittings and Unions: ASME B16.22.

C. Brazing Filler Metals: AWS A5.8.

2.3 VALVES AND SPECIALTIES

A. Thermostatic Expansion Valve: Comply with ARI 750.

1. Forged brass or steel body, stainless-steel internal parts, copper tubing filled with refrigerant charge for 40 deg. F suction temperature; 700-psig (4820-kPa) working pressure, and 240 deg F (116 deg C) operating temperature.

B. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a Nationally Recognized Testing Laboratory.

1. Plated steel body and bonnet, 240 deg F (116 deg C) temperature rating, 400-psig (2760-kPa) working pressure, 240 deg F (116 deg C) operating temperature; and 24-V, normally closed holding coil.

D. Moisture/Liquid Indicators:

1. Forged brass body, 500-psig (3450-kPa) operating pressure, 240 deg F (116 deg C) operating temperature; with replaceable, polished, optical viewing window and color-coded moisture indicator.

- E. Replaceable-Core Filter Dryers: Comply with AHRI 730.
 - 1. Steel shell with ductile-iron cover; 500-psig (3450-kPa) operating pressure; 240 deg F (116 deg C) operating temperature.
- F. Permanent Filter Dryers: Comply with AHRI 730.
 - 2. Steel shell with ductile-iron cover; 500-psig (3450-kPa) operating pressure; 240 deg F (116 deg C) operating temperature.
- H. Welded steel with corrosion-resistant coating and socket ends; 500-psig (3450-kPa) operating pressure; 240 deg F (116 deg C) operating temperature.

2.4 REFRIGERANTS

- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.
 - 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements in Section 230500 "Common Work Results for HVAC" for basic piping installation requirements.
- B. Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Section 230500 "Common Work Results for HVAC" for wall penetration systems.
- C. Install refrigerant piping and charge with refrigerant according to ASHRAE 15.
- D. Belowground, install copper tubing in PVC conduit. Vent conduit outdoors.
- E. Insulate suction lines to comply with Section 230700 "HVAC Insulation."
- F. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- H. Install thermostatic expansion valves as close as possible to distributors on evaporator coils.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

3.4 PIPING APPLICATIONS FOR REFRIGERANT R-410A



- A. Suction Lines: Copper, [Type ACR] [Type K (A)] [Type L (B)], annealed- or drawn-temper tubing and wrought-copper fittings with [brazed] [or] [soldered] joints.
- B. Hot-Gas and Liquid Lines: Copper, [Type ACR] [Type K (A)] [Type L (B)], annealed- or drawn-temper tubing and wrought-copper fittings with [brazed] [or] [soldered] joints.

END OF SECTION 232300

23 31 00 HVAC Ducts and Casings

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Shop Drawings detailing duct layout and including locations and types of duct accessories, duct sizes, transitions, radius and vaned elbows, special supports details, and inlets and outlet types and locations.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Comply with NFPA 96 for ducts connected to commercial kitchen hoods.
- D. Comply with UL 181 for ducts and closures.

PART 2 – PRODUCTS

2.1 DUCTS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip galvanized coating
- B. Joint and Seam Tape, and Sealant: Comply with UL 181A.
- C. Rectangular Metal Duct Fabrication: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ACCESSORIES

- A. Volume Dampers and Control Dampers: Single-blade standard leakage rating, and suitable for horizontal or vertical applications; factory fabricated and complete with required hardware and accessories.
- B. Flexible Connectors: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" unless otherwise indicated.
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Outdoor, Supply-Air Ducts: Seal Class A.
 - 2. Outdoor, Exhaust Ducts: Seal Class C.

3. Outdoor, Return-Air Ducts: Seal Class C.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher than 2-Inch wg ((500 Pa)): Seal Class B.
10. Conditioned Space, Exhaust Ducts: Seal Class B.
11. Conditioned Space, Return-Air Ducts: Seal Class C.

- B. Conceal ducts from view in finished and occupied spaces.
- C. Avoid passing through electrical equipment spaces and enclosures.
- D. Support ducts to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Hangers and Supports."
- E. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- F. Install volume and control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
- G. Clean new duct system(s) before testing, adjusting, and balancing.

3.2 TESTING, ADJUSTING, AND BALANCING

- A. Balance airflow within distribution systems, including sub-mains, branches, and terminals to indicated quantities.

END OF SECTION 22 31 13



23 34 00 Bathroom Exhaust Fan

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Power ventilators shall comply with UL 705.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70E, by a qualified testing agency, and marked for intended location and application.

2.3 THROUGH-THE-WALL VENTILATION FAN

- E. Panasonic
 - 1. Ventilation Fan servicing the bathroom
 - 2. Model: FV-08WQ1

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units with clearances for service and maintenance according to the manufacturer's instructions.
- B. Ground power ventilators.

END OF SECTION 23 34 00



23 37 13 Diffusers, Registers and Grilles

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data: For each type of product indicated, including color charts for factory finishes.

PART 2 - PRODUCTS

2.1 REGISTERS AND GRILLES

- A. Adjustable Bar Grille <Insert Drawing designation>:
 - 1. Material: Aluminum.
 - 2. Finish: Anodized aluminum
 - 3. Mounting: Lay in

- D. Fixed-Face Register <Insert Drawing designation>:
 - 1. Material: Aluminum
 - 2. Finish: Anodized aluminum
 - 3. Mounting: Lay in

- E. Fixed-Face Grille <Insert Drawing designation>:
 - 1. Material: Aluminum.
 - 2. Finish: Anodized aluminum
 - 3. Mounting: Lay in

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.

- B. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

23 56 13.13 Heating, Solar, Vacuum-Tube Collectors

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product, including rated capacities, operating characteristics, and furnished specialties and accessories.
2. Product Certificates: For each type of solar collector, certifying compliance with Florida Solar Energy Center (FSEC) and Solar Rating and Certification Corporation (SRCC) OG-100.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hail Resistance: Able to withstand 1-inch-diameter hail.

2.2 MANUFACTURERS

- A. Apricus.

2.3 COLLECTORS

- A. Enclosure: Extruded aluminum with painted white finish. Glass wool insulation with a minimum thermal resistance (R-value) of R-7.5 on the back and R-5 on the sidewalls.
- B. Mounting Frame: Stainless-steel construction fabricated to withstand wind loads of up to 130 mph (210 km/h) with no separation of the collector from the frame or the frame from the structure. Profile to be medium angle, 21 to 28 degrees.

2.4 CAPACITIES AND CHARACTERISTICS

- A. Area:
 1. Gross: 44.76 sq. ft.
 2. Net Aperture: 32.05 sq. ft.
- B. Dry Weight: <209 lb.
- C. Fluid Type: Water.
- D. Fluid Capacity: 24 fl. oz.
- E. Test Pressure: 116 psig.
- F. Maximum Operating Temperature: 225 deg F.

G. SRCC-Certified Performance Rating:

1. Clear Day at 2000 Btu/sq. ft. per Day ((23 MJ/sq. m per Day)): 40.6.
2. Mildly Cloudy Day at 1500 Btu/sq. ft. per Day ((17 MJ/sq. m per Day)): 29.3.
3. Cloudy Day at 1000 Btu/sq. ft. per Day ((11 MJ/sq. m per Day)): 18.

PART 3 - EXECUTION

3.1 SOLAR-COLLECTOR INSTALLATION

- A. Examine substrates, areas, conditions, and solar-collector piping for compliance with requirements for installation and other conditions affecting performance of the Work.
- B. Comply with manufacturer's written instructions for collector mounting and installation.
- C. Install the collector according to ASHRAE's "Active Solar Heating Systems Installation Manual."
- D. Install low-voltage wiring from the sensor to the energy-management panel.
- E. Place high-temperature-resistant covers over the header to prevent contaminants from entering the headers.
- F. Coat the controller's sensor with a layer of thermal paste and insert into the collector sensor port to full depth. Apply a silicone sealant around the entire perimeter of the sensor where it enters the collector. Completely cover the opening with insulation to prevent water ingress. Only use high-temperature-rated, minimum 395 deg F (202 deg C), sensors and cabling.
- G. After connecting the inlet and outlet of the collectors to the system, purge the system of all air.
- H. Install collectors with not less than minimum space for access and service as recommended by solar-collector manufacturer.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping."
- B. Where installing piping adjacent to solar collectors, allow space for service and maintenance.
- C. Install ball valve and union at inlet and outlet of solar collectors. Comply with requirements in Section 230523 "General-Duty Valves for HVAC Piping" for materials and installation requirements for ball valves and unions.
- D. Connect solar collectors to lightning protection system. Comply with requirements in Section 264113 "Lightning Protection for Structures."

END OF SECTION 235613.13



23 72 00 Air-to-Air Energy Recovery Equipment

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Energy recovery ventilator that transfer humidity and recover energy from that humidity, helps maintain a fresh environment even when the heating or cooling system is not operating.

1.2 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.3 COMPLIANCE

- A. Comply with NFPA 70 and 2011 NEC.

PART 2 - PRODUCTS

2.1 ENERGY RECOVERY VENTILATOR

- A. Manufacture: Greenheck
 - 1. Model: Minicore-5-VG
 - 2. 12" intake duct
 - 3. 9.8" discharge duct

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:
 - 1. Greenheck Minicore-5-VG Residential Energy Recovery Ventilator Installation Instructions.
- B. Connect and install ducts as described in Section 23 31 00.

END OF SECTION 23 72 00



23 81 26 Split-System Air-Conditioners

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings.
- B. Comply with NFPA 70, "National Electrical Code."
- C. Warranties: Provide standard manufacturer's written warranty, without monetary limitation, signed by manufacturer agreeing to promptly repair or replace products that fail in materials or workmanship for the period of 7 years for compressor, 5 years for parts.

PART 2 - PRODUCTS

2.1 OUTDOOR UNIT

- A. Trane 4TWZ0024A1000A OUTDOOR HEAT PUMP
 1. 24,000 BTUH, 20 SEER, Variable speed heating and cooling
 2. <http://www.trane.com/residential/products/heat-pumps/xl20i-heat-pumps>

2.2 INDOOR VARIABLE SPEED MODULAR COMUNICATING AIR HANDLER

- A. Trane TAM8A0A24V21CB Air Handler

2.3 SUPPLEMENTARY ELECTRIC HEATER FOR AIR HANDLER

- A. Trane BAYEVAC05BK1AA

2.4 INSTALLATION MATERIALS

- A. TAM8A0A24V21CB unit comes with wall-mount installation plates, remote control holder, hardware, and Anti-Allergen and deodorizing filters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be executed as per installation manuals provided by the Manufacturer.
- 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 10 00 Energy Monitoring Systems

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals:

1. Product Data.

B. Compliance:

1. NFPA 70, "National Electrical Code"

1.02 SECTION REQUIREMENTS

A. Sitesage M4-44

1. 2 x 150A CT
2. 10 x 50A CT
3. 32 x 20A CT
4. Gateway

B. inDAC Data Acquisition

1. Microcontroller with inputs for digital, analog, MODBUS, pulse counters, and 1-Wire networks. Wired to Monitor Gateway.

C. inSense CO₂, RH, Temp

1. InSense CO₂ Sensor

D. Analog Flowmeter (1.5 - 26.5 GPM)

1. 3/4"

E. MKIII RTI-LR

F. IP-100

1. RainWise Network Interface

G. Solar Radiation (MKIII)

1. Silicon Photo Diode
2. Solar Radiation (MKIII)

H. Weather Station Mono Mount

I. inView Dashboard

1. InView Modular Dashboard



J. inControl 1.0 Modbus

K. inGate Modbus

1. inGate 1.0 Commercial grade ethernet Gateway

L. inSense Relative Humidity/Temp

1. 1-Wire Relative Humidity / Temperature Sensor
2. Wall mount
3. 12VDC Power input

PART 3 – EXECUTION

3.01 INSTALLATIONS

- A. Prepare substrate by cleaning, removing projections, filling voids, sealing joints, and as otherwise recommended in manufacturer's written instructions.
- B. Network equipment to be installed according to manufacturer's specifications.
- C. Set units level, plumb, and true to line and anchor securely in place.
- D. Correct deficiencies in or remove and reinstall materials that do not comply with requirements.
- E. Repair, refinish, or replace substrate damaged during installation or transit, as directed by Architect.

END OF SECTION 25 10 00



Division 26 – Electrical

26 05 19 Low-Voltage Electrical Power Conductors and Cables

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70E.

2.2 CONDUCTORS AND CABLES

- A. Conductors and Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW, Type THHN/THWN, or Type XHHW.
- B. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for nonmetallic-sheathed cable, Type NM with ground wire.
- C. Cable Type NM-B Cable: Comply with UL 719, with Type THHN/THWN conductors complying with UL 83.
- D. Cable Type SEU: Comply with UL 854, with Type THHN/THWN conductors complying with UL 83.
- E. Cable Type UF-B: Comply with UL 493, with Type THHN/THWN conductors complying with UL 83.

2.3 CONNECTORS AND SPLICES

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Feeders and Branch Circuits: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Service Entrance: Type XHHW-2, single conductors in raceway.

- C. Exposed Feeders, Branch Circuits, and Class 1 Control Circuits, Including in Crawlspace: Nonmetallic-sheathed cable, Type NM.
- D. Feeders and Branch Circuits Concealed in Ceilings, Walls, Partitions, and Crawlspace: Nonmetallic-sheathed cable, Type NM.
- E. Feeders and Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Underground feeder cable, Type UF.
- F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain-relief device at terminations to suit application.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- B. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- C. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."
- D. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Use manufacturer-approved pulling compound or lubricant where necessary.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- G. Make splices, terminations, and taps that are compatible with conductor material. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors. Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
- H. Identify conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding all critical equipment and services for compliance with requirements.



2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Cables will be considered defective if they do not pass tests and inspections.
- B. Test and Inspection Reports: Prepare a written report showing procedures used, results complying with requirements, and corrective action taken to achieve compliance.

END OF SECTION 260519



26 05 26 Grounding and Bonding for Electrical Systems

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data for each type of product indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70E, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. S-5-PV Kit

2.3 GROUNDING MATERIALS

- A. Conductors: Solid for No. 8 AWG and smaller; stranded for No. 6 AWG and larger unless otherwise indicated.
 - 1. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable code or authorities having jurisdiction.
 - 2. Bare, Solid-Copper Conductors: Comply with ASTM B 3.
 - 3. Bare, Stranded-Copper Conductors: Comply with ASTM B 8.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pipe and Equipment Grounding-Conductor Terminations: Bolted.
- B. Connections to Structural Steel: Bolted.
- C. Install grounding conductors routed along shortest and straightest paths possible unless otherwise indicated or required by code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- D. Install ground rods driven into ground until tops are 2 inches (50 mm) below final grade or 4 inches (100 mm) above finished floor slab unless otherwise indicated.
- E. Make connections without exposing steel or damaging coating if any.
- F. Install bonding straps and jumpers in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
- J. Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
- K. Bond to equipment mounted on vibration isolation hangers and supports so vibration is not transmitted to rigidly mounted equipment.
- L. Grounding and Bonding for Piping:
 - 1. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
- M. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
 - 1. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - 2. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Report measured ground resistances that exceed 10 ohms.
 - 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526



26 05 33 Raceway and Boxes for Electrical Systems

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Shop Drawings for custom enclosures and cabinets.
- B. Seismic qualification certificates for enclosures, cabinets, conduit racks, and mounting provisions.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70E, by a qualified testing agency, and marked for intended location and application.
- B. Galvanized Rigid Conduit: Comply with ANSI C80.1 and UL 6.
- C. Raceway Fittings: Specifically designed for raceway type used in Project.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70E, by a qualified testing agency, and marked for intended location and application.
- B. Electrical Nonmetallic Tubing: Comply with NEMA TC 13 and UL 1653.
- C. Rigid Nonmetallic Conduit (RNC): Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Raceway Fittings: Specifically designed for raceway type used in Project.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- B. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Metal Floor Boxes:
 - 1. Material: sheet metal.
 - 2. Type: Semi-adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70E, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Outdoor Raceways Applications:
 - 1. Exposed or Concealed: IMC.
 - 2. Underground, Single Run: RNC.
 - 3. Connection to Vibrating Equipment: LFMC.
 - 4. Boxes and Enclosures: Metallic, NEMA 250, Type 3R or Type 4.
- B. Indoor Raceways Applications:
 - 1. Exposed or Concealed: EMT.
 - 2. Connection to Vibrating Equipment: FMC; in wet or damp locations, use LFMC.
 - 3. Damp or Wet Locations: IMC.
 - 4. Boxes and Enclosures: Metallic, NEMA 250, Type 1, unless otherwise indicated.
- C. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- D. Install raceways and cables at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
- G. Install pull wires in empty raceways.
- H. Connect motors and equipment subject to vibration, noise transmission, or movement with a 72-inch (1830-mm) maximum length of flexible conduit.
- I. Install raceways and cables concealed within finished walls, ceilings, and floors unless otherwise indicated.

3.2 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

END OF SECTION 260533

26 24 16 Panelboards

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70E, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7].

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Seismic-Restraint Loading: Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Enclosures: Surface mounted cabinets; NEMA 250, Type 1.
- C. Service Equipment Label: Nationally Recognized Testing Laboratory (NRTL) labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- E. Panelboard Short-Circuit Current Rating: 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; listed and labeled for series-connected short-circuit rating by an NRTL.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.3 DISTRIBUTION PANELBOARDS

- A. Panelboard
 1. Manufacturer: Square D
 2. Model: QO142L225G
 3. Rated Current: 225 A
 4. Rated Voltage: 120/240 V AC
 5. Spaces: 42

- B. Panelboard cover
 - 1. Manufacturer: Square D
 - 2. Model: QOC42US
- C. Panelboards: NEMA PB 1, power and feeder distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- E. Mains: Convertible with lugs.
- F. Branch Overcurrent Protective Devices: Plug-in circuit breakers.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Main Circuit Breaker
 - 1. Manufacturer: Square D
 - 2. Model: QOM2150VH
 - 3. Main Circuit Breaker Rating: 150-A, 240-V AC
 - 4. Convertible Load Center Mains Rating: 150-225
- B. Plug On Circuit Breaker:
 - 1. Manufacturer: Square D
 - 2. Models: QO220VH, QO225VH, QO230VH, QO235VH, QO240VH
 - 3. 2 Pole – 120/240 Vac Common Trip
 - 4. Ampere Rating: 20-A, 25-A, 30-A, 35-A, 40-A
- C. Combination Arc Fault Interrupter (Pigtail Neutral):
 - 1. Manufacturer: Square D
 - 2. Models: QO115VHCAFI, QO120VHCAFI
 - 3. 1 Pole – 120-V AC
 - 4. Ampere Rating: 15-A, 20-A
- D. Combination Arc Fault and Ground Fault Circuit Interrupter with Pigtail Neutral:
 - 1. Manufacturer: Square D
 - 2. Models: QO115VHDF, QO120VHDF
 - 3. 1 Pole – 120-V AC
 - 4. Ampere Rating: 15-A, 20-A

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store, and install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- B. Mount top of trim 80 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.

END OF SECTION 262416

26 27 26 Wiring Devices

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70E, by a qualified testing agency, and marked for intended location and application.

- B. Comply with NFPA 70E.

2.2 RECEPTACLES

- A. Device Color: White unless otherwise indicated or required by NFPA 70E or device listing.
- B. Residential-Grade, Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498. Labeled to comply with NFPA 70E, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.
 - 1. Hubbell BR20WHITR
- C. Weather-Resistant and Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498. Labeled to comply with NFPA 70E, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.
 - 1. Hubbell RR15SWTR
- D. Duplex Ground-Fault Circuit-Interrupter (GFCI) Convenience Receptacles: 125-V, 20-A, straight blade, feed-through type. NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
 - 1. Hubbell GFTR20W
- E. Range and Dryer Power Receptacles: 125/250-V, 30A and 125/250-V, 50A. Flush mount power receptacle, 3 pole, 4 wire, with ground, mounts on one or two-gang box. UL Listed E1706, CSA certified.
 - 1. Hubbell RR430F
 - 2. Hubbell RR450F

2.3 SWITCHES

- A. Device Color: White unless otherwise indicated or required by NFPA 70E or device listing.
- B. Toggle Switches, Square Face, 120-V, 15 A AC: Comply with NEMA WD 1, UL 20, and FS W-S-896. Single-pole, grounding, push and side wire terminators.
 - 1. Hubbell RS115W

- C. Toggle Switches, Square Face, 120-V, 15 A AC: Comply with NEMA WD 1, UL 20, and FS W-S-896. Three-way, grounding, push and side wire terminators.
 - 1. Hubbell RS315W

2.5 WALL-BOX DIMMERS

- A. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

2.6 WALL PLATES

- A. Wall Plates, Finished Areas: White, Smooth, high-impact thermoplastic, fastened with metal screws having heads matching plate color.
 - 1. Hubbell NP1W
 - a. 1-gang, 1-toggle
 - 2. Hubbell NP2W
 - a. 2-gang, 2-toggle
 - 3. Hubbell NP4W
 - a. 4-gang, 4-toggle
 - 4. Hubbell NP26W
 - a. 1-gang blank cover
 - 5. Hubbell NP8W
 - a. 1-gang, 1-duplex
 - 6. Hubbell 5175-1
 - a. 2-gang blank cover
- B. Wall Plates, Unfinished Areas: White, Smooth, high-impact thermoplastic with metal screws.
- C. Wall Plates, Damp Locations: White, Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet locations.

2.6 OLD WORK BOXES

- A. Old work switch/outlet boxes: nonmetallic. Comply with NEMA OS-2, UL 514C.
 - 1. Carlon B114R-UPC
 - a. 1-gang, with mounting ears and swing clamps
 - 2. Carlon B225R-UPC
 - a. 2-gang, with mounting ears and 2 swing clamps

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.



- C. Select device colors and wall plates as follows:
 - 1. For plastic covers, white.
 - 2. Above kitchen counters, use white devices.

- D. Install unshared neutral conductors on line and load side of dimmers.

- E. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multigang wall plates.

END OF SECTION 26 27 26



26 27 29 Electric Vehicle Charging Station

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: The work specified in this Section includes, but shall not be limited to, complete, electric vehicle charging stations as indicated on the Drawings and as specified herein.
1. The extent of the electric vehicle charging infrastructure work shall be as indicated by the Drawings and by the requirements of this Section, including, but not limited to, the following:
 - a. Panelboards or load centers.
 - b. Integral branch circuit metering options for certain utilities that want to offer discounted electric vehicle charging rates.
 - c. Power monitoring meters where the Owner wants to monitor the kW consumed by the charging station.
 - d. Interface for demand response signals options (for future versions of electric vehicle charging station products).
 - e. Work stations, software, and communications hardware when installing power monitoring devices.
 2. System installation shall include, but shall not be limited to, the following:
 - a. Wiring of branch circuit conductors.
 - b. Installation of external metering devices and wiring to the charging station where electric vehicle rates are offered by utilities.
 - c. Installation of communications conductors and associated hardware when installing external power monitoring devices.

1.2 REFERENCES

- A. General: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
- B. American Society of Civil Engineers (ASCE):
1. ASCE 7, "Minimum Design Loads for Buildings and Other Structures" (copyrighted by ASCE, ANSI approved).
- C. ASTM (ASTM):
1. ASTM E 329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction."
- D. California Code of Regulations (CCR):
1. CCR Title 24, "California Building Standards Code."
- E. International Code Council (ICC):
1. ICC ES AC156, "Acceptance Criteria for Seismic Qualification by Shake Table Testing of Nonstructural Components and Systems."
 2. ICC IBC, "International Building Code."
- F. National Fire Protection Association (NFPA):

1. NFPA 70, "National Electrical Code" (copyrighted by NFPA, ANSI approved) hereinafter referred to as NEC.
2. NFPA 5000, "Building Construction and Safety Code."

G. SAE International (SAE):

1. SAE J1772, "Standard for Electric Vehicle Conductive Charge Coupler."

H. Underwriters Laboratories, Inc. (UL):

1. UL 991, "Standard for Tests for Safety Related Controls Employing Solid State Devices."
2. UL 1998, "Standard for Software in Programmable Components."
3. UL 2231 1, "Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements."
4. UL 2231 2, "Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems."
5. UL 2251, "Standard for Plugs, Receptacles and Couplers for Electric Vehicles."
6. UL 2594, "Standard for Electric Vehicle Supply Equipment."

1.3 SUBMITTALS

- A. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications, including, but not limited to, manufacturer's product data and installation instructions for each component and system.
- B. Wiring Diagrams: Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer installed wiring and field installed wiring, and between components provided by the manufacturer and those provided by others.
1. Submit typical connection diagrams for all components including, but not limited to, panelboards, communications devices, and personal computers.
- C. Contract Closeout Submittals:
1. Operation and Maintenance Data: Submit operation and maintenance data for electric vehicle charging stations to include in operation and maintenance manuals.
 2. Warranty Data: Submit manufacturer's standard warranty documents.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
- B. Standards: Comply with applicable requirements of the following standards:
1. NEMA Compliance: Applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
 2. NEC Compliance: Applicable portions of the NEC, including, but not limited to, Article 625.
 3. UL Compliance: Applicable UL standards for electric vehicle supply equipment, panelboards, circuit breakers, and energy management equipment.
 4. FCC Emissions: Comply with FCC emissions standards.



- 5. CCR Title 24: Lighting control equipment shall be certified by the California Energy Commission.
- 6. Seismic Compliance: NFPA 5000, ASCE 7, ICC ES AC156, and/or ICC IBC, as applicable to the Project location and as required by authorities having jurisdiction.

D. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be listed and labeled as defined in NEC, Article 100, by an inspecting and testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Coordination: Coordinate the work in this Section with all of the trades covered in other sections of the Specification to provide a complete and operable system. Furnish inserts and anchors that must be built into other work. Work closely with installers of finish materials so that units are properly aligned with adjacent materials.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
- B. Store materials in their original, undamaged packages and containers, inside a well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install electric vehicle charging stations until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.8 WARRANTY

- B. Warranty Period: Warranty period shall be 18 months from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Product specified is "Electric Vehicle (EV) Charging Station" as manufactured by Square D by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.
 - 1. Substitutions: If a system from another manufacturer is submitted for review and acceptance, the following submittals shall be required:
 - a. Short circuit study demonstrating NEC 110.10 compliance for remotely operated switching devices.
 - b. Elevation drawing showing placement of equipment in equipment rooms.

2.2 CIRCUIT BREAKERS

- A. Branch Circuit Breakers: Branch circuit breakers shall provide overload and short circuit protection suitable for the location in the electrical system, as defined in the panelboard and load center schedules. Circuit breaker devices shall have, but shall not be limited to, the following:
1. Integral branch circuit overcurrent protection as required by the NEC. Circuit breakers shall have an UL listed interrupting rating sufficient for the application or UL listed series connected ratings for the maximum available fault current at that point in the system.
 2. UL listed SWD ratings for 40 ampere two pole branch devices, HID ratings, and HACR ratings.
 3. There shall be an in built auto ground fault reset functionality in the charging station that shall reset automatically after ground fault waits for 16 minutes and then shall attempt to supply power. This trial shall happen four times and at the end of fourth attempt the auto reset function shall quit. This functionality shall be nullified if a ground fault breaker is installed ahead of the charging station (so, always use a non GFCI breaker).
 4. Provide visible flag that shall clearly indicate the status of the circuit breaker contacts with the panel trim installed. Flag shall indicate, but shall not be limited to, on, off, and tripped circuit breaker states. The visible flag shall be mechanical in nature, directly tied to the circuit breaker mechanism, and shall be provided in addition to any status indicator supplied by the system electronics.

2.3 MASTER PANELBOARD

- A. Master panelboards shall provide power and control for operating and monitoring operated branch circuit breakers located in both master and slave panelboards.
- B. Master panelboards shall contain a nameplate label, located on the panel trim, indicating its designation and the designations of associated slave panels.

2.4 ELECTRIC VEHICLE SUPPLY EQUIPMENT OUTDOOR (EVSE)

- A. Power Specifications (Each charging unit):
1. Input Power: 208 volts AC to 240 volts AC/30 amperes, single phase, 60 hertz.
 2. Input Power Connection: Line 1, line 2, and ground.
 3. Feeder Circuit Breaker: Two pole, 40 amperes, non GFCI type.
 4. Output Power: 208 volts AC to 240 volts AC, 30 amperes.
- B. Physical Specifications:
1. Enclosure Type: Type 3R.
 2. Enclosure Dimensions: See the Drawings.
 3. Enclosure Mounting: Wall mounted.
 4. Cable Type: SAE J1772.
 5. Cable Length: 18 feet.
 6. Cable Management: Non retractable, integral with the enclosure.
 7. Unit Options: Single unit (wall mounted).

- C. User Interface:
 - 1. Power available status indicator.
 - 2. Charging blinking blue indicator.
 - 3. System detected fault red status indicator.

- D. Authentication:
 - 1. Type non networked RFID/key fob.
 - 2. Programming radio frequency remote control.

- E. Protection:
 - 1. Ground fault protection integral, CCID 5 mA, auto reset.
 - 2. Ground fault protection system test automatic at the beginning of each charge cycle.

- F. Environmental:
 - 1. Operating Temperature: 22 °F (30 °C) to 131 °F (55 °C).
 - 2. Electrostatic Discharge: 15 kV open air, 8 kV contact.
 - 3. Surge: 6 kV.
 - 4. Radiated Immunity: 20 V/m.
 - 5. Conducted Immunity: 20 volts.
 - 6. Electrical Fast Transient/Burst (EFTB): 2 kV.
 - 7. Emissions FCC Class: Class B.

- G. Standards Compliance:
 - 1. NEC, Article 625.
 - 2. SAE J1772.
 - 3. UL 991, UL 1998, UL 2231 1, UL 2231 2, UL 2251, and UL 2594.

2.5 METERING

- A. In cases where utilities offer separate rates for electric vehicle charging, provide standard or revenue grade meters as required by the specific utility.

- B. Power meter shall transmit data using RS 485 Modbus RTU protocol, Ethernet, or cellular.

- C. Power metering shall monitor the following parameters:
 - 1. Power measurement.

2.6 SOURCE QUALITY CONTROL

- A. Component Testing: Electronic component board assemblies shall be factory tested and burned in prior to installation.

PART 3 EXECUTION

3.1 INSTALLATION



- A. Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings. System installation shall be coordinated with related and adjacent work. Define each circuit breaker.

3.3 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the electric vehicle charging stations shall be without damage at time of Substantial Completion.

END OF SECTION 26 27 29

26 31 00 Photovoltaic Collectors

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data: For each type of product.
 - 2. Shop Drawings: For photovoltaic (PV) modules.
- B. Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period of 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Nationally Recognized Testing Laboratory Listing: Entire assembly shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for electrical and fire safety, Class C, according to UL 1703.
- B. FM approved for NFPA 70E, Class 1, Division 2, Group C and Group D hazardous locations.

2.2 PHOTOVOLTAIC COLLECTORS

- A. Silevo
 - 1. Triex U280
 - 2. Hybrid Monocrystalline / Amorphous Silicone Cells with Tunneling Junction Technology
 - 3. <http://silevosolar.com/>

2.3 SYSTEM DESCRIPTION

- A. Grid-Tied PV System: An array of 24 modules to generate a total nominal 6720-rated W connected via a utility meter to the electrical utility.
- B. Front Panel:
 - 1. Glass: Fully tempered, with antireflective coating.
 - 2. 0.125-inch- (3.2-mm-) thick glass.
- C. Bypass Diode Protection: Internal.
- D. Junction Box:
 - 1. IP65 rated with 4 bypass diodes
- E. Output Cabling:
 - 1. 1000mm / MC4 Connectors

- F. Series Fuse Rating: 12A.

2.4 CAPACITIES AND CHARACTERISTICS

A. Minimum Electrical Characteristics:

1. Rated Open Circuit Voltage (Voc): 77.2 V dc.
2. Maximum System Voltage: 500 V dc.
3. Maximum Power at Voltage (Vpm): 350 V dc.
4. Short-Circuit Temperature Coefficient: 40 mA/deg C.
5. Rated Short-Circuit Current (Isc): 5.59 A.
6. Rated Operation Current (Imp): 19.2 A.
7. Maximum Power at Standard Test Conditions Defined in IEC 61215 (Pmax): 6.72 kW.

B. Normal Operating Temperature Characteristics (NOTC):

1. Temperature at Nominal Operating Cell Temperature: 46 +/- 2 deg C>.
2. Temperature Coefficient (NOTC Pmax): -0.27% / deg C.
3. Temperature Coefficient (NOTC Voc): -0.262% / deg C.
4. Temperature Coefficient (NOTC Isc): -0.04% / deg C.

2.5 MODULE FRAMING

A. PV laminates mounted in anodized extruded-aluminum frames.

1. Entire assembly UL listed for electrical and fire safety, Class C, according to UL 1703, complying with IEC 61215.
2. Finish: Black aluminum.

2.6 ARRAY CONSTRUCTION

A. Framing:

1. Material: Galvanized steel.
2. Maximum System Weight: Less than 4 lb/sq. ft. (19.53 kg/sq. m).

2.7 POWER OPTIMIZER

A. SolarEdge P400:

1. Output Current Rating: 15A dc.
2. Output Voltage Rating: 60V dc.
3. PV Maximum Open Input Voltage: 80 V dc.
4. Power Conversion Efficiency: 99.5 percent.

2.8 INVERTER SYSTEM

- A. Control Type: Maximum-power-point-tracker (MPPT) control.

- B. Solar Edge Single Phase SE60000A-US:

1. Maximum Voc: 264 V ac.
 2. PV Start Voltage: 8 V dc.
 3. MPPT Voltage Range: 8-80 V dc.
 4. Maximum Input Current: 18A.
 5. Number of Independent MPPT Circuits: 24.
 6. Nominal Output Voltage: 240 V ac.
 7. Maximum Output Current: 25A.
 8. Peak Efficiency: 98.3 percent.
 9. DC/AC Terminal Range (AWG): 24-6 AWG.
 10. NEMA 250 Enclosure Rating: 3R.
- C. Operating Conditions:
1. Operating Ambient Temperatures: Minus 13 to plus 140 deg F.
 2. Relative Humidity: Zero to 95 percent, noncondensing.
- D. Inverter shall have the following:
1. Overcurrent protection.
 2. Generator input breaker box.
 3. Digital display.
 4. Disconnect switch.
 5. Surge overload protection.
- E. Enclosure: NEMA 250, Type 3R.
- F. Protective Functions:
1. AC over/under voltage.
 2. AC over/under frequency.
 3. Ground over current.
 4. Overtemperature.
 5. AC and dc overcurrent.
 6. DC over voltage.
- G. Disconnects:
1. Low-voltage disconnect.
 2. Low-voltage reconnect.
 3. High-temperature disconnect.
 4. High-temperature reconnect.
- H. Regulatory Approvals:
1. IEEE 1547.1.
 2. IEEE 1547.3.
 3. UL 1741.
- I. Characteristics:
1. Inverter Dimensions: 30.5" x 12.5" x 7.5"
 2. Inverter Weight: 54.7 pounds.



2.9 MOUNTING STRUCTURES

- A. Canopy Roof Mount: Extruded aluminum, two rails, 22 degree tilt legs, and roof standoffs.
- B. Mounting Clip: S-5!
 - 1. S-5-PV Kit
 - 2. EdgeGrab™

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed. Do not begin installation until mounting surfaces have been properly prepared.
- B. Install arrays per manufacturer's written instructions.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. Perform tests and inspections with the assistance of a factory-authorized service representative.

END OF SECTION 26 31 00

26 50 00 Lighting

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data for each luminaire, including lamps.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fixtures, Emergency Lighting Units, Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Exterior Luminaires: Comply with UL 1598 and listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- C. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- D. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. TS Light XT-13
 1. Voltage: 120 V ac.
 2. Mounting: Track.
 3. Lamps: One LED Module.
 4. Lens: 60 degree, 20 degree.
 5. External Finish: Silver.
- B. TS Light SX-7
 1. Voltage: 120 V ac.
 2. Mounting: Track.
 3. Lamps: One LED Module.
 4. Lens: 40 degree.
 5. External Finish: Silver.
- C. Eureka Pixel 4526
 1. Voltage: 120 V ac.
 2. Mounting: Recessed Ceiling.
 3. Lamps: One LED Module.
 4. Lens: 48 degrees.



5. External Finish: Satin Aluminum.

D. Tech Lighting Gia Bath

1. Voltage: 120 V ac.
2. Mounting: Surface Wall.
3. Lamps: One LED Channel.
5. External Finish: Satin Nickel

E. Diode LED Fluid View 12V Wet Location LED Strip Light

1. Voltage: 12 V dc.
2. Mounting: Undermount.
3. Lamps: Continuous LED Tape Light.
5. External Finish: White

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate ceiling-mounted luminaires with ceiling construction, mechanical work, and security and fire-prevention features mounted in ceiling space and on ceiling.
- B. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- C. Comply with NFPA 70 for minimum fixture supports.
- D. Seismic Protection: Luminaire attachments to building walls and ceilings shall comply with seismic criteria in applicable electrical code.
- E. Suspended Lighting Fixture Support: Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- F. Adjust aimable lighting fixtures to provide required light intensities.

END OF SECTION 26 50 00



Division 28 – Electronic Safety and Security

28 31 00 Fire Detection and Alarm

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification addresses fire alarm systems installations.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product submittal data and installation instructions, detailed wiring diagrams.

1.3 COMPLIANCE

- A. National Fire Protection Association (NFPA):
 1. NFPA 70 National Electrical Code
 2. NFPA 72 National Fire Alarm Code
 3. NFPA 101 Life Safety Code
- B. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.1 SMOKE DETECTORS

- A. Combination smoke & carbon monoxide detectors.
 1. BRK
 2. Model #: SC9120B

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and test systems according to NFPA 72 and manufacturer's instructions.

END OF SECTION 28 31 00

Division 31 – Earthwork

31 66 00 Competition Foundation

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Structural Performance: Design, engineer, fabricate, and install foundation system to withstand structural loads required by the U.S. Department of Energy Solar Decathlon Building Code.
- B. Submittals: Product Data

PART 2 - PRODUCTS

2.1 ADJUSTABLE PREFABRICATED STEEL PIERS

- A. Ellis Manufacturing Co. Inc.
 - 1. Light Duty Steel Shores: STL-10, STL-14
 - 2. Adjustable structural support column for temporary or permanent support.
 - 3. Load Rating: 20,000 lbs., 18,000 lbs.
 - 4. Minimum/Maximum Height: 10-14-inches, 14-22-inches
 - 5. www.ellisok.com
- B. Or approved equivalent.

2.4 FINISHES

- A. Steel Finishes: Cleaned, primed, and painted by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare ground by cleaning, removing projections, and as otherwise recommended in stand manufacturer's written instructions and DOE Solar Decathlon Building Code foundation provisions.
- B. Set units level, plumb, and true to line, without warp or rack of materials. Adjust products to achieve level foundation within manufacturer's specified minimum and maximum heights. Provide appropriate blocking if necessary.
- C. Fasten stands securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated in drawings. Adjust as needed to integrate stability throughout system.
- D. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.



- E. Correct deficiencies in or remove and reinstall products that do not comply with requirements.
- F. Repair, refinish, or replace products damaged during installation, as directed by Architect.
- G. Lubricate hardware and moving parts.
- H. Secure with approved anchoring system.

END OF SECTION 31 66 00

Division 32 – Exterior Improvements

32 93 00 Plants

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Summary:

1. This section includes plant material and soil specifications used within the landscape design and the respective storage and installation requirements to place and maintain these in the specified location in the project.

B. Submittals: Product data and certificates:

1. Images and physical, environmental and maintenance characteristics and requirements of plants to be submitted prior to final selection of materials.

PART 2 - PRODUCTS

2.1 PLANTING MATERIALS

A. Quality Assurance:

1. The appointed Nursery shall be qualified to grow, raise, maintain, care for and store all specified plants and growing mediums necessary for the latter until October of 2015.
2. Healthy root systems shall be developed by the appointed nursery for all species of plants to be provided, by transplanting or root pruning. Supplied plants shall be well shaped, fully branched, healthy vigorous stock, densely foliated when leafed and free from disease, parasites, defects, injuries and disfigurements complying with applicable requirements in ANSI Z60.1.
3. All plants to be supplied shall be typical of the species and variety. All plants shall be healthy, fully branched, developed exhibiting vigor and healthy root systems with no signs of damage, injuries, bark abrasions, defects, plant diseases, insect eggs, borers or any other form of infection complying with applicable requirements in ANSI Z60.1.

NOTE: Product substitution shall not be permitted in any scenario except the written consent of the project manager and the design advisors.

B. Delivery , Storage and Handling:

1. Plants to be carefully transported from the appointed Nursery to the competition site in protective containers with necessary amounts of soil mixture as specified by the supplier, the Nursery, which shall also provide the means of transportation for the same from the place of cultivation to the competition site. Method of transportation and the transported materials shall all be in accordance with any federal state regulations necessary for entering California.
2. All plants delivered on site to be examined before accepting delivery by the concerned project manager on site. Any plants exhibiting visual, physical or physiological deficiencies or decay as mentioned above shall be rejected and immediately discarded and replaced at the earliest at no added cost by the Nursery
3. Any shipment invoice, delivery slips or legal documentation arriving with the delivery shall be filed with the field manager.
4. Once on site the transported plant cases shall be unloaded by the Nursery employees and placed in designated space away from other materials and construction in progress by the competition members to ensure no damage to the plants.
5. Plants shall be stored prior to installation in area with access to sunlight and necessary supply of water, as per instructions of the nursery and compliant with the rules of the competition.



6. No plant material shall be planted or places in the project location until approved by the field manager. All rejected plants shall be removed from the building immediately and replaced with new ones

C. Manufacturers/ Supplier:

1. Alegria Fresh
1575 Blue Bird Canyon Dr.
Laguna Beach Ca, 92651

2. Plant schedule:

H. TOMATOES

- H1. BLACK CHERRY
- H2. AMISH PASTE
- H3. GLOBE
- H4. YELLOW PEAR
- H5. SAN MARZANO
- H6. GRAPE

B. KALE

C. CABBAGE

L. LETTUCE

R. ROSEMARY

A. LAVANDER

T. THYME

S2. LEAF PARSLEY

P. RED PEPPERS

J. JALAPENOS

N. HABANERO PEPPERS

I. CILANTRO

S. PARSLEY

- S1. ITALIAN

- S2. LEAF

Q. BASIL

G. CHIVES

O. ONIONS

- O1. RED

- O2. YELLOW

- O3. GREEN

U. SHALLOT

V. GARLIC

X. BLUEBERRY

Y. RASPBERRY

W. YELLOW SQUASH

M. CUCUMBERS

Z. ZUCCHINI

K. NASTURTIUMS

D. BROCCOLI



- E. BEETS
- F. CAULIFLOWER

C. Ground Covers and Plants: Established and well rooted in GardenSoxx or equivalent filter fabric product.

PART 3 - EXECUTION

3.1 PREPARATION

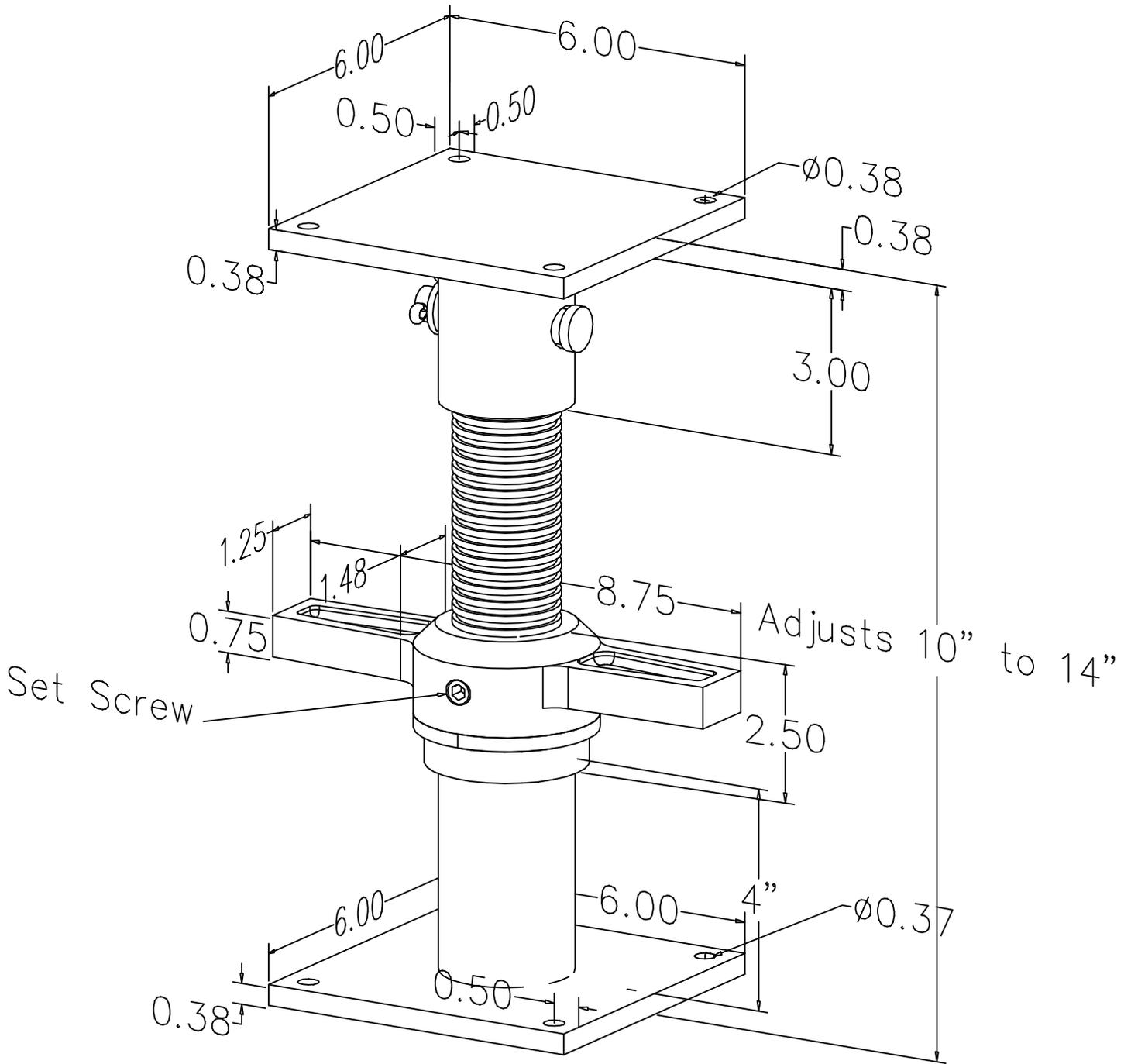
A. Trees and Shrubs: All trees and shrubs are to remain in their containers for this is not a permanent structure.

3.2 MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

END OF SECTION 32 93 0

Division 05 – Metals



STL-10 Light Duty Steel Shore
 with Roller Bearings and Set Screw
 Adjusts 10" to 14"
 Load Capacity: 20,000 Lbs.
 Weight: 18 Lbs. Ea.

Division 07 – Thermal and Moisture Protection



Tyvek.

DUPONT™ TYVEK® COMMERCIALWRAP®

A DURABLE, HIGH PERFORMANCE WEATHER BARRIER ENGINEERED SPECIFICALLY FOR COMMERCIAL CONSTRUCTION



DESCRIPTION

Engineered to provide excellent performance as an air and water barrier, Tyvek® CommercialWrap® delivers the added strength and durability needed in commercial construction. As a part of DuPont™ Tyvek® Commercial Air and Water Barrier Systems, Tyvek® CommercialWrap® can easily be integrated with other system components to provide superior air and water hold-out with high tear-resistance, high wind-load resistance and 9-month UV resistance. It provides the best balance of air and moisture management resulting in more durable and energy efficient structures.

Tyvek® CommercialWrap® is backed by a 10-year limited warranty and industry-leading technical support.

TYPICAL PROPERTIES (APRIL, 2015)

Please contact your local DuPont™ Tyvek® Specialist before writing specifications around this product. Product properties are as follows.

Test Method	Property	Unit	Value
ASTM E2357	Air Penetration Resistance	cfm/ft ² @ 1.57 psf	<0.01
Gurley Hill (TAPPI T-460)	Air Penetration Resistance	sec/100cc	>1500
ASTM E1677	Air Penetration Resistance	cfm/ft ² @ 1.57 psf	Type 1
ASTM E2178	Air Penetration Resistance	cfm/ft ² @ 1.57 psf	.001
ASTM E283	Wall Assembly Air Penetration Resistance	cfm/ft ² @ 1.57 psf	<0.01
ASTM E96-00	Water Vapor Transmission	Method A g/m ² -24 hrs	163
ASTM E96-00	Water Vapor Transmission	Method A (perms)	23
ASTM E96-00	Water Vapor Transmission	Method B g/m ² -24 hrs	200
ASTM E96-00	Water Vapor Transmission	Method B (perms)	28
AATCC 127	Water Penetration Resistance	cm	280
ASTM E331	Wall Assembly Water Penetration Resistance	Tested to 15 psf	No leakage
TAPPI T-410	Basis Weight	oz/yd ²	2.7
ASTM D882	Breaking Strength	lbs/in	38/35
ASTM D1117	Tear Resistance	lbs	12/10
ASTM E84	Surface Burning Characteristics	Flame Spread Index Class	10 Class A
ASTM E84	Surface Burning Characteristics	Smoke Developed Index Class	10 Class A
NFPA 285	Flame Propagation/Multiple Assemblies	–	Pass
	Ultra Violet Light Exposure (UV)	Days Months	270 9

Test results shown represent roll averages. Individual results may vary either above or below averages due to normal manufacturing variations, while continuing to meet product specifications

PRODUCT INFORMATION—FEATURES/BENEFITS

Air and Water Barrier Performance

- Offers the ideal combination of air and water holdout plus vapor permeability.
- Air Barrier Association of America evaluated to exceed ABAA, ASHRAE 90.1 and IECC air leakage requirements when tested in accordance with ASTM E2357.

Ease of Installation

- Easily installed, prior to the building's exterior facade, to help protect against air and water infiltration.

High Performance Durability

- Offers high tear-resistance and high wind-load-resistance to help stand up to commercial construction site conditions.
- Withstands up to nine months of UV exposure.

Sustainable Solutions

- DuPont™ Tyvek® CommercialWrap® may contribute toward LEED® points in the areas of Energy and Atmosphere (EA): Optimizing the Building Envelope and Indoor Environmental Air Quality (EQ): Construction IAQ Management Plan and Low Emitting Materials. In addition, the use of a continuous air barrier is a prerequisite for LEED® applications requiring compliance with ASHRAE 90.1-2010.
- By helping to effectively seal the building envelope, Tyvek® CommercialWrap® helps to reduce the amount of energy required for heating and cooling

Complete System

Tyvek® CommercialWrap® can be integrated with DuPont self-adhered flashing products and Tyvek® Fluid Applied products to offer seamless protection for wall systems that require mechanically fastened and fluid applied air and water barriers.



Tyvek.

DUPONT™ TYVEK® FLEXWRAP™ NF



DuPont™ FlexWrap™ NF addresses the issues of flashing vulnerable bottom corners of the sill where water damage is most likely to occur.

An integral component of DuPont Weatherization Systems, DuPont™ FlexWrap™ NF is a conformable, self-adhesive flashing solution for sills and non-straight portions of windows, doors and other wall penetrations.

DuPont™ FlexWrap™ NF is a premium performance, extendable self-adhered flashing material that can be applied over a wide range of building substances, including non-nailable sheathing materials like PS foam board, fiberboard, concrete masonry unit (CMU) and other such materials. Unlike competitive products, DuPont™ FlexWrap™ NF does not require the use of mechanical fasteners in the flexed corner areas.

DuPont™ FlexWrap™ NF also flashes round-top or custom-shaped windows in a seamless manner, eliminating the need to cut and place individual pieces of conventional flashing on an arched opening.

BENEFITS

Superior protection from water damage

- Helps seal the building envelope when used with DuPont Weatherization Systems products
- Meets the AAMA 711-13 material standard at the highest classification levels: Class A (no primer) and Level 3 Thermal Exposure (80°C / 176°F for 7 days)
- Meets and Exceeds ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference: no leakage at 300 Pa (equivalent to 50 mph windload), even after thermal aging (0-120°F)
- Does not contain asphaltic / bitumen adhesive materials which many window manufacturers prohibit due to adverse material reactions, such as black staining, oozing, and deformation over time, particularly with vinyl flanges.
- Can be installed at external temperatures as low as -4°C (25°F) as long as the surface is clean and free from frost and ice

Easy installation

- Packaged in ready-to-use 6", 9" x 75 ft rolls
- Helps to facilitate the creation of airtight and water tight seals around windows, door sills, chimney breasts, pipe penetrations, and any custom shapes.

Superior durability

- Extendable flashing constructed with a durable, micro-creped DuPont™ Tyvek® top-sheet, a premium butyl adhesive layer, and a specially designed release liner
- Designed to withstand up to 270 days of UV exposure

Excellent adhesion performance

- 100% butyl adhesive performs through extreme temperatures
- Adheres to most common building materials



Tyvek.

DUPONT™ TYVEK® STRAIGHTFLASH™ VF



DuPont™ StraightFlash™ VF ties the window or door frame directly to the sheathing or water-resistant barrier to protect from bulk water leaks.

An innovative dual-sided flashing material that integrates brick mold, non-integral flanged and non-flanged windows and doors with the building envelope.

DuPont™ StraightFlash™ VF (Versatile Flange) is an innovative, dual-sided self-adhered flashing material that provides a reliable moisture seal to integrate brick mold, non-integral flanged and non-flanged windows and doors with the building envelope. The unique dual-sided adhesive and specially designed release papers allow this flashing to tie the window or door frame directly to the sheathing or water-resistant barrier to protect from bulk water leaks providing superior protection against the elements.

When used as part of the DuPont Weatherization System, DuPont™ StraightFlash™ VF also helps contribute towards

U.S. Green Building Council LEED® points, LEED® for Homes points, and The National Green Building Standard™, as well as helping to create more sustainable, durable structures.

BENEFITS

Superior protection from water damage

- 100% butyl sealant provides excellent adhesion to most common building materials
- Meets the AAMA 711-13 material standard at the highest classification levels: Class A (no primer) and Level 3 Thermal Exposure (80°C / 176°F for 7 days)
- Meets and Exceeds ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference: no leakage at 300 Pa (equivalent to 50 mph windload), even after thermal aging (0-120°F)
- Does not contain asphaltic / bitumen adhesive materials which many window manufacturers prohibit due to adverse material reactions, such as black staining, oozing, and deformation over time, particularly with vinyl flanges.
- Can be installed at external temperatures as low as -4°C (25°F) as long as the surface is clean and free from frost and ice

Easy installation

- Features unique dual-sided adhesive and quick-release, scored backing
- Forgiving initial tack provides ability to correct installation mistakes
- Packaged in ready-to-use 6" x 125 ft rolls in an easy dispensing carton

Superior durability

- Constructed with a durable, micro-creped DuPont™ Tyvek® top-sheet, a 100% butyl adhesive layer, and a specially designed, scored release liner
- Designed to withstand up to 270 days of UV exposure
- Tough, tear-resistant

Excellent adhesion performance

- 100% butyl adhesive performs through extreme temperatures
- Adheres to most common building materials

Division 08 – Openings

Architect Series®

Designer Series®



OUT-SWING DOOR

OUT-SWING FRENCH DOORS



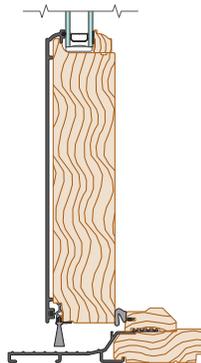
Out-Swing French Doors are traditional in every detail—with all the Pella innovations you demand. Pella's EnduraGuard protection formula, together with our immersion-treatment method, provides strong protection on every exterior wood surface of your windows and patio doors. This innovation provides advanced protection against the effects of moisture, decay, stains from mold and mildew - as well as termite damage. The exterior of the wood doors are protected by Pella's low-maintenance EnduraClad®, or EnduraClad Plus, exterior aluminum-cladding. We maintain our high standard of energy efficiency with weatherstripping on a common plane. The corrosion-resistant hardware with three-point lock system has a center deadbolt plus shoot bolts that engage at the head and sill simultaneously.



River Court Condominiums, Cambridge, MA. Steffian Bradley Associates, Inc.

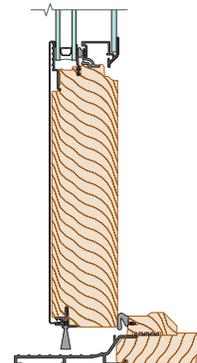
ARCHITECT SERIES®

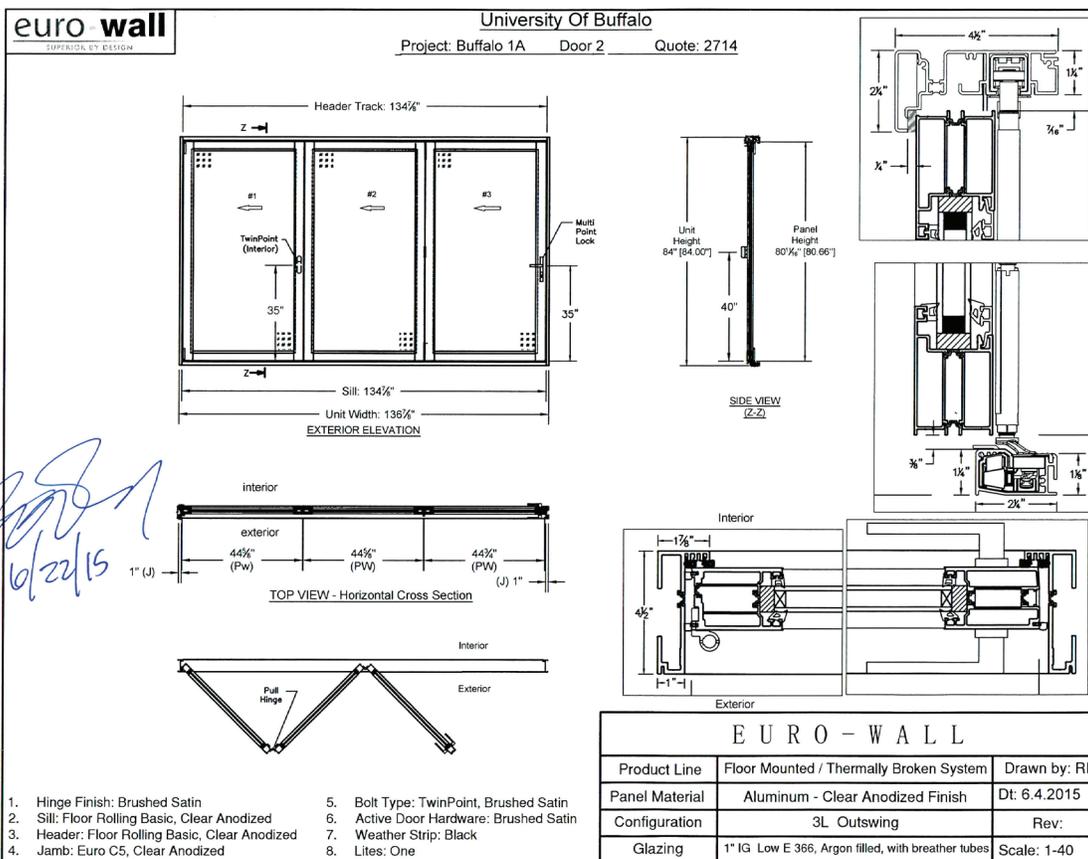
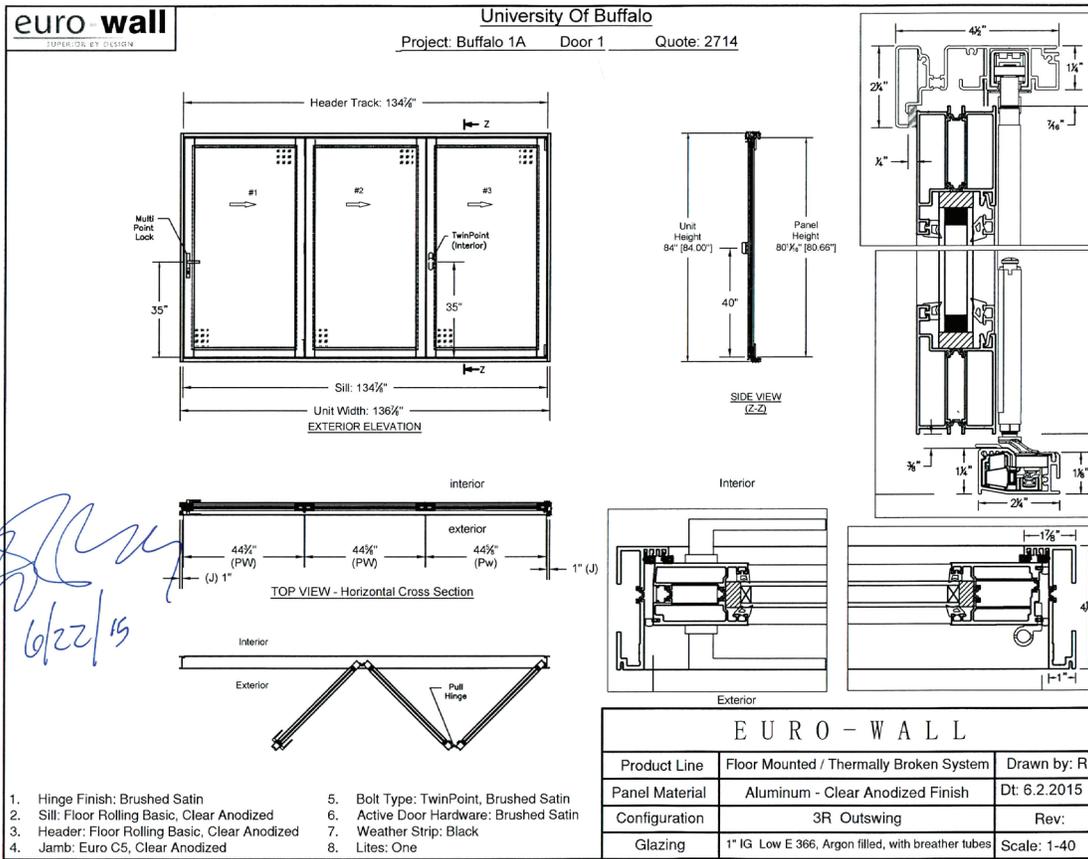
- A wide range of Glazing options as well as HurricaneShield® impact-resistant glass
- Divided light options available in Integral Light Technology® grilles or wood removable grilles in standard and custom patterns
- EnduraClad aluminum-clad exteriors in standard and feature colors plus nearly unlimited custom colors
- ADA compliant sizes and sill options



DESIGNER SERIES®

- Snap-in between-glass shades, and blinds as well as removable between-glass grilles
- EnduraClad aluminum-clad exteriors in standard and feature colors plus nearly unlimited custom colors
- ADA compliant sizes and sill options







CASEMENT

BRAND SUMMARY



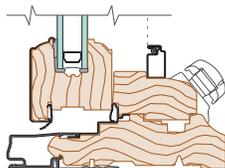
Casement Windows are traditional in every detail - with all the Pella innovations you demand. Pella's EnduraGuard protection formula, together with our immersion-treatment method, provides strong protection on every exterior wood surface of your windows and patio doors. This innovation provides advanced protection against the effects of moisture, decay, stains from mold and mildew - as well as termite damage. The exterior of the wood windows are protected by Pella's low-maintenance EnduraClad® protective finish, or EnduraClad® Plus protective finish. We maintain our high standard of energy efficiency with weatherstripping at the sides of sash, and full perimeter weatherstripping to reduce air infiltration. Pella maintains its high standards by taking the time to test virtually every vent unit for air infiltration, so you know you're getting a quality product.



Midtown Community Elementary School, Neptune Township, NJ, SSP Architectural Group

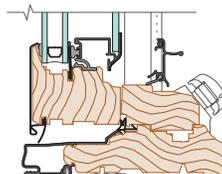
ARCHITECT SERIES®

- A wide range of glazing options as well as HurricaneShield® impact-resistant Casements
- Divided light options available in Integral Light Technology® grilles, Grilles-Between-the-Glass or wood removable grilles in standard and custom patterns
- EnduraClad® protective finish in standard and feature colors plus nearly unlimited custom colors
- EnduraClad Plus protective finish in standard and feature colors plus nearly unlimited custom colors
- InView™ screens or Vivid View® screens or Rolscreen



DESIGNER SERIES®

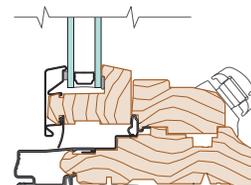
- Simplicity of insulated glass with the distinction of exclusive options
- Snap-in between-glass shades, and blinds as well as removable between-glass grilles—the ultimate solution for dressing a window
- EnduraClad aluminum-clad exteriors in standard and feature colors plus nearly unlimited custom colors
- InView™ screens or Vivid View® screens or Rolscreen



Triple-Pane Glazing System

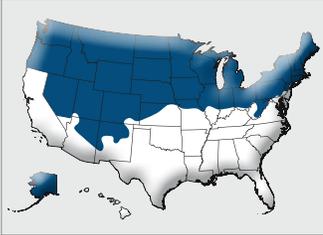
PELLA® PROLINE 450

- EnduraClad aluminum clad exteriors in standard and feature colors
- Removable room side grilles, Grilles-Between-the-Glass, Simulated-Divided-Lite grilles
- Prefinished stain, prefinished White, Bright White, Linen White or factory primed interiors
- Stainless steel operating arms and hinges resist rust and corrosion
- InView™ screens or Vivid View® screens





ClimaGuard 70/36
Variable climate low-E with improved solar control



When the sun is shining, ClimaGuard 70/36 regulates heat inside.

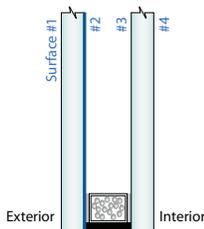
ClimaGuard 70/36 is designed to keep interior temperatures comfortable when the sun is shining and solar heat gain is a concern. Homeowners can maximize daylight and enjoy the view while keeping air conditioning costs to a minimum.

Keep the view while losing the heat

Sunshine is beautiful but adds heat to a home. Dark window tints, window films, exterior solar screens, and room-darkening blinds and drapes can block the sun, but they also block the view. With ClimaGuard 70/36, the numbers are impressive. “70” indicates that 70% of the sun’s visible light shines through the glass. “36” indicates that only 36% of the sun’s heat makes its way through (the other 64% is blocked). That means plenty of sunshine can add beauty to a home without adding too much heat.

Maintain comfort in cold weather, too

In addition to providing relief from the intense heat of the sun, ClimaGuard 70/36 also provides superior insulating performance to help save energy and maintain comfort during cold winter nights by reflecting the heat of a home’s furnace back into the house.



	Visible Light				UV Trans	SHGC	U-Factor			
	Trans	Reflect Out	Reflect In				1/2" Gap Argon	Air	5/16" Gap Argon	Air
Double Glazed										
70/36	70%	11%	13%	30%	0.362	0.247	0.294	n/a	n/a	
70/36 + IS-30	70%	10%	11%	30%	0.363	0.214	0.251	n/a	n/a	
70/36 + IS-20	68%	12%	13%	28%	0.353	0.205	0.239	n/a	n/a	
Triple Glazed										
70/36 + 70/36	54%	14%	14%	14%	0.311	0.124	0.158	0.167	0.217	
70/36 + 80/70	63%	14%	17%	19%	0.333	0.133	0.166	0.175	0.224	
80/70 + 70/36	63%	17%	14%	19%	0.437	0.131	0.165	0.174	0.223	

Double glazed: 3.0mm Clr: Air and 90% Argon/10% Air Filled Units. Primary low-E coating on the #2 surface; ClimaGuard IS coatings are on the #4 surface. Triple glazed: 3.0mm Clr: Air and 90% Argon/10% Air Filled Units. Low-E coatings in the triple-glazed configurations are on the #2 and #5 surfaces respectively. Performance data calculated for center-of-glass only (no spacer or framing) using LBNL Window 6, IGDB v.41.0.

ClimaGuard 70/36 at a glance

- Helps meet ENERGY STAR® requirements.
- Reduces solar heat gain without sacrificing picturesque views.
- Saves money on utility bills all year long.
- Uniform, neutral appearance that enhances the beauty of any home.
- Easy to fabricate and available from all Guardian U.S. coating facilities.
- Available in full truckloads, partial truckloads or case quantities.



ClimaGuard Product Information
Phone: 855.660.5905
ClimaGuardProductInfo@Guardian.com



AGC Glass Calculator Performance Data



Configuration:

Lite 1/8" (3 mm) Clear / .030" (0.76 mm) / 1/8" (3 mm) Clear

Visible Light

Transmittance (LT)	88%
Reflectance - Outdoors (LR)	7%
Reflectance - Indoors	7%

Solar Energy

Transmittance	76%
Reflectance - Outdoors (ER)	7%

U.V. Light

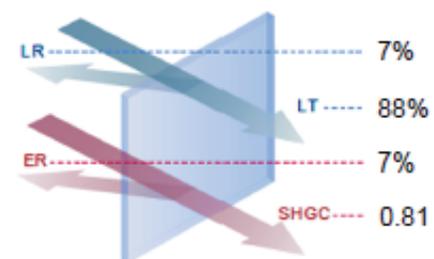
Transmittance	0%
Damage Weighted Index -ISO	57%

U-Values

Winter - Air	1.00
Summer - Air	0.91

Other Values

Solar Heat Gain Coefficient (SHGC)	0.81
Shading Coefficient	0.93
Relative Heat Gain - BTU/Hr/Sq. Ft.	199
Light to Solar Heat Gain Ratio	1.09



*Performance values are based on representative production samples and product modeling data using LBNL Window Software. Actual values may differ due to variations in the manufacturing process.

*Thermal stresses or building codes may require the use of heat-treated glass. This document is not an evaluation of the risk of glass breakage from thermal stresses. Contact AGC's Technical Services department to ensure the correct form of glass to be supplied for the structure. 1-888-234-8380

AGC offers the Broadest Product Range in the Industry

ARCHITECTURAL

ENERGY SELECT
SOLAR CONTROL LOW-E

ENERGY SELECT 25
HI PERFORMANCE LOW-E

U4 4TH SURFACE TECHNOLOGY

STOPSOL
REFLECTIVE COATED GLASS

SOLARSHIELD
TINTED FLOAT GLASS

INTERIOR

KRYSTAL KOLOURS
BACK-PAINTED GLASS

KRYSTAL PATTERNS
TEXTURED GLASS

KRYSTAL IMAGES
DIGITAL IMAGING

KRYSTAL KLEAR
PREMIUM LOW-IRON GLASS

MATELUX
ACID-ETCHED GLASS

RESIDENTIAL

COMFORT SELECT
SOLAR CONTROL LOW-E

COMFORT SELECT
SOLAR GAIN LOW-E

U4 4TH SURFACE TECHNOLOGY

SOLARSHIELD
TINTED FLOAT GLASS

FIRE-RATED

PYROBEL™
FIRE-RESISTANT GLASS

PYROEDGE™ 20

VISION 120

STILELITE
FRAMING SYSTEMS

PYRAN® PLATINUM
FIRE-PROTECTIVE GLASS

1-888-234-8380

info@us.agc.com

us.agc.com

Division 09 – Finishes

Bruce®

hardwood floors



D2310687-43



Product Selection



Oak Sugar White

Solid	Low Profile Solid
2-1/4" x 3/4" Model #: SHD2500 SKU #: 1000024604	2-1/4" x 5/16" Model #: SNHD2500 SKU #: 1000024647
3-1/4" x 3/4" Model #: SHD3500 SKU #: 1000024757	Click-Lock
5" x 3/4" Model #: SHD5500 SKU #: 1000025047	3" x 3/8" Model #: EHD3500L SKU #: 1000025555
	5" x 3/8" Model #: EHD5500L SKU #: 1000025653



Oak Tinted Tea

Solid	Low Profile Solid
2-1/4" x 3/4" Model #: SHD2323 SKU #: 1000024613	2-1/4" x 5/16" Model #: SNHD2323 SKU #: 1000024648
3-1/4" x 3/4" Model #: SHD3323 SKU #: 1000024769	Click-Lock
5" x 3/4" Model #: SHD5323 SKU #: 1000025048	3" x 3/8" Model #: EHD3323L SKU #: 1000025555
	5" x 3/8" Model #: EHD5323L SKU #: 1000025655

TECHNICAL DATA SHEET



PREMIUM PLUS ULTRA® INTERIOR EGGSHELL ENAMEL PAINT

NO. 2750 ULTRA PURE WHITE® BASE,
2754 MEDIUM BASE, 2753 DEEP BASE



PRODUCT INFORMATION

BEHR PREMIUM PLUS ULTRA® Eggshell Enamel Paint is a 100% acrylic paint and primer in one with advanced stain-blocking formula that will change the way you paint. This exciting product, featuring NANOGUARD® technology, forms an extra-protective shell that offers outstanding stain, scuff, mar and mildew resistance and an easy-to-clean, STAYS LOOKING NEW LONGER® finish with superior stain removal. This sophisticated color palette delivers exceptional hide and maximum moisture resistance.

RECOMMENDED USES:

Use on properly prepared, coated and uncoated, interior surfaces. Ideal for family rooms, living rooms, dining rooms, kitchens, bathrooms, bedrooms, kids' rooms, hallways, doors, windows, trim, cabinets, interior furniture and ceilings.

PRODUCT SPECIFICATIONS:

No. 2752 White Base

Tint Bases/Max Tint Load:

*No. 2750 Ultra Pure White Base 128 oz / 2 oz

No. 2754 Medium Base 120 oz / 10 oz

No. 2753 Deep Base 116 oz / 14 oz

Gloss: 7-12 @ 60°

Sheen: 17-22 @ 85

Vehicle Type: 100% Acrylic

***Weight per Gallon:** 11.1 +/- 0.2 lbs. /gal

***% Solids:**

By Volume: 41.9 +/- 2%

By Weight: 55.4 +/- 2%

VOC: <50 (g/l)

Flash Point: Not Applicable

Viscosity: 100-110 KU

***Recommended Film Thickness:**

Wet: 6.4 Dry: 2.5 mils @ 250 SFPG

Wet: 4.0 Dry: 1.5 mils @ 400 SFPG

***Coverage:** 250-400 Square Feet Per Gallon, depending on application method and substrate porosity. Does not include the loss of material from spraying.

APPLICATION:

Brush: Nylon/polyester

Roller: Use 3/8"-1/2" nap cover on smooth surfaces and 1/2"-3/4" on rough, porous surfaces.

Air-less Spray: At packaged consistency

Tip: .015"-.019"

Filter: 60 mesh

Thinning: (If required) No more than 1/2 pint of water per gallon.

† Dry Time: @ 77° & 50% RH

Longer dry time may be required in cooler temperatures and higher humidity.

† To Touch: 1 hours

† To Recoat: 2 hours

† Full Cure: 4 weeks

RECOMMENDED PRIMER / SYSTEMS:

PROPERLY PREPARED NEW SURFACES:

Gypsum Wallboard/Drywall, Plaster, Masonry, Galvanized Metal, Metal & Aluminum and Wood.
(2 coats minimum required for new or uncoated surfaces.)

*For Severe Tannin/Stain-blocking:

- BEHR PREMIUM PLUS® Interior All-In-One Primer & Sealer No. 75

PREVIOUSLY PAINTED SURFACES:

- Use a full coat, or spot prime repaired, or uncoated surfaces such as woods with heavy tannins (Redwood and Cedar) with BEHR PREMIUM PLUS ULTRA Paint.

CAUTIONS/LIMITATIONS:

- Protect from freezing.
- Do not use on floors.
- For best results, apply at temperatures between 50° F - 90° F. Temperatures above 90° F may affect the application such as drying too fast. Avoid painting in direct sun. NOTE: If the surface is hot to the touch it should be considered too hot to apply this coating.
- Avoid heavy traffic for 24 hours.
- Allow four weeks before washing or cleaning for full cure.
- Shelf life under normal conditions is two years unopened.

COMPLIES WITH BELOW AS OF 6/19/2013

OTC	YES	MPI X-GREEN	YES
SCAQMD	YES	GREENGUARD® GOLD CERTIFIED	YES
CARB	YES		
MPI #	52	CHPS	YES
NAHB	YES	LEED®: R/NC	YES
LEED: R/CI	YES	LEED: SC	YES
LEED: HC	YES	LEED: H	YES
LEED: CS	YES		

CLEAN UP:

Clean all tools and equipment with clean water. For disposal of empty containers and unused product, contact your household refuse collection service.

† WARNING! If you scrape sand or remove old paint, you may release lead dust. **LEAD IS TOXIC. EXPOSURE TO LEAD DUST CAN CAUSE SERIOUS ILLNESS, SUCH AS BRAIN DAMAGE, ESPECIALLY IN CHILDREN. PREGNANT WOMEN SHOULD ALSO AVOID EXPOSURE.** Wear a NIOSH-approved respirator to control lead exposure. Clean up carefully with a HEPA vacuum and a wet mop. Before you start, find out how to protect yourself and your family by contacting the National Lead Information Hot line at 1-800-424-LEAD or log on to www.epa.gov/lead. **WARNING!** This product contains chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **WARNING!** Sanding or scraping pressure treated lumber may be hazardous; wear appropriate protection.



BEHR PREMIUM PLUS ULTRA® Interior Eggshell Enamel

- Paint & Primer in One
- Advanced Stain-Blocking Formula
- Excellent Hide in Fewer Coats
- Stain and Scuff Resistant
- Antimicrobial-Mildew Resistant Finish

- Ideal for Every Room
- Easy-Clean, Soft Velvety Appearance
- Low VOC, 100% Acrylic

No. 2750 Ultra Pure White®
No. 2752 White
No. 2753 Deep Base
No. 2754 Medium Base



1 Hr Dry Time
2 Hr Recoat Time



250-400 Sq. Ft.
Coverage per Gallon



Soap & Water
Clean-Up



Protect
from Freezing

FOR TINT BASES – DO NOT USE WITHOUT THE ADDITION OF TINTING COLORANTS

BEHR PREMIUM PLUS ULTRA® is a paint and primer in one coating that will change the way you paint. This exciting product features NANOGUARD® technology with an extra-protective shell that offers a STAYS LOOKING NEW LONGER® finish for ultimate durability. It is ideal for use in every room including high traffic areas and on surfaces where moisture, mildew, or fungus growth may be a problem. This sophisticated color palette delivers COLORS THAT PERFORM BEAUTIFULLY® with superior stain removal.

WHERE TO USE

Properly prepared coated and uncoated Interior surfaces. Ideal for Family Rooms, Living Rooms, Dining Rooms, Bedrooms, Hallways and Ceilings.

PREPARATION & PRIME

- All surfaces should be properly prepared and cleaned.
- Remove loose paint, wash off dirt and grease with detergent, rinse and allow to dry.
- Remove mildew stains with a mildew stain remover.
- Scuff sand glossy surfaces and repair imperfections.
- Remove all dust with a damp cloth, allow to dry.
- Allow new stucco, plaster and masonry to cure for 30 days before painting.
- Use BEHR PREMIUM PLUS ULTRA® paint as a primer for properly prepared uncoated or painted interior surfaces.
- Lock in stains with BEHR PREMIUM PLUS ULTRA as a spot primer. For heavy stains, test for stain bleed-through by applying BEHR PREMIUM PLUS ULTRA to a small section. If the stain bleeds through, spot prime another coat to the stained area and test again. If bleeding continues, a longer dry time is needed before topcoating.
- For drastic color changes or when applying deep colors denoted with a dagger (†) on the color chip, apply a tinted primer coat of BEHR PREMIUM PLUS ULTRA if needed.

LIMITED LIFETIME GUARANTEE Behr Process Corporation guarantees your satisfaction with the performance of this paint when applied to a properly prepared surface and cared for according to the label directions. This guarantee shall be effective for so long as you reside in your home and is made to the original residential consumer paint purchaser. This guarantee is not transferable. If you are not satisfied with this paint's performance, Behr Process Corporation will, at its option and upon proof-of-purchase (the original receipt), either furnish an equivalent amount of paint or refund the purchase price of this paint to you. **This guarantee excludes (1) labor and costs of labor for the application or removal of any product and (2) any incidental or consequential damages, whether based on breach of express or implied warranty, negligence, strict liability or any other legal theory.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This guarantee gives you specific legal rights and you may also have other rights, which vary from state to state.

To consult with a Behr Certified Coatings Professional, call 1-800-854-0133 Ext. 2 (U.S.A. only).

BEHR
A Masco Company

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Santa Ana, CA 92704 U.S.A. • behr.com
V.O.C. (C.O.V.) <50 g/L • REV. 01/12

APPLICATION

Apply when air and surface temperatures are between 50-90°F (10-32°C). Stir paint occasionally. Intermix containers of same product to ensure color and sheen uniformity. Use a high quality 3/8-1/2" nap roller cover, nylon/polyester brush or airless sprayer (.015-.019" spray tip, 60 mesh filter). Do not thin if using a roller or brush; however, if using a sprayer and thinning is required, thin with water at a rate of no more than 1/2 pint per gallon. Certain colors may require more than one coat for complete hide. Darker colors may require additional dry time between coats. Cooler temperatures or higher humidity may prolong drying time. After 4 weeks, cured paint film may be cleaned with a mild, non-abrasive liquid detergent. Dry paint film is mildew resistant.

DISPOSAL

For disposal of empty containers, unused paint and soiled rags, contact your household refuse collection service.

Visit behr.com for painting tips, expert project advice and the perfect color coordination with **COLORSMART BY BEHR™**.

WARNING! If you scrape, sand or remove old paint, you may release lead dust. LEAD IS TOXIC. EXPOSURE TO LEAD DUST CAN CAUSE SERIOUS ILLNESS, SUCH AS BRAIN DAMAGE, ESPECIALLY IN CHILDREN. PREGNANT WOMEN SHOULD ALSO AVOID EXPOSURE. Wear a NIOSH approved respirator to control lead exposure. Clean up carefully with a HEPA vacuum and a wet mop. Before you start, find out how to protect yourself and your family by contacting the National Lead Information Hotline at 1-800-424-LEAD or log on to www.epa.gov/lead.

WARNING! This product contains chemicals known to the state of California to cause cancer and birth defects or other reproductive harm.

CAUTION! IRRITANT! HARMFUL IF SWALLOWED. CONTAINS: ETHYLENE GLYCOL. MAY CAUSE EYE, NOSE AND THROAT IRRITATION. AVOID CONTACT WITH SKIN AND EYES AND AVOID BREATHING OF VAPORS AND SPRAY MIST. WEAR EYE PROTECTION AND PROTECTIVE CLOTHING. USE ONLY WITH ADEQUATE VENTILATION. To avoid breathing vapors and spray mist, 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. If properly used, a respirator (NIOSH approved for organic vapor with P series particulate pre-filter) may offer additional protection; obtain professional advice before using. A dust mask does not provide protection against vapors. Avoid contact with eyes and skin. Wash thoroughly after handling. Close container after each use. **FIRST AID:** If you experience difficulty in breathing, leave the area to obtain fresh air. If continued difficulty is experienced, get medical assistance immediately. In case of eye contact, flush immediately with plenty of water for at least 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. If swallowed, get medical attention immediately.

CAUTION: KEEP OUT OF REACH OF CHILDREN - DO NOT TAKE INTERNALLY.

TECHNICAL DATA SHEET



SEMI-TRANSPARENT WEATHERPROOFING ALL-IN-ONE WOOD STAIN & SEALER

NO. 5077



PRODUCT INFORMATION

BEHR PREMIUM® Semi-Transparent Weatherproofing All-In-One Wood Stain & Sealer is a 100% acrylic formula that seals out the elements, and sun's harmful UV rays, for up to 6 years on decks and up to 8 years on fences & siding. It's available in 60 custom colors to help you create a look that's as beautiful as it is durable.

RECOMMENDED USES:

Recommended for properly prepared new to moderately weathered, unsealed exterior wood surfaces (0-10 years exposure) such as:

- Decks
- Railings
- Shakes
- Shingles
- Siding
- Fences
- Wood Patio Furniture

PRODUCT SPECIFICATIONS:

Tint Bases/Max Tint Load:

No. 5077 120 oz / 8 oz
No. 5088 124 oz / 4 oz

Pre-Mixed Colors:

No. 5533 Cedar Naturaltone
No. 5330 Redwood

Resin Type: Advanced 100% Acrylic

Weight per Gallon: 8.6 lbs

% Solids by Volume: 25.4%

% Solids by Weight: 27.2%

VOC: <100 g/L

Flash Point: N/A

Viscosity: 15-30 sec #2 Zahn Cup

Recommended Film Thickness:

Wet: 6.4 Dry: 1.6 mils @ 250 Sq. Ft./Gal.
Wet: 3.2 Dry: 0.8 mils @ 500 Sq. Ft./Gal.

Coverage: 250-600 Sq. Ft./Gal. Apply a thinner second coat at spread rate of approximately 500- 600 Sq. Ft./Gal. 2 coats are required for optimal appearance and durability.

APPLICATION:

Brush: Nylon/polyester

Roller: 3/8" nap

Pad Applicator

Airless Spray: At packaged consistency

Tip: .015"-.019"

Filter: 60 mesh

Dry Time: @ 77° & 50% RH

To Recoat: 1-2 hours

Light Foot Traffic: 24-48 hours

Full Cure: 72 hours

- Follow spraying immediately with a pad, back brushing or back rolling for a uniform appearance.
- Work in small sections lightly saturating the surface and immediately back-brush or use pad applicator to eliminate puddling; remove excess and evenly distribute the finish.
- Maintain a wet edge when applying.

SURFACE PREPARATION:

The following steps and products are recommended for best results: If you use a product such as BEHR PREMIUM® Wood Stain & Finish Stripper No. 64 to remove loose wood fibers, latex, oil-based and 100% acrylic coatings on new weathered wood, then you must use a product such as BEHR PREMIUM® All-In-One Wood Cleaner No. 63 to clean, brighten & neutralize wood. If you do not use a product such as BEHR PREMIUM Wood Stain & Finish Stripper No. 64, then use a product such as BEHR PREMIUM All-In-One Wood Cleaner No. 63 to clean and brighten the wood surface and to remove light to medium stains caused by mold, mildew, algae & fungus. Rinse thoroughly and allow to dry before coating. On new wood, use a product such as BEHR PREMIUM All-In-One Wood Cleaner No. 63 to remove mill glaze and open the pores of the wood. Lightly sand to remove remaining wood fibers/fuzz.

WARNING! If you scrape, sand or remove old paint, you may release lead dust. **LEAD IS TOXIC.** Contact the National Lead Information Center at 1-800-424-LEAD or log on to www.epa.gov/lead.

CLEAN UP:

Clean all tools and equipment with clean water. For proper disposal of empty containers and unused product, contact your household refuse collection service.

COMPLIES WITH THE BELOW AS OF 9/1/2014

SCAQMD	YES	LADCO	YES
CARB	YES	AIM	YES
OTC	YES		

CAUTIONS/LIMITATIONS:

- Protect from freezing
- Do not use without the addition of tinting colorants
- Do not use if rain is expected within 24 hours
- DO NOT THIN PRODUCT
- Avoid applying stain in direct sunlight or hot surfaces
- Test product for color on a small hidden area before proceeding
- Over application of stain will lead to surface failure including peeling & cracking
- Stained surfaces may become slippery when wet.
- Shelf life under normal conditions is 2 years (unopened containers)
- Temperature Range: 40-90°F (4.5-32°C)

GENERAL INFORMATION:



Warning! Causes eye and skin irritation. Harmful if swallowed. Wear protective clothing, gloves, eye, and face protection. Do not eat, drink, or smoke when using this product. Take off contaminated clothing and wash it before reuse. Wash hands thoroughly after handling. Collect spillage and avoid release to the environment. Dispose of unused, contents, container and other contaminated wastes in accordance with local, state, federal and provincial regulations.

First aid: If in eyes: Rinse cautiously with water for several minutes and remove contacts if present and easy to do. Continue rinsing and get medical attention if eye irritation persists. **If on skin:** Wash with plenty of soap and water. **If swallowed:** Rinse mouth and get medical attention if you feel unwell.





TECHNICAL DATA SHEET

Advanced Waterproofer

100% PENETRATING WATER REPELLENT WITH MICRO-LOK®

PRODUCT DESCRIPTION

ADVANCED WATERPROOFER is a solvent free, 100% active solid, repellent. ADVANCED WATERPROOFER self emulsifies to form a high performance and deep penetrating, alkali resistant water repellent emulsion. When applied, ADVANCED WATERPROOFER forms a long-chain water repellent barrier deep within the masonry surface. This hydrophobic barrier repels water yet remains highly vapor permeable and allows moisture to escape. ADVANCED WATERPROOFER performance is not affected by weathering, UV light or wind driven rain.

MICRO-LOK creates a micro-molecular chemical and mechanical bond between the water-repellent chemicals and the substrate. ADVANCED WATERPROOFER penetrates deep into the applied surfaces to provide long lasting and virtually indestructible water repellent protection that is not affected by weather or sunlight. Helps prevent spalling and cracking caused by freeze thaw cycles. Helps prevent chloride ion intrusion and efflorescence.

PRODUCT FEATURES

1. Exclusive MICRO-LOK formulation
2. Mold and mildew inhibitor
3. Protection not affected by weathering or UV light
4. Single or multiple coat application
5. V.O.C. compliant
6. Contains no known carcinogens
7. Maintenance free
8. Breathable – does not trap moisture
9. Can be used in cold temperature applications

Guarantee Period:	10 Year Limited	
HCK= Home Care Kit	G=Gallon	QT.= Quart
Part Numbers:	USA	International
1 Gallon	TPC-0201	TPC-0205-CA
5 Gallon	TPC-0205	TPC-0205-CA
Eco-Pod	TPC-0801	TPC-0801-CA
HCK w/ Sprayer	TPC-0700	TPC-0700-CA
2 Gallon QT.	TPC-0702	TPC-0702-CA
5 Gallon QT.	TPC-0701	TPC-0701-CA
HCK W/ POD	TPC-0800	TPC-0800-CA
HCK W/ QT. 2G	TPC-0704	TPC-0704-CA
HCK W/ QT. 5G	TPC-0703	TPC-0703-CA
1/4 Pallet w/18HCK	TPC-0900	TPC-0900-CA
1/4 Pallet w/15HCK And 42 PODS	TPC-0901	TPC-0901-CA

RECOMMENDED USES:

- Masonry block
- Concrete
- Stucco
- EFIS or cement plaster
- May be used on composite construction with a variety of substrates.
- Wood Surfaces
- Recommended for both horizontal and vertical surfaces
- Oil, gas and brake fluid repellent

COVERAGE RATES (THEORETICAL):

Substrate	Sq Ft/ Gallon
CMU Precision Block	60-70
Split Faced	50-70
Scored/Fluted	65-80
Lightweight	40-55
Clay Brick	125-150
Stucco	100-150
Dense Masonry Surfaces	125-150
Adobe Block	70-90
Clay Block	50-60
EFIS	80-120
Wood	300

- Extremely porous surfaces may require multiple coats.

Division 10 – Specialties



LEVITY™

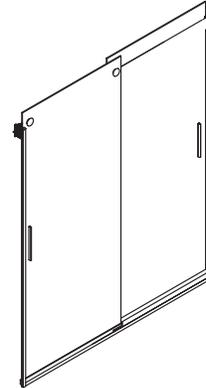
Features

- 1/4" (6 mm) thick tempered glass available in Crystal Clear or Frosted
- CleanCoat® glass treatment helps maintain glass appearance over time
- New bypass system provides an amazing feel with a modern look
- Innovative roller design simplifies installation and provides out-of-plumb adjustability
- Door tracking system is accomplished with a hidden, cushioned, center guide for smooth, quiet sliding action
- Hardware options inside and outside the shower include a blade handle or gently curved towel bars
- Anodized aluminum hardware prevents rusting or corrosion
- Smooth, easy-to-clean lineals

SLIDING BATH/SHOWER DOORS

K-706000

ALSO K-706001, K-706002



Codes/Standards Applicable

Specified model meets or exceeds the following:

- ANSI Z97.1 (tempered glass)
- 16 CFR Part 1201

Glass Options

- L: Clear
- D3: Frosted

Frame Finishes/Colors

- SH: Bright Silver
- MX: Matte Nickel
- ABV: Brushed Bronze

Specified Model

Model	Application	Style	Glass Options		Frame Finishes/Colors		
K-706000	Bath	Handle	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706001	Low bath	Handle	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706002	Low bath	Handle	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706004	Bath	Towel bar	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706005	Low bath	Towel bar	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706006	Low bath	Towel bar	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706008	Shower	Handle	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706009	Shower	Handle	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706014	Shower	Towel bar	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV
K-706015	Shower	Towel bar	<input type="checkbox"/> L	<input type="checkbox"/> D3	<input type="checkbox"/> SH	<input type="checkbox"/> MX	<input type="checkbox"/> ABV

Product Specification

Sliding bath or shower door shall have 1/4" (6 mm) thick tempered glass available in Crystal Clear or Frosted. Product shall feature CleanCoat glass treatment that helps maintain glass appearance over time. Door shall feature new bypass system providing a modern look. Door shall have innovative roller design to simplify installation and provide out-of-plumb adjustability. Door shall have door tracking system accomplished with a hidden, cushioned center guide for smooth, quiet sliding action. Door shall have hardware options inside and outside the shower including a blade handle or gently curved towel bars. Door shall have anodized aluminum hardware to prevent rusting or corrosion and smooth, easy-to-clean lineals. Door shall be Kohler Model K-_____ - _____ - _____.

Division 11 – Equipment



30" (76.2 cm) ELECTRIC INDUCTION COOKTOP

PRODUCT MODEL NUMBERS

GCI3061X

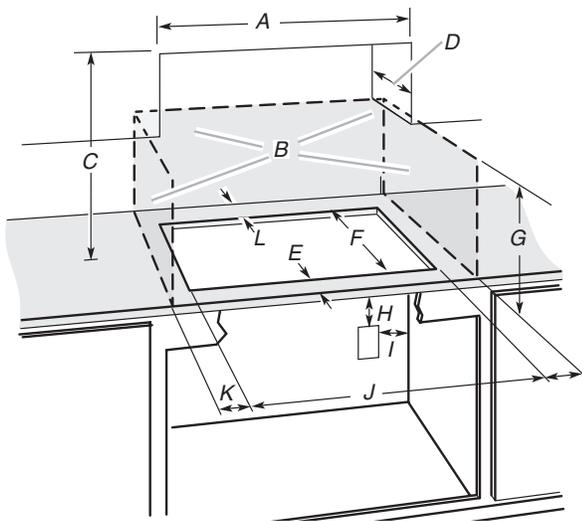
ELECTRICAL REQUIREMENTS:

To properly install your cooktop, you must determine the type of electrical connection you will be using and follow the instructions provided for it here.

- A 4-wire or 3-wire, single phase, 240 volt, 60 Hz., AC only electrical supply is required on a separate, 50-amp circuit (36" [91.4 cm] models) or 40-amp circuit (30" [76.2 cm] models), fused on both sides of the line.
- The cooktop should be connected directly to the junction box through flexible, armored or nonmetallic sheathed, copper cable. The flexible, armored cable extending from the fuse box or circuit breaker box should be connected directly to the junction box.
- Locate the junction box to allow as much slack as possible between the junction box and the cooktop so that the cooktop can be moved if servicing becomes necessary in the future.
- Do not cut the conduit. The length of conduit provided is for serviceability of the cooktop.
- A UL listed or CSA approved conduit connector must be provided at each end of the power supply cable (at the cooktop and at the junction box). A listed conduit connector is already provided at the cooktop.

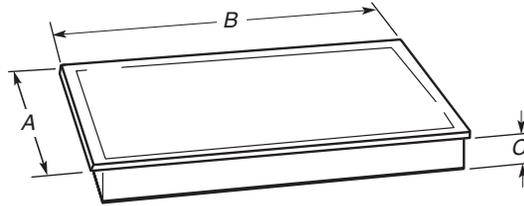
CABINET DIMENSIONS

IMPORTANT: If installing a range hood or microwave hood combination above the range, follow the range hood or microwave hood combination installation instructions for dimensional clearances above the cooktop surface.



PRODUCT DIMENSIONS

30" (76.2 cm) Cooktops



Models GCI3061

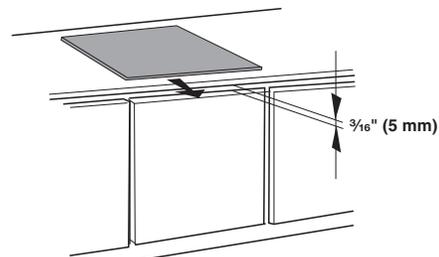
- A. 21⁵/₁₆" (54.1 cm)
- B. 30³/₁₆" (77.0 cm)
- C. 2³/₈" (6.0 cm)

- A. 29¹/₂" (75.0 cm)
- B. Combustible area above countertop (shown by dashed box above)
- C. 30" (76.2 cm) minimum clearance between top of cooktop platform and bottom of uncovered wood or metal cabinet (24" [61 cm] minimum clearance if bottom of wood or metal cabinet is covered by not less than 1/4" [0.6 cm] flame retardant millboard covered with not less than No. 28 MSG sheet steel, 0.015" [0.04 cm] stainless steel, or 0.024" [0.06 cm] aluminum or 0.020" [0.05 cm] copper)
- D. 13" (33.0 cm) recommended upper cabinet depth
- E. 2" (5.1 cm)
- F. 19⁵/₁₆" (49.0 cm)
- G. 18" (45.7 cm) minimum clearance from upper cabinet to countertop within minimum horizontal clearances to cooktop
- H. Junction box or outlet; 12" (30.5 cm) minimum from bottom of countertop
- I. Junction box or outlet; 10" (25.4 cm) from right-hand side of cabinet
- J. 29¹/₂" (75.0 cm)
- K. 1" (2.5 cm) minimum distance to nearest left and right side combustible surface above cooktop
- L. 1" (2.5 cm) minimum clearance between back wall and countertop

NOTES: After you make the countertop cutout, some installations may require notching down the base cabinet side walls to clear the cooktop base. To avoid this modification, use a base cabinet with sidewalls wider than the cutout.

If cabinet has a drawer, a 5¹/₈" (13 cm) depth clearance from the countertop to the top of the drawer (or other obstruction) in base cabinet is required.

For proper ventilation, provide a vent of 3/16" (5 mm) under the countertop, in the front of the cabinet. The clearance should be the length of the cooktop cutout.



Whirlpool® Undercounter Dishwasher

PRODUCT MODEL NUMBERS

WDF110PAB	WDF510PAY	WDF730PAY
WDF111PAB	WDF520PAD	WDT710PAY
WDF310PAA	WDF530PAY	WDT720PAD
WDF310PCA	WDF530PLY	WDT770PAY
WDF310PLA	WDF530PSY	
WDF320PAD	WDF540PAD	

Electrical Requirements: 120-volt, 60-Hz, AC-only, 15- or 20-amp. fused electrical supply. Copper wire only. A timedelay fuse or circuit breaker and separate circuit is recommended.

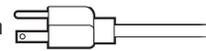
If direct wiring dishwasher: Use flexible, armored or nonmetallic, sheathed copper wire with grounding wire that meets the wiring requirements for your home and local codes and ordinances.



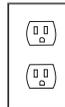
Use a U.L.-listed or CSA-approved conduit connector.

If connecting dishwasher with a power supply cord:

Use Power Supply Cord Kit (Part No. 4317824) marked for use with dishwashers. Follow the kit instructions for installing the power supply cord.



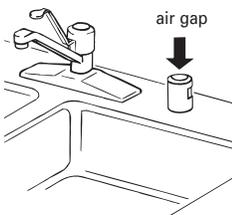
Power supply cord must plug into a grounded three-prong, outlet, located in the cabinet next to the dishwasher opening. Outlet must meet all local codes and ordinances.



Water Supply Requirements: A hot water line with 20 to 120 psi (138 to 862 kPa) water pressure. Water temperature must be 120°F (49°C) water at dishwasher. Use 3/8" O.D. copper tubing with compression fitting or flexible braided water supply line (1/2" minimum plastic tubing is not recommended). Use a 90° elbow with 3/4" N.P.T. external pipe threads on one end. Do not solder within 6" (15.2 cm) from water inlet valve.

Drain Requirements: A new drain hose is supplied with your dishwasher. If this is not long enough, use a new drain hose with a maximum length of 12' (3.7 m) (Part No. 3385556) that meets all current AHAM/IAPMO test standards, is resistant to heat and detergent, and fits the 1" (2.5 cm) drain connector of the dishwasher.

Make sure to connect the drain hose to waste tee or disposer inlet above drain trap in house plumbing and 20" (50.8 cm) minimum above the floor. It is recommended that the drain hose either be looped up and securely fastened to the underside of the counter, or be connected to an air gap.

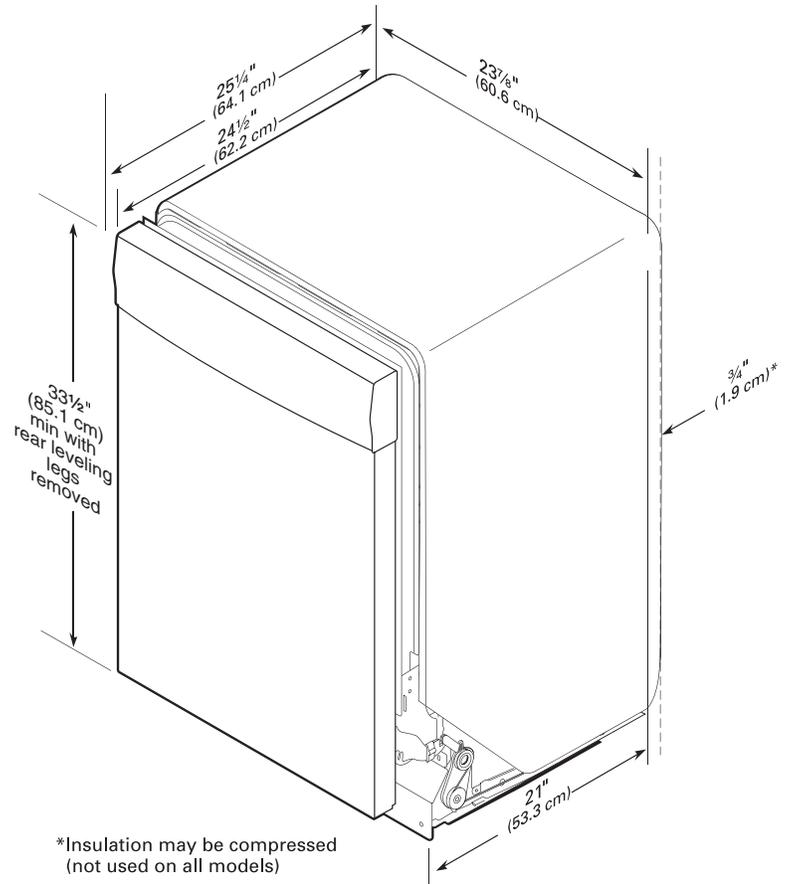


Make sure to use an air gap if the drain hose is connected to house plumbing lower than 20" (50.8 cm) above subfloor or floor.

Use 1/2" (1.3 cm) minimum I.D. drain line fittings.

If required, the air gap should be installed in accordance with the air gap installation instructions. When connecting the air gap a rubber hose (not provided) will be needed to connect to the waste tee or disposer inlet.

PRODUCT DIMENSIONS



*Insulation may be compressed (not used on all models)

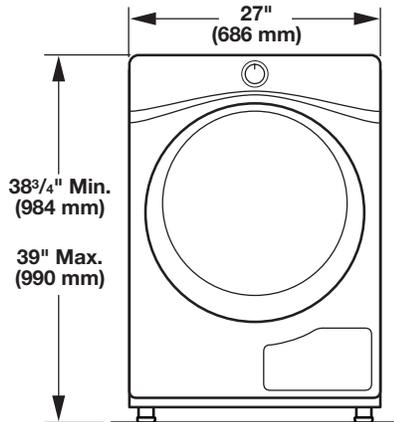


Electric Heat Pump Dryer

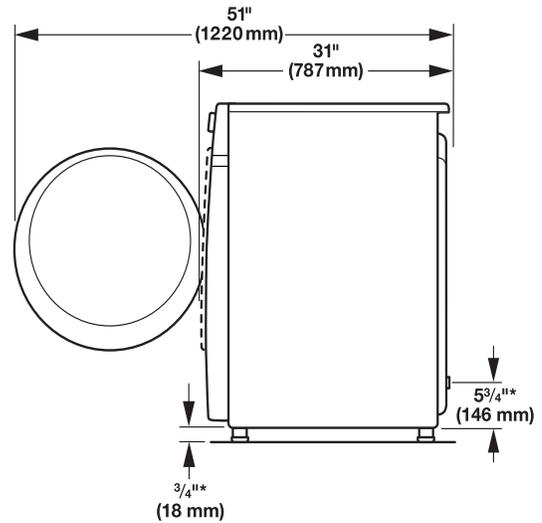
PRODUCT MODEL NUMBERS

WED99HED

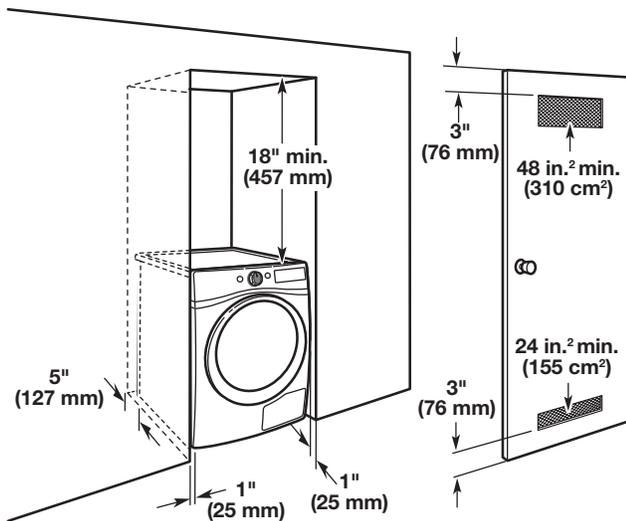
Front view:



Side view:



Recommended installation clearances (dryer only):

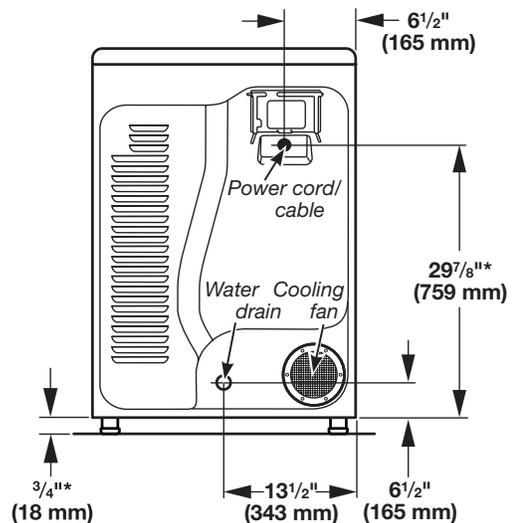


Installation spacing for recessed area or closet installation

All dimensions show recommended and minimum spacing allowed.

- Additional spacing should be considered for ease of installation and servicing.
- Additional clearances might be required for wall, door, floor, moldings, and drain system.
- Additional spacing should be considered on all sides of the dryer to reduce noise transfer.
- For closet installation, with a door, minimum ventilation openings in the top and bottom of the door are required. Louvered doors with equivalent ventilation openings are acceptable.
- Companion appliance spacing should also be considered.

Back view:



* Approx. measurement.

NOTE: Allow clearance behind dryer for proper drain hose routing and cooling fan ventilation. Push dryer back as far as possible and make sure drain hose is not crushed or kinked.

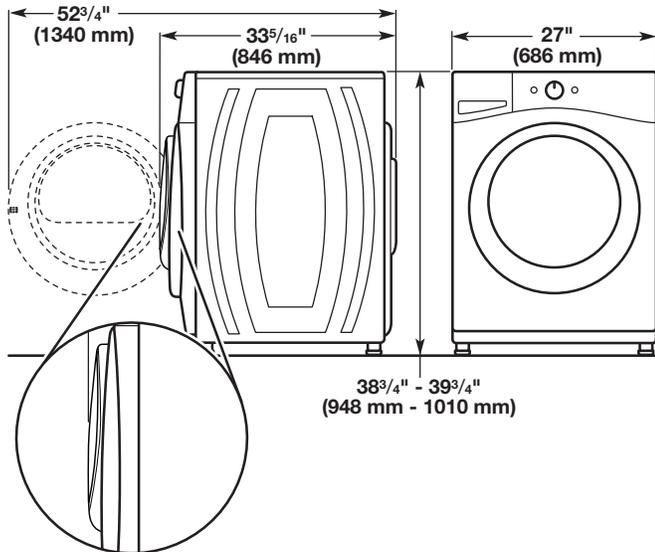


Front-Loading Washer

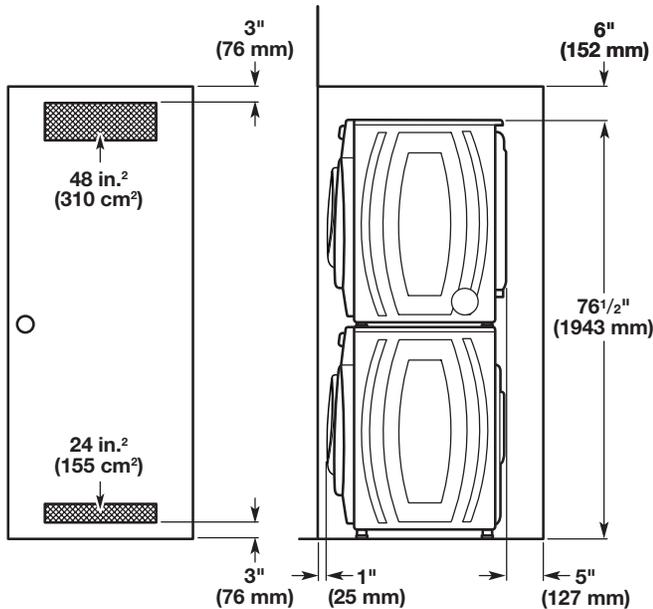
PRODUCT MODEL NUMBERS

WFW88HEA, WFW94HEA, **WFW96HEA**,
WFW95HED, WFW97HED

Washer Dimensions:



Recessed or closet installation - stacked washer and dryer

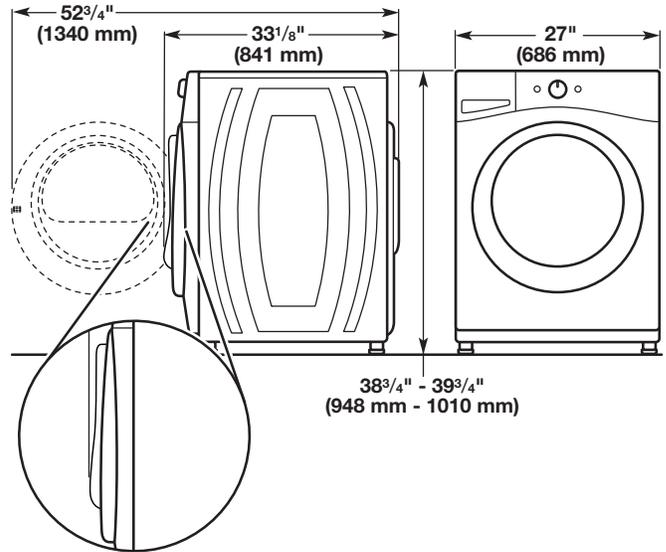


* Add spacing of 1" (25 mm) on all sides of washer/dryer.

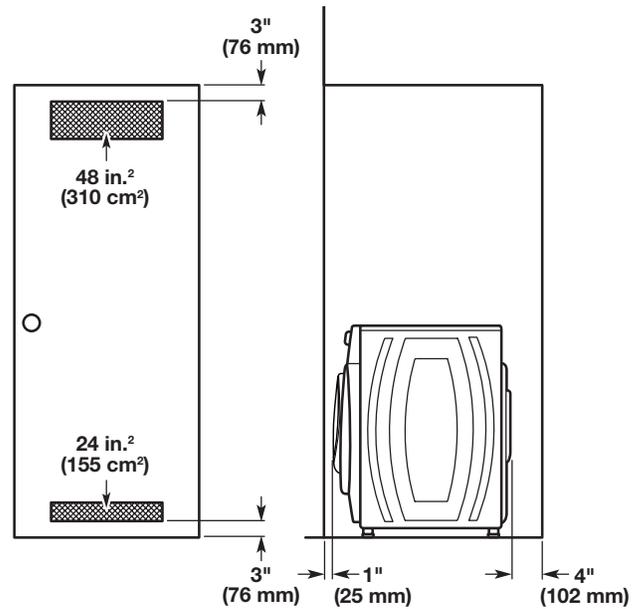
PRODUCT MODEL NUMBERS

WFW61HEB, WFW70HEB, WFW80HEB,
WFW8640B, WFW86HEB, WFW72HED,
WFW81HED, WFW82HED, WFW8740D,
WFW87HED

Washer Dimensions:



Recessed area or closet installation (washer only):



* Add spacing of 1" (25 mm) on all sides of washer.

Whirlpool® 27" (68.6 CM) AND 30" (76.2 CM) ELECTRIC SINGLE AND DOUBLE BUILT-IN OVEN

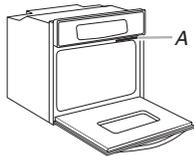
PRODUCT MODEL SERIES

WOD51EC0A	WOD93EC7A	WOS92EC0A
WOD51EC7A	WOS51EC0A	WOS92EC7A
WOD93EC0A	WOS51EC7A	

Electrical:

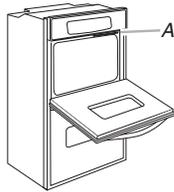
To properly install your oven, you must determine the type of electrical connection you will be using and follow the instructions provided for it here.

- Oven must be connected to the proper electrical voltage and frequency as specified on the model/serial number rating plate. The model/serial number rating plate is located under the control panel on single ovens and under the control panel on the upper oven cavity on double ovens. See the following illustrations.



Single Oven

A. Model/serial number plate



Double Oven

A. Model/serial number plate

- Models rated from 7.3 to 9 kW at 240 volts (5.4 to 7.4 kW at 208 volts) require a separate 40-amp circuit. Models rated at 4.8 kW and below at 240 volts (3.6 kW and below at 208 volts) require a separate 20-amp circuit.

- A circuit breaker is recommended.

- Connect directly to the circuit breaker box (or fused disconnect) through flexible, armored or nonmetallic sheathed, copper cable (with grounding wire). See "Make Electrical Connection" section.

- Flexible conduit from the oven should be connected directly to the junction box.

- Fuse both sides of the line.

- Do not cut the conduit. The length of conduit provided is for serviceability of the oven.

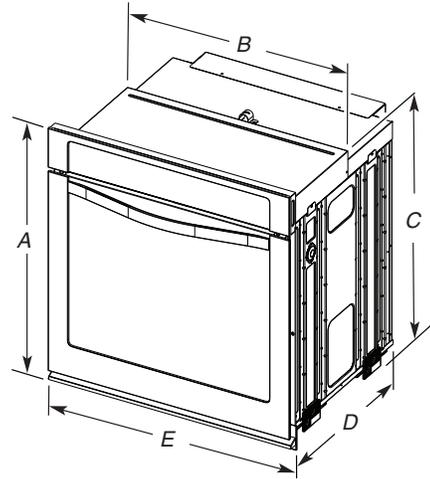
- A UL listed or CSA approved conduit connector must be provided.

- If the house has aluminum wiring, follow the procedure below:
 1. Connect a section of solid copper wire to the ends of the flexible conduit leads.
 2. Connect the aluminum wiring to the added section of copper wire using special connectors and/or tools designed and UL listed for joining copper to aluminum. Follow the electrical connector manufacturer's recommended procedure. Aluminum/copper connection must conform with local codes and industry accepted wiring practices.

For power requirements for models WOS51EC7A, WOS51EC0A, WOD51EC7A, WOD51EC0A, WOS92EC7A, WOS92EC0A, WOD93EC7A, and WOD93EC0A, refer to the following table.

Voltage	Single Thermal	Single Convect	Double Thermal	Double Convect
240 VAC	3690 W	3720 W	7370 W	7400 W
208 VAC	2790 W	2820 W	5580 W	5610 W
240 VAC	15.4 A	15.5 A	30.7 A	30.8 A
208 VAC	13.4 A	13.6 A	26.8 A	27.0 A

PRODUCT DIMENSIONS

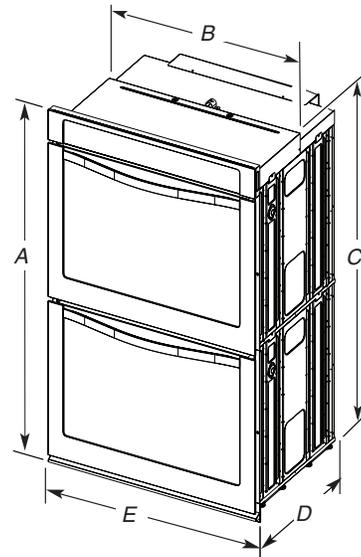


27" (68.6 cm) models

- A. 28 3/4" (72.8 cm) max. overall height
- B. 25 7/16" (64.6 cm) max. recessed width
- C. 26 3/4" (67.9 cm) recessed height
- D. 23 1/4" (59.1 cm) max. recessed depth
- E. 27" (68.6 cm) overall width

30" (76.2 cm) models

- A. 28 3/4" (72.8 cm) max. overall height
- B. 28 1/2" (72.4 cm) max. recessed width
- C. 26 3/4" (67.9 cm) recessed height
- D. 23 1/4" (59.1 cm) max. recessed depth
- E. 30" (76.2 cm) overall width



27" (68.6 cm) models

- A. 51 3/16" (130.0 cm) max. overall height
- B. 25 7/16" (64.6 cm) max. recessed width
- C. 48 13/16" (124.0 cm) recessed height
- D. 23 1/4" (59.1 cm) max. recessed depth
- E. 27" (68.6 cm) overall width

30" (76.2 cm) models

- A. 51 3/16" (130.0 cm) max. overall height
- B. 28 1/2" (72.4 cm) max. recessed width
- C. 48 13/16" (124.0 cm) recessed height
- D. 23 1/4" (59.1 cm) max. recessed depth
- E. 30" (76.2 cm) overall width

Whirlpool® 30" (76.2 CM) AND 36" (91.4 CM) Wall-Mount Canopy Range Hood

PRODUCT MODEL NUMBERS

GXW7330DX GXW7336DX

ELECTRICAL REQUIREMENTS

• A 120 volt, 60 Hz, AC only, 15- or 20-amp, fused electrical circuit is required.

VENTING REQUIREMENTS

This canopy hood is factory set for venting through the roof or wall.

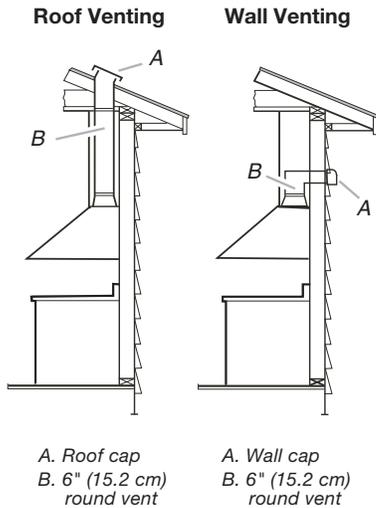
A 6" (15.2 cm) round vent system is needed for installation (not included). The hood exhaust opening is 6" (15.2 cm) round.

NOTE: Flexible vent is not recommended. Flexible vent creates back pressure and air turbulence that greatly reduce performance.

Vent system can terminate either through the roof or wall. To vent through a wall, a 90° elbow is needed.

Rear discharge

A 90° elbow may be installed immediately above the hood.



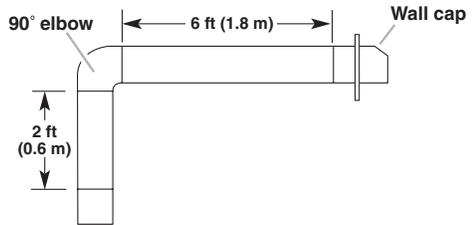
Calculating Vent System Length

To calculate the length of the system you need, add the equivalent feet (meters) for each vent piece used in the system.

Vent Piece	6" (15.2 cm) Round
45° elbow	2.5 ft (0.8 m)
90° elbow	5.0 ft (1.5 m)

Maximum equivalent vent length is 35 ft (10.7 m).

Example vent system



The following example falls within the maximum recommended vent length of 35 ft (10.7 m).

1 - 90° elbow	= 5.0 ft (1.5 m)
1 - wall cap	= 0.0 ft (0.0 m)
8 ft (2.4 m) straight	= 8.0 ft (2.4 m)
Length of system	= 13.0 ft (3.9 m)

LOCATION REQUIREMENTS

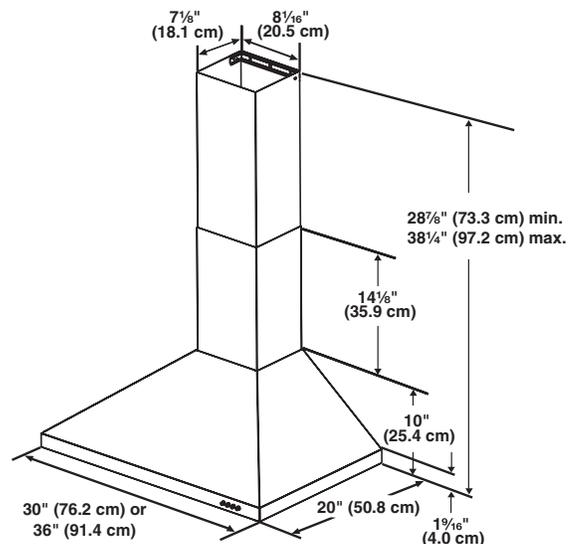
Have a qualified technician install the range hood. It is the installer's responsibility to comply with installation clearances specified on the model/serial rating plate. The model/serial rating plate is located behind the left filter on the rear wall of the vent hood.

Canopy hood location should be away from strong draft areas, such as windows, doors and strong heating vents.

For Mobile Home Installations

The installation of this range hood must conform to the Manufactured Home Construction Safety Standards, Title 24 CFR, Part 328 (formerly the Federal Standard for Mobile Home Construction and Safety, Title 24, HUD, Part 280) or when such standard is not applicable, the standard for Manufactured Home Installation 1982 (Manufactured Home Sites, Communities and Setups) ANSI A225.1/NFPA 501A, or latest edition, or with local codes.

PRODUCT DIMENSIONS



Whirlpool® Top Mount Refrigerator

PRODUCT MODEL NUMBERS

WRT111SFD

Electrical: A 115-volt, 60-Hz, AC-only, 15- or 20-amp fused, grounded electrical supply is required. It is recommended that a separate circuit serving only your refrigerator be provided. Use an outlet that cannot be turned off by a switch. Do not use an extension cord.

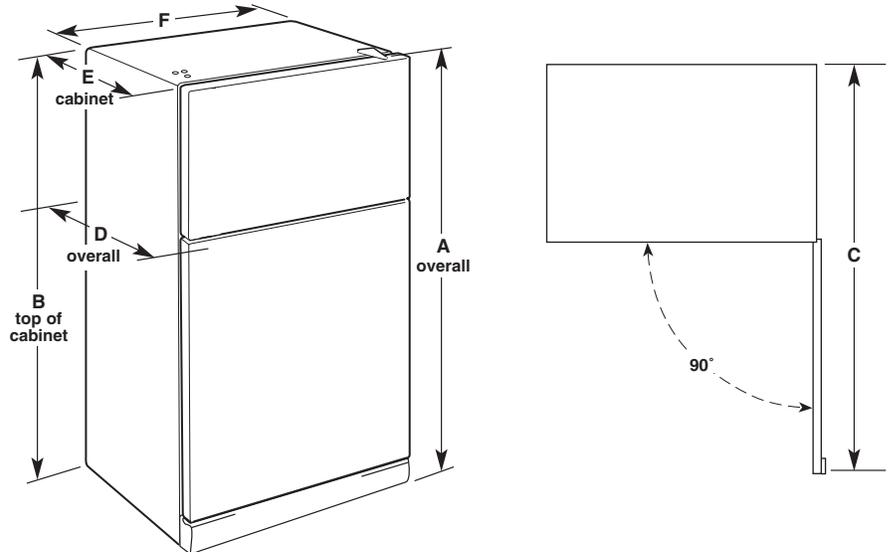
NOTE: Before performing any type of installation, cleaning, or removing a light bulb, turn the control (Thermostat, Refrigerator or Freezer Control depending on the model) to OFF and then disconnect the refrigerator from the electrical source. When you are finished, reconnect the refrigerator to the electrical source and reset the control (Thermostat, Refrigerator or Freezer Control depending on the model) to the desired setting. See "Using the Controls."

Water: A cold water supply with water pressure between 30 and 120 psi (207 and 827 kPa) is required to operate ice maker and water dispenser. If you have questions about your water pressure, call a licensed, qualified plumber.

IMPORTANT: The pressure of the water coming out of a reverse osmosis system going to the water inlet valve of the refrigerator needs to be between 30 and 120 psi (207 and 827 kPa).

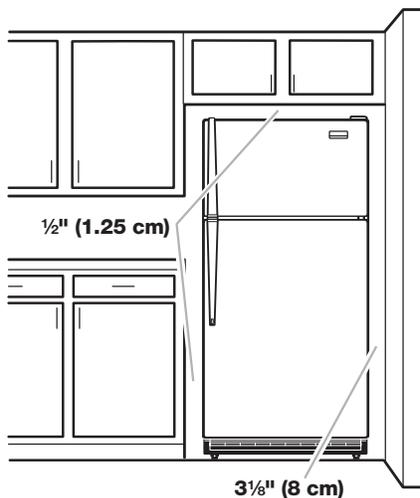
Reverse Osmosis Water Supply: If a reverse osmosis water filtration system is connected to your cold water supply, the water pressure to the reverse osmosis system needs to be a minimum of 40 to 60 psi (276 to 414 kPa).

PRODUCT DIMENSIONS



Model Size	Reversible Door	Height - Overall "A"	Height - Top of Cabinet "B"	Depth - Door Open 90° "C"	Depth - Overall "D"	Depth - Cabinet Only "E"	Width - Cabinet "F"
10.7 cu. ft.	Yes	61¼" (156.8 cm)	60⅝" (153.4 cm)	48½" (123.2 cm)	28¼" (71.8 cm)	21½" (54.6 cm)	24½" (62.2 cm)

LOCATION REQUIREMENTS



To ensure proper ventilation for your refrigerator, allow for a ½" (1.25 cm) space on each side and at the top. Allow at least 2" (5.08 cm) between back of cabinet and the wall. If your refrigerator has an ice maker, make sure you leave some extra space at the back for the water line connections.

If you are installing your refrigerator next to a fixed wall, leave 3/8" (8 cm) minimum on the hinge side (depending on your model) to allow for the door to swing open.

NOTE: This refrigerator is intended for use in a location where the temperature ranges from a minimum of 55°F (13°C) to a maximum of 110°F (43°C). The preferred room temperature range for optimum performance, which reduces electricity usage and provides superior cooling, is between 60°F (15°C) and 90°F (32°C). It is recommended that you do not install the refrigerator near a heat source, such as an oven or radiator.

Division 21 – Fire Suppression



Submittal

Ref. #: 499697.1 rev1

E.2 series dry motor circulator

Model: **Series E19.2 ci 240V** Part number: **182212-608**

Project name: **UB Solar Decthalon**
 Location: _____ Representative: _____
 Date submitted: **7/15/2015** Phone number: _____
 Engineer: _____ e-mail: **gdenecke@armstrongfluidtechnology.com**
 Contractor: _____ Submitted by: **George Denecke**

Application design data

Tag number:	FirePumps	Pipe orientation:	Single
Service:		Suction pressure:	0 ft
Location:		Fluid:	Water:
Quantity:	2	Operating temperature:	60 F
Duty flow per pump:	32 USgpm	Viscosity:	31 SSU
Duty head:	21 ft	Specific gravity:	1.0000
Total dissolved solids:	0 ppm		

Materials of construction

Construction:	STD125	Impeller:	30% Glass-filled Noryl
Rating:	Not applicable	Bearings:	Permanently lubricated SS
Connections:	Inlet: 1.5 in, Outlet: 1.5 in		

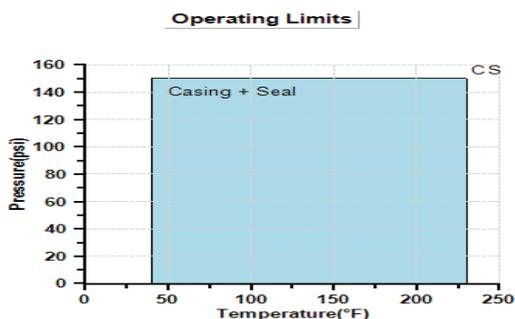
Mechanical seal data

Manufacturer:	Armstrong	Seal:	Silicon Carbide
Seal type:	Bellows-style Silicon Carbide		

Motor electrical data

Supplier:	Factory Choice	Insulation class:	Not applicable
Size:	0.4 hp	Inverter motor type:	Not applicable
Frame number:	Not applicable	Efficiency:	Std
Enclosure:	ODP	Speed:	3400 rpm
Motor Electrics:	230/1/60		

Operating limits (temperature - pressure)



Maximum pressure: 150 psi

Maximum temperature: 230 F

Division 22 – Plumbing



Submittal Data Information

Indirect Residential Storage Tanks

#SS-9.1-1

Effective: January 31, 2012

Job: _____ Engineer: _____ Contractor: _____ Rep: _____

Applications

High quality tanks for use in closed loop or drainback systems where a tank with an integral heat exchanger is required.

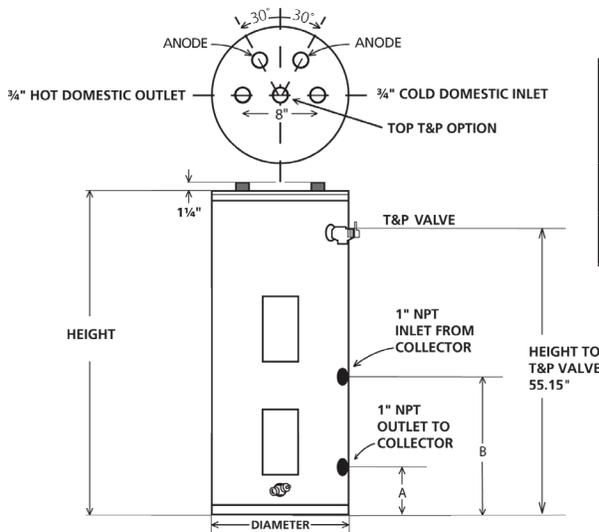
Features

- Single wall, internal coil heat exchanger
- Temperature sensor ports
- Diffuser dip tube
- 2" non-CFC insulation (R-16)
- One mid-tank 4500W electric element
- CSA certified and ASME rated T&P valve
- Rated for continuous operation up to 160°F



Model	Capacity (gallons)	Element Wattage (240V)	Recovery 90° Rise (gallons per hour)	Dimensions (inches)				Approx. Shipping Weight (lbs)
				Height	A	B	Diameter	
PTK-SOLX-80	76	4500	21	63-1/4	5-3/8	30-1/8	24	257
PTK-SOLX-120	108	4500	21	63-1/4	5-3/8	26-1/2	28	365

All dimensions in inches. Recovery capacity based on element performance. Maximum working pressure = 150 psi.



Heat Exchanger Data

Model	Tube I.D. (inches)	Surface Area (sq. ft)	Fluid Capacity (gallons)	Tube Length (ft)
PTK-SOLX-80	1.3	16	2.8	40.8
PTK-SOLX-120	1.55	18.8	4	41

Flow Rate (GPM)	Pressure Drop Through Coil (Feet of H2O)	
	Head Loss (Feet)	
	PTK-SOLX-80	PTK-SOLX-120
2	0.1	0.05
4	0.3	0.15
6	0.5	0.25

Sustainable HOT WATER Solutions, Delivered by APRICUS

6 Sycamore Way, Branford, Connecticut 06405 USA Ph: 203-488-8215 Fax: 203-488-8572
office-usa@apricus.com www.apricus.com



Submittal

Ref. #: 499697.1 rev1

Vertical multistage pump

Model: Series 4700-VMS-03:03-0.75 hp Pump (Motor supplier: Armstrong choice)

Project name: UB Solar Decthalon

Location:

Representative:

Date submitted: 7/15/2015

Phone number:

Engineer:

e-mail: gdenecke@armstrongfluidtechnology.com

Contractor:

Submitted by: George Denecke

Application design data

Tag number:	Main Water Pump2	Pipe orientation:	Single
Service:		Suction pressure:	0 ft
Location:		Fluid:	Water:
Quantity:	1	Operating temperature:	60 F
Duty flow per pump:	12 USgpm	Viscosity:	31 SSU
Duty head:	35 psig	Specific gravity:	1.0000
Total dissolved solids:	0 ppm		

Materials of construction

Construction:	SS300	Pump casing:	AISI 304 SS
Rating:	250 lb	Pump shaft:	AISI 316 SS
Connections:	Inlet: 1.25 in, Outlet: 1.25 in		

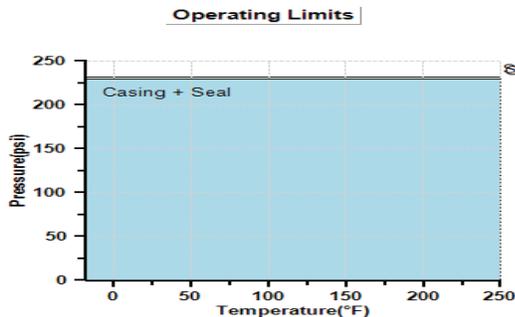
Mechanical seal data

Seal type:	Single Spring Inside	Rotating face:	Carbon
Manufacturer code:	Not Applicable	Stationary seat:	Silicon Carbide
Springs:	Stainless Steel	Secondary seal:	FPM
Rotating hardware:	Stainless Steel		

Motor electrical data

Supplier:	Factory Choice	Insulation class:	Not applicable
Size:	0.75 hp	Inverter motor type:	Not applicable
Frame number:	56C	Efficiency:	NEMA 12.11 Equivalent
Enclosure:	ODP	Speed:	3500 rpm
Motor Electrics:	230/1/60		

Operating limits (temperature - pressure)



Maximum pressure: 230 psi

Maximum temperature: 250 F



VITREOUS CHINA

TOILET
DF-21-318

LAVATORIES



**ULTRA DUAL-FLUSH™
Pressure-Assist Toilet
17" High, Elongated**

12" Rough-in

Features:

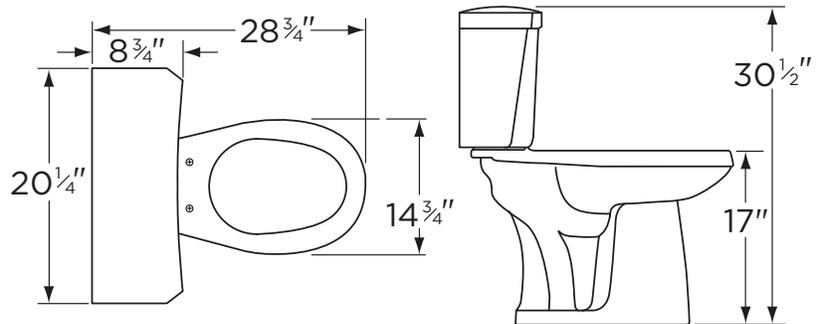
- Low Consumption Dual-Flush (1.1/1.6 gpf) (4.0/6.0 Lpf)
- Elongated Bowl
- Extra Seat Height
- Pressurized Flushing Action
- Close Coupled Flushometer Tank
- Siphon Jet
- Front Tank Lever
- Available With Tank Lever On Right Side - By Special Order
- 2 Bolt Caps
- ADA Compliant



Dimensions:

- Height 30 1/2"
- Width 20 1/4"
- Depth 28 3/4"
- Rough-in 12"
- Water Surface from Rim 4 1/2"
- Trapway (min)..... 2"
- Water Surface 12" x 10"
- Water Seal 2 1/2"
- Shipping Weight 94 lbs

Specifications: Bowl—#21-377 Elongated Bowl Tank—#DF-28-380
Seat not included



THIS FIXTURE QUALIFIES ACCORDING TO ASME TEST PROCEDURES AS A LOW CONSUMPTION WATER CLOSET WITH AN AVERAGE CONSUMPTION OF 1.6 gpf (6 Lpf) OR LESS.



www.gerberonline.com

Job Name	
Date	
Model Specified	
Quantity	
Customer	
Contractor	
Architect/engineer	

TOILETS

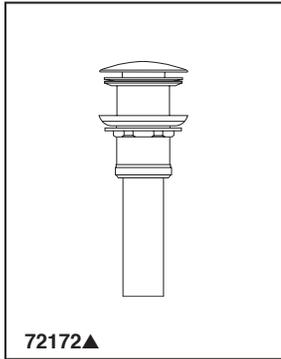
BIDETS / URINALS

CAST IRON



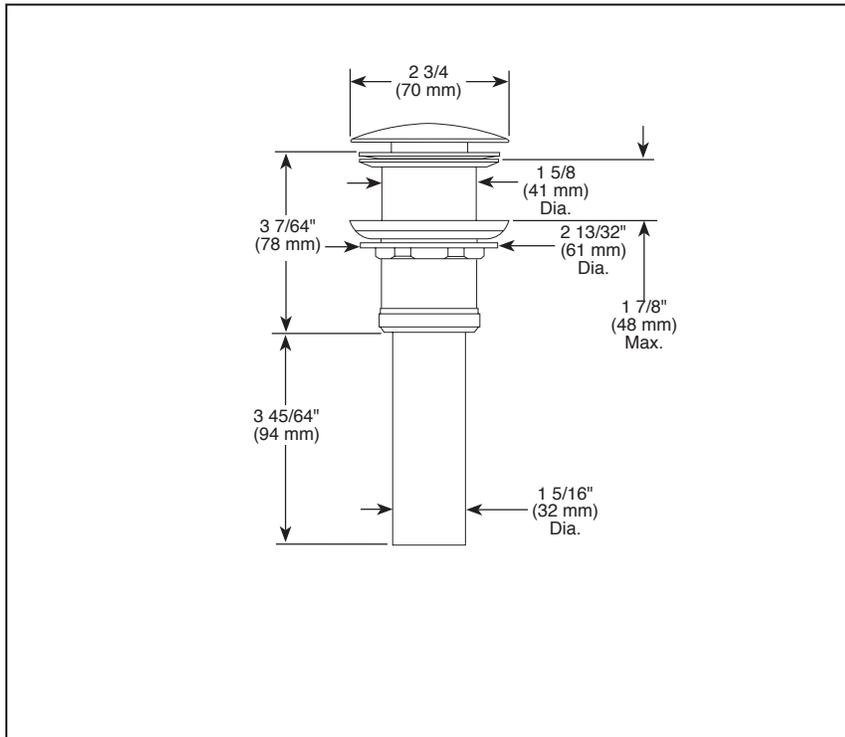
PUSH POP ASSEMBLY

■ Push Pop Assembly Less Overflow Holes



Submitted Model No.: _____

Specific Features: _____



STANDARD SPECIFICATIONS:

- All metal construction push pop
- Tailpiece chrome plated for all finishes
- For use with sinks without overflow

WARRANTY

- Lifetime limited warranty on parts (other than electronic parts and batteries) and finishes: or, for commercial users, for 5 years from date of purchase.
- 5 year limited warranty on electronic parts (other than batteries); or, for commercial users, for 1 year from the date of purchase. No warranty is provided on batteries.

▲ Designate Proper Finish Suffix

COMPLIES WITH:

- ASME A112.18.2 / CSA B125.2



55 E. 111th Street, Indianapolis, Indiana 46280
 350 South Edgeware Road, St. Thomas, ON N5P 4L1
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Delta reserves the right (1) to make changes in specifications and materials, and (2) to change or discontinue models, both without notice or obligation. Dimensions are for reference only. See current full-line price book or www.deltafaucet.com for finish options and product availability.



Buy it for looks. Buy it for life.®

FAUCET DESCRIPTION

- Metal construction with chrome plated or brushed nickel finishes
- Includes showerhead, arm, flange and diverter spout

OPERATION

- Lever style handle with temperature indicator on the escutcheon, pull-on/push-off operation
- Temperature operates through an 180° arc of handle travel (full cold to full hot)
- Adjustable temperature limit stop to control maximum hot water temperature
- Pressure balancing mechanism maintains selected discharge temperature to ± 2°

FLOW

- Showerhead limited to 2.5 gpm (9.5 L/min)

CARTRIDGE

- 1225° cartridge design
- Nonmetallic/nonferrous and stainless steel materials
- Accommodates back to back installations

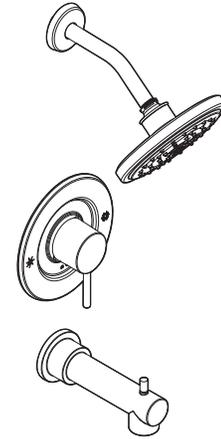
STANDARDS

- Third party certified to ASME A112.18.1M/CSA B-125, and all applicable requirements referenced therein
- **ADA** for lever handles

WARRANTY

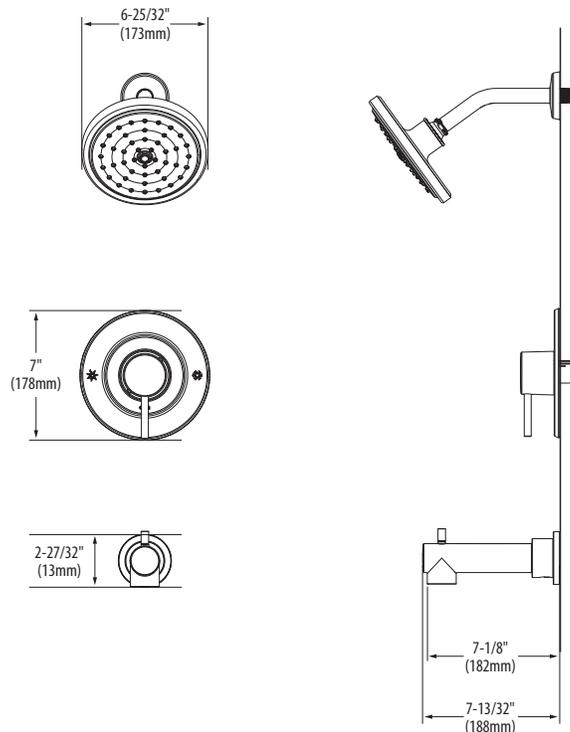
- Lifetime limited warranty against leaks, drips and finish defects to the original consumer purchaser
- 5 year warranty if used in commercial installations

Specifications



**ALIGN™ MOENTROL®
Single-Handle Tub/Shower Trim Only**

- Models:** T3291 series - valve trim only
 T3292 series - shower trim only
 T3293 series - tub/shower trim
- Valves:** 63100, 3500 Series



CRITICAL DIMENSIONS

(DO NOT SCALE)

FOR MORE INFORMATION CALL: 1-800-BUY-MOEN

www.moen.com

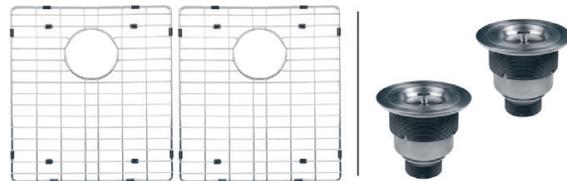
RVH7350

**Undermount Stainless Steel
Kitchen Sink Double Bowl**



Features

- 16 gauge stainless steel
- Premium 304 grade stainless steel (18/10 Chromium/Nickel)
- Luxurious satin finish - Easy to clean and long-lasting
- Heavy duty sound guard padding and undercoating
- Slanted bottom with elegant drain grooves for easy draining
- Zero radius corners
- Drain placement - Rear

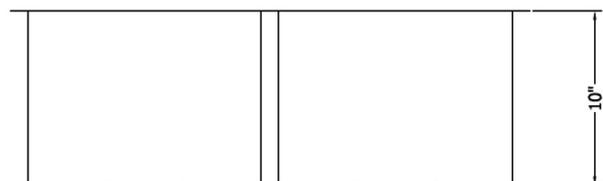
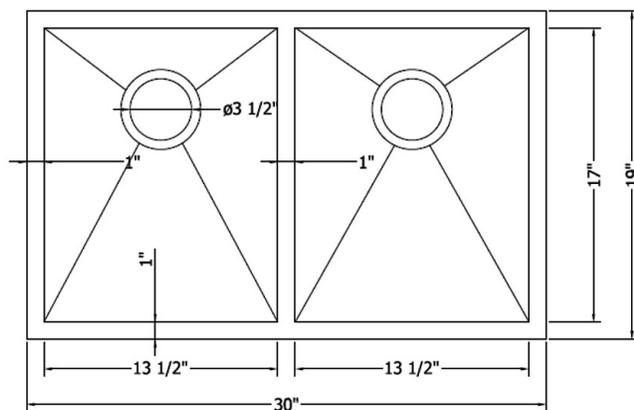


In the Box

- Cut out template
- Sink
- Mounting and installing brackets
- Two (2) basket strainers (drains)
- Bottom rinse grids (set of 2)

Dimensions

Model Number	Width	Length	Depth
RVH7350	30" (overall), 13.5" (L), 13.5" (R)	19"	10"

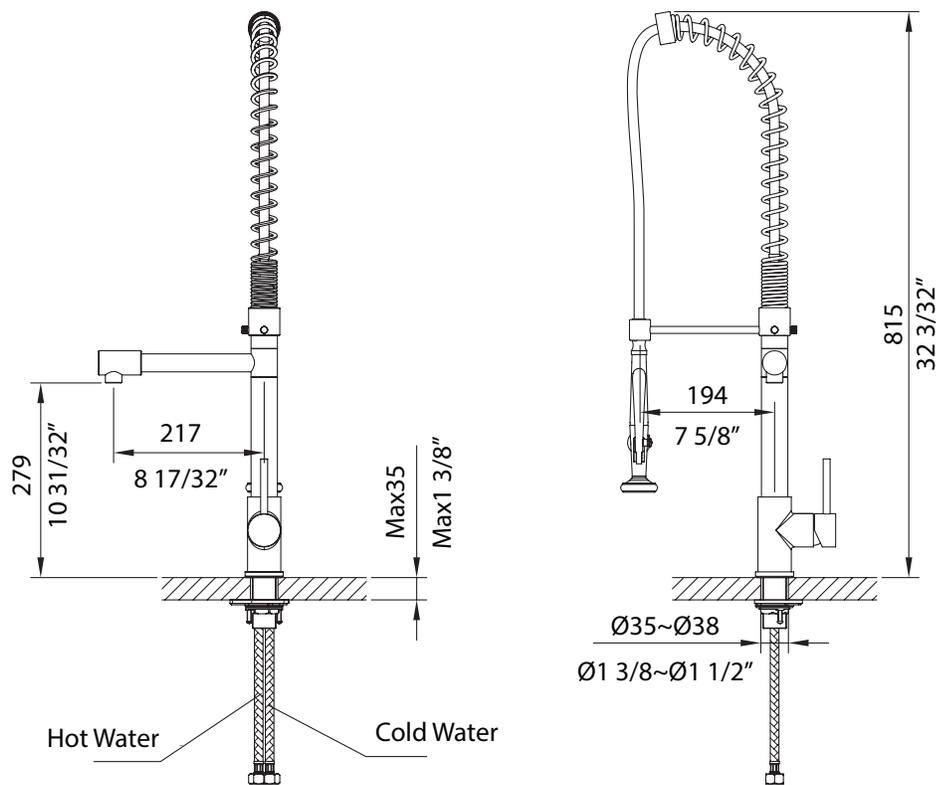




Single Lever Pull Out Kitchen Faucet

KPF-1602

Dimension Drawings





VITREOUS CHINA

LAVATORY
12-760

LAVATORIES

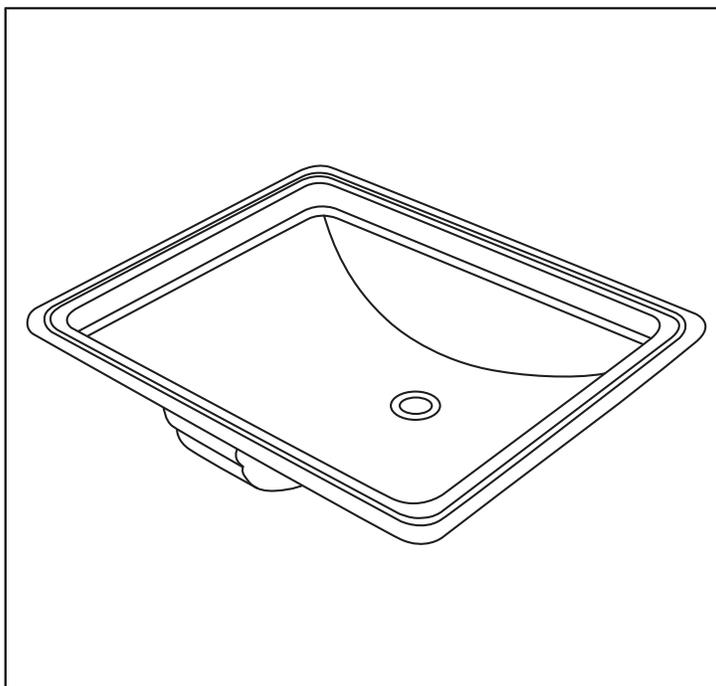
**LOGAN SQUARE™
Undercounter**

Features:

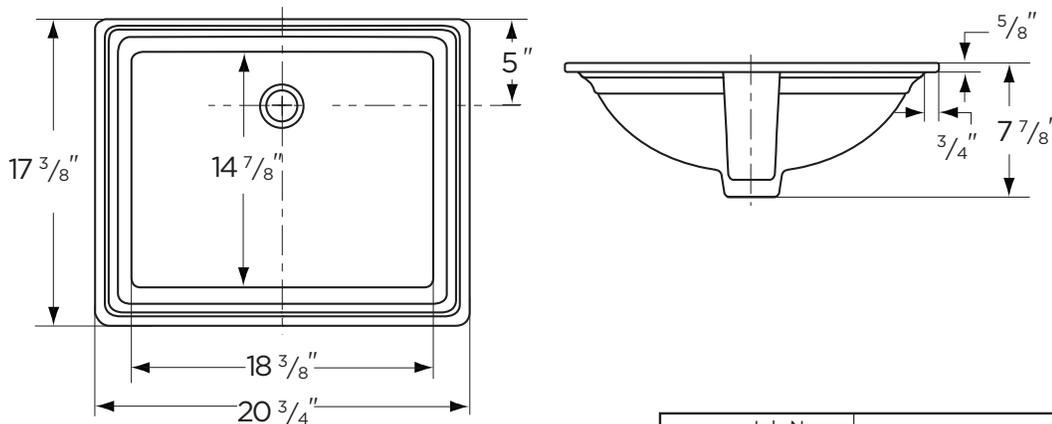
- 20 3/4" x 17 3/8" Lavatory
- 18 3/8" x 14 7/8" Bowl
- Concealed Front Overflow
- Available in White and Biscuit

Dimensions:

Height 7 7/8"
 Width 20 3/4"
 Depth 17 3/8"
 Shipping Weight 25 lbs



Specifications: Lavatory—#12-760
 Drain and anchoring kit not included



TOILETS

BIDETS / URINALS

CAST IRON



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Job Name	
Date	
Model Specified	
Quantity	
Customer	
Contractor	
Architect/engineer	

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Tools & Home Improvement > Kitchen & Bath Fixtures > Bathroom Fixtures > Bathroom Sink Faucets > Touch On Faucets



Roll over image to zoom in

APEC Water Systems FAUCET-CD-NP APEC Ceramic Disc Designer Faucet Non-Air Gap Faucet, Brushed Nickel

[APEC Water Systems](#)
27 customer reviews
[answered questions](#)

\$45.50

Check out now and save even more. Order within **3 hrs 47 mins** to receive **One-Day Shipping** at checkout. [Details](#)

Brushed Nickel



- Premium Ceramic Disc Designer Faucet
 - NSF Certified Standard No.61
 - Lead-Free RO Drinking Water Dispensing Faucets
 - 1/2" input and 1/4 turn ceramic disc valve
 - Mounting Dimension Range: 1/2" D to 1-1/4" D Hole
- [See more product details](#)

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on Dawn AB04 3277C Single-Lever Pull-Out S...

[Ad feedback](#)

Frequently Bought Together



Price for all three: \$263.03

Add all three to Cart

Add all three to Wish List

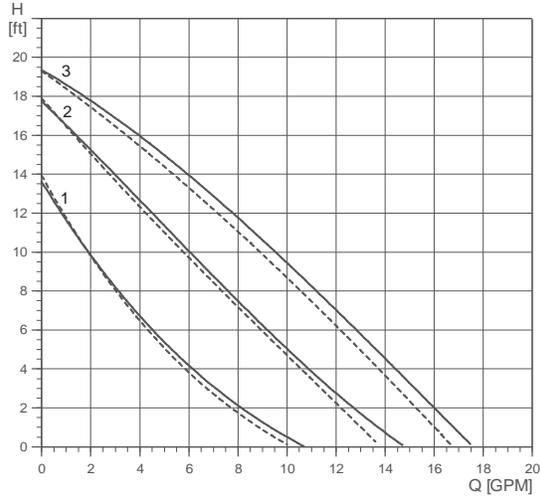
[Show availability and shipping details](#)

- This item:** APEC Water Systems FAUCET-CD-NP APEC Ceramic Disc Designer Faucet Non-Air Gap Faucet, Brushed ... **\$45.50**
- APEC - Top Tier - Built in USA - Ultra Safe, Premium 5-Stage Reverse Osmosis Drinking Water Filter ... **\$199.00**
- APEC Water Systems ICEMAKER-KIT-1-4-RO APEC Water Icemaker Kit for Reverse Osmosis Systems and ... **\$18.53**

Customers Who Bought This Item Also Bought

Technical data

UPS 15-58 FC/FRC

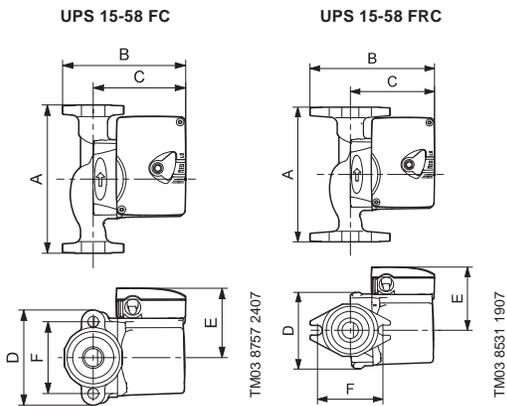


TM03 5535 0907

Flow range: 0-17 gpm
 Head range: 0-19.5 feet
 Motors: 2-pole, single-phase
 Max. liquid temperature: 230 °F (110 °C)
 Min. liquid temperature: 36 °F (2 °C)
 Max. system pressure: 145 psi (10 bar)

Model	Spd	Volts	Amps	Watts	Hp	Capacitor
UPS 15-58 FC/FRC	3	115	0.75	87	1/25	10µF/180 V
	2		0.66	80	1/25	
	1		0.55	60	1/25	

— Without check valve
 - - - With check valve



Approvals



Model type	Product number	Dimensions [inches]						Connection type and size	Shipping weight [lbs]
		A	B	C	D	E	F		
UPS 15-58 FC	59896341	6 1/2	5 1/4	4	4 3/16	3	3 5/32	GF 15/26 flange (2) 1/2" dia. bolt holes	7 1/4
UPS 15-58 FRC	59896343	6 1/2	5 1/4	4	4 3/16	3	3 5/32	GF 15/26 flange (2) 1/2" dia. bolt holes	7 1/4

Note: The check valve can be removed.
 Dimensions in inches unless otherwise noted.



Submittal Data Information

AP-30 Solar Collector

#SS-1.1-6

Effective: August 19, 2011

Job: _____ Engineer: _____ Contractor: _____ Rep: _____

Part Codes

APSE-30 Solar Collector Complete comprises:
 1 x APSE-30-KIT (Manifold and standard frame)
 3 x BOX-ET/HP-10/10 (Tubes and heat pipes)

Applications

The Apricus AP-30 collector is designed to be used in a wide variety of solar thermal (heat) applications in almost any climate. The evacuated tube and heat pipe technology provides very efficient and reliable solar thermal production in a simple to install, low maintenance design.

Features

- Twin glass evacuated tube (passive solar tracking)
- Freeze protected heat pipes
- NSF 61 certified copper header
- 3/4" copper head connections
- Recycled glass wool manifold insulation
- 10 year warranty on tubes and heat pipes
- 15 year warranty on copper header and SS frame
- Efficient performance at high differential temperatures

Materials of Construction

Evacuated Tubes:	Borosilicate 3.3 Glass
Absorber:	Al-N on Al on Glass
Heat Pipes:	High purity copper
Heat Transfer Fins:	Aluminum
Rubber Components:	HTV Silicone Rubber
Mounting Frame:	439 Stainless Steel
Manifold Casing:	3A21 Anodized Aluminum

Performance Data

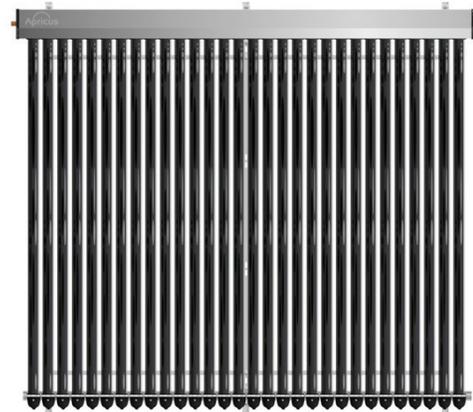
Ideal Flow Rate:	0.8 gpm
Max Flow Rate:	4 gpm
Peak Power Output:	1944 W / 6632 Btuh
Eta0:	0.687
a1 (W/m ² K):	1.505
a2 (W/m ² K ²):	0.0111

Physical Specifications

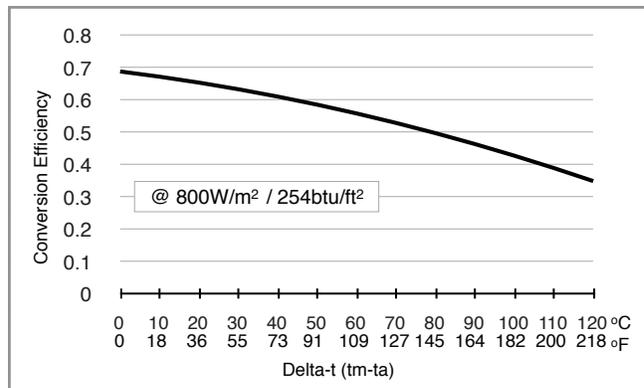
Dimensions:	2.0m x 2.2m / 78.9" x 86.4"
Aperture Area:	2.98m ² / 32.05ft ²
Gross Area:	4.15m ² / 44.76ft ²
Gross Dry Weight:	95 kg / 209 lb
Fluid Capacity:	790 ml / 26.7 fl oz
Max Pressure:	800 kPa / 116 psi
Stagnation Temperature:	220°C / 432°F

Certifications

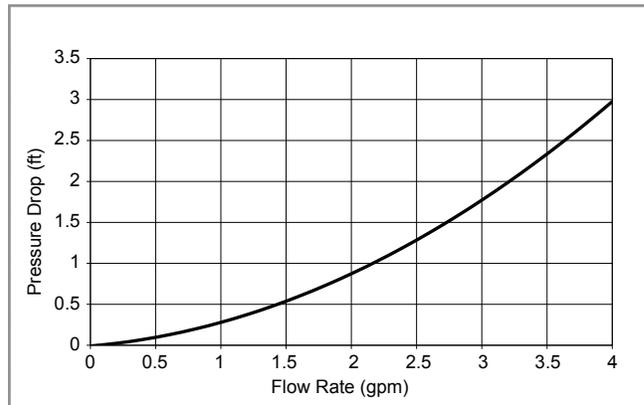
OG-100:	100-2007033A
FSEC:	00442N
IAPMO USEC:	S-5995
Solarkeymark:	011-7S161 R
AS2712:2007:	100633
NSF-61 Tested:	1420-10001
CSA:	2375921



Collector Performance (aperture area)

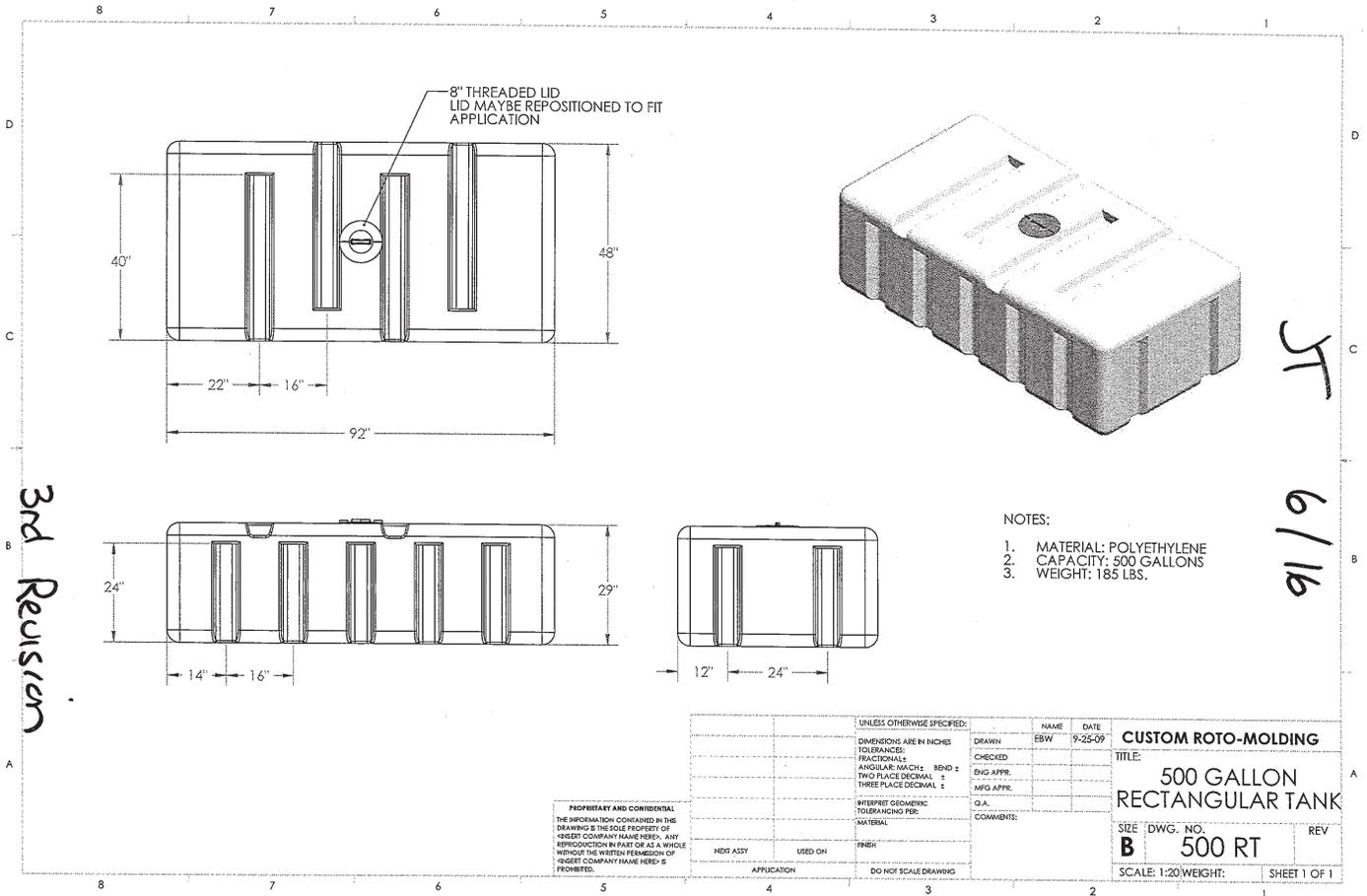


Pressure Drop



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 office-usa@apricus.com www.apricus.com



For Heating and Cooling Systems

Job Name _____
 Job Location _____
 Engineer _____
 Approval _____

Contractor _____
 Approval _____
 Contractor's P.O. No. _____
 Representative _____

Series ETX, ETSX Pressurized Expansion Tanks for Heating and Cooling Systems*

Series ETX and ETSX Pressurized Expansion Tanks for Heating and Cooling Systems are designed to absorb the increased volume of water created when water is heated. These tanks maintain system pressure below the relief setting of the relief valve. The Series ETX and ETSX's pre-pressurized steel tank features a durable expansion membrane that prevents contact of the water with the air in the tank. This rugged diaphragm minimizes loss of the air change and ensures long and trouble-free life for the system.



ETX

Features

- Precharged at 12psi (83 kPa)
- Rugged flexible butyl diaphragm
- In-line and free standing models
- Compatible with glycol in systems
- Steel construction

Models

ETX Mounts to supply piping
 ETSX Free standing



ETSX

Specifications

Furnish and install as shown on plans a Watts Model ETX/ETSX _____ gallon _____ " diameter x _____ " (high) pre-charged steel expansion tank with a fixed butyl bladder. The tank shall have an NPT system connection and a .302"-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank shall be factory precharged to 12psi. The tank shall be a Watts Regulator Company Series ETX or ETSX.

Ratings

Maximum Working Temperature: 220°F (104°C)
 Maximum Working Pressure:
 ETX-15, ETX-30, ETX-60: 75psi (517 kPa)
 ETX-90 and ETSX Series: 100psi (6.9 bar)
 Precharge (field adjustable): 12psi (83 kPa)

*Not for use on potable water systems.

Materials

Diaphragm: Butyl rubber
 Outer Shell: Carbon Steel with Epoxy finish

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.



Models: PLT-5, PLT-12, PLT-20

Potable Hot Water Expansion Tank

Installation Instructions

⚠ WARNING!

Improper installation, adjustment, alteration, service or maintenance can cause property damage, serious bodily injury or death. Read instructions completely before proceeding with installation. Only qualified personnel may install or service this equipment in accordance with local codes and ordinances.

Do not exceed 80psi (5.5 bar) air charge. Air charge pressure exceeding 80psi (5.5 bar) could become hazardous and will void any and all warranties, either written or implied. Failure to follow these instructions will result in the possibility of property damage, serious bodily injury or death.

This Expansion Tank is designed and intended for water storage at a maximum pressure of 150psi (10.3 bar) and a maximum temperature of 200°F (93°C). Any use other than for potable water or a sustained or instantaneous pressure in excess of 150psi (10.3 bar) or 200°F (93°C) is **UNSAFE** and can cause property damage, serious bodily injury or result in death.



Certified to ANSI/NSF 61
(73°F/23°C)



Listed by IAPMO

Disclaimer: The manufacturer of this tank does not accept any liability or other responsibility for personal injury or property damage resulting from improper use, installation or operation of this tank or the system of which it is a part.

Notice: The expansion tank, piping and your connections may in time leak. Select a location to install the expansion tank where a water leak will not damage the surrounding area. The manufacturer is not responsible for any water damage in connection with this expansion tank.

Acceptance Volume

Air Side Pre-pressure (psi) (bar)	Water Side Volume at 150psi (10.3 bar) (gallons)		
	PLT-5	PLT-12	PLT-20
20 (1.4)	1.48	3.42	7.102
40 (2.8)	1.26	2.88	5.882
60 (4.1)	1.0	2.49	4.705
80 (5.5)	.80	1.85	4.009

	PLT-5 Order No. 0067370	PLT-12 Order No. 0067371	PLT-20 Order No. 0067372
Description			
Max. Pressure - psi	150	150	150
Max. Temp. - °F	200	200	200
Tank Volume - gal.	2.1	4.5	8.5
Tank Acceptance - gal.	1.26	2.8	3.4
Air Pre-charge - psi	20	20	20
Connections Size - in.	¼ male	¼ male	¼ male
Diameter - in.	8	10.5	12½
Length - in.	11	13.5	19¾
Weight - lbs.	5.5	10	15

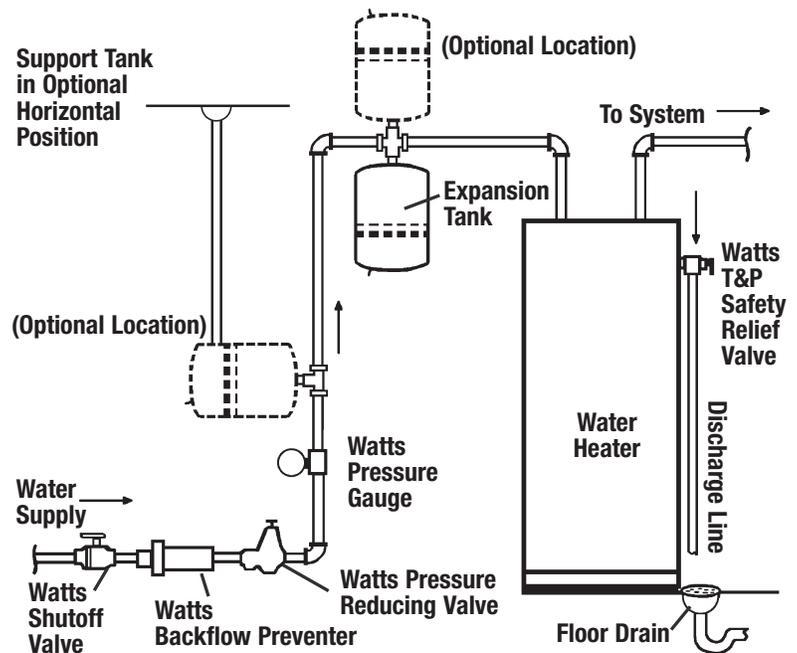


Figure 1



**Division 23 – Heating, Ventilating, and Air-Conditioning
(HVAC)**

INSTALLER'S GUIDE

18-GJ09D1-1

**ALL phases of this installation must comply with
NATIONAL, STATE AND LOCAL CODES**

Models:

BAYEVAC05BK1A	BAYEVAC10LG1A
BAYEVAC05LG1A	BAYEVBC15BK1A
BAYEVAC08BK1A	BAYEVBC20BK1A
BAYEVAC08LG1A	BAYEVAC10LG3A
BAYEVAC10BK1A	BAYEVBC15LG3A

Supplementary Electric Heaters for Air Handler Installations

IMPORTANT—This Document is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

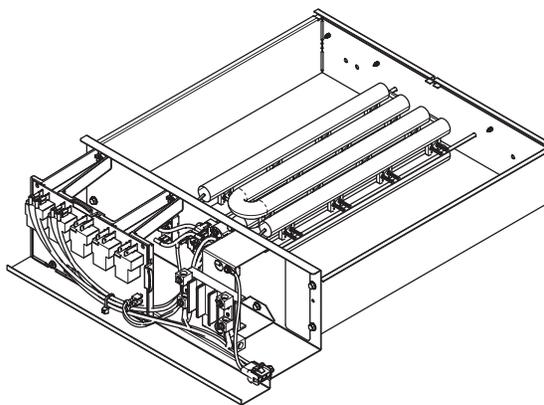
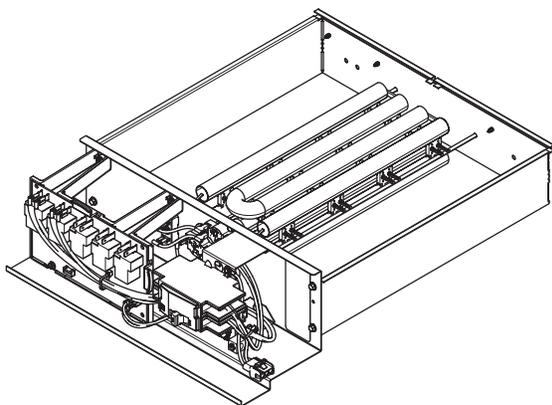


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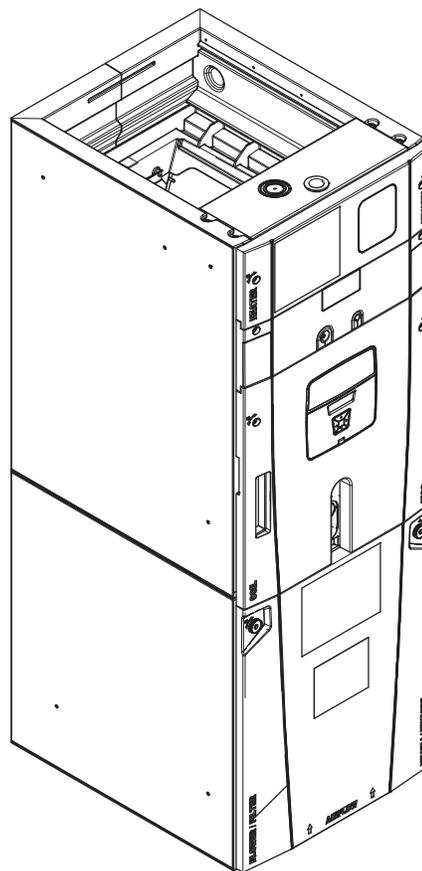
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Section 2. General Information	3
Section 3. Heater Assembly Labeled	3
Section 4. Heater Selection	4
Section 5. Adjust Heater	6
Section 6. Install Heater	8
Section 7. Tables	12
Section 8. Sequence of Operation	14



Variable Speed Outdoor Compatible Convertible Air Handlers 2-5 Tons

Black Epoxy Coil
TAM8C0A24V21EA
TAM8C0B30V21EA
TAM8C0C36V31EA
TAM8C0C42V31EA
TAM8C0C48V41EA
TAM8C0C60V51EA

Standard Coil
TAM8C0A24V21CB
TAM8C0B30V21CB
TAM8C0C36V31CB
TAM8C0C42V31CB
TAM8C0C48V41CB
TAM8C0C60V51CB



**IMPORTANT: TZONE850/950
communicating thermostats
MUST be used for Variable
Speed Outdoor units.**



FV-08WQ1

Specification Submittal Data / Panasonic Ventilation Fan

Description

Ventilating fan shall be Low Noise wall mount type rated for continuous run. Fan shall be ENERGY STAR® rated and certified by the Home Ventilating Institute (HVI). Evaluated by Underwriters Laboratories and conform to both UL and cUL safety standards.

Motor/Blower:

- Four-pole totally enclosed condenser motor rated for continuous run.
- Power Rating shall be 120 volts and 60 Hz.
- Fan shall be UL and cUL listed for tub/shower enclosure when used with a GFCI branch circuit wiring.
- Motor equipped with thermal-cut-off fuse.

Housing:

- Rust proof paint, galvanized steel body.
- Outside hood with built in backdraft damper and bird screen.
- Expandable sleeve up to 10".

Grille:

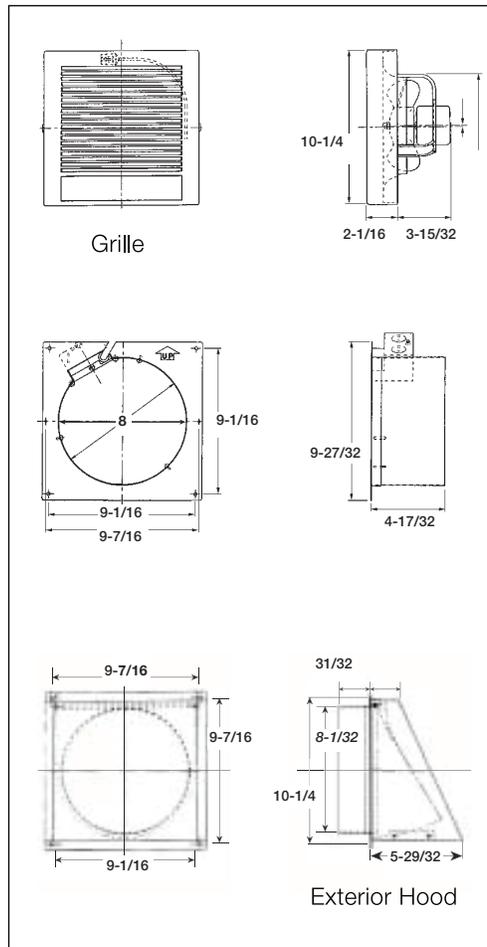
- Attractive design using ABS material.
- Attaches directly to housing.

Warranty:

- ALL Parts: For period of 3 years from the date of the original purchase.

Architectural Specifications:

Ventilating Fan shall be of the through-the-wall mount, ENERGY STAR rated type, with no less than 70 CFM and no more than 1.1 sone as certified by the Home Ventilating Institute (HVI). Power consumption shall be no greater than 18 watts and ENERGY STAR rated with efficiency rating of no less than 3.9 CFM/watt. The motor shall be totally enclosed, four pole condenser type engineered to run continuously. Power rating shall be 120v/60Hz. Duct diameter shall be 8". Fan shall be UL and cUL listed for tub/shower enclosure when used with GFCI branch circuit wiring. Outside hood shall be painted steel with a spring damper and foam seal. Hood shall include a bird screen. Fan shall be ASHRAE 62.2, LEED, ENERGY STAR IAP, EarthCraft, California Title-24, and WA Ventilation Code compliant.



FV-08WQ1

Specifications: WhisperWall FV-08WQ1	
Static Pressure in inches w.g.	0.03
Air Volume (CFM)	70
Noise (sones)	1.1
Power Consumption (watts)	18
Energy Efficiency (CFM/Watt)	3.9
Speed (RPM)	660
Energy Star Rated	Yes
Washington State VIAQ Code	Yes

As of date 4/11

For complete Installation Instructions visit www.panasonic.com/building

Model	Quantity	Comments	Project:
			Location:
			Architect:
			Engineer:
			Contractor:
			Submitted by:
			Date:

Panasonic Home and Environment Company
 Division of Panasonic Corporation of North America
 One Panasonic Way
 Secaucus, NJ 07094

www.panasonic.com/building



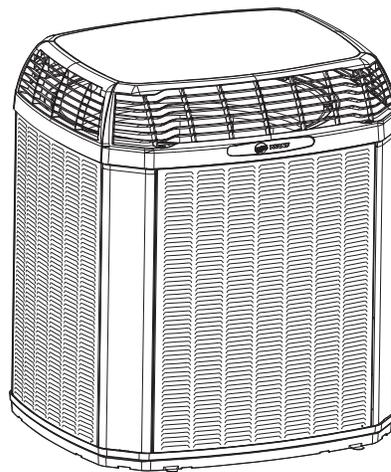
Panasonic ideas for life



Product Data

Variable Speed ComfortLink™ II Heat Pumps

4TWV0024A1000A
4TWV0036A1000A
4TWV0048A1000A
4TWV0060A1000A



Note: "Graphics in this document are for representation only. Actual model may differ in appearance."

18-HD61D1-2

Installer's Guide

BAYSEN01ATEMPA

Outdoor Temperature Sensor

ALL phases of this installation must comply with NATIONAL, STATE AND LOCAL CODES

IMPORTANT — This Document is **customer property** and is to remain with the outdoor unit. Please return to service information pack upon completion of work.

The BAYSEN01ATEMPA is a 10K ohm thermistor sensor assembly used to sense outdoor temperature. Proper installation of this sensor is required for it to accurately sense outdoor temperature. Read this entire installation instruction before beginning the installation.

⚠ CAUTION

Turn off all power to the heating and cooling equipment before attempting to connect control wiring to Comfort Control's subbase.

⚠ WARNING

This information is for use by individuals having adequate backgrounds of electrical and mechanical experience. Any attempt to repair a central air conditioning product may result in personal injury and/or property damage. The manufacturer or seller cannot be responsible for the interpretation of this information, nor can it assume any liability in connection with its use.

Installation- Location

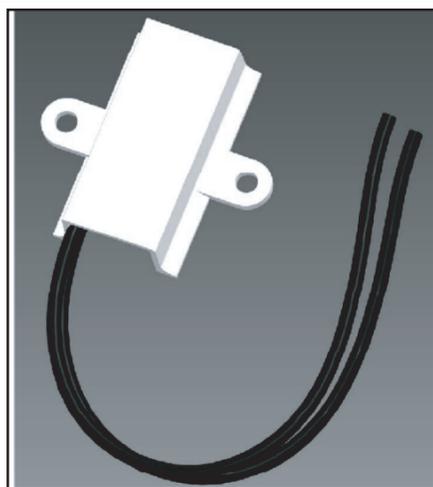
Careful consideration of the following recommendations will help to insure that the outdoor sensor provides accurate readings:

1. Mount the outdoor sensor on the north facing side of the building in an area where it is exposed to freely circulating airflow and out of direct sunlight.
2. Do not allow hot air from the attic or drafts from inside exterior walls to bias the sensor's operation. Always seal the hole where sensor's wiring passes to the outside of the structure. Use non-hardening caulk, putty, or insulation.
3. Avoid locations such as near dryer vents or close to, or directly above, the outdoor unit where it would be exposed to hot discharge air from the condenser fan.
4. Install the sensor a minimum of 12 inches above normal expected snow accumulation.

Wiring

- Maximum length of field wiring to sensor is 200 feet.
- Minimum wire gauge is 18AWG.

1. Turn all power off to the indoor air handler or furnace.



2. Separate the control from the mounting base. Route sensor wires through the large hole in mounting base.
3. Adjust length and routing of the sensor wires to reach the proper terminals on the connector block on mounting base. Strip only 1/4-in. of insulation from each wire to prevent adjacent wires from shorting together when connected.
4. Connect the sensor's wires to the proper terminals on the connector block.
5. Push any excess wire back into the wall and **seal the hole to prevent air leaks**.

Note:

Air leaks in the wall behind the control can cause improper operation.

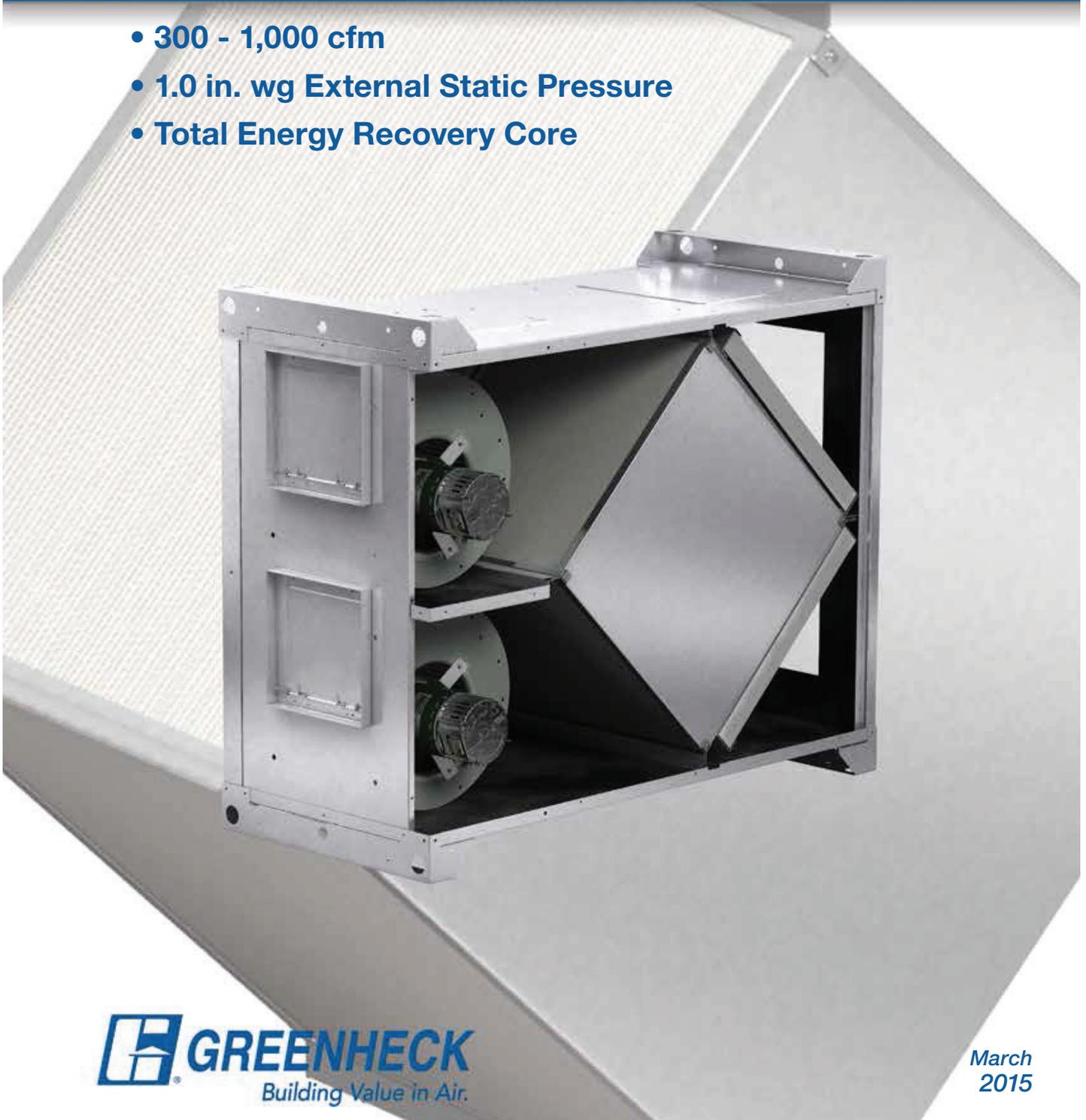
Control setup and checkout

1. Reinstall the control on its mounting base.
2. Turn ON power to the furnace or air handler.
3. Enter the Comfort Control's Installer Setup mode and enable the Outdoor Temperature for display only or for display and control. See the control's installation/setup instructions for details.
4. After setup is complete, verify that the sensor and control are operating properly. The outdoor temperature should display with no service icon present.

Energy Recovery Ventilator Model MiniCore

Preconditioner

- 300 - 1,000 cfm
- 1.0 in. wg External Static Pressure
- Total Energy Recovery Core





Printed Date: 6/30/2015
Job: Solar Decathlon ERV
Mark: ERV-1

Minicore-5-VG

CONSTRUCTION FEATURES AND ACCESSORIES

Unit Overview

Model	Outside Air (CFM)	Exhaust (CFM)	Electrical V/C/P
Minicore-5-VG	300	300	115/60/1

Features

- Exterior housing constructed of galvanized steel
- Hydrosopin resin energy recovery core
- Two direct drive blower and motor assemblies
- Ball bearing motors
- Corrosion resistant fasteners
- Forward curved steel wheels
- Housing lined with .5 in insulation
- Pleated 2 in filters (30% efficient)
- Single point wiring
- Four factory mounted hanging brackets
- Removable panels enable easy access to internal components

Options and Accessories

- Listed to UL-1812
- Frost Control: Timed Exhaust Panel Non UL Listed
- Speed Control: Motor Mounted Potentiometer
- Neoprene Vibration Isolation Kit, Hang Mounting



Note: Weight does NOT include skid/crating and may vary by 15% based on selected options.



18-HD64D1-1

ComfortLink™ II Installation Guide

Other Installation Guides may be necessary, based on system configuration. A complete list of other optional components is shown below.



TZONE950AC52ZA

1 Thermostat	
2	Relay Panel For use with 24V indoor systems (optional)
3	Zone Panel (optional)
4	Zone Sensor with Display (optional)
5	Zone Sensor (optional)
6	Zone Dampers (optional)

ALL phases of this installation must comply with NATIONAL, STATE AND LOCAL CODES

IMPORTANT — This Document is customer property and is to remain with this unit.

These instructions do not cover all variations in systems or provide for every possible contingency to be met in connection with the installation. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to your installing dealer or local distributor.

Section 1. Safety

⚠ WARNING

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⚠ WARNING

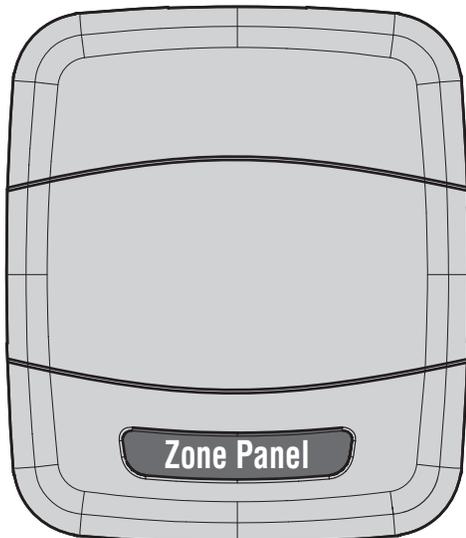
LIVE ELECTRICAL COMPONENTS!
During installation, testing, servicing, and troubleshooting of this product, it may be necessary to work with live electrical components. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Table of Contents

Section 1. Safety 1
Section 2. General Information..... 2
Section 3. Physical Installation 5
Section 4. Wiring..... 7
Section 5. Installer Setup..... 9
Section 6. Advanced Features..... 13
Section 7. Troubleshooting..... 17
Section 8. Installer Setup Parameters 18

NOTE: See the User's Guide for wireless setup information.

18-HD66D1-3



ZZONEPNLAC52ZB (Kit)
ZZONEEXPAC52ZB (Zone Panel)

Installation Guide

Other Installation Guides may be necessary, based on system configuration. A complete list of other optional components is shown below.

1	Control (required) *ZONE950AC52ZA
2	Relay Panel For use with 24V indoor systems (optional)
3	Zone Panel
4	Zone Sensor with Display (optional)
5	Zone Sensor (optional)
6	Zone Dampers (optional)

ALL phases of this installation must comply with NATIONAL, STATE AND LOCAL CODES

IMPORTANT — Proper application is critical when installing zoning systems. Not done correctly, the HVAC and zoning systems will not provide the expected comfort. Reference application bulletins CNT-APG003-EN/Trane and CNT-APG004-EN/AS for detailed information on Zoning Application

IMPORTANT — This Document is customer property and is to remain with this unit. Please return to service information pack upon completion of work.

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Section 1. Safety

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- Section 1. Safety..... 1
- Section 2. General Information 2
- Section 3. Installation..... 6
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- Section 7. User Interface 25
- Section 8. Control Board Test Points 26
- Section 9. Troubleshooting..... 28

Division 26 – Electrical

Straight Blade Devices 20A, 125V, 2 Pole, 3 Wire Grounding Commercial Specification Grade Duplex Receptacles

HUBBELL



Features

- Tamper-resistant shutter complies with national electrical code requirements
- Smooth face
- Wrap-around galvanized steel straps
- Triple wipe contacts

Ordering Information

Description	Device Color	UPC	Catalog Number
Tamper-Resistant, back and side wired, smooth face	White	783585144160	BR20WHITR

Listings

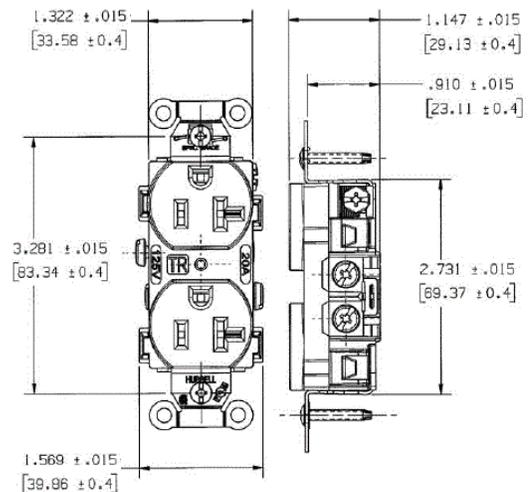
UL Listed to UL498 File No. E2186 File No. E2186
Certified to CSA C22.2, No. 42
NEMA® WD-6 Compliant

Specifications

Face	Nylon
Base	Nylon
Power Contacts	.030 in. (.8) Brass
Ground Contacts	Brass
Wire Clamp	.062 in. (1.6) Nickel plated steel
Terminal Screws	Plated steel
Mounting Strap	.040 in. (1) Galvanized steel
Automatic Self-grounding Staple	Stainless steel
Mounting Screws	Galvanized Steel

Performance

Electrical	
Current Interrupting	Certified for current interrupting at full rated current
Dielectric Voltage	Withstands 2,000V minimum
Mechanical	
Product Identification	Ratings are a permanent part of the device
Terminal Accommodation	#12-#10 AWG copper stranded or solid conductor only
Terminal Identification	Terminals identified in accordance with UL 498 and CSA
Environmental	
Flammability	UL 94 V-2
Operating Temperatures	Maximum continuous 75°C; minimum -40°C (w/o impact)



Accessories

Wallplate or Weatherproof Cover Duplex Opening

Resources

Customer Use Drawing
eCatalog

Dimensions in Inches (mm)

Hubbell Wiring Device-Kellems • Hubbell Incorporated (Delaware) • 40 Waterview Drive • Shelton, CT 06484

Phone (800) 288-6000 • Fax (800) 255-1031 • Specifications subject to change without notice.



QO and Homeline Dual Function Circuit Breakers



Combination
Arc Fault
Protection



Ground
Fault
Protection

Save time and money with combined Combination Arc Fault Protection and Ground Fault Protection in one device.



QO and Homeline Dual Function Circuit Breakers are available in 15 and 20 ampere ratings.

The innovative Square D QO™ and Homeline™ Dual Function Circuit Breaker saves space and installation time while meeting prevailing National Electrical Code® requirements. Available in both standard Pigtail and time-saving Plug-on Neutral configurations, these circuit breakers combine two critical, state-of-the-art technologies; Combination Arc Fault and Ground Fault (Class A) protection, in one easy-to-install device. The Dual Function Circuit Breaker offers superior electrical safety for homeowners.

The 2014 National Electrical Code now requires both Combination Arc Fault (CAFI) and Ground Fault (GFCI) protection on all 1-Pole, 15 A, and 20 A kitchen and laundry circuits. Prior to the release of the Dual Function Circuit Breaker, a contractor or homeowner's only choice was to use a Combination Arc Fault circuit breaker in conjunction with an expensive, bulky Ground Fault receptacle. The new Dual Function circuit breakers help reduce cost and eliminate the hassle of using two separate devices to provide critical protection. It's a win for contractors and homeowners alike. Like all Square D™ CAFI Circuit Breakers, it is integrated with TIME SAVER Diagnostics, a unique feature that provides additional circuit information and improves troubleshooting at the touch of a button.

Benefits:

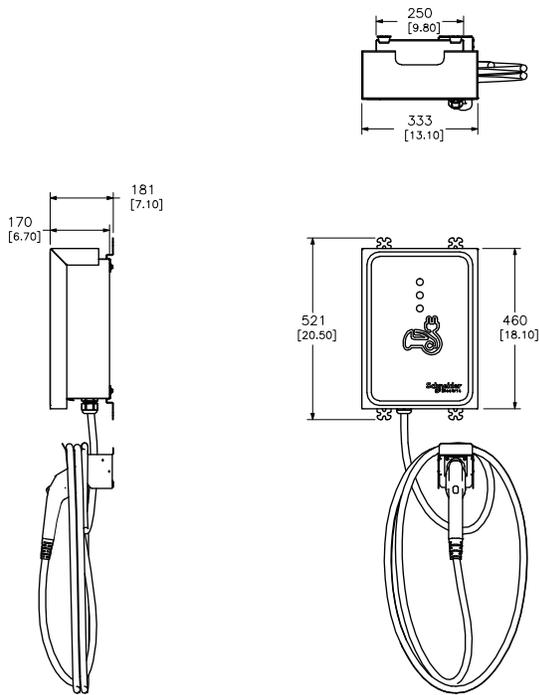
- **Saves time** — Combination Arc Fault and Ground Fault protection in a single device enables faster installation.
- **Saves money** — Lower cost than purchasing two separate devices.
- **Saves space** — Two state-of-the-art technologies engineered into one small device. No need for wiring a bulky GFI receptacle.
- **Easy-to-use** — Equipped with simple and effective TIME SAVER Diagnostics, it provides circuit information at the touch of a button.
- **Reliable** — Engineered with the quality and craftsmanship that have made Square D the preferred brand of electricians and homeowners for over 50 years.



The Dual Function Circuit Breaker meets 2014 National Electrical Code requirements and quickly responds when a hazardous condition occurs.

 **SQUARE D**™

by **Schneider Electric**



POWER SPECIFICATIONS (EACH CHARGING UNIT)	
INPUT POWER CONNECTION	208-240VAC, 30A, SINGLE PHASE, 60HZ
FEEDER CIRCUIT BREAKER	LINE 1, LINE 2, AND GROUND
FEEDER CIRCUIT BREAKER	2-POLE, 40A, NON-GFCI TYPE
OUTPUT POWER	208-240VAC

PHYSICAL SPECIFICATIONS	
ENCLOSURE TYPE	TYPE 3R
ENCLOSURE MOUNTING	WALL
CABLE TYPE	SAE J1772
CABLE LENGTH	18 FT (5.5M)
CABLE MANAGEMENT	NON-RETRACTABLE, INTEGRAL WITH THE ENCLOSURE
UNIT OPTIONS	SINGLE UNITS (WALL-MOUNT)

USER INTERFACE	
POWER AVAILABLE	STATUS INDICATOR
CHARGING	BLINKING BLUE INDICATOR
SYSTEM DETECTED FAULT	RED STATUS INDICATOR

AUTHENTICATION	
TYPE	NON-NETWORKED RFID AUTHENTICATION CARD
PROGRAMMING	RADIO FREQUENCY REMOTE CONTROL

PROTECTION	
GROUND FAULT PROTECTION	INTEGRAL, CCID 20mA, AUTO RESET
GROUND FAULT PROTECTION SYSTEM TEST	AUTOMATIC AT THE BEGINNING OF EACH CHARGE CYCLE

ENVIRONMENTAL	
OPERATING TEMPERATURE	-22°F TO 131°F (-30°C TO 55°C)
ELECTRO-STATIC DISCHARGE	15 KV OPEN AIR, 8 KV CONTACT
SURGE	6 KV
RADIATED IMMUNITY	20 V/M
CONDUCTED IMMUNITY	20 V
ELECTRICAL FAST TRANSIENT/BURST (EFTB)	2 KV
EMISSIONS	FCC CLASS B

STANDARDS COMPLIANCE	
NEC ARTICLE	625
SAE	J1772
UL	UL2594, UL2231-1 & UL2231-2, UL991, UL1998 AND UL2251

DUAL DIMENSIONS: MILLIMETERS
INCHES

CATALOG NUMBER	OUTPUT VOLTAGE SYSTEM	OUTPUT CURRENT	MOUNTING TYPE	CHARGING UNIT	APPLICATION	AUTHENTICATION
EV230WSR	208-240VAC	30A	WALL	SINGLE	OUTDOOR	-

EVLINK SINGLE WALL MOUNT
30A OUTDOOR CHARGING STATION



DWG# EV230WSR

REF DWG # EV230WSR

GFTR20W -- Tamper Resistant Commercial Grade GFCI with LED



20A 125V, 5-20R, With LED, White

Product Specifications

GFCI Product Type	 <p>Receptacles</p>
Receptacle Version	Tamper Resistant LED
Receptacle Grade	Commercial Grade
Amperage	20A
Color	 <p>White</p>
Voltage	125V AC
Packaging	Single
Trip Level	4-6 mA
Trip Time	0.025 seconds
Frequency	60Hz
Voltage Range	120V AC +10% -15%
Amperage Range	15A/20A, 20 Amps Feed Thru
Max Humidity	0.95
Operating Temp	Deg F -30 to 150 (Deg C -30 to 66)
Codes and Standards	Meets UL 943 Class A GFCIs and UL 498 for Receptacles. Complies to NEC, CEC & OSHA. UL File E-41978, CSA File LR-24886
Terminal Accommodations	#14 -10 AWG stranded or solid copper conductors only.
Note:	GFCI Receptacles should not be used in critical care patient areas or for electrical life support equipment.
UPC Number	88377811475
Weight in LBs	0.35

Product data sheet

Characteristics

QOC42US

LOAD CENTER COVER QO



by Schneider Electric

Product availability: Stock - Normally stocked in distribution facility
Price*: 111.00 USD



Main

Commercial Status	Commercialised
Range of product	QO
Product or component type	Load Center Cover

Complementary

Device mounting	Surface
Cover type	Surface cover
Product compatibility	For indoor load center

Ordering and shipping details

Category	00001 - QO 1PH LC, 12-42 CKT, NEMA 1
Discount Schedule	DE3A
GTIN	00785901746058
Nbr. of units in pkg.	1
Package weight(Lbs)	11.44
Product availability	Stock - Normally stocked in distribution facility
Returnability	Y
Country of origin	US

Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Compliant - since 1248 - Schneider Electric declaration of conformity
REACH	Reference not containing SVHC above the threshold
Product end of life instructions	Need no specific recycling operations

Contractual warranty

Period	18 months
--------	-----------

The information provided in this documentation contains general descriptions and/or technical characteristics of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. *Prices are indicative

Product data sheet

Characteristics

QO142L225G

LOAD CENTER QO MLO 240V 225A 1PH 42SP



by Schneider Electric

Price*: 717.00 USD



Main

Commercial Status	Commercialised
Product or component type	Load Center
Range of product	QO
Load center type	Convertible Mains (lugs)
[In] rated current	225 A
Number of spaces	42
Short-circuit current	65 kA
Number of circuits	42
Number of tandem circuit breakers	0
Network number of phases	1 phase
[Ue] rated operational voltage	120/240 V AC

Complementary

AWG gauge	6...300 AWG/kcmil copper 6...300 AWG/kcmil aluminium
NEMA degree of protection	NEMA 1 indoor
Cover type	Order separately
Device composition	Grounding bar included (not installed)
Electrical connection	Lugs
Wiring configuration	3-wire
Material	Tin plated copper busbar
Product certifications	UL listed

Ordering and shipping details

Category	00001 - QO 1PH LC,12-42 CKT,NEMA1
Discount Schedule	DE3A
GTIN	00785901867753
Nbr. of units in pkg.	1
Package weight(Lbs)	20.74
Returnability	Y
Country of origin	US

Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Compliant - since 1248 - Schneider Electric declaration of conformity
REACH	Reference not containing SVHC above the threshold
Product end of life instructions	Need no specific recycling operations

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1Ø3W—120/240 Vac—UL Listed

Table 1.16: Main Lugs (Accepts Only QO Plug-On Circuit Breakers.)

Mains Rating	Spaces	Max. 1P Circuits [▲]	Max. Tandem Circuit Breakers	\$ Price (Interior, Box and Cover)	Load Center Box and Interior		Indoor Cover with Door (Order Separately)			Main Wire Size AWG/kcmil		Equipment Ground Bar Kit (Order Separately)		Box No. See Page 1-17
					Cat. No.	\$ Price	Flush Cat. No.	Surface Cat. No.	\$ Price	Al	Cu	Cat. No.	\$ Price	
Fixed Mains—Factory-Installed Main Lugs—10 kA Short Circuit Current Rating														
30 A	2	2	0	41.70	QO2L30S◆★	41.70	Cover Included—Without Door			12–10	14–10	PK3GTA1	11.40	1
70 A	2	4	2	69.00	QO24L70F/S▼△	69.00	Cover Included—Without Door			12–3	14–4	PK4GTA	10.80	2
100 A	6	12	6	87.00	QO612L100F/S▼□	87.00	Cover Included—Without Door			8–1		PK7GTA	11.70	4
	6	12	6	90.00	QO612L100DF/S▼□	90.00	Cover Included—With Door					PK7GTA	11.70	4
	8	16	8	131.00	QO816L100F/S▼□	131.00	Cover Included—Without Door					PK7GTA	11.70	4
	8	16	8	143.00	QO816L100DF/S▼□	143.00	Cover Included—With Door					PK7GTA	11.70	4
	6	12	6	111.00	QO612L100DFCU/SCU▼□◇	111.00	Cover Included—With Door					PK7GTA	11.70	4
	8	16	8	174.00	QO816L100DFCU/SCU▼□◇	174.00	Cover Included—With Door					PK7GTA	11.70	4
125 A	4	8	4	93.00	QO148L125GF/S▼★	93.00	Cover Included—Without Door			12–2/0	14–2/0	PK7GTA*		21
Convertible Mains—Factory-Installed Main Lugs—65 kA Short Circuit Current Rating QOM1 Main Frame Size—Convertible to Main Circuit Breaker—Cu Bus														
125 A	12	12	0	196.70	QO112L125G	159.00	QOC16UF	QOC16US	37.70	6–2/0		PK9GTA*		6
	12	24	12	235.70	QO11224L125G	198.00	QOC16UF	QOC16US	37.70			PK15GTA*		6
	16	16	0	255.70	QO116L125G	218.00	QOC24UF	QOC24US	37.70			PK12GTA*		7
	16	24	8	300.70	QO11624L125G	263.00	QOC24UF	QOC24US	37.70			PK15GTA*		7
	20	20	0	271.70	QO120L125G	234.00	QOC24UF	QOC24US	37.70			PK15GTA*		7
	20	24	4	370.70	QO12024L125G	333.00	QOC24UF	QOC24US	37.70			PK15GTA*		7
	24	24	0	381.70	QO124L125G	344.00	QOC24UF	QOC24US	37.70			PK15GTA*		7
	32	32	0	434.60	QO132L125G	395.00	QOC32UF	Use Flush	39.60			PK23GTA, LK100AN*		8
Convertible Mains—Factory-Installed Main Lugs—65 kA Short Circuit Current Rating—Convertible to Main Circuit Breaker—Cu Bus														
150 A	20	30	10	419.00	QO12030L150G	332.00	QOC30UF	QOC30US	87.00	6–250		PK23GTA, LK100AN*		9
	24	24	0	431.00	QO124L150G	344.00	QOC30UF	QOC30US	87.00			PK15GTA*		9
	30	30	0	437.00	QO130L150G	350.00	QOC30UF	QOC30US	87.00			PK23GTA, LK100AN*		9
200 A	12	12	0	353.00	QO112L200G	266.00	QOC30UF	QOC30US	87.00	6–250		PK15GTA*		9
	24	36	12	819.00	QO12436L200FT†	732.00	QOC40UF	QOC40US	87.00			PK23GTA, LK100AN*		10
	30	30	0	494.00	QO130L200G	407.00	QOC30UF	QOC30US	87.00			PK23GTA, LK100AN*		9
	30	40	10	554.00	QO13040L200G	467.00	QOC30UF	QOC30US	87.00			PK23GTA, LK100AN*		9
	40	40	0	746.00	QO140L200G	659.00	QOC40UF	QOC40US	87.00			PK23GTA, LK100AN*		10
	40	60	20	944.00	QO14060L200G	857.00	QOC40UF	QOC40US	87.00			(2) PK15GTA*		10
225 A	42	52	10	921.00	QO14252L200G	810.00	QOC42UF	QOC42US	111.00	6–300		(2) PK15GTA*		11
	42	42	0	828.00	QO142L225G	717.00	QOC42UF	QOC42US	111.00			PK23GTA, LK100AN*		11
Fixed Mains—Factory-Installed Main Lugs—65 kA Short Circuit Current Rating														
400 A	30	30	0	1641.00	QONQ30LS400 (Int) MH50 (box)◊	1080.00 75.00	NC50NQVF	NC50NQVS	486.00	(1) 1/0–750 or (2) 1/0–300		PK27GTA◊ or PK15GTA6	33.80 53.00	15
	42	42	0	1746.00	QONQ42LS400 (Int)◊ MH50 (box)	1185.00 75.00	NC50NQVF	NC50NQVS	486.00			PK27GTA◊ or PK15GTA6	33.80 53.00	15

- Above listings through 200 A mains rating meet Federal Specification W-P-115C as Type 1, Class 2.
- ▲ Maximum single pole branch circuits utilizing QO and/or QOT circuit breakers.
 - ◆ UL short circuit current rating depends on lowest interrupting rating of circuit breaker installed.
 - ◆ Will not accept QO-EPD or Qwik-Gard™ QO-GFI or QO-AFI circuit breakers.
 - ★ Mains rated 25 A when Al wire is used.
 - ▼ Order F for flush device or S for surface device.
 - △ Use 10 AWG maximum size wire for GFI and AFI circuit breakers.
 - 70 A Max. branch circuit breaker and 70 A max. back fed main circuit breaker.
 - ◇ CU indicates copper bus.
 - ☆ Copper bus.
 - ▽ UL Listed 5000 A short circuit current rating for corner grounded Delta systems. Use QO-H circuit breakers only.
 - ◊ Supplied with feed-thru lugs.
 - ◊ Factory-included.
 - ◊ Interior only, order box separately.
 - ◊ PK27GTA includes a 6–2/0 AWG Al/Cu lug.
 - ◊ PE1A Discount Schedule.



QO120L125G



QO816L100F or S without cover

1Ø, Field-Installed Main Circuit Breaker Kits

Table 1.17: Use with Convertible Main Load Centers Only

Main Circuit Breaker Rating [‡]	QOM1 Frame Size		Lug Wire Size † AWG/kcmil	QOM2 Frame Size †				
	Convertible Load Center Mains Rating	22 k AIR ◊ Main Circuit Breaker \$ Price		Main Circuit Breaker Rating [‡]	Convertible Load Center Mains Rating	22 k AIR ◊ Main Circuit Breaker \$ Price	Lug Wire Size † AWG/kcmil	
50 A	100–125	QOM50VH 140.00	12–2/0 Al or Cu	100 A	150–225	QOM2100VH 468.00	4–300 Al or Cu	
60 A	100–125	QOM60VH 140.00		125 A	150–225	QOM2125VH 468.00		
70 A	100–125	QOM70VH 140.00		150 A	150–225	QOM2150VH 468.00		
80 A	100–125	QOM80VH 201.00		175 A	200–225	QOM2175VH 468.00		
90 A	100–125	QOM90VH 201.00		200 A	200–225	QOM2200VH 468.00		
100 A	100–125	QOM100VH 201.00		225 A	225	QOM2225VH 468.00		
110 A	125	QOM110VH 468.00		—	—	—		—
125 A	125	QOM125VH 468.00		—	—	—		—

- ◆ Do not exceed the load center mains rating.
- ◊ 22 k AIR main circuit breaker UL Listed for use ahead of QO, QOT and QO-PL 10 k AIR branch circuit breakers to permit their application on systems with up to 22 kA available fault current.
- ‡ Wire range listed for QOM circuit breaker kits is the wire range of that circuit breaker. To find out maximum wire size permitted in a particular load center per UL, see pages 1–5 through 1–11 under Main Wire Size.
- † Add suffix 1021 for 120, 208 or 240 Vac shunt trip.



QOM1 Frame Size 50–125 Amperes



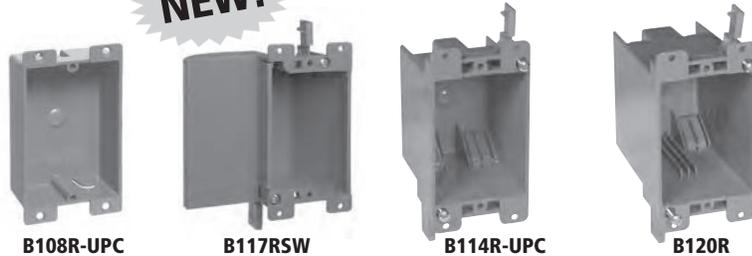
QOM2 Frame Size 100–225 Amperes

LOAD CENTERS

Old Work Switch/Outlet Boxes – Nonmetallic

Old Work Boxes

- Meets NEMA OS-2
- UL Listed to UL 514C



One-Gang

Part No.	Volume (cu. in.)	Description	Size	Integral Clamps	Std. Ctn. Qty.	Std. Ctn. Wt. (lbs.)
†B108R-UPC	8	One-Gang Shallow Box w/ mounting ears	1 1/4"D x 2 3/8"W x 3 5/8"L	–	25	3
•†B114R-UPC	14	One-Gang Box w/ mounting ears and swing clamps	2 3/4"D x 2 1/4"W x 4 1/8"L	4 (2 each end)	50	10
•†B114RR-UPC	14	One-Gang Box w/ mounting ears and swing clamps	2 3/4"D x 2 1/4"W x 4 1/8"L	4 (2 each end)	25	5
•†B117RSW	17	One-Gang Shallow Box w/ access panel, mounting ears and swing clamps	2.00"D x 4.07"W x 3.64"L (2.20" opening)	2	30	7.6
•†B120R	20	One-Gang Box w/ mounting ears and swing bracket	3 5/8"D x 2 5/16"W x 4 1/8"L	4 (2 each end)	50	12

- Suitable for masonry walls
- † Not UL Classified for Fire Resistance



Two-Gang

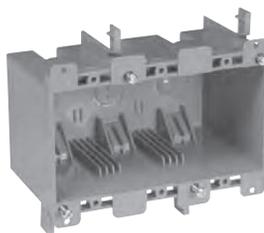


Part No.	Volume (cu. in.)	Description	Size	Integral Clamps	Std. Ctn. Qty.	Std. Ctn. Wt. (lbs.)
•†B225R-UPC	25	Two-Gang Box w/ mounting ears and 2 swing clamps	2 3/4"D x 3 1/8"W x 3 15/16"L	6 (3 each side)	30	8

- Suitable for masonry walls
- † Not UL Classified for Fire Resistance



Three-Gang



Part No.	Volume (cu. in.)	Description	Size	Integral Clamps	Std. Ctn. Qty.	Std. Ctn. Wt. (lbs.)
•†B355R	55	Three-Gang Box w/ mounting ears and 2 swing clamps	3.69"D x 2.79"W x 5.72"L	6	6	3

- Suitable for masonry walls
- † Not UL Classified for Fire Resistance



Four-Gang



Part No.	Volume (cu. in.)	Description	Size	Integral Clamps	Std. Ctn. Qty.	Std. Ctn. Wt. (lbs.)
•†B468R	68	Four-Gang Case w/ mounting ears and 2 swing clamps	3.56"D x 2.89"W x 7.57"L	8	6	4.03

- Suitable for masonry walls
- † Not UL Classified for Fire Resistance

SINGLE-GANG DEVICE COVERS

WEATHERPROOF BOXES,
COVERS AND LIGHTING

Application

- For use whenever weatherproof protection is required for an outdoor receptacle

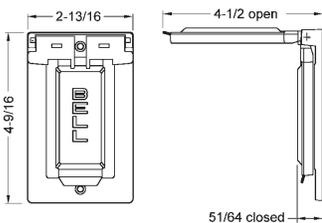
Product Features

- Rugged metallic construction
- State-of-the-art powder coat finish provides maximum weatherability and scratch resistance
- Self-closing lids assure weatherproof protection when the receptacle is not in use
- Includes installation hardware, gasket, and multi-lingual instructions

Compliances

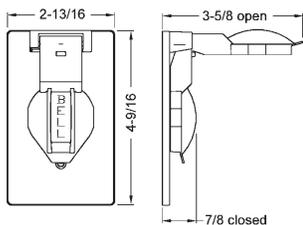
-  [®]
- NEMA 3R Rated

GFCI STYLE COVERS

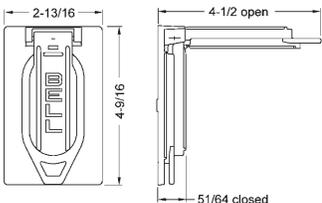


SINGLE RECEPTACLE STYLE COVERS

NOTE: DIMENSIONS FOR DEVICE-MOUNT AND BOX-MOUNT COVERS ARE THE SAME



DUPLEX STYLE COVER

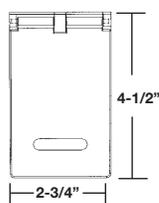


ORDERING INFORMATION - DIMENSIONS

VERTICAL – DEVICE MOUNT					
CATALOG NUMBER	COLOR	RECEPTACLE TYPE	PKG. TYPE	STD. PKG.	UPC BAR CODE
5146-0	Gray	Duplex	Shrink	24	
5146-1	White	Duplex	Shrink	24	
5146-5	Gray	Duplex	Carded	6	
5147-0	Gray	Duplex	Shrink	24	
5103-0	Gray	GFCI	Shrink	24	
5103-1	White	GFCI	Shrink	24	
5103-2	Bronze	GFCI	Shrink	24	
5103-5	Gray	GFCI	Carded	6	
5103-6	White	GFCI	Carded	6	
5103-7	Bronze	GFCI	Carded	6	
5104-0	Gray	GFCI	Shrink	24	
5155-0	Gray	Single, 1.406" diameter	Shrink	24	
5155-1	White	Single, 1.406" diameter	Shrink	24	
5155-2	Bronze	Single, 1.406" diameter	Shrink	24	
5155-5	Gray	Single, 1.406" diameter	Carded	6	
5155-6	White	Single, 1.406" diameter	Carded	6	

VERTICAL – BOX MOUNT					
CATALOG NUMBER	COLOR	RECEPTACLE TYPE	PKG. TYPE	STD. PKG.	UPC BAR CODE
5095-0	Gray	Duplex	Shrink	24	
5091-0	Gray	Single, 1.406" diameter	Shrink	24	

CAT. NO. 5104-0, 5147-0

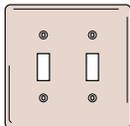
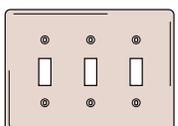
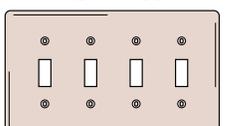
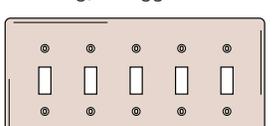
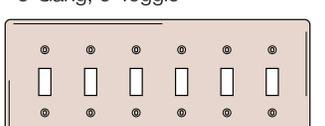


Wallplates & Weather Resistant Covers

Toggle Switch Wallplates



- ◆ Curved corners blend into any interior.
- ◆ Screws pre-inserted in single-gang wallplates for faster assembly.
- ◆ Individually packaged.
- ◆ Virtually unbreakable nylon.
- ◆ UL Listed E92074, CSA Certified.

Description	UL	CSA	Color	Nylon Standard	Nylon Mid-Size	Material	Metal Catalog No.
1-Gang, 1-Toggle 			Almond Black Brown Gray Ivory Light Almond White	NP1AL NP1BK NP1 NP1GY NP1I NP1LA NP1W	NPJ1AL NPJ1BK NPJ1 NPJ1GY NPJ1I NPJ1LA NPJ1W	Brass Brass Plated Chrome Stainless Steel	SB1 SBP1 SCH1 SS1
2-Gang, 2-Toggle 			Almond Black Brown Gray Ivory Light Almond White	NP2AL NP2BK NP2 NP2GY NP2I NP2LA NP2W	NPJ2AL NPJ2BK NPJ2 NPJ2GY NPJ2I NPJ2LA NPJ2W	Brass Brass Plated Chrome Stainless Steel	SB2 SBP2 SCH2 SS2
3-Gang, 3-Toggle 			Almond Black Brown Gray Ivory Light Almond White	NP3AL NP3BK NP3 NP3GY NP3I NP3LA NP3W	NPJ3AL NPJ3BK NPJ3 NPJ3GY NPJ3I NPJ3LA NPJ3W	Brass Brass Plated Chrome Stainless Steel	SB3 SBP3 SCH3 SS3
4-Gang, 4-Toggle 			Almond Black Brown Gray Ivory Light Almond White	NP4AL NP4BK NP4 NP4GY NP4I NP4LA NP4W	NPJ4AL NPJ4BK NPJ4 NPJ4GY NPJ4I NPJ4LA NPJ4W	Brass Brass Plated Chrome Stainless Steel	SB4 SBP4 — SS4
5-Gang, 5-Toggle 			Almond Black Brown Gray Ivory White	NP5AL NP5BK NP5 NP5GY NP5I NP5W	— — — — — —	Brass Brass Plated Chrome Stainless Steel	SB5 — — SS5
6-Gang, 6-Toggle 			Almond Brown Gray Ivory White	NP6AL NP6 NP6GY NP6I NP6W	— — — — —	Brass Brass Plated Chrome Stainless Steel	SB6 — — SS6

Wallplates & Weather Resistant Covers

Toggle Switch Wallplates



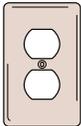
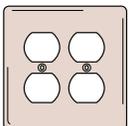
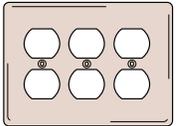
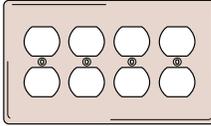
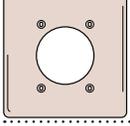
Wallplates & Weather Resistant Covers

Duplex & Single Receptacle Wallplates

- ◆ Curved corners blend into any interior.
- ◆ Screws pre-inserted in single-gang wallplates for faster assembly.
- ◆ Individually packaged.
- ◆ Virtually unbreakable nylon.
- ◆ UL Listed E92074, CSA Certified.

Wallplates & Weather Resistant Covers

Duplex & Single Receptacle Wallplates

Description	UL  SP 	Color	Nylon Standard	Nylon Mid-Size	Material	Metal Catalog No.
1-Gang, 1-Duplex 		Almond Black Brown Gray Ivory Light Almond White	NP8AL NP8BK NP8 NP8GY NP8I NP8LA NP8W	NPJ8AL NPJ8BK NPJ8 NPJ8GY NPJ8I NPJ8LA NPJ8W	Brass Brass Plated Chrome Stainless Steel	SB8 SBP8 SCH8 SS8
2-Gang, 2-Duplex 		Almond Black Brown Gray Ivory Light Almond White	NP82AL NP82BK NP82 NP82GY NP82I NP82LA NP82W	NPJ82AL NPJ82BK NPJ82 NPJ82GY NPJ82I NPJ82LA NPJ82W	Brass Brass Plated Chrome Stainless Steel	SB82 SBP82 SCH82 SS82
3-Gang, 3-Duplex 		Almond Brown Ivory White	NP83AL NP83 NP83I NP83W	— — — —	Brass Brass Plated Chrome Stainless Steel	— SBP83 — SS83
4-Gang, 4-Duplex 		Almond Brown Ivory White	NP84AL NP84 NP84I NP84W	— — — —	Brass Brass Plated Chrome Stainless Steel	— — — SS84
1-Gang, 1-Single 1.40" Dia. Hole 		Almond Black Brown Gray Ivory Light Almond White	NP7AL NP7BK NP7 NP7GY NP7I NP7LA NP7W	NPJ7AL NPJ7BK NPJ7 NPJ7GY NPJ7I NPJ7LA NPJ7W	Brass Brass Plated Chrome Stainless Steel	SB7 SBP7 SCH7 SS7
1-Gang, 1-Single 1.60" Dia. Hole 		Almond Black Brown Gray Ivory White	NP720AL NP720BK NP720 NP720GY NP720I NP720W	— — — — — —	Brass Brass Plated Chrome Stainless Steel	— — — SS720
1-Gang, 1-Single 2.15" Dia. Hole 		Almond Black Brown Gray Ivory White	NP724AL NP724BK NP724 NP724GY NP724I NP724W	NPJ724AL NPJ724BK NPJ724 NPJ724GY NPJ724I NPJ724W	Brass Brass Plated Chrome Stainless Steel	— — SCH723 SS723
2-Gang, 1-Single 2.15" Dia. Hole 		Almond Black Brown Gray Ivory White	NP703AL NP703BK NP703 NP703GY NP703I NP703W	NPJ703AL NPJ703BK NPJ703 NPJ703GY NPJ703I NPJ703W	Brass Brass Plated Chrome Stainless Steel	— — — SS703

Switches and Receptacles

Range and Dryer Power Receptacles and Plugs



Range and dryer devices offer heavy-duty connections in either surface mount or flush mount configurations. Made of rugged thermoplastic. Available in 30 Amp and 50 Amp, 75° C Rated.

- ◆ Terminals accept up to #4 AWG conductors.
- ◆ Power outlets are suitable for copper or aluminum conductors.
- ◆ Flush mount outlets fit 1 and 2-gang boxes.
- ◆ UL Listed E1706, CSA Certified.

	Description  	Rating	Color	Catalog No.
	Flush Mount Power Receptacle, 3 Pole, 4 Wire, with Ground, Mounts on One or Two-Gang Box	30A 125/250V	Black	RR430F
		30A 125/250V	White	RR430FW
		50A 125/250V	Black	RR450F
		50A 125/250V	White	RR450FW
	Flush Mount Power Receptacle, 3 Pole, 3 Wire, without Ground, Mounts on One or Two-Gang Box	30A 125/250V	Black	RR330F*
		50A 125/250V	Black	RR350F*
	Panel Mount, 3 Pole, 4 Wire, with Ground	30A 125/250V	Black	RR430PM
		50A 125/250V	Black	RR450PM
	Flush Mount Power Receptacle, 3 Pole, 4 Wire, with Ground, Integrated Wallplate Cover, Mounts on 4 ¹ / ₁₆ " Square Box	30A 125/250V	White	RR430WIP
		50A 125/250V	White	RR450WIP
	Surface Mount Power Receptacle, 3 Pole, 4 Wire, with Ground	30A 125/250V	Black	RR430
		50A 125/250V	Black	RR450
	Surface Mount Power Receptacle, 3 Pole, 3 Wire, without Ground	30A 125/250V	Black	RR330*
		50A 125/250V	Black	RR350*
	Angled Plugs, 3 Pole, 4 Wire, with Ground 3 Pole, 3 Wire, without Ground Plugs supplied with interchangeable blades for 30 or 50 Amp configuration.	30/50A 125/250V	Black	RR435P
		30/50A 125/250V	Black	RR335P
	Surface Mount Wallplate, 1-Gang, 1-Single Hole 2.15" Dia.	Ivory	NP724I	NPJ724I
		White	NP724W	NPJ724W
		Chrome	SCH723	—
		Stainless Steel	SS723	—
	Surface Mount Wallplate, 2-Gang, 1-Single Hole 2.15" Dia.	Ivory	NP703I	NPJ703I
		White	NP703W	NPJ703W
		Stainless Steel	SS703	—

Switches and Receptacles

Range and Dryer Power Receptacles and Plugs



* For replacement use only.



**Electric Vehicle Charging Solutions
Outdoor Charging Stations**

Outdoor Charging Stations

Wall-Mount

Features

Interface:

- Power status
- Charge indicator
- System detected fault indicator

Authentication:

- Localized RFID solution (optional)

Cable Holder:

- Supports and helps organize the cable
- Independently mounted from enclosure

Protection:

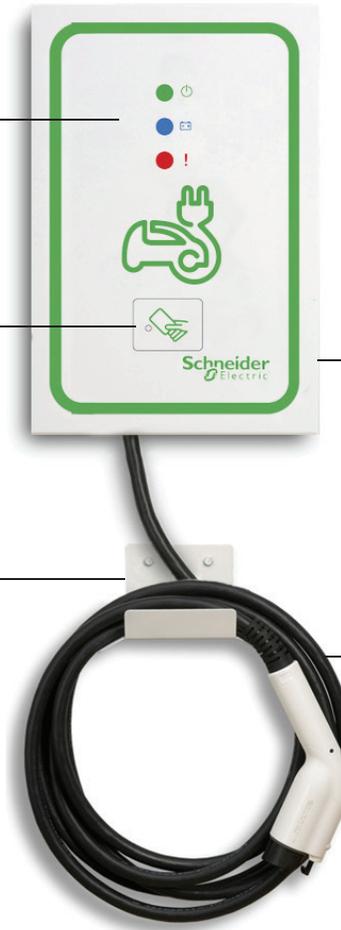
- Integral Ground Fault Protection at 5 mA
- Ground fault function tested before each charge cycle begins
- Auto restart after ground fault or main power loss

Enclosure:

- Metallic enclosure
- Indoor/outdoor wall-mount

Connector and Cord:

- Complies with SAE J1772
- Cable length: 18 ft. (5.5 meter)



Outdoor Charging Station (Wall-Mount)
Residential and Commercial Applications

Catalog Numbers

Table 3: Outdoor Charging Stations—Wall-Mount

Catalog Number	Output Voltage System	Output Current	Mounting Type	Charging Units	Application	Features
EV230WSR	208–240 Vac	30 A	Wall	Single	Indoor/Outdoor	—
EV230WSRR	208–240 Vac	30 A	Wall	Single	Indoor/Outdoor	RFID (non-networked)

QO™ and QOU Miniature Circuit Breakers

QO™ Miniature Circuit Breakers



Class 730, 731, 733 / Refer to Catalog 0730CT9801

by Schneider Electric
www.schneider-electric.us

QO™ miniature circuit breakers are plug-on products for use in QO load centers, NQOD panelboards, NQOD OEM interiors or Speed-D™ switchboard distribution panels. Bolt-on QOB circuit breakers are for use in NQOD panelboards or interiors.▲ The QO exclusive Qwik-Open™ mechanism, with a trip reaction within 1/60th of a second, is standard on all 1P 15 A and 20 A QO circuit breakers.

Table 7.1: Plug-On Circuit Breakers

Ampere Rating ■	1P—120/240 Vac		2P—120/240 Vac Common Trip		2P—240 Vac + Common Trip		3P—240 Vac Common Trip		
	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	Cat. No.	\$ Price	
10 k AIR									
10 A	QO110	29.10	QO210	67.00	—	—	QO310	248.00	
15 A	QO115*▼	29.10	QO215*	67.00	QO215H	200.00	QO315*	248.00	
20 A	QO120*▼	29.10	QO220*	67.00	QO220H	200.00	QO320*	248.00	
25 A	QO125*	29.10	QO225*	67.00	QO225H	200.00	QO325*	248.00	
30 A	QO130*	29.10	QO230*	67.00	QO230H	200.00	QO330*	248.00	
35 A	QO135*	29.10	QO235*	67.00	—	—	QO335*	248.00	
40 A	QO140*	29.10	QO240*	67.00	QO240H	200.00	QO340*	248.00	
45 A	QO145*	29.10	QO245*	67.00	—	—	QO345*	248.00	
50 A	QO150*	29.10	QO250*	67.00	QO250H	200.00	QO350*	248.00	
60 A	QO160*	29.10	QO260*	67.00	QO260H	200.00	QO360*	248.00	
70 A	QO170*	67.00	QO270*	134.00	QO270H	224.00	QO370*	315.00	
80 A	—	—	QO280*	189.00	QO280H	315.00	QO380*	366.00	
90 A	—	—	QO290*	189.00	QO290H	315.00	QO390*	366.00	
100 A	—	—	QO2100*	189.00	QO2100H	315.00	QO3100*	366.00	
110 A	—	—	QO2110*	428.00	—	—	—	—	
125 A	—	—	QO2125*	428.00	—	—	—	—	
150 A	—	—	QO2150*△◇	491.00	—	—	—	—	
175 A	—	—	QO2175*△◇	491.00	—	—	—	—	
200 A	—	—	QO2200*△◇	491.00	—	—	—	—	
Molded Case Switch 60 A max.—240 Vac				—	—	QO200	70.00	QO300	248.00
Molded Case Switch 100 A max.—240 Vac				—	—	QO200*	200.00	QO300*	366.00
22 k AIR*									
15 A	QO115VH▼	63.00	QO215VH□	146.00	—	—	QO315VH□	371.00	
20 A	QO120VH▼	63.00	QO220VH□	146.00	—	—	QO320VH□	371.00	
25 A	QO125VH	73.00	QO225VH□	146.00	—	—	QO325VH□	371.00	
30 A	QO130VH	73.00	QO230VH□	146.00	—	—	QO330VH□	371.00	
40 A	QO140VH	73.00	QO240VH□	146.00	—	—	QO340VH□	371.00	
50 A	QO150VH	73.00	QO250VH□	146.00	—	—	QO350VH□	371.00	
60 A	QO160VH	73.00	QO260VH□	146.00	—	—	QO360VH□	371.00	
70 A	QO170VH	112.00	QO270VH□	224.00	—	—	QO370VH□	477.00	
80 A	—	—	QO280VH□	315.00	—	—	QO380VH□	530.00	
90 A	—	—	QO290VH□	315.00	—	—	QO390VH□	530.00	
100 A	—	—	QO2100VH□◇	315.00	—	—	QO3100VH□	530.00	
110 A	—	—	QO2110VH□◇	1034.00	—	—	—	—	
125 A	—	—	QO2125VH□◇	1034.00	—	—	—	—	
150 A	—	—	QO2150VH△◇	1061.00	—	—	—	—	
175 A	—	—	QO2175VH△◇	1061.00	—	—	—	—	
200 A	—	—	QO2200VH△◇	1061.00	—	—	—	—	
42 k AIR*									
40 A	—	—	QOH240*	317.00	—	—	—	—	
45 A	—	—	QOH245*	317.00	—	—	—	—	
50 A	—	—	QOH250*	317.00	—	—	—	—	
60 A	—	—	QOH260*	317.00	—	—	—	—	
70 A	—	—	QOH270	528.00	—	—	—	—	
80 A	—	—	QOH280	651.00	—	—	—	—	
90 A	—	—	QOH290	651.00	—	—	—	—	
100 A	—	—	QOH2100	651.00	—	—	—	—	
110 A	—	—	QOH2110*	1389.00	—	—	—	—	
125 A	—	—	QOH2125	1389.00	—	—	—	—	
65 k AIR*									
15 A	QH115▼	117.00	QH215	293.00	—	—	QH315*	507.00	
20 A	QH120▼	117.00	QH220	293.00	—	—	QH320	507.00	
25 A	QH125*	117.00	QH225*	293.00	—	—	QH325*	507.00	
30 A	QH130	117.00	QH230	293.00	—	—	QH330	507.00	



QO 1P
1 Space Required



QOT 1P Tandem
1 Space Required



QO 2P
2 Spaces Required



QO2200 2P 200 A
4 Spaces Required



QO 3P
3 Spaces Required

7 MINIATURE AND MOLDED CASE CIRCUIT BREAKERS

Table 7.2: QO-QOB Ring Terminal (20% \$ Price Adder)—Factory Installed Only

Ampere Rating	Poles	Suffix
10–30 A	1, 2, 3	5237
35–60 A	1, 2	5238
35–50 A	3	5238
70–110 A	2	5273
60–100 A	3	5273

Table 7.3: Wire Sizes ■

Circuit Breaker Type	Ampere Rating	Wire Size (AWG/kcmil)
QO 1P	10–30 A	14–8 Al/Cu
	10–30 A	(2) 14–10 Cu
	35–70 A	8–2 Al/Cu
QO 2P	10–30 A	14–8 Al/Cu
	10–30 A	(2) 14–10 Cu
	35–70 A	8–2 Al/Cu
	80–125 A	4–2/0 Al/Cu
QO 3P	10–30 A	14–8 Al/Cu, (2) 14–10 Cu
	35–70 A	8–2 Al/Cu
QOB-VH	80–125 A	4–2/0 Al/Cu
	150–200 A	4–300 Al/Cu
QOT	110–150 A	4–300 Al/Cu
QOT	15–20 A	12–8 Al 14–8 Cu
QO-AFI, QO-GFI & QO-EPD	15–30 A	12–8 Al 14–8 Cu
QO-PL	40, 50, 60 A	12–4 Al 14–6 Cu
	10–60 A	12–2 Al 14–2 Cu

Table 7.4: QOT Tandem Circuit Breakers

Ampere Rating ■	Cat. No.*	\$ Price
1P—120/240 Vac		
15 A & 15 A	QOT1515	58.00
15 A & 20 A	QOT1520	58.00
20 A & 20 A	QOT2020	58.00
2P—120/240 Vac		
Order two QOT1515 or QOT2020 circuit breakers and handle tie QOTHT for common switching of center two poles.		

Table 7.5: Replacement Tandem Circuit Breakers

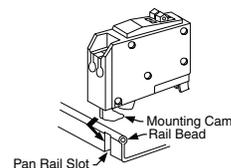
For Use in Old Style Non-Class CTL QO Load Centers—10 k AIR

Ampere Rating ■	Cat. No.*	\$ Price
1P—120/240 Vac—1 Space Required		
15 A & 15 A	QO1515	73.00
15 A & 20 A	QO1520	73.00
20 A & 20 A	QO2020	73.00
20 A & 30 A	QO2030	73.00
30 A & 20 A	QO3020	73.00
Two 1P Individual Trip—120/240 Vac—2 Spaces Required		
15 A & 15 A	Order Two QO1515 or QO2020 circuit breakers and handle tie QOTHT for common switching of center two poles.	—
15 A & 20 A	—	—
20 A & 20 A	—	—
20 A & 30 A	QO20303020▽	134.00
30 A & 20 A	—	—

- ▲ See Digest Section 1 for load centers, and Section 9 for panelboards and interiors.
- 10–30 A circuit breakers are suitable for use with 60°C or 75°C conductors. 35–125 A circuit breakers are suitable for use with 75°C conductors.
- ◆ UL Listed 5 k AIR on corner grounded Delta systems.
- ★ UL Listed as HACR type for use with air conditioning, heating and refrigeration equipment having motor group combinations and marked for use with HACR type circuit breakers.
- ▼ UL Listed as SWD (switching duty) rated. Suitable for switching 120 Vac fluorescent lighting loads.
- △ Requires four spaces (1 AWG–300 kcmil Al/Cu.) Suitable for switching 120 Vac fluorescent lighting loads.
- UL Listed for use ahead of QO, QO-GFI, QO-EPD, QO-AFI, QOT, QOCAFI, and QO-PL 10 k AIR circuit breakers to permit their application at 22 kA fault level.
- ◇ 100 A maximum branch mounted opposite.
- ☆ Order only. Contact your local Field Office.
- ▽ Includes two circuit breakers (one QO2030 and one QO3020) and handle tie QOTHT.
- Not suitable for use in 3Ø panels. Use only in 1Ø panel rated 150 A or greater.

Interrupting Ratings Page 7-2
Accessories Page 7-12
Dimensions Page 7-54

QOT Tandem



Circuit limiting QOT tandem circuit breakers have a mounting cam as shown. Installation into a QO load center can only be made in those positions having a mounting pan rail slot. Meets Paragraph 408.15 of the NEC®. UL Listed as Class CTL

Miniature and Molded Case Circuit Breakers



H-Frame



J-Frame



L-Frame



M-Frame



P-Frame



R-Frame

Selection Information 7-2

QO™ and QOU Miniature Circuit Breakers 7-10

- QO™ Miniature Circuit Breakers 7-10
- QO™ Circuit Breaker Accessories 7-12
- QO™ and Multi 9™ Mounting Bases 7-13
- QOU Miniature Circuit Breakers and QYU Supplementary Protectors 7-14
- QOU Accessories 7-15

Multi 9™ Miniature Circuit Breakers 7-16

PowerPact™ Molded Case Circuit Breakers 7-21

- PowerPact Family 7-21
- New!* H- and J-Frame Circuit Breakers 7-22
- Q-Frame Circuit Breakers 7-24
- New!* L-Frame Circuit Breakers 7-25
- M-Frame Circuit Breakers 7-26
- P-Frame Circuit Breakers 7-27
- R-Frame Circuit Breakers 7-28

Motor Circuit Protectors 7-29

- New!* PowerPact™ H- and J-Frame Electronic Motor Circuit Protectors 7-29
- H-Frame and J-Frame MCP Selector 7-30
- New!* Motor Circuit Protectors and Motor Protector Circuit Breakers 7-31
- H-, J-, and LA-Frame MCP Selection 7-32
- Motor Protection Selection Tables 7-33

Automatic Switches 7-34

500 Vdc Circuit Breakers 7-35

Mission Critical Circuit Breakers 7-37

PowerPact™ Circuit Breaker Accessories 7-39

Micrologic™ Electronic Trip Units 7-46

Masterpact™ Universal Power Circuit Breakers 7-50

Ground-Fault Protection 7-51

Dimensions and Shipping Weights 7-54

Circuit Breaker Enclosures 7-56

New! **Photovoltaic Circuit Breakers and Switches** 7-59



by Schneider Electric

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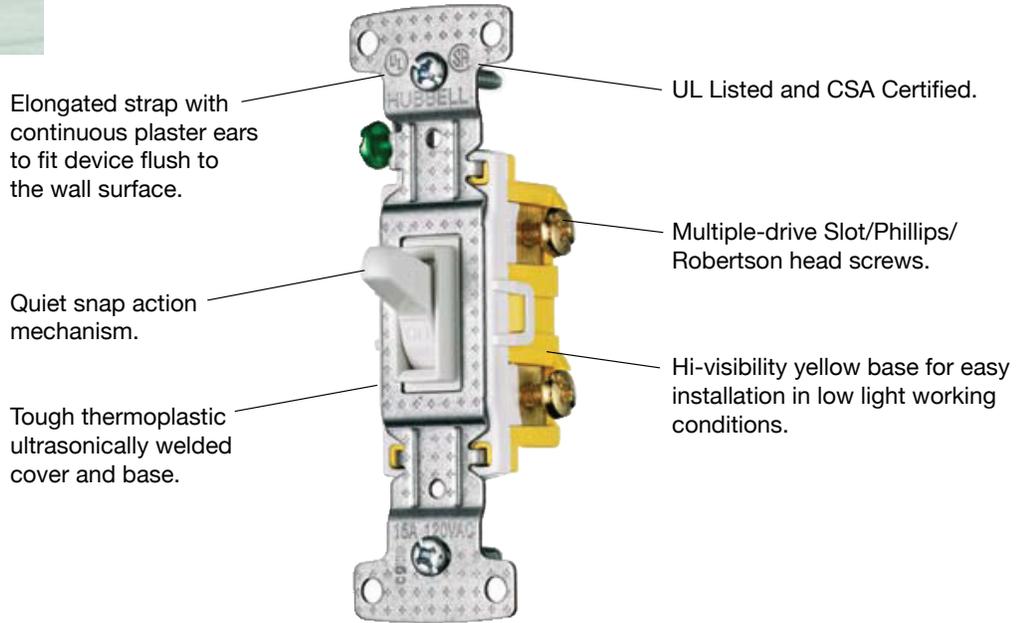




Switches and Receptacles

Single-Pole Toggle Switches

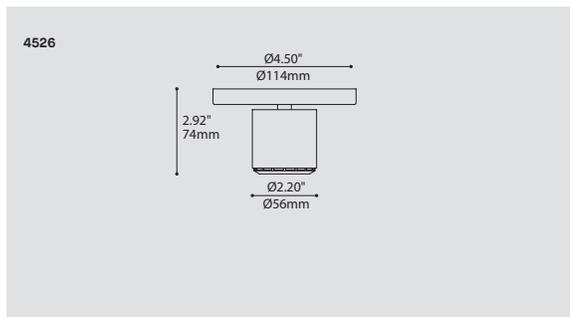
Switches and Receptacles



Description	 	Rating	Color	Catalog No.
Single-Pole Toggle Switch, Grounding, Push and Side Wire Terminations		15A 120V AC	Almond Brown Ivory Light Almond White	RS115AL RS115 RS115I RS115LA RS115W
Single-Pole Toggle Switch, Self-Grounding, Push and Side Wire Terminations		15A 120V AC	Almond Brown Ivory Light Almond White	RS115SAL RS115S RS115SI RS115SLA RS115SW
Single-Pole Toggle Switch, Illuminated, Self-Grounding, Push and Side Wire Terminations		15A 120V AC	Clear Almond Ivory Light Almond White	RS115ILC RS115ILAL RS115ILI RS115ILLA RS115ILW
Frame is clear and illuminates, toggle is colored. Does not require a neutral wire.				

PIXEL 4526

PROJECT PROJET
SPEC TYPE
NOTES



ORDERING SPECIFICATION	SPÉCIFICATION DE COMMANDE	CODE
MODEL MODÈLE		4526
4526	PIXEL	
LIGHT SOURCE SOURCE LUMINEUSE		
<small>(WATTAGE, LAMP TYPE, OTHER INFO)</small>		
LED.4.30.17	4W, LED 3000K (WARM), 17°	
LED.4.30.48	4W, LED 3000K (WARM), 48°	
LED.4.40.17	4W, LED 4000K (NEUTRAL), 17°	
LED.4.40.48	4W, LED 4000K (NEUTRAL), 48°	
LED.8.30.17	8W, LED 3000K (WARM), 17°	
LED.8.30.48	8W, LED 3000K (WARM), 48°	
LED.8.40.17	8W, LED 4000K (NEUTRAL), 17°	
LED.8.40.48	8W, LED 4000K (NEUTRAL), 48°	
VOLTAGE VOLTAGE		
120V	120 VOLT	
277V*	277 VOLT	
	<small>*3983 ACCESSORY IS PROVIDED FOR 277V</small>	
DIMMING OPTION OPTION DE GRADATION		
<small>FOR LED ONLY</small>		
DV*	0-10V DIMMING (120-277V)	
DP*	PHASE DIMMING (120V ONLY)	
	<small>*3983 ACCESSORY IS PROVIDED FOR DIMMING OPTION</small>	
MOUNTING MONTAGE		RC
RC	ROUND CANOPY / PAVILLON ROND 0.5" CANOPY (2401C)	
STRUCTURE FINISH FINI STRUCTURE		CHR
CHR	CHROME	
CYLINDER FINISH FINI CYLINDRE		
BLKA	BLACK ANODIZED	
SA	SATIN ALUMINUM	
WH	WHITE	
HEATSINK FINISH FINI RADIATEUR		BLKA
BLKA	BLACK ANODIZED	
ACCESSORY ACCESSOIRE		
3983	DEEP JUNCTION BOX (PROVIDED FOR DIMMING LED AND 8W 277V AS PER ABOVE)	

PRODUCT CHARACTERISTICS CARACTÉRISTIQUES DU PRODUIT

BIM **DIM** **IES** **LED**

DESIGN:	Same beautiful proportions and clean look of the Point, Voxel and Pixel are smaller sized minimalist projectors. The cleverly integrated heat sink provides a beautiful front edge detail and allows for incredible LED performance in a mini-projector.
INSTALLATION:	Both Pixel and Voxel float on a round chrome ceiling mounted canopy and are supplied without swivel.
LIGHT SOURCE:	4W and 8W LED in 3000K (Warm white) or 4000K (Neutral white) with 0-10V (DV) or phase (DP) dimming versions available.
STRUCTURE:	CNC machined aluminum housing with black, white or clear satin finish. Die-cast aluminum heat sink with black satin anodized finish and inner die-formed steel parts with black polyester powder finish.
OPTIC:	17° or 48° beam angle total internal reflecting (TIR) multi-lens.
CERTIFIED:	c-CSA-us
CONCEPTION:	De proportions élégantes et familières au Point, Voxel et Pixel sont les plus petits de notre gamme de projecteurs minimaliste. La délicate intégration du radiateur procure un détail distinctif et permet une gestion thermique efficace, assurant ainsi un puissant éclairage DEL.
INSTALLATION:	Les plafonniers Pixel et Voxel sont montés sur un pavillon rond chromé et sont fournis sans pivot.
SOURCE LUMINEUSE:	DEL 4W et 8W disponible en 3000K (blanc chaud) ou 4000K (blanc neutre), disponible avec gradation de type 0-10V (DV) ou phase (DP).
STRUCTURE:	Cylindre d'aluminium usiné avec fini blanc, anodisé noir ou satin clair. Radiateur injecté en aluminium avec fini noir anodisé et pièces internes en acier et finies à la peinture électrostatique noire.
OPTIQUE:	Angle de faisceau lumineux de 17° ou 48° total interne multi-lentilles (TIR).
CERTIFIÉ:	c-CSA-us


Features

- ETL Listed power supply
- Protections: push-to-reset circuit breaker
- Dimmable with compatible MLV dimmers
- NEMA 3R enclosure for wet location/outdoor use
- Cooling by free-air convection


Technical Specifications

Input	Voltage / Frequency	120VAC / 60Hz
	Current (Full Load)	2.13A
	Efficiency / Power Factor	87% / 0.92
	Wire or Terminal Connection	PVC 600V 18AWG wire leads w/ framed ground connection
Output	Voltage (Full Load)	11.3VDC
	Voltage Boost	Yes (.5 ~ 1VDC boost tap)
	Max Current (Full Load)	0 ~ 15.6A
	Power (Wattage) ¹	200W
	Wire or Terminal Connection	PVC 300V 12AWG wire leads
	# Output Connections	1
Environment	Thermal Class	B130°C (266°F)
	Operating Temp.	-4 ~ +158°F (-20 ~ +70°C)
	Ambient Temp.	-4 ~ +104°F (-20 ~ +40°C)
	Location	Outdoor/wet location NEMA 3R enclosure
	Class 2 Compliance	No
	Safety Standards	ETL Listed, CSA Listed
Additional Information	Housing / Cooling	Black powder coated steel enclosure. Cooling by free-air convection.
	Reset Breaker	One push-to-reset circuit breaker, protecting load & driver.
	Coil Former	Double Section Bobbin
	Dimmability ²	Must be paired with a compatible 120VAC Magnetic Low Voltage (MLV) dimmer installed between main power and driver.
	Dimensions	3.1 x 3.0 x 9.8 in. (L x W x H)
	Weight	5.44 lbs.

Note ¹ Ensure to de-rate load 20% for maximum longevity. See dimmer switch specifications for minimum load requirements.

Note ² See 'Magnetic Dimmable Driver/Dimmer Switch Compatibility List' for compatible dimmers.

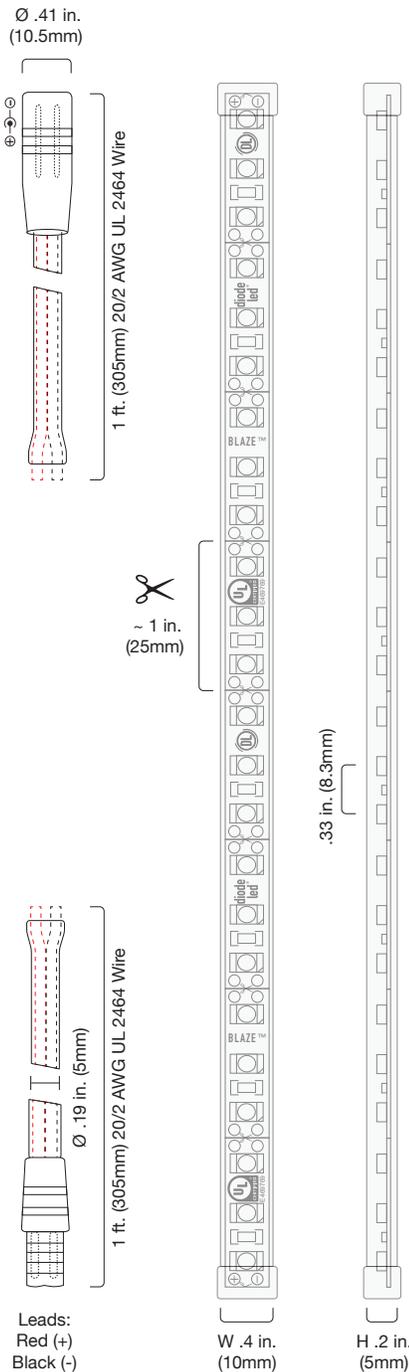
SUBMITTAL FORM

JOB / PROJECT NAME _____	DATE _____
JOB TYPE _____	JOB LOCATION _____
SPECIFIER NAME _____	CATALOG NUMBER _____
CONTACT PHONE _____	OTHER _____
CONTACT E-MAIL _____	

FLUID VIEW® 12V WET LOCATION LED STRIP LIGHT

SPECIFICATION SHEET

- Medium brightness
- Outdoor / wet location
- 16.4 ft. maximum run
- UL Listed & R/C SAM Manual
- Suitable for closet use
- 5-Year limited warranty



SPECIFICATIONS

Input Voltage: 12VDC Constant Voltage
Power Consumption / ft.: 1.44W / 120mA
LED Chip Type: Epistar 3528 SMD Chip
LED Chip Beam Angle: 120°
LED Chips / ft.: 18
Mounting: Includes mounting clips & screws
Field Cuttable: ~ 2 in.
Maximum Run ¹: 16.4 ft.
Connections ²: 3 ft. female wet location plug one end, 3 ft. male wet location plug opposing end, Wire gauge: 20/2 AWG
Dimmable: Yes

Ambient Temp ³: -4 ~ 122°F (-20 ~ 50°C)
Operating Temp ⁴: -4 ~ 176°F (-20 ~ 80°C)
Environment ⁵: Outdoor / wet location
Dimensions: .4 x .2 in. (W x H)
Certifications: UL Listed 2108. UL 1598 / CSA 250.0-08, UL 8750. UL 879 / CAN/CSA-C22.2 no. 207-M89. E469769 (UL Listed), E469770 (SAMS Manual). Suitable for installation in a clothes closet.
Included Items (per spool): 6 mounting clips, 12 screws, 5 end caps, 2 terminal caps, 1 Wet Location Splice Connector Pair

Item #	Connector Size	CCT (Kelvin) ⁶	Lumens / ft. ⁷	CRI	Efficacy (lm/W) ⁸
DI-12V-FV30-W8016 (16.4 ft.)	10.5mm	3000K	100	85.9	69.4

- Note ¹** Each maximum run requires a dedicated power feed from the driver. Do not extend beyond the recommended maximum run length.
- Note ²** Wire leads and accessories are not rated for in-wall installation unless otherwise noted. Attached wire leads and connections are field-cuttable.
- Note ³** Do not install product in an environment outside the listed ambient temperature. Exceeding the maximum ambient temperature may damage LED chips, reduce the total lamp life, lumen output, and/or adversely impact color consistency.
- Note ⁴** Operating temperature is measured according to the minimum and maximum ambient temperature environment.
- Note ⁵** Do not install near or around chlorinated/treated water. This product is not rated as submersible. Do not install in location where water may pool or collect. Do not install in location where LED chips are exposed to direct sunlight as damage to the phosphor will occur.
- Note ⁶** Epistar 3528 SMD Chip binning ranges: (3000K 70 CRI: 2870-3045K).
- Note ⁷** Lumen value measured in accordance to IES LM-79-08. LED chips have a luminous flux range with a tolerance of +/- 5%.
- Note ⁸** Actual efficacy value is dependent to specified LED driver (power supply). An estimated efficacy value has been provided and calculated as follows: Lumen value (measured in accordance to IES LM-79-08) divided by average power consumption per foot.

Item #:	Project:
---------	----------



8829-CW4

Lampholders



Brand Features

Leviton produces lamp holders for virtually every light source equipped with incandescent, fluorescent, or CFL lamps. Lamp-holders include incandescent medium base, and specialty sizes & fluorescent lamp holders, in addition to a large line of porcelain lamp holders including pulse-rated mogul-base products, and an extensive selection of devices for high-intensity lamps.

Item Description

660W/250V Medium Base One-Piece White Urea Outlet Box Mount Incandescent Lampholder, Keyless, Single Circuit, 2 Screws Top Wired - White

Technical Information

Electrical Specifications

Wiring Access: Top Wired
Max. Lamp Wattage: 660W
Voltage: 600 Volt

Material Specifications

Body Material: White Urea
Construction: One-Piece
Socket Shell Material: Aluminum
Color: White
Availability: Distribution

Mechanical Specifications

Lamp Socket Base: Medium
Operator Type: Keyless
Circuit: Single Circuit
Sequence: ON-OFF
Termination: 4 Terminal Screws
Mounting Type: Twist-lock
Fits Outlet Box Size: 3-1/4 or 4 Inch

Product Features

Lamp Socket Base: Medium
Construction: One-Piece
Operator Type: Keyless
Circuit: Single Circuit
Sequence: ON-OFF
Wiring Access: Top Wired
Max. Lamp Wattage: 660W
Voltage: 600 Volt
Termination: 4 Terminal Screws
Mounting Type: Twist-lock
Fits Outlet Box Size: 3-1/4 or 4 Inch
Standards and Certifications: UL/CSA
Warranty: 1 Year Limited
Availability: Distribution

Standards and Certifications

UL Listed: File E3810
CSA Certified: File LR-1863

UPC Code: 07847710318

Country of Origin: Please Contact Customer Service

SPECIFICATION SUBMITTAL

JOB NAME: <input type="text"/>	CATALOG NUMBERS: <input type="text"/>	
JOB NUMBER: <input type="text"/>	<input type="text"/>	<input type="text"/>

Leviton Manufacturing Co., Inc.
 201 North Service Road, Melville, NY 11747
 Telephone: 1-800-323-8920 · FAX: 1-800-832-9538 · Tech Line (8:30AM-7:30PM E.S.T. Monday-Friday): 1-800-824-3005

Leviton Manufacturing of Canada, Ltd.
 165 Hymus Boulevard, Pointe Claire, Quebec H9R 1E9 · Telephone: 1-800-469-7890 · FAX: 1-800-824-3005 · www.leviton.com/canada

Leviton S. de R.L. de C.V.
 Lago Tana 43, Mexico DF, Mexico CP 11290 · Tel.: (+52)55-5082-1040 · FAX: (+52)5386-1797 · www.leviton.com.mx

Visit our Website at: www.leviton.com
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 If you would like to know where your local Leviton office is located please go to: www.leviton.com/international/contacts/



Job Name: Fixture Type: Qty:

LED Series by Times Square Lighting



SX7 9.7W, 700 Lumen LED

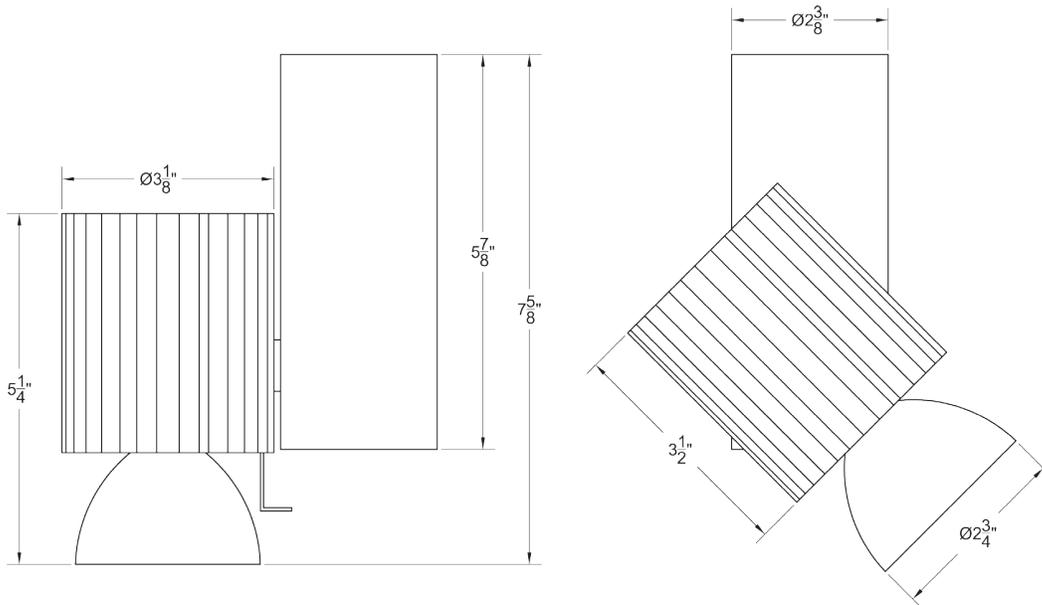
The SX7 is designed around the Xicato™ LED remote phosphor module. This module produces an even field of illumination for the most demanding applications. The SX7 is ideal for museum and retail lighting where a low wattage, high output LED fixture would be required. Xicato™ LEDs exceed ANSI specifications by maintaining tight color consistency over the life of the LED module.

The SX7 is available in standard black, white, or silver finishes. Custom colors are available upon request.

Features:

- 100-277 Volt available
- 9.7-Watt Xicato™ module
- 50,000 Hour life
- Integral electronic driver
- 20°, 40° and 60° Field-changeable reflectors
- Choice of color temperature: 2700, 3000, or 4000.
- CRI ≥80 (≥95 as an option)
- No UV or IR
- Dimmable (optional)

Manufactured in the USA - IBEW



Maximum ambient temperature: 35°C
Maximum operating angle: 45° from vertical

Last updated 04/07/2014.



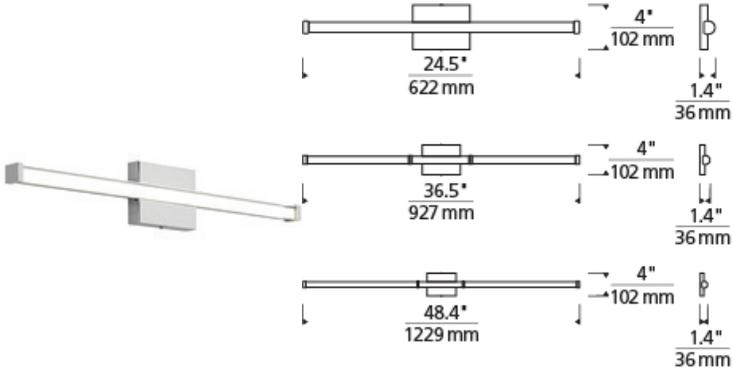
5 Holt Drive • Stony Point, NY 10980
Phone: 845-947-3034 • Fax: 845-947-3047 • www.tsilight.com
Specifications are subject to change without notice.

BATH COLLECTION



DESCRIPTION

A perfect balance of simplicity and sophistication. A sleek plate of glass floats in front of a special co-extruded remote phosphor LED channel to provide flawless, even illumination. 2' version includes 7.8 watts, 600 net lumens or 15.6 watts, 1200 net lumens; 4' version includes 15.6 watts, 1200 net lumens or 31.2 watts, 2400 net lumens of LEDs available in 4 CCT options and 2 CRI options.



COLOR OPTIONS

- clear
- smoke

ORDERING INFORMATION

700BCGIAR	SHAPE OR SIZE	LENGTH (A)	COLOR	FINISH	LAMP	VOLTAGE
3	300LMS/FT	24 24"	C CLEAR	C CHROME	- LED 80 CRI 2400K	120 VOLT
6	600LMS/FT	48 48"	K SMOKE	S SATIN NICKEL	LED824 - LED 80 CRI 3000K LED830 - LED 80 CRI 3500K LED835 - LED 80 CRI 4000K LED840 - LED 90 CRI 3000K LED930	-277 277 VOLT

TECH LIGHTING®
 7400 Linder Avenue T 847.410.4400
 Skokie, Illinois 60077 F 847.410.4500
Tech Lighting, L.L.C.

700 BCGIAR _____

FIXTURE TYPE: _____

JOB NAME: _____

NOTES: _____

Job Name: Fixture Type: Qty:

Current Limiters by Times Square Lighting



Manufactured in the USA - IBEW



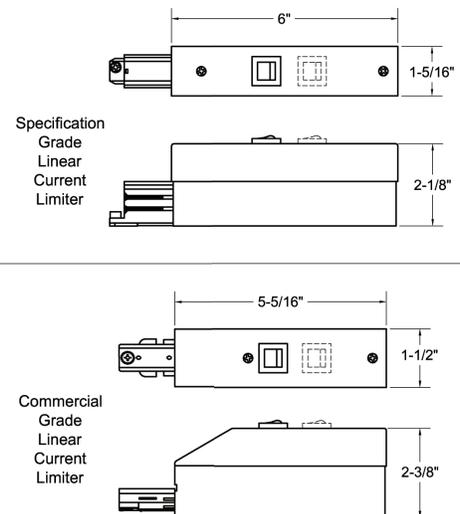
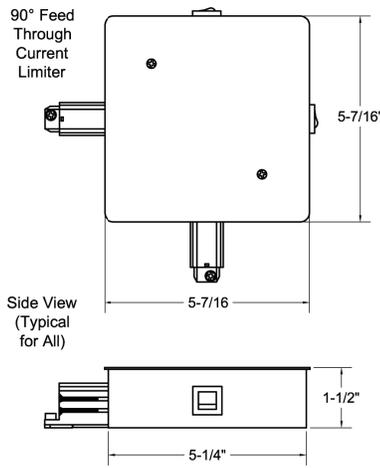
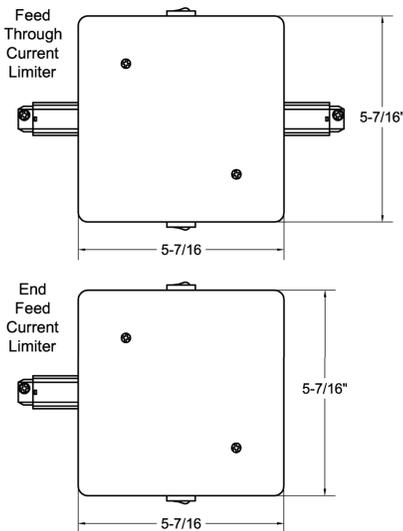
TSC Model Track Current Limiters

Times Square Track Current Limiters are designed to provide an answer to energy limitations on wattage per foot requirements for 120V track installations. Some newer energy codes set a rating of 30 to 70 watts per linear foot of track irrespective of the actual wattage that is meant to be used on the track, unless a current limiting device is permanently installed between the track and the line feeding it. Times Square current limiters are available in over 12 different current ratings.

Available in black, white and silver finishes. Custom colors are available by request and at an additional charge.

Features:

- Available with ratings from 1-10, 12 and 15 Amps (others available as special order)
- Feed only or feed through design (surface mount only)
- Available for use with commercial or specification grade track
- Linear specification grade limiters will fit into recessed track sleeves



Specify:	Model	Track Type	Feed Style	Color	1st Ckt ^a	2nd Ckt ^a (if req'd)	Notes:				
	TSC	<input type="text"/>									
	L	Comm Grade 1 Ckt	E	End Feed	B	Black	1	1 Amp	1	1 Amp	
	H	Comm Grade 2 Ckt	F	Feed Thru	W	White	2	2 Amp	2	2 Amp	
	U	Spec Grade 1 Ckt	R	Linear *	S	Silver	3	3 Amp	3	3 Amp	
	T	Spec Grade 2 Ckt	N	90° Feed Thru	C	Custom	etc	**	etc	**	

* Not available in 1-circuit specification grade
 ** Also available as standard: 4-10, 12 and 15. Other ratings available as special order - consult factory
^a Use the table below to assist in determining Circuit Rating

Desired Wattage	Ckt Rating (Amps)
120	1
240	2
360	3
480	4

Desired Wattage	Ckt Rating (Amps)
600	5
720	6
840	7
960	8

Desired Wattage	Ckt Rating (Amps)
1080	9
1200	10
1440	12
1800	15

Last updated 01/22/2014.



Job Name: Fixture Type: Qty:

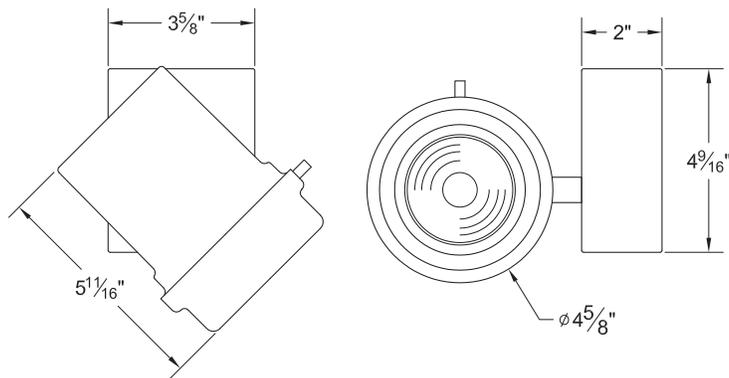
LED Series by Times Square Lighting



XT13 13W, 1300 Lumen LED

The XT13 is designed around the Xicato™ LED remote phosphor module. This module produces an even field of illumination for the most demanding applications. The XT13 is ideal for museum and retail lighting where a low wattage, high output LED fixture would be required. Xicato™ LEDs exceed ANSI specifications by maintaining tight color consistency over the life of the LED module.

The XT13 is available in standard black, white, or silver finishes. Custom colors are available upon request.



Manufactured in the USA - IBEW



LED

- Xicato™ cold remote phosphor LED module
- Color temp options: 2700K, 3000K, 3500K, 4000K
- CRI: 83 standard or 98 optional (R9=96)
- Lumen maintenance: 86% of initial lumen output at 50,000 hours on LM-80 testing
- SDCM: 1 x 2 MacAdam Ellipse. 50 kelvin tolerance
- No UV or IR

Module	Total Wattage	Delivered Lumen	Efficacy (Lm/W)	CRI
83	13	1235	95	83
98	17	1235	67	98

* Total wattage equals LED plus driver. Delivered lumen may vary depending on LED module, color temperature, optics, and accessories.

Dimming

- Trailing edge (ELV): 120-277V
- Leading edge (Triac): 120V only
- 0-10V: 120-277V with surface mounting. For track applications, use E-series 2-circuit with data bus (120V only)
- IP (Integral dimmer): 120-277V

Ordering Matrix

Model	LED Module	Color Temp	Finish	Voltage	Optics	Mounting	Dimming*	Accessories
XT13	83	27 = 2700K	B = Black	100	20 = 20°	See Mounting Options	TE = Trailing Edge LE = Leading Edge 010 = 0-10V IP = Integral Pot ND = Non-Dimming	See Accessory Options
	98	30 = 3000K	W = White	120	40 = 40°			
		35 = 3500K	S = Silver	240	60 = 60°			
		40 = 4000K	CC = Custom Color	277				

Maximum ambient temperature: 35°C
Maximum operating angle: 45° from vertical

* See "Notes on Dimming" on reverse



IP-100

View your weather data
from anywhere in the world



RainWise iPhone and iPad Apps



RainwiseNet™ Online Data Portal

The Rainwise



IP-100
Network Interface



inTouch In-Home Touchscreen Display

A New and Innovative Weather Data Access Solution from RainWise!

The IP-100 facilitates unprecedented transmission and access to real time weather data in multiple formats. Whether connecting online, through our high tech, free standing touchscreen display, or via the RainWise iPhone app, your weather data is available to you any time, any where.

Our new online cloud based data hosting and web portal, **RainwiseNet™**, accepts IP-100 information from your weather stations. RainwiseNet provides real-time and historical data and can be customized for private or public access. Multiple weather stations can be grouped for agricultural or educational programs. Additionally the IP-100 can be integrated to 3rd party solutions via a XML API data interface.

The IP-100 can also feed real-time data to the RainWise **inTouch** free-standing screen display from your local

weather station. The **inTouch** 7" display offers vivid color touch screen technology and has easy to read graphs that cover the last 48 hours for all weather parameters, including wind speed and direction. This display device is also capable of being a digital photo-frame and can stream 1000's of movies (including Netflix), videos and music. Many more free apps are available.

The IP-100 delivers instant mobile real-time weather data to you via your **iPhone**, **iPod Touch** and **iPad** RainWise apps, all available through Apple iTunes. When in range of your IP-100 residential wireless network, these devices provide automatically enabled data detection. Customize your screen view with our new, high tech design - or use our traditional RainWise Weather Oracle screen display. Either way you'll have all your weather data right at your fingertips!



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(800) 762-5723

Rainwise Website: www.rainwise.com
Online Data: www.rainwise.net

MKIII-LR Weather Station

The MKIII-LR is a wireless, solar-powered weather station providing the best accuracy of any consumer weather station on the market. This compact, rugged and elegantly designed unit comes fully assembled providing quick and easy installation.

Known for our accurate and reliable sensor assembly, the MKIII-LR has several groundbreaking features including:

- 1) Transmission range of up to one mile (when positioned with an unobstructed line-of-site view to the receiver) that surpasses the current long-range distance of 1000 feet.
- 2) Rapid data refresh rate of every 2 seconds makes receiving your data virtually real-time.
- 3) This unit is available with the option of including our tipping bucket rain gauge - the tipping bucket design was originally developed by RainWise in 1974 and has become the industry standard for rain gauges!
- 4) Our unique aervane design: others use 3-cup anemometers that are susceptible to collecting water that can cause freezing and breaking, leading to repeated down time and ongoing expensive replacements. Our trademark rotary blade design eliminates this concern. In addition our design utilizes an internal, contact-free magnetic system that provides constant horizontal wind tracking, leaving no mechanical parts to wear out over time and require replacement. Finally, our aervane is crafted in such a way as to minimize crevices in the body that would be susceptible to ice build-up causing downtime and breakage.

The MKIII-LR's lightweight and compact design makes installation quick and easy. Various mounting options are available including the RainWise Mono Mount. The MKIII-LR is supplied with a detachable mast section that can be secured to an existing structure.

Features

- Temperature Sensor
- Humidity Sensor
- Wind Speed sensor
- Wind Direction Sensor
- Barometer
- Adjustable Solar Panel
- 1 mile line-of-site transmission
- Optional Rain Gauge
- Optional Solar Radiation
- Optional UV Index
- 2-Year Warranty
- Easy to install
- Solid Construction
- 100% Made in the USA





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Analog Flow Meters Specifications:

These flow meters are designed to monitor water use, boilers, domestic hot water, solar hot water systems (water and glycol), and heat pumps. Flow meters come with integrated temperature sensors, which can be used for calculating BTUs. Select the appropriate model based on anticipated flow rates. These analog flow meters can be used with the eMonitor Gateway and the PowerWise inDAC (Data Acquisition Controller).



Hardware Specifications

Flow ranges: 1-12, 1.3-20, 2-40, 5-100, 10-200 and 20-400 l/min.
 Based on vortex shedding
 Voltage output (ratiometric, ideal for use with microprocessor and PLC)
 Compact and robust design
 Approved for potable water: WRAS, KTW, W270, ACS

Benefits

No moving parts
 Flow and temperature sensor in one package
 Fast temperature response (direct media contact)
 Compatible with wet, aggressive media
 Cost-effective and robust construction

Power Supply Requirements

5 VDC
 separated from hazardous live circuitry by double or reinforced insulation
 power limitation: 150 VA; current limitation: 8 A.



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CO2 Multi Sensor Specifications:

This intelligent sensor was designed to monitor temperature, relative humidity, and CO₂. The ICO₂ sensor uses Non Dispersive Infrared (NDIR) technology to measure CO₂ levels from 400 to 2000 ppm. The CO₂ Multi Sensor is 1-Wire compatible and is designed for use with the eMonitor Gateway, the Sensor Hub, and the PowerWise inDAC (data acquisition controller).



Hardware Specifications

Power Specification:

The power supply is reverse voltage, overvoltage, and short circuit protected.

Input Voltage Range:	7-26VDC
Current Consumption:	< 35mA

Operating Environment:

Temperature:	0°C to 50°C
Humidity:	5-95% Non-Condensing

Exterior Dimensions:

Enclosure:	3.1" x 3.1" x 1.25"
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Sensor Specifications

Ambient Air Temperature:

Range:	-55°C to 125°C
Accuracy:	+/- 0.5°C at 25°C
Resolution:	0.0625°C

Relative Humidity:

Range:	0 to 100%
Accuracy:	+/-3% at 25°C and 50% RH

CO₂:

Range:	400 to 2000 ppm
Accuracy:	500ppm +/-35ppm
	800ppm +/-60 ppm
	1000ppm +/-75 ppm
	1200ppm +/-90ppm

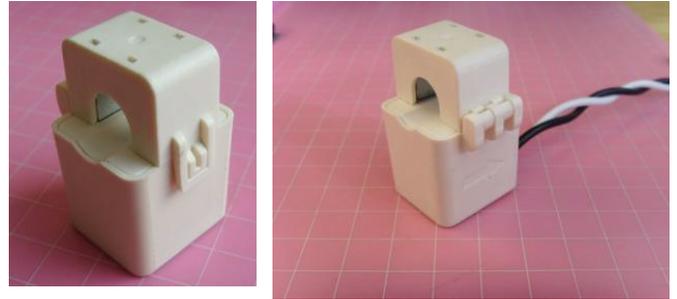
Miniature Split Core Current Transformer

The **CTSA010 r3.0** Series of low cost miniature split-core current transformers are designed for fast and easy installation. The split-core design permits non-contact current measurements through magnetic field induction without requiring that the primary wire be taken offline and disconnected for CT installation. This method permits a safer, easier and portable current measurement.

The relatively small physical size accommodates applications where the installation of the CT will be in physically small spaces.

Miniature split-core current transformers models:

- CTSA010 Series – 10.2mm (0.40”) opening
- CTSA016 Series – 16.2mm (0.64”) opening
- CTSA024 Series – 24.2mm (0.95”) opening



Features:

- Rated Primary: 5A, 10A, 15A, 20A, 30A, 50A or 75A
- Output: 0.333V at rated current (Optional: mA secondary output).

Specifications:

- Frequency: 50 to 400Hz.
- Maximum operating voltage: 720VAC.
- Dielectric withstand voltage: 2,500V for 1 minute.
- Dielectric resistance: 100 MOhms @ 500 VDC
- Operating Temperature: -15°C to +60°C.
- Construction:
 - Ferrite core material.
 - Epoxy encapsulated housing.
 - Case material – Nylon, UL flame retardant rating 94 V-0.

- Leads: 0.61m (2Ft), AWM 1015, Twisted Pair, 0.34mm² (22AWG), 600V.
- Lead termination: Stripped and tinned.
- ETL Certified (Control Number 4002689)



- RoHS compliant.



Performance:

- Accuracy Class: 0.5, 1.0 (IEC 60044-1)
- Accuracy: < 1%
- Phase Angle: < 120 minutes
- Linearity: ±1% from 5% to 130% of rated primary current.



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eMonitor Specification:



The eMonitor provides circuit-level monitoring for single phase and 3-phase electricity. This device provides minute-by-minute electricity data, as well as overall electricity use. The software service provides costs, projected costs, kilowatt use, equipment analytics, safety and use alerts, smart thermostat support, and integration with numerous sensors.

Hardware Specifications

eMonitor

Power Specification: Connects to 120V/15A breaker or to optional step down transformer for 277V operation	Power Requirements: 120VAC, 60Hz 2.5W
Communication Protocol: eLink Wireless 2.4Ghz connection to eMonitor Gateway RS485 link protocol to Pin eMonitor expansion module (xpod)	Environmental Specifications: LxHxW: 7" x 2.5" x 1.75"; Weight = 4oz xPod: L x H x W: 3.75" x 1.875" x 0.875"; Weight = 2oz Operating Temperature -10 degrees C to +60 degrees C (14 degrees F to 140 degrees F) Humidity 5% to 95% non-condensing

Gateway

eMonitor Gateway (outside of panel): 1x10/100 RJ-45 Ethernet Port 1 x High Speed PJ-14 Serial Port 3 Analog Inputs – wire pair - +/-2V; 3 Digital Input/Output USNAP 2.0 Modular Connector	Power Requirements: 120VAC, 60Hz
Communication Protocol: TC-IP via Ethernet (802.3) 10/100/base-T Wi-Fi/802.11/b/g/n Local via High Speed Serial Port Zigbee (802.15) mesh networking (optional USNAP module)	Environmental Specifications: LxHxW: 5.25" x 3.25" x 1.5"; Weight = 6oz Operating Temperature -10 degrees C to +60 degrees C (14 degrees F to 140 degrees F) Humidity 5% to 95% non-condensing



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inDAC (Data Acquisition Controller) Specifications:

The inDAC is a microcontroller designed for monitoring and controlling building systems. The inDAC features a MODBUS RTU communication protocol for connection to a MODBUS enabled gateway device. Multiple inDAC units can be placed in series via MODBUS to expand analog and digital inputs/outputs for increased monitoring and control.



Digital Inputs:

- (4x) 0-5 V state/contact inputs, sinking
- (4x) 0-1 kHz counter inputs, sinking
- (1x) 1-Wire master. Up to 20 unique sensor ID's.

Analog Inputs:

- (6x) 12 bit, 0-5 VDC

Digital Outputs:

- (4x) 0-5 VDC TTL

Power Requirements:

Power Output: 5VDC @ 300mA, Unregulated 12VDC @ 150mA

Power Input: 5-24VDC @ 2 A

Operating Environment:

Temperature: -40°C to 60°C (-40 to 140°F)

Humidity: 0-95% Non-Condensing

Dimensions:

Length 4.125"

Width 4.375"

Height 2.5"



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inGate Specifications:

The inGate is a commercial-grade Ethernet Gateway for monitoring and controlling building systems.

Performance data from HVAC, hot water, renewable energy, and other systems can be transmitted from this gateway to the internet. Customers can access performance data through online dashboards or locally via the SD card.

This gateway can read data from MODBUS devices, such as solar PV inverters, heating systems, electricity meters, flow meters, pumps, and commercial equipment. When used in conjunction with the inDAC from PowerWise, the inGate can read a variety of sensor data, including temperature, relative humidity, CO₂, VOC, water use, and DC signals. Future versions of the inGate will have support for ZigBee and Z-Wave devices.



Capabilities:

MODBUS RTU
SD Internal Memory
Programmable Embedded Web Server

Power:

Input: 12 VDC
Output: 12/5 VDC

ROHS Compliant

Operating Environment:

Temperature: -40°C to 60°C (-40 to 140°F)
Humidity: 0-95% Non-Condensing

Dimensions:

Length 4.25"
Width 4.25"
Height 2.125"

Low Cost Clamp-on Current Transformers

The LCTC Series of low cost clamp-on style current transformers are designed for fast and easy installation. The clamp-on core design permits non-contact current measurements through magnetic field induction without requiring that the primary wire be taken offline and disconnected for CT installation. This method permits a safer, easier and portable current measurement.

Features:

- Low cost.
- Small size.
- Clamp-on core design provides for safer and easier installation, portable use.
- Core material - Fe Nanocrystalline.

Applications:

The low cost clamp-on current transformer offers the accuracy and minimal phase shift required by current measurement and electric power quality measurement applications.

Specifications:

- Frequency: 50 Hz to 400Hz.
- Maximum Operating Voltage: 600VAC.
- Operating Temperature: -25°C to +70°C.
- Dielectric Resistance: 1,000 M Ohm @ 500 VDC.
- Isolation Voltage: 2,500 V_{RMS} for 1 minute.
- High Potential: 2500 Volts/min.
- Secondary Burden Resistance:
 - Current output: < 10 Ohms
 - Voltage output: ≥ 100K Ohm
- Case material: ABS, UL 94 V-0 rated



- Leads: 22AWG, 600mm (23.6") in length. A 3.5mm straight, mono termination connector can be incorporated.
- RoHS Compliant.



Performance:

- Accuracy Class: 1.0 (IEC 60044-1)
- Phase shift error: ≤ 2° @ 50% of rated current



Amplified Pyranometer

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Specifications

Cosine Response

- 45° zenith angle: $\pm 1\%$
- 75° zenith angle: $\pm 5\%$

Absolute Accuracy

- $\pm 5\%$

Repeatability

- $\pm 1\%$

2.5 V Option

- Output: 0 to 2.5 V (2.2 V = full sunlight 1100 W m^{-2})
- Input Power: 2.5 to 5.5 VDC
- Sensitivity: Custom calibrated to exactly 0.5 W m^{-2} per mV

5.0 V Option

- Output: 0 to 5 V (4.4 V = full sunlight 1100 W m^{-2})
- Input Power: 5 to 5.5 VDC
- Sensitivity: Custom calibrated to exactly 0.25 W m^{-2} per mV

Materials

- Anodized aluminum with cast acrylic lens

Long-Term Drift

- Less than 3% per year

Operating Environment

- -25 to 55 C
- 0 to 100% relative humidity
- Designed for continuous outdoor use
- Can be submerged in water

Current Draw

- 285 μA

Cable

- 5 meters of twisted-pair wire
- Foil shield
- Santoprene jacket
- Ending in pigtail leads
- Additional cable is available in multiples of 5 meters

Dimensions

- 2.4 cm diameter by 2.75 cm height

Mass

- 70 g (with 2 meter lead wire)

Warranty

- 1 year against defects in materials and workmanship



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Sensor Hub Specifications:

This device was designed to be connection interface between the eMonitor Gateway and external sensors. The Sensor Hub provides a clean and protected connection point for the various Intellergy sensors. The hub can accommodate two flow meters and up to 50 1-Wire sensors which is limited by total power consumption listed below.



Hardware Specifications

Power Specification:

The power supply is reverse voltage, overvoltage, and short circuit protected.

Input

Input Voltage Range:	8-14VDC
Maximum Current	unlimited

Output

Input Voltage Range:	Unregulated 8-14VDC
Maximum Sensor Current	350mA

Operating Environment:

Temperature:	-40°C to 60°C (-40 to 140°F)
Humidity:	0-100% Non-Condensing

Exterior Dimensions:

Enclosure:	4" x 2.25" x 1.125"
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