PRIMARY STUDENT CONTACT
Chris Baldwin
chris.baldwin@ontarioSD.ca
Team Ontario, Solar Decathlon
c/o Carleton Student Eng. Society
1125 Colonel By Drive
Carleton University
Ottawa, ON, K1S 5B6

AS-BUILT

August 22, 2013

TEAM ONTARIO
U.S. Department of Energy Solar Decathlon 2013

TABLE OF CONTENTS

01 SUMMARY OF CHANGES

SUMMARY OF CHANGES

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

11.20.2012 REVISION
The Project Manual has been updated from the previous issue. Revisions include:

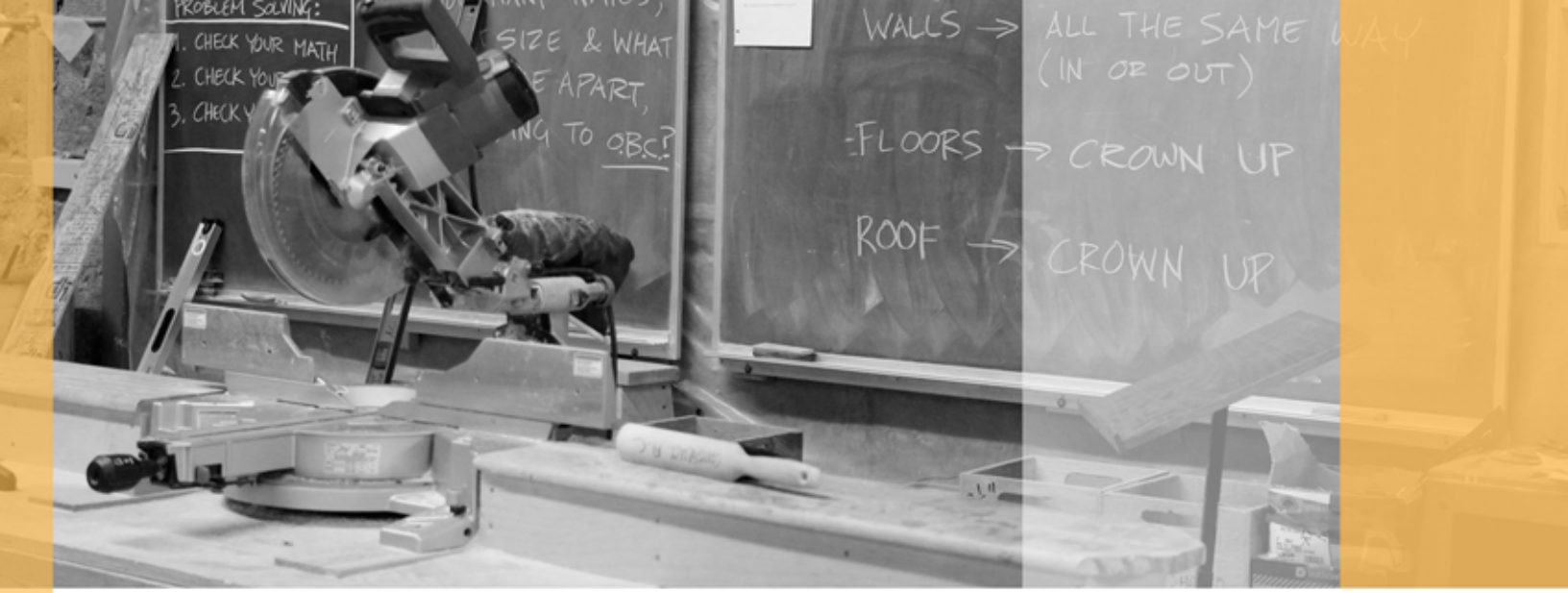
- Updated Rules Compliance Checklist
- Added Section 02 43 13.13 Building Relocation to Construction Specifications

02.14.2013 REVISION
The Project Manual has been updated from the previous issue. Revisions include:

- Updated Construction Specifications
    - Added Section 08 50 00 Windows
    - Added Section 09 29 00 Gypsum Board
    - Added Section 09 30 00 Tiling
    - Added Section 09 90 00 Painting and Coating
    - Added Section 10 28 00 Toilet, Bath, and Laundry Accessories
- Updated Energy Analysis
- Updated Structural Calculations
- Updated Product Data Sheets
- Added Appendix C, Administrative Modification
- Updated Rule Compliance Checklist

08.22.2013 REVISION
The Project Manual has been updated from the previous issue. Revisions include:

- Updated Rules Compliance Checklist
- Updated Structural Calculations
- Updated Detailed Water Budget
- Updated Summary of Reconfigurable Features
- Updated Interconnection Application Form
- Updated Energy Analysis Results and Discussion
- Updated Quantity Takeoff of Competition Prototype
- Updated Construction Specifications
- Updated Administrative Modifications



02 RULES COMPLIANCE CHECKLIST

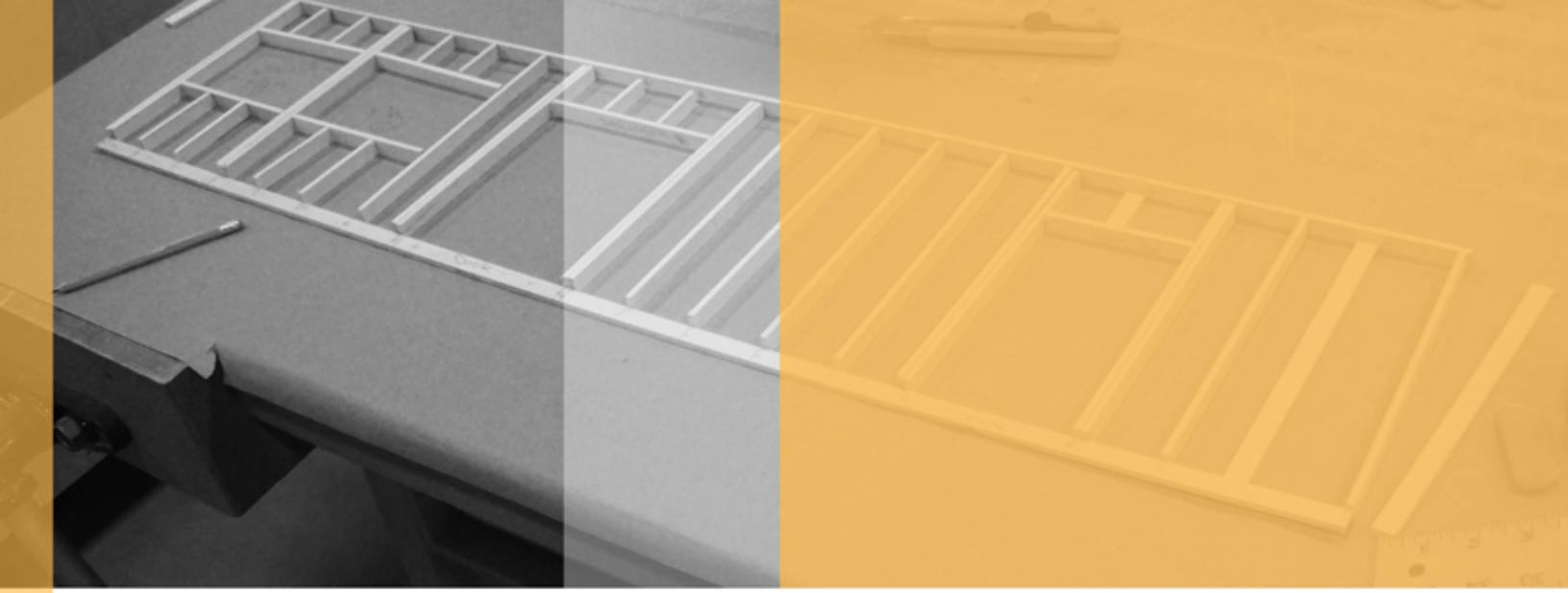
RULES COMPLIANCE CHECKLIST

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	CD: O-101, O-102, O-103, O-104, O-105, O-106
Rule 4-2	Construction Equipment	Specifications for heavy machinery	PM: 02 43 13.13
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	CD: C-101
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	CD: C-101
Rule 4-5	Generators	Specifications for generators (including sound rating)	NA
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
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	PM: 22 05 00, 22 05 13, 22 05 23, 22 13 16, 22 33 00, 23 05 23, 23 21 13, 23 21 23, 23 56 13.13, 23 81 46
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 12 in. (30.48 cm) of vertical elevation change exists	PM: Structural Calculations
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 12 in. (30.48 cm) of vertical elevation change exists on the lot	CD: S-502, S-512, S-521
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	CD: A-101. A-201, A-202
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	PM: Administrative Modification

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	PM: Structural Calculations CD: S-001 through S-901
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	CD: A-111, 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	NA
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	CD: 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	CD: A-101
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	NA
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	CD: E-601
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	NA
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	NA
Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	NA
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	NA
Rule 8-5	Village Grid	Completed interconnection application form	PM: Interconnection Application Form

Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	CD: A-101, A-111, A-201, A-202, A-211, E-101, E-106, E-201, G-103
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	PM: 26 24 16, 26 27 13, 26 31 00, 48 19 19
Rule 8-5	Village Grid	One-line electrical diagram	CD: E-601
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	CD: E-603
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	CD: A-111
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	CD: A-201, A-211
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	CD: P-101, P-102, P-103
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. PDT or between 8 a.m. and 4 p.m. solar time on October 1	CD: P-101, P-102, P-103
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	PM: Detailed Water Budget
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	NA
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	CD: L-101
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	NA
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	NA
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	NA

Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	CD: O-107, O-108
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	PM: Manufacturer's Specifications
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	CD: O-109, O-110
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	PM: Manufacturer's Specifications
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	CD: G-103



03 STRUCTURAL CALCULATIONS

STRUCTURAL CALCULATIONS

Please see Appendix A for structural calculations.

04 DETAILED WATER BUDGET

DETAILED WATER BUDGET

FUNCTION	WATER USE (GALLONS)	CALCULATIONS Gallons	Events	NOTES
Hot Water Draw	240	15	16	16 draws of 15 gallons each
Water Vaporization	6	1	6	Must start the competition with minimum of 6 lbs (0.72 gallons) of water
Dishwasher	20	4	5	Based on a 4 gallon cycle for 5 events
Clothes Washer	96	12	8	Based on a 12 gallon cycle for 8 events
Dinner Party	14	7	2	Based on a 7 gallon requirement for 2 events
Movie Night	5	5	1	Based on a 5 gallon requirement for 1 event
Vegetation	75	5	15	5 gallons per day for 15 days
Fire Protection	294	294	1	2 sprinklers running at 21 gpm each for 7 minutes
Testing	50	50	1	Estimate
Initial Systems Fill	250	250	1	120 gallon tank and 45 gallon for pipe bleed and fill
Water Feature Fill	254	254	1	1 fill of the exterior water feature on the West end of the house
Subtotal	**1304**			
Safety Factor	**196**			15% of subtotal
Water Required	**1500**			

05 SUMMARY OF UNLISTED ELECTRICAL COMPONENTS

SUMMARY OF UNLISTED ELECTRICAL COMPONENTS

All electrical components in Team Ontario's Solar Decathlon 2013 house, ECHO, carry an approved testing agency's listing per Section 6-7 of the SD2013 Building Code.

06 SUMMARY OF RECONFIGURABLE FEATURES

SUMMARY OF RECONFIGURABLE FEATURES

ECHO is equipped with several reconfigurable features.

The reconfigurable features within ECHO include the following:

- Dining Room Table
- Multi-Use Room Configurable Bed/Desk
- Master Bedroom Configurable Bed/Sofa
- Retractable Clothes Line
- Window Shading System
- Interchangeable Heat Recovery Ventilator (HRV) and Energy Recovery Ventilator(ERV)

DEMONSTRATION OF RECONFIGURABLE FEATURES FOR JURY

Dining Room Table
The dining room table can be extended to seat extra guests when needed. Feature can be seen on drawing A-401.

Multi-Use Room Configurable Bed/Sofa
The bed unit changes from a bed to a functional sofa. The operation of this will be demonstrated during the jury walk through. The location of the bed can be seen in drawings A-405. The configurations of the bed can be seen on in the Construction Document drawings on page A-406.

Master Bedroom Configurable Bed/Sofa
The bed will fold up to a sofa. The bed will be in the down position during the walk-through. Details for this component can be reviewed in the Construction Document drawings on page A-405.

Retractable Clothes Line
There is a retractable clothes line that spans the middle opening of the exostructure. Details for this component can be reviewed in the Construction Document drawings on page A-401.

Window Shading System
ECHO incorporates an exterior predictive window shading system that will close when necessary to properly block unwanted solar thermal gains in the home. Since this system is automated it is not feasible to fully demonstrate live to each juror or visitor to the home. Details for this component can be reviewed in the Construction Document drawings on page A-212, drawing A1.

Interchangeable HRV/ERV
ECHO incorporates an interchangeable HRV/ERV to allow for the investigation for frost migration strategies. A more detailed description of the system can be seen in the Energy Analysis section 07 HVAC Modeling. During the competition the ERV will be used to condition ventilation air. Although the heat exchange core will likely not be swapped during the competition, the feature will be displayed and discussed during the pedestrian walk through and the Juried walkthrough.

07 INTERCONNECTION APPLICATION FORM

INTERCONNECTION APPLICATION FORM

Team Ontario – Lot 120

PV SYSTEM

MODULE MANUFACTURER	SHORT DESCRIPTION OF ARRY	DC RATING OF ARRAY (kW)
Eclipsall Energy	30 x 260W NRG60M PV modules. Each module is connected to a microinverter.	7.8

Total DC power of all arrays is 7.8 kW (in tenths)

INVERTERS

INVERTER MANUFACTURER	MODEL NUMBER	VOLTAGE (V)	RATING (kW)	QUANTITY
SPARQ Systems	S215NA2240	240	0.215	30

Total AC power of all inverters is 7 kW (in whole numbers)

REQUIRED INFORMATION

	LOCATION
One-line electrical schematic	E-601
Calculations of service/feeder net computed load and neutral load (NEC 220)	E-603
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	G-103

08 ENERGY ANALYSIS

RESULTS AND DISCUSSION

ENERGY ANALYSIS RESULTS AND DISCUSSION: OVERVIEW

LIST OF FIGURES

LIST OF TABLES

01 INTRODUCTION

Energy analysis and simulation is an integral component of high performance building design. Opportunities to reduce energy consumption and increase energy production potential were considered from the initial concept stage through to design development. Results from these analyses helped inform the design and construction of ECHO, enabling the creation of a net-positive home – a home that produces more energy than it consumes on an annual basis.

The design goal of ECHO is to create a home that is appropriate for the climate and lifestyle of young, sustainably-minded families in Ontario. Ottawa and Kingston experience cold, dark, snowy winters and moderate-to-hot summers with high humidity. **Table 1** compares the space-conditioning degree-days for Kingston, Ottawa, and Irvine, based on a five-year average from 2008 to 2012 (DegreeDays.net):

Table 1. *Heating and cooling degree-days for Kingston, Ottawa, and Irvine*

	Kingston	Ottawa	Irvine
Heating degree-days (65°F base)	7039	7859	1527
Cooling degree-days (65°F base)	540	601	1056

ECHO`s systems are optimized for Ontario`s heating-dominated climate. This approach requires significant south-facing glazing to maximize solar gains, high levels of insulation, and a simple shape with few joints between modules to reduce air infiltration. Ventilation for indoor air quality is controlled through a mechanical system with heat recovery. In keeping with the target demographic of a young family interested in sustainable living, the expected number of occupants is 2-3.

Despite the emphasis on high performance in Ontario, ECHO will have to perform well during the competition, which will be dominated by cooling conditions. This poses particular challenges for a house designed for a heating-dominated climate, and will require careful management to prevent overheating and excessive electrical consumption during the competition.

A brief explanation of the Team's approach to energy analysis is presented in the next section. This is followed in Section 3 by an introduction to the various software tools used by the team and the weather file inputs. Sections 4, 5, and 6 outline the method and results for whole building simulation, predictive shading, and the mechanical systems, respectively. The energy analysis concludes in Section 7 with annual and competition energy balances, including photovoltaic electrical production.

02 APPROACH TO ENERGY ANALYSIS

Team Ontario made extensive use of energy modeling to support the integrated design process, which is an iterative process that requires models to be continually updated as new information becomes available. The results of energy analysis activities were communicated to the entire team to provide an understanding of the implications of different design decisions. This iterative approach is shown visually in **Figure 1**.

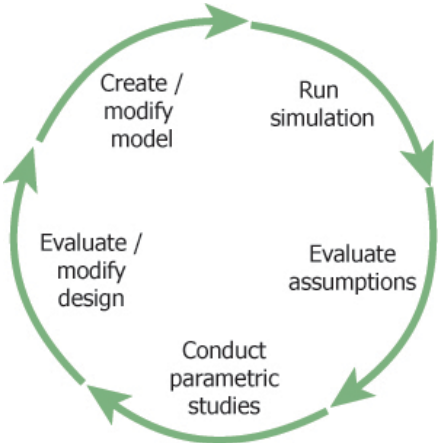


***Figure 1**: The iterative design process*

'Traditional' building design only incorporates energy simulation after many features have already been determined, if at all. In high performance building design, however, energy simulation should be utilized as early as possible to help make informed decisions [2]. Team Ontario used energy simulation at a very early stage in the design process, making assumptions when detailed information was not available.

Through the iterative design process, models were continually updated as more information became available and the design evolved. The timeline for this process is shown in **Figure 2,** for whole-building simulation modeling. A similar approach was used for modeling of other energy systems, such as solar thermal systems.

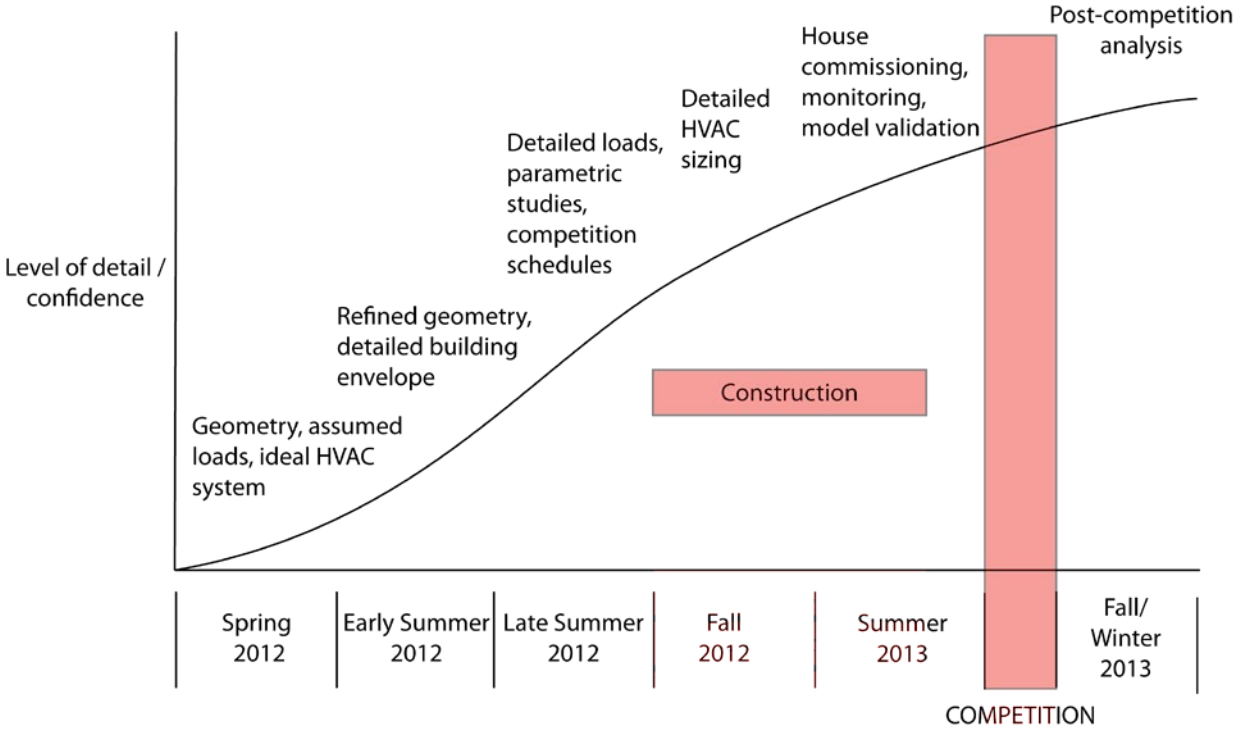


Figure 2. *Building simulation timeline*

As shown in **Figure 2**, preliminary results were available at an early stage. This helped quantify the relative impact of different design decisions – even if model performance was not necessarily indicative of the actual performance of ECHO, once constructed. More detailed models supported the design development stage of the project, when specific component properties were determined. The commissioning process, during which actual performance was compared to simulation results, informed the control strategy and helped validate modeling results. Post-competition analysis, including a 'lessons learned' exercise, will conclude the modeling process.

Energy modeling is a complex and non-linear science, and an understanding of the underlying physics is essential to proper interpretation of results. Therefore, energy analyses were supported by 'hand calculations' where possible, using heat transfer and energy conservation equations. Multiple simulation tools were used to model the same system and the results were compared. Input from faculty advisors and benchmarking with known examples of high performance houses further increased confidence that results are reasonable.

03 MODELING SOFTWARE & WEATHER DATA

The use of software tools to model and predict the performance of ECHO was critical to the success of the project. It is well-established by rating systems such as Leadership in Energy and Environmental Design (LEED) that energy analysis software is a major component in the design of high performance buildings [3]. This becomes especially important when considering the use of atypical systems – for example, when specifying building envelope insulation values much higher than is usually seen in Canadian housing. Use of these tools is often not a trivial exercise and requires considerable practice; one benefit of the Solar Decathlon project is the training and capacity-building conducted by Team Ontario to help prepare the next generation of sustainable design experts.

The following is a list of related modeling tools used by Team Ontario, with a brief description:

- *REVIT 2012* – a powerful, industry-standard Building Information Modeling (BIM) software. It enabled collaborative work among the architecture team and provided a central repository for information about the house geometry.

- *Google Sketch-up 8* – a free, easy-to-use 3D modeling software. Using the *Openstudio* plug-in, house geometry was easily incorporated into the EnergyPlus and TRNSYS models. This allowed the energy impact of architectural changes to be quickly evaluated.

- *EnergyPlus 7.1.0* – a whole-building energy analysis tool. EnergyPlus is an attractive tool in that it is free to download and use, is well-documented, has a large user base, and can be used to model buildings to a relatively arbitrary level of complexity. This allowed the design team to model a building at an early stage of development, when many details were still unknown. This program was used to determine appropriate geometry and building envelope parameters and to refine the internal gain schedules.

- *TRNSYS 17* – 'Transient Systems Simulation' is a powerful energy simulation tool. It uses built-in subroutines to model the transient operation of a wide variety of energy system components, such as solar thermal collectors, thermal storage and heat pumps, and PV panels. It provides a flexible modeling environment and gives the user a high level of control over system parameters. *TRNBuild,* a TRNSYS plug-in, was also used to create whole-building simulation models that communicate directly with the TRNSYS mechanical system models.

- *Microsoft Excel 2010* – the use of spreadsheet software was critical to evaluate simulation results, create graphs and charts, and communicate results to the entire team. In particular, energy analysis templates using pivot tables enabled sensitivity studies to be evaluated quickly and in a standardized manner.

- *PVWatts Version 2* – a web-based photovoltaic performance calculator, used to appropriately size the PV array based on house energy requirements.

- *LBNL WINDOW 6.3* – this tool was used to investigate the performance parameters of different windows. It was used to help ensure accurate inputs to the building simulation models and to compare characteristics of different window options.

- *THERM 6.3* – a finite-difference software program used to model the two-dimensional thermal performance of building envelope components.

- *MATLAB R2012B* – a high level numerical engine that uses technical programming language to analyze data, compute algorithms, and create models and applications. It was particularly useful for control system design and analysis, and system optimization.

Most energy simulation requires the use of representative or typical weather data. For simulations with TRNSYS and EnergyPlus, a Typical Meteorological Year 2 (TMY2) dataset was used. The competition dataset was the Santa Ana – John Wayne Airport site. The airport is about 7.5 miles (15 kilometers) from the competition site in Irvine, California, and is thus assumed to be indicative of weather conditions experienced at the site. For annual performance modeling in Ontario, Ottawa was chosen over Kingston to add a conservative bias to energy analysis. As per **Table 1**, the climate is slightly more extreme in the former, which likely results in greater heating, ventilation, and air conditioning (HVAC) loads. The climatic difference can be attributed to the moderating effect of Lake Ontario on the Kingston area.

TMYs are created from analyzing several decades' worth of weather information. Hourly weather data for each month are compared to the long-term averages, and the month that most closely resembles those averages – weighted heavily towards solar radiation and dry bulb temperature – is chosen. Twelve months chosen in this manner are then concatenated to form a dataset for a full year of hourly weather variables [4]. The simulation programs interpolate when using sub-hourly timesteps.

To support an 'apples-to-apples' comparison of results from TRNSYS and EnergyPlus, the same weather file was used for each program. For use in EnergyPlus, the TMY file was first processed to ensure the correct format, using a conversion utility that accompanies the program.

04 WHOLE-BUILDING MODELING

Whole-building simulation models were developed in EnergyPlus and TRNSYS to determine dynamic space conditioning loads. The models were used to investigate the impact on loads of different design options, such as the wall construction, window type, or internal gain levels. The space conditioning loads were also used as inputs to mechanical system design, as discussed in Section 6.

Initial modeling work for the building design was conducted in EnergyPlus. Output loads were used as inputs to the TRNSYS models. For some iterations of EnergyPlus modeling, a representative building was constructed in the TRNSYS simulation environment and the results compared, to gain greater comfort in the accuracy of the EnergyPlus model. Later in the design process, the TRNSYS building model was directly coupled to the mechanical systems model.

A distinction is made between annual performance in an Ontario climate and performance specifically during the competition. Annual schedules (e.g. occupancy, lighting) are based on assumptions of generic behavior, while competition performance was modeled based on situations that will actually be experienced during the Solar Decathlon – such as occupancy during specific events and the timing of appliance operation.

Users of TMY files are cautioned against interpreting results for specific days or weeks, as the variability of short-term weather is significantly greater than long-term averages [4]; thus system performance results are expected to have a greater potential error for the competition simulation than for the annual simulation.

INTERNAL GAINS AND LOSSES

Internal gains consist of heat and moisture additions to the house and tend to reduce HVAC loads in the heating season and increase HVAC loads in the cooling season. Sources of internal gains include:

- Occupants
- Lights
- Appliances
- Miscellaneous electronics

Additionally, air infiltration through cracks in the building envelope plays a significant role in building loads. A relatively air-tight construction was assumed; blower-door testing after construction can validate this assumption for as-built simulation models.

There are two main variables to consider with internal gains: the magnitude of the gain and the schedule. At the early stages of design, ‘indicative’ values were determined through a literature review [5] [6]. These values are shown in **Table 2**.

Table 2. *Base model annual plug-related load*

Source	Electrical Power		Heat Gain[1]		Annual Energy Use (kWh)	Notes
	Btu/hr	W	Btu/hr	W		
Lights	1706	500	1706	500	886	~5 W/m^2
Oven/Range	8670	2541	8760	2541	528	Latent fraction: 0.3
Dishwasher	1686	494	1266	371	155	Latent fraction: 0.15
Dryer	10148	2974	2030	595	472	Latent fraction: 0.05
Fridge/Freezer	143	42	143	42	368	Always on Latent fraction: 0
Washing Machine	1617	474	1293	379	75	Latent fraction: 0
TV	925	271	925	271	182	Fraction lost: 0 Latent fraction: 0.1
Misc. Appliances	1283	376	1283	376	1563	Includes monitoring and control equipment Latent fraction: 0.1

The schedule refers to the time and day in which the gains are present. As appliance and lighting use in houses is primarily a function of occupant-specific variables, such as occupant behavior and demographic conditions [7], it is difficult to say, *a priori,* that one specific schedule is more accurate than another.

Therefore, a 'keep it simple' approach to scheduling was taken, where appliance use remains constant throughout the year – e.g., the washing machine is used at the same times every week. To represent Team Ontario's holistic approach to sustainability, it is assumed that the occupants are energy-conscious and seek to minimize wasteful energy use, such as leaving lights on when they are not home. This approach is supported by innovations such as the mobile application, which allows users to control the house remotely, and the predictive shading system, which automates the use of window shades to reduce unwanted solar gain.

Other gains and losses include, on an annual basis:

- People: 2 people absent from 9:00 AM - 6:00 PM every day. 341 Btu/h (100 W) per person, 60% sensible.
- Air ventilation rate of 59 cfm (28 L/s) as per the requirements of ASHRAE 62.2. An HRV with an overall effectiveness of 75% was assumed.
- Infiltration: 'constant' infiltration set to 0.85 air changes per hour, or ~14.8 – 17 cfm (~7-8 L/s)[2].

[1] Some appliances do not convert their entire electric load into heat gain, as they vent or drain to the outdoors.

PARAMETRIC STUDIES

A parametric study, also referred to as a sensitivity analysis, involves conducting a series of simulations while changing one input variable at a time, to observe the change in output that can be attributable to the chosen variable. To determine limits of performance, the parameter in question is set to either 0 or a very high value. In other cases it is used to determine the point at which diminishing returns set in – for example by incremental increases in the thermal resistance of the walls.

These studies were conducted at various stages of model development. The final models were developed in steps, or iterations, with each iteration adding more detail and accuracy. Iteration details for the building model are shown in **Table 3**.

Table 3. *List of building model iterations*

Iteration #	Notes
1	Simple Geometry
2	Added Exostructure
3	Added Ventilation & Infiltration
4	Added Internal Gains and Lighting
5	Added Shading Schedules and Setpoints
6	Added ERV and Economizer Bypass
7	Added Humidity Controls and Refined Geometry
X	*To be developed after commissioning/competition*

Early building models utilized an 'ideal' space conditioning system, which precisely matched the load without consideration for how the system moved heat. Later models utilized more realistic HVAC components to better-understand system efficiencies and transient effects.

The following parametric study results refer to the latest model iteration as noted in the above table, unless otherwise noted.

[2] Infiltration was set to constant in the building model but varies slightly throughout the yearly simulation

Building Envelope

Building envelope parametric studies primarily involve modifying the thermal resistance of the walls, roof, and ceilings. The impact on heating and cooling loads, expressed as a percentage deviation from a base case in Ottawa, is shown in **Figure 3**, **Figure 4**, and **Figure 5**. The base case model thermal resistance was R-50, R-60, and R-50 for the roof, walls, and floor, respectively.

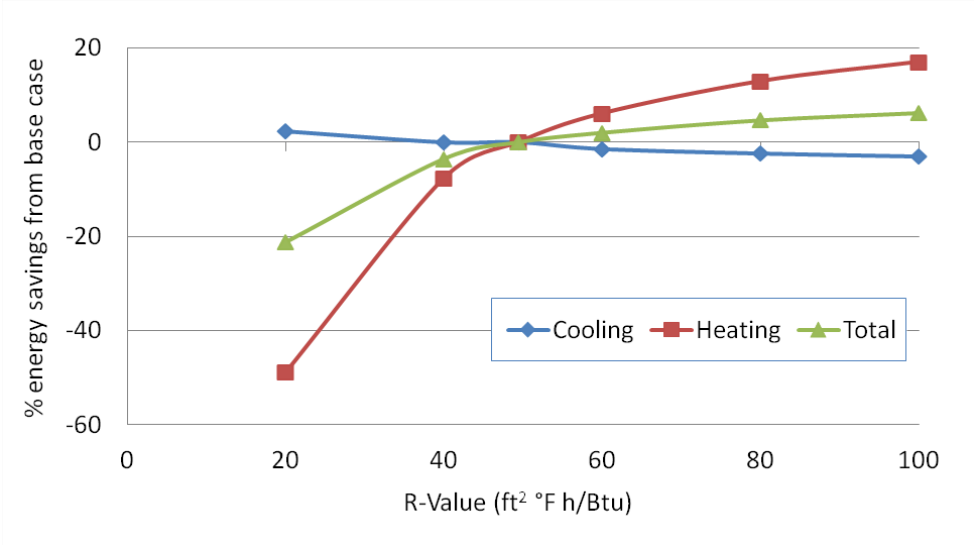


Figure 3. *Effect of changing roof thermal resistance*

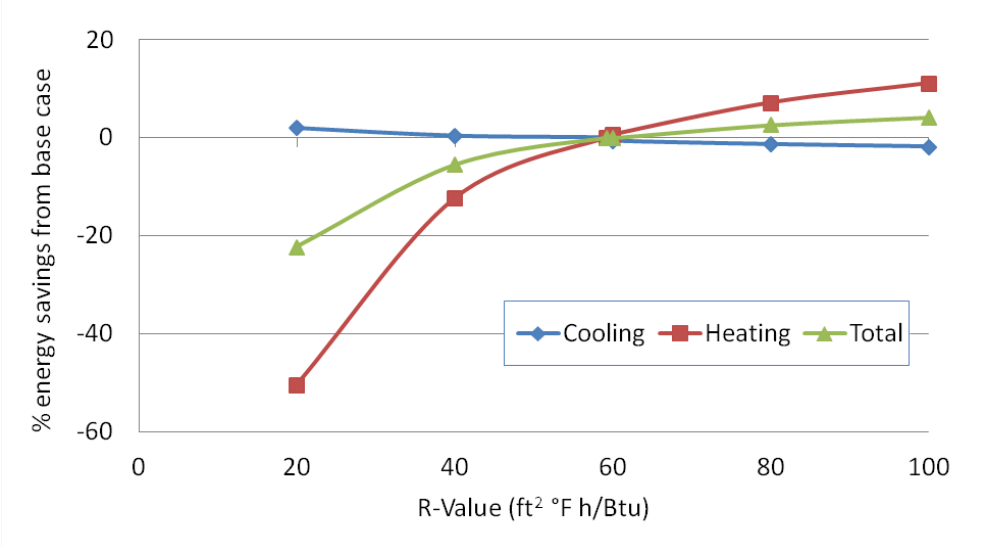


Figure 4. *Effect of changing wall thermal resistance*

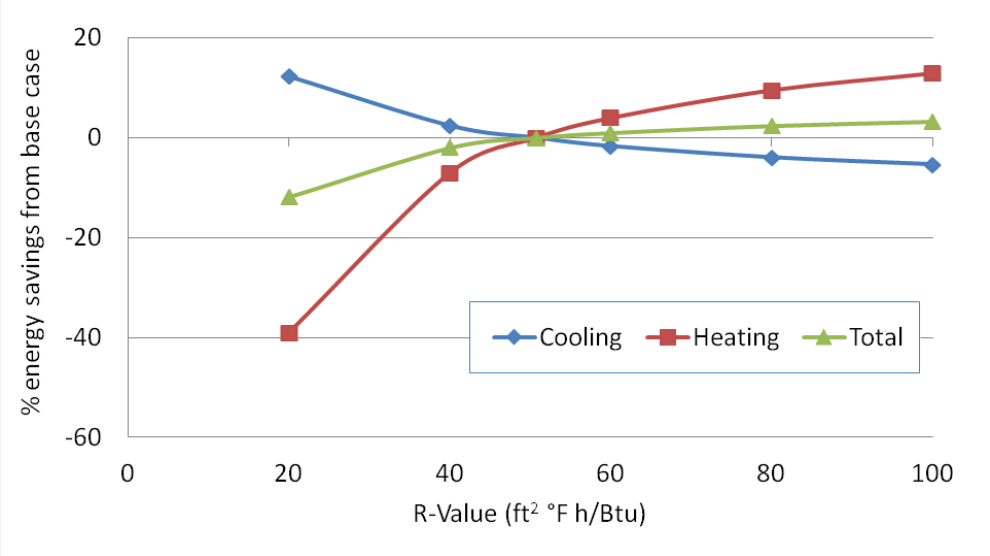


Figure 5. *Effect of changing floor thermal resistance*

In the preceding three cases, a recurring trend in HVAC loads is observed when varying the thermal resistivity of the building envelope. Increasing the R-value of envelope components decreased the heating load and increased the cooling load. In Ottawa, this has the effect of increasing the overall energy savings of the house, but could contribute to overheating issues during the competition.

This trend is not linear, as further increasing the R-value from the base case gives increasingly diminishing returns. Hence, the floor and roof in ECHO are designed to achieve an R-value of 50, and the walls an R-value of 60.

Interior Thermal Mass

The use of materials with a high heat capacity can 'smooth out' fluctuations in temperature and significantly reduce space conditioning loads. This concept has been used throughout human history, such as in adobe buildings (Kennedy, An overview of natural building techniques). Often in North America this refers to the use of concrete as a building material. This approach was rejected by Team Ontario due to concerns with weight and cracking during shipping, potential additional complications during the construction process, and environmental concerns over the concrete manufacturing process.

A more moderate approach using high thermal mass interior finishes was considered – specifically for the kitchen floor tiles on the south side of the house. However, modeling indicated that changing this material had essentially no impact on loads. Furthermore, this approach is very sensitive to occupant behavior, such as location a table or an area rug over the floor material in question. Therefore the use of thermal mass as an energy feature was not used as a principle design consideration, and the choice of interior finishes was primarily driven by considerations of interior design and environmental sustainability.

Exostructure

One of the most distinct exterior features of ECHO is the exostructure shown in **Figure 6**, which provides a racking surface for the PV and solar thermal systems, acts as an overhang for passive shading purposes, and provides additional architectural elements to the house façade.

Figure 6. *South facade of ECHO*

The base height and horizontal distance of the exostructure from the south wall were varied to explore the impact on loads. From the base height of 10.2 ft (3.1 m), the impact of varying height is shown in **Figure 7**; as expected, increasing the height reduces the amount of shading on the windows throughout the year, resulting in a slightly lower heating load and a slightly higher cooling load.

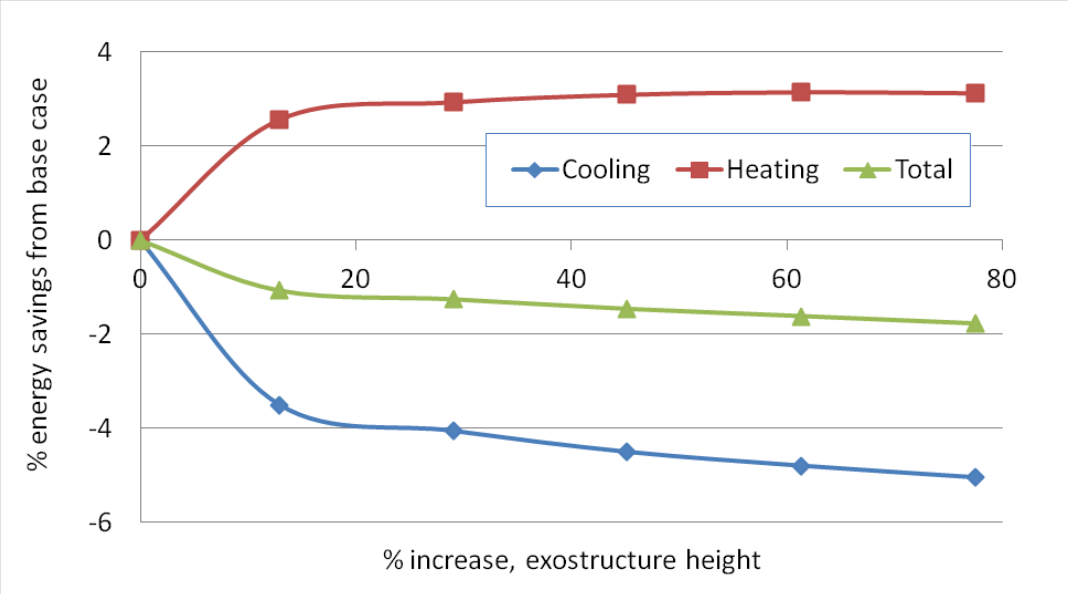


Figure 7. *Effect of varying exostructure height*

The positioning of the exostructure relative to the building was also investigated. The horizontal distance from the south wall was varied from a base 8.2 ft (2.5 m). Changing the distance to between 1.6 ft (0.5 m) and 13.1 ft (4 m) from the south wall indicated no appreciable impact on building loads.

Windows

Window parametric studies included modifying the solar heat gain coefficient (SHGC) and U-factor. The base model parameters were 0.579 and 0.143 Btu/hr-sf-°F (0.812 W/(m^2-K)), respectively. Parametric studies indicated that increasing the SHGC and U-factor would decrease heating loads. The impact on cooling was inconclusive.

Infiltration Rate

The initial air infiltration rate was set to 0.85 ACH. As demonstrated in **Figure 8**, an increased air infiltration rate significantly increases heating loads. This unsurprising result reinforces the need to construct as tight an envelope as possible, and to follow construction with a blower-door test.

An increased infiltration rate also modestly reduces cooling loads. This result highlights a potential for free-cooling under certain conditions by increasing ventilation rates.

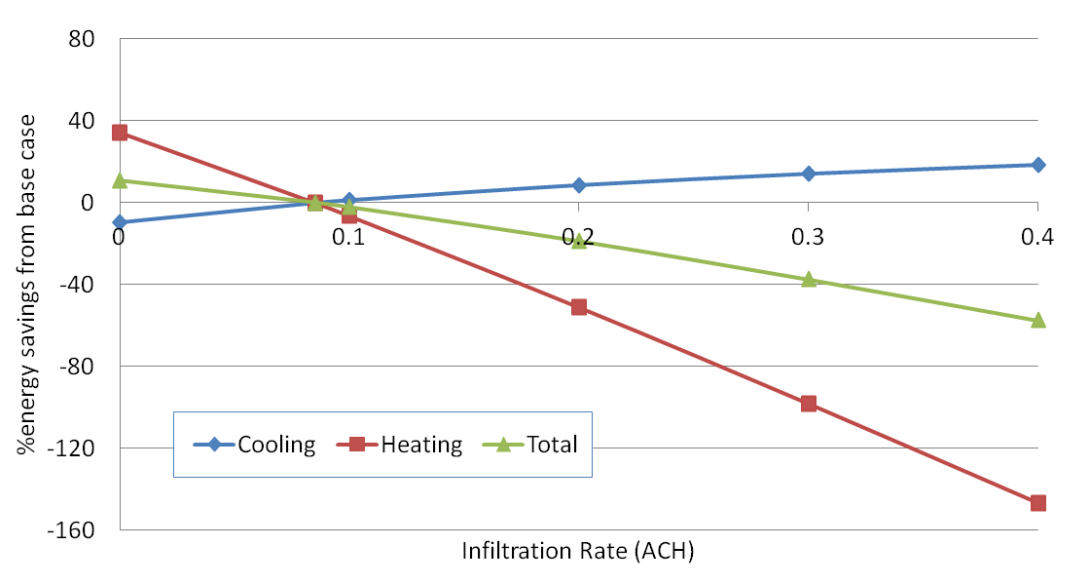


***Figure 8**. Effect of varying air infiltration rate*

MODEL COMPARISON

Although the majority of sensitivity analysis was conducted on the EnergyPlus models, representative models were also constructed in the TRNBuild plug-in for TRNSYS 17. These models were created to provide a basis for comparison, potentially increasing confidence in model results. A comparison of the ideal heating and cooling loads for the models are shown in **Figure 9** and **Figure 10**.

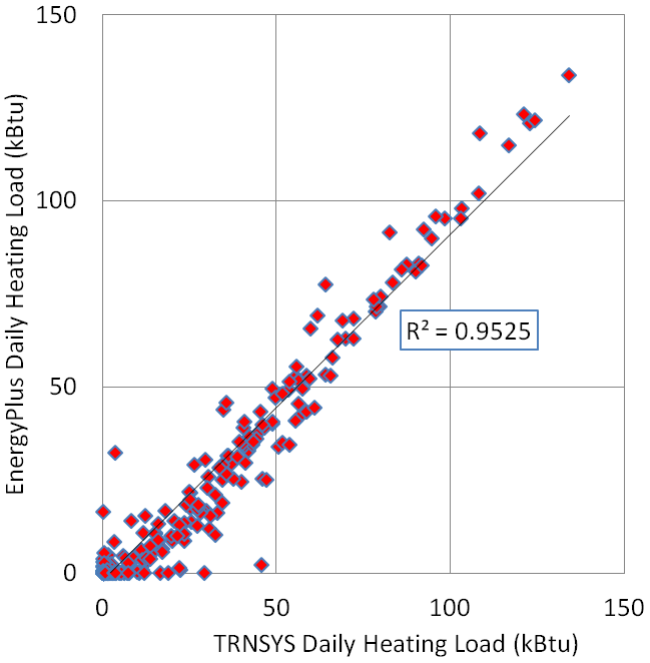


***Figure 9**. Comparison of daily heating loads*

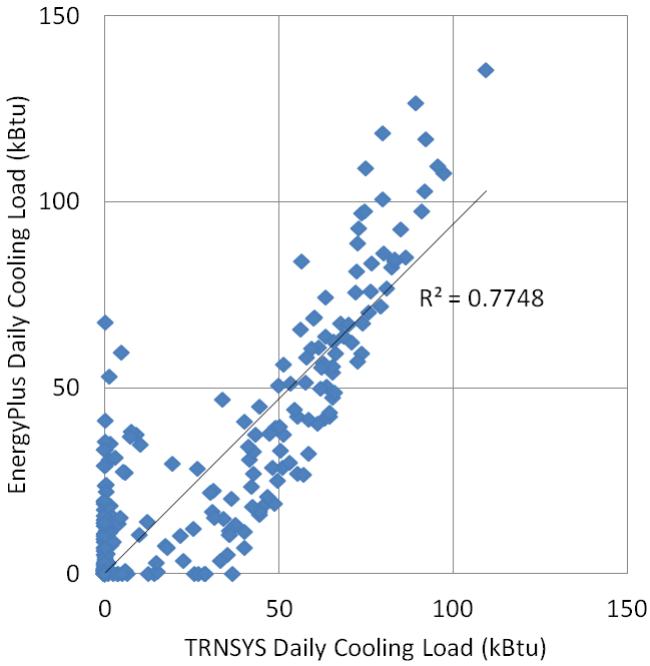


***Figure 10.** Comparison of daily cooling loads*

These results demonstrate good agreement between model results for daily heating loads. Daily cooling loads were less accurate, with EnergyPlus exhibiting more extreme events – i.e., more days of almost no cooling load or a very high cooling load as compared to the TRNSYS model.

Estimated annual loads are shown in **Table 4**. Interestingly, the cooling loads are closer in value, despite the heating loads demonstrating a greater daily correlation as measured by the coefficient of determination (R^2 value). Annual heating and cooling loads are within 14% and 3%, respectively. The maximum air conditioning rate shows similar agreement; values are within 12% and 7% of each other for heating and cooling, respectively.

Table 4. *Comparison of TRNSYS and EnergyPlus annual space conditioning requirements*

	Annual Heating Load		Annual Cooling Load		Max Heating Rate		Max Cooling Rate	
	kBtu	GJ	kBtu	GJ	kBtu/hr	kW	kBtu/hr	kW
TRNSYS	6800	7.2	6800	7.2	13.3	3.9	9.2	2.7
EnergyPlus	5900	6.2	7000	7.4	15.0	4.4	9.9	2.9

05 PREDICTIVE SHADING

Predictive shading is intended to provide a more energy efficient method of shading control than is obtained by strategies that employ schedules, reactive activation, or manual intervention. The system utilizes weather forecasts and building simulations to generate a daily shading schedule that minimizes HVAC and lighting loads by accounting for the thermally delayed effects from any control decisions.

Figure 11 demonstrates the impact of this type of system for ECHO, as compared to a 'predictive' shading model, for a number of arbitrary days.

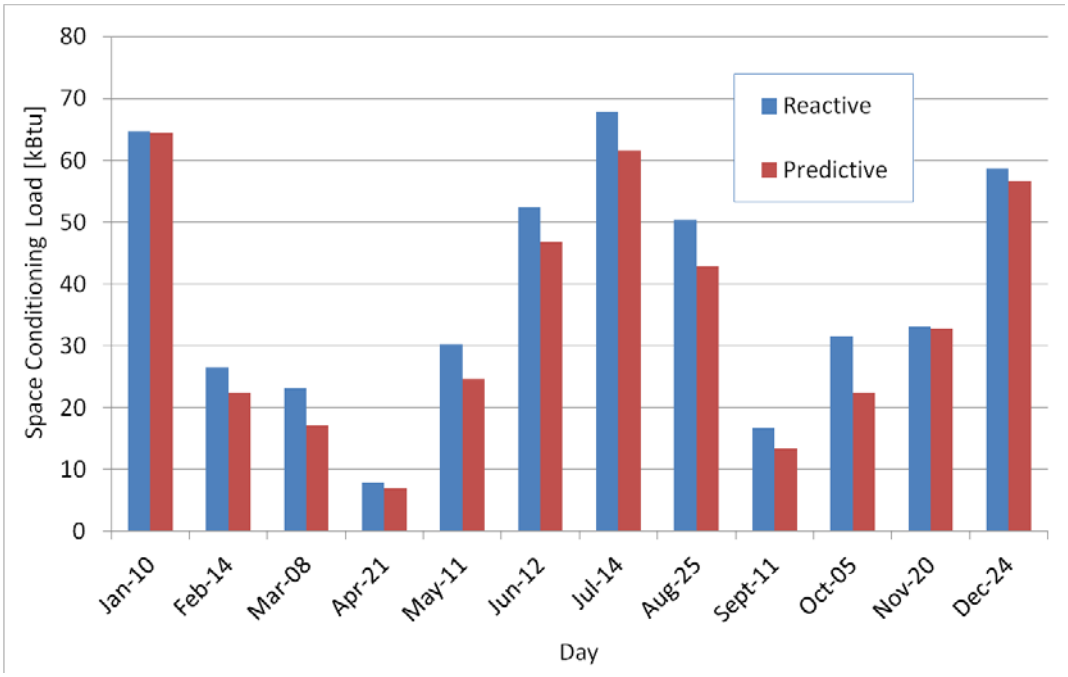


Figure 11. *Comparison of reactive shading control and predictive shading control*

The predictive shading system consists of two bottom-up[3], exterior, motorized shades that are located on the wide south-facing windows in the kitchen. Motors are wired to a receiver that supplies power and position control signals, whether through the predictive control system or via manual override

Based on a detailed analysis summarized in **Figure 12** and **Figure 13**, it is proposed to use a shading system with 3 positions (i.e., 0%, 50% and 100% coverage) rather than one with 6 positions (i.e., 0%, 20%, 40%, 60%, 80% and 100% coverage). It was found that the increased resolution did not have a noticeable increase in HVAC loads and therefore the system did not merit the additional complexity.

[3] Bottom-up shades unravel from the bottom and are drawn upwards, as opposed to traditional shades which are drawn down

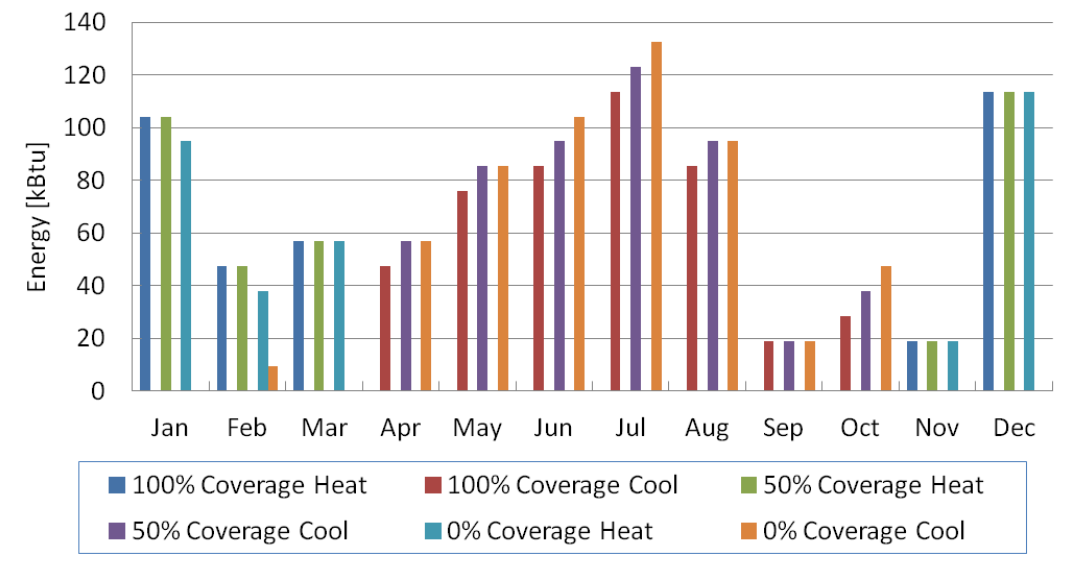


Figure 12. *West zone HVAC loads on the 14th day of each month, using a 3-position shade*

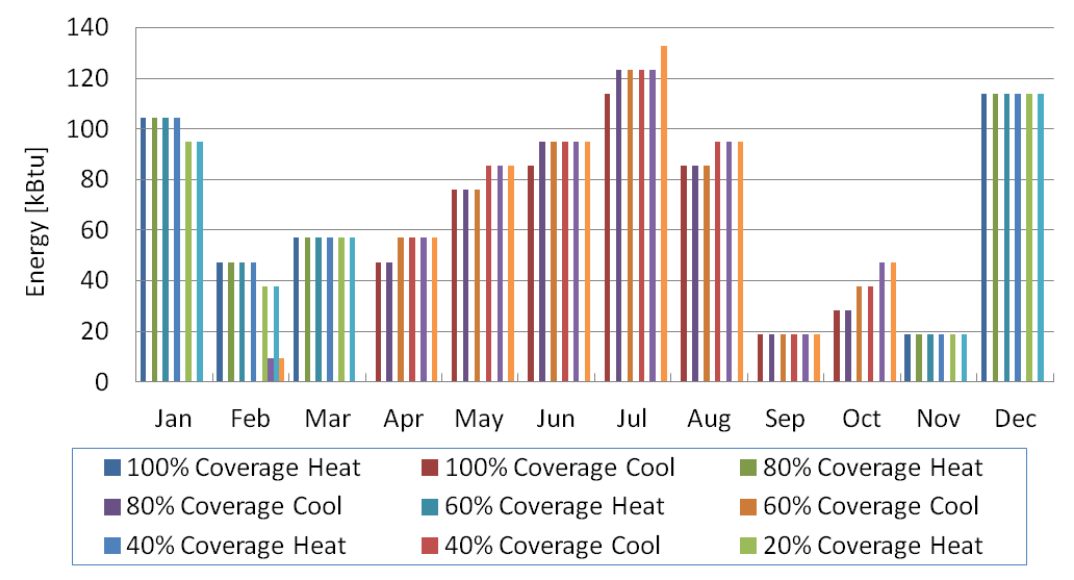


Figure 13. *West zone HVAC loads on the 14th day of each month, using 6-position shade*

The predictive shading algorithm utilizes MATLAB and EnergyPlus. MATLAB is used as the central control of the shading algorithm, completing the tasks of program calling, data analysis, and result exporting. Using an Internet connection, MATLAB accesses the most recent 24-hour weather forecast provided by the North American Mesoscale Forecast System (NAM) [9]. These data are inserted into the weather data file that is called by EnergyPlus during simulation. Using the modified weather file and an EnergyPlus model with blank shading control schedules, simulations are run for daylight hours.

The simulation begins at 6:00 AM and looks at possible shading combinations, with shades placed with 0%, 50%, and 100% coverage of the main south windows over the next five hours. Using a control model as illustrated in **Figure 14**, a decision on shade position is made based on the lowest total load of heating, cooling, and lighting energy, while keeping illuminance above a fixed value. The resulting shading position for the first hour is written to the shading schedule and output to a shading level file. The same simulation process is run for the next hour (i.e. 7:00 AM) with the updated shading schedule. Once again the loads are analyzed and the results output to the shading level file. This process is repeated until 8:00 PM, at which point the blinds are closed for occupant privacy.

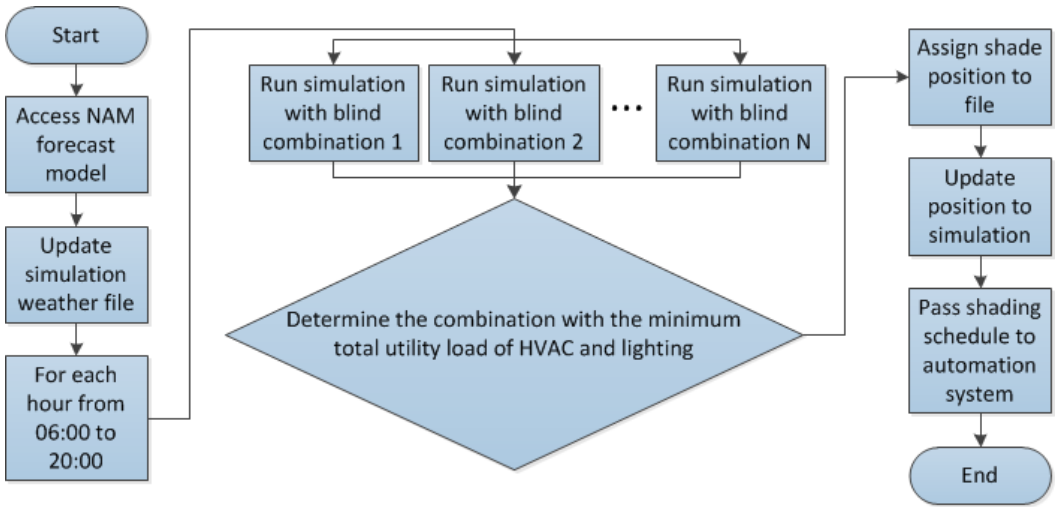


***Figure 14**: MATLAB decision flowchart*

06 HVAC MODELING

This section outlines the details of the heating, ventilation, and air-conditioning (HVAC) equipment in ECHO and describes the modeling process.

Air-source heat pumps (ASHPs) are a common space conditioning solution for entrants into the Solar Decathlon competition. However, these systems can experience problems in cold climates such as Ontario, including low heat output and efficiency at colder temperatures and reliance on electric resistance heaters for backup. Furthermore, few companies design and market ASHPs specifically for cold climate applications [10]. Therefore Team Ontario sought a solution that would couple heat pump technology with solar thermal collectors and heat storage, to mitigate the impact of cold outdoor temperatures on system performance.

This 'Integrated Mechanical System' (IMS) provides a highly efficient method of conditioning the space and meeting domestic hot water requirements. Design of the system seeks to maximize efficiency and use of solar thermal energy and waste heat, in order to minimize the size of the (costly) photovoltaic array.

The IMS consists of several subsystems, including:

- An indirect solar assisted heat pump system;
- An energy recovery ventilator; and,
- A centralized HVAC system.

The main performance evaluation metric for the IMS is the free energy fraction (FEF). The FEF is the portion of the domestic hot water (DHW), space heating, space cooling, and dehumidification loads that is met through stored solar energy or waste heat recovery; the higher the FEF, the lower the electrical input required to meet the loads.

Space heating and cooling loads were developed from the whole-building simulation model and used as inputs to the mechanical system model. Domestic hot water loads were estimated by coupling a draw profile to weather data in TRNSYS that describes the water mains temperature. The draw profile is based on the CSA F379.1 Standard [11], although the daily load was reduced from 225 L/day to 180 L/day. The justification for this modification is that ECHO may have fewer-than-average occupants and that homeowners are 'eco-aware' and consciously manage their energy consumption.

A brief description of each subsystem of the IMS follows.

SOLAR ASSISTED HEAT PUMP

An indirect solar assisted heat pump provides energy for space heating, space cooling, and DHW requirements. The underlying philosophy of this system is to efficiently harvest low-grade heat energy, thus further reducing dependence on electricity. The main components of this system are solar thermal collectors, a 'hot' and a 'cold' storage tank, and a liquid-to-liquid heat pump.

Figure 15 shows a schematic of the integrated mechanical system. Solar collectors and cooling coils are used to supply thermal energy to the cold tank. The cold tank subsystem improves the efficiency of the solar thermal

collectors, as the heat pump extracts heat from the working fluid prior to circulation through the collectors. The lower temperature of the working fluid (as compared to a conventional system) increases heat gain from, and decreases heat loss to, the environment.

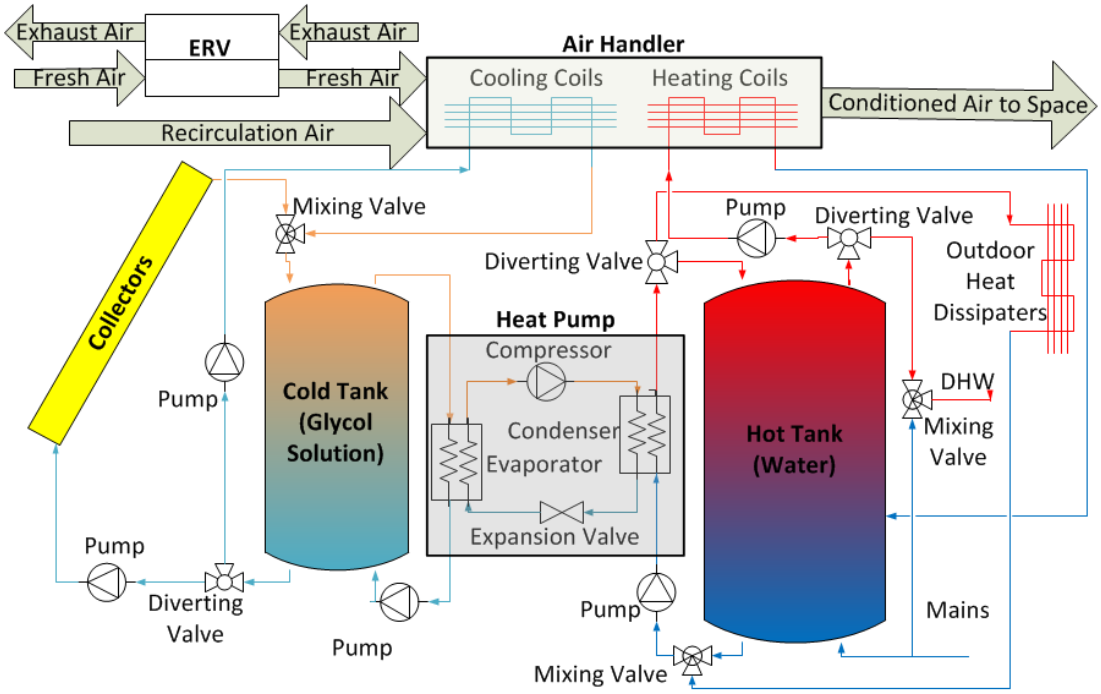


Figure 15. *Schematic of the Integrated Mechanical System*

During the cooling season, heat is transferred from the indoor air to the cold tank. The heat pump thus draws energy out of the cold tank and heats the water in the hot tank year-round. This process generates hot water for DHW, space-heating in the winter, and improves space-cooling performance by removing heat from the cold tank.

The air entering the heating and cooling coils is a mixture of fresh air from the energy recovery ventilator and recirculated air from within the house. When dehumidification is required, the air is first cooled to 50°F (10°C) in the cooling coil to condense water vapour, and then is reheated to 60.8°F (16°C) before being released into the space. The cold tank is filled with a non-toxic, food-grade propylene-glycol solution to avoid freezing in the solar collector or heat pump evaporator.

The upper section of the hot water tank is equipped with an internal auxiliary heating coil, which provides back-up heat when necessary. A thermostat in the top of the hot tank maintains it at a minimum of 131°F (55°C). For domestic hot water requirements, water drawn from the hot tank mixes with cold city mains water in a thermostatic mixing valve, as per a regular hot water heater.

During the cooling season, heat extracted from the house and from the operation of the heat pump will accumulate in the hot tank before dissipating through an outdoor heat-dump radiator. Some of this energy will be used for domestic water and outdoor air reheat following dehumidification (when necessary).

ENERGY RECOVERY VENTILATOR

For mechanical ventilation, the IMS utilizes a Venmar AVS EKO 1.5 high-efficiency energy recovery ventilator (ERV). In the winter, heat and moisture is recovered from the mechanically exhausted air and transferred to the incoming fresh air, reducing the heating load and avoiding issues of over-dry air within the space. During the summer, the incoming fresh air passing through the ERV releases heat and moisture to the exhaust air, moderating both sensible and latent cooling loads.

During the cooling season, it is possible for the ambient air enthalpy to be lower than the indoor enthalpy. In these situations, space cooling might still be required due to internal and solar gains; a 'free cooling' effect can be achieved through natural ventilation, supported by automated actuators on the east and west windows.

ERVs are often not recommended in cold climates, such as Eastern Ontario, due to concerns of frost build-up on the heat exchange core. The heat exchange core can be exchanged to convert the unit to a heat recovery ventilator (HRV) that will limit moisture exchange, and hence will have fewer issues with defrost.

HRVs do not recover moisture and therefore generally tend to experience fewer frost issues than ERVs. This feature presents an opportunity for ECHO to be used as an experimental platform to investigate frost mitigation strategies in cold climates, such as circulating indoor air to melt any frost build-up on the core or using an air pre-heating system. If an ERV proves infeasible, it can be changed for an HRV core. As HRVs tend to have a higher sensible effectiveness than ERVs, the chosen model provides the opportunity to further decrease sensible heating loads in the winter.

CENTRALIZED HVAC SYSTEM

The inlet air from the ERV is mixed with recirculated air from the house. A fan coil (for heating) and a cooling coil (for sensible cooling and dehumidification) serve to condition the air to the required supply temperature and appropriate humidity level to meet required internal loads. The conditioned air is then channeled through two main distribution branches ducts: one running along the south wall and the other along the north. This is shown in **Figure 16**.

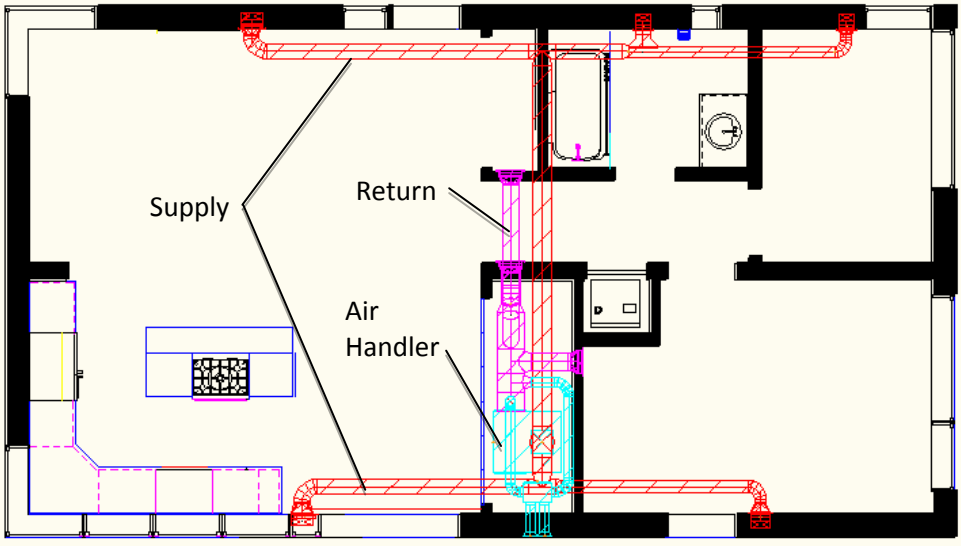


Figure 16. *Air duct layout*

The return-air duct runs north-south along the center of the house and returns the air at ceiling level. The air is supplied at ground level and is returned at the ceiling, as shown in **Figure 16**. This displacement ventilation approach ensures good mixing of air in the house during heating conditions. During cooling conditions, buoyancy-driven movement of cooling air due to local heating by occupants and equipment contributes to the mixing effect of fresh and stale air. This approach tends to direct stale and contaminated air above the occupied zone, potentially contributing to better indoor air quality.

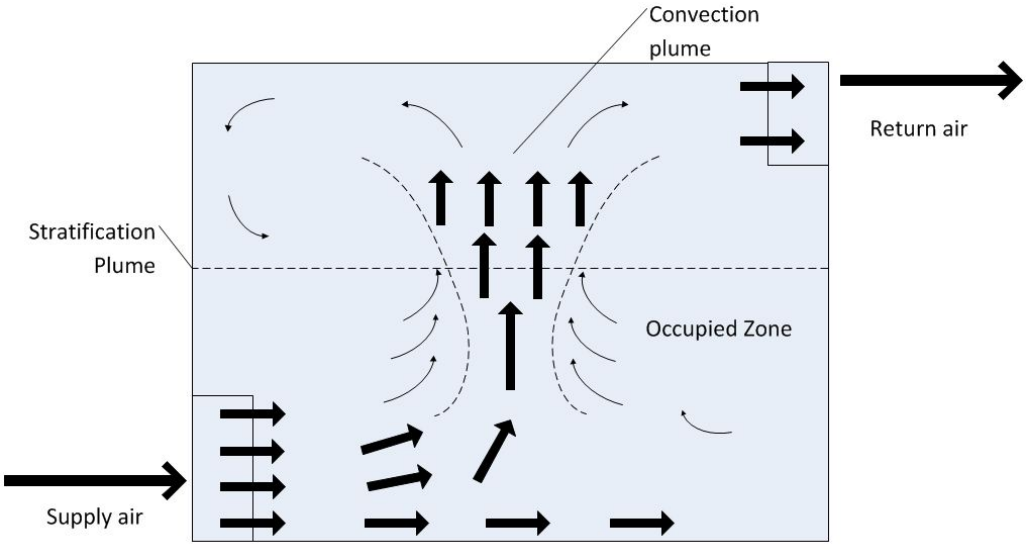


Figure 17. *Principles of displacement ventilation*

PARAMETRIC STUDIES

TRNSYS 17 was used to model the integrated mechanical system and size components in order to maximize the free energy fraction. **Figure 18** shows some of the key components of the TRNSYS model and their connections. Heating and cooling loads were initially provided through an input file containing the EnergyPlus simulation results; later, the housing model developed in TRNSYS for comparative purposes was used directly in the IMS model.

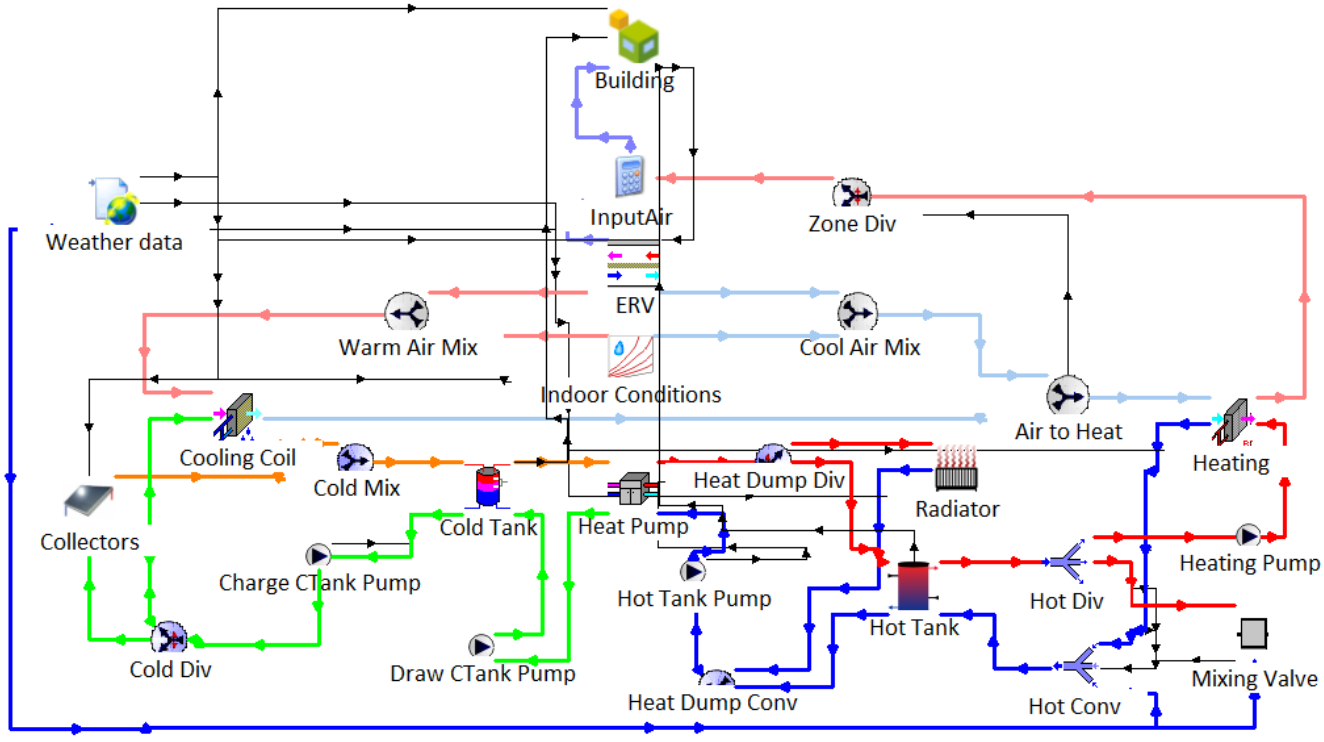


Figure 18. *TRNSYS model of Integrated Mechanical System*

Sensitivity studies were conducted for various parameters within the system, based on a typical year in Ottawa. ***Table 5*** lists the parameters of interest and the input values that were used for the baseline model.

Table 5. *Baseline model parameters for sensitivity studies*

Parameter	Value (Imperial)	Value (SI)
Collector area (glazed flat plates)	129 ft^2	12 m^2
Thermal Solar Collector tilt angle	90°	90°
Solar loop flow rate	5.5 lbm/min	150 kg/hr
Cold storage tank size	71 US gallon	270 L
Hot storage tank size	119 US gallon	450 L
Tank loss coefficient	0.202 $Btu/hr.ft^2.R$	4.132 $kJ/hr.m^2.K$
Heat pump source side minimum inlet temperature	42°F	6°C
Heat pump load side maximum inlet temperature	104°F	40°C
ERV sensible heating effectiveness	0.75	0.75
ERV latent exchange effectiveness	0.5	0.5
Heat pump nominal power input	85.3 Btu/min	1.5 kW
Heat pump (heating) capacity	284 Btu/min	5 kW
Hot tank auxiliary heater position[4]	Node 5	
Hot tank hot side inlet height[6]	Node 5	
Hot tank mains water & heating coil return inlet [6]	Node 25	

[4] The hot tank is divided into 30 equal sections from the top of the tank to the bottom of the tank. Each section is referred to as a node. Node 1 is the node at the top of the tank and node 30 is the node at the bottom of the tank.

The annual free energy fraction achieved by the base model is approximately 57.1%. **Figure 19** shows the results of several parametric studies of key system components.

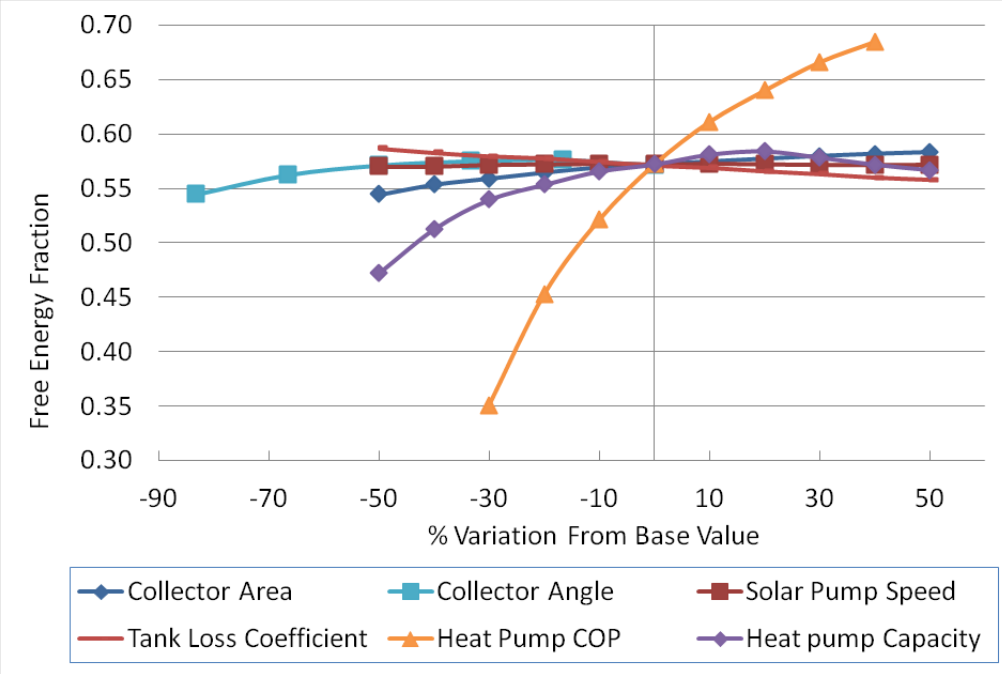


Figure 19. *Effect of high-level system parameters on free energy fraction*

The results suggest that the heat pump coefficient of performance (COP)[5] has the largest influence on the performance of the system. The FEF increases as tank loss coefficient decreases, collector area increases, and heat pump COP increases. The optimal collector angle is approximately 75° and optimal heat pump capacity was found to be 341 Btu/min (6 kW).

Heat Pump Inlet Temperature

The effects of the inlet temperatures to the heat pump were also investigated. As shown in **Figure 20**, the FEF increases as the minimum source side inlet temperature decreases and the maximum load side inlet temperature increases.

[5] The coefficient of performance is the ratio of the energy output over the energy input; in other words, how effectively the heat pump moves heat.

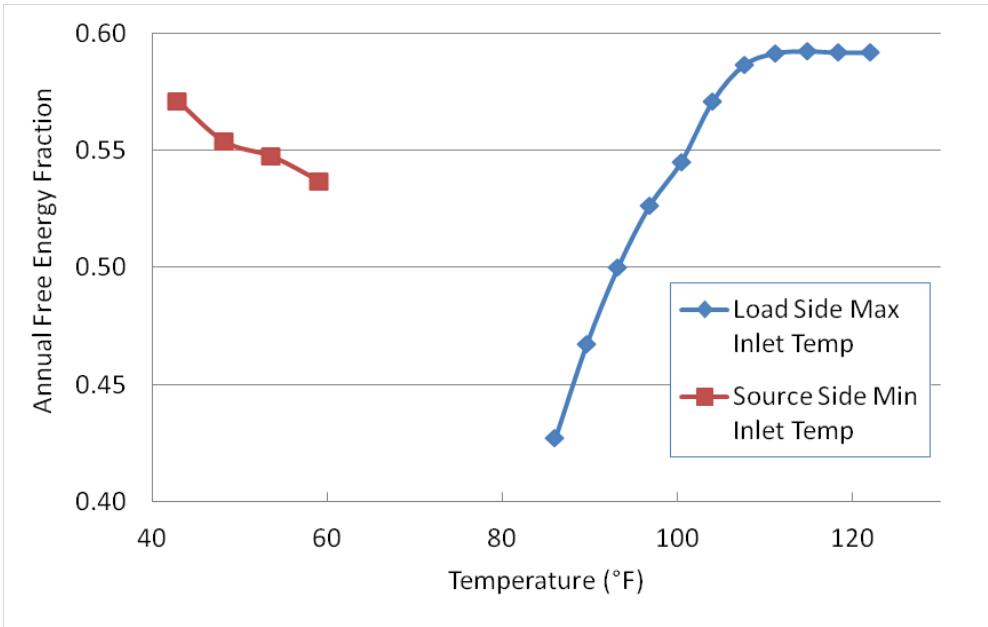


Figure 20. *Effect of varying heat pump inlet temperature on free energy fraction*

Solar Collector Type and Area

The collectors used in the base model were single-glazed flat plate collectors. A second set of simulations were conducted using evacuated tube collectors. The effect of changing the collector area on the free energy fraction is shown **Figure 21**.

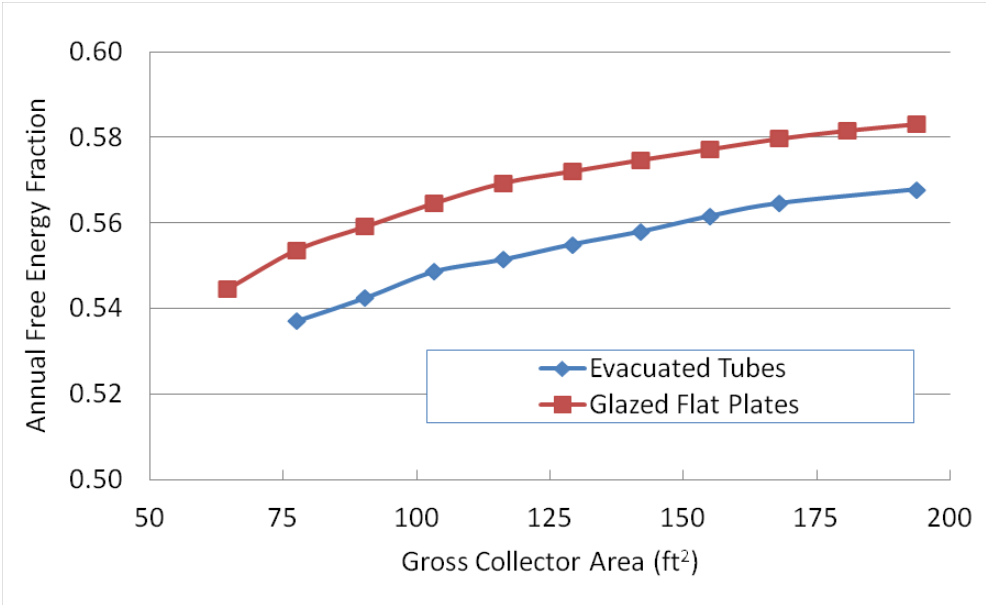


Figure 21. *Impact of type and size of solar collector on annual free energy fraction*

These results indicate that the flat plate collectors perform better than the evacuated tube collectors in this application. These results are reasonable because the temperature of the glycol entering the collectors is lower than is typical for a standard solar domestic hot water system, due to the cold tank and the heat pump extracting heat from the fluid. Because the fluid temperature is lower, thermal losses from the solar collectors are reduced, increasing efficiency in the flat-plate collectors and negating the benefits of the low-heat loss characteristics of the vacuum-tube collectors. The higher heat loss coefficient in the flat plate also increases the potential to absorb more energy from the surrounding air, even in the winter.

Thermal Storage Tanks

The initial set of sensitivity studies show that the hot tank size has little effect on the overall performance of the system. The size of the collectors and cold tank in the base model was suspected to be limiting the performance of the system.

Another hot tank sensitivity study was conducted by altering the base model to have 194 ft^2 (18 m^2) of collector area and a 120 US gallon (450 L) cold tank. This modified model is shown in green in **Figure 22**, along with the effect of tank size on the annual FEF.

This study indicated that a large cold tank can improve performance and, with a large cold tank and collector area, a smaller hot tank is more desirable.

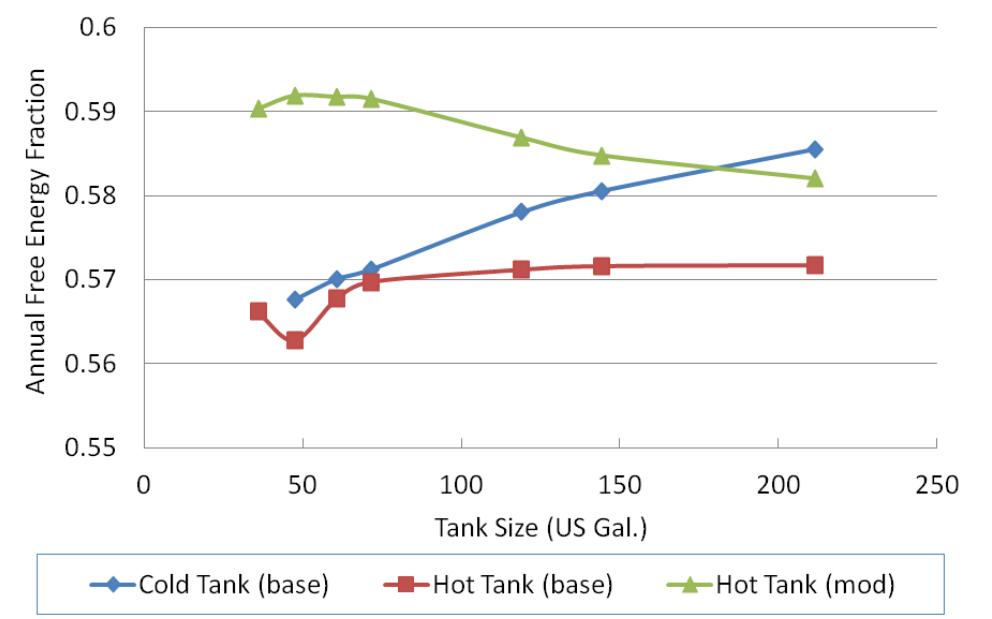


Figure 22. *Effect of variation in hot or cold tank volume on annual free energy fraction*

The water inside the hot tank is not at a uniform temperature. Ensuring good thermal stratification allows the hottest water to be drawn for heating purposes, thus increasing overall system efficiency. Thermal

stratification levels are influenced by the location of inlets and outlets on the storage tanks and the placement of the auxiliary heater element. These effects were investigated by varying the vertical position of inlet nodes and the auxiliary heater. The results of this analysis are displayed in **Figure 23**, where node 30 at the bottom of the tank. Note that hot water for heating purposes is drawn from the top of the tank.

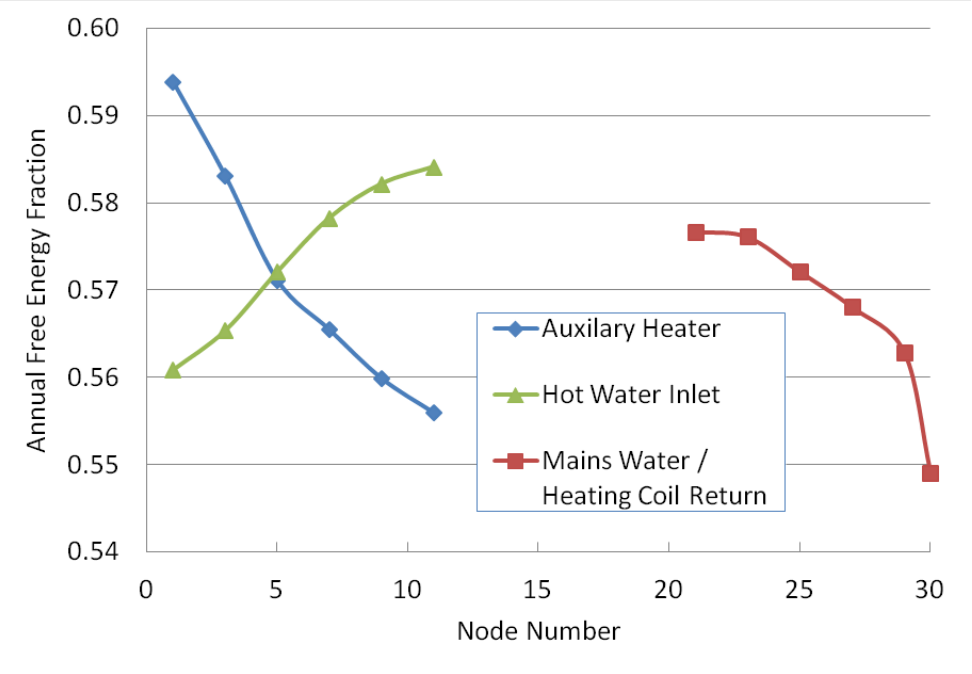


Figure 23. *Effect of hot tank storage inlet, auxiliary heater and heating coil return height on annual free energy fraction*

The sensitivity study indicates increased performance with increased height (relative to the ground) of the mains water inlet to the hot tank storage. This is a surprising result, as it was surmised that having the coldest water enter at the very bottom of the tank would promote the greatest thermal stratification. However, in the base case system, the heating coil return water, which is generally at a higher temperature than the mains water, also enters though this inlet, increasing mixing and de-stratification in tank.

This effect can be mitigated by specifying a storage tank with another inlet port, located part way up the tank. Splitting the heating return input from the mains water input can increase the free energy fraction by 1-2%[6]. This result is influenced by the general level of mixing in the storage tank, which depends on pump flow rates. These effects are the subject of further study.

Energy Recovery Ventilator

The effectiveness of the ERV is demonstrated in **Figure 24**. The latent effectiveness appears to have little influence on the overall performance of the system. Increasing the sensible effectiveness from 0.5 to 0.9 increases the free energy fraction by over 2%.

[6] Comparison of the two different tank component subroutines in TRNSYS with identical parameters yielded a slightly better result for the multi-inlet tank. This is attributed to computational differences and is not significant.

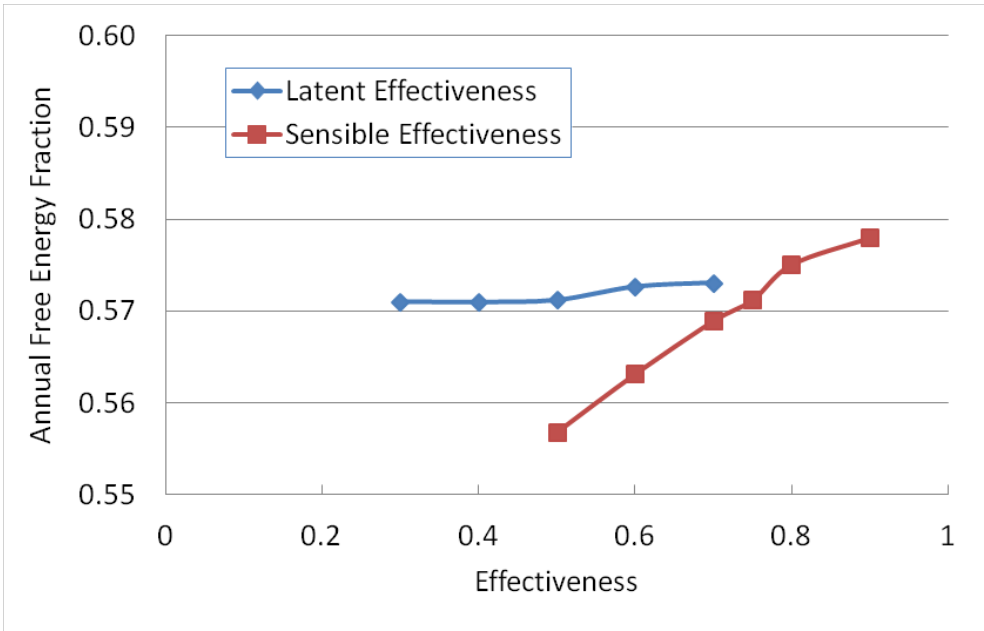


Figure 24. *Effect of ventilation heat recovery effectiveness on annual free energy fraction*

Best-case simulation results indicate an annual free energy fraction of 58.3% in Ottawa, which is approximately 3.4% greater than the base model performance. Significant changes from the base model to the optimal system include:

- Reducing the collector area by 50%;
- Sourcing a heat pump with a higher COP;
- Adding an additional inlet to split the mains water and heating coil return streams; and,
- Lowering the hot water inlet (from the heat pump) while keeping the hot water outlet and auxiliary heater at the top of the tank

Table 6 outlines the optimal system parameters.

***Table 6**. Recommended parameters for the Integrated Mechanical System*

PARAMETER	VALUE (Imperial)	VALUE (SI)	NOTES / JUSTIFICATION
Collector area (glazed flat plates)	65 ft^2	6 m^2	Minimal effect on performance. Reducing area by 50% reduces FEF by only 2%.
Collector tilt angle	90°	90°	Minimal improvement from 90° to 75° from horizontal. Retained at 90° to minimize mounting complexity.
Solar pump speed	5.5 lbm/min	150 kg/hr	Minimal effect on overall performance.
Cold storage tank size	71 US gallon	270 L	Maintained at a standard 71 US gallons
Hot storage tank size	119 US gallon	450 L	Larger tank specified to ensure adequate thermal capacity in winter.
Tank loss coefficient	0.202 Btu/hr.ft^2.R	4.132 kJ/hr.m^2.K	Base model parameter.
Heat pump source side min inlet temp	42°F	6°C	Limited in current study by heat pump input data in the TRNSYS model.
Heat pump load side max inlet temp	104°F	40°C	Limited in current study by heat pump input data in the TRNSYS model.
ERV sensible effectiveness	0.9	0.9	Highest sensible effectiveness achievable is recommended
ERV Latent effectiveness	0.5	0.5	Increasing effectiveness has minimal impact on performance
Heat pump power consumption	102 Btu/min	1.8 kW	Optimal performance from 1.8 kW power draw and 6 kW pump capacity
Heat pump heating capacity	341 Btu/min	6 kW	
Hot tank auxiliary heater position	node 5	node 5	Kept at node 5 to ensure availability of a sufficient volume of 55°C water
Hot tank hot side inlet height	node 10	node 10	Locating hot water inlet below auxiliary heater could improve performance
Heating coil return inlet height	node 21	node 21	Heating coil return water is higher temperature than mains water and should be higher than mains inlet

As-Built System

The optimal parameters provided a basis for the Team to source components. However, the as-built parameters for the system deviate from the optimal configuration mainly due to the market availability of components. Major differences between the as-built system and the optimal system include:

- The collector area is increased to 129 ft^2 (12 m^2) as it slightly improves performance and the exostructure was design for accommodate 4 panels (129 ft^2);
- The heat pump heating capacity and power consumption were decreased to about 284 Btu/min (5 kW) and 85 Btu/min (1.5 kW);
- The auxiliary heater position is about 2/3 up from the bottom of the tank;
- The set point for the top of the hot tank was reduced from 131°F (55°C) to 122°F (50°C).
- The cold storage tank size was 80 US gallons (303 L); and,
- The cooling coil set point was increased from 50°F (10°C) to 55.4°F (13°C), as the air can still be adequately dehumidified at this temperature.

The predicted free energy fraction for the as-built system built is 56%.

07 SUMMARY OF ENERGY TRANSFORMATION

Initial building modeling was conducted using EnergyPlus, and the output loads used as inputs to the design of the Integrated Mechanical System. However, the dynamic behavior of the Integrated Mechanical System is important to overall energy performance. Therefore, the TRNSYS building model was coupled directly with the IMS and simulations conducted for a typical year in Ottawa and for the eight days that comprise the energy balance competition for a typical year in Irvine.

One of the most striking results was that ideal loads from EnergyPlus significantly underestimated the predicted loads in TRNSYS when using a more realistic control strategy. This highlights the importance of maintaining a high level of control during the competition in order to meet comfort conditions and maintain a net-positive energy balance.

Table 7 outlines the functioning of the IMS annually in Ottawa. The table illustrates how solar energy and residual heat recovery supplement direct electrical energy input.

***Table 7**. Energy flow in the Integrated Mechanical System annually in Ottawa*

	kBtu	GJ	kWh
Energy Demand			
Domestic Hot Water	9300	9.8	2730
Heating Coil	9920	10.5	2910
Cooling Coil	12070	12.7	3540
Reheat Coil	2980	3.1	870
Auxiliary Energy			
Heat Pump Compressor	11020	11.6	3230
Auxiliary Heat	3720	3.9	1090
Waste Heat			
Heat Dump	13000	13.7	3810
Energy Input			
Solar Gain	7690	8.1	2250
Electrical Input	14740	15.6	4320

Table 8 details the system performance during the competition.

Table 8. *Energy flow in the Integrated Mechanical System during the competition in Irvine*

	kBtu	MJ	kWh
Energy Demand			
Domestic Hot Water	103	109	30
Heating Coil	0	0	0
Cooling Coil	547	577	160
Reheat Coil	99	104	29
Auxiliary Energy			
Heat Pump Compressor	313	330	92
Auxiliary Heat	92	97	27
Waste Heat			
Heat Dump	757	799	222
Energy Input			
Solar Gain	0	0	0
Electrical Input	406	428	119

Photovoltaic energy simulations were conducted in PVWatts for Ottawa and the Long Beach area using PVWatts. **Table 9** and **Table 10** on the two following pages show the estimated annual electricity demand and production in Ottawa, and competition electricity demand and production in Irvine.

Table 9. *Estimated annual electricity demand and production in Ottawa*

End Use	Electricity Demand (kWh)
Lighting	
Interior	333
Exterior	30
Total	**363**
Appliances	
Dishwasher	141
Clothes Washer	110
Dryer	480
Refrigerator	440
Oven/Cooktop	550
Other	700
Total	**2421**
Space Conditioning	
Space Heating	1303
Space Cooling	2062
Pumps and Fans	456
Total	**3821**
DHW	**1153**
Grand Total	**7758**
PV Production	**9846**
Surplus	**2088**

Table 10. *Estimated electricity demand and production during the competition in Irvine*

End Use	Electricity Demand (kWh)
Lighting	
Interior	15
Exterior	2
Total	**17**
Appliances	
Dishwasher	4
Clothes Washer	2
Dryer	8
Refrigerator	9
Oven/Cooktop	6
Cooking Contest	11
Other	19
Total	**59**
Space Conditioning	
Space Heating	0
Space Cooling	102
Pumps and Fans	20
Total	**122**
DHW	**16**
Grand Total	**214**
PV Production	**263**
Surplus	**49**

Figure 25 compares the estimated annual electricity consumption of ECHO to 2010 energy consumption figures for Canada and Ontario [12]. Note that ECHO estimates account for the impact of the Integrated Mechanical System on reducing loads due to solar thermal storage and heat recovery. Space cooling figures only account for homes with active space cooling, about 42% of residential floor area in Canada [13].

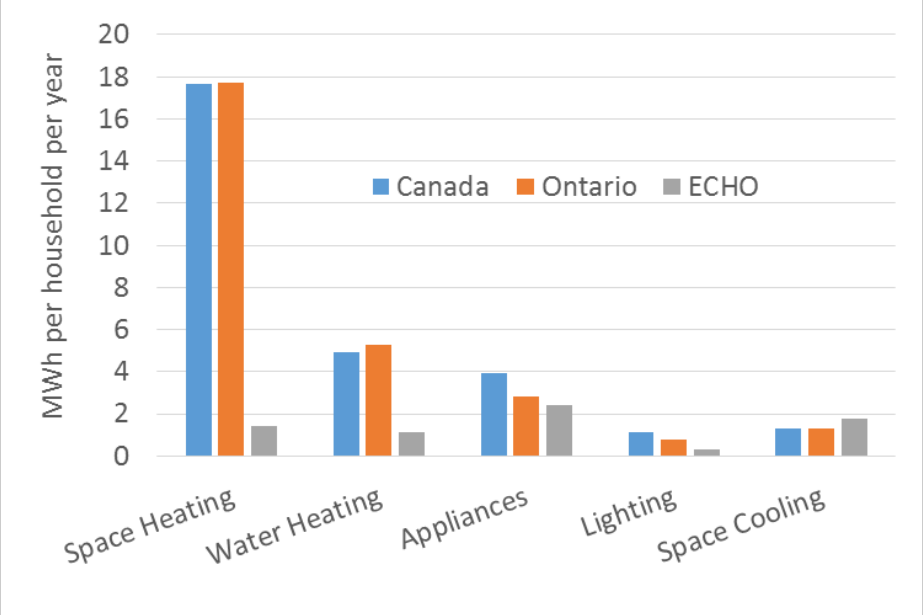


Figure 25. *Comparison of ECHO energy consumption to Canadian and Ontario 2010 residential averages*

Figure 25 indicates that the design of ECHO is extremely effective at reducing space heating and water heating loads, which account for about 80% of secondary energy use in Canadian housing. Appliance loads are reduced by using EnerGuide ratings as a guideline for selecting energy-efficient appliances, without sacrificing performance. Lighting loads are further reduced through the use of highly efficient light-emitting diode (LED) technology.

Space cooling loads are actually higher than typical for actively space-cooled housing in Canada, despite ECHO's passive and acting shading approach. There are a number of possible explanations for this trend:

- The high thermal insulation of the building envelope and low air infiltration rates 'trap' heat inside;
- Natural ventilation ('free cooling') and active shading of glazing could potentially be improved;
- Air conditioning set-points for ECHO do not reflect the way Canadians typically use their air conditioners.

To illustrate the last point, about 3% of the cooling load occurs in April and 11% in May. Although there are times when the internal temperature of ECHO strays outside the set-point, thus triggering cooling conditions, it is likely that actual homeowners would not turn their cooling system on at these times and simply tolerate the brief periods of overheating, or open a window. Measurement and verification of the energy performance of ECHO could permit further improvements to space cooling and other loads.

Conclusion

The integrated design process, which combined multiple design objectives with an understanding of the climatic constraints and opportunities of Ontario, resulted in a design that is expected to use less than 25% of the secondary energy of a typical Canadian home. This energy is entirely provided by the sun, resulting in zero operational carbon emissions. The combination of energy efficiency, bioclimatic design, and renewable energy is an inspiration for the next generation of homeowners to demand more from their homes, and represents a milestone in Team Ontario's vision of sustainable housing as a scalable reality across Canada and the world.

08 REFERENCES

[1] "DegreeDays.net," [Online]. Available: http://www.degreedays.net. [Accessed 20 Aug 2012].

[2] G. Lindsey, J. A. Todd, S. J. Hayter and P. G. Ellis, “A handbook for planning and conducting charrettes for high-performance projects.,” National Renewable Energy Laboratory, 2009.

[3] W. N. Hien, L. K. Poh and H. Feriadi, "Computer-based performance simulation for building design and evaluation: the Singapore perspective," *Simulating & Gaming,* vol. 34, no. 3, pp. 457-477, 2003.

[4] W. Marion and K. Urban, “User's manual for TMY2s - typical meteorological years,” National Renewable Energy Laboratory, 1995.

[5] R. Hendron, R. Anderson, C. Christensen, M. Eastment and P. Reeves, “Development of an energy savings benchmark for all residential end-uses,” National Renewable Energy Laboratory, 2004.

[6] I. Knight, H. Ribberink, N. Kreutzer, M. Manning and M. Swinton, “European and Canadian non-HVAC electric and DHW load profiles for use in simulating the performance of residential cogeneration systems: a report of subtask A of FC+COGEN-SIM - the simulation of building-integrated fuel cell and other cogeneration systems,” Annex 42 of the International Energy Agency Energy Conservation in Buildings and Community Systems Programme, 2007.

[7] L. G. Swan, V. I. Ugursal and I. Beausoleil-Morrison, “Occupant related household energy consumption in Canada: Estimation using a bottom-up neural network technique.,” *Energy and Buildings,* vol. 43, pp. 326-337, 2011.

[8] J. F. Kennedy, "An overview of natural building techniques," [Online]. Available: http://www.networkearth.org/naturalbuilding/overview.html. [Accessed 20 07 2012].

[9] National Oceanic and Atmospheric Administration, "North American Mesoscale Forecast System," 2013. [Online]. Available: http://www.emc.ncep.noaa.gov/index.php?branch=NAM. [Accessed August 2013].

[10] V. Stevens, C. Craven and R. Garber-Slaght, "Air source heat pumps in Southeast Alaska: A review of literature, a market assessment, and preliminary modeling on residential air source heat pumps in Southeast Alaska," Cold Climate Housing Research Centre, 2013.

[11] CSA F379.1, "Solar Domestic Hot Water Systems," Canadian Standards Association, 1988.

[12] Natural Resources Canada, "Comprehensive Energy Use Database, 1990 to 2010," Government of Canada, 2012. [Online]. Available: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/list.cfm?attr=0. [Accessed 6 June 2013].

[13] Natural Resources Canada, "Energy efficiency trends in Canada - 1990 to 2009," Government of Canada, 2011.

[14] ASHRAE, "ANSI/ASHRAE 55-2010: Thermal Environmental Conditions for Human Occupancy," American Society of Heating, Refrigerating and Air Conditioning Engineers, 2010.

[15] Canadian Green Building Council, "LEED Canada Reference Guide for Green Building Design and Construction," CaGBC, Ottawa, 2009.

09 QUANTITY TAKEOFF OF COMPETITION PROTOTYPE

QUANTITY TAKEOFF OF COMPETITION PROTOTYPE HOUSE

Specification Number	Brief Description	Detailed Description	Qty	Unit
Division 01	General Requirements			
01 54 19	Typical House Crane	80-ton truck-mounted crane, plus crew.	3	Day
01 54 33	Spray Foam	Rent, foam spray rig, including box trailer, compressor, generator, proportioner, Incl. Hourly Oper. Cost.	2	Day
Division 05	Metals			
05 05 23	Metal Fasteners	#14 self-drilling screws, 7/16" nylon head, neoprene washer	100	lb.
Division 06	Wood, Plastics and Composites			
06 05 23	Fasteners	2" clipped head, Paslode air nails, attaches sheathing to walls 6" along perimeter and 12" along studs	3	Packs
06 05 23	Fasteners	3" Galvanized spirals	50	lb.
06 05 23	Fasteners	2 1/2" Deck screws, zinc coated, weather resistant	100	lb.
06 05 23	Fasteners	3 1/2" Resin coated common sinkers for Laminated Veneer Lumber	100	lb.
06 10 00	Rafters	2" x 12" x 12' tapered rafters, No. 2 spruce	23	Each
06 10 53	Blocking	Two continuous rows of blocking, 2 x 4 material, standard & better lumber, 4’ O.C. from base of floor framing, excludes waste.	250	L.F.
06 11 00	2 X 6 Stud Walls	Wood framing, standard & better lumber, 2" x 6" studs, 24" O.C., 9' high, includes single bottom plate and double top plate, excludes waste	124	L.F.
06 11 00	2 X 6 Partition Walls	Wood framing, partitions, standard & better lumber, 2" x 6" studs, 24" O.C., 9' high, includes single bottom plate and double top plate, excludes waste	60	L.F.
06 11 00	2 X 4 Partition Walls	Wood framing, partitions, standard & better lumber, 2" x 4" studs, 24" O.C., 9' high, includes single bottom plate and double top plate, excludes waste	40	L.F.
06 11 00	2 x 3 Exterior Walls	Bluwood Framing, standard & better lumber, 2" x 3" studs, 24" O.C, 11' high, includes single top plate and single bottom plate	124	L.F.
06 13 23	Heavy Timber Framing	Rafters, structural grade, 8" x 12"	70	L.F.

06 13 23	Heavy Timber Framing	Columns, structural grade, 8" x 10"	150	L.F.
06 13 23	Heavy Timber Framing	Roof Purlins, 2.5" thick, structural grade	220	L.F.
06 13 23	Heavy Timber Framing	Roof Purlins, 3.5" thick, structural grade	90	L.F.
06 13 23	Heavy Timber Framing	Girders, select grade, 8"x10"	40	L.F.
06 13 23	Heavy Timber Framing	Cross Braces, select grade, 8"x10"	150	L.F.
06 15 13	2X8 Deck Framing	Porch or deck framing, treated lumber, joists, 2" x 8"	900	L.F.
06 15 33	Deck Boards	5/4" Western Red Cedar deck boards	700	S.F.
06 16 23	Subflooring	3/4" Tongue and Groove plywood, standard & better lumber, spruce, includes floor framing, excludes waste.	900	S.F.
06 16 26	Underlayment	Underlayment, plywood, underlayment grade, 1/2" thick, pneumatic nailed	960	S.F
06 16 26	Underlayment	Underlayment, plywood, underlayment grade, 3/4" thick	500	S.F
06 17 13	Laminated Veneer Lumber	Floor framing members, 1 3/4" x 7 1/4", 24" O.C., includes joists and double rim, excludes waste.	80	L.F.
06 17 53	Shop Fabricated Wood Trusses	Mono pitch truss for south module, 2x4 top and bottom chord, engineered by Centennial Truss	23	Each
Division 07	Thermal and Moisture Protection			
07 21 13.19	Floor and Roof Insulation	SR.P400 Type 4, graphite, expanded polystyrene insulation, 30 psi, ship- lapped edges	1800	S.F.
07 21 13.19	Floor and Roof Insulation	SR.P100 Type 1, graphite, neoprene bead, ship-lapped edges.	1800	S.F.
07 21 13.19	Wall insulation	SR. 2x4 Type 1, graphite, neoprene bead, spaced for 24" O.C.	1100	S.F.
07 21 29	Floor and Roof Insulation	BASF Walltite Spray insulation, polyurethane, ceiling and floor, 2#/CF density, ±6" thick, R39, sprayed, 2" Thick.	1800	S.F.
07 21 00	Thermal Insulation	Vacuum Insulated Panels, 18.5" x 22.5", Foil faced, 1/2" Thickness	1800	S.F.
07 21 29	Air/water Resistive Barrier	BASF Enershield system, water based, low VOC, ASTM E84 Class 1 flame spread, roll on application, full wall covering	1100	S.F.
07 42 23	Wood Siding	Horizontal Tongue and Groove siding, 1" x 5" Eeastern White Pine	700	S.F
07 42 23	Wood Siding	Vertical Tongue and Groove siding, 1" x 3" Eeastern White Pine	700	S.F

07 46 29	Plywood	Exterior grade, 1/2" spruce, underside of floor system	900	S.F.
07 53 29	Roofing Underlayment	Self-adhering, SBS rubberized asphalt compound laminated, Impermeable to air, vapor, and water. 1.6 ng/Pa.m2.s (0.03 perms) vapor permeance	900	S.F.
07 58 10	Roll Roofing	1 ply #15 felt roofing, lap 19", nailed	500	S.F
07 61 00	Metal Roofing	Steel roofing panels, on steel frame, flat profile, standard finish, 1-3/4" standing seams, 18" wide, 24 gauge, Hidden fastener	1460	S.F.
07 62 00	Sheet Metal Flashing and Trim	Sheet metal flashing, aluminum, flexible, mill finish, .013" thick, including up to 4 bends	160	L.F.
07 71 23	Gutters	Steel, Galv, 28 ga, custom mould.	124	L.F.
Division 08	Openings			
08 13 00	MAIN ENTRY AND MASTER BEDROOM, 45 1/2"W x 83"H, JELD-WEN 1 3/4" THK. JELD-WEN STEEL FRAMED INSULATED DOOR	Rule of Thumb - Typical Exterior Door, prehung, exterior, insulated steel	2	Each
08 13 00	SOUTH DECK FRENCH DOORS, 69 1/2"W x 83"H, JELD-WEN 1 3/4" THK. TRP. GLAZED ARGON FILLED LITES, THERMOTECH STEEL FRAMED INSULATED DOOR	Rule of Thumb - Typical Exterior Door, prehung, exterior, insulated steel	1	Each
08 50 00	FIXED 1'9 1/2" x 1'9 1/2", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Fixed Window	462	Sq. In.
08 50 00	FIXED 1'8" x 6'9"", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Fixed Window	1620	Sq. In.
08 50 00	FIXED 3'11 5/8" x 5'10 3/4"", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Fixed Window	3369	Sq. In.
08 50 00	FIXED 2 - 5'5 3/4" x 2'8"", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Fixed Window	4208	Sq. In.
08 50 00	FIXED 1'9 1/2" x 6'7 1/2", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Fixed Window	1709	Sq. In.
08 50 00	FIXED 4'4" x 5'10 3/4", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Fixed Window	3679	Sq. In.

08 50 00	FIXED 3'9 1/2" x 2'8", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Fixed Window	1456	Sq. In.
08 50 00	Awning 2 - 3'9 1/2" x 1'8 1/4", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Awning Window	1843	Sq. In.
08 50 00	Casement 3'5" x 3'8", JELD-WEN VINYL-ALUMINUM CLAD TRP. LOW-E	Rule of Thumb - Typical Casement Window	1804	Sq. In.
Division 09	Finishes			
09 29 10	Gypsum Board	1/2" gypsum board, walls, standard, taped and finished to level 5	2100	S.F
09 29 10	Gypsum Board	1/2" gypsum board, ceiling, standard, taped and finished to level 5	940	S.F
09 29 10	Gypsum Board	1/2" gypsum board, walls, mould resistant, taped and finished to level 5	90	S.F
09 30 13	Ceramic Tile	3" x 6" subway tiles, white, thin set, walls	100	S.F
09 30 13	Ceramic Tile	12" x 24" porcelain tile, black, thin set, floors	100	S.F
09 30 29	Metal Tiling	12" x 12" Sheet, stainless steel backsplash	30	S.F
09 64 00	wood flooring	3.5mm hardwood, Hickory, 10 ply yellow birch base	800	S.F.
09 81 16	Acoustic Insulation	3" Batt insulation, Roxul Safe and Sound	160	S.F.
09 91 13	Exterior Painting	2 coats, clear stain, exterior wood siding	700	S.F
09 91 13	Exterior Painting	2 Coats, latex based exterior stain, wood siding.	700	S.F.
09 91 23	Interior Painting	2 coast, latex, no VOC	3000	S.F.
Division 10	Specialties			
10 21 13	Residential Bath Accessories	Kohler Toilet Tissue Dispenser, Brushed Chrome	1	Each
10 21 13	Residential Bath Accessories	Kohler 24 in. x 48 in. Framed Rectangle Mirror in Brushed Chrome	1	Each
10 21 13	Residential Bath Accessories	Kohler 24" Towel Bar	1	Each
10 21 13	Toilet Compartments	Caroma	1	Each
10 21 13	Toilet Compartments	Adelaide Cube 270 Easy Height Round Front Plus	1	Each
10 21 13	Toilet Compartments	Free-Standing Bath	1	Each
10 21 13	Toilet Compartments	Kohler dual flush toilet	1	Each
10 21 13	Toilet Compartments	Poured concrete vanity with built in sink.	1	Each
10 21 13	Toilet Compartments	Kohler Single Handle Wall Mount Vessel Faucet from the Masina Collection	1	Each

10 21 16	Shower and Dressing Compartments	Fleruco double pane glass shower door, single hinge	1	Each
Division 11	Equipment			
11 26 00	Kitchen Sink	Undermount, stainless steel. 1. 31.5” long, 18” wide, 9.5” deep	1	Each
11 26 00	Kitchen Faucet	Kohler Single-lever, European-style spout with pull-out spray.	1	Each
11 31 00	Electric Oven	Whirlpool Built-in, single electric, self-cleaning wall oven with broiler unit.	1	Each
11 31 00	Electric Cooktop	GE 30-inch (762-mm), built-in cooktop with four burner elements.	1	Each
11 31 00	Refrigerator/Freezer	Fisher & Paykel Freestanding, frost-free two-door refrigerator with bottom-mounted freezer	1	Each
11 31 00	Dishwasher:	Fisher & Paykel;: Built-in, undercounter, automatic dishwasher	1	Each
11 31 00	Clothes Washer	LG Freestanding, front-loading, automatic clothes washer with 4.3-cu. ft. capacity, Energy star	1	Each
11 31 00	Clothes Dryer	LG Freestanding, front-loading clothes dryer, 7.1-cu. ft. capacity, Energy star	1	Each
Division 12	Furnishings			
12 36 61	Poured Concrete Countertops		43	S.F.
Division 21	Fire Suppression			
21 12 13	Pendant Sprinkler Head		2	Each
21 12 13	Semi-Recessed Sprinkler Head		5	Each
21 12 13	CPVC 1/4 Bend		5	Each
21 12 13	Sprinkler Female Head Adaptors		7	Each
21 12 13	CPVC Piping		120	L.F.
21 12 13	CPVC Couplings		2	Each
21 12 19	CPVC Single Hangars		40	Each
21 12 23	Tamper Switch		1	Each
21 30 00	Fire Suppression Pump		1	Each
Division 22	Plumbing			
22 05 00	Hangers	1.5"- 3"	15	Each
22 05 00	hangers	1/2"	60	Each
22 05 00	J- Hooks	2"	15	Each
22 05 13	submersible pump	submersible pump	1	Each

22 05 13	supply pump	1/2 h.p.	1	Each
22 13 16	drain attachment	1.5"	3	Each
22 13 16	drain attachment	2"	1	Each
22 13 16	bathtub drain with strainer	2"	1	Each
22 13 16	p-trap	1.5"	2	Each
22 13 16	p-trap	2"	3	Each
22 13 16	sanitary tee	1.5"x1.5"x1.5" Sink Vent	3	Each
22 13 16	sanitary tee	2"x2"x2"	2	Each
22 13 16	sanitary tee	3"x3"x1.5" Sink Vent	2	Each
22 13 16	sanitary tee	3"x3"x2" Shower Vent	4	Each
22 13 16	appliance wye	1.5"x1.5"x.75" Dishwasher Adaptor	1	Each
22 13 16	1/4 bend short	1.5"	2	Each
22 13 16	1/4 bend short	2"	13	Each
22 13 16	1/4 bend short	3"	3	Each
22 13 16	bathtub drain insert	1.5"	1	Each
22 13 16	cleanout	1 1/2"	1	Each
22 13 16	cleanout	2"	1	Each
22 13 16	cleanout	3"	1	Each
22 13 16	ABS pipe	1.5" Sink Vent	9.5	L.F.
22 13 16	ABS pipe	2" Shower Vent	60	L.F.
22 13 16	ABS pipe	3" DWV	56	L.F.
22 33 00	Cold tank	80 gallon, double element	1	Each
22 33 00	Hot tank	120 gallons required	1	Each
Division 23	Heating, Ventilating, and Air-Conditioning			
23 05 23	Ball valves	1/2" and 3/4'' brass ball valves	26	Each
23 05 23	Check valves	3/4" Brass check valve	3	Each
23 05 23	Drain valves	3/4" Purge valve	4	Each
23 05 23	Pressure and temperature relief valve	Manual flow adjustment valve	2	Each
23 05 23	Pressure relief valve	Rated at 50 psi	1	Each
23 05 23	Thermostatic tempering valve	3/4" anti-scald	1	Each
23 05 23	3-way Zone Valve (Diverting)	3/4" Brass 3-way diverting valve	2	Each
23 07 00	Pipe insulation	0.5" Thickness foam insulation	60	Ft
23 21 13	3/4" Copper pipe	Copper water tube, Type M Hard Temper ASTM -	15	Ft

		B88		
23 21 13	1/2" Copper pipe	Copper water tube, Type M Hard Temper ASTM - B88	40	Ft
23 21 13	1" Pex Piping	1" Heatlink Pex Piping	20	L.F.
23 21 13	3/4" Pex Piping	3/4" Heatlink Pex Piping	20	L.F.
23 21 13	90° Bend	3/4" Heatlink Pex PPE bend	10	Each
23 21 13	1/2" Pex Piping	1/2" Heatlink Pex Piping	200	L.F.
23 21 13	90° Bend	1/2" Heatlink Pex PPE bend	30	Each
23 21 13	Pex Coupling	1/2" Heatlink Pex PPE coupling	5	Each
23 21 13	Plumbing manifold	6 Port	2	Each
23 21 23	Hydronic pumps	Flanged and swept connections, 1/2" and 3/4" size	4	Each
23 21 13 1.3B	Expansion tanks	2.1 gallon	3	Each
23 31 00 2.2A1	Galvanized Steel Spiral Round Duct	6" Round Duct	9	Ft
23 31 00 2.2A1	Galvanized Steel Spiral Round Duct	7" Round Duct	8	Ft
23 31 00 2.2A1	Galvanized Steel Spiral Round Duct	8" Round Duct	48	Ft
23 31 00 2.2A1	Galvanized Steel Spiral Round Duct	10" Round Duct	18	Ft
23 31 00 2.2A2	Galvanized Steel Stack Duct	4" X 10" Stack duct	22	Ft
23 31 00 2.2A2	Galvanized Steel Stack Duct	4" X 12" Stack duct	15	Ft
23 31 00 2.2A3	Galvanized Steel Round Tee	8"X8"X8" Tee (full flow)	1	Each
23 31 00 2.2A4	Galvanized Steel Round Duct Transition	7" X 7" to 8" Round	1	Each
23 31 00 2.2A4	Galvanized Steel Round Duct Transition	15" X 16" to 10" Round	2	Each
23 31 00 2.2A5	Galvanized Steel Round Duct Reducer	7" to 8" Short reducer	2	Each
23 31 00 2.2A5	Galvanized Steel Round Duct Increaser	8" to 7" Short Reducer	2	Each
23 31 00 2.2A6	Galvanized Steel Round Elbow	6" Round 90° Elbow	1	Each

23 31 00 2.2A6	Galvanized Steel Round Elbow	7" Round 90° Elbow	1	Each
23 31 00 2.2A6	Galvanized Steel Round Elbow	8" 90° Elbow	2	Each
23 31 00 2.2A6	Galvanized Steel Round Elbow	10" 90° Elbow	2	Each
23 31 00 2.2A6	Galvanized Steel Round Elbow	8"Adjustable elbow 45°	1	Each
23 31 00 2.2A7	Galvanized Steel Rectangular Elbow	4" X 10" 90° Elbow	3	Each
23 31 00 2.2A7	Galvanized Steel Rectangular Elbow	4" X 12" 90° Elbow	2	Each
23 31 00 2.2A8	Galvanized Steel Boot Fitting	4"X10"X 7" Angle Boot	1	Each
23 31 00 2.2A8	Galvanized Steel Boot Fitting	4"X10"X 6" Angle boot	2	Each
23 31 00 2.2A8	Galvanized Steel Boot Fitting	4"X 12"X 8" Angle boot	2	Each
23 31 00 2.2A9	Galvanized Steel Wye	10"X10"X10" Wye (Full flow)	1	Each
23 31 00 2.2A10	Galvanized Steel Boot Fitting	4" X 12" X 8" Universal Boot	5	Each
23 31 00 2.3A	Volume Control Damper	Honeywell 8" Round motorized duct damper	4	Each
23 31 00 2.3C	Galvanized Steel Round Flexible Duct	4" Flexible round duct	12	Ft
23 31 00 2.3D	Intake Hood	Bowflex Intake Cap 6"	1	Each
23 31 00 2.3E	Exhaust Vent Cap	Bowflex Vent Cap 6"	1	Each
23 31 00 2.3E	Exhaust Vent Cap	Bowflex Vent Cap 4"	1	Each
23 34 23	Energy Recovery Ventilator	Venmar EKO 1.5 Energy Recovery Ventilator	1	Each
23 34 23	Bathroom Fan	Air King 0.5-Sone 50 CFM White Bath Fan ENERGY STAR	1	Each
23 37 13 2.1A	Trussteal Baseboard Grille	4" X 10" Supply Grille	3	Each
23 37 13 2.1B	Trussteal Baseboard Grille	4" X 12" Supply Grille	2	Each
23 37 13	Trussteal Return Grille	4" X 12" Return Grille	2	Each

2.1D				
23 37 13 2.1E	Trussteal Return Grille	12" X 12" Return Grille	1	Each
23 56 13.13	Collectors	Enerworks commercial panels	4	Each
23 81 46	Heat pump	Liquid source heat pump	1	Each
23 82 19	Heat dissipaters	Radiators	1	Each
23 82 19	Air Handling Unit	Custom Cancoil Airhander	1	Each
Division 25	Integrated Automation			
25 35 16	Generic Sensors, Router, Software for monitoring electrical circuits, heat and humidity		1	Project
25 35 16	PLC's Mitsubishi and Fox Con, W/PROGRAMMING	Generic Programmable Logic Controller PLC'S	2	Each
25 35 16	Central Controller	Crestron CLSC6	1	Each
25 35 16	Lighting Controller	Crestron CLSC6, PAC2M	2	Each
25 35 16	Dimmer Panels	Crestron CLSC6	1	Each
25 12 13	eMonitor Residential Gateway	Relays sensor information from the intellergy HUB to the web based internet portal.	1	Each
25 11 16	Intellergy Sensor HUB	Sends data from the PowerWise sensors to the eMonitor Gateway.	1	Each
25 35 16	MK-III RTI-LR Sensor Assembly	Weather Station. Records weather data.	1	Each
25 12 23	IP-100/LR Network Interface	Relays information from the MK-III RTI-LR Sensor Assembly to the online web portal.	1	Each
25 14 16	Arduino Uno R3	A PCB that controls the automated windows and predictive shading from server input.	1	Each
25 35 13	MARVEL Electronic Window Operator	Window actuators that electronically open and close three awning windows.	3	Each
25 35 13	MechoSystems motorized Roller Shades	Double motor bottom/up roller shades for predictive shading system.	1	Each
25 36 26	Regulvar ERDRC-CCR	Wireless lighting controller with ballast control output.	7	Each
25 05 28	MK III Mono Mount	Mounting apparatus for the weather station.	1	Each
Division 26	Electrical			
26 09 43	Regulvar MOS-17C	Wireless occupancy detector.	6	Each
26 09 33	Regulvar RW-PTM265	Wireless wall-mounted lighting switch.	8	Each
26 09 43	Can2Go UN2	Universal controller for lighting applications.	1	Each
26 09 43	Regulvar TAP-17C	Wireless ambient lighting sensor.	5	Each
26 09 16	RTS Dry-Contact Interface	Communication interface between the Arduino	1	Each

		and motorized shades.		
26 09 13	Residential eMonitor 12r	Relays information from circuit breaker on electrical energy consumption.	1	Each
Division 28	Electronic Safety and Security			
28 31 00	Fire Alarm System	Fire Detection Systems, remote annunciator, 8 zone lamp, excluding wires & conduits	1	Each
Division 31	Earthwork			
31 62 16	AP Small Complete	AP Small Complete	4	Each
31 62 16	Seismic Pier	11" CP-Seismic Pier on plywood	4	Each
31 62 16	Standard pier	18" pier	37	Each
31 62 16	Perimiter Pier	18" perimeter pier	5	Each
31 62 16	Safety Top	Safety top	50	Each
31 62 19	Plywood Base	2 x 12 x 30" Pressure Treated	50	Each

10 CONSTRUCTION SPECIFICATIONS

CONSTRUCTION SPECIFICATIONS: OVERVIEW OF SECTIONS COVERED

DIVISION 01	**GENERAL REQUIREMENTS**
01 25 00	SUBSTITUTION PROCEDURES
01 42 00	REFERENCES
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 70 00	EXECUTION AND CLOSEOUT REQUIREMENTS
01 74 19	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 81 13	SUSTAINABLE DESIGN REQUIREMENTS
DIVISION 02	**EXISTING CONDITIONS**
02 43 13.13	BUILDING RELOCATION
DIVISION 06	**WOOD, PLASTICS, AND COMPOSITES**
06 10 00	ROUGH CARPENTRY
06 10 53	MISCELLANEOUS ROUGH CARPENTRY
06 15 33	WOOD PATIO DECKING
06 16 00	SHEATHING
06 17 53	SHOP-FABRICATED WOOD TRUSSES
06 20 00	FINISH CARPENTRY
DIVISION 07	**THERMAL AND MOISTURE PROTECTION**
07 21 00	THERMAL INSULATION
07 25 00	WEATHER BARRIERS
07 41 13	METAL ROOF PANELS
07 46 23	WOOD SIDING
07 71 00	ROOF SPECIALTIES
DIVISION 08	**OPENINGS**
08 13 00	METAL DOORS
08 50 00	WINDOWS
08 80 00	GLAZING
DIVISION 09	**FINISHES**
09 29 00	GYPSUM BOARD
09 30 00	TILING
09 64 00	WOOD FLOORING
09 90 00	PAINTING AND COATING

DIVISION 10	**SPECIALTIES**
10 28 00	TOILET, BATH, AND LAUNDRY ACCESSORIES
10 28 19	TUB AND SHOWER DOORS
DIVISION 11	**EQUIPMENT**
11 26 00	UNIT KITCHENS
11 31 00	RESIDENTIAL APPLIANCES
DIVISION 21	**FIRE SUPPRESION**
21 05 00	COMMON WORK RESULTS FOR FIRE SUPPRESSION
21 10 00	WATER-BASED FIRE-SUPPRESSION SYSTEMS
DIVISION 22	**PLUMBING**
22 05 00	COMMON WORK RESULTS FOR PLUMBING
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
22 05 23	GENERAL-DUTY VALVES FOR PLUMBING PIPING
22 13 16	SANITARY WASTE AND VENT PIPING
22 33 00	ELECTRIC DOMESTIC WATER HEATERS
DIVISION 23	**HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**
23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 23	GENERAL-DUTY VALVES FOR HVAC PIPING
23 07 00	HVAC INSULATION
23 21 13	HYDRONIC PIPING
23 21 23	HYDRONIC PUMPS
23 31 00	HVAC DUCTS AND CASINGS
23 34 23	HVAC POWER VENTILATORS
23 37 13	DIFFUSERS, REGISTERS, AND GRILLES
23 56 13.13	HEATING, FLAT-PLATE, SOLAR COLLECTORS
23 81 46	WATER-SOURCE UNITARY HEAT PUMPS
23 82 19	FAN COIL UNITS
DIVISION 25	**INTEGRATED AUTOMATION**
25 05 00	COMMON WORK RESULTS FOR INTEGRATED AUTOMATION
25 13 00	INTEGRATED AUTOMATION CONTROL AND MONITORING NETWORK
DIVISION 26	**ELECTRICAL**
26 09 23	LIGHTING CONTROL DEVICES
26 24 16	PANELBOARDS
26 27 13	ELECTRICITY METERING
26 31 00	PHOTOVOLTAIC COLLECTORS
26 50 00	LIGHTING

DIVISION 28	**ELECTRONIC SAFETY AND SECURITY**
28 31 00	FIRE DETECTION AND ALARM
DIVISION 48	**ELECTRICAL POWER GENERATION**
48 19 19	ELECTRICAL POWER GENERATION INVERTER

Division 01 – GENERAL REQUIREMENTS

SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUBSTITUTION PROCEDURES

A. Substitutions include changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.
2. Submit requests within 7 days after the Notice to Proceed.
3. Identify product to be replaced and show compliance with requirements for substitutions. Include a detailed comparison of significant qualities of proposed substitution with those of the Work specified, a list of changes needed to other parts of the Work required to accommodate proposed substitution, and any proposed changes in the Contract Sum or the Contract Time should the substitution be accepted.

C. Architect will review proposed substitutions and notify Contractor of their acceptance or rejection. If necessary, Architect will request additional information or documentation for evaluation.

1. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

D. Do not submit unapproved substitutions on Shop Drawings or other submittals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 42 00 – REFERENCES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Abbreviations and Acronyms: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AHAM	Association of Home Appliance Manufacturers
AHRI	Air-Conditioning, Heating, and Refrigeration Institute, The

AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	Association of the Wall and Ceiling Industry

AWCMA	American Window Covering Manufacturers Association (Now WCMA)
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI, Inc.
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CEA	Consumer Electronics Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CPA	Composite Panel Association

CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet and Rug Institute (The)
CRRC	Cool Roof Rating Council
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association (Electrostatic Discharge Association)
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.

FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Part of GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydronics Institute
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
IAPSC	International Association of Professional Security Consultants
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers Association, Inc.
ICPA	International Cast Polymer Association
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGMA	Insulating Glass Manufacturers Alliance

ILI	Indiana Limestone Institute of America, Inc.
ISA	Instrumentation, Systems, and Automation Society, The
ISO	International Organization for Standardization Available from ANSI
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA (Now ETL SEMCO)
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LGSEA	Light Gauge Steel Engineers Association
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MCA	Metal Construction Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association

NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCMA	National Concrete Masonry Association
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NOMMA	National Ornamental & Miscellaneous Metals Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association

NTMA	National Terrazzo & Mosaic Association, Inc. (The)
PCI	Precast/Prestressed Concrete Institute
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SCAQMD	South Coast Air Quality Management District
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SIA	Security Industry Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane

	Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
TCNA	Tile Council of North America, Inc.
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)

WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN	Deutsches Institut fur Normung e.V.
IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.

DIN	Deutsches Institut fur Normung e.V.
IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Accessible Temporary Egress: Comply with applicable provisions in ICC A117.1.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

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

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

3.2 SUPPORT FACILITIES INSTALLATION

A. Install project identification and other signs in locations indicated to inform the public and persons seeking entrance to Project.

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

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

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

D. Install and maintain temporary fire-protection facilities. Comply with NFPA 241.

3.4 MOISTURE AND MOLD CONTROL

A. Before installation of weather barriers, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

1. Protect stored and installed material from flowing or standing water.
2. Remove standing water from decks.
3. Keep deck openings covered or dammed.

B. After installation of weather barriers but before full enclosure and conditioning of building, protect as follows:

1. Do not load or install drywall or porous materials into partially enclosed building.
2. Discard water-damaged material.
3. Do not install material that is wet.
4. Discard, replace, or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion.

C. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period.

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.

1. Show compliance with requirements for comparable product requests.
2. Architect will review the proposed product and notify Contractor of its acceptance or rejection.

C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.

D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.

E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
4. Store materials in a manner that will not endanger Project structure.
5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

F. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.

1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
2. Where products are accompanied by the term "as selected," Architect will make selection.
3. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:

1. Products:

a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.

2. Manufacturers:

a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.

3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.

C. Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

D. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Architect will consider Contractor's request for comparable product when the following conditions are satisfied:

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 EXECUTION REQUIREMENTS

A. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

B. Cutting and Patching:

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.2 CLOSEOUT SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

C. Operation and Maintenance Data: Submit one copy of manual.

D. PDF Electronic File: Assemble manual into a composite electronically indexed file. Submit on digital media.

E. Record Drawings: Submit one set of marked-up record prints.

F. Record Digital Data Files: Submit data file and one set of plots.

G. Record Product Data: Submit one annotated PDF electronic files and directories of each submittal.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

A. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

B. Submittals Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:

1. Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other sections, including project record documents, operation and maintenance manuals, property surveys, similar final record information, warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit maintenance material submittals specified in other sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect.
4. Submit test/adjust/balance records.
5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Advise Owner of changeover in heat and other utilities.
6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
7. Remove temporary facilities and controls.
8. Complete final cleaning requirements, including touchup painting.
9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1.4 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare final Certificate for Payment after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

2.2 OPERATION AND MAINTENANCE DOCUMENTATION

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize manual into separate sections for each system and subsystem, and separate sections for each piece of equipment not part of a system.

C. Organize data into three-ring binders with identification on front and spine of each binder, and envelopes for folded drawings. Include the following:

1. Manufacturer's operation and maintenance documentation.
2. Maintenance and service schedules.
3. Maintenance service contracts. Include name and telephone number of service agent.

4. Emergency instructions.
5. Spare parts list and local sources of maintenance materials.
6. Wiring diagrams.
7. Copies of warranties. Include procedures to follow and required notifications for warranty claims

2.3 RECORD DRAWINGS

A. Record Prints: Maintain a set of prints of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Mark to show actual installation where installation varies from that shown originally. Accurately record information in an acceptable drawing technique.

1. Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings.

1. Format: Annotated PDF electronic file.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

B. Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Verify compatibility with and suitability of substrates.
2. Examine roughing-in for mechanical and electrical systems.
3. Examine walls, floors, and roofs for suitable conditions.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Take field measurements as required to fit the Work properly. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.

E. Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.2 CONSTRUCTION LAYOUT AND FIELD ENGINEERING

A. Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks.

B. Engage a professional engineer to lay out the Work using accepted surveying practices.

C. Engage a professional engineer to prepare a final property survey showing significant features (real property) for Project.

1. At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
3. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations.

C. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

D. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed.

E. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.

F. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

G. Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

A. Provide temporary support of work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

D. Cutting: Cut in-place construction using methods least likely to damage elements retained or adjoining construction.

1. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

E. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will minimize evidence of patching and refinishing.
2. Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.
3. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

3.5 CLEANING

A. Clean Project site and work areas daily, including common areas. Dispose of materials lawfully.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
3. Remove debris from concealed spaces before enclosing the space.

B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
2. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.

3. Remove labels that are not permanent.
4. Clean transparent materials, including mirrors. Remove excess glazing compounds.
5. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances. Sweep concrete floors broom clean.
6. Vacuum carpeted surfaces and wax resilient flooring.
7. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and foreign substances. Clean plumbing fixtures. Clean light fixtures, lamps, globes, and reflectors.
8. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

3.6 OPERATION AND MAINTENANCE MANUAL PREPARATION

A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are unavailable and where the information is necessary for proper operation and maintenance of equipment or systems.

C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams.

3.7 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Include a detailed review of the following:

1. Include instruction for basis of system design and operational requirements, review of documentation, emergency procedures, operations, adjustments, troubleshooting, maintenance, and repairs.

END OF SECTION 01 70 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Action Submittals:

1. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

B. Informational Submittals:

1. Waste Reduction Progress Reports: Submit concurrent with each Application for Payment. Include total quantity of waste, total quantity of waste salvaged and recycled, and percentage of total waste salvaged and recycled.
2. Records of Donations and Sales: Receipts for salvageable waste donated or sold to individuals and organizations. . Indicate whether organization is tax exempt.
3. Recycling and Processing Facility Records: Manifests, weight tickets, receipts, and invoices.
4. Landfill and Incinerator Disposal Records: Manifests, weight tickets, receipts, and invoices.
5. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations.

C. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

D. Waste Management Plan: Develop a waste management plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

1. Salvaged Materials for Reuse: Identify materials that will be salvaged and reused.
2. Salvaged Materials for Sale: Identify materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: Identify materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Clean salvaged items and install salvaged items to comply with installation requirements for new materials and equipment.

B. Salvaged Items for Sale and Donation: Permitted on Project site.

C. Salvaged Items for Owner's Use: Clean salvaged items and store in a secure area until delivery to Owner.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs.

F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

3.3 RECYCLING WASTE

A. General: Recycle paper and beverage containers used by on-site workers.

B. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

C. Wood Materials:

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

D. Metals: Separate metals by type.

E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

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

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

3.4 DISPOSAL OF WASTE

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

B. Do not burn waste materials.

END OF SECTION 01 74 19

SECTION 01 81 13 - SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Definitions:

1. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

2. Recycled Content: The recycled content shall be determined by weight.

   a. "Post-consumer" material is defined as waste material generated by end users of the product, which can no longer be used for its intended purpose.
   b. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as scrap generated in a process that is reclaimed in the same process that generated it.

B. Submittals:

1. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for plumbing mechanical electrical and wood-based construction materials. Submit within 30 days of date established for commencement of the Work.
2. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product. Submit within 30 days of date established for commencement of the Work.
3. List of proposed regional materials. Submit within 30 days of date established for commencement of the Work.
4. List of proposed certified wood products. Submit within 30 days of date established for commencement of the Work.
5. Product Data.
6. Chain-of-custody certificates for certified wood products. Include statement of cost for each product.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide products and procedures necessary to meet requirements of this Section. Although other Sections may specify similar requirements, the Contractor shall determine additional materials and procedures necessary to comply with this Section.

B. Recycled Content of Materials: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 10 percent of cost of materials used for Project.

1. Do not include mechanical and electrical components in the calculation.

C. Regional Materials: Not less than 10 percent of building materials (by cost) shall be regional materials.

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

E. Certified Wood:

1. Wood or wood-based products shall be certified to the requirements of one of the following:

a. American Forest Foundation's "American Tree Farm System."
b. CSA Z809, "Sustainable Forest Management System Standards."
c. FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship" and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
d. Sustainable Forestry Initiative, Inc.'s "Sustainable Forestry Initiative."
e. Other product programs recognized by Programme for the Endorsement of Forest Certification schemes.

2.2 LOW-EMITTING MATERIALS

A. Adhesives and sealants shall comply with the following limits for VOC content:

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.

9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Single-Ply Roof Membrane Adhesive: 250 g/L.
20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, PTFE, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
21. Top and Trim Adhesive: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.
34. Single-Ply Roof Membrane Sealants: 450 g/L.
35. Other Sealants: 420 g/L.
36. Sealant Primers for Nonporous Substrates: 250 g/L.
37. Sealant Primers for Porous Substrates: 775 g/L.
38. Modified Bituminous Sealant Primers: 500 g/L.
39. Other Sealant Primers: 750 g/L.

B. Exterior adhesives and sealants shall comply with Green Seal's GS-36 and the following limits for VOC content:

1. Construction Adhesives: 75 g/L.
2. Reactive sealants: 50 g/L.
3. Other Caulks and Sealants: 30 g/L.
4. Contact Adhesives: 480 g/L.

C. Interior adhesives and sealants 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. Paints and coatings shall comply with the following limits for VOC content:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints, Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Clear Wood Finishes, Varnishes: 350 g/L.
9. Clear Wood Finishes, Lacquers: 550 g/L.
10. Floor Coatings: 100 g/L.
11. Shellacs, Clear: 730 g/L.
12. Shellacs, Pigmented: 550 g/L.
13. Stains: 250 g/L.

E. Composite wood and agrifiber products and adhesives shall not contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 REFRIGERANT REMOVAL

A. Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant.

3.2 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

B. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. (4 300 000 L) of outdoor air per sq. ft. (sq. m) of floor area while maintaining an internal temperature of at least 60 deg F (16 deg C) and a relative humidity no higher than 60 percent.

END OF SECTION 01 81 13

Division 02 – EXISTING CONDITIONS

SECTION 02 43 13.13 – BUILDING RELOCATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the methods, equipment and schedules necessary for the transportation of ECHO from Perth, ON to Irvine, CA and back.

1.2 SYSTEM DESCRIPTION

A. The building is comprised of two modules that will be temporarily mounted on double drop mini deck trailers for delivery and lifted onto a seismic pier anchored foundation.

B. The 2 trailers will be pulled by semi-trucks. The DOT has established these vehicle limits:102 inches wide, 13.5 feet in height, and 80,000 pounds gross weight. These limits can be exceeded as individual states have the right to issue temporary oversize and/or overweight permits.

C. The 2 trailers will be pulled by any standard Medium Duty 3/4 - 1 ton truck.

D. Design Requirements

1. ECHO is designed as two group of connectable parts, each of which shall not exceed the allowable dimensions of a flatbed truck, nor shall it exceed the allowable dimensions for highway transportation under federal highway laws. Each component does not exceed the 13 ft 6 in height from ground when resting on the bed of the truck[s].

2. The modules are designed to sit on standard 8’ wide trailers, which can legally be pulled by medium duty trucks. Both modules have been designed to fit within the 12 ft maximum dimension for oversize loads requiring one escort. A permit will be purchased prior to shipment.

1.3 SUBMITTALS

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

1.4 PERFORMANCE REQUIREMENTS

A. ECHO as a whole must perform identically before and after transportation and re-construction.

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

PART 2 - EXECUTION

2.1 QUALITY ASSURANCE

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

2.2 DELIVERY, STORAGE & HANDLING

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

B. Additional transportation:
1. Conditioned flower trucks for all plants.
2. One trailer towing two 20 ft shipping containers containing the deck modules and the exo-structure
3. Moving truck for furnishings

C. All trailers shall be wrapped with waterproof wrapping to protect the surfaces. For the two main house trailers, a temporary structure shall be constructed at marriage lines to protect the interior of the trailers.

2.3 INSTALLATION

A. ECHO and all of its components shall be disassembled, reassembled, packed, secured, and shipped by designated individuals in accordance with the specified instructions.

PART 3 - EXECUTION (Not Used)

END OF SECTION 02 43 13.13

Division 06 – WOOD, PLASTICS AND COMPOSITES

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: ICC-ES evaluation reports for Bluwood evaluation report, LVL evaluation report, Joist Hanger report, 5/8-inch threaded rod.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: All wood has been sourced through Lowes Canada and approved FSC pure

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: West Fraser LVL is designed as a solid-sawn lumber in accordance with the applicable code and the National Design Specification for Wood Construction (NDS). Allowable design values are as listed within the ICC-ES evaluation report. Maximum allowable member design values can be found in Table 1 of the report.

2.2 TREATED MATERIALS

A. Preservative-Treated Materials: BluWood studs.

1. Treated with Disodium Octaborate Tetrehydrate
2. Kiln-dried to a moisture content of 19%

B. Provide preservative-treated materials for items indicated on the drawings and the following:

1. Exterior framing in contact with steel siding.

2.3 FRAMING

A. Certified Wood: All wood has been sourced through Lowes Canada and approved FSC pure

B. Dimension Lumber:

1. Maximum Moisture Content: 15% moisture content for 2-inch nominal (38mm)
2. Non-Load-Bearing Interior Partitions: No.2 Spruce stud, 2-inch x 4-inch.
3. Framing Other Than Non-Load-Bearing Interior Partitions: No.2 Spruce stud

C. Laminated-Veneer Lumber: Manufactured with exterior-type adhesive complying with ASTM D 2559.

1. Manufacturers: West Fraser LVL 3100F_b-2.0E
2. Extreme Fiber Stress in Bending, Edgewise: 3100 psi
3. Modulus of Elasticity, Edgewise: 2,000,000 psi

D. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.

1. Manufacturer: West Fraser LVL
2. Material: Laminated-Veneer Lumber
3. Thickness: 1 ¾ inch (45mm actual)

2.4 MISCELLANEOUS LUMBER

A. Miscellaneous Dimension Lumber: No.2 Spruce, blocking, 15% percent maximum moisture.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: ½-inch plywood, Class A fire retardant coated

2.6 MISCELLANEOUS PRODUCTS

A. Fasteners:

1. Power-Driven Fasteners: 3-inch clipped head air nails.
2. Bolts: 5/8-inch threaded cold rolled steel bolts, nut welded to 1/8-inch stainless steel plate.

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

1. Manufacturers: Simpson Strong-Tie
2. HUTF/HUSTF Heavy Duty and double shear Joist Hangers, galvanized, 3½-inch for double hangers, 1 ¾-inch for single.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Leveled using laser level, squared, all members plumb, true to line, cut, and fitted. Blocking 4-foot o.c. from bottom of rim to fit sheathing.

B. Framing Standard: 24-inch (600mm) o.c. framing

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

1. CABO NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in the IBC, Table 9.23.3.4 “Nailing for Framing” in the OBC.

END OF SECTION 06 10 00

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. None required

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: All wood has been sourced through Lowes Canada and approved FSC pure

2.2 LUMBER

A. Certified Wood: All wood has been sourced through Lowes Canada and approved FSC pure

B. Interior Partition Framing: No.2 grade construction spruce studs, 2-inch x 4-inch and 2-inch x 6-inch, with 19% maximum moisture content.

C. Miscellaneous Dimension Lumber: No.2 grade spruce, with 19% maximum moisture content, for blocking.

2.3 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: ½-inch Plywood, Class A fire retardant coated

2.4 FASTENERS

A. Fasteners: 3 ½-inch resin coated commons, 2 ½-inch resin coasted commons

PART 3 - EXECUTION

3.1 INSTALLATION

A. Leveled using laser level, squared, all members plumb, true to line, cut, and fitted. Blocking set o.c. to attach to other units.

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

1. CABO NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in the IBC, Table 9.23.3.4 “Nailing for Framing” in the OBC.

END OF SECTION 06 10 53

SECTION 06 15 33 - WOOD PATIO DECKING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: All wood has been sourced through Lowes Canada and approved FSC pure

2.2 TREATED MATERIALS

A. Preservative-Treated Boards and Dimension Lumber:

1. Ecolife Stabilized Weather-Resistant Wood, AWPA approved

B. Provide preservative-treated materials for all exterior rough carpentry unless otherwise indicated, items indicated on Drawings, and the following:

.

1. Decking.

2.3 LUMBER

A. Certified Wood: All wood has been sourced through Lowes Canada and approved FSC pure

B. Dimension Lumber:

1. Maximum Moisture Content: 15 percent for 2-inch nominal (38-mm actual) thickness
2. Deck Framing: No.2 standard pressure treated spruce framing
3. Dimension Lumber Posts: No.2 Spruce-pine-fir 4-inch x 4-inch pressure treated posts.
4. Dimension Lumber Decking and Stair Treads: No.2 standard pressure treated spruce
5. Dimension Lumber Railing Members and Benches: No.2 hand selected pressure treated spruce

C. Boards:

1. Maximum Moisture Content: 15% percent.
2. Board Decking and Stair Treads: 5/4-inch Standard Treated Decking

D. Fasteners: Kreg 700-count #8 x 2 ½-inch Stainless Steel Square Drive Pan Head Deck/Patio Screws

E. Metal Framing Anchors:

1. Simpson Strong Tie, Structural Angle Irons. 3-inch x 5-inch x 40-foot in length, Prefinished Galvanized G-90, supported on 5/8-inch threaded 12-foot rod, ¼-inch Lag Bolted into Rim.

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's "Details for Conventional Wood Frame Construction" unless otherwise indicated.

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

1. 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.

D. Secure decking to framing with concealed decking fasteners.

E. Secure stair treads and risers by gluing and screwing to carriages. Countersink fastener heads, fill flush, and sand filler. Extend treads over carriages.

F. Railing Installation: Countersink fastener heads, fill flush, and sand filler.

1. Fit balusters to railings, glue, and screw in place.
2. Secure newel posts to stringers and risers with countersunk-head wood screws and glue.
3. Secure wall rails with metal brackets. Fasten freestanding railings to newel posts and to trim at walls with countersunk-head wood screws or rail bolts and glue.

END OF SECTION 06 15 33

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. No specific requirements

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Plywood Wall Sheathing: ½-inch Spruce Plywood Sheathing.

2.2 ROOF SHEATHING

A. Plywood Roof Sheathing: ½-inch Spruce Plywood Sheathing, structural.

2.3 SUBFLOORING AND UNDERLAYMENT

A. Subflooring:

1. Plywood Subflooring: ¾-inch Spruce plywood, structural, tongue and groove.

B. Underlayment:

1. Plywood Underlayment for Resilient Flooring: ½-inch Spruce plywood, exterior grade structural

2.4 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated.

1. 2-inch Phosphate coated common sinkers for walls, 2-inch and 3-inch flooring screws for subfloor

B. Adhesives for Field Gluing Panels to Framing: LEPAGE PL 400, meets or exceeds APA APF-01

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach to substrates, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in the IBC, Table 9.23.3.5 “Fasteners for Sheathing and Subflooring” in the OBC.

B. Fastening Methods:

   1. Subflooring:

      a. Glued and screwed to wood framing.

   2. Wall and Roof Sheathing:

      a. Screwed to wood framing.
      b. Roof complete with H-clips.

END OF SECTION 06 16 00

SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Fabricator Qualifications: Quality Assurance done independently through System ForeTruss Inc. Engineering firm. Centennial Truss is a member of the Lanark-Leeds Home Builders Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Analysis conforms to TPIC-COM, standard formula NBCC2005

2.2 MATERIALS

A. Lumber: No.2 Spruce

B. Minimum Chord Size for Roof Trusses: 2-inch x 4-inch for both top and bottom chords

C. Connector Plates: FT20 steel truss connector plates, 20 gauge, zinc G90 coating, 8 nail teeth per square inch, max factored resistance of 538-lbs/square inch.

1. Manufacturers: ForeTruss Systems Inc.

2.3 FABRICATION

A. All trusses manufactured by Centennial Trusses

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

B. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchor.

C. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses.

D. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Section 061000 "Rough Carpentry.", Section 061053 "Miscellaneous Rough Carpentry."

E. Install wood trusses within installation tolerances in TPI 1.

F. Do not alter trusses in field.

G. Remove wood trusses that are damaged or do not meet requirements and replace with trusses that do meet requirements.

END OF SECTION 06 17 53

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Samples for siding, 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.

2.2 EXTERIOR FINISH CARPENTRY

A. Lumber Siding: Kiln-dried, Eastern white select pine

1. Maximum Moisture Content: 19 percent.

2.3 INTERIOR STANDING AND RUNNING TRIM

A. Interior Softwood Lumber Trim: Finger Jointed Pine

1. Maximum Moisture Content: 19 percent.

2.4 FIRE-RATED INTERIOR DOOR FRAMES

A Frames, complete with casings, fabricated from solid fire-retardant-treated wood. Frames shall be labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, based on testing per NFPA 252.

1. Species: Solid Pine

2. Fire Rating: 20 minutes

2.5 SHELVING AND CLOTHES RODS

A. Shelving: 3/4-inch (19-mm) solid pine

B. Clothes Rods: 1-5/16-inch- (33-mm-) diameter, chrome-plated-steel tubes

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

2.6 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: hot-dip galvanized steel

PART 3 - EXECUTION

3.1 INSTALLATION

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

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

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

1. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

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

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

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

END OF SECTION 06 20 00

Division 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: BASF expandable Polystyrene beads report, Walltite Closed-Cell Polyurethane Foam Insulation evaluation

PART 2 - PRODUCTS

2.1 INSULATION PRODUCTS

A. Extruded-Polystyrene Board Insulation: SR.P100 type 1 graphite with ship lapped edges, SR.P400 type 4 graphite with ship lapped edges

1. Manufacturers: Styro Rail

B. Molded-Polystyrene Board Insulation: SR. 2-inch by 4-inch type 1 graphite with spacing at 24-inch o.c.

1. Manufacturers: Styro Rail

C. Closed-Cell Polyurethane Foam Insulation: Walltite superior insulation

1. Manufacturers: BASF Corporation

PART 3 - EXECUTION

3.1 INSTALLATION

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

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

C. Spray-Applied Insulation: Apply 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 items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs.

END OF SECTION 07 21 00

SECTION 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: Self-adhering, SBS rubberized asphalt compound laminated, Impermeable to air, vapor, and water. 1.6 ng/Pa.m^2.s (0.03 perms) vapor permeance

1. Products
   a. Henry; Blueskin SA LT

2.2 ACCESSORIES

A. Flexible Flashing: Self-adhering, SBS rubberized asphalt compound laminated, Impermeable to air, vapor, and water.

1. Products:
   a. Henry; Blueskin SA LT

B. Building Wrap Tape: Tuck Tape red sheathing house wrap tape, UV resistant poly propylene film.

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

END OF SECTION 07 25 00

SECTION 07 41 13 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Summary: Factory-formed metal roof panels, fasciae, and trim.

B. Submittals: Product Data

C. Warranties: Provide manufacturer's standard written warranty, without monetary limitation, signed by manufacturer agreeing to promptly repair or replace metal roof panels that fail to remain weather tight within 40 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL ROOF PANELS

A. Wind-Uplift Resistance of Roof Assemblies: UL 580, Class 90

B. Roof Panel Type: Exposed fastener, standing seam

1. Manufacturers: Ideal Roofing

C. Metallic-Coated Steel Roof Panels: Fabricated from galvanized lightweight structural-steel sheet, ASTM-A653 SS, Grade 80, Z275 (G-90)

1. Nominal Metal Thickness: 0.021 inch, 26 gauge
2. Finish: Manufacturer's standard, four coat protection, Charcoal color.

2.2 ACCESSORIES

A. Flashing and Trim: 0.025 inch galvanized steel flashing and trim

B. Self-Adhering Sheet Underlayment, High Temperature: SBS-rubberized asphalt; slip-resisting-polyethylene surfaced, silicone release film backing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Apply self-adhering sheet underlayment at eaves and rakes from edges of roof 24 inches inside exterior wall line.

B. Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

C. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.

1. Steel Roof Panels: Fasten with Galvanized screws with neoprene washers
2. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.

END OF SECTION 07 41 13

SECTION 07 46 23 – WOOD SIDING

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

B. Section includes the wood cladding for the exterior of ECHO as described in the construction documents.

1.3 SUBMITTALS

C. None

PART 2 - PRODUCTS

2.1 MATERIALS

A. Vertical tongue and groove clear pine siding
   1. Dimensions: 1-inch x 2.5-inch
   2. Area: 700 sq. ft.
   3. Coating: None
   4. Kiln-dried (KD) between 13 % to 19 % humidity and is FSC certified
   5. Low-volatile organic compounds (VOCs) water-based stains.

D. Horizontal tongue and groove clear pine siding
   1. Dimensions: 1-inch x 5-inch
   2. Area: 700 sq. ft.
   3. Coating: None
   4. Kiln-dried (KD) between 13 % to 19 % humidity and is FSC certified
   5. Low-volatile organic compounds (VOCs) water-based stains.

2.2 ACCESSORIES

B. Concealed fasteners: Galvanized Steel.

PART 3 - EXECUTION

3.1 INSTALLATION

E. Install wood in such a manner that horizontal lines are true and level and vertical lines are plumb.

F. Remove and replace any panels or components which are damaged beyond successful repair.

3.2 CLEANING

G. Remove all scrap and construction debris from the site.

END OF SECTION 07 46 23

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Shop Drawings

PART 2 - PRODUCTS

2.1 MATERIALS

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

B. Self-Adhering Sheet Underlayment, High Temperature: Butyl or SBS-modified asphalt; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F (116 deg C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.

1. Products:
   a. Henry Company; Blueskin PE200 HT.

C. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements.
1. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel.

2.2 ROOF SPECIALTIES

A. Gutters and Downspouts:

1. Manufacturers :Ottawa Valley Metal

2. Gutters: Manufactured in uniform section lengths, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish expansion joints, and expansion-joint covers.

   a. Gutter Style: Rectangular
   b. Prepainted, Zinc-Coated Steel: 0.028 inch (0.71 mm)
   c. Gutter Supports: Gutter brackets

B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) designed to snap into through-wall-flashing receiver and compress against base flashings with joints lapped.
   1. Formed Aluminum: 0.032 inch (0.81 mm)

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

C. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less 3/4 inch (19 mm) for wood screw

D. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 30 inches (762 mm) apart. Attach ends with rivets and seal with sealant to make watertight.

END OF SECTION 07 71 00

Division 08 – OPENINGS

SECTION 08 13 00 – METAL DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product data sheet.

PART 2 - PRODUCTS

2.1 Manufacturers: Only the following:

A. JELD-WEN, Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Quality Standard: WDMA I.S.1-A.

B. Fire-Rated Wood Doors: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at positive pressure according to NFPA 252 or UL 10C.

C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784 and installed in compliance with NFPA 105.

D. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

E. Door Hardware: Provide doors with three point locking door hardware.

F. Door Glazing: See Section 088000 “Glazing”.

2.3 FABRICATION AND FINISHING

H. Factory fit doors to suit frame-opening sizes indicated and to comply with clearances specified.

I. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.

J. Cut and trim openings to comply with referenced standards.

1. Factory install glazing in doors indicated to be factory finished.

K. Factory finish doors indicated for opaque finish with manufacturer's standard finish.

1. Sheen: Satin

2. Colour: Black

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors to comply with manufacturer's written instructions and WDMA I.S.1-A, and as indicated.

B. Align doors in frames with uniform clearances and bevels.

C. Clearances: As follows unless otherwise indicated:

1. 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
2. 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering.
3. 1/4 inch (6.4 mm) from bottom of door to top of threshold.
4. Comply with NFPA 80 for fire-rated doors.

D. Repair, refinish, or replace factory-finished doors damaged during installation, as directed by Architect.

END OF SECTION 08 13 00

SECTION 08 50 00 - WINDOWS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Architectural detail manual Casement window DF3103, Architectural detail manual Awning window DF3113

PART 2 - PRODUCTS

2.1 HYBRID VINYL WINDOWS

A. Manufacturer: JELD-WEN Inc.

B. Basis-of-Design Product: JELD-WEN; Casement window DF3103, Awning window DF3113

C. Window Types: The following types, as indicated on Drawings:

5. Casement.
6. Awning
7. Fixed.

D. Window Color: White interior, Black exterior

2.2 WINDOWS

A. Performance Requirements:

1. Performance Class: Energy Star zone D
2. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 1.14 W/sq. m x K (0.20 Btu/sq. ft. x h x deg F)
3. Solar Heat-Gain Coefficient: Must comply with Section 088000 "Glazing."

B. Trim: 1 ½” brickmould exterior trim, clear pine interior extension.

C. Glaze units with low-e coated, argon-filled, sealed insulating glass, complying with Section 088000 "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. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

C. Adjust operating panels, screens, and hardware to provide a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

D. Clean glass and aluminum and vinyl surfaces immediately after installing windows. Remove nonpermanent labels from glass surfaces.

END OF SECTION 08 50 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data Sheet

L. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated.

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

M. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

PART 2 - PRODUCTS

2.1 GLASS, GENERAL

A. Fire-Resistance-Rated Assemblies: Provide products that comply with NFPA 80 and are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for applications indicated.

B. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201. Provide safety glazing labeling where safety glass is indicated.

2.2 GLASS PRODUCTS

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

2.3 INSULATING-GLASS TYPES

A. Glass Type: Low-e-coated, clear insulating glass.

1. Overall Unit Thickness: 1 3/8 inch (35 mm), door glazing: 1 inch (25 mm)
2. Thickness of Each Glass Lite: 3.0 mm
3. Outdoor Lite: Float glass with low e coating.
4. Interspace Content: Argon

5. Middle Lite: Float glass with low-e-coating.
6. Interspace Content: Argon
7. Indoor Lite: Float glass with low-e-coating.
8. Visible Light Transmittance: 51 percent minimum.
9. U-Factor: 0.15 maximum.
10. Solar Heat Gain Coefficient: 0.50 maximum.

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.

1. Products: One of the follow

a. Dow Corning Corporation; 799.
b. GE Advanced Materials - Silicones; UltraGlaze SSG4000, UltraGlaze SSG4000AC.
c. May National Associates, Inc.; Bondaflex Sil 200 GPN, Bondaflex Sil 201 FC.
d. Polymeric Systems, Inc.; PSI-631.
e. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.
f. Tremco Incorporated; Proglaze SSG, Tremsil 600.

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.

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

END OF SECTION 08 80 00

Division 09 – FINISHES

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. Regular Type:

1. Basis-of-Design Product: G-P Gypsum; ToughRock Gypsum Board
2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

B. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Basis-of-Design Product: G-P Gypsum; ToughRock CD Ceiling Board

2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

2.3 GYPSUM TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C 1396/C 1396M.

1. Core: 1/2 inch (12.7 mm), regular type

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Basis-of-Design Product: G-P Gypsum; ToughRock Tape
2. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

3. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.

a. Basis-of-Design Product: G-P Gypsum; ToughRock Sandable Setting Compound

D. Joint Compound for Tile Backing Panels:

4. Basis-of-Design Product: G-P Gypsum; ToughRock Setting Compound.
5. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
6. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.5 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

END OF SECTION 09 29 00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data

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 Standard grade requirements in ANSI A137.1, "Specifications for Ceramic Tile."

B. Tile Type RF.CR.P03.1224: porcelain paver tile.

1. Manufacturers; Olympia Floor and Tile – Cromie Collection
2. Face Size: 12 by 24 inches
3. Thickness: ½ inch
4. Face: Plain with square edges
5. Finish: Mat, opaque
6. Color and Pattern: Charcoal
7. Grout Color: Grey

C. Tile Type[U072]: Glazed wall tile.

1. Manufacturers: U.S. Ceramic Tile
2. Module Size: 3 by 6 inches
4. Thickness: 5/16 inch (8 mm).
5. Face: Plain with cushion edges
6. Finish: Bright, opaque
7. Color and Pattern: White
8. Grout Color: Grey
9. Mounting: Pregrouted sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.

D. Tile Type[CMTLST1061]: Glazed wall tile.

1. Manufacturers: Ceragres Metal
2. Module Size: 0.6 by 3.9 inch

3. Thickness: 5/16 inch (8 mm).
4. Face: Plain with cushion edges
5. Finish: Bright, opaque
6. Color and Pattern: metal brick
7. Grout Color: white
8. Mounting: Pregrouted sheets of tiles factory assembled and grouted with manufacturer's standard white silicone rubber.

2.2 INSTALLATION MATERIALS

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

1. Thin-Set Mortar Type for Wood Subfloors: EGP latex-portland cement.

a. Manufacturers: Bostik, Inc.

2. Grout Type: Standard cement

a. Manufacturers: Bostik, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.

D. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

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: [TCA F141 (cement mortar bed with cleavage membrane)]

H. Interior Wall Tile Installation Method(s):

1. Bathtub/Shower Wall Installations, Wood Studs or Furring: [TCA B411 (cement mortar bed)]

END OF SECTION 09 30 00

SECTION 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.

2.2 FIELD-FINISHED WOOD FLOORING

A. Engineered-Wood Plank Flooring: HPVA EF, bonding agent contains no urea formaldehyde.

1. Manufacturers: DAVA
3. Species: Hickory
4. Grade: 3.5mm Hardwood, 10-ply yellow birch plywood
5. Thickness: 5/8 inches
6. Construction: 11 ply
7. Width: 6 inches
8. Length: Manufacturer's standard.
9. Edges: Beveled

B. Urethane Finish System: 10 coats of aluminum oxide, semi gloss finish

1. VOC Content:

a. Finish Coats and Floor Sealers: Not more than 350 g/L.
b. Stains: Not more than 250 g/L.

2. Low-Emitting Materials: Finish system materials 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."
3. Stain: Penetrating and nonfading type.

a. Color: Black Walnut

4. Floor Sealer: Pliable, penetrating type.

5. Finish Coats: semi-gloss

2.3 ACCESSORY MATERIALS

A. Fasteners: Stainless steel, fluted rod, gauge 16, according to ACNOR B 111-1974, Two nails per plank at 16”. First nail should be between 3/4” and 1” bottom of the board and the second at 2 1/2" of the upper plank.

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 ½ inch.

C. Engineered-Wood Flooring: Nail flooring to wooden subfloor.

END OF SECTION 09 64 00

SECTION 09 90 00 - PAINTING AND COATING

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 PAINT

A. Manufacturers; Mythic

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

1. Interior Painting Materials:

a. Primer Sealer, Institutional Low Odor/VOC: MPI #149.
b. Latex, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.
c. Latex, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.

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. Use interior paints and coatings that comply with the following limits for VOC content:

1. Flat Paints and Coatings: <11 g/L.
2. Primers, Sealers, and Undercoaters: <11g/L.

E. Colors: Not determined

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 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 for exterior painting and 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.

E. 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 PAINT APPLICATION SCHEDULE

A. Concrete, Nontraffic Surfaces:

3.4 INTERIOR PAINT APPLICATION SCHEDULE

A. Wood: Including wood trim.

1. Semi-gloss Institutional Low-Odor/VOC Latex: two coats latex primer for wood: MPI INT 6.3V.

B. Gypsum Board

1. Flat Institutional Low-Odor/VOC Latex: Two coats over low-odor/VOC primer/sealer: MPI INT 9.2M.

3.5 EXTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

A. Wood, non-traffic surfaces, including wood siding

1. Semitransparent Stain: Two coats: MPI EXT 6.2L.

B. Wood, traffic surfaces, including wood decks

1. Deck Stain over Wood Preservative: one coat over preservative: MPI EXT 6.5D.

END OF SECTION 09 90 00

Division 10 – SPECIALTIES

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

A. Manufacturers; Kohler

B. Toilet Tissue Dispenser:

1. Basis-of-Design Product: Finial Traditional toilet tissue holder
2. Type: Single-roll dispenser
3. Mounting: Surface mounted with concealed anchorage
4. Material: Chrome-plated zinc alloy
5. Operation: Non-control delivery with standard spindle
6. Capacity: Designed for 5-inch- (127-mm-) diameter-core tissue rolls

C. Glass Shower Doors:

1. Basis-of-Design Product: MAXX tub-shield 1 panel
2. Material and Finish: Aluminum, polished, clear anodized
3. Glass: Clear

D. Towel Bar:

1. Basis-of-Design Product: Kelston by Kohler
2. Description: 3/4-inch- (19-mm-) round tube with circular end brackets
3. Mounting: Flanges with concealed fasteners.
4. Length: 18 inches
5. Material and Finish: Polished aluminum

2.2 MATERIALS

A. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

B. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

C. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10 28 00

SECTION 10 28 19 - TUB AND SHOWER DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

Q. Submittals: Product Data and Shop Drawings.

R. Warranties: Provide 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 10 years.

PART 2 - PRODUCTS

2.1 TUB AND SHOWER DOORS

A. Manufacturers: Fleurco

B. Manufacturers listed below supply glazing and metal components for their products. Several other manufacturers who offer only the metal components are not listed but could be added.

C. Semi-Frameless Units: Provide metal-framed units, with hardware-supported glass doors that do not have metal framing.

D. Hardware-Supported Units: supported by fastened shelf

E. Door Operation: Swinging on hinges

1. Safety Clip System: screwed to frame

F. Fasteners: Manufacturer's standard, stainless steel or other non-corrosive fasteners.

2.2 MATERIALS

G. Glass Doors and panel Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.

H. Clear Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Kind FT.

1. Sandblasted

I. Glass Nominal Thickness: 10 mm

J. Framing: Aluminum

K. Hardware: Aluminum

L. Aluminum Finish: Polished, clear anodized

M. 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 10 28 19

Division 11 – EQUIPMENT

SECTION 11 26 00 - UNIT KITCHENS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 UNIT KITCHENS

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's Accessibility Guidelines and ICC A117.1.

B. Cabinets: Wood.

C. Countertop: Solid surfacing.

D. Wall Shields: Provide wall shields matching countertop at back wall and side walls between countertop splash and wall cabinets.

E. Sink: Drop in, stainless steel.

1. 39 3/8 inches (1000 mm) by 20 7/8 inches (5300 mm).

F. Faucet: Single-lever, European-style spout with pull-out spray.

G. 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install level, plumb, and true; shim as required, using concealed shims.

B. Anchor unit kitchens at ends and at not more than 36 inches (910 mm) o.c. Install anchors through reinforcing or blocking; use concealed fasteners.

C. Test, adjust, and verify operation of each appliance, plumbing fixture, and component of unit kitchens.

END OF SECTION 11 26 00

SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Allowances: See Section 012000 "Price and Payment Procedures" for appliance allowances.

B. 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.
2. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's Accessibility Guidelines ICC A117.1

C. Induction Cooktop: 30-inch (762-mm), built-in cooktop with four burner elements.

1. Manufacturers: GE

2. Color: Stainless

D. Electric Wall Oven: Built-in, single electric, self-cleaning wall oven with broiler unit.

1. Manufacturers: Whirlpool

2. Color: Stainless

E. Exhaust Hood: 30-inch (762-mm), suspended-island-canopy, recirculating, nonventing exhaust hood with three-speed automatic fan.

1. Manufacturers

2. Color: Stainless
3. Fan Control: Hood-mounted switch, with separate light switch.
4. Weatherproof roof cap with backdraft damper and rodent-proof screening.

F. Refrigerator/Freezer: Freestanding, frost-free two-door refrigerator with bottom-mounted freezer, baked-enamel-on-steel, ABS thermoplastic-copolymer interior cabinet liners.

1. Manufacturers:
   a. Fisher & Paykel.

2. Color: Stainless
3. Fresh Food Compartment Volume: 12.4 cu. ft. (0.44 cu. m)
4. Freezer Compartment Volume: 5.1 cu. ft. (0.15 cu. m)
5. Shelf Area: 2 adjustable glass shelves, 26 sq. ft. (2.42 sq. m)
6. Energy Performance: 440kWh/yr

G. Dishwasher: Built-in, undercounter, automatic dishwasher, sized to replace 24-inch- (610-mm-) base cabinet, 9 wash cycles with hot-air and heat-off drying cycles, stainless-steel tub and door liner, PVC-coated sliding dish racks.

1. Manufacturers:
   a. Fisher & Paykel.

2. Color: Stainless
3. Energy Performance: Energy star rated CEE tier 1

H. Clothes Washer: Freestanding, front-loading, automatic clothes washer with 4.3-cu. ft. capacity stainless-steel tub and 7 wash cycles including regular, delicate, and permanent press

1. Manufacturers:
   a. LG Appliances.

2. Color: Gray
3. Energy Performance: Energy Star, 110kWh/yr

I. Electric Clothes Dryer: Freestanding, front-loading clothes dryer, 7.1-cu. ft. capacity with stainless-steel interior.

1. Manufacturers:
   a. LG Appliances.

2. Color: Gray

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 21 – FIRE SUPPRESSION

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II

a. Component Importance Factor: 1.5.
b. Component Response Modification Factor: 3.0.
c. Component Amplification Factor: 1.0.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 150%.
4. Design Spectral Response Acceleration at 1-Second Period: 60%.

2.2 SLEEVES

A. Mechanical Sleeve Seals: Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. Galvanized-Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. PVC Pipe: ASTM D 1785, Schedule 40.

2.3 ESCUTCHEONS & FLOOR PLATES

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

2.4 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2.5 SEISMIC-RESTRAINT DEVICES

A. Channel Support System: MFMA-4, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

B. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face and matched to type and size of attachment devices used.

C. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

1. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

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. Sleeves:

1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

2. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
3. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

D. Escutcheons & Floor Plates:

1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
3. Install floor plates for piping penetrations of equipment-room floors.
4. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

E. Install unions at final connection to each piece of equipment.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.

B. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install bushing assemblies for anchor bolts, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

D. Install bushing assemblies for mounting bolts, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Do not damage existing reinforcing or embedded items during coring or drilling.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications

END OF SECTION 21 05 00

SECTION 21 10 00 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design and Installation Approval: Acceptable to authorities having jurisdiction.

B. Hydraulically design sprinkler systems according to NFPA 13.

C. Comply with NFPA 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.

C. Provide hangers, supports, and seismic restraints with UL listing and FM approval for fire-protection systems.

2.3 VALVES

A. Fire-Protection Service Valves: UL listed and FM approved, with 175-psig (1207-kPa) nonshock minimum working-pressure rating. Indicating valves shall be butterfly or ball type, bronze body, and integral indicating device with visual 115-V ac, electric, single-circuit supervisory switch indicator.

B. Gate Valves: UL 262, cast bronze, solid wedge, outside screw and yoke, rising stem.

C. Swing Check Valves, NPS 2 (DN50) and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc.

D. Alarm Check Valves: UL 193, 175-psig (1200-kPa) working pressure, designed for horizontal or vertical installation, with cast-iron, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, retarding chamber, fill-line attachment with strainer, and drip cup assembly.

E. Ball Drip Valves: UL 1726, automatic drain valve, NPS 3/4 (DN 20), ball check device.

2.4 SPRINKLERS

A. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 1626, for residential applications.

B. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

C. Sprinkler types include the following:

1. Upright, pendent, and sidewall sprinklers.
2. Quick-response sprinklers.

D. Sprinkler Finishes: White enamel and bronze.

E. Sprinkler Escutcheons: White enamel steel, one piece, semi-recessed; with finish to match sprinklers.

F. Sprinkler Guards: Wire-cage type, including fastening device.

G. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and one wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on Project.

2.5 PIPING SPECIALTIES AND ALARM DEVICES

A. Fire Department Connection: UL 405, flush, wall type, with cast-brass body; NH-standard thread inlets matching local fire department threads.

1. Finish: Polished chrome-plated.

B. Water-Motor-Operated Alarms: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- (250-mm-) diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 (DN 20) inlet and NPS 1 (DN 25) drain connections.

C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig (1725-kPa) pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

F. Pressure Gages: 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 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling

3.2 SERVICE-ENTRANCE PIPING

A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Connect sprinkler piping to water-service piping for service entrance to building.

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

E. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

A. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve.

B. Install sprinkler zone control valves, test assemblies, and drain headers adjacent to standpipes.

C. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

D. Install alarm devices in piping systems and connect to fire-alarm system.

E. Protect piping from earthquake damage as required by NFPA 13.

F. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Install gages to permit removal, and install where they will not be subject to freezing.

G. 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.

H. Install check valve in each water supply connection. Install backflow preventers in potable-water supply sources.

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

3.4 SPRINKLER SCHEDULE

A. Rooms without Ceilings: Upright sprinklers.

B. Rooms with Suspended Ceilings: Semi-recessed sprinklers.

C. Sprinklers Subject to Freezing: Upright, pendent, or sidewall, dry sprinklers as indicated.

D. Special Applications: Extended coverage or quick-response sprinklers as indicated.

E. Sprinkler Finishes: White enamel in finished spaces, rough bronze in unfinished spaces, and white in residential spaces. Provide escutcheons in finished and residential spaces.

F. Install sprinklers in suspended ceilings in center of long dimension of ceiling panels.

3.5 PIPING SCHEDULE

A. Use CPVC plastic pipe and fittings and metal-to-plastic transition fittings with solvent-cemented joints.

B. Pipe between Fire Department Connections and Check Valves: Use galvanized-steel pipe with flanged or threaded joints.

C. Install shutoff valve, check valve, pressure gage, drain, and other accessories indicated at connection to water service piping.

3.6 TESTING

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

END OF SECTION 21 10 00

Division 22 – PLUMBING

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL (Not Used)

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hangers and Supports for Plumbing Piping Equipment:

1. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

a. Design supports for multiple pipes capable of supporting combined weight of supported systems, and system contents.
b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
c. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.

2.2 PRESSURE GAGES AND TEST PLUGS

A. Direct-Mounted, Metal-Case , Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed Open-front, pressure relief type(s); cast aluminum or drawn steel .
3. Movement: Mechanical, with link to pressure element and connection to pointer.
4. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
5. Pointer: Dark-colored metal.
6. Window: Plastic.
7. Ring: Metal.

2.3 HANGERS AND SUPPORTS FOR PLUMBING PIPING EQUPMENT

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

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. Meters and Gages:

1. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
2. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
3. Adjust faces of meters and gages to proper angle for best visibility.

D. Install unions at final connection to each piece of equipment.

E. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.

3.2 HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.

B. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).

2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

3.3 GENERAL EQUIPMENT INSTALLATIONS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 22 05 00

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Coordination:

1. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

a. Motor controllers.
b. Torque, speed, and horsepower requirements of the load.
c. Ratings and characteristics of supply circuit and required control sequence.
d. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. 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.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.

a. Service Factor: 1.15.

2. Multispeed Motors: Variable torque.

a. For motors with 2:1 speed ratio, consequent pole, single winding.
b. For motors with other than 2:1 speed ratio, separate winding for each speed.

3. Rotor: Random-wound, squirrel cage.
4. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
5. Temperature Rise: Match insulation rating.

6. Insulation: Class F
7. Code Letter Designation:

    a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

8. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Polyphase Motors with Additional Requirements:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

E. Single Phase Motors:

1. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Used)

END OF SECTION 22 05 13

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

2.2 GENERAL-DUTY VALVES

A. Valve Sizes: Same as upstream piping unless otherwise indicated.

B. End Connections: Threads shall comply with ANSI B1.20.1. Flanges shall comply with ANSI B16.1 for cast-iron valves and with ANSI B16.24 for bronze valves. Solder-joint connections shall comply with ANSI B16.18.

C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

D. Bronze, Swing Check Valves: Class 125, bronze body with metal disc and seat.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use gate and ball valves for shutoff duty; globe and ball for throttling duty.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves for each fixture and item of equipment.

D. Install three-valve bypass around each pressure-reducing valve using throttling-type valves.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in a position to allow full stem movement.

G. Install check valves for proper direction of flow in horizontal position with hinge pin level.

END OF SECTION 22 05 23

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. For solvent cements and adhesive primers, documentation including printed statement of VOC content.
3. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1.2 FIELD CONDITIONS

A. Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service and do not proceed without written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components.

2.2 PIPES AND FITTINGS

A. PVC Plastic, DWV Pipe and Fittings: ASTM D 2665, Schedule 40, plain ends with PVC socket-type, DWV pipe fittings.

1. Adhesive Primer: ASTM F 656.

a. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent Cement: ASTM D 2564.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Comply with requirements in Section 220513 "Common Work Results for Plumbing" 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 220513 "Common Work Results for Plumbing" for wall penetration systems.

1. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

D. 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.

E. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

F. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

G. Comply with requirements in Section 220513 "Common Work Results for Plumbing" for basic piping joint construction.

H. Comply with requirements in Section 220513 "Common Work Results for Plumbing" for pipe hanger and support devices.

3.2 PIPE SCHEDULE

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

END OF SECTION 22 13 16

SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type and size of domestic-water heater indicated.

2. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.

B. Comply with performance efficiencies prescribed in ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings." Design certified by CSA, suitable for potable water and space heating applications.

2.2 WATER HEATERS, GENERAL

A. Insulation: Suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.

B. Anode Rods: Factory installed, magnesium.

C. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

D. Drain Valve: Factory or field installed.

2.3 ELECTRIC WATER HEATERS

A. Manufacturer: Rheem Manufacturing Company

B. Household, Storage, Electric Water Heaters: UL 174, 80-gal. (303-L) and 120-gal. (454-L) capacity; steel with 150-psig (1035-kPa) working-pressure rating. One electric, screw-in, immersion-type heating elements with adjustable thermostat and wiring arrangement with maximum 30-A circuit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temperature and pressure relief valves.

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 22 33 00

Division 23 – HVAC

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

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. Hangers and Supports for Plumbing Piping Equipment:

1. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

a. Design supports for multiple pipes capable of supporting combined weight of supported systems, and system contents.
b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
c. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 SLEEVES AND SLEEVE SEALS

A. Galvanized-Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. PVC Pipe: ASTM D 1785, Schedule 40.

C. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

D. Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

E. Stack-Seal Fitting: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2.4 ESCUTCHEONS AND FLOOR PLATES

A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.5 PRESSURE GAGES AND TEST PLUGS

A. Direct-Mounted, Metal-Case , Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed Open-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
3. Movement: Mechanical, with link to pressure element and connection to pointer.
4. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
5. Pointer: Dark-colored metal.
6. Window: Plastic.
7. Ring: Metal.
8. Accuracy: Grade C, plus or minus 3 percent of middle half of scale range.

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

2.6 HANGERS AND SUPPORTS FOR HVAC

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel
3. Galvanized Steel Unistrut with Pipe clamps for mounting pumps.

C. Fastener Systems:

1. Verify suitability of fasteners in this article for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
2. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
3. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

D. Miscellaneous Materials:

1. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

   a. Properties: Nonstaining, noncorrosive, and nongaseous.
   b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

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. Sleeves:

1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

2. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

    a. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

3. Install stack-sleeve fittings in new slabs as slabs are constructed.
4. Exterior Wall, Pipe Penetrations: Mechanical sleeve seals installed in steel or cast-iron pipes for wall sleeves.
5. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078446 "Penetration Firestopping."

D. Sleeve-Seal-System Installation:

1. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

E. Escutcheons & Floor Plates:

1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
3. Install floor plates for piping penetrations of equipment-room floors.
4. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

F. Install unions at final connection to each piece of equipment.

G. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.

H. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.

3.2 HANGERS AND SUPPORTS

A. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.

B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.

C. Install powder-actuated fasteners and mechanical-expansion anchors in concrete after concrete is cured. Do not use in lightweight concrete or in slabs less than 4 inches (100 mm) thick.

D. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

3.3 GENERAL EQUIPMENT INSTALLATIONS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

Mix and install grout for pump and other equipment base plates, and anchors. Place grout, completely filling equipment bases.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Coordination:

1. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

a. Motor controllers.
b. Torque, speed, and horsepower requirements of the load.
c. Ratings and characteristics of supply circuit and required control sequence.
d. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTOR CHARACTERISTICS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

1. Duty: Continuous duty at ambient temperature of 104 deg F (40 deg C) and at altitude of 3300 feet (1000 m) above sea level.

C. Single Phase Motors:

1. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
2. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

PART 3 - EXECUTION (Not Used)

END OF SECTION 23 05 13

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUBMITTALS:

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2.2 GENERAL-DUTY VALVES

A. Valve Sizes: Same as upstream piping unless otherwise indicated.

B. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions.

C. End Connections: Threads shall comply with ANSI B1.20.1. Flanges shall comply with ANSI B16.1 for ANSI B16.24 for bronze valves. Solder-joint connections shall comply with ANSI B16.18.

D. One-Piece, Brass Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 150-psig (2760-kPa) WSP rating and blowout-proof stem.

E. Two-Piece, Copper-Alloy Ball Valves: Bronze with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig (4140-kPa) minimum WOG noon-shock rating and blowout-proof stem.

F. Brass, Swing Check Valves: Class 125, brass body with metal disc and seat. Maximum working pressure 175-psig.

G. Pressure and temperature relief valve: ASME Rated, CSA Listed., bronze body with stainless steel spring, thermostat with a thermo-bonded coating.

H. Drain valve: Ball valve purge port. Solder inlet and solder outlet or solder inlet and female NPT outlet. Brass body with plated brass ball and Virgin PTFE seats.

I. Bronze Globe Valves: Threaded IPS bonnet, rising stem, bronze disc, bronze body, and threaded end connections.

J. Thermostatic tempering valve: Bronze body, solid wax hydraulic principle thermostat, solder connections, and adjustment cap.

K. Automatic diverting valve: 3 way motorized diverting zone valve, 120 VAC, NPT female or sweat connections. Forged brass body, stainless steel stem, EPDM seals, 300 psig pressure rating.

L. Backflow preventer: Two in-line independent check valves, captured springs, and replaceable check seats with intermediate relief valve. Bronze body construction, ball valve test cocks, fused epoxy coated cast iron body.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use gate and ball valves for shutoff duty; globe and ball for throttling duty.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves for each fixture and item of equipment.

D. Install three-valve bypass around each pressure-reducing valve using throttling-type valves.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in a position to allow full stem movement.

G. Install check valves for proper direction of flow in horizontal position with hinge pin level.

END OF SECTION 23 05 23

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

H. Submittals:

1. Product Data: For each type of product indicated.
2. For adhesives and sealants, documentation including printed statement of VOC content.

I. Quality Assurance: Labeled with maximum flame-spread index of 25 and maximum smoke-developed index of 50 according to ASTM E 84.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics:

1. Indoor Insulation and related materials: To be factory labeled designating maximum flame-spread index of 25 or less, and smoke-developed index of 50 or less according to ASTM E 84.
2. Outdoor Insulation and related materials: To be factory labeled designating maximum flame-spread index of 75 or less, and smoke-developed index of 150 or less according to ASTM E 84.

2.2 INSULATION MATERIALS

A. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

C. Mineral-Fiber Blanket Insulation: Comply with ASTM C 553, Type II and ASTM C 1290, Type I.

D. Mineral-Fiber, Pipe and Tank Insulation: Complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB; and having factory-applied ASJ. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in. /h x sq. ft. x deg F (0.042 W/m x K) or less.

E. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall, Partition, and Floor Penetrations: Install insulation continuously through penetrations. Seal penetrations. Comply with requirements in Section 078413 "Penetration Firestopping."

D. Flexible Elastomeric Insulation Installation:

1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Mineral-Fiber Insulation Installation:

1. Insulation Installation on Straight Pipes and Tubes: Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
4. Blanket and Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
5. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier.

F. Plenums and Ducts Requiring Insulation:

1. Concealed and exposed supply and outdoor air.
2. Concealed and exposed return air located in nonconditioned space.
3. Concealed and exposed exhaust between isolation damper and penetration of building exterior.

G. Plenums and Ducts Not Insulated:

1. Metal ducts with duct liner.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

H. Piping Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawlspaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.2 DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed duct insulation shall be[one of] the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.
2. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and [1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] thick and [3.75-lb/cu. ft. (60-kg/cu. m)] nominal density.

B. Exposed duct insulation shall be[one of] the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and [1.5-lb/cu. ft. (24-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] thick and [3.75-lb/cu. ft. (60-kg/cu. m)] nominal density.

3.3 HVAC PIPING INSULATION SCHEDULE

A. Chilled Water: Insulation shall be one of the following:

1. Flexible Elastomeric: [1/2 inch (13 mm)] thick.
2. Mineral-Fiber, Preformed Pipe, Type I or Pipe Insulation Wicking System: 1/2 inch (13 mm) thick.
3. Polyolefin: 1/2 inch (13 mm) thick.

B. Heating-Hot-Water Supply and Return: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe, Type I: 1/2 inch (13 mm) thick.

END OF SECTION 23 07 00

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL (Not Used)

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Hard Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) with ASME B16.22 wrought-copper solder fittings and ASTM B 32, 95-5 tin antimony solder.

C.

B. Unions: ASME B16.39, malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure, 250 deg F (121 deg C) maximum operating temperature.

D. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, ends.

E. PEX Pipe and fittings:
1. Pipe Material: PEX plastic according to ASTM F 876. For service at 100 psig (690 kPa) and 180 deg F (82 deg C).
2. Fittings: ASTM F 1807, plastic or metal insert and steel or copper crimp rings.

2.2 SPECIAL-DUTY VALVES

A. Safety Relief Valves: Brass or bronze body with brass and rubber, wetted, internal working parts; to suit system pressure and heat capacity; according to ASME Boiler and Pressure Vessel Code: Section IV.

2.3 HYDRONIC SPECIALTIES

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

B. Diaphragm-Type Expansion Tanks: 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

B. Install piping free of sags and bends and install fittings for changes in direction and branch connections.

C. Use the fewest number of joints belowground and within floor slabs.

D. Make reductions in pipe sizes using eccentric reducer fitting installed with level side up.

E. Install branch connections to mains using tee 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.

F. Install unions in pipes adjacent to each valve, at final connections with each piece of equipment, and elsewhere as indicated.

G. Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before soldering or brazing.

3.2 VALVE INSTALLATIONS

A. Shutoff Duty: Use gate or ball valves.

B. Throttling Duty: Use globe or ball valves.

C. Install shutoff-duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.

D. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple and cap.

F. Install check valves on each pump discharge and elsewhere as required to control flow direction.

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.

3.3 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.

3.4 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.

B. Condensate Drain Lines: PEX piping and fittings.

END OF SECTION 23 21 13

SECTION 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 HYDRONIC PUMPS

A. Close-Coupled, In-Line Centrifugal Pumps: Factory-assembled and -tested, overhung impeller, designed for installation with pump and motor shafts mounted horizontally or vertically. Rated for 1.9-psig (13.1-kPa) minimum working pressure and minimum continuous water temperature of 36 deg F (2 deg C).

1. Manufacturers: Grundfos Pumps Corporation.
2. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
3. 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.
4. Pump Shaft: Steel, with copper-alloy shaft sleeve.
5. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

B. Less Than 1/2 HP (373 W): Built-in thermal-overload protection.

C. 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. Install vertical in-line pumps on concrete bases.

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 and strainer on suction side of pumps.

I. Install nonslam check valve and throttling valve on discharge side of pumps.

END OF SECTION 23 21 23

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. Documentation indicating that duct systems and accessories comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
3. Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning." and Section 6.4.4 - "HVAC System Construction and Insulation."
4. Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
5. For adhesives and sealants, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

G. Comply with NFPA 96 for ducts connected to commercial kitchen hoods.

H. Comply with UL 181 for ducts and closures.

2.2 DUCTS

A. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip galvanized coating.
1. Spiral Duct; Nominal Diameters: 6”, 7”, 8”, 10”, 12”
2. Stack Duct; Nominal Sizes: 4” X 10”, 4” X 12”
3. Round Tee; Nominal Sizes: 6”X6”X6”, 8”X8”X7”, 10”X10”X10”, 12”X12”X12”
4. Duct Reducer; Nominal Diameters: 8” to 7”
5. Duct Increaser; Nominal Diameters: 7” to 8”, 10” to 12”
6. Round Elbow; 90 degreed, Nominal diameters: 6”, 7”, 8”
7. Rectangular Elbow; Sizes: 4” X 10”, 4” X 12”
8. Angle Boot; Nominal Sizes: 4” X 10”X 7”, 4” X 10” X 6”, 4” X 12” X 8”
9. Wye: Nominal Size: 10”X8”X8”
10. Universal Boot; Nominal Size: 4”X12”X8”

B. Fibrous-Glass Duct Board: Comply with UL 181, Class 1, 1-inch- (25-mm-) thick, fibrous glass with fire-resistant, reinforced foil-scrim-craft barrier, and having the air-side surface treated to prevent erosion.

C. Joint and Seam Tape, and Sealant: Comply with UL 181A.

D. Rectangular Metal Duct Fabrication: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Fibrous-Glass Duct Fabrication: Comply with SMACNA's "Fibrous Glass Duct Construction Standard."

2.3 ACCESSORIES

A. Volume Dampers and Control Dampers: Single-blade and minimal leakage rating. Round damper with 24-volt spring return damper motor used to control volume of circulating air. Spring open/power closed.

B. Flexible Connectors: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Flexible Ducts: Galvanized Round Flex Duct – 22 Gauge complying with UL 181, Class 1.

D. Intake Caps: Bowflex Intake Cap; Nominal Diameters: 6”

E. Exhaust Vent Cap: Bowflex Vent Cap; Nominal Diameters: 6”,4”

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.
4. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
6. Unconditioned Space, Exhaust Ducts: Seal Class C.
7. Unconditioned Space, Return-Air Ducts: Seal Class B.
8. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: 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.

C. Conceal ducts from view in finished and occupied spaces.

D. Avoid passing through electrical equipment spaces and enclosures.

E. Support ducts to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Hangers and Supports."

F. 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.

G. Install volume and control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.

H. Install fire dampers according to UL listing.

I. Install fusible links in fire dampers.

J. Clean new duct system before testing, adjusting, and balancing.

3.2 TESTING, ADJUSTING, AND BALANCING

A. Balance airflow within distribution systems, including submains, branches, and terminals to indicated quantities.

END OF SECTION 23 31 00

SECTION 23 34 23 - HVAC POWER VENTILATORS

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. Products shall be licensed to use the AMCA-Certified Ratings Seal.

B. Power ventilators shall comply with UL 705.

C. 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 BATHROOM VENTILATORS

A. Manufacturers: Air King Ventilation Products

B. Basis-of-Design Product: Air King-0.5 Sone 50 CFM White Bath Fan

C. Housing: Removable PC/ABS polymeric; dimensions 8 1/2 " x 9 1/8" x 4 3/4".
1. Wall-Mounting Units: Designed to mount in ceilings with at least 6” of clearance. The unit is mounted directly to the joist using a separate lock-in bracket (included with unit). The housing will mount through drywall thickness up to ¾”, with a rough-in opening of 8 ½” X 9 1/8”.

D. Fan Wheels: One piece polymetric wheel 5 1/8” diameter wide, with 48 fins.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing.

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted [**inside**] [**outside**] fan housing, factory wired through an internal aluminum conduit.
2. Grill: White, polymetric grill secured in place with torsion springs; removable. Dimensions – 10" X 10"
3. Duct collar: Plastic collar for 4" duct connection, comes with built non-metallic draft damper for quiet operation.

G. Capacities and Characteristics:

1. Airflow: 50 cfm (23.6 L/s).
2. Static Pressure: 0.1 inches wg **(0.025 kPa)**>.
3. Motor Horsepower: 0.038 horsepower.
4. Fan RPM: 1225.
5. Electrical Characteristics:

   a. Volts: 120 Volts
   b. Phase: Single
   c. Hertz: 60.

2.3 ENERGY RECOVERY VENTILATORS

A. Manufacturer: Venmar AVS ERV EKO 1.5 *Part no. 43911*

B. Accessories:

1. 2 ECM Motors: Thermally protected, insulation class B.
2. Polymerized paper energy recovery core.
3. 2 Washable Merv 7 core filters.

C. Capacities and Characteristics:

1. Airflow: 40-80cfm, 53-105cfm, 67-120cfm, 84-140cfm
2. Static Pressure: 0.4 in.w.g
3. Motor Horsepower:
4. Fan RPM: Variable Speed
5. Electrical Characteristics:

   a. Volts: 120.
   b. Phase: Single.
   c. Hertz: 60.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units with clearances for service and maintenance.

END OF SECTION 23 34 23

SECTION 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 SUPPLY

A. 12-inch by 4-inch Two-way sidewall register:

1. Manufacturers: Imperial
2. Basis-of-Design Product: Multi Shutter Register; Imperial; Two-way sidewall register
3. Material: Steel
4. Finish: Powder Coat Paint Finished
5. Mounting: Countersunk Screw

B. 10-inch by 4-inch Two-way sidewall register:

1. Manufacturers: Imperial
2. Basis-of-Design Product: Multi Shutter Register; Imperial; Two-way sidewall register
3. Material: Steel
4. Finish: Powder Coat Paint Finished
5. Mounting: Countersunk Screw

C. 8-inch by 4-inch Two-way sidewall register:

1. Manufacturers: Imperial
2. Basis-of-Design Product: Multi Shutter Register; Imperial; Two-way sidewall register
3. Material: Steel
4. Finish: Powder Coat Paint Finished
5. Mounting: Countersunk Screw

2.2 RETURN

D. 12-inch by 4-inch Sidewall Grille:

1. Manufacturers: Imperial
2. Basis-of-Design Product: Sidewall Grille; Imperial; 1/3” spaced fins at 20 degrees
3. Material: Steel
4. Finish: Powder Coat Paint Finished
5. Mounting: Countersunk Screw

E. 12-inch by 12-inch Sidewall Grille:

1. Manufacturers: Imperial
2. Basis-of-Design Product: Sidewall Grille; Imperial; 1/3” spaced fins at 20 degrees
3. Material: Steel
4. Finish: Powder Coat Paint Finished
5. Mounting: Countersunk Screw

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 23 37 13

SECTION 23 56 13.13 - HEATING, FLAT-PLATE SOLAR 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 the solar collectors, certifying compliance with SRCC OG-100 (Solar Rating and Certification Corporation).

B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace solar collectors that fail in materials or workmanship within 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hail Resistance: Able to withstand 1-inch- (25-mm-) diameter hail.

2.2 MANUFACTURERS

A. Manufacturers: EnerWorks, Inc.

2.3 COLLECTORS

A. Enclosure: Steel with Galvalume coating. Aluminum back sheet. Mineral fiber back insulation and isocyanurate foam edge insulation with a minimum thermal resistance (R-value) of R-5.8 on the back and R-7 on the sidewalls.

B. Absorber Plate: Aluminum sheet and copper tubes. Header and absorber tubes to be copper, NPS 3/4 (DN 65).

C. Glazing: Single-sheet, low-iron, tempered glass with textured finish. Gaskets to be UV-resistant EPDM with molded corners and extruded silicone grommets.

D. 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 high angle.

2.4 CAPACITIES AND CHARACTERISTICS

A. Area:

1. Gross: 30.92 sq. ft. (2.873 sq. m).
2. Net Aperture: 28.96 sq. ft. (2.691 sq. m).

B. Dry Weight: 111 lb (50 kg).

C. Fluid Type: 50/50 % (by vol.) propylene glycol.

D. Fluid Capacity: 0.5 gal. (1.9 L).

E. Test Pressure: 75 psig (517 kPa).

F. Maximum Operating Temperature: 405 deg F (207 deg C).

SRCC Certified Performance Rating (Water Heating, Cool Climate):

1. Clear Day at 2000 Btu/sq. ft. per Day (23 MJ/sq. m per Day): 25.5 kBtu/panel per Day (26.9 MJ/panel per Day).
2. Mildly Cloudy Day at 1500 Btu/sq. ft. per Day (17 MJ/sq. m per Day): 14.9 kBtu/panel per Day (15.7 MJ/panel per Day).
3. Cloudy Day at 1000 Btu/sq. ft. per Day (11 MJ/sq. m per Day): 5.1 kBtu/panel per Day (5.4 MJ/panel per Day)

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. After connecting the inlet and outlet of the collectors to the system, purge the system of all air.

D. 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.

END OF SECTION 23 56 13.13

SECTION 23 81 46 - WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

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

a. Include rated capacities, accessories and color charts for cabinet finishes.
b. Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace refrigeration components of water-source heat pumps that fail in materials or workmanship within ten years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. ASHRAE Compliance:

1. ASHRAE 15.
2. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
3. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

C. Comply with safety requirements in UL 484 and UL 1995.

2.2 COMPONENTS

A. Factory-assembled and -tested, packaged water-source heat pumps complete with controls.

B. Cabinet and Chassis: Galvanized-steel casing: Access panels for access and maintenance of internal components. Knockouts for electrical and piping connections. Glass-fiber liner, complying with UL 181.

C. Water Circuit: Refrigerant-to-water heat exchanger leak tested to 600 psig (4137 kPa) on refrigerant side and 450 psig (3102 kPa) on waterside. Factory mounted heat exchanger on resilient rubber vibration isolators.

D. Refrigerant Circuit Components: Sealed refrigerant circuit rated per ARI-ISO-13256. Service fittings on suction and liquid for charging and testing. Pilot-operated, sliding-type reversing valve with replaceable magnetic coil. ASTM B 743 copper refrigerant piping with wrought-copper fittings and brazed joints.

1. Filter-Dryer: Factory installed to clean and dehydrate refrigerant circuit.
2. Compressor: Installed on vibration isolators in an acoustically treated enclosure with anti-recycle timer; high- and low-pressure cutout, or loss of charge switch; and internal thermal-overload protection.

a. Freezestat stops compressor if water-loop temperature falls below 32 deg F (0 deg C).
b. Condensate overflow switch stops compressor with high condensate level in pan.

E. Basic Unit Controls: Low- and high-voltage protection. Overcurrent protection for compressor. Random time delay, three to ten seconds, starts on power-up. Control voltage transformer.

F. Electrical Connection: Single electrical connection.

G. Hose kits rated for minimum 350-psig (2413-kPa) working pressure, and operating temperatures from 35 to 180 deg F (2 to 82 deg C). Tag to equipment designations. Two-piece bronze body ball valves with stainless-steel ball and stem, and galvanized-steel lever handle. Y-type with blowdown valve in supply connection. Balancing device with meter ports to allow flow measurement with differential pressure gage. Automatic balancing valve. Controls in addition to those required for other options.

1. Thermostat Optional Features:

a. Concealed temperature set-point and indication.
b. Deg C indication.

2. Terminal Controller Options:

a. Scheduled operation for occupied and unoccupied periods on seven-day clock with minimum four periods per day.
b. Unoccupied period override.
c. Backup for volatile memory.

2.3 CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS (21 kW) AND SMALLER

A. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.

1. Manufacturers: WaterFurnance International, Inc.

B. Water Circuit: Refrigerant-to-water heat exchanger.

1. Domestic Water Heating: Refrigerant-to-domestic water heat exchanger shall be double-wall vented type with factory-mounted pump and controls.
2. Waterside Economizer: Copper tube and aluminum fin coil with three-way valve and entering-water temperature sensor and controller.
3. Water Regulating Valves: Limit water flow and control head pressure.

C. Refrigerant Circuit: Charge with R-410A refrigerant. Scroll compressor. Thermal expansion valve refrigerant metering device.

D. Control Options: Return-water temperature high-limit (firestat) to stop unit on high temperature.

E. Capacities and Characteristics:

1. Domestic Water Heat Exchanger (Option):

a. Heating Capacity: 22,200Btu/h (6.5kW).
b. Entering-Domestic Water Temperature: 104 deg F (40 deg C).
c. Domestic Water Flow: 5 gpm (0.32L/s).
d. Pressure Loss: 3 feet wg (9 kPa).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Connect supply and return hydronic piping to heat pump with hose kits.

B. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap.

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance.

END OF SECTION 23 81 46

SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: Include rated capacities, operating characteristics, furnished specialties, accessories, and color charts for cabinet finishes.
2. Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.2 FACTORY-ASSEMBLED UNITS

A. Manufacturers: Cancoil:

B. Basis-of-Design Product: Hydronic Air Handling Unit from Cancoil

C. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

D. Coil Section Insulation: 1/2-inch (13-mm) thick, foil-covered, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Main and Auxiliary Drain Pans: Plastic formed to slope from all directions to the drain connection as required by ASHRAE 62.1.

F. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

G. Cabinet: Stainless Steel with factory prime coating.

1. Vertical Unit Front Panels: Removable, steel, with stainless steel discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with cast-aluminum discharge grilles.
3. Stack Unit Discharge and Return Grille: Aluminum double-deflection discharge grille, and louvered- or panel-type return grille; color as selected by Architect from manufacturer's standard colors. Return grille shall provide maintenance access to fan-coil unit.
4. Steel recessing flanges for recessing fan-coil units into ceiling or wall.

H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

I. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

J. Cabinet Finish: Baked-enamel finish in manufacturer's standard paint color as selected.

K. Accessories:

1. Aluminum wall boxes with integral eliminators and insect screen.
2. Steel subbase, height as indicated.
3. Permanently lubricated, multispeed motor, resiliently mounted on motor board.
4. Steel recessing flanges for recessing fan-coil units into ceiling or wall.
5. Filters: 1-inch- (25-mm-) thick, throwaway filters in fiberboard frames with a MERV rating of 7.

L. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounting thermostat with the following features:

a. Heat-cool-off switch.
b. Fan on-auto switch.
c. Fan-speed switch.
d. Automatic changeover.
e. Adjustable deadband.
f. Concealed set point.

g. Concealed indication.
h. Degree C indication.

3. Wall-mounting temperature sensor.
4. Unoccupied-period-override push button.

M. Capacities and Characteristics:

1. Fan:

a. Airflow: 300 cfm.
b. External Static Pressure: 0.7 kPa.
c. Motor Horsepower: 0.223 horsepower

2. Cooling Capacity:

a. Total: 13648.6 (4) Btu/h (kW).
b. Sensible: 7370.23 (2.16) Btu/h (kW).
c. Entering-Air Dry-Bulb Temperature: 26.11 deg C.
d. Entering-Air Wet-Bulb Temperature -4.9 deg C.

3. Chilled-Water Coil:

a. Water Flow: 15 L/s.
b. Water-Side Pressure Loss: 5 feet wg.
c. Entering-Water Temperature: 10 deg C.

4. Heating Capacity:

a. Output: 3 kW.
b. Entering-Air Temperature: 18 deg C.
c. Air-Temperature Rise: 12 deg C.

5. Hot-Water Heating Coil:

a. Water Flow: 3.5 L/s.
b. H Water-Side Pressure Loss: 6 feet wg kPa.
c. Entering-Water Temperature: 50 deg C.

6. Electrical Characteristics:

a. Volts: 120.
b. Phase: Three.
c. Hertz: 60.
d. Full-Load Amperes: 1.3.
e. Maximum Circuit Ampacity: 1.3

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fan-coil units to comply with NFPA 90A.

B. Install units level and plumb and firmly anchored.

C. Connect to supply and return piping with shutoff valve and union at each connection.

D. Connect units to wiring systems and to ground.

END OF SECTION 23 82 19

Division 25 – INTEGRATED AUTOMATION

SECTION 25 05 00 – COMMON WORK RESULTS FOR INTEGRATED AUTOMATION

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data

B. Comply with NFPA 70, “National Electrical Code.”

PART 2 – PRODUCTS

2.1 MOUNTING

A. MK-III Mono Mount

B. Adjustable angle base footprint.

C. http://www.rainwise.com/products/attachments/6717/20060607034800.pdf

2.2 SHELF RACK

A. 2 X 4 X 12 #2 Prime Treated Lumber

B. Provide shading fascia continuous blocking support.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Prepare substrate by cleaning, filling voids, removing projections and sealing joints, or as otherwise recommended in manufacturer's written instructions.

B. Install products according to manufacturer's specifications.

C. Set mounting as flat roof mount on roof north-west corner.

D. Correct deficiencies or remove and reinstall materials that do not comply with requirements.

E. Repair, refinish, or replace substrate damaged during installation or transit.

END OF SECTION 25 05 00

SECTION 25 13 00 – INTEGRATED AUTOMATION CONTROL AND MONITORING NETWORK

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data

B. Comply with NFPA 70, “National Electrical Code.”

PART 2 – PRODUCTS

2.01 TEMPERATURE SENSORS

A. Thermocouple Wire – T Type, Duplex Insulated

B. http://www.omega.com/Temperature/pdf/GG_T_TC_WIRE.pdf

2.02 DATABASE COMPUTER

A. DGBox Hardware Box

B. Marvel Sheeva Core Embedded CPU @ 1.2 GHz with 4 GB internal micro-SD.

C. http://dglogik.com/dgbox

2.03 MICROCONTROLLER

A. Arduino Uno R3

B. ATmega328 microcontroller board with 14 digital pins and 6 analog inputs.

2.04 PHOTOVOLTAIC MONITOR

A. SPARQ’s Monitoring Solution

B. Online portal for real time performance data.

2.05 FLOWMETER

A. Omega FP-5600, Low Flow Sensor

B. http://www.omega.com/Green/pdf/FP5600_8500A.pdf

C. Long-Life Pulse Output Water or Glycol Flowmeter, ¾" NPT, FTB-4605

D. http://www.powerwisesystems.com/products/catalog1/sensors-and-flowmeters/flow-meter/

2.06 HUMIDITY SENSOR

A. Omega HX94 Relative Humidity/Temperature Transmitter

B. http://www.omega.com/Temperature/pdf/HX94.pdf

2.07 LIGHTING SENSOR

A. Regulvar TAP-17C

B. http://www.echoflexsolutions.com/files/8DC-0074%20TAP-17%20Datasheet.pdf

2.08 OCCUPANCY DETECTOR

A. Regulvar MOS-17C

B. http://www.echoflexsolutions.com/files/8DC-0276%20MOS-17C%20Datasheet.pdf

2.09 WEATHER STATION

A. RainWise MK-III RTI-LR Weather Transmitter

B. http://www.weathershack.com/products/rainwise/manuals/mk-III-rti-lr-manual.pdf

2.11 COMMUNICATION HUB

A. SPARQ Communication Hub

B. http://www.sparqsys.com/PDF/SPARQ_comm_hub_v.1.7.pdf

2.12 MOTORIZED SHADES

A. Somfy ILT 50 RTS motor

B. RTS motors for the MechoSystems Electro/2 double motor bottom/up roller shades.

2.13 WINDOW ACTUATOR

A. Marvel electronic window operator

B. http://www.truth.com/main/catalog/contents/HW47%20Marvel.r4.pdf.pdf

2.14 NETWORK INTERFACE

A. PowerWise IP-100/LR Network Interface

B. http://www.rainwise.com/products/attachments/6861/20111110091547.pdf

C. RTS Dry-Contact Interface

D. http://www.blindshademotors.com/documents/accessories-special-applications/rts-dry-contact-interface.pdf

2.15 WIRELESS SWITCH

A. Regulvar RW-PTM265

B. http://www.enocean-alliance.org/en/products/echoflex-solutions_ptm265/

C. RTS Transmitter wall switch

D. http://www.diversions-cda.com/pdf/Section_4_pages_41_45.pdf

2.14 WIRELESS RECEIVER

A. MechoSystems RTS wireless controller/receiver

B. http://www.diversions-cda.com/pdf/Section_4_pages_41_45.pdf

2.16 ROUTER

A. Can2Go UN2, Universal controller

B. http://www.can2go.com/documents/can2go_specs_un2.pdf

2.17 POWER CONSUMPTION MONITOR

A. Brultech GreenEye Power Monitor

B. http://www.greeneyemonitor.com/

2.18 LIGHTING RELAY

A. Regulvar ERDRC-CCR

B. http://www.enocean-alliance.org/en/products/echoflex-solutions_ERCRC-CC- 120/277_/_ERDRC-CC-120/3471/

2.19 SENSOR GATEWAY

A. Energy Server SafePlug Model 1703

B. provides ZigBee-to-Ethernet gateway, data logging, control, and plug-load identification.

2.20 Energy Manager Outlet

A. Energy Manager Duplex-Receptacle SafePlug Model 1203

B. http://www.cepro.com/images/products/155_spec_sheet_SafePlug_1203_Energy_Manager_outlet_ data_sheet.pdf

PART 3 – EXECUTION

3.1 INSTALLATION

A. Prepare substrate by cleaning, filling voids, removing projections and sealing joints, or as otherwise recommended in manufacturer's written instructions.

B. Install equipment according to manufacturer's specifications.

D. Correct deficiencies or remove and reinstall materials that do not comply with requirements.

E. Repair, refinish, or replace substrate damaged during installation or transit.

END OF SECTION 25 13 00

Division 26 – ELECTRICAL

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 DEVICES

A. Digital Time Switches

1. Products:

a. GE; In Wall 60 Minute Digital Count Down Timer (15263).

2. Contact Rating: 15-A, 120-V ac.
3. Multiple discreet set points.

B. Outdoor Photoelectric Switches: Solid state, with SPST or DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, and microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 15-second minimum.
3. Surge Protection: Metal-oxide varistor.

C. Indoor, Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit complying with UL 773A, with separate relay unit mounted on luminaire rated for 20-A ballast load at 120- and 277-V ac. Cadmium sulfide photoresistors are not acceptable.

1. Type: Passive infrared.
2. Voltage: 120/277 V.
3. Switch Rating: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac.
4. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx), with an adjustment for turn-on and turn-off levels within that range.
5. Time Delay: Adjustable from 5 to 300 seconds.
6. Set-Point Adjustment: With deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
7. Indicator: Two LEDs.

D. Indoor, Wall-Switch Occupancy Sensors:

1. Products:

    a. Echoflex; PIR Occupancy and Motion Sensor.

2. Type: Passive infrared.
3. Voltage: 120/277 V.
4. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
5. Time Delay: Adjustable up to 30 minutes.
6. Field of View: 180 degrees.
7. Minimum Coverage Area: 900 sq. ft. (84 sq. m).

E. Outdoor, Weatherproof Motion Sensors:

1. Type: Passive infrared.
2. Switch Rating:

    a. Lighting-Fixture-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent.
    b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac..

3. Voltage: 120/277 V.
4. Time Delay: Adjustable up to 15 minutes.
5. Detection Coverage: 180-degree field of view and 110-foot (34-m) detection range.

F. Lighting Contactors: Electrically operated and electrically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

C. Label time switches and contactors with a unique designation.

D. Verify actuation of each sensor and adjust time delays.

END OF SECTION 26 09 23

SECTION 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 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets; NEMA 250, Type 1.

B. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

C. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

D. 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, and listed and labeled for series-connected short-circuit rating by an NRTL.

E. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.3 PANELBOARDS

A. Mains: Circuit breaker.

B. Branch Overcurrent Protective Devices: Plug-in circuit breakers.

C. Main Service Panel:

1. Service panel for connecting the grid, Photovoltaic array and house branch circuits.
2. Schneider Electric – Square D

    a. Model Number: QP40200
    b. 200A Service Panel
    c. 40 Spaces
    d. 1 Phase, 3-Wire, 120/240VAC

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 408.

B. Comply with mounting and anchoring requirements specified in Section 260500 "Common Work Results for Electrical."

C. Mount top of trim 72 inches (1829 mm) above finished floor unless otherwise indicated.

D. Arrange conductors into groups; bundle and wrap with wire ties.

E. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory.

END OF SECTION 26 24 16

SECTION 26 27 13 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Shop Drawings.

B. Coordinate with utility companies for services and components they furnish.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

C. Meter Sockets: Comply with requirements of electrical power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

E. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with lugs only or disconnect device, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below:

1. Comply with requirements of utility company for meter center.
2. Housing: NEMA 250, Type 3R enclosure.
3. Minimum Short-Circuit Rating: 22,000 A symmetrical at rated voltage.
4. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.
5. Surge-Protective Device: Integrally mounted, complying with UL 1449 Type 1.
6. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house loadcenters and panelboards that have 10,000-A interrupting capacity.

a. Identification: Provide legend identifying tenant's address.
b. Physical Protection: Tamper resistant, with hasp for padlock.

7. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

END OF SECTION 26 27 13

SECTION 26 31 00 - PHOTOVOLTAIC COLLECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the photovoltaic collectors for ECHO.

1.2 REFERENCES

A. 2011 National Electrical Code (NEC) Article 690.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Eclipsall Energy Corporation

5900 Finch Avenue East

Toronto, Ontario, Canada M1B 5X7

Tel: (416) 716-3390

info@eclipsall.com

www.eclipsall.com

2.2 SYSTEM DESCRIPTION

A. The photovoltaic collectors are to be installed on the exo-structure of ECHO. The photovoltaic collectors (or solar panels) are to collect and convert solar energy into electricity.
   1. Performance Requirements: The installation of the photovoltaic collectors should be optimal for peak power production with grid-tied applications.
   2. Installation Requirements: Compliance with NEC Article 690.

2.3 PRODUCT

A. Eclipsall NRG 60M

B. Capacities and Characteristics:

1. 60 multi-crystalline photovoltaic cells connected in series.

2. Electrical Characteristics at STC (Standard Testing Conditions):
   a. Maximum Power Voltage (Vmp) : 30.42 V
   b. Maximum Power Current (Imp) : 8.53 A
   c. Open Circuit Voltage (Voc) : 37.81 V
   d. Short Circuit Current (Isc) : 8.85 A

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with the manufacturer's recommendations.

B. Connection the Photovoltaic system should be completed in compliance to NEC Article 690.

3.2 FIELD QUALITY CONTROL

A. Photovoltaic modules whose operation characteristics do not fall within the manufacturer's specifications shall be deemed defective.

B. Physically damaged Photovoltaic modules shall be subject to replacement.

3.3 ADJUSTING

A. Test and adjust the Photovoltaic module to ensure proper functionality in accordance with the manufacturer's specifications.

3.4 CLEANING

A. Clean energy generating surface of the Photovoltaic module to ensure maximum power generating capacity is achieved by removing obstructions of sunlight.

END OF SECTION 26 31 00

SECTION 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. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

D. Exterior Luminaires: Comply with UL 1598 and listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

E. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3 BALLASTS

A. Ballasts for Linear Fluorescent Lamps:

1. Electronic: Comply with ANSI C82.11; programmed-start type.

    a. Sound Rating: A, except B for T12/HO and T12/Slimline lamp ballasts.
    b. BF: 0.85 or higher.
    c. Power Factor: 0.98 or higher.

2. luminaires controlled by occupancy sensors shall have programmed-start ballasts.

3. Electromagnetic: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
4. For Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.
5. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures 0 deg F (minus 18 deg C) and higher.
6. Dimmer Controlled: Electronic type.

    a. Dimming Range: 100 to 5 percent of rated lamp lumens.
    b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

B. Ballasts for Compact Fluorescent Lamps: Electronic programmed rapid-start type, complying with ANSI C 82.11.

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. BF: 0.95 or higher unless otherwise indicated.
5. Power Factor: 0.95 or higher.

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 Section 260500 "Common Work Results for Electrical."

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

F. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

G. Adjust aimable lighting fixtures to provide required light intensities.

END OF SECTION 26 50 00

Division 28 – ELECTRIC SAFETY AND SECURITY

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes smoke detectors, fire alarm signaling, power and signal wires and cables.

1.2 SYSTEM DESCRIPTION

A. Fire alarm system with interconnect alarm signaling.

B. Power supply consisting of a hardwired connection to 120V AC with a rechargeable lithium-ion battery backup.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Kidde
   1. Silhouette (Model Number: KN-SMFM-I-CA)

B. Substitutions: Permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install 14-3 AWG minimum size conductors for fire alarm power supply and interconnection.

B. Mount outlet boxes to house the wiring and mount the devices.

C. Conform to NFPA 72 for installation of the devices.

3.2 FIELD QUALITY CONTROL

A. Test the device functionality in accordance with NFPA 72 and local fire code requirements.

END OF SECTION 28 31 00

Division 48 – ELECTRICAL POWER GENERATION

SECTION 48 19 19 - ELECTRICAL POWER GENERATION INVERTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes all information for the Photovoltaic power inverters for ECHO.

1.2 SYSTEM DESCRIPTION

A. The Photovoltaic inverters are of the “Microinverter” size classification.

B. The Photovoltaic inverters are to be installed such that each Photovoltaic module is connected to its own Photovoltaic inverter (microinverter) to convert the direct-current (DC) into alternating-current (AC) compatible with the local utility.

1.3 SUBMITTALS

A. Product Data.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. SPARQ Systems Inc.
116 Barrie Street
Kingston, Ontario
CANADA
K7L 3J9
P: 1-613-533-3438
E: support@sparqsys.com
W: www.sparqsys.com

2.2 PRODUCT

A. SPARQ Microinverter

1. Compliant with UL 1741, IEEE 1547

2. Maximum Output Power: 215 Watts
3. Warranty: 25 Years

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the Enphase Engage cable by sizing and cutting it to the appropriate length. Cap off the end of the cable using the water tight sealing caps. Connect the beginning of the cable to the rooftop pass-through enclosure. Attach the Engage cable to the racking using the cable clips. Then Engage cable should be adjusted to ensure a flush position in the wire channel of the racking.

B. Fasten a microinverter at the centre position for each Photovoltaic panel.

C. Attach the grounding conductor to the microinverter exterior.

D. Connect the microinverter to the Engage.

E. Note the serial number and the position of each microinverter in the array for future reference and set up of the Envoy monitor.

F. Cap off any unused connectors.

G. Verify system completeness, safety and microinverter functionality.

END OF SECTION 48 19 19

A STRUCTURAL CALCULATIONS

Structural Design Narrative

General

Echo is an energy efficient single storey structure comprised of repetitive wood framed members spaced at 24" o.c. Special considerations have been made to allow for higher levels of insulation than are required by governing building codes and specifically the use of vacuum insulation panels. The structure incorporates a shallow slope roof, a continuous perimeter header and is constructed in two seperate modules to be shipped via flat bed trailers.

Foundation System

A temporary foundation is included in this structural analysis for use during construction and at Orange County Great Park during Solar Decathlon 2013. The foundation system as designed is not intended to be used as a permanent foundation upon completion of the competition. A permanent foundation is to be designed for the permanent resting location according to the local building code utlizing the post saddle on APPENDIX A - EXOSTRUCTURE SHOP DRAWING S-909.

External Structures

The external roof structures are purpose built to support Echo's photovoltaic array and provide shading. The external structures have not been considered in the following analysis. The external structure is to be independently supported and not attached to the main framing of the house is any structural manner.

Analysis

Structural analysis was conducted assuming all loads are acting on the building in it's as assemblied state. Individual modules are not designed to withstand all loads indepently.

Structural Design

Applicable Building Codes and Standards

The following building codes and design standards were used to conduct the structural analysis of Echo:

A. U.S. DOE Solar Decathlon 2013 Draft Building Code: Updated May 14, 2013
B. 2009 International Residential Code (IRC)
C. 2006 Ontario Building Code (OBC)
D. 2005 Canadian Wood Council Wood Design Manual (WDM)
E. ASCE-7-10 Minimum Design Loads for Buildings and Other Structures
F. International Building Code

The largest specified design load taken from the above codes and standards was used as the governing design load for structural calculations. When referring to the International Residential Code, Orange County Great Park was used as the site location. When referring to the Ontario Building Code, Ottawa Ontario was used as the site location.

Roof Deflection	Deflection in the roofing structural members is limited to the length of the member divided by 360. This is done according to the WDM to allow the installation of gypsum or plaster board without the risk of cracking.
Floor Deflection	Deflection in the floor structural members is limited to the length of the member divided by 180 to avoid noticable movement in the floor.
Deck Deflection	Deflection in the deck members was limited to the length of the member divided by 240 for full serviceability load as per the WDM. The members are also limited to a deflection of the member length divided by 360 for the live load component only.
Renovation and Expansion Revision	This structural analysis does not make consideration for extensive renovations or expansion built in the future.

Design Information

Design Information

The design loads below are the governing loads for each of the categories from the above mentioned codes and standards. The process of applying the governing loads and subsequently analysing the structure has been performed in accordance with the 2006 Ontario Building Code.

Snow Factors: Ottawa

S_s	2.4	kPa	[50 psf]
S_r	0.4	kPa	[8 psf]
C_b	0.8		
C_w	1		
C_s	1		
C_a	1		
I_s	1		
S	$I_s [S_s(C_b*C_w*C_s*C_a) + S_r]$		

Gravity Loads

Design Loads

Floor

Dead:			
1/2" plywood	0.06	kPa	[1 psf]
Type 4 EPS	0.07	kPa	[1 psf]
Type 1 EPS	0.01	kPa	[0 psf]
VIP	0.03	kPa	[1 psf]
2 lb spray foam 2" thick	0.02	kPa	[1 psf]
Partitions	1	kPa	[21 psf]
Radiant floor	0.1	kPa	[2 psf]
Interior Finishes	0.8	kPa	[17 psf]
	2.09	kPa	[44 psf]
Live:	2.4	kPa	[50 psf]

Roof

Dead:			
Metal cladding (16 Ga)	0.16	kPa	[3 psf]
Grace Ice and water shield	0.01	kPa	[0 psf]
1/2" plywood	0.06	kPa	[1 psf]
Type 4 EPS	0.07	kPa	[1 psf]
Type 1 EPS	0.01	kPa	[0 psf]
VIP	0.04	kPa	[1 psf]
2 lb spray foam 2" thick	0.02	kPa	[1 psf]
Allowance for M and E	0.25	kPa	[5 psf]
Ceiling finish	0.12	kPa	[3 psf]
	0.74	kPa	[15 psf]
Live:	0.90	kPa	[19 psf]
Snow:	2.32	kPa	[48 psf]
Wind (Structural Components):	-0.80	kPa	[-17 psf]
Wind (Components and Cladding):	-1.90	kPa	[-40 psf]

Lateral Loads

Seismic

Site Class	D		
Importance Factor	1		
Project City:	Irvine, California		
S_s	1.75	g	
F_a	1		
S_1	0.6	g	
F_v	1.5		
C_s	0.18		
R	6.5		
V	25233	N	[5673 lbf]

Base Shear; Static, Governing Conditions

North/South (governing direction)

V_{base}	25.2	kN	[5665 lbf]
M_{base}	94.7	kN	[21289 lbf]

Wind

Exposure Category	C		
Basic Wind Speed	85	mph	
Method 1: Simplified Design			
λ	1.21		
K_{zt}	1		
I	1		
ps_{30} determined according to figure 6-2			
p_{net} determined according to figure 6-3			
Wind (Structural Components):	0.67	kPa	[14 psf]
Wind (Components and Cladding):	1	kPa	[21 psf]

North/South (governing direction)

V_{base}	41.87	kN	[9413 lb]
M_{base}	89.2	kN.m	[65800 ft.lb]

1.0 Structural Glossary

D	=	Dead Load
E	=	Modulus of Elasticity
EI	=	Combination of Modulus of Elasticity and Moment of Inertia
EsI	=	Bending Stiffness
I	=	Moment of Inertia
J_n	=	Nail Diameter Factor
J_{sp}	=	Species Factor for Framing Material
K_d	=	Load duration Factor
K_e	=	Effective Length
K_h	=	System Factor
K_l	=	Lateral Stability Factor
K_s	=	Service Condition Factor
K_t	=	Treatment Factor
KΔ	=	Deflection Factor
l	=	Cantilevered Length of Beam
L	=	Live Load
L	=	Length
L_d	=	Depth of Diaphragm
M_f	=	Max Moment
M'_f	=	Max Moment due to Lateral Loading
M_r	=	Moment Resistance
nf	=	Number of Fasteners
P_e	=	Eulers Buckling Load
P_f	=	Factored Compression
P_r	=	Compression Resistance
P'_r	=	Fixed Percentage of the Maximum Compressive Load, Pr.
S	=	Snow Load
SLS	=	Serviceability Limit States
T_f	=	Factored Tensile Force
T_r	=	Factored Tensile Resistance
ULS	=	Ultimate Limit States
V	=	Base shear force for seismic loading
V_d	=	Specified Shear Strength per Unit Length for Shear Walls or Diaphragms
V_f	=	Factored Shear Force
V_r	=	Shear Resitance
W	=	Wind Load
w	=	Point Load
w_f	=	Uniformly Distibuted Load

w_r	=	Maximum Compressive Load
w'_r	=	Fixed Percentage of the Maximum Compressive Load
Δ	=	Total Deflection
ΔL	=	Deflection Due to Lateral Load
Δt	=	Total Lateral Deflection

2.0 Roof Analysis

2.1 Wind Load

ULS	-0.80 kPa	[-17 psf]
SLS	-0.72 kPa	[-15 psf]

These loads were calculated using the IBC and ASCE

Since the loads are negative it will be used to design the anchors for the roof

2.2 Load combinations for ULS

OBC - table 4.1.3.2. and WDM - table 1.2

Principal Loads		Companion Loads		Total
1.4 *D	1.40 kPa			
1.25*D + 1.5*L	2.69 kPa	0.5*S	1.16 kPa	3.85 kPa
1.25*D + 1.5*S	4.73 kPa	0.5*L	0.48 kPa	5.23 kPa (governs)
1.25*D +1.4*W	0.13 kPa	0.5*S	1.16 kPa	1.29
1.0*D+1.0*E		0.25*S	0.58 kPa	

Total design Load ULS **5.23 kPa** **[109 psf]**

3.3 Load combinations for SLS

Principal Loads		Companion Loads		
1.0*D	1.00 kPa			
1.0*D + 1.0*L	1.96 kPa	0.5*S	1.04 kPa	3.00 kPa
1.0*D +1.0*S	3.09 kPa	0.5*L	0.48 kPa	3.59 kPa (governs)
1.0*D +1.0*W	0.28 kPa	0.5*S	1.04 kPa	1.32 kPa

Total design load SLS **3.59 kPa** **[75 psf]**

3.0 Roof Joists

w_f	=	3.18	kN/m	[218 lb/ft]
L	=	3.16	m	[10.4 ft]
Weight	=	0.04	kN/m	[2.74 lb/ft]
Max Moment	=	$w_f*L^2/8$		
	=	4.02	kN.m	[2967 lb.ft]
Max Shear	=	$w_f*L/2$		
	=	5.09	kN	[1144 lb]

South Module:
An engineered roof truss will be designed to meet the applied loads.
See drawing Appendix B: Engineered Wood Truss Shop Drawing - S-912

North Module:
To be constructed with a tapered 2x12 SPF No.1/No.2

M_r	=	5.72	kN.m
V_r	=	10.60	kN

The tapered member has been checked at critical section

Check 2x12 tapered section

L/360	=	8.79	mm	[0.36 in]
M_r	=	5.72	kN.m	[46554 lb.ft]
V_r	=	10.60	kN	[19022 lb]
w	=	2.19	kN/m	[7840 lb]
EI	=	7.04E+11	MPa	[1900000 lb/ft^2]
Δ	=	$5wl^4/(384EI)$		
	=	4.05	mm	[0.17 in]

Notes:
The critical section for moment in the tapered setion is located mid-span. The height at this point is 245 mm.
Moment resistance was conservatively chosen as the resistance corresponding to 38 x 235.
The critical section for shear is located at the lower end of the tapered section, 203 mm.
Shear resistance was conservatively chosen as the resistance corresponding to 38 x 184.

Acceptable - the deflection does not exceed the L/360 limit

4.0 Header

Cantilevered section governs the design of the continuous header

M_f	=	6.28	kN.m
V_f	=	9.79	kN
Δ (cantilever)	=	0.55	mm

Notes:

w_f from WDM: Beam overhang one support pg. 571.

Check deflection of 2-2x10 members No.1/No.2 SPF

L/360 for cantilever	=	3.42	mm	[0.13 in]
M_r	=	8.99	kN.m	[6630 lb.ft]
V_r	=	19.40	kN	[4361 lb]

Notes:

Mr from WDM - built-up beam selection tables pg. 74

Vr from WDM - built-up beam selection tables pg. 74

Acceptable - the deflection does not exceed the L/360 limit

5.0 Beam

The center beam is sized to support half the load on one of the modules

w_f	=	8.80	kN/m	[603 lb/ft]
L	=	5.79	m	[19 ft]
Weight	=	0.23	kN/m	[15.9 lb/ft]
Max Moment	=	$d*L^2/8$		
	=	37.86	kN.m	[27900 lb.ft]
Max shear	=	d*L/2		
	=	26.15	kN	[5880 lb]

Notes:

Weight is for a 2-ply 1 3/4" x 14" Laminated Veneer Lumber beam

Check 2-ply 1 3/4" x 14" LVL 3000Fb - 1.9E

L/360	=	16.08	mm	[0.63 in]
M_r	=	63.08	kN m	[46554 lb.ft]
V_r	=	84.62	kN	[19022 lb]
w	=	3.46	kN/m	[7840 lb]
E	=	13100	MPa	[1900000 lb/in^2]
I	=	3.33E+08	mm^4	[800 in^4]
Δ	=	$5wL^4/(384EI)$		
	=	11.62	mm	[0.43 in]

Notes:

Mr is from West Fraser's LVL users guide pg. 6

Vr is from West Fraser's LVL users guide pg. 6

w is an unfactored distributed snow load on the roof

E is from West Fraser's LVL users guide pg. 6

I is from West Fraser's LVL users guide pg. 6

Acceptable - the deflection does not exceed the L/360 limit

6.0 Structural Stud Wall (Interior) (SW1)

Wind Load	=	0.48	kPa	[10 psf]
Wall Height	=	2.8	m	[9.19 ft]
Stud Spacing	=	0.61	m	[24 in]
Factored Wind Load	=	0.41	kN/m	[28.1 lb/ft]
Factored Roof Load	=	8.83	kN/m	[606 lb/ft]
Pf	=	5.39	kN	[1210 lb]

Note:

Factored wind load is multiplied by a factor of 1.4 and the stud spacing

Factored roof load is multiplied by the tributary area for the structural wall

Assuming 3 m height of the wall and using the stud wall selection tables a 2x6 SPF No.1/No.2 is sufficient

P'_r	=	9.63	kN
w'_r	=	1.63	kN/m

Note:

Selection table used is from WDM pg.195

7.0 Structural Stud Wall (Exterior) (S2)

Wall Height	=	2.77	m	[9.09 ft]
Stud Spacing	=	0.61	m	[24 in]
Live Loads				
ULS	=	1.01	kPa	[21.1 psf]
SLS	=	0.91	kPa	[19 psf]
Dead Loads				
Roof	=	1	kPa	[20.9 psf]
Wall Weight	=	0.17	kPa	[3.55 psf]
Interior Finishes	=	0.6	kPa	[12.54 psf]
Cabinets	=	1	kPa	[10.9 psf]
Total	=	1.17	kPa	[24.39 psf]
Combined Loading				
Lateral Wind Pres.	=	1.01	kPa	[21.08 psf]
Snow Load per m	=	3.92	kN/m	[269 lb/ft]
Dead Load per m	=	7.59	kN/m	[521 lb/ft]

Notes:

ULS is referenced previously using the loading from the ASCE components and cladding

SLS is referenced previously using the loading from the ASCE components and cladding

Load Case 1:		=	1.25D + 1.5S + 0.4W	
		=	15.37 kN/m	[1054 lb/ft]
	P_f	=	9.37 kN	[2110 lb/ft]
	w_f	=	0.25 kN/m	[17 lb/ft]
Load Case 2:		=	1.25D + 1.4W + 0.5S	
		=	11.45 kN/m	[785 lb/ft]
	P_f	=	6.98 kN	[1570 lb]
	w_f	=	0.86 kN/m	[59 lb/ft]
Check 2x6 SPF No.1/No.2				
	P'_r	=	9.63 kN	
	w'_r	=	1.63 kN/m	

Notes:

w_f is the wind load multiplied by the stud spacing and a factor of 0.4 for Case 1

w_f is the wind load multiplied by the stud spacing and a factor of 1.4 for Case 2

8.0 Lintels for Bending

Largest Lintel	=	1.83	m	[6 ft]
Factored Wind Load	=	1.41	kPa	[3880 psf]
Tributary Width	=	1.37	m	[4.48 ft]
Wind Load per m	=	1.93	kN/m	[132 lb/ft]
Max Moment	=	0.81	kN.m	[600 ft.lb]
Mr	=	1.44	kN.m	[1060 ft.lb]

Notes:

Mr is from WDM - joist selection tables pg. 39

The lagest lintels is satisfactory in bending at 1-ply

9.0 Column (C1)

Tributary Beam L	=	1.2	m	[3.9 ft]
Column Height	=	2.8	m	[9.2 ft]
Factored Load	=	8.83	kN/m	[605 lb/ft]
Wind Load	=	0.67	kPa	[14 psf]
Factored Wind Load	=	1.13	kN/m	[113 lb/ft]
P_f	=	10.6	kN	[2383 lb]
M'_f	=	1.10	kN.m	[1216 ft.lb]
Esl	=	1.7E+11	$N.mm^2$	[4.1E+05 $lb.ft^2$]
ΔL	=	$5*w*l^4/(384*ESI)$		
	=	5.30	mm	[0.30 in]
P_e	=	$pi^2*Esl/(K_e*L)^2$		
	=	229.15	kN	[4.7E+04 lb]
Δt	=	$\Delta L*(1/(1-P_f/P_e))$		
	=	5.56	mm	[0.26 in]
M_f	=	$M'_f+P_f*\Delta t$		
	=	1.16	kN.m	[988 ft.lb]

Notes:

Factored load is the factored load from the roof multiplied by the tributary area for column

P_f is the factored load multiplied by the tributary beam length

Esl is from WDM built up beam selection tables

K_e is for a pinned-pinned connection

Check 2-ply 2x6 No.1/No.2

$P_f/P_r + M_f/M_r <=1$

P_r	=	17.7	kN	[4000 lb]
M_r	=	4.06	kN.m	[3000 ft.lb]
$P_f/P_r + M_f/M_r$	=	0.89		

Notes:

P_r is from WDM - Built-up column selection tables pg. 146

M_r is from WDM - built up beam selection tables pg. 74

Since $P_f/P_r + M_f/M_r$ is less than 1, a 2-ply 2x6 column is acceptable

10.0 Column (C2)

Tributary Beam L	=	1.71	m	[5.6 ft]
Column Height	=	2.8	m	[9.2 ft]
Factored Load	=	8.83	kN/m	[605 lb/ft]
Wind Load	=	1.01	kPa	[21.1 psf]
Factored Wind Load	=	2.42	kN/m	[164 lb/ft]
Pf	=	15.10	kN	[3372 lb]
M'f	=	2.37	kN.m	[2490 ft.lb]
Esl	=	2.5E+11	$N.mm^2$	[6E+05 $lb.ft^2$]
ΔL	=	$5*w*l^4/(384*Esl)$		
	=	7.74	mm	[0.43 in]
Ke	=	1		
Pe	=	$pi^2*Esl/(K^e*L)^2$		
	=	3.15E+05	N	[7E+04 lb]
Δt	=	$\Delta L*(1/(1-P_f/P_e))$		
	=	8.13	mm	[0.47 in]
Mf	=	$M'_f+P_f*\Delta t$		
	=	2.49	kN.m	[2680 ft.lb]

Notes:

Factored load is the factored load from the roof multiplied by the tributary area for column

P_f is the factored load multiplied by the tributary beam length

Esl is from WDM built up beam selection tables

K_e is for a pinned-pinned connection

Check 3-ply 2x6 No.1/No.2

$P_f/P_r + M_f/M_r <=1$

P_r	=	56	kN	[1.3E+04 lb]
M_r	=	6.09	kN.m	[6280 ft.lb]
$P_f/P_r + M_f/M_r$	=	0.68		

Notes:

P_r is from WDM - Built-up column selection tables pg. 146

M_r is from WDM - built up beam selection tables pg. 74

Since $P_f/P_r + M_f/M_r$ is less than 1 a 3-ply 2x6 column is acceptable

11.0 Floor Analysis

11.1 Loads

Live	=	2.4 kPa	[50 psf]
Dead	=	2.1 kPa	[44 psf]
Wind	=	0.1 kPa	[10 psf]

11.2 Load Combinations for ULS

Principal Loads		Companion Loads		Totals	
1.4 *D	2.94 kPa			2.94 kPa	
1.25*D + 1.5*L	6.23 kPa	0.4*W	0.05 kPa	6.28 kPa	(governs)
1.25*D + 1.5*S	2.63 kPa	0.5*L	1.20 kPa	3.83 kPa	
1.25*D +1.4*W	2.81 kPa	0.5*L	1.20 kPa	4.01 kPa	
1.0*D+1.0*E		0.5*L	1.20 kPa	1.20 kPa	
		Total design Load ULS		**6.28 kPa**	**[131 psf]**

11.3 Load Combinations for SLS

Principal Loads		Companion Loads		Totals	
1.0*D	2.10 kPa			2.10 kPa	
1.0*D + 1.0*L	4.50 kPa	0.5*S	0 kPa	4.50 kPa	(governs)
1.0*D +1.0*S	2.10 kPa	0.5*S	0 kPa	2.10 kPa	
1.0*D +1.0*W	2.24 kPa			2.24 kPa	
		Total Design Load SLS		**4.50 kPa**	**[105 psf]**

12.0 Floor Joists

w_f	=	3.83	kN/m	[262 lb/ft]
L	=	3.16	m	[10.4 ft]
Weight	=	0.005	kN/m	[0.3 lb/ft]
Max Moment	=	$w_f*L^2/8$		
	=	4.78	kN.m	[3500 lb.ft]
Max Shear	=	$w_f*L/2$		
	=	6.05	kN	[4460 lb]

Notes:

Weight is for a 1.75" x 7.25" LVL

Check 1.75" x 7.25" LVL 3100 Fb - 2.0 E

M_r	=	9.45	kN.m	[6967 ft.lb]
V_r	=	21.9	kN	[4925 lb]
L/180	=	17.56	mm	[0.72 in]
joist spacing	=	0.61	m	[24 in]
E	=	13790	MPa	
I	=	2.33E+07	mm^4	[56 in^4]
Δ	=	$5*w*l^4/(384*ESI)$		
	=	6.22	mm	[0.29 in]

Notes:

L/180 is from WDM - section 2.1 pg. 15

E is from West Fraser's LVL users guide pg. 6

I is from West Fraser's LVL users guide pg. 6

Δ is calculated for the effects of live load only

Acceptable - the deflection does not exceed the L/180 limit

13.0 Floor Rim Joist

Following similar procedure for section to section 4.0 of the structural analysis the floor rim joist was designed to meet the maximum allowable deflection.

The rim joist is oversized to eliminate deflection during craning of the modules. Note also that the load from the roof was considered on the floor rim joist.

Rim joist in the floor will be a 2-ply 1.75" x 7.25"

14.0 Mechanical Room Considerations

Increased loads in mechanical room

Dead Load	=	2.1	kPa	[44 psf]
Live Load	=	4	kPa	[83.5 psf]
Area of Mech. R.	=	3	m^2	[32.3 ft^2]
ULS	=	8.75	kPa	[183 psf]
Joist Spacing	=	0.61	m	[24 in]
Load per meter	=	5.3	kN/m	[360 lb/ft]
L	=	3.16	m	[10.4 ft]
Max Moment	=	6.68	kN.m	[4927 ft.lb]
Max Shear	=	8.44	kN	[1900 lb]

Notes:

Live load includes 2 - 450L water tanks

Check 2 - ply 1.75" x 7.25" LVL 3100 Fb - 2.0 E

M_r	=	18.9	kN.m	[13934 ft.lb]
V_r	=	43.8	kN	[9850 lb]
L/180	=	17.56	mm	[0.7 in]
w	=	12.8	kN	[2880 lb]
E	=	13790	MPa	
I	=	4.66E+07	mm^4	[112 in^4]
Δ	=	$5*w*l^4/(384*E_S I)$		
	=	6.22	mm	[0.24 in]

Notes:

M_r is from West Fraser's LVL users guide - canada pg. 6

V_r is from West Fraser's LVL users guide - canada pg. 6

$E_s I$ is from WDM - joist selection tables pg. 39

The 2-ply joists are acceptable

15.0 Subflooring (06 16 36.A1)

Live Load	=	2.4 kPa	[50 psf]
Plywood Thickness	=	18.5 mm	[0.73 in]
Support Spacing	=	600 mm	[23.6 in]

Notes:

Plywood thickness is taken from WDM - sheathing selection (Floors) pg. 21

Support spacing assumes 600 mm is referencing 24" o.c. as seen else where

3/4" T&G required as per design

16.0 Seismic Loading on Wall Section

V	=	25.2 kN	[5670 lb]
W_{tot}	=	140.6 kN	[31600 lb]

Analysis according to OBC 4.1.11 (6)

F_t	=	$0.07*T_a*V$	
	=	262 N	[59 lb]
T_a	=	$0.05*h_n^{3/4}$	
	=	0.15	
h_n	=	4.27 m	[15 ft]
F_x	**=**	**$(V-F_t)*W_xh_x/sum(W_ih_i)$**	
W_1	=	1E+05 N	[22.5E+06 lb]
h_1	=	0.61 m	[24 in]
W_2	=	2722 kN	[6.1E+05 lb]
h_2	=	4.27 m	[14 ft]
F_1	=	21.7 kN	[4880 lb]
F_2	=	3.27 kN	[735 lb]

Notes:

F_t was calculated using OBC - 4.1.8.11 (6)

T_a was calculated using OBC - 4.1.8.11 (3)

F_1 is the siesmic load on the 1st floor

h_1 is taken at 2' for the foundation height

F_2 is the siesmic load on the roof

h_2 is taken at 12'

Both seismic loads are divided by two as the loads are shared by two exterior walls

$F_1/2$	=	10.9 kN	[2451 lb]
$F_2/2$	=	1.6 kN	[360 lb]
$F_t/2+F_1+F_2$	=	12.6 kN	[2830 lb]

17.0 Shear Force Due to Wind

Wind Loading	=	0.67	kPa	[14 psf]
Factored W. Load	=	0.93	kPa	[19.4 psf]
South Wall Area	=	44.8	m^2	[483 ft^2]

Point load due to wind on south wall

	=	41.9	kN	[9420 lb]

Load on each of the 4 corners

	=	10.5	kN	[2360 lb]

Total load on East or West wall

V_f	=	20.9	kN	[4700 lb]

Note:

This load governs in the design of shearwalls along the east and west walls

Check sheathing SPF 12.5 mm, 3" nail length, nail spacing 100 mm

V_r	=	8.05	kN/m	[552 lb/ft]
L_w	=	2.743	m	[7.88 ft]

Shearwall resistance

$= V_r * L_w$

	=	22.08	kN	[4964 lb]

Notes:

V_r is taken from WDM - shearwall selection table pg. 488

V_r is greater than V_f therefore the specified sheathing can be used along east and west walls

Point load due to wind on east or west wall

	=	21.06	kN	[4735 lb]
East Wall Area	=	22.57	m^2	[243 ft^2]

Load on each of the 4 corners

	=	5.265	kN	[1184 lb]

Total load on north and south walls

	=	10.53	kN	[2367 lb]

Note:

The seismic loading governs for the design of shear walls along the north and south side

17.1 Uplift at the ends of the shear wall on the east side (governing case)

Wind load at the top corner			
	=	10.5	kN
Dead load of shear wall			
	=	1.79	kN
Length of shear wall			
	=	2.74	m
Height of shear wall	=	2.77	m
Uplift	=	9.72	kN

Note:

Simpson strong tie with adequate resistance has been provided at the bottom corners of the shearwalls

18.0 Diaphragm Design

Wind Load	=	0.67	kPa	[14 psf]
Factored W. Load	=	0.93	kPa	[19.4 psf]

Wind load governs in the north-south direction

= Factored wind load * south wall height/2

= 1.61 kN/m [110 lb/ft] (governs)

Seismic forces in the east-west direction

= seismic force on the roof/Length of south wall

= 0.52 kN/m [36 lb/ft]

Wind load in the east-west directions

= 1.56 kN/m [107 lb/ft]

18.1 Shear force along east and west wall

w_f	=	1.61	kN/m	[110 lb/ft]
L	=	12.8	m	[42 ft]
L_d	=	6.33	m	[20.8 ft]

V_f = w_f*L/(2*Ld)

= 1.63 kN/m [112 lb/ft]

18.2 Shear force along north and south wall

w_f	=	1.56	kN/m	[107 lb/ft]
L	=	6.33	m	[20.8 ft]
L_d	=	12.8	m	[42 ft]

V_f = w_f*L/(2*L_d)

= 0.39 kN/m [27 lb/ft]

Notes:

V_f is from WDM - shearwall and diaphragm design pg. 462

Design of sheathing:

12.5 mm plywood with 3.25 mm diameter nails (2" long minimum).
The plywood layout is for case 2 for the wind load north-south and case 4 for the wind load east-west.
Using an unblocked diaphragm with nails spaced at 150 mm at the diaphragm and at all edges, the factored resistance for both loads is:

V_r	=	3.16 kN/m	[217 lb/ft]

Sheathing design is acceptable because V_r is larger than the max shear force as seen along the east-west wall.

Notes:

V_r is from WDM - diaphragm selection tables pg. 466
2" nails spaced 300 mm o.c. along itermediate framing members is required.
Nails must not be placed within 9 mm of the panel edge or over-driven by 15% of the
of the panel thickness. WDM - 9.2 diaphragm design.
This is assuming that the 1" XPS is not there.

18.3 Chords and Struts

w	=	1.63 kN/m	[112 lb/ft]	
L	=	12.8 m	[42 ft]	
h	=	6.33 m	[20.8 ft]	
M_f	=	$w*L^2/8$		
	=	33.4 kN/m	[2290 lb/ft]	joists resist moment alogn beam
$P_f = T_f$	=	M_f/h		
	=	5.27 kN	[1180 lb]	

Check 1 - 2x10 No.1/No.2

T_r	=	48.6 kN	[10900 lb]
P_r	=	86.7 kN	[19500 lb]

Notes:

T_r is from WDM - tensile resistance selection tables pg. 162
P_r is from WDM - post selection table pg.109

18.4 Moment Resistance of the Fasteners When the Force is From North/South

We are checking if the fasteners can ultimately transfer the load resisted by the diaphragm to the framing below.

Factored W. Load	=	0.94 kPa	[19.6 psf]
Wind Load per m.	=	1.72 kN/m	[118 lb/ft]
Load per Joist	=	1.05 kN	[236 lb]
Joist Spacing	=	0.61 m	[24 in]
M_f	=	26.7 kN.mm	[19700 ft.lb]
Moment arm	=	25.4 mm	[1 in]
S_x	=	$pi*d^3/32$	
	=	5.18 mm^3	[0.3E-03 in^3]
d	=	3.75 mm	[0.15 in]
F_y	=	200 Mpa	[4.2E+06 psf]
M_f	=	26.6 kN.mm	[19600 ft.lb]
Number of nails	=	M_f/M_r	
	=	29	
Spacing	=	220 mm	[8.7 in]

Notes:

The diaphragm design specifies nail spacing at 150 mm o.c. and so it wil govern.

The nails need a minimum penetration of 38 mm (1.5") and so specify a minimum of 3" with a diameter no less than 0.148"

19.0 Check Joist Hangers Over Open Space in Living and Kitchen Area

Check joist hangers over open space in living and kitchen area

Total load on joist hanger				
	=	5.11	kN	[1150 lb]
Uplift of the roof				
	=	-1.9	kPa	[-39.7 psf]
Factored uplift on the roof				
	=	2.67	kPa	[55.8 psf]
Factored uplift on one joist				
	=	0.74	kPa	[15.5 psf]
Dead load per joist				
	=	1.53	kN	[343 lb]
Total uplift				
	=	3.96	kN	[890 lb]
Uplift for one joist hanger				
	=	1.98	kN	[445 lb]

Note:

Need joist hangers with a normal factored resistance greater than 5.1 kN and 2 kN in uplift.

Use joist hangers at all joist connections due to uplift force.

Suggested connector:

Simpson Strong-tie LUS210

Uplift	=	4.47	kN	[1005 lb]
Snow	=	5.8	kN	[1305 lb]
Roof	=	6.29	kN	[1415 lb]

20.0 Check Connection of Beams Running East/West to North/South Walls for Uplift

Uplift per meter along South and North walls

= 4.5 kN/m [308 lb/ft]

Dead load per meter along these beams

= 1.25 kN/m [86 lb/ft]

Total uplift of these beams

= 3.3 kN/m [226 lb/ft]

Note: Simpson Stong Tie with adequate strength has been provided to account for uplift of wall and beam sections

21.0 Blu Wall Section (S2)

This is a non-load bearing wall and will be anchored at the top and bottom.
It will also be fastened at all openings, windows and doors.

Wind Load	=	1.01	kPa	[21.1 psf]
Fact. Wind Load	=	1.41	kPa	[29.4 psf]
Wind Load p. m	=	0.43	kN/m	[29.5 ft/lb]
Length of Member	=	1.65	m	[5.4 ft]
Max Moment	=	0.15	kN.m	[110 ft.lb]

Check a 2x3 Blu Wall Moment Resistance

Φ	=	0.9		
f_b	=	8.6	MPa	[180000 psf]
K_d	=	1.15		
K_h	=	1.1		
K_{sb}	=	1		
K_t	=	1		
F_b	=	$f_b*(K_d*K_h*K_{sb}*K_t)$		
	=	10.88	MPa	[227000 psf]
K_{zb}	=	1.7		
b	=	38	mm	[1.5 in]
h	=	63.5	mm	[2.5 in]
S	=	$b*h^2/6$		
	=	15282	mm^3	[0.93 in^3]
K_l	=	1		
M_r	=	$\Phi*F_b*S*K_{zb}*K_l$		
	=	0.25	kN.m	[184 ft.lb]

Notes:

Φ is from WDM - 5.5.4.1

f_b is from WDM - Table 5.3.1A

K_d is from WDM Table 4.3.2.2 short term is 1.15

K_h is from WDM - Table 5.4.4.

K_{sb} is from WDM - Table 5.4.2

K_t is from WDM - Table 5.4.3 assumed preservative treated

K_{zb} is from WDM - Table 5.4.5

K_l is from WDM pg.35

Acceptable since M_r is greater than Max Moment for member length of 1.65 m.

Max Unsupported Length allowed

L_{max} = sqrt (M_r * 8 / 0.43)

= 2.15 m [7.05 ft]

Therefore the max unsupported length of a single Blu Wall member is 2.15 m.

Max Shear

V_{max} = 0.36 kN [81 lb]

Check a 2x3 Blu Wall Shear Resistance

K_{sv} = 1

f_v = 2.6 Mpa [54000 psf]

F_v = f_v*(K_d*K_h*K_{sv}*K_t)

2.86 MPa [60000 psf]

K_{zv} = 1.7

A_n = 2413

V_r = Φ*Fv*2*A_n/3*K_{zv}

= 7.04 kN [1580 lb]

Notes:

f_v is from WDM - Table 5.3.1B

K_{zv} is from WDM - Table 5.4.5

Acceptable since the shear resistance is greater than the max shear force.

Check Fasteners at Bluwall Midheight.

Load per bolt = 1.42 kN [319 lb]

T_r = 26.4 kN [5940 lb]

Bearing resistance of wood members

Factored compressive strength perpendicular to grain

= 4.24 Mpa [88600 psf]

Washer Area = 2970 mm^2 [4.6 in^2]

Fact. Compressive pressure from washer to wood

= 0.48 Mpa [10000 psf]

Notes:

T_r is from WDM - Table 7.6 pg. 246

Strength perpendicular to grain is from WDM - Bearing selection tables pg. 218

Washer area is from WDM - Fastening Table 11.16 pg. 543

Acceptable since the compressive strength of the wood is greater than force on washer and the tensile resistance of the bolt is greater than the load.

Weight of material bearing down onto sill carrying blu wood and cladding.

Blu Wood Est. p. m	=	0.1	kN/m	[7 lb/ft]
Cladding Est. p. m	=	1.3	kN/m	[89 lb/ft]
Total	=	1.4	kN/m	[96 lb/ft]
Moment Arm	=	95	mm	[3.7 in]
Max Moment	=	0.133	kN.m	[98.1 ft.lb]
Max Shear	=	1.4	kN	[315 lb]

Check 2x8 Sill Member

Φ	=	0.9		
f_b	=	11.8	Mpa	[[246000 psf]
K_d	=	0.65		
K_t	=	1		
K_{sb}	=	1		
F_b	=	$f_b*(K_d*K_h*K_{sb}*K_t)$		
	=	7.67	MPa	[160000 psf]
b	=	95	mm	[3.7 in]
h	=	38	mm	[1.5 in]
S	=	$b*h^2/6$		
	=	22863	mm^3	[1.4 in^3]
K_{zb}	=	1		
K_L	=	1		
M_r	**=**	**$\Phi*F_b*S*K_{zb}*K_l$**		
	=	**0.158**	**kN.m**	**[117 ft.lb]**

Notes:

f_b is from WDM - Table 5.3.1A

K_d is from WDM - Table 4.3.2.2 permanent load

K_t is from WDM - Table 5.4.3

K_{sb} is from WDM - Table 5.4.2

b is the portion of the sill place member that is cantilevered

K_{zb} is from WDM - clause 5.4.5.2

K_L is from WDM - clause 5.5.4.2.1

f_v	=	1.5	Mpa	[31000 psf]
K_d	=	0.65		
K_h	=	1		
K_{sv}	=	1		

K_t	=	1	
F_v	=	$f_v*(K_d*K_h*k_{sv}*K_t)$	
	=	0.975 MPa	[20400 psf]
A_n	=	3610 mm^2	[5.6 in^2]
K_{zv}	=	1	
V_r	**=**	**$\Phi*F_v*2*A_n/3*K_{zv}$**	
	=	**2.11 kN**	**[474 lb]**

Notes:

K_d is from WDM - Table 5.4.4

K_h is from WDM - Table 5.4.4

Acceptable since the max moment and shear resistance of a 2x8 sill are larger than the loads.

22.0 Foundation Piers (P1 & P2)

22.1 Load on Floor Rim Joist North/South

Roof	=	8.8	kN/m	[603 lb/ft]
Floor	=	10.6	kN/m	[726 lb/ft]
Bluwall/Cladding	=	0.03	kN/m	[2.1 lb/ft]
Stud wall	=	0.25	kN/m	[17 lb/ft]
Deck	=	0	kN/m	[421 lb/ft]
Total Load per m.	=	19.68	kN/m	[1770 lb/ft]
L	=	12.2	m	[40 ft]
Load	=	240.1	kN	[7.4E+04 lb]

22.2 Load on Centerline of House

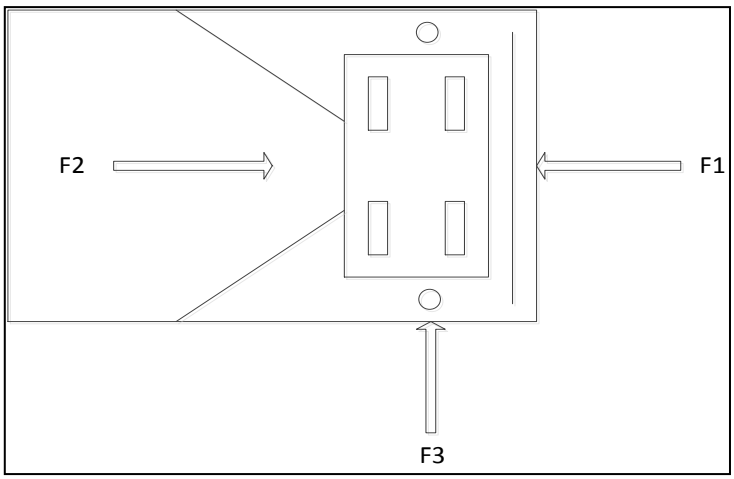
Roof	=	17.6	kN/m	[1206 lb/ft]
Floor	=	21.2	kN/m	[1453 lb/ft]
Total Load per m.	=	38.8	kN/m	[2659 lb/ft]
Load	=	496	kN	[1.1E+05 lb]

22.3 Design Capacities of Foundation Components

18" Seimic Perimeter Pier - Central Piers Inc. (P1)

Vertical	=	63	kN	[14207 lb]
F1	=	7.8	kN	[1756 lb]
F2	=	7.7	kN	[1727 lb]
F3	=	9.3	kN	[2087 lb]

Diagram of Loads on Seismic Perimeter Pier



Standard Pier - Central Piers Inc. (P2)

Vertical	=	26.7 kN	[6000 lb]

Plywood Pads (0.75" x 24" x 24") - Central Piers Inc.

Vertical	=	26.7 kN	[6000 lb]

Allowable Bearing Capacity

	=	287 kPa	[6000 psf]

Given a 2' x 2' Pad this equates to

	=	107 kN	[24000 lb]

Notes:

Design capacity of the seismic piers are according to December 2004 Test Results taken from, "Test Report: Lateral and Vertical Load Tests of C.P. Seismic Pier, Seismic Perimeter Pier & Foundation Pads".

Bearing capacity of the standard piers and plywood pad are taken from Central Pier's catalogue where it states all standard piers are designed with a 3 to 1 safety factor.

22.4 Bearing Load

Using 26.7 kN as the max design capacity and 24" x 24" plywood pad

North/South	=	352/26.7
	=	8.992
	=	9 piers evenly spaced at a minimum

Centerline	=	496 kN / 26.7 kN
	=	18.6
	=	19 piers evenly spaced at a minimum

22.5 Lateral Load

The largest lateral force is the wind pressure against the South wall.

Factored Wind Pres.	=	0.93 kPa	[19.4 psf]
South Wall Area	=	44.9 m^2	[483 ft^2]
Wind Load S. Wall	=	41.8 kN	[9400 lb]
Lateral Resistance	=	7.7 kN	[1727 lb]

Seismic Piers	=	41.8 kN / 7.7 kN
	=	5.4
	=	6 piers

Lateral load resisted by each pier

	=	6.967 kN	[1567 lb]

Note:

Lateral resistance is taken from the weakest direction of an 18" seismic perimeter pier
by Central Piers.
Since this is the largest load resisted by the weakest load direction of the pier, the 6 piers
is able to resist all lateral loads from any direction.
Piers can therefore be installed in any orientation.

22.6 Overturning

Check the Seismic Moment Causing Overturning

Designed to resist earthquake forces determined in 4.1.8.11 (6) of OBC and overturning moment
at level x.

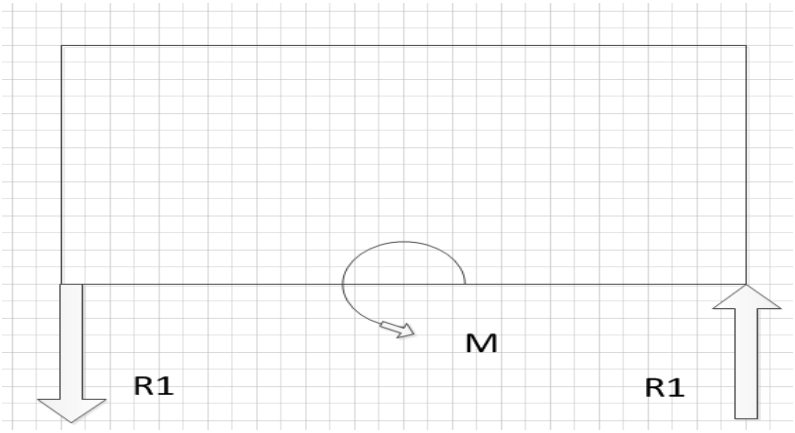
h_1	=	0.61 m	[2 ft]
h_2	=	4.27 m	[14 ft]
J	=	1	
J_x	=	1.0 for $h_x >= 0.6*h_n$	
	=	$J + (1-J)(h_x/(0.6*h_n))$ for $h_x < 0.6*h_n$	
J_1	=	1	
J_2	=	1	
F_1	=	21.7 kN	[4880 lb]
F_2	=	3.27 kN	[735 lb]
M_x	=	$J_x*Sum[i=x \text{ to } n](F_i*(h_i-h_x))$	
M_1	=	11.9 kN.m	[8780 ft.lb]
M_2	=	0 kN.m	[0 ft.lb]

Check the Wind Load Moment Causing Overturning

Wind Load S. Wall	=	41.8 kN	[9400 lb]
M	=	41.8 kN / 2 * h2	
	=	89.24 kN.m	[65800 ft.lb]
R_1	=	14.1 kN	[3170 lb]

Note:

Wind load moment is greater than seismic load moments therefore wind load moment governs



22.7 Dead Load Analysis

Roof Dead Load	=	0.74	kPa	[15.5 psf]
Wall Dead Load	=	neglecting as a coservative measure		
Floor Dead Load	=	0.74	kPa	[15.5 psf]
Total	=	1.48	kPa	[30.9 psf]
Total downward force resulting from dead load on North/South wall				
	=	1.48 kPa * (width/2 * length)		
	=	30	kN	[6745 lb]
w. Safety Factor 2	=	15	kN	[3370 lb]

Acceptable since the dead load is greater than the resulting overturning force along the North/South where the load are the greatest.

22.8 Check Chord Members loaded by Overturning Forces

F_j	=	10.5	kN	[2342 lb]
H_{s+d}	=	2.77	m	[9.1 ft]
h	=	2.56	m	[8.4 ft]
D	=	1.79	kN	[402.4 lb]
l	=	1.28	m	[4.2 ft]
P_f and T_f	=	$(F_j*(H_s+d) - D*l)/h$		
	=	10.47	kN	[6340 lb]

Notes:

F_j is the factored load on the shear wall segment

H_{s+d} is the total storey height

h is the distance between tension and compression resisting chords (length of shear walls)

D is the dead load on the shear wall

l is the moment arm about which the dead load counteracts the overturning

Check 2x6 member in tension and compression

T_r	=	34.2 kN	[7690 lb]
P_r	=	41.7 kN	[9380 lb]

Notes:

T_r is from WDM - tension member selection tables, 2x6 No.1/No.2 pg. 162

P_r is from WDM - stud wall selection tables, 2x6 No.1/No.2 pg. 106

2x6 member is acceptable as chord in the shear wall to resist loads in tension and compression.

23.0 Deck Design

Loads:

Live	=	4.8	kPa	
Dead	=	0.48	kPa	4.438
Snow	=	1.5	kPa	2.926
joist length	=	3.125	m	
joist spacing	=	0.6096	m	
w_f	=	5.21208	kN/m	
M_f	=	6.3624	kN.m	
V_f	=	8.14388	kN	

Check 2x8 No.1/No.2

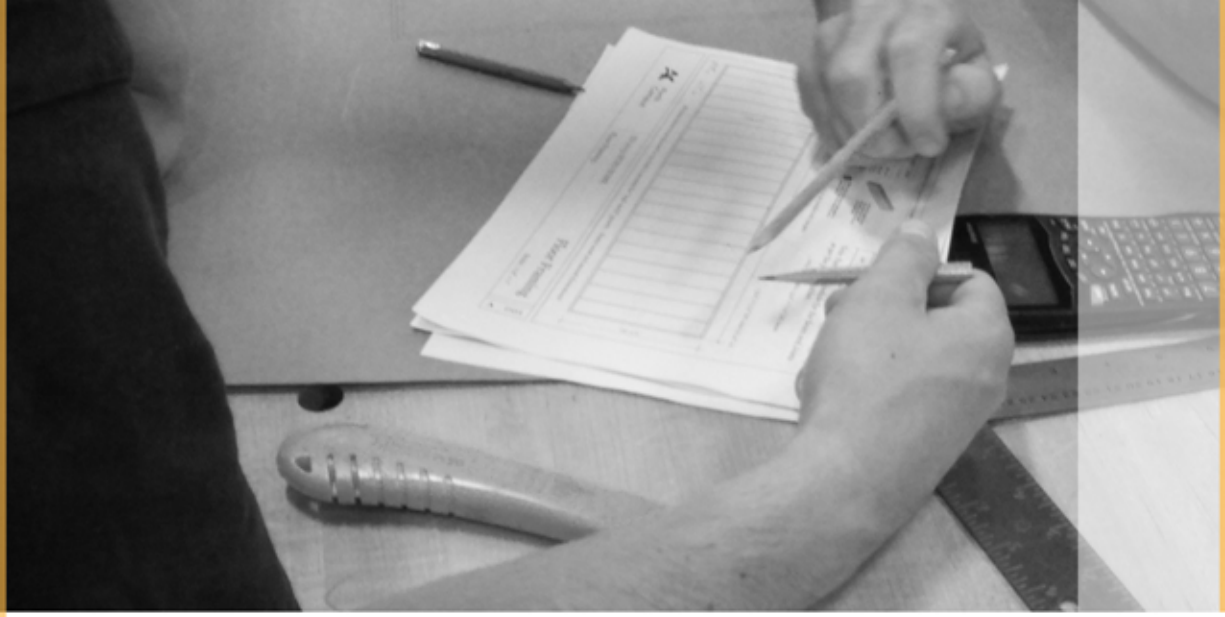
M_r	=	3.003	kN.m
V_r	=	8.305	kN
E_sI	=	1.87E+11	N.mm^2
L/360	=	8.68056	mm
Δ (Live)	=	$5*w*l^4/(384*E_sI)$	
		19.4305	mm
L/240	=	13.0208	mm
Δ (Full)	=	$5*w*l^4/(384*E_sI)$	
	=	34.61	mm

Notes:

Max joist length is 2.13 m

E_sI is from WDM - joist selection tables pg 39

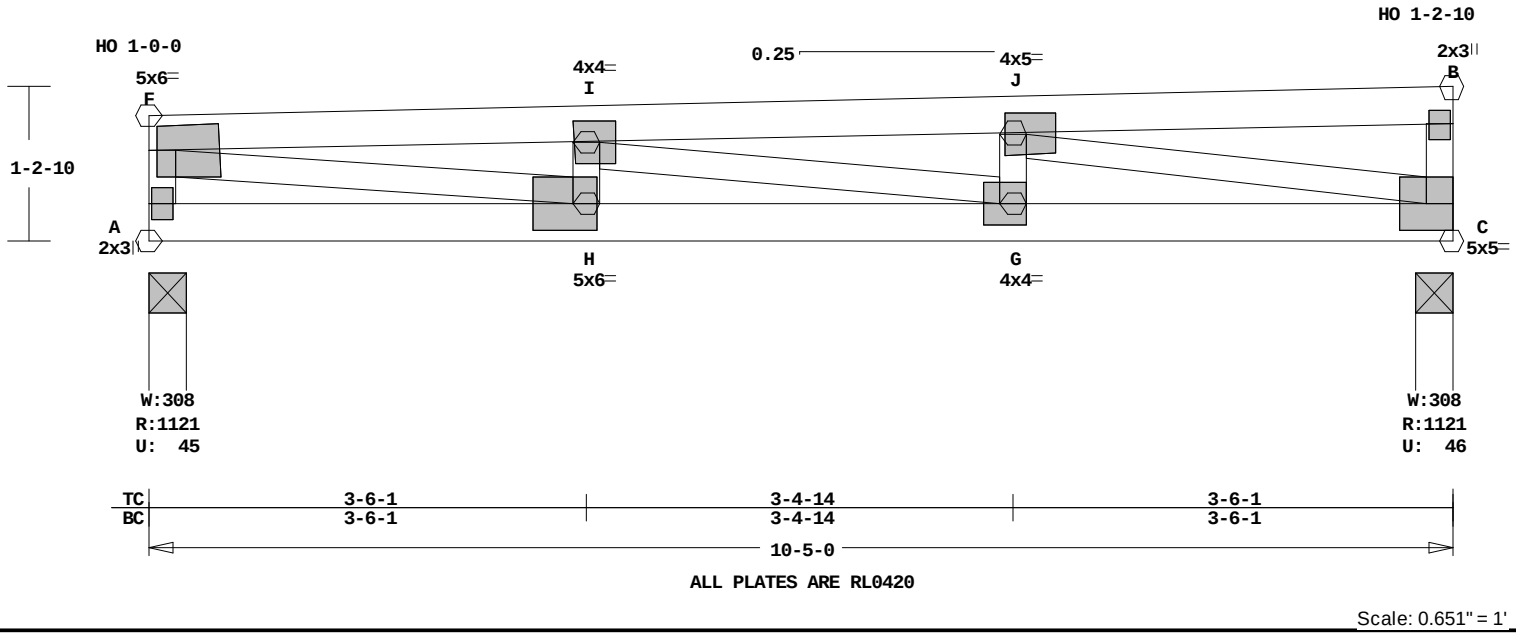
L/240 and L/360 is from WDM - section 2.1 pg 15



B MANUFACTURER'S SPECIFICATIONS

Job	Mark	Quan	Type	Span	P1-H1	Left OH	Right OH	*Engineering*
ALGONQUIN-1	*A1*	1	MONO	100500	0.25	0	0	

Algonquin



Scale: 0.651" = 1'

MiTek® Online Plus™ APPROX. TRUSS WEIGHT: 61.0 LBS

Online Plus -- Version 28.0.006
RUN DATE: 19-SEP-12

	CSI	-Size-	----Lumber----
TC	0.65	2x 4	SPF-#2
BC	0.68	2x 4	SPF-#2
WB	0.73	2x 3	SPF-#2

Importance Category : Normal
Condition at Manufacture : Dry
Treatment : Untreated
Service Condition : Dry

Brace truss as follows:

	O.C.	From	To
TC	Cont.	0- 0- 0	10- 5- 0
BC	72.0"	0- 0- 0	10- 5- 0

psf-Ld	Dead	Live	Wind	Snow
TC	15.0	0.0	0.0	50.1
BC	7.0	10.0	0.0	0.0
TC+BC	22.0	10.0	0.0	50.1
Total	82.1	Spacing	24.0"	

TC Fb=1.10 Fc=1.10 Ft=1.10
BC Fb=1.10 Fc=1.10 Ft=1.10

Unfactored Reactions (Lbs)

Jt	-DL-	-LL-	-WL-	-SL-
A	229D	104D	180U	522D
C	229D	104D	180U	522D

TL Factored Reactions (Lbs)

Jt	Down	Uplift	Horiz-
A	1122	45 U	35 R
C	1122	46 U	

Jt	Brg Size	Required
A	3.5"	1.5"
C	3.5"	1.5"

Maximum Downward Loadcase
LC# 1 NBCC 1

Plf	TC	Beg	End	From	To
Dist	Dead	30	30	0.0	10.4
Dist	Snow	100	100	0.0	10.4
Plf	BC	Beg	End	From	To
Dist	Dead	14	14	0.0	10.4
Dist	Live	20	20	0.0	10.4

Maximum Uplift Loadcase
LC# 7 NBCC 13

Plf	TC	Beg	End	From	To
Dist	Dead	30	30	0.0	10.4
Dist	Wind	-35	-35	0.0	10.4
Plf	BC	Beg	End	From	To
Dist	Dead	14	14	0.0	10.4

Plf		Beg	End	From	To
Dist	Wind	24	24	0.1	0.7
Dist	Wind	12	12	0.1	0.9

Membr	CSI	P Lbs	Axl-CSI-Bnd
----------Top Chords----------			
F -I	0.65	3174 C	0.34 0.31
I -J	0.55	2989 C	0.32 0.23
J -B	0.29	10 C	0.00 0.29
--------Bottom Chords---------			
A -H	0.15	29 C	0.00 0.15
H -G	0.68	3174 T	0.51 0.17
G -C	0.59	2989 T	0.48 0.11
------------Webs-------------			
A -F	0.15	1043 C	WindLd
F -H	0.73	3243 T	
H -I	0.09	607 C	
I -G	0.04	190 C	
G -J	0.05	192 T	
J -C	0.71	3081 C	
C -B	0.04	304 C	WindLd

TL Defl -0.21" in H -G L/557
TL Panel -0.04" in F -I L/937
LL Defl -0.15" in H -G L/780
Shear // Grain in J -B 0.27

Plates for each ply each face.
PLATING CONFORMS TO TPIC 96
AND STANDARD CAN3-O86-01
(LIMIT STATES) GRIP VALUES
BASED ON NET AREA METHOD
FOR SPRUCE-PINE-FIR LUMBER.
NO. CCMC 10929-L
RL04 Denotes FT20
Plate - RL04 20 Ga. Net Area
Plate - RL05 18 Ga. Net Area

Jt	Type	Plt Size	X	Y	JSI
F	RL04	5.0x 6.0	1.3	Ctr	0.82
I	RL04	4.0x 4.0	0.7	Ctr	0.31
J	RL04	4.0x 5.0	1.7	Ctr	0.86
B	RL04	2.0x 3.0	Ctr	Ctr	0.25
A	RL04	2.0x 3.0	Ctr	Ctr	0.49
H	RL04	5.0x 6.0	-2.2	Ctr	0.87
G	RL04	4.0x 4.0	-0.8	Ctr	0.30
C	RL04	5.0x 5.0	Ctr	Ctr	0.86

Placement Tolerance Used 0.25 in.
Allowance For Ineffective Teeth
shall be 10.0%
Allowance for Rotation on Joint
shall be 5.0 deg.

NOTES:
Trusses Manufactured by:

CENTENNIAL TRUSS
Analysis Conforms To:
TPIC-COM , Standard Formula
NBCC2005
This truss must be installed
as shown. It cannot be
installed upside-down.
Wind Loads - TPIC 2007 Edition
Truss is designed as a Main
Wind-Force Resistance System.
Wind Pressure: 8.5 psf
Truss Location: At End
Mean Roof Height: 25-0
Building Type: Part. Enc
Terrain: Rough
TC Dead Load : 0.0 psf
BC Dead Load : 0.0 psf
Design Roof Snow Load Use:
Ground Snow Load = 52.2 psf
Rain Load = 8.4 psf
Non-slippery Roof
Importance Factor 1.00
Exposed to Wind Factor 1.00
Balanced Load Factor 0.80
Unbalanced Load Factor 0.00
Unbalanced Loads Checked
Load Factors = 1.00 and 0.00

ICC-ES Evaluation Report

ESR-3100

Reissued November 1, 2011
This report is subject to renewal in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 41 13—Metal Roof Panels

REPORT HOLDER:

IDEAL ROOFING COMPANY LTD.
1418 MICHAEL STREET
OTTAWA, ONTARIO K1B 3R2
CANADA
(613) 746-3206
www.idealroofing.ca

EVALUATION SUBJECT:

HF-16 AND HF-20.25 ROOF PANELS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- *2006 International Building Code®* (IBC)
- *2006 International Residential Code®* (IRC)

Properties evaluated:

- Fire classification
- Wind uplift resistance and gravity loads
- Weather resistance

2.0 USES

The HF-16 and HF-20.25 roof panels are metal roof panels conforming to IBC Section 1507.4 and IRC Section R905.10. The panels are used as Class A roof coverings on new roofs over solid or closely fitted sheathing. The panels are also used on roofs permitted to be nonclassified when installed over spaced sheathing.

3.0 DESCRIPTION

The HF-16 and HF-20.25 roof panels are metal roof panels that are roll-formed from sheet steel conforming to ASTM A 653, SS Grade 33, with a galvanized coating designation of Z275 (G90). The panels are painted with a baked-on proprietary coating. See Figure 1 for panel profiles.

3.1 HF-16:

The HF-16 roof panel is formed from sheet steel having a design base-metal thickness of 0.018 inch (0.46 mm) (No. 26 gage). The panel is $17^{3}/_{4}$ inches wide (451 mm) with $1^{7}/_{16}$-inch-high (36.5 mm) profiles on 16-inch (406 mm) centers, with four lower ribs located adjacent to the rib on either side and at third points between the ribs. The panel is available in lengths up to 42 feet (12.8 m).

3.2 HF-20.25:

The HF-20.25 roof panel is formed from sheet steel having a design base-metal thickness of 0.024 inch (0.61 mm) (No. 24 gage). The panel is 22 inches wide (559 mm) with $1^{7}/_{16}$-inch-high (36.5 mm) profiles on $20^{1}/_{4}$-inch (514 mm) centers, with five lower ribs located adjacent to the rib on either side and at three other equidistant points between the ribs. The panel is available in lengths up to 42 feet (12.8 m).

3.3 Fasteners:

Screw fasteners used to attach the HF panel to sheathing or supports are Master Gripper No. 12 by 1-inch (25.4 mm), corrosion-resistant, self-drilling steel screws with Teflon-coated washers. Master Gripper No 10 by $1^{1}/_{2}$-inch (38 mm), corrosion-resistant, hex-head, self-drilling steel screws with neoprene washers are used to attach accessory components.

3.4 Accessories:

Accessories such as drip edges and ridge caps are manufactured from the same material as the panels. Details must be submitted to the code official for each installation.

4.0 DESIGN AND INSTALLATION

4.1 Installation:

The HF-16 and HF-20.25 roof panels may be installed over solid, spaced or closely fitted sheathing complying with the IBC or IRC, as described in Sections 4.2 through 4.4. Installation and roof slope must be in accordance with IBC Section 1507.4.2, Item 1 or 2; or, for roof slopes of 2:12 up to less than 3:12, where a lap sealant is not used, an underlayment complying with ASTM D 226, Type II, must be used.

The HF-16 and HF-20.25 roof panels are attached to sheathing or framing with the fasteners specified in Section 3.3. At the eave, fasteners are positioned as shown in Figure 2, with one fastener for the HF-16 Panel and two fasteners for the HF-20.25 panel. Fasteners along the length of the panel are spaced at 16 inches (406 mm) on center.

4.2 Wind Resistance and Gravity Loads:

When attached to solid or closely fitted sheathing in accordance with Section 4.1, the roof panels are limited to use in areas subject to maximum basic wind speeds of 100 mph, on roofs having a mean height of 40 feet, in Exposure B areas. When attached to framing or nominally 1-by spaced sheathing, the allowable wind uplift loads are 53 psf (2.5 kPa) for the HF-16 panel and 45 psf (2.2 kPa) for the HF-20.25 panel. The design wind pressure must be determined in accordance with ASCE 7 (IBC) or IRC Section R301.2.1.

The allowable gravity loads are 156 psf (761 kg/m^2) for the HF-16 panel and 156 psf (761 kg/m^2) for the HF-20.25 panel. Positive (gravity) loads are limited to the adequacy of the supporting structural framing and sheathing.

4.3 Fire Classification:

The HF-16 and HF-20.25 roof panels, when installed in accordance with Section 4.1, are recognized as Class A roof assemblies in accordance with IBC Section 1505.2 and IRC Section R902.1, when installed over minimum $^{15}/_{32}$-inch (11.9 mm) plywood sheathing covered with two layers of ELK VersaShield underlayment (ESR-2053). Other installation configurations are considered nonclassified roofing.

5.0 CONDITIONS OF USE

The HF roof panels described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The panels must be manufactured, identified and installed in accordance with this report and the manufacturer's published instructions. In the event of a conflict between the manufacturer's published installation instructions and this report, this report governs.

5.2 The minimum roof slope must be determined in accordance with Section 4.1 of this report.

5.3 Sealants must be approved by the code official.

5.4 The HF-16 and HF-20.25 roof panels are manufactured in Ottawa, Ontario, Canada, under a quality control program with inspections by Intertek Testing Services NA Ltd. (AA-691).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Metal Roof Coverings (AC166), dated May 2008.

6.2 Reports of fire classification tests in accordance with ASTM E 108.

7.0 IDENTIFICATION

Each pallet of panels must be labeled with the Ideal Roofing Company Ltd. name and address, the product name (HF-16 or HF-20.25), the evaluation report number (ESR-3100) and the name of the inspection agency (Intertek Testing Services NA Ltd.).

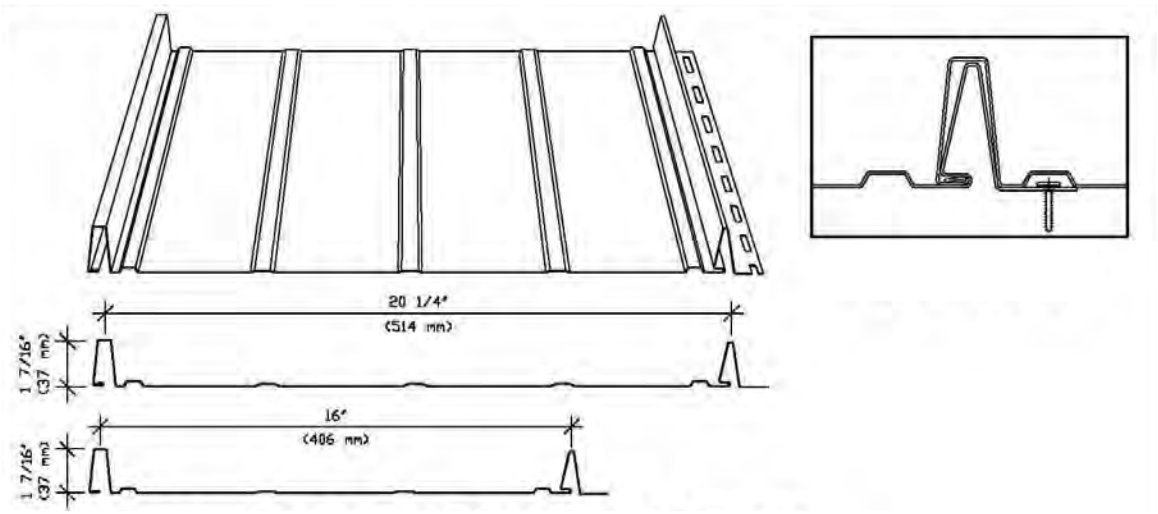


FIGURE 1—HF PANELS

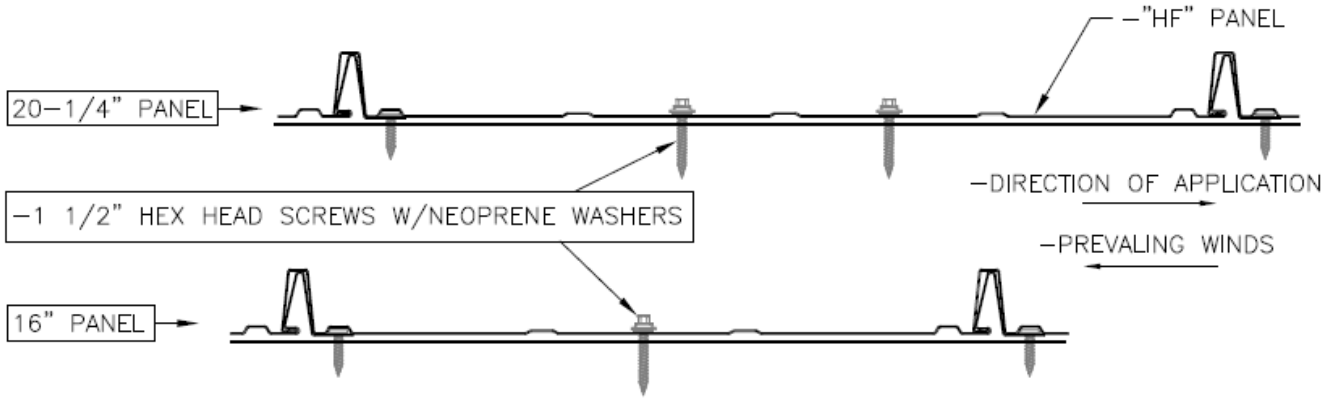


FIGURE 2—HF PANEL

ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-2606

Reissued January 1, 2011

This report is subject to re-examination in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTIC, AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY, INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE STRUCTURAL ANGLES, CLIPS, AND PLATES FOR WOOD FRAMING

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2009 *International Residential Code*® (2009 IRC)
- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie structural angles, clips, and plates described in this report are used as wood-to-wood connectors in accordance with Section 2304.9.3 of the IBC. The angles, clips, and plates may also be used in structures regulated under the IRC when an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The angles, clips, and plates described in this report are used as wood-to-wood connections in structural systems that have been designed to transfer loads from their point of origin to load-resisting elements.

3.1.1 A Series Angles: The A series angles are formed from No. 18 gage galvanized steel. See Table 1 for angle model numbers, angle dimensions, fastener schedules, and allowable loads. See Figure 1 for a drawing of A series angles connecting a wood post to a wood sill plate.

3.1.2 A34 and A35 Framing Angles: The A34 and A35 framing angles are formed from No. 18 gage galvanized steel. The A35 angle has slots and bend lines to permit field adjustments of the legs for two- and three-way tied connections. The A34 is an equal leg angle without slots or bend lines. See Table 2 for angle dimensions, fastener schedules, and allowable loads. See Figure 2 for illustrations of framing configurations with the A34 and A35 angles.

3.1.3 LTP4 Lateral Tie Plate: The LTP4 lateral tie plate is formed from No. 20 gage galvanized steel. See Table 3 for fastener schedules and allowable loads. See Figure 3 for dimensions of the LTP4 connector and a drawing of the LTP4 used as a top plate-to-rim joist connections.

3.1.4 FC Series Framing Clips: The FC series framing clips are formed from No. 16 gage galvanized steel. See Table 4 for clip model numbers, clip dimensions, fastener schedules, and allowable loads. See Figure 4 for clip dimensions and a drawing of FC framing clips used as an alternative to cripple studs for headers and used to connect a wood post to a wood sill plate.

3.1.5 HH Series Header Hangers: The HH series header hangers are formed from No. 16 gage galvanized steel. See Table 5 for hanger model numbers, hanger dimensions, fastener schedules, and allowable loads. See Figure 5 for hanger dimensions and a drawing of an HH hanger connecting a wood door header to jambs.

3.1.6 GA Series Gusset Angles: The GA series gusset angles are formed from No. 18 gage galvanized steel. See Table 6 for gusset angle model numbers, angle length, fastener schedules, and allowable loads. See Figure 6 for a drawing of a GA angle connecting a joist to a header.

3.1.7 L Series Reinforcing Angles: The L series reinforcing angles are formed from No. 16 gage galvanized steel. See Table 7 for angle model numbers, angle length, fastener schedules, and allowable loads. See Figure 7 for angle dimensions and a drawing of an L angle connecting a joist to a header.

3.1.8 LS Series Skewable Angles: The LS series skewable angles are formed from No. 18 gage galvanized steel. The angle is fabricated to assist field adjustment from zero degrees up to a 135-degree bend. See Table 8 for angle model numbers, angle length, fastener schedules, and allowable loads. See Figure 8 for angle dimensions and a drawing of an LS angle connecting a skewed joist to a header.

3.1.9 Z Series Panel Stiffener Clips: The Z series stiffener clips are formed from No. 12 gage galvanized steel. The Z clips are used to support nominally 2-by-4 or

2-by-6 wood blocking between joists or trusses that provide solid backing for ceiling panel material. See Table 9 for Z clip model numbers, clip dimensions, fastener schedules, and allowable loads. See Figure 9 for Z clip dimensions and an illustration of Z clips supporting wood blocking for ceiling panels.

3.2 Materials:

3.2.1 Steel: The angles, clips, and plates described in this report are manufactured from galvanized steel in accordance with ASTM A 653, SS designation, Grade 33, with a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum tensile strength, F_u, of 45,000 psi (310 MPa). Base-metal thicknesses for the connectors in this report are as follows:

NOMINAL THICKNESS (inches)	MINIMUM BASE-METAL THICKNESS (inch)
No. 12	0.0975
No. 16	0.0555
No. 18	0.0445
No. 20	0.0335

For **SI:** 1 inch = 25.4 mm.

The connectors have a minimum G90 zinc coating specification in accordance with ASTM A 653. Some models (designated with a model number ending with Z) are available with a G185 zinc coating specification in accordance with ASTM A 653. Some models (designated with a model number ending with HDG) are available with a hot-dip galvanization, also known as "batch" galvanization, in accordance with ASTM A 123, with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides. Model numbers in this report do not include the Z or HDG ending, but the information shown applies. The lumber treater or holder of this report (Simpson Strong-Tie Company) should be contacted for recommendations on minimum corrosion resistance of steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

3.2.2 Wood: Wood members which the connectors are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), and having a maximum moisture content of 19 percent (16 percent for engineered lumber) except as noted in Section 4.1. The thickness of the wood main member must be equal to or greater than the length of the fasteners specified in the tables in this report, or as required by wood member design, whichever is greater.

3.2.3 Fasteners: Nails used for connectors described in this report must comply with ASTM F 1667 and have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

COMMON NAIL	SHANK DIAMETER (inch)	NAIL LENGTH (inches)	F_{yb} (psi)
8d × $1^1/_2$	0.131	$1^1/_2$	100,000
10d × $1^1/_2$	0.148	$1^1/_2$	90,000
10d	0.148	3	90,000
16d	0.162	$3^1/_2$	90,000

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

Fasteners used in contact with preservative treated or fire retardant treated lumber must comply with Section 2304.9.5 of the IBC, Section R317.3 of the 2009 IRC or Section R319.3 of the 2006 IRC, as applicable. The lumber treater or this report holder (Simpson Strong-Tie Company) should be contacted for recommendations on minimum corrosion resistance of fasteners and connection capacities of fasteners used with the specific proprietary preservative treated or fire retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The tabulated allowable loads shown in this report are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the NDS.

Tabulated allowable loads apply to products connected to wood used under dry conditions and where sustained temperatures are 100ºF (37.8ºC) or less. When products are installed to wood having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected, the allowable loads must be adjusted by the wet service factor, C_M, specified in the NDS. When connectors are installed in wood that will experience sustained exposure to temperatures exceeding 100ºF (37.8ºC), the allowable loads in this report must be adjusted by the temperature factor, C_t, specified in the NDS.

Connected wood members must be analyzed for load-carrying capacity at the connection in accordance with the NDS.

4.2 Installation:

Installation of the connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

4.3 Special Inspection:

Periodic special inspection must be conducted when the connectors are components within the main wind-force-resisting system of structures constructed in areas listed in 2009 IBC Section 1706.1 (Section 1705.4 for the 2006 IBC). Special inspection requirements do not apply to structures, or portions thereof, that qualify for exception under 2009 IBC Section 1704.1 or 1706.2 (Section 1704.1 for the 2006 IBC).

Periodic special inspection must be conducted in accordance with the applicable portions of Section 1707 when the connectors are components within the seismic-force-resisting system of structures constructed in Seismic Design Category C, D, E or F. Special inspection requirements do not apply to structures, or portions thereof, that qualify for exception under IBC Section 1704.1, 1705.3 or 1707.3.

For installations under the IRC, special inspection is not normally required. However, for an engineered design where calculations are required to be signed by a registered design professional, periodic special inspection requirements and exemptions are as stated in Sections 4.3.1 and 4.3.2 of this report, as applicable for installations under the IRC.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie structural angles, clips, and plates described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of connectors with preservative treated or fire retardant treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative treated or fire retardant treated lumber must be in accordance with Section 3.2.3 of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Joist Hangers and Similar Devices (AC13), dated October 2010.

7.0 IDENTIFICATION

The products described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of an index evaluation report (ESR-2523) that is used as an identifier for the products recognized in this report.

TABLE 1—ALLOWABLE LOADS FOR THE A ANGLES

MODE NO.	ANGLE DIMENSIONS[1] (in)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3,4,5,6] (lbs)							
	L	W_1	W_2	Supporting Member (Base)	Supported Member (Post)	F_1 where C_D =				F_2 where C_D =			
						1.0	1.15	1.25	1.6	1.0	1.15	1.25	1.6
A21	$1^3/_8$	2	$1^1/_2$	2-10d x 1½	2-10d x 1½	180	210	230	245	175	175	175	175
A23	$2^3/_4$	2	$1^1/_2$	4-10d x 1½	4-10d x 1½	365	420	455	485	365	420	455	485

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Refer to Figure 1 for definitions of angle dimension nomenclature (L, W_1, W_2) and allowable load directions (F_1 and F_2).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]F_1 and F_2 loads cannot be combined.
[4]The F_1 allowable loads are for one connector. When angles are installed on each side of wood member, the minimum member thickness must be 3 inches.
[5]The F_2 allowable loads apply only when the connectors are used in pairs.
[6]Allowable loads under C_D = 1.6 columns have been increased for wind or earthquake loading. No further increase is allowed.

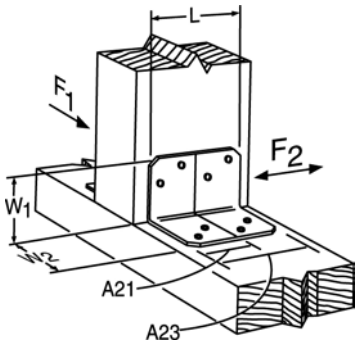


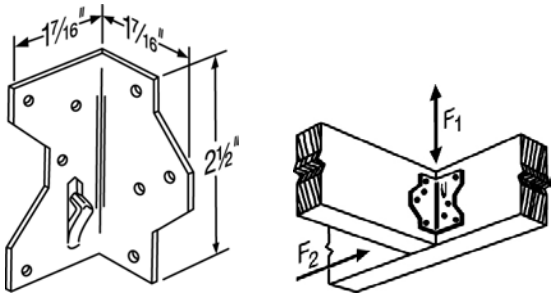
FIGURE 1—A21 AND A23 ANGLE INSTALLATION DETAIL

TABLE 2—ALLOWABLE LOADS FOR A34 AND A35 FRAMING CONNECTORS

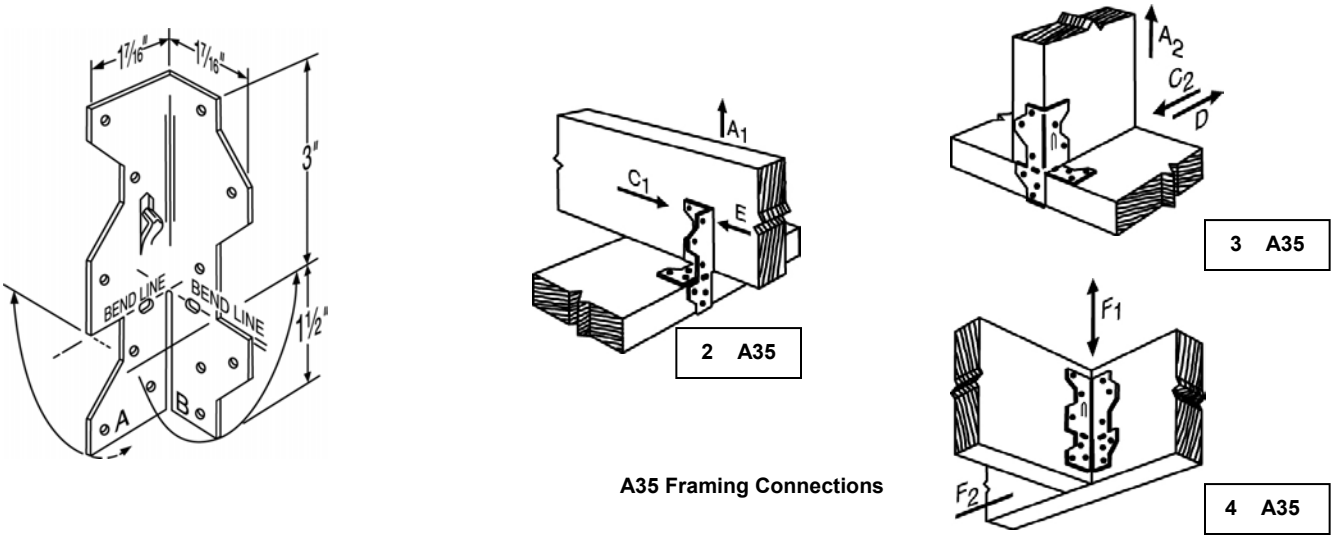
MODEL NO.	FASTENERS (Quantity-Type)		CONNECTION CONFIGURATION[1]	LOAD DIRECTION[2]	ALLOWABLE LOADS[3,4,5] (lbs)		
	Joist	Header/Plate			C_D = 1.0	C_D = 1.15	C_D = 1.25 C_D = 1.6
A34	4-8d x 1½	4-8d x 1½	See A34 Framing Illustration	F_1	345	365	365
				F_2 [(6)]	280	280	280
A35	3-8d x 1½	6-8d x 1½	2	A_1	260	295	320
				E	260	295	320
				C_1	170	170	170
	6-8d x 1½	6-8d x 1½	3	A_2	260	295	320
				C_2	260	295	315
				D	150	150	150
	6-8d x 1½	6-8d x 1½	4	F_1	450	450	450
				F_2 [(6)]	515	595	645

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Some illustrations show connections that could cause cross-grain tension or bending of the wood during loading if not reinforced sufficiently. In this case, mechanical reinforcement should be considered.
[2]Refer to the illustrations in Figure 2 for definitions of load directions (A_1, A_2, C_1, C_2, D, E, F_1, F_2).
[3]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[4]Allowable loads are for one anchor. When anchors are installed on each side of the joist, the minimum joist thickness is 3 inches.
[5]Allowable loads under C_D = 1.6 column have been increased for wind or earthquake loading. No further increase is allowed. Allowable loads must be reduced when other load durations govern.
[6]Connectors are required on both sides of joist to achieve F_2 loads in both directions.



A34 Framing Connection



A35 Framing Connections

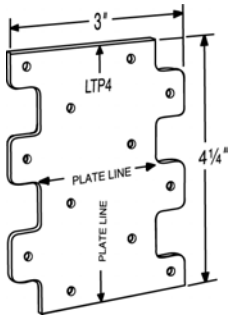
FIGURE 2—A34 AND A35 FRAMING CONNECTORS

TABLE 3—ALLOWABLE LOADS FOR THE LTP4 FRAMING CONNECTOR

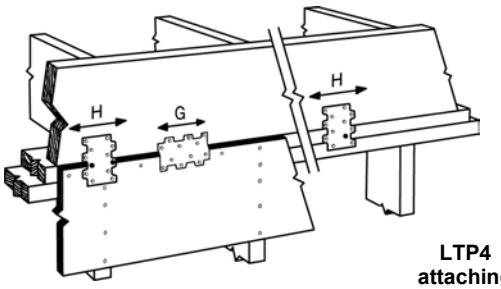
MODEL NO.	FASTENERS (Quantity-Type)		DIRECTION OF LOAD	ALLOWABLE LOADS[1,2] (lbs)			
	Plates	Rim Joist or Blocking		C_D = 1.0	C_D = 1.15	C_D = 1.25	C_D = 1.6
LTP4	6-8d x $1^1/_2$	6-8d x $1^1/_2$	G	515	590	645	685
	6-8d x $1^1/_2$	6-8d x $1^1/_2$	H	515	590	645	685

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[2]The LTP4 may be installed over wood-based structural sheathing (as shown in Figure 3) having a maximum thickness of $^1/_2$ inch without adversely affecting the tabulated allowable loads.



LTP4 Dimensions



LTP4 Installed over Sheathing

LTP4 attaching Top Plates to Rim Joist

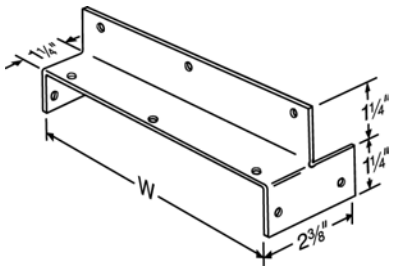
FIGURE 3—LTP4 FRAMING CONNECTOR

TABLE 4—ALLOWABLE LOADS FOR THE FC FRAMING CONNECTORS[1,2,3]

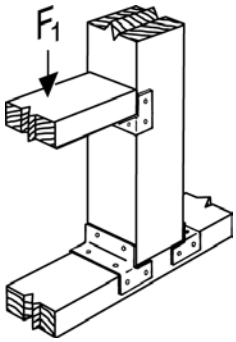
MODEL NO.	CONNECTOR WIDTH (W) (in)	FASTENERS (Quantity-Type)	ALLOWABLE DOWNLOAD, F_1 Where C_D=1.0 C_D=1.15 C_D=1.25 (lbs.)
FC4	$3^9/_{16}$	8-16d	800
FC6	$5^1/_2$	10-16d	920

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[2]Minimum thickness of the supporting member (post) must be $2^1/_2$ inches to achieve the table load value (similar to Figure 5).
[3]Loads may not be increased for short-term loading.



FC Connector Dimensions



Typical FC Connector Installation

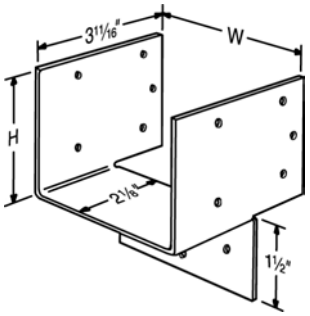
FIGURE 4—FC CLIPS

TABLE 5—ALLOWABLE LOADS FOR THE HH HEADER HANGERS

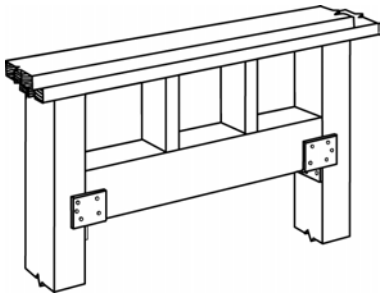
MODEL NO.	HANGER DIMENSIONS[1] (in)		FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3,4,5] (lbs)					
	W	H	Stud	Header	F_1 where C_D =		F_2 where C_D =		F_3 where C_D =	
					1.0	1.25	1.0	1.6	1.0	1.6
HH4	$3^9/_{16}$	$2^7/_8$	9-16d	4-16d	1,195	1,495	530	710	530	710
HH6	$5^1/_2$	$5^1/_4$	12-16d	6-16d	1,595	1,995	800	1,065	800	1,065

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

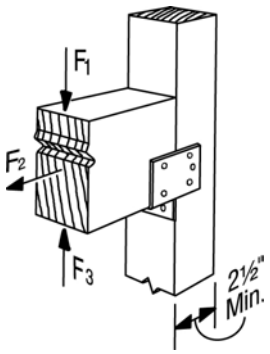
[1]Refer to Figure 5 for definitions of angle dimension nomenclature (W and H).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]Allowable F_2 and F_3 loads under C_D = 1.6 column have been increased for wind or earthquake loading. No further increase is allowed. Allowable loads must be reduced when other load durations govern.
[4]Duration of load increase for F_1 direction may not exceed 25 percent.
[5]Minimum lumber thickness must be $2^1/_2$ inches to achieve tabulated allowable load values.



HH4 Hanger Dimensions



Typical HH Installation



Allowable Load Directions

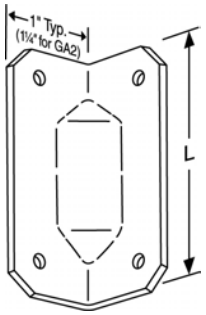
FIGURE 5—HH HEADER HANGERS

TABLE 6—ALLOWABLE LOADS FOR THE GA ANGLES

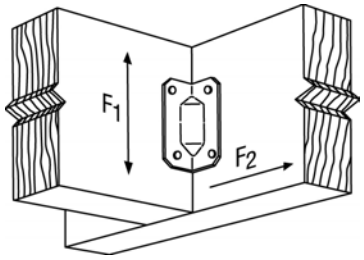
MODEL NO.	ANGLE LENGTH (L) (inches)	FASTENERS (Quantity-Type)	ALLOWABLE LOADS[1,2,3] (lbs)							
			F_1 where C_D =				F_2 where C_D =			
			1.0	1.15	1.25	1.33 or 1.6	1.0	1.15	1.25	1.6
GA1	$2^3/_4$	4-10d	185	185	185	185	220[4]	260[4]	280[4]	300[4]
GA2	$3^1/_4$	6-10d	335[4]	385[4]	415[4]	450[4]	335[4]	385[4]	420[4]	450[4]

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[2]Allowable F_1 and F_2 loads under C_D = 1.6 column have been increased for wind or earthquake loading. No further increase is allowed. Allowable loads must be reduced when other load durations govern.
[3]Connectors are required on both sides to achieve F_2 loads in both directions.
[4]10dx$1^1/_2$-inch-long nails may be used provided the tabulated allowable loads are multiplied by 0.81, except for the GA1 angles in the F_1 direction, which must be limited to 185 lbs for all load durations.



GA1



Typical GA Installation

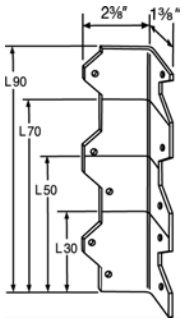
FIGURE 6—GA ANGLES

TABLE 7—ALLOWABLE LOADS FOR THE L REINFORCING ANGLES

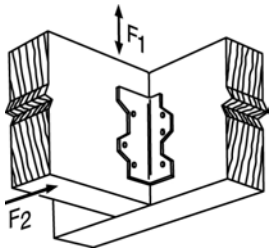
MODEL NO.	ANGLE LENGTH (L) (inches)	FASTENERS (Quantity-Type)	ALLOWABLE LOADS[1,2,3,4] (lbs)							
			F_1 where C_D =				F_2 where C_D =			
			1.0	1.15	1.25	1.6	1.0	1.15	1.25	1.6
L30	3	4-10d	220	240	240	240	220	255	280	295
L50	5	6-10d	335	385	415	445	335	385	415	445
L70	7	8-10d	445	510	555	565	445	510	555	565
L90	9	10-10d	555	640	695	740	555	640	695	740

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[2]Allowable F_1 and F_2 loads under C_D = 1.6 column have been increased for wind or earthquake loading. No further increase is allowed. Allowable loads must be reduced when other load durations govern.
[3]Minimum lumber thickness must be $2^1/_2$ inches to achieve the tabulated allowable load values.
[4]10dx$1^1/_2$ nails may be used provided the tabulated allowable loads are multiplied by 0.81.
[5]Connectors are required on both sides to achieve F_2 loads in both directions.



L Angle



Typical L50 Installation and Allowable Load Directions

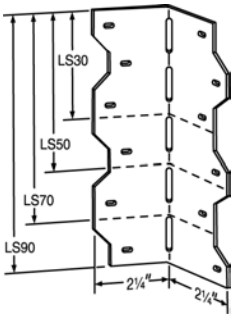
FIGURE 7—L REINFORCING ANGLES

TABLE 8—ALLOWABLE LOADS FOR THE LS REINFORCING ANGLES

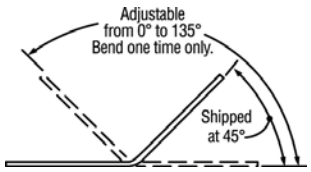
MODEL NO.	ANGLE LENGTH (in)	FASTENERS (Quantity-Size)	ALLOWABLE LOAD PARALLEL TO LENGTH OF ANGLE[1,2] (lbs)			
			C_D = 1.0	C_D = 1.15	C_D = 1.25	C_D = 1.6
LS30	3 3/8	6-10d	335	385	395	395
LS50	4 7/8	8-10d	450	520	560	600
LS70	6 3/8	10-10d	560	645	665	665
LS90	7 7/8	12-10d	670	770	840	890

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

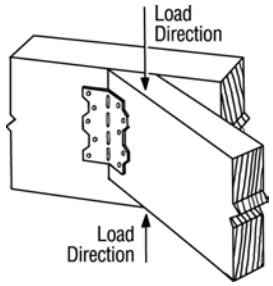
[1]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[2]The tabulated allowable loads are for a single connector.



LS Angle Dimensions



Allowable Bend Angles



LS Angle Installed

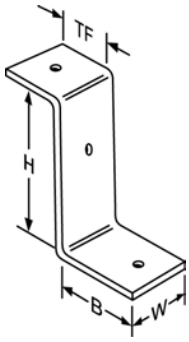
FIGURE 8—LS REINFORCING ANGLE

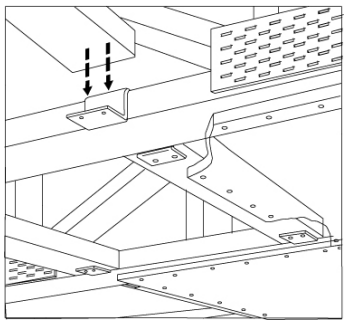
TABLE 9—ALLOWABLE LOADS FOR THE Z CLIPS

MODEL NO.	CLIP DIMENSIONS[1] (in)				FASTENERS		ALLOWABLE DOWNLOAD Where C_D=1.0 C_D=1.15 C_D=1.25 (lbs.)
	W	H	B	TF	Top	Seat	
Z4	1 1/2	3 1/2	2 1/8	1 3/4	1 - 16d	1 - 16d	465
Z6	1 1/2	5 3/8	2	1 3/8	1 - 16d	1 - 16d	485
Z44	2 1/2	3 1/2	2	1 3/8	2 - 16d	2 - 16d	865

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Refer to Figure 9 for definitions of clip dimension nomenclature (W, H, B, TF).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]Compression perpendicular-to-grain capacity for the joists bearing on the clips must be verified and must not exceed the allowable loads noted in the table.





Z Connector

FIGURE 9—Z CLIPS

ICC-ES Evaluation Report

ESR-1498*

Reissued December 1, 2011

This report is subject to renewal December 1, 2013.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 21 00—Thermal Insulation

REPORT HOLDER:

BASF CORPORATION
1609 BIDDLE AVENUE
WYANDOTTE, MICHIGAN 48192
(973) 519-3991
www.StyroporEPS.com

EVALUATION SUBJECT:

EXPANDABLE POLYSTYRENE BEADS: BASF STYROPOR® TYPES BF, BFL, (F95)BF, (F95)BFL, F, KF AND MF

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 and 2006 *International Building Code®* (IBC)
- 2009 and 2006 *International Residential Code®* (IRC)
- 2009 and 2006 *International Fire Code®* (IFC)
- 2009 and 2006 *International Energy Conservation Code®* (IECC)
- Other Codes (see Section 8.0)

Properties evaluated:

- Physical properties
- Surface-burning characteristics
- Attic and crawl space evaluation

2.0 USES

BASF polystyrene beads are used by independent manufacturers in the production of expanded polystyrene (EPS) insulation products.

3.0 DESCRIPTION

BASF expandable polystyrene beads designated as BASF Styropor® Types BF, BFL, (F95)BF, (F95)BFL, F, KF and MF are used by independent manufacturers to produce EPS insulation boards. Boards manufactured with the BASF beads are produced through the introduction of heat. This process expands the beads which are then molded into insulation boards with maximum densities and thicknesses no greater than those specified in Table 1. EPS boards formed from Styropor® beads have thermal resistance values as noted in Table 2. The end use of the polystyrene beads, including the manufacture of boards, is outside the scope of this report and must be addressed in a separate evaluation report. At densities and thicknesses no greater than those specified in Table 1, insulation boards produced from the BASF beads have a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E84.

The expandable beads have been qualified in accordance with Section 4.5.15.1 of the ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12). The boards can be used to produce expanded polystyrene products that comply with the ASTM C578 (with types as noted in Table 1), provided the final product is recognized in a current ICC-ES evaluation report and has been qualified in accordance with Section 4.5.15.1.2 of AC12.

4.0 INSTALLATION

4.1 General:

Installation must be as noted in the corresponding ICC-ES evaluation report on the foam plastic assembly, or as otherwise permitted in applicable codes noted in Section 1.0 of this report.

4.2 Installation in Attics or Crawl Spaces:

Insulation boards produced from BASF Styropor® Types (F95)BF, (F95)BFL, BF, BFL, F, KF and MF beads can be used in attics or crawl spaces with no covering applied to the attic or crawl space side of the foam plastic, provided all of the following conditions are met:

1. Entry to the attic or crawl space is only to service utilities, and no storage is permitted.
2. There are no interconnected attic or crawl space areas.
3. Air in the attic or crawl space is not circulated to other parts of the building.
4. Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, as applicable. Under-floor (crawl space) ventilation is provided when required by IBC Section 1203.3 or IRC Section R408.1, as applicable.
5. Combustion air is provided in accordance with Section 701 of the 2009 *International Mechanical Code* (IMC) or Sections 701 and 703 of the 2006 IMC, as applicable.
6. The boards are produced from BASF Styropor® Types (F95)BF, (F95)BFL, BF, BFL, F, KF and MF beads, and have a maximum thickness of 4 inches (102 mm) at 1.0 pcf (16.0 kg/m^3), a maximum thickness of 2 inches (50.8 mm) at 2.0 pcf (32.0 kg/m^3), or intermediate density and thickness combinations not to exceed the equivalent mass of 2 inches (50.8 mm) at 2.0 pcf (32.0 kg/m^3) density boards.

***Revised September 2012**

5.0 CONDITIONS OF USE

The BASF Styropor® Types BF, BFL, (F95)BF, (F95)BFL, F, KF and MF expandable polystyrene beads described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0, subject to the following conditions:

5.1 The maximum density and thickness of the insulation boards produced from the expanded beads are as noted in Table 1.

5.2 Products manufactured from the polystyrene beads described in this report must be recognized in a current ICC-ES evaluation report.

5.3 Insulation boards produced from BASF Styropor® beads must be separated from the building interior by a thermal barrier complying with IBC Section 2603.4, IRC Section R316.4 (Section R314.4 for the 2006 IRC), or IFC Section 803.7.2, as applicable.

5.4 Boards produced from the BASF Styropor® beads can be used in attic and crawl spaces without an ignition barrier as described in Section 4.2.

5.5 The Styropor® Types BF, (F95)BF, F, BFL and F95)BFL beads are produced by BASF's joint-venture partner Polioles S. A. de C.V., at Altamira, Tamaulipas, Mexico, with quality control inspections by Intertek Testing Services NA, Inc. (AA-690).

5.6 The Styropor® Type KF beads are produced by BASF Company Ltd. at the Ulsan Plastics Site, Republic of South Korea, with quality control inspections by Intertek Testing Services NA, Inc. (AA-690).

5.7 The Styropor® Type MF beads are produced by BASF (Malaysia) at Pasir Gudang, Johor, Malaysia, with quality control inspections by Intertek Testing Services NA, Inc. (AA-690).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12), dated June 2012, including data in accordance with Appendix B.

7.0 IDENTIFICATION

The bead containers must bear a label noting the component designation; the name and address of BASF; the evaluation report number (ESR-1498); the lot number; and the logo of the inspection agency (Intertek Testing Services, NA, Inc.).

8.0 OTHER CODES

In addition to the codes referenced in Section 1.0, the products described in this report were evaluated for compliance with the requirements of the 1997 *Uniform Building Code*® (UBC).

The BASF Styropor® Types BF, BFL, (F95)BF, (F95)BFL, F, KF and MF expandable polystyrene beads comply with the UBC as described in Sections 2.0 to 7.0 of this report, with the revisions noted below:

- **Installation:** Same as Section 4.0, except replace item 4 in Section 4.2 with the following: Attic ventilation must be provided in accordance with UBC Section 1505, and under-floor (crawl space) ventilation must be provided that complies with UBC Section 2306.7.
- **Conditions of Use:** Same as Section 5.0, except replace the wording in Section 5.3 with the following: Insulation boards produced from BASF Styropor® beads must be separated from the building interior by a thermal barrier complying with UBC Section 2602.4.

TABLE 1—MAXIMUM INSULATION BOARD DENSITY AND THICKNESS

BEAD TYPE	ASTM C578 Types	BEAD SIZE	MAXIMUM DENSITY (pcf)	MAXIMUM THICKNESS (inches)
(F95)BF	I, II, VIII, IX	195, 295, 295M, 395, 395S, 495	1.25 2.0	6 5
(F95)BFL	I, II, VIII, IX	295, 395, 397, 397S, 495	1.25 2.0	6 5
BF	I, II, VIII, IX	222, 322, 327 and 422	1.25 2.0	6 5
BFL	I, II, VIII, IX	222, 322, 327 and 422	1.25 2.0	6 5
F	I, II, VIII, IX	F0507, F0710, F0710(s), F1015, F1525	2.0	5
KF	I, II, VIII	KF212, KF262, KF312, KF362, KF412, KF462	2.0 1.25	5 6
MF	I, II, VIII	MF212, MF262, MF312, MF362, MF412, MF462	2.0 1.25	5 6

For **SI:** 1 inch = 25.4 mm, 1 pcf = 16.02 kg/m^3.

TABLE 2—THERMAL RESISTANCE OF EPS FOAM PLASTIC INSULATION

EPS TYPE	MINIMUM DENSITY (pcf)	*R*-VALUE PER INCH OF THICKNESS (°F•ft^2•h/Btu)
I	0.90	3.6
VIII	1.15	3.8
II	1.35	4.00
IX	1.80	4.20

For **SI:** 1 pcf = 16.02 kg/m^3, 1°F·ft^2·hr/Btu = 0.176 m^2·K/W, 1°F = 1.8°C+32.

ICC-ES Evaluation Report

ESR-1498 FBC Supplement

Issued September 1, 2012
This report is subject to renewal December 1, 2013.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

. **DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION**
Section: 07 21 00—Thermal Insulation

REPORT HOLDER:

BASF CORPORATION
1609 BIDDLE AVENUE
WYANDOTTE, MICHIGAN 48192
(973) 519-3991
www.StyroporEPS.com

EVALUATION SUBJECT:

EXPANDABLE POLYSTYRENE BEADS: BASF STYROPOR® TYPES (F95)BF, (F95)BFL, BF, BFL, F, KF AND MF

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that BASF Styropor® Types (F95)BF, (F95)BFL, BF, BFL, F, KF and MF expandable polystyrene beads, recognized in ICC-ES master report ESR-1498, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2010 *Florida Building Code—Building*
- 2010 *Florida Building Code—Residential*

2.0 CONCLULSIONS

The BASF Styropor® Types (F95)BF, (F95)BFL, BF, BFL, F, KF and MF expandable polystyrene beads described in Sections 2.0 through 7.0 of the master evaluation report ESR-1498 comply with the 2010 *Florida Building Code—Building* and the 2010 *Florida Building Code—Residential*, provided the installation is in accordance with the *International Building Code®* (IBC) provisions noted in the master report.

Use of BASF Styropor® Types (F95)BF, (F95)BFL, BF, BFL, F, KF and MF expandable polystyrene beads has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the 2010 *Florida Building Code—Building* and the 2010 *Florida Building Code—Residential,* under the condition that the expandable polystyrene beads used to manufacture insulation boards for exterior walls of multistory buildings located in the High-Velocity Hurricane Zone are in compliance with Section 2612.3.2.4 of the *Florida Building Code—Building.*

For products falling under Florida Rule 9N-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report issued on December 1, 2011.

ICC-ES Evaluation Report

ESR-3255

Issued June 1, 2012
This report is subject to renewal June 1, 2013.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 83—Shop-Applied Wood Coatings

REPORT HOLDER:

ECO BUILDING PRODUCTS, INC.
909 WEST VISTA WAY
VISTA, CALIFORNIA 92083
(877) 732-6258
www.ecob.net
info@ecob.net

EVALUATION SUBJECT:

ECO RED SHIELD™ WOOD PROTECTION COATING

ADDITIONAL LISTEES:

ECOPRIME LLC
550 BLACKBORN DRIVE
MARTINEZ, GEORGIA 30907

GUTHRIE LUMBER AND DISTRIBUTION CENTERS, INC.
3300 GONZALES
AUSTIN, TEXAS 78702

INTERSTATE & LAKELAND LUMBER CORPORATION
247 MILL STREET
GREENWICH, CONNECTICUT 06830

NORTHERN CROSSARM COMPANY, INC.
POST OFFICE BOX 34
CHIPPEWA FALLS, WISCONSIN 54729

STRUCTURAL TECHNOLOGIES, LLC
126 SOUTH LYNNHAVEN ROAD
VIRGINIA BEACH, VIRGINIA 23452

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012 and 2009 *International Building Code®* (IBC)
- 2012 and 2009 *International Residential Code®* (IRC)
- Other Codes (see Section 8.0)

Properties evaluated

- Decay resistance above ground
- Termite resistance
- Corrosion
- Structural

2.0 USES

Eco Red Shield™ Wood Protection Coating is used to treat wood products used in aboveground applications that are required by code to be protected against decay and termites.

3.0 DESCRIPTION

3.1 General:

Eco Red Shield™ Wood Protection Coating wood products are recognized for use in aboveground applications and to resist attack by fungal decay and subterranean termites, including Formosan termites.

Eco Red Shield™ Wood Protection Coating uses DOT containing formulations supplied by Eco Building Products Inc. and used by the wood treatment facilities listed in Table 3, to coat wood members in accordance with the Eco Red Shield™ Quality Control Manual.

3.2 Preservative System:

Eco Red Shield™ Wood Protection Coating is a disodium octaborate tetrahydrate (DOT) treatment chemical for coating wood members.

3.3 Materials:

The following wood products may be treated with the Eco Red Shield™ Wood Protection Coating:

a. Dimensional lumber and timbers of the following species: mixed Southern pine, hem-fir and Douglas fir.
b. Plywood complying with US DOC PS-1 and OSB complying with U.S. DOC PS-2, consisting of Southern pine and Douglas fir.
c. Laminated veneer lumber (LVL)
d. Parallel strand lumber (PSL)
e. Laminated beams

Minimum borate concentration levels must be as shown in Table 1.

4.0 DESIGN AND INSTALLATION

4.1 General:

Eco Red Shield™ Wood Protection Coating treated wood is installed in locations required to have preservative-treated lumber, timbers and OSB in accordance with the requirements of the applicable code.

Eco Building Products Inc. installation instructions, industry-published installation instructions for wood and pressure-treated wood and this report must be strictly adhered to, and a copy of the instructions must be available at all times on the jobsite during installation.

The instructions within this report govern if there are any conflicts between the Eco Building Products Inc. instructions and this report.

4.2 Applications:

Eco Red Shield™ Wood Protection Coating wood products may be used in locations where wood is permitted and/or in locations where wood is required by the code to be fungal decay or termite resistant in all building types and occupancies, as defined by the applicable code. The treated wood members are recognized for use in aboveground applications where they are continuously protected from liquid water. Wood treated with Eco Red Shield™ Wood Protection Coating may be used as sill-plates over concrete slabs and foundations in accordance with the applicable code. Typical applications are listed in Table 2.

Locations requiring preservative-treated wood for decay or termite resistance are described in Section 2304.11 of the IBC, and Sections R317 and R318 of the IRC.

4.3 Fasteners:

Fasteners used with Eco Red Shield™ Wood Protection Coating wood products must be in accordance with Section 2304.9.5 of the IBC and Section R317.3 of the IRC, except that aluminum fasteners are also permitted when wood products are used in interior applications.

4.4 Protection from Water:

The borate preservative in Eco Red Shield™ Wood Protection Coating wood is water-soluble and the coated wood must be protected from liquid water, where permanently installed.

Eco Red Shield™ Wood Protection Coating wood used in weather-protected exterior applications must be continuously protected from direct wetting with a minimum of one coat of primer and two coats of finish paint.

4.5 Structural—Duration of Load:

The maximum load duration factor allowed for Eco Red Shield™ Wood Protection Coating wood products used for structural members is 1.6, in accordance with Section 2.3 of the American Forest & Paper Association (AF&PA) National Design Specification for Wood Construction (NDS).

5.0 CONDITIONS OF USE

The Eco Red Shield™ Wood Protection Coating described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Use of the preservative-treated wood is limited to the types of applications noted in Section 4.2.

5.2 Surface treatment of field cuts and bored holes must be in accordance with the recommendations of Eco Building Products Inc. and AWPA M4.

5.3 The Eco Red Shield™ Wood Protection Coating wood products are limited to the wood products noted in Section 3.3 and the minimum application rate as noted in Table 1.

5.4 Treated materials used for protection against Formosan termites must be labeled/identified for this use as described in Section 7.0.

5.5 The Eco Red Shield™ Wood Protection Coating must only be factory-applied by applicators trained by the report holder, in a manner complying with all applicable state and federal regulations.

5.6 The Eco Red Shield™ Wood Protection Coating treated products must be protected from continuous wetting during shipping and storage.

5.7 Treatment of wood products is at the facilities of the treaters noted in Table 3, under a quality control program with inspections by Timber Products Inspection Inc. (AA-664 and AA-696).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Liquid Borate Fungal Decay and Termite-resistant Treatment Applied to Wood Members (AC433), dated June 2012.

7.0 IDENTIFICATION

Eco Red Shield™ Wood Protection Coating treated lumber, timber, plywood and OSB must be stamped or end tagged with the name of the inspection agency (Timber Products Inspection Inc.); the product name (Eco Red Shield™); the Eco Building Products Inc. name; the treatment company name and plant location (refer to Table 3); the name of the preservative component (DOT); the intended end use application (see Table 2); and the evaluation report number (ESR-3255). Bulk shipments directly from the manufacturing plant to a jobsite may have only one label per unit of material. A sample label is shown in Figure 1.

Products treated for protection against Formosan termites must be labeled as shown in Figure 2.

8.0 OTHER CODES

In addition to the codes referenced in Section 1.0, the products described in this report were evaluated for compliance with the requirements of the following legacy codes and earlier editions of the International Codes:

- 2006, 2003 and 2000 *International Building Code*® (IBC)
- 2006, 2003 and 2000 *International Residential Code*® (IRC)
- 1997 *Uniform Building Code*™ (UBC)
- BOCA® *National Building Code*/1999 (BNBC)
- 1999 *Standard Building Code*© (SBC)

The Eco Red Shield™ Wood Protection Coating wood products described in this report comply with, or are suitable alternatives to what is specified in, the codes listed above, subject to the provisions of Sections 8.1 through 8.6.

8.1 Uses:

See Section 2.0.

8.2 Description:

See Section 3.0.

8.3 Installation:

See Section 4.0, except for the following modifications:

Locations requiring preservative-treated wood for decay or termite resistance are described in Section 2304.11 of the 2006, 2003 and 2000 IBC, Sections R319 and R320 of the 2006 and 2003 IRC, Sections R323 and R324 of the 2000 IRC, Section 2304 of the SBC, Section 2311 of the BNBC, and Section 2306 of the UBC.

Fasteners used with Eco Red Shield™ Wood Protection Coating wood products must be in accordance with Section 2304.9.5 of the 2006, 2003 and 2000 IBC, Section R319.3 of the 2006 and 2003 and IRC, Section R323.3 of the 2000 IRC, Section 2306.3 of the SBC, Section 2311.3.3 of the BNBC, and Section 2304.3 of the UBC, except that aluminum fasteners are also permitted when the treated wood products are used in interior applications**.**

8.4 Conditions of Use:

See Section 5.0.

8.5 Evidence Submitted:

See Section 6.0.

8.6 Identification:

See Section 7.0.

TABLE 1—MINIMUM CONCENTRATION APPLICATION RATE REQUIREMENTS FOR ECO RED SHIELD™ WOOD PROTECTION COATING WOOD PRODUCTS BY END USE

END USE	MINIMUM APPLICATION RATE
	DOT - B_2O_3
Aboveground applications UC1, UC2 and UC3A, not subject to contact with liquid water, species and products listed in Section 3.3.	Minimum application rate shall provide a DOT loading of 0.0068 g/in^2. The concentration is suitable for exposure to Formosan termites.

TABLE 2—TYPICAL APPLICATIONS FOR ECO RED SHIELD™ WOOD PROTECTION COATING WOOD PRODUCTS

SERVICE CONDITIONS	AWPA USE CATEGORY	TYPICAL APPLICATIONS
Interior construction, above ground, dry	UC1	Interior construction - millwork and furnishings
Interior construction, above ground, damp	UC2	Interior construction - interior beams, timbers, flooring, millwork and sill plates
Exterior construction, above ground, coated and rapid water runoff	UC3A	Refer to Section 4.4 Exterior - coated millwork, siding and trim

TABLE 3—WOOD TREATMENT LOCATIONS

LISTEE	WOOD PRESERVATIVE TREATMENT LOCATIONS
Eco Building Products	Colton, CA Salem, OR
EcoPrime LLC	Augusta, GA
Guthrie Lumber & Distribution Centers, Inc.	Austin, TX
Interstate & Lakeland Lumber	Bethel, CT
Northern Crossarm Co. Inc. Northern Crossarm Co. Inc. (Rocky Mountain BluWood)	Chippewa Falls, WI Denver, CO
Structural Technologies, LLC	Doswell, VA

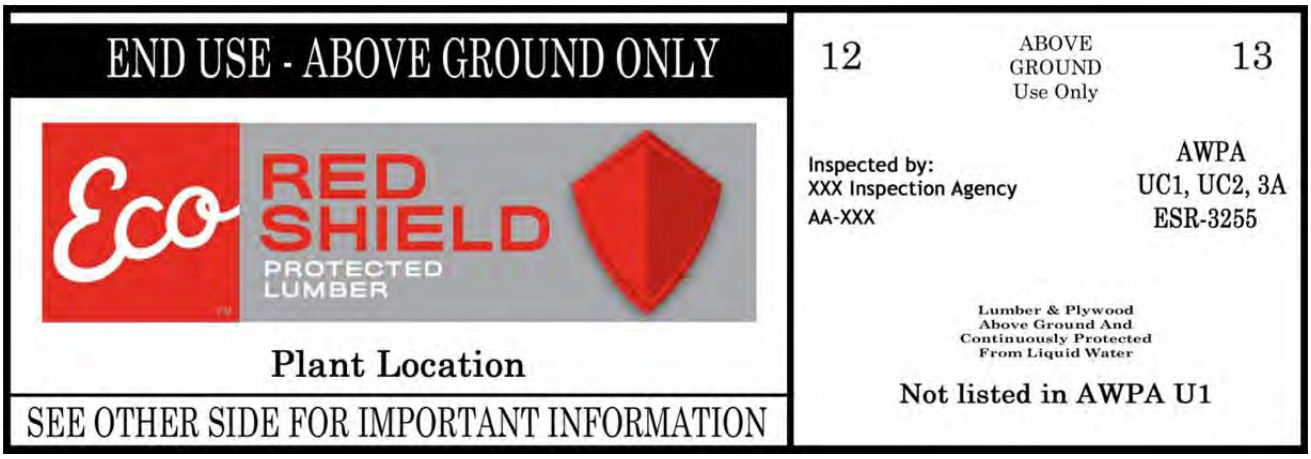


FIGURE 1—SAMPLE PRODUCT LABEL

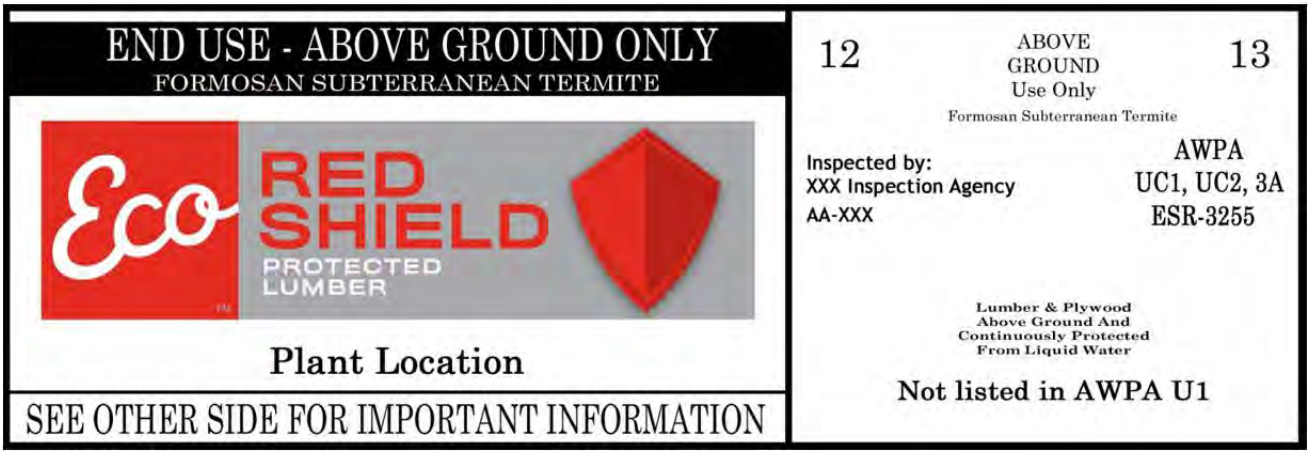


FIGURE 2—SAMPLE PRODUCT LABEL—FORMOSAN TERMITES

ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-1930

Reissued March 1, 2011

This report is subject to renewal in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 30 05—Roofing Felt and Underlayment

REPORT HOLDER:

HENRY COMPANY
909 NORTH SEPULVEDA BOULEVARD, SUITE 650
EL SEGUNDO, CALIFORNIA 90245
(800) 486-1278
www.henry.com

EVALUATION SUBJECT:

BLUESKIN® RF 200 SELF-ADHERED ROOF UNDERLAYMENT AND EAVEGUARD® SELF-ADHERED SHINGLE UNDERLAYMENT

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code®* (IBC)
- 2006 *International Residential Code®* (IRC)

Properties evaluated:

- Physical properties
- Water resistance

2.0 USES

Blueskin® RF 200 Self-adhered Roof Underlayment and Eaveguard® Self-adhered Shingle Underlayment are self-adhering membranes used as alternatives to the ice dam membrane specified in Chapter 15 of the IBC and Chapter 9 of the IRC.

3.0 DESCRIPTION

3.1 Blueskin® RF 200 Self-adhered Roof Underlayment:

Blueskin® RF 200 is a nominally 40-mil-thick [0.040 inch (1.00 mm)], reinforced modified bitumen membrane with a polyethylene film on the top surface. The membrane is backed with a release film that serves to protect the membrane adhesive and to prevent self-adhesion of the material. The membrane is blue in color and is supplied in rolls.

3.2 Eaveguard® Self-adhered Shingle Underlayment:

Eaveguard® is a nominally 45-mil-thick [0.045 inch (1.14 mm)], reinforced modified bitumen membrane with a sand coating on the top surface. The membrane is backed with a release film that serves to protect the membrane adhesive and to prevent self-adhesion of the material. The membrane is black in color and is supplied in rolls.

4.0 INSTALLATION

4.1 General:

Installation of the membranes must comply with the requirements of the applicable code, this report and the manufacturer's published installation instructions. The installation instructions must be available at the jobsite at all times during installation.

Prior to application of the membranes, the deck surface must be free of frost, dust and dirt, loose nails, and other protrusions. Damaged sheathing must be replaced. Installation of the membranes is limited to plywood substrates complying with the requirements of the applicable code. The membranes must not to be applied when the ambient air and deck temperatures are below 40°F (4.4°C).

If, during application, the membrane becomes misaligned, the roll must be cut and restarted. The membrane is pressed firmly into place, from the center to the edge. After application, the membrane must be inspected, and any defects repaired. "Fish mouths" must be slit, pressed flat, and covered with a patch of membrane of sufficient width and length to overlap each side and end of the slit a minimum of 6 inches (152 mm). Flashing around protrusions or metal drip edges must be installed over the membranes, to prevent water backup.

Installation of the roof covering can proceed immediately following application of the membranes. The membranes are not intended to be left exposed and must be covered by an approved roof covering.

4.2 Blueskin® RF 200 Self-adhered Roof Underlayment:

4.2.1 General: The Blueskin® RF 200 membrane may be installed either parallel or perpendicular to the roof slope. When applied perpendicular to the slope, the membrane is applied starting at the lowest point of the roof and continuing up to the highest point. The installation of successive courses proceeds in a shingle fashion. The upper half of the release film is removed and the membrane is firmly pressed in place. The lower half of the release film is then removed and the membrane firmly pressed in place. When the membrane is applied parallel to the roof slope, the membrane is aligned with the lower edge of the roof and set in place. The remainder of the membrane is applied directly to the roof deck by removing the release film and firmly pressing the membrane into place. End and edge seams must be overlapped a minimum of $2^3/_4$ inches (70 mm) for either installation method. When applied perpendicular to the roof slope, the subsequent courses of membrane are applied parallel to the eave, from the lower edge of the roof upwards in a

shingle-lap manner. The membrane is installed in sufficient courses to extend up the roof the minimum distance prescribed by IBC Chapter 15 or IRC Chapter 9 inside the exterior wall line of the building.

4.2.2 Reroofing: For reroofing applications, the same preparation as described in Section 4.1 and Section 4.2.1 applies, after the removal of the existing roof covering and roofing felts to expose the roof deck.

4.3 Eaveguard® Self-adhered Shingle Underlayment:

4.3.1 General: The Eaveguard® membrane is installed perpendicular to the roof slope and is aligned with the lower edge of the roof and temporarily held in place with tack nails set in the selvage. The nails are not to be driven fully, as they are to be removed. The edge of the first sheet is folded back and the release film removed from the lower edge of the membrane, and the membrane is firmly pressed in place. The nails are removed and the release film from the upper portion of the membrane removed, and the membrane is firmly pressed in place. End and edge seams are overlapped a minimum of $2^3/_4$ inches (70 mm). The subsequent courses of membrane must be applied parallel to the eave, from the lower edge of the roof upwards in a shingle-lap manner. The membrane must be installed in sufficient courses to extend up the roof the minimum distance prescribed by IBC Chapter 15 or IRC Chapter 9 inside the exterior wall of line the building.

4.3.2 Reroofing: For reroofing applications, the same preparation as described in Section 4.1 and Section 4.3.1 applies, after the removal of the existing roof covering and roofing felts to expose the roof deck.

5.0 CONDITIONS OF USE

The Blueskin® RF 200 Self-adhered Roof Underlayment and Eaveguard® Self-adhered Shingle Underlayment described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Installation must comply with the requirements of the applicable code, this report and the manufacturer's published installation instructions. In the event of conflict between this report and the installation instructions, this report governs.

5.2 Installation is limited to use on plywood roof substrates on structures located in areas where nonclassified roof assemblies are permitted. Applications where classified roof coverings are required are outside the scope of this report.

5.3 Installation is limited to roofs with a slope of 2:12 (16.67%) or greater.

5.4 Installation is limited to use with roof coverings that are mechanically fastened through the underlayment to the sheathing or rafters.

5.5 Installation is limited to roofs with ventilated attic spaces, in accordance with the requirements of the applicable code.

5.6 The membranes are manufactured in Petrolia, Ontario, Canada, under a quality control program with inspections provided by Underwriters Laboratories Inc. (AA-668).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Roof Underlayment for Use in Severe Climate Areas (AC48), dated October 2005 (corrected July 2009).

6.2 Report of testing in accordance with ASTM D 1970.

7.0 IDENTIFICATION

The Blueskin® RF 200 Self-adhered Roof Underlayment and Eaveguard® Self-adhered Shingle Underlayment described in this report must be identified by a label, on the container of each roll of membrane, bearing the Henry Company name and address, the applicable product name, the manufacturing location (Petrolia, Ontario, Canada), the evaluation report number (ESR-1930) and the name of the inspection agency (Underwriters Laboratories Inc.).

ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-1851*

Reissued August 1, 2011

This report is subject to renewal August 1, 2012.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 73.13—Preservative Wood Treatment

REPORT HOLDER:

VIANCE, LLC
200 EAST WOODLAWN ROAD, SUITE 350
CHARLOTTE, NORTH CAROLINA 28217
(704) 522-0825
www.treatedwood.com

EVALUATION SUBJECT:

ECOLIFE™ II PRESERVATIVE-TREATED WOOD

ADDITIONAL LISTEES:

CULPEPER WOOD PRESERVERS
15487 BRAGGS CORNER ROAD
CULPEPER, VIRGINIA 22701

SUNBELT FOREST PRODUCTS CORPORATION
HIGHWAY 17 AND SPIRIT LAKE ROAD
BARTOW, FLORIDA 33830

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012 and 2009 *International Building Code®* (IBC)
- 2012 and 2009 *International Residential Code®* (IRC)
- Other Codes (see Section 8.0)

Properties evaluated:

- Preservative-treated wood
- Decay resistance
- Termite resistance
- Corrosion
- Structural

2.0 USES

Ecolife™ II preservative-treated wood is used in aboveground applications that are required by the code to be protected against decay and termites.

3.0 DESCRIPTION

3.1 General:

Ecolife™ II preservative-treated wood products are recognized for use in aboveground applications and to resist attack by fungal decay and subterranean termites, including Formosan termites.

Viance Ecovance™ brand wood preservative is produced by Viance, LLC, and is used by the wood-preservative treatment facilities listed in Table 3 of this report to preservative- treat wood members and plywood in accordance with the Viance, LLC, Standard Ecolife™ II-2011.

3.2 Preservative System:

Ecovance™ brand wood preservative is a DCOIT fungicide wood preservative containing 4, 5-Dichloro-2-n-octyl-4-isothiazolin-3-one and the insecticide Imidacloprid. The Ecovance fungicide is diluted in water or Ecovance work solution. The Imidacloprid insecticide is provided as a water-soluble concentrate.

3.3 Materials:

The following products may be treated with the Ecolife™ II preservative system:

a. Dimensional lumber and timbers of the following species consisting of primarily sapwood: southern pine, mixed southern pine, radiata pine, Patula pine, Caribbean pine, red pine, Ponderosa pine, eastern white pine, and German Scots pine.

b. Dimensional lumber of the following species consisting primarily of heartwood: hem-fir, hem-fir North, eastern hemlock, subalpine fir, Douglas fir, redwood, and western red cedar.

c. Lumber, of nominal size of 2-by-8 or less, for decking and specialty use of the species listed in (a) and (b) above.

d. Southern pine and Douglas fir plywood.

Minimum preservative retention levels must comply with the values shown in Table 1 of this evaluation report.

4.0 INSTALLATION

4.1 General:

Ecolife™ II preservative-treated wood is installed as preservative-treated lumber and timbers in accordance with the requirements of the applicable code.

Viance, LLC, industry published installation instructions for wood and pressure-treated wood and this report must be strictly adhered to, and a copy of the instructions must be available at all times on the jobsite during installation.

The instructions within this report govern if there are any conflicts between Viance, LLC, instructions and this report.

4.2 Applications:

Ecolife™ II preservative-treated wood products may be used in aboveground locations where wood is permitted and/or in aboveground locations required by the code to be resistant to fungal decay or termites. The treated wood products are limited to use in aboveground applications in all building types and occupancies where permitted by the applicable code. Typical applications are described in Table 2.

Locations requiring preservative-treated wood for fungal decay or termite resistance are described in Section 2304.11 of the IBC and Sections R317 and R318 of the IRC.

4.3 Fasteners:

Fasteners used with Ecolife™ II preservative-treated wood products must be in accordance with Section 2304.9.5 of the IBC and Section R317.3 of the IRC, except that aluminum fasteners are also permitted.

4.4 Structural:

4.4.1 Duration of Load: The maximum load duration factor allowed for Ecolife™ II treated wood products used for structural members is 1.6, in accordance with Section 2.3 of the American Forest & Paper Association (AF&PA) National Design Specification for Wood Construction (NDS).

4.4.2 Incising Factor: When the treated wood products have been incised, the reference design values must be multiplied by the incising factor, Ci, in accordance with Section 4.3.8 of the NDS.

5.0 CONDITIONS OF USE

The Ecolife™ II preservative-treated wood products described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Use of the preservative-treated wood is limited to the types of applications noted in Section 4.2.

5.2 Surface treatment of field cuts must be in accordance with the recommendations of Viance, LLC.

5.3 The Ecolife™ II preservative-treated wood products are limited to the wood species noted in Section 3.3 and minimum retention levels noted in Table 1.

5.4 Treatment of wood products is at the facilities of the treaters noted in Table 3, under a quality control program with inspections by Timber Products Inspection Inc. (AA-664 and AA-696).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with Appendix C, DCOIT Wood Preservative Systems (Formerly AC314), of the ICC-ES Acceptance Criteria for Proprietary Wood Preservative Systems-Common Requirements for Treatment Process, Test Methods and Performance (AC326), dated February 2012.

6.2 Quality control documentation in accordance with Section 5.0 of AC326 with AWPA M22 compliance.

7.0 IDENTIFICATION

Ecolife™ II preservative-treated lumber must be labeled with the name of the inspection agency (Timber Products Inspection Inc. or Southern Pine Inspection Bureau, Inc.); the product name (Ecolife™ II) or logo (see Figure 1); the treatment company name and plant location (refer to Table 3); the name of the preservative components; the intended end use; and the evaluation report number (ESR-1851). A sample label is shown as Figure 1.

8.0 OTHER CODES

8.1 Evaluation Scope:

In addition to the codes referenced in Section 1.0, the products described in this report were evaluated for compliance with the requirements of the following legacy codes and earlier editions of the International Codes:

- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)
- 2003 *International Building Code*® (2003 IBC)
- 2003 *International Residential Code*® (2003 IRC)
- 2000 *International Building Code*® (2000 IBC)
- 2000 *International Residential Code*® (2000 IBC)

The Ecolife™ II preservative-treated wood products described in this report comply with, or are suitable alternatives to what is specified in, the codes listed above, subject to the provisions of Sections 8.1 through 8.6.

8.2 Uses:

See Section 2.0.

8.3 Description:

See Section 3.0.

8.4 Installation:

See Section 4.0, except for the following modifications:

Locations requiring preservative-treated wood for decay or termite resistance are described in Section 2304.11 of the 2000, 2003 and 2006 IBC, Sections R323 and R324 of the 2000 IRC, Sections R319 and R320 of the 2003 and 2006 IRC.

Fasteners used with Ecolife™ II preservative-treated wood products must be in accordance with Section 2304.9.5 of the 2000, 2003 and 2006 IBC, Section R323.3 of the 2000 IRC, Section R319.3 of the 2003 and 2006 IRC, except that aluminum fasteners are also permitted.

8.5 Conditions of Use:

See Section 5.0.

8.6 Evidence Submitted:

See Section 6.0.

8.7 Identification:

See Section 7.0.

TABLE 1—MINIMUM PRESERVATIVE RETENTION REQUIREMENTS FOR ECOLIFE™ II WOOD PRODUCTS BY END USE

END USE	MINIMUM TOTAL RETENTION, pcf (kg/m^3)	MINIMUM COMPONENTS RETENTION[1], pcf (kg/m^3)	
		DCOIT	Imidacloprid
Above ground UC1, UC2, UC3A, UC3B	0.0187 (0.3)	0.0187 (0.3)	Note 2

[1]Retention is expressed in pounds of preservative per cubic foot (kilograms per cubic meter) of preservative actives.
[2]The Imidacloprid insecticide is blended with the Ecovance brand wood preservative solution.

TABLE 2—TYPICAL APPLICATIONS FOR ECOLIFE™ II WOOD PRODUCTS

SERVICE CONDITIONS	AWPA USE CATEGORY	TYPICAL APPLICATIONS
Interior construction, above ground, dry	UC1	Interior construction - millwork and furnishings
Interior construction, above ground, damp	UC2	Interior construction - interior beams, timbers, flooring, millwork and sill plates
Exterior construction, above ground, coated and rapid water runoff	UC3A	Exterior - coated millwork, siding and trim
Exterior construction, above ground, uncoated and poor water runoff	UC3B	Decking, guardrails, spindles, flooring, deck joists, beams and framing, deck posts above grade support on concrete piers with a steel bracket, trim and fascia, sill plates, fence rails, trellises, gazebos

TABLE 3—WOOD PRESERVATIVE TREATMENT LOCATIONS

LISTEES	WOOD PRESERVATIVE TREATMENT LOCATIONS
Culpeper Wood Preservers	Streator, IL Columbia, SC Culpeper, VA Fredericksburg, VA
Sunbelt Forest Products	Bartow, FL

TABLE 4—ALTERNATE BRAND NAMES BY INDIVIDUAL LISTEES FOR LUMBER AND PLYWOOD TREATED WITH ECOLIFE™ II

COMPANY	PRIVATE BRAND NAME
Culpeper Wood Preservers	Prodigy, Pure Pine
Sunbelt Forest Products	Tropical Decking
Viance, LLC	Ecolife II

FIGURE 1—SAMPLE PRODUCT LABEL
(Product must also be labeled with the minimum retention as specified in Table 1)

ICC-ES Evaluation Report

ESR-2553

Reissued January 1, 2011

This report is subject to re-examination in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTIC, AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY, INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE TOP-FLANGE HANGERS FOR SAWN LUMBER

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2009 *International Residential Code*® (2009 IRC)
- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie top-flange hangers described in this report are used as wood framing connectors in accordance with Section 2304.9.3 of the IBC. The products may also be used in structures regulated under the IRC when an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The Simpson Strong-Tie top-flange hangers described in this report are U-shaped hangers with one or two flanges that bear onto the supporting wood member or welded to a steel beam. A hanger with two flanges is fabricated from the same piece of steel that forms the U-shaped stirrup of the hanger. A hanger with one flange is fabricated from a steel angle that is factory-welded to the U-shaped stirrup of the hanger. The U-shaped stirrup of each hanger has a width and height designed to support sawn lumber joists or beams.

3.1.1 JB and LB Hanger Series: The JB series hangers are fabricated from No. 18 gage galvanized steel, and the LB hangers are fabricated from No. 14 gage galvanized steel. The top flange must be supported by a wood beam, girder, nailer or ledger. Alternatively, the top flange of the LB hangers may be welded to a steel beam. See Table 1 for hanger dimensions, fastener schedules, and allowable loads. See Figures 1a and 1b for drawings of a typical LB and JB hangers, respectively.

3.1.2 W, WNP, WNPU, HW, and HWU Hanger Series: The W hanger series consists of No. 12 gage steel angles factory-welded to No. 12 gage U-shaped steel stirrups. The WNP and WNPU hanger series consist of No. 7 gage steel angles factory-welded to No. 12 gage steel U-shaped stirrups. The HW hanger series consists of No. 3 gage steel angles factory-welded to No. 11 gage steel U-shaped stirrups. The HWU hanger series consists of No. 3 gage steel angles factory-welded to No. 10 gage steel U-shaped stirrups. See Table 2a for a hanger model numbers and seat width and hanger height dimensions. See Table 2b for fastener schedules and allowable loads based on hanger model dimensions. See Figures 2a through 2e for drawings of the W, WNP, HW, HWU, and WNPU hanger series showng top flange dimensions.

3.1.3 HUTF Hanger Series: The HUTF hanger series is formed from No. 12 gage galvanized steel. HUTF hangers have two header flanges, which extend over the top of the header, and have predrilled holes for the installation of 16d common nails as shown in Figure 3b. The hanger seat width (W) is sized for the net width of the supported member. HUTF hangers having a seat width equal to or greater than $2^{9}/_{16}$ inches (65 mm) are available with concealed header flanges (i.e., the portion of the hanger fastened to the carrying header) as shown in Figure 3b. See Table 3 for hanger models, hanger dimensions, fastener schedules, and allowable loads.

3.1.4 HUSTF Series Hangers: The HUSTF Series joist hangers are fabricated from No. 14 gage galvanized steel. The hanger has a U-shaped stirrup with prepunched holes for installing nails, minimum 16d common, that must be driven at a 45-degree angle through the supported wood joist and into the carrying wood member. This is described in the manufacturer's installation instructions as double shear nailing. See Table 4 for hanger models, hanger dimensions, fastener schedules, and allowable loads. See Figure 4a for a drawing of a typical HUSTF hanger, and Figure 4b for drawing of a top view of double shear nailing.

3.1.5 PF, PFD, PFA, and PFDS Hanger Series: The PF hangers support nominally 2-by-4 and 2-by-6 wood members and are fabricated from No. 18 gage galvanized

steel. The PFA, PFD and PFDS hangers support nominally 2-by-4 or 2-by-6 wood joists and are fabricated from No. 20 gage galvanized steel. The PFA hangers support a single joist member. The PFD and PFDS hangers, which are installed in a saddle configuration over the carrying wood member, support two horizontally aligned joists. The U-shaped portion of the hangers have prepunched holes for installing nails, minimum 10d common, that must be driven at a 45-degree angle through the supported wood joist and into the carrying wood member. This is described as double shear nailing in the installation instructions. See Table 5 for hanger dimensions, fastener schedules, and allowable loads. See Figure 5a for a drawing of the PF24 and PF26 hangers; Figure 5b for a drawing of the PFD24, PFD26, and PFDS26 hangers; Figure 5c for a drawing of the PF24A and PF26A hangers; and Figure 5d for a top view of double shear nailing.

3.1.6 RR Ridge Rafter Connector: The RR ridge rafter connector supports nominally 2-inch-wide sawn wood roof rafters from a sawn wood ridge board or beam. The hanger is fabricated from No. 18 gage galvanized steel. The top flange of the RR connector is configured to interlock with an RR connector installed on the opposing face of the ridge board as shown in Figure 6. The RR connector may be used with a rafter having a maximum slope of 7:12 (30 degrees). See Table 6 for fastener schedules and allowable loads. See Figure 6 for a drawing of the RR connector and a typical connector installation detail.

3.2 Materials:

3.2.1 Steel: The galvanized hangers described in this report are manufactured from steel complying with ASTM A 653, SS designation, Grade 33. The ungalvanized hangers described in this report are fabricated from ASTM A 1011, SS designation, Grade 33. The steel used to fabricate the hangers comply with the following:

MODEL SERIES		ASTM STEEL SPECIFI-ATION	MINIMUM STRENGTH (ksi)		NOMINAL THICK-NESS (gage)	MINIMUM BASE-METAL THICK NESS (inch)
			Yield, Fy	Tensile, Fu		
JB		A 653	33	45	No. 18	0.0445
LB		A 653	33	45	No. 14	0.0685
W	U-shaped Stirrup	A 1011	33	52	No. 12	0.0955
	Flange	A 1011	33	52	No. 12	0.0955
WNP, WNPU	U-shaped Stirrup	A 1011	33	52	No. 12	0.0955
		A 1011	33	52	No. 7	0.0955
WNP, WNPU	Flange	A 1011	33	52	No. 7	0.1705
HW	U-shaped Stirrup	A 1011	33	52	No. 11	0.1105
	Flange	A 1011	33	52	No. 3	0.2285
HWU	U-shaped Stirrup	A 1011	33	52	No. 10	0.1255
	Flange	A 1011	33	52	No. 3	0.2285
HUTF		A 653	33	45	No. 12	0.0975
HUSTF		A 653	33	45	No. 14	0.0685
PF		A 653	33	45	No. 18	0.0445
PFD		A 653	33	45	No. 20	0.0335
PFDS		A 653	33	45	No. 20	0.0335
RR		A 653	33	45	No. 18	0.0445

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

The galvanized hangers have a minimum G90 zinc coating specification in accordance with ASTM A 653. Some models (designated with a model number ending with Z) are available with a G185 zinc coating specification in accordance with ASTM A 653. Some models (designated with a model number ending with HDG) are available with a hot-dip galvanization, also known as "batch" galvanization, in accordance with ASTM A 123, with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (610 g/m2), total for both sides. Model numbers in this report do not include the Z or HDG ending, but the information shown applies. The lumber treater and the holder of this report (Simpson Strong-Tie Company) should be contacted for recommendations on the appropiate level of corrosion resistance to specify for use of the steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

3.2.2 Wood: Wood members with which the connectors are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), and having a maximum moisture content of 19 percent (16 percent for engineered lumber) except as noted in Section 4.1. The thickness of the supporting wood member (header) must be equal to or greater than the length of the fasteners specified in the tables in this report, or as required by wood member design, whichever is greater.

Nails used for hangers described in this report must comply with the material requirements, physical properties, tolerances, workmanship, protective coating and finishes, certification, and packaging and package marking requirements specified in ASTM F 1667. The nails must have the following minimum fastener dimensions and bending yield strengths (*Fyb*):

FASTENER	SHANK DIAMETER (inch)	NAIL LENGTH (inches)	F_{yb} (psi)
10d × $1^1/_2$	0.148	$1^1/_2$	90,000
10d	0.148	3	90,000
16d	0.162	$3^1/_2$	90,000

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

Fasteners used in contact with preservative treated or fire retardant treated lumber must comply with Section 2304.9.5 of the IBC, Section R317.3 of the 2009 IRC or Section R319.3 of the 2006 IRC, as applicable. For use with treated lumber, the lumber treater or this report holder (Simpson Strong-Tie Company), or both, should be contacted for recommendations on the appropriate level of corrosion resistance to specify for the fasteners as well as the connection capacities of fasteners used with the specific proprietary preservative treated or fire retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The tabulated allowable loads shown in this report are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the NDS.

Tabulated allowable loads apply to products connected to wood used under dry conditions and where sustained temperatures are 100ºF (37.8ºC) or less. When products are installed to wood having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected, the allowable loads must be adjusted by the wet service factor, C_M, specified in the NDS. When connectors are installed in wood that will experience sustained exposure to

temperatures exceeding 100ºF (37.8ºC), the allowable loads in this report must be adjusted by the temperature factor, C_t, specified in the NDS.

Connected wood members must be analyzed for load-carrying capacity at the connection in accordance with the NDS.

4.2 Installation:

Installation of the connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie top-flange hangers for solid-sawn lumber described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of connectors with preservative treated or fire retardant treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative treated or fire retardant treated lumber must be in accordance with Section 3.2.3 of this report.

5.6 Welded hangers are manufactured under a quality program with inspections by Professional Service Industries, Inc. (AA-660) or by Intertek Testing Services NA, Inc. (AA-688).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Joist Hangers and Similar Devices (AC13), dated October 2010.

7.0 IDENTIFICATION

The products described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of an index evaluation report (ESR-2523) that is used as an identifier for the products recognized in this report. Additionally, the factory-welded hangers manufactured in the United States are identified with the acronym of the inspection agency (PSI), and factory-welded hangers manufactured in Canada are identified with the name of the inspection agency (Intertek).

TABLE 1—ALLOWABLE LOADS FOR THE JB AND LB SERIES JOIST HANGERS

HANGERS ERIES	MODEL NO.	HANGER DIMENSIONS[1] (inches)				COMMON NAILS (Quantity – Size)		ALLOWABLE LOADS[2,3,4] (lbs)	
		W	H	B	TF	Header	Joist	Uplift[5] where C_D=1.6	Download where C_D = 1.0, C_D = 1.15, C_D = 1.25
JB	JB26	1 9/16	5 3/8	1 1/2	1 5/16	4–10d	—	—	1,040
	JB28	1 9/16	7 1/4	1 1/2	1 5/16	4–10d	—	—	1,050
	JB210	1 9/16	9 1/4	2	1 3/16	4–16d	—	—	1,255
	JB212	1 9/16	11 1/8	2	1 3/16	6–16d	—	—	1,540
	JB214	1 9/16	13 1/8	2	1 1/4	6–16d	2–10d x 1 1/2	235	1,505
LB	LB26	1 9/16	5⅜	1½	1 1/2	4–16d	2–10d x 1 1/2	240	1,380
	LB28	1 9/16	7 1/4	1½	1 1/2	4–16d	2–10d x 1 1/2	240	1,270
	LB210	1 9/16	9 1/4	2	1 1/2	4–16d	2–10d x 1 1/2	240	1,525
	LB212	1 9/16	11 1/8	2	1 1/2	4–16d	2–10d x 1 1/2	240	1,580
	LB214	1 9/16	13 1/8	2	1 1/2	4–16d	2–10d x 1 1/2	240	1,450
	LB216	1 9/16	15 1/8	2	1 1/2	4–16d	2–10d x 1 1/2	240	1,425

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 1b (this page) for definitions of hanger nomenclature (W, H, B, TF).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]LB Series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to the vertical position of the joist is 0.125 inch (3.2 mm).
[4]The LB hangers are permitted for welded applications to a supporting steel member provided 1/8-inch thick (throat) by 1 1/2-inch long fillet welds are placed along each edge (dimension "TF" in Figure 1b) of each top flange. Welds must conform to the current A.W.S. D1.3 structural welding code for sheet steel. Uplift loads do not apply for welded hangers.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.

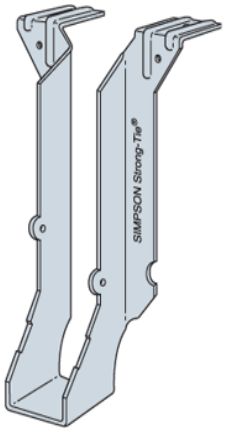


FIGURE 1a—LB HANGER

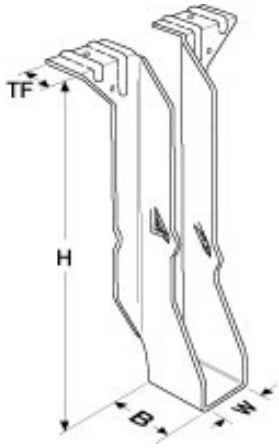


FIGURE 1b—JB HANGER

TABLE 2a—DIMENSIONS OF W, WNP, WNPU, HW, AND HWU SERIES JOIST HANGERS

HANGER SERIES	MODEL NO.	DIMENSIONS (in)	
		(W)	(H)
W	W26	1 9/16	5 3/8
	W28		7 1/8
	W210		9 1/8
	W212		11
	W214		13
	W216		15
	W34	2 9/16	3 7/16
	W36		5 3/8
	W38		7 1/8
	W310		9 1/8
	W44	3 9/16	3 7/16
	W46		5 3/8
	W48		7 1/8
	W410		9 1/8
WNP	WNP312	2 9/16	11
	WNP314		13
	WNP316		15
	WNP26-2	3 1/8	5 3/8
	WNP28-2		7 1/8
	WNP210-2		9 1/8
	WNP212-2		11
	WNP214-2		13
	WNP216-2		15
	WNP412	3 9/16	11
	WNP414		13
	WNP416		15
	WNP66	5 1/2	5 3/8
	WNP68		7 1/8
	WNP610		9 1/8
WNPU	WNPU312	2 9/16	11
	WNPU314		13
	WNPU316		15
WNPU (cont.)	WNPU210-2	3 1/8	9 1/8
	WNPU212-2		11
	WNPU214-2		13
	WNPU216-2		15
	WNPU412	3 9/16	11
	WNPU414		13
	WNPU416		15
HW	HW3.25	3 1/4	5 (min), 19 1/2 (max)
	HW46	3 9/16	5 3/8
	HW48		7 1/8
	HW410		9 1/8
	HW412		11
	HW414		13
	HW416		15
	HW5.25	5 1/4	5 (min), 19 1/2 (max)
	HW66	5 1/2	5 3/8
	HW68		7 1/8
	HW610		9 1/8
	HW612		11
	HW614		13
	HW616		15
	HW86	7 1/2	5 3/8
	HW88		7 1/8
	HW810		9 1/8
	HW812		11
	HW814		13
	HW816		15
HWU	HWU410	3 9/16	9 1/8
	HWU412		11
	HWU414		13
	HWU416		15

For **SI:** 1 inch = 25.4 mm.

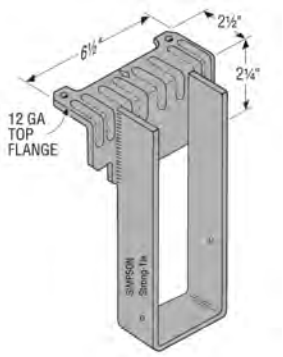


FIGURE 2a—W HANGER SERIES

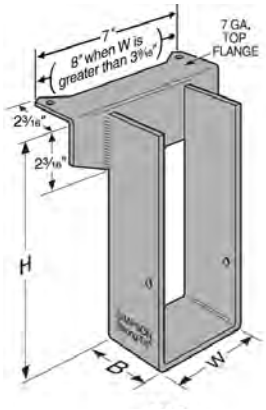


FIGURE 2b—WNP HANGER SERIES

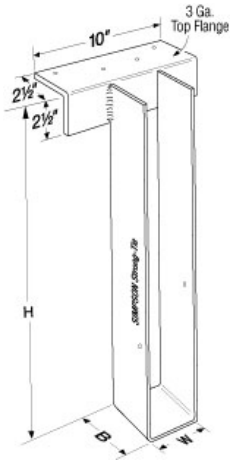


FIGURE2c—HW AND HWU HANGER SERIES

TABLE 2b—ALLOWABLE LOADS FOR THE W, WNP, WNPU, HW, AND HWU SERIES JOIST HANGERS

HANGER SERIES	HANGER DIMENSIONS[1] (inches)			FASTENERS (Quantity – Size)		ALLOWABLE LOAD[2,3] (lbs)	
	(W)	(H)	(B)	Header	Joist	Uplift[4] C_D=1.6	Download C_D = 1.0, C_D = 1.15, C_D = 1.25
W	1 9/16	5 3/8 (min), 15 (max)	2 1/2	2-10d	2-10d x 1/2	—	2,200
	2 9/16 (min), 3 9/16 (max)	3 7/16 (min), 9 1/8 (max)	2	2-10d	2-10d x 1/2	—	2,200
WNP	2 9/16	11 (min), 15 (max)	2 1/2	2-10d	2-10d x 1/2	—	3,255
	3 1/8	5 3/8 (min), 15 (max)	2 1/2	2-10d	2-10d x 1/2	—	3,255
	3 9/16 (min), 5 1/2 (max)	5 3/8 (min), 15 (max)	2 1/2	2-10d	2-10d x 1/2	—	3,255
WNPU	2 9/16	11 (min), 15 (max)	3	7-16d	6-10d x 1/2	—	4,165
	3 1/8 (min), 3 9/16 (max)	9 1/8 (min), 15 (max)	3	7-16d	6-10d	—	4,165
HW3.25	3 1/4	5 (min), 19 1/2 (max)	4	4-10d	2-10d	—	5,285
HW5.25	5 1/4	5 (min), 19 1/2 (max)	2 1/2	4-10d	2-10d		5,285
HW	3 9/16	5 3/8 (min), 15 (max)	2 1/2	4-10d	2-10d	—	5,285
	5 1/2 (min), 7 1/2(max)	5 3/8 (min), 15 (max)	2 1/2	4-10d	2-10d	—	5,285
HWU	3 9/16	9 1/8 (min), 15 (max)	3 1/4	8-16d	6-10d	—	6,335

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Refer to Figure 2b (previous page) for definitions of hanger nomenclature (W, H, B).
[2]Hangers may be welded to steel headers with weld size to match hanger flange material thickness (approximate thickness shown in Section 3.2.1 of this report).
W hanger series: The throat size of the fillet weld must be 3/16-inch thick.
WNP hanger series: The throat size of the fillet weld must be 1/8-inch thick.
WNPU, HW, and HWU hanger series: The throat size of the fillet weld must be 1/4-inch thick.
The length of the weld at each flange must be at least 1 1/2 inches long. Welds must conform to the current A.W.S. D1.3 structural welding code for sheet steel, and the weld material must be E-70S.
[3]The connectors provide a torsional resistance up to a maximum joist depth of 16 inches for the W, WNP, and WNPU hangers and 22 inches for the HW and HWU hangers, where torsional resistance is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to the vertical position of the joist is 0.125 inch (3.2 mm).
[4]Uplift loads for these hangers are beyond the scope of this report.

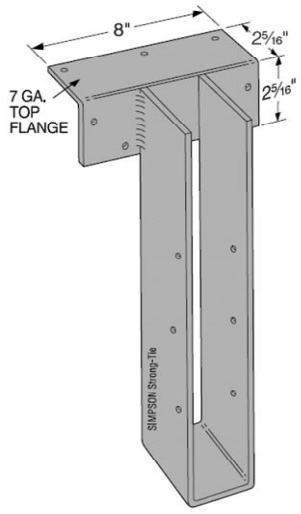


FIGURE 2d—WNPU HANGER SERIES

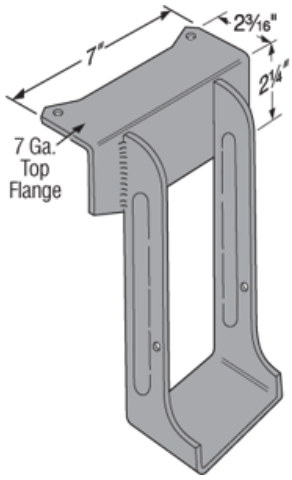


FIGURE 2e—WNP412, WNP414, and WNP416 HANGERS

TABLE 3—ALLOWABLE LOADS FOR THE HUTF SERIES JOIST HANGERS

MODEL NO.	HANGER DIMENSIONS[1] (in)				FASTENERS (Quantity–Size)		ALLOWABLE LOADS[2,3,4]			
	W	H	B	TF	Header	Joist	Uplift[5]	Download		
							C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
HU24TF	$1^9/_{16}$	$3^7/_{16}$	$2^1/_4$	$2^1/_2$	6–16d	2–10d x $1^1/_2$	245	2,060	2,085	2,100
HU26TF		$5^3/_8$			10–16d	4–10d x $1^1/_2$	490	2,245	2,300	2,335
HU28TF		$7^1/_8$			10–16d	4–10d x $1^1/_2$	490	2,245	2,300	2,335
HU210TF		$9^1/_8$			12–16d	4–10d x $1^1/_2$	490	2,245	2,300	2,335
HU212TF		11			14–16d	6–10d x $1^1/_2$	735	2,335	2,335	2,335
HU214TF		13			16–16d	6–10d x $1^1/_2$	735	2,425	2,510	2,565
HU216TF		15			18–16d	8–10d x $1^1/_2$	980	2,610	2,720	2,795
HU34TF	$2^9/_{16}$	$3^7/_{16}$	$2^1/_2$	$2^1/_2$	8–16d	2–10d x $1^1/_2$	245	2,600	2,600	2,600
HU36TF		$5^3/_8$			10–16d	4–10d x $1^1/_2$	490	3,495	3,550	3,585
HU38TF		$7^1/_8$			12–16d	4–10d x $1^1/_2$	490	3,495	3,550	3,585
HU310TF		$9^1/_8$			14–16d	6–10d x $1^1/_2$	735	3,675	3,760	3,815
HU312TF		11			16–16d	6–10d x $1^1/_2$	735	3,675	3,760	3,815
HU314TF		13			18–16d	6–10d x $1^1/_2$	980	4,335	4,335	4,335
HU316TF		15			20–16d	8–10d x $1^1/_2$	980	3,860	3,970	4,045
HU24-2TF	$3^1/_8$	$3^7/_{16}$	$2^1/_2$	$2^1/_2$	8–16d	2–10d	310	2,600	2,600	2,600
HU26-2TF		$5^3/_8$			10–16d	4–16d	625	3,730	3,855	3,900
HU28-2TF		$7^1/_8$			12–16d	4–16d	625	3,900	3,900	3,900
HU210-2TF		$9^1/_8$			14–16d	6–16d	935	4,170	4,170	4,170
HU212-2TF		11			16–16d	6–16d	935	4,335	4,335	4,335
HU214-2TF		13			18–16d	8–16d	1,250	4,335	4,335	4,335
HU216-2TF		15			20–16d	8–16d	1,250	4,335	4,335	4,335
HU44TF	$3^9/_{16}$	$3^7/_{16}$	$2^1/_2$	$2^1/_2$	8–16d	2–10d	310	2,600	2,600	2,600
HU46TF		$5^3/_8$			10–16d	4–16d	625	3,165	3,165	3,165
HU48TF		$7^1/_8$			12–16d	4–16d	625	3,500	3,500	3,500
HU410TF		$9^1/_8$			14–16d	6–16d	935	4,150	4,150	4,150
HU412TF		11			16–16d	6–16d	935	4,560	4,810	5,110
HU414TF		13			18–16d	8–16d	1,250	4,835	5,050	5,050
HU416TF		15			20–16d	8–16d	1,250	5,050	5,050	5,050
HU210-3TF	$4^{11}/_{16}$	$9^1/_8$	$2^1/_2$	$2^1/_2$	14–16d	6–16d	1,105	4,150	4,150	4,150
HU212-3TF		11			16–16d	6–16d	1,105	4,560	4,810	5,110
HU214-3TF		13			18–16d	8–16d	1,470	4,835	5,050	5,050
HU216-3TF		15			20–16d	8–16d	1,470	5,050	5,050	5,050
HU66TF	$5^1/_2$	$5^3/_8$	$2^1/_2$	$2^1/_2$	10–16d	4–16d	735	3,165	3,165	3,165
HU68TF		$7^1/_8$			12–16d	4–16d	735	3,500	3,500	3,500
HU610TF		$9^1/_8$			14–16d	6–16d	1,105	4,150	4,150	4,150
HU612TF		11			16–16d	6–16d	1,105	4,550	4,810	5,105
HU614TF		13			18–16d	8–16d	1,470	4,830	5,125	5,450
HU616TF		15			20–16d	8–16d	1,470	5,105	5,445	5,795

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N.

[1]Refer to Figure 3a (next page) for definitions of hanger nomenclature (W, H, B, TF).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]The minimum wood header or ledger size that can be used with HUTF hangers is $3^1/_2$ inches. See Figure 3b (next page).
[4]The hanger provides a torsional resistance up to a maximum joist depth of $16^1/_2$ inches, where torsional resistance is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to the vertical position of the joist is 0.125 inch (3.2 mm).
[4]Tabulated allowable uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.

TABLE 4—ALLOWABLE LOADS FOR THE HUSTF SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)				FASTENERS (Quantity – Size)		ALLOWABLE LOADS[2,3] (lbs)			
	W	H	B	TF	Header	Joist[4]	Uplif[5]	Download		
							C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
HUS26-2TF	3 1/8	5 3/8	2	1 3/4	6–16d	4–16d	1,080	2,820	3,000	3,000
HUS28-2TF	3 1/8	7 1/4	2	1 3/8	8–16d	6–16d	1,550	3,455	3,720	3,895
HUS210-2TF	3 1/8	9 1/4	2	1 1/2	10–16d	8–16d	2,160	3,585	3,925	4,155
HUS212-2TF	3 1/8	11 1/8	2	2 1/4	10–16d	8–16d	2,000	4,435	4,535	4,605
HUS214-2TF	3 1/8	13 1/8	2	2 1/4	12–16d	8–16d	2,160	4,435	4,535	4,605
HUS46TF	3 9/16	5 3/8	2	1 9/16	6–16d	4–16d	1,080	2,700	2,890	3,000
HUS48TF	3 9/16	7 1/4	2	1 9/16	8–16d	6–16d	1,550	3,225	3,495	3,670
HUS410TF	3 9/16	9 1/4	2	1 1/4	10–16d	8–16d	2,160	3,365	3,710	3,935
HUS412TF	3 9/16	11 1/8	2	2 1/16	10–16d	8–16d	2,000	4,420	4,760	4,990
HUS414TF	3 9/16	13 1/8	2	2 1/16	12–16d	8–16d	2,160	4,765	5,100	5,100

For **SI:** 1 lb = 4.45 N, 1 inch = 25.4 mm.

[1]Refer to Figure 4a (this page) for definitions of hanger nomenclature (W, H, B, TF).
[2]Tabulated allowable load capacities must be selected based on duration of load as permitted by the applicable building code.
[3]The HUSTF Series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to the vertical position of the joist is 0.125 inch (3.2 mm).
[4]The U-shaped portion of the hangers have pre-punched holes for the installation of joist that are driven at a 45-degree angle through the joist and into the header, which is described as double shear nailing in the installation instructions. See Figure 4b (this page).
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.

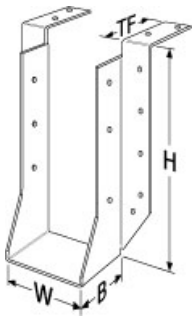


FIGURE 3a—HUTF HANGER SERIES (See Table 3)

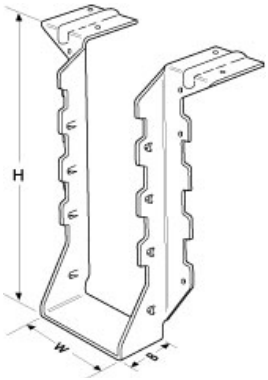


FIGURE 4a—HUSTF HANGER SERIES (See Table 4)

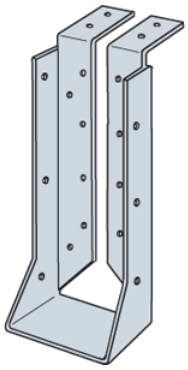


FIGURE 3b—HUTF HANGER (with concealed flanges) (See Table 3)

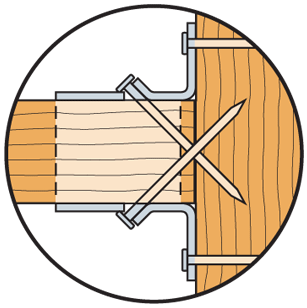


FIGURE 4b—TOP VIEW OF DOUBLE SHEAR NAILING REQUIRED FOR HUSTF HANGERS (See Footnote 4, Table 4)

TABLE 5—ALLOWABLE LOADS FOR THE PF/PFA/PFD SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)					FASTENERS (Quantity–Size)		ALLOWABLE LOADS[2,3] (lbs)			
	W	H	B	TF	S	Header	Joist[4]	Uplift[5]	Download		
								C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
PF24	1 9/16	5 3/8	1 1/2	1 1/16	—	2–10d	2–10d	260	955	955	955
PF26	1 9/16	5 5/16	1 1/2	1 1/16	—	2–10d	2–10d	260	955	955	955
PFD24	1 9/16	3 1/2	1 1/4	—	1 9/16	—	2–10d	235	910	935	955
PFD26	1 9/16	5 1/2	1 1/4	—	1 9/16	—	4–10d	470	1,085	1,140	1,175
PFDS26	1 9/16	5 1/2	1 1/4	—	3 1/4	4–10d	4–10d	520	1,045	1,090	1,120
PF24A	1 9/16	3 1/2	1 1/4	1 1/2	—	2–10d	2–10d	235	800	800	800
PF26A	1 9/16	5 1/2	1 1/4	1 1/2	—	2–10d	4–10d	520	1,045	1,090	1,120

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N.

[1]Refer to Figures 5a and 5c (this page) for definitions of PF and PFA hanger nomenclature (W, H, B, TF). Refer to Figures 5b (this page) for definitions of PFD hanger nomenclature (W, H, B, S).
[2]Tabulated allowable load capacities must be selected based on duration of load as permitted by the applicable building code.
[3]The connectors provide a torsional resistance up to a maximum joist depth of 5 1/2 inches, where torsional resistance is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to the vertical position of the joist is 0.125 inch (3.2 mm).
[4]The U-shaped portion of the hangers have pre-punched holes for the installation of nails that are driven at a 45-degree angle through the joist and into the header, which is described as double shear nailing in the installation instructions. See Figure 5d (this page).
[5]The uplift loads have been increased for wind or earthquake loading with no further increase is allowed. The allowable uplift loads must be reduced when other load durations govern.

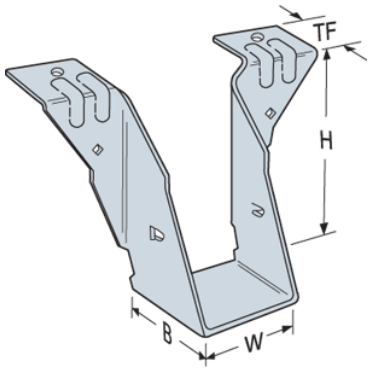


FIGURE 5a—PF24 and PF26 HANGERS

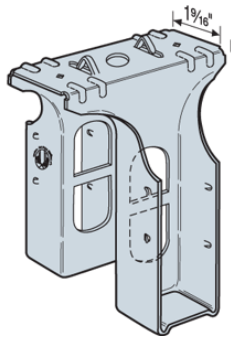


FIGURE 5b—PFD24, PFD26, and PFDS26 HANGERS

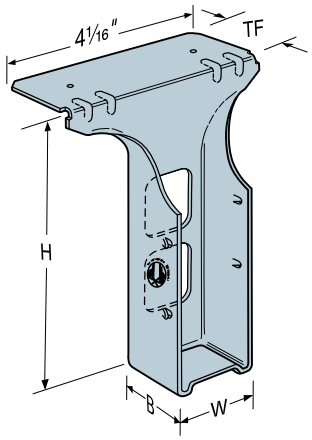


FIGURE 5c—PF24A AND PF26A HANGERS

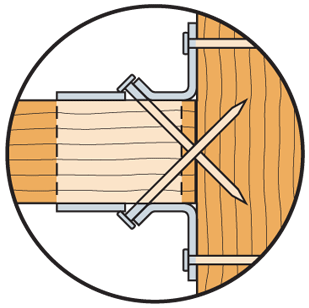


FIGURE 5d—TOP VIEW OF DOUBLE SHEAR NAILING REQUIRED FOR PF/PFA/PFD HANGERS (See Footnote 4, Table 5)

TABLE 6—ALLOWABLE LOADS FOR THE RR RIDGE RAFTER CONNECTOR

MODEL NO.	FASTENERS (Quantity – Size)		ALLOWABLE LOADS[1,2] (lbs)		
	Header	Joist	C_D = 1.0	C_D = 1.15	C_D = 1.25
RR	4–10d x $1^1/_2$	4-10d x $1^1/_2$	365	415	415

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N.

[1]The connector may be used with a rafter slope up to 30 degrees maximum.
[2]RR hangers provide a torsional resistance up to a maximum joist depth of $13^1/_2$ inches, where torsional resistance is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to the vertical position of the joist is 0.125 inch (3.2 mm).
[3]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.

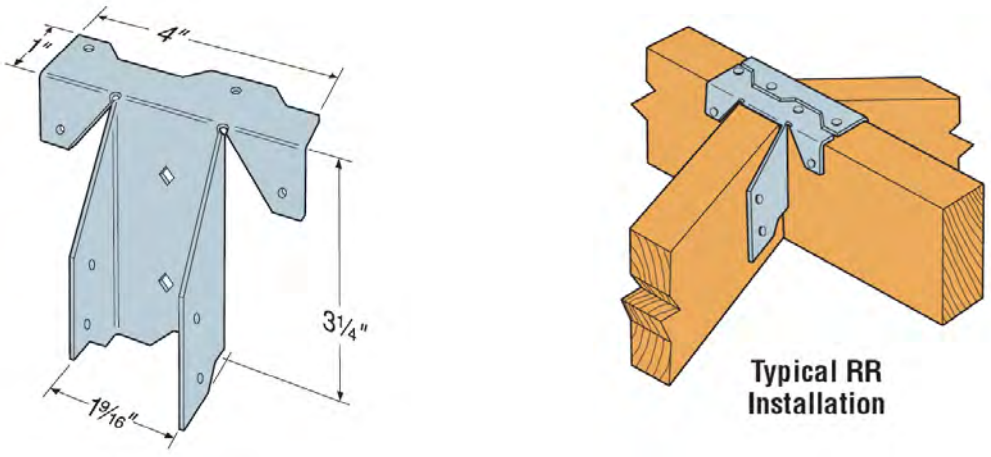


FIGURE 6—RR RIDGE RAFTER CONNECTOR

ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-1618*

Reissued March 1, 2011

This report is subject to renewal in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 17 13—Laminated Veneer Lumber

REPORT HOLDER:

SUNDRE FOREST PRODUCTS INC.
POST OFFICE BOX 1737
ROCKY MOUNTAIN HOUSE, ALBERTA T4T 1B3
CANADA
(403) 845-5522

ADDITIONAL LISTEE:

BLUELINX CORPORATION
4300 WILDWOOD PARKWAY
ATLANTA, GEORGIA 30339
(770) 953-7000

EVALUATION SUBJECT:

WEST FRASER™ LVL LAMINATED VENEER LUMBER

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 *International Building Code*® (IBC)
- 2009 *International Residential Code*® (IRC)
- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)

Property evaluated:

Structural

2.0 USES

West Fraser™ LVL Laminated Veneer Lumber (LVL) is used as beams, headers, joists and rafters.

3.0 DESCRIPTION

West Fraser™ LVL is manufactured by laminating lodgepole pine, white spruce, Douglas fir and aspen veneers singularly or in combination. Veneer sheets are stress-graded based on Ultrasonic Propagation Time (UPT) and sorted in accordance with their UPT classifications. Graded veneer sheets are then scarfed or lapped before being sent to the sheet feeder. From the sheet feeder, veneer is sequenced into prescribed lay-ups, with glue applied on the top face of each veneer sheet, with the exception of the top veneer. Adhesive is exterior-grade phenolic resin complying with the requirements of ASTM D 2559. The grain of all veneer is oriented along the length of the billet. The lay-up is then subjected to hot pressing until the adhesive is cured. West Fraser™ LVL members are available in thicknesses from $^{3}/_{4}$ inch (19 mm) to $3^{1}/_{2}$ inches (89 mm), depths of $1^{1}/_{2}$ inches (38 mm) to 48 inches (1219 mm), and lengths up to 80 feet (24.4 m).

4.0 INSTALLATION

Application and installation of West Fraser™ LVL must comply with this report and the applicable code. Drawings, and/or manufacturer's published installation instructions for the erection and installation on each job, must be available on the jobsite during installation.

4.1 Design and Allowable Stresses:

West Fraser™ LVL is designed as solid-sawn lumber in accordance with the applicable code and the National Design Specification for Wood Construction (NDS). Allowable design values are as listed within this report. Maximum allowable member design values are as noted in Table 1.

4.2 Fasteners:

Maximum allowable connection design values must be determined in accordance with the applicable section of the NDS, using the equivalent specific gravities provided in Table 2. Nails installed perpendicular to the gluelines on the wide face are permitted, with the same spacing, edge, and end distances as specified in the NDS for solid-sawn lumber. Nails installed parallel to the gluelines on the narrow face of material at least $^{3}/_{4}$ inch (19 mm) thick and $3^{1}/_{2}$ inches (89 mm) wide must be spaced a minimum of 4 inches for 10d and 12d common nails, and 3 inches (76 mm) for 8d common nails. Sixteen-penny common nails must be spaced a minimum of 8 inches (203 mm) when installed parallel to the gluelines on the narrow face of material that is at least $1^{1}/_{2}$ inches (38 mm) thick and $5^{1}/_{4}$ inches (13 mm) wide.

5.0 CONDITIONS OF USE

The West Fraser™ LVL Laminated Veneer Lumber described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Drawings and design details verifying compliance with this report must be submitted to the code official for approval. The drawings and calculations must be prepared by a registered design professional when required by the statutes of the jurisdiction in which the project is to be constructed.

***Revised January 2012**

5.2 LVL must not be used in applications where it will obtain a moisture content greater than16 percent.

5.3 This report does not contain an evaluation of connectors other than those specifically noted in Section 4.0 of this report.

5.4 Cutting, drilling or notching of LVL is beyond the scope of this report.

5.5 This report does not evaluate the effect of fire-retardant or preservative treatment on LVL.

5.6 The compression edges of all applications of West Fraser™ LVL must be laterally restrained.

5.7 West Fraser™ LVL is produced at Rocky Mountain House, Alberta, Canada, under a quality control program with inspections by APA—The Engineered Wood Association (AA-649).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Structural Wood-based Products (AC47), dated February 2011.

7.0 IDENTIFICATION

West Fraser™ LVL Laminated Veneer Lumber covered by this report must be identified by a stamp bearing the manufacturer's name or the name of the additional listee noted in this report, the product trade name, the grade, the evaluation report number (ESR-1618), the production shift and date of manufacture and the name of the inspection agency (APA–The Engineered Wood Association).

TABLE 1—ALLOWABLE DESIGN PROPERTIES FOR WEST FRASER™ LVL[1,2,3,4,5,6,7]

PROPERTY		DESIGN STRESS (psi)				
		1.3E Grade[1]	1.7E Grade [1]	1.8E Grade[2]	1.9E Grade[2]	2.0E Grade[1]
Bending (F_b)	Joist	1700	2750	3000	3000	3100
	Plank	1900	2600	3000	3000	3500
Tension parallel to grain (F_t)		1300	1950	1950	1950	2100
Longitudinal shear (F_v)	Joist	220	290	290	350	350
Compression parallel ($F_{c\|}$)		1800	2350	2350	2500	3000
Compression perpendicular ($F_{c\_}$)	Joist	600	700	750	750	750
Modulus of Elasticity (10^6), MOE		1.3	1.7	1.8	1.9	2.0

For **SI:** 1 psi = 6.89 kPa, 1 inch = 25.4 mm.

[1]The tabulated values are based on loads of a normal duration and a reference depth of 12 inches. For depths of $3^1/_2$ inches and deeper, when loaded edgewise, the allowable bending stress for 1.3E, 1.7E and 2.0E grades must be modified by $(^{12}/_d)^{0.1111}$ as shown in the following table:

Depth Factor									
Depth (in.)	$3^1/_2$	$5^1/_2$	$7^1/_4$	$9^1/_2$	$11^7/_8$	14	16	18	24
Multiply by	1.15	1.09	1.06	1.03	1.00	0.98	0.97	0.96	0.93

[2]The tabulated values are based on loads of a normal duration and a reference depth of 12 inches. For depths of $3^1/_2$ inches and deeper, when loading is edgewise, the allowable bending stress for 1.8E and 1.9E grades must be modified by $(^{12}/_d)^{0.1361}$ as shown in the following table:

Depth Factor									
Depth (in.)	$3^1/_2$	$5^1/_2$	$7^1/_4$	$9^1/_2$	$11^7/_8$	14	16	18	24
Multiply by	1.18	1.11	1.07	1.03	1.00	0.98	0.96	0.95	0.91

[3]Tension (F_t) of the 1.3E, 1.7E, 1.8E, 1.9E and 2.0E grades is based on a gauge length of 4 feet. For specimens longer than 4 feet, a length factor of $(4/L)^{1/11}$ must be used to adjust the F_t, where L is the actual length in feet.
[4]Load parallel to glueline is for joist, and perpendicular to glueline is for plank.
[5]Stresses may be adjusted for duration of load in accordance with the applicable code.
[6]Tabulated flexural stress (F_b) may be increased by 4 percent when the member qualifies as a repetitive member as defined in AFPA NDS.
[7]Deflection of uniformly loaded simple span beams is calculated as follows:

$$\Delta = \frac{270WL^4}{Ebd^3} + \frac{28.8\,WL^2}{Ebd}$$

where:

Δ = Deflection, in
W = Uniform load, plf
L = Span, ft
b = Beam width, in
d = Beam depth, in
E = Modulus of elasticity, psi

TABLE 2—FASTENER DETAILS

FASTENER DESCRIPTION[2]		EQUIVALENT SPECIES AND SPECIFIC GRAVITY[1]				
		1.3E Grade	1.7E Grade	1.8E Grade	1.9E Grade	2.0E Grade
Nail Withdrawal						
Face	Installed perpendicular to the wide face	Hem-Fir (0.43)	Hem-Fir (North) (0.46)	Hem-Fir (North) (0.46)	Douglas Fir–Larch (0.50)	Douglas Fir–Larch (0.50)
Edge	Installed perpendicular to the narrow face	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)
Nail Lateral						
Face	Installed perpendicular to the wide face	Hem-Fir (0.43)	Douglas Fir–Larch (0.50)	Douglas Fir–Larch (0.50)	Douglas Fir–Larch (0.50)	Douglas Fir–Larch (0.50)
Edge	Installed perpendicular to the narrow face	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)
Bolt Installed Perpendicular to the Wide Face						
Loaded parallel to grain		Northern Species (0.34)	Hem-fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)
Loaded perpendicular to grain		Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)	Hem-Fir (0.43)

[1]Allowable lateral values for nails noted in the applicable code apply to the LVL for conditions and the species noted in the table.
[2]See Figure 1 for orientation details.

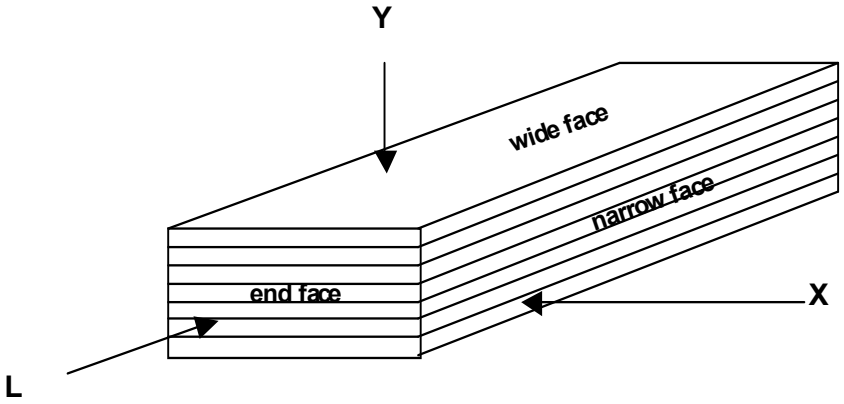


FIGURE 1—WEST FRASER™ LVL FASTENER ORIENTATION

West Fraser LVL

3100Fb – 2.0E 1¾" and 3½" THICK

HEADERS AND BEAMS

DESIGN PROPERTIES

3100F_b-2.0E 1¾" WEST FRASER™ LVL FACTORED RESISTANCES (STANDARD TERM)

Design Property	Depth									
	5½"	7¼"	9¼"	9½"	11½"	11⅞"	14"	16"	18"	24"
Moment (ft.lbs.)	4134	6967	11037	11608	16652	17693	24146	31073	38816	66835
Shear (lbs.)	3736	4925	6284	6454	7813	8067	9511	10870	12228	16304
Moment of Inertia (in^4)	24	56	115	125	222	244	400	597	851	2016
Weight (lbs./lin.ft.)	2.7	3.6	4.6	4.7	5.7	5.9	7.0	8.0	9.0	12.0

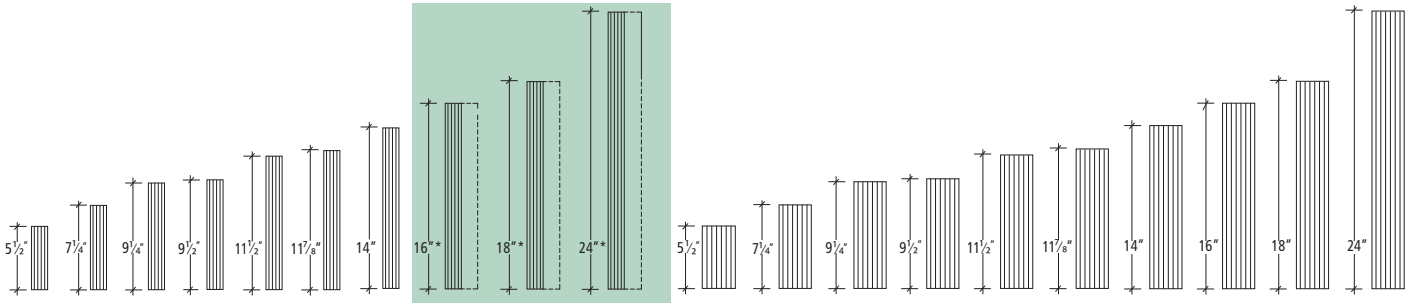
1. Lateral support of beam compression edge is required at intervals of 24" o/c or closer.
2. Lateral support of beam is required at bearing locations.
3. All 16" and greater beam depths are to be used in multiple member units only.

3100F_b-2.0E 3½" WEST FRASER™ LVL FACTORED RESISTANCES (STANDARD TERM)

Design Property	Depth									
	5½"	7¼"	9¼"	9½"	11½"	11⅞"	14"	16"	18"	24"
Moment (ft.lbs.)	8269	13933	22075	23215	33305	35386	48292	62146	77631	133669
Shear (lbs.)	7473	9851	12568	12908	15625	16135	19022	21739	24457	32609
Moment of Inertia (in^4)	49	111	231	250	444	488	800	1195	1701	4032
Weight (lbs./lin.ft.)	5.5	7.2	9.2	9.5	11.5	11.8	14.0	15.9	17.9	23.9

1. Lateral support of beam compression edge is required at intervals of 24" o/c or closer.
2. Lateral support of beam is required at bearing locations.

3100F_b -2.0E 1¾" AND 3½" WEST FRASER™ LVL AVAILABLE SIZES



*can only be used as a 2-ply minimum

3100F_b -2.0E WEST FRASER™ LVL SPECIFIED STRENGTHS (STANDARD TERM)

Modulus of Elasticity	E	= 2.0 x 10^6 psi
Bending Stress	F_b	= 5729 psi
Shear (joist)	F_v	= 647 psi
Compression Perpendicular to Grain (joist)	$F_{c(perp)}$	= 1300 psi
Compression Parallel to Grain	$F_{c(para)}$	= 4786 psi

1. F_b based on 12" depths. For other depths, multiply by (12/d)^(1/9).
2. $F_{c(perp)}$ and E shall not be increased for duration of load.

FACTORED RESISTANCE TABLES

GENERAL NOTES

- Tables are for one-ply 1¾" beams. When properly connected, double the values for two-ply beams, triple for three. Minimum bearing lengths shown for one-ply will be the same for two-ply and three-ply. See page 9 for multiple-ply connection details.
- Resistances shown are the maximum factored and/or unfactored resistances, in pounds per lineal foot, that can be applied to the beam in addition to its own weight.
- Tables are based on uniform loads and the most restrictive of simple or continuous spans and dry-use conditions. Refer to West Fraser's sizing software for other loads or span configurations.
- Lateral support of beam compression edges is required at intervals of 24" o/c or closer.
- Lateral support of beams is required at bearing locations.
- Spans of multiple spans must be at least 40% of adjacent span.
- West Fraser™ LVL beams are made without camber; therefore, in addition to complying with the deflection limits of the applicable building code, other deflection considerations, such as long term deflection under sustained loads (including creep), must be evaluated.
- All 16" and deeper beams are to be used in multiple member units only.
- Unfactored total load resistance is limited to a deflection of L/240. Unfactored live load resistance is based on a deflection of L/360. Check local code requirements for other deflection criteria.
- For an unfactored live load deflection limit of L/480, multiply UNFACTORED LOAD L/360 resistance by 0.75. The resulting unfactored live load shall not exceed the total factored load shown.
- Roof must have positive slope in order to prevent ponding.
- Tables will accommodate beam slopes to a maximum of 2:12.
- Bearing lengths are based on 1300 psi specified strength for 3100F_b-2.0E Grade materials which cannot be increased for duration of load. Bearing length may need to be increased if support member's allowable bearing stress is less.
- Spans shown are measured centre-to-centre of bearing.

INSTRUCTIONS FOR USE

1. Determine the factored total load and unfactored total and live load on the beam in pounds per lineal foot (plf).
2. Locate a span that meets or exceeds the required beam span, centre-to-centre of bearing.
3. Scan from left to right within the SPAN row until you find a cell where; (1) the UNFACTORED LOAD L/360 resistance meets or exceeds the unfactored live load, (2) the UNFACTORED LOAD L/240 resistance meets or exceeds the unfactored total load and (3) the FACTORED TOTAL LOAD resistance meets or exceeds the factored total load. All three rows must be checked and satisfied. Where no unfactored resistances are shown, factored total load will control.
4. To size a member for a span not shown, use capacities for the next larger span shown.

FACTORED RESISTANCE TABLE (POUNDS PER LINEAL FOOT)

3100F_b-2.0E West Fraser™ LVL — FLOOR or ROOF (Standard Term)

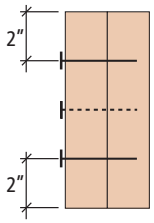
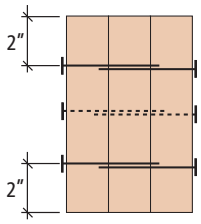
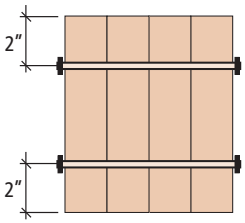
Span (ft)	Depth	1¾" WIDTH									
		5-1/2"	7-1/4"	9-1/4"	9-1/2"	11-1/2"	11-7/8"	14"	16"	18"	24"
6	Unfactored Load (LL) L/360	305	660	1263	1353	2186	2363	3473			
	Unfactored Load (TL) L/240	455	986	1890	2025						
	Factored Total Load	916	1545	2105	2177	2793	2917	3675	4490	5426	9305
	Min. End / Int. Bearing (in)	1.5/3.8	2.5/6.4	3.5/8.7	3.6/9.0	4.6/11.5	4.8/12.0	6.1/15.1	7.4/18.5	8.9/22.4	15.3/38.3
7	Unfactored Load (LL) L/360	197	431	840	903	1488	1614	2423	3313		
	Unfactored Load (TL) L/240	292	643	1256	1349	2226					
	Factored Total Load	672	1134	1739	1796	2281	2377	2957	3566	4244	6853
	Min. End / Int. Bearing (in)	1.5/3.5	2.2/5.5	3.3/8.4	3.5/8.6	4.4/11.0	4.6/11.4	5.7/14.2	6.9/17.1	8.2/20.4	13.2/32.9
8	Unfactored Load (LL) L/360	134	296	585	629	1052	1144	1746	2423	3196	
	Unfactored Load (TL) L/240	198	440	872	939	1572	1711				
	Factored Total Load	514	867	1375	1446	1927	2006	2474	2956	3485	5423
	Min. End / Int. Bearing (in)	1.5/3.5	1.9/4.8	3.0/7.6	3.2/7.9	4.2/10.6	4.4/11.0	5.4/13.6	6.5/16.2	7.7/19.1	11.9/29.8
9	Unfactored Load (LL) L/360	95	211	422	454	768	837	1293	1816	2423	
	Unfactored Load (TL) L/240	140	313	628	677	1146	1250	1932			
	Factored Total Load	406	684	1086	1142	1639	1734	2126	2525	2955	4486
	Min. End / Int. Bearing (in)	1.5/3.5	1.7/4.2	2.7/6.7	2.8/7.1	4.1/10.1	4.3/10.7	5.3/13.1	6.2/15.6	7.3/18.3	11.1/27.7
10	Unfactored Load (LL) L/360	70	156	313	338	576	629	981	1390	1873	3700
	Unfactored Load (TL) L/240	102	230	465	502	858	938	1464	2077		
	Factored Total Load	328	554	878	924	1326	1410	1864	2203	2565	3824
	Min. End / Int. Bearing (in)	1.5/3.5	1.5/3.8	2.4/6.0	2.5/6.3	3.6/9.1	3.9/9.7	5.1/12.8	6.1/15.1	7.0/17.6	10.5/26.3
11	Unfactored Load (LL) L/360		118	239	258	442	484	760	1085	1473	2976
	Unfactored Load (TL) L/240		174	354	382	658	719	1132	1619	2200	
	Factored Total Load		457	725	763	1095	1164	1589	1953	2266	3333
	Min. End / Int. Bearing (in)		1.5/3.5	2.2/5.5	2.3/5.8	3.3/8.3	3.5/8.8	4.8/12.0	5.9/14.8	6.8/17.1	10.1/25.2
12	Unfactored Load (LL) L/360		92	186	201	346	379	599	861	1176	2423
	Unfactored Load (TL) L/240		134	275	297	514	563	892	1283	1755	
	Factored Total Load		383	609	640	919	977	1334	1718	2029	2952
	Min. End / Int. Bearing (in)		1.5/3.5	2.0/5.0	2.1/5.3	3.0/7.6	3.2/8.1	4.4/11.0	5.7/14.2	6.7/16.7	9.7/24.3
13	Unfactored Load (LL) L/360		73	148	160	276	302	480	694	952	1994
	Unfactored Load (TL) L/240		105	217	235	408	448	713	1032	1419	
	Factored Total Load		326	518	545	783	832	1136	1463	1828	2650
	Min. End / Int. Bearing (in)		1.5/3.5	1.9/4.6	1.9/4.9	2.8/7.0	3.0/7.4	4.1/10.1	5.2/13.1	6.5/16.3	9.5/23.7
14	Unfactored Load (LL) L/360		58	119	129	223	245	390	566	781	1657
	Unfactored Load (TL) L/240		84	174	188	329	361	579	841	1162	
	Factored Total Load		281	446	469	674	716	979	1260	1575	2404
	Min. End / Int. Bearing (in)		1.5/3.5	1.7/4.3	1.8/4.5	2.6/6.5	2.8/6.9	3.8/9.4	4.8/12.1	6.1/15.1	9.2/23.1
15	Unfactored Load (LL) L/360		48	97	105	183	201	321	468	647	1390
	Unfactored Load (TL) L/240		68	141	153	269	296	475	694	962	2073
	Factored Total Load		244	388	408	586	623	852	1097	1371	2199
	Min. End / Int. Bearing (in)		1.5/3.5	1.6/4.0	1.7/4.2	2.4/6.0	2.6/6.4	3.5/8.8	4.5/11.3	5.6/14.1	9.1/22.7
16	Unfactored Load (LL) L/360			81	87	152	167	268	390	542	1176
	Unfactored Load (TL) L/240			116	126	222	244	394	578	804	1752
	Factored Total Load			340	358	515	547	748	963	1204	2026
	Min. End / Int. Bearing (in)			1.5/3.7	1.6/3.9	2.3/5.7	2.4/6.0	3.3/8.2	4.2/10.6	5.3/13.2	8.9/22.3
17	Unfactored Load (LL) L/360			67	73	128	140	225	329	458	1003
	Unfactored Load (TL) L/240			97	105	186	204	331	486	678	1492
	Factored Total Load			301	317	455	484	661	852	1066	1838
	Min. End / Int. Bearing (in)			1.5/3.5	1.5/3.7	2.1/5.3	2.3/5.7	3.1/7.7	4.0/9.9	5.0/12.4	8.6/21.5
18	Unfactored Load (LL) L/360			57	62	108	119	191	280	390	861
	Unfactored Load (TL) L/240			81	88	156	172	279	412	577	1279
	Factored Total Load			268	282	405	431	589	759	949	1638
	Min. End / Int. Bearing (in)			1.5/3.5	1.5/3.5	2.0/5.0	2.1/5.3	2.9/7.3	3.8/9.4	4.7/11.7	8.1/20.3
19	Unfactored Load (LL) L/360				53	92	101	163	240	335	744
	Unfactored Load (TL) L/240				74	133	146	238	352	494	1104
	Factored Total Load				253	363	386	528	681	851	1469
	Min. End / Int. Bearing (in)				1.5/3.5	1.9/4.7	2.0/5.0	2.8/6.9	3.6/8.9	4.4/11.1	7.7/19.2
20	Unfactored Load (LL) L/360					79	87	141	207	290	647
	Unfactored Load (TL) L/240					113	125	204	303	426	959
	Factored Total Load					327	348	476	613	767	1325
	Min. End / Int. Bearing (in)					1.8/4.5	1.9/4.8	2.6/6.5	3.4/8.4	4.2/10.5	7.3/18.2
21	Unfactored Load (LL) L/360					69	76	122	180	252	566
	Unfactored Load (TL) L/240					97	107	176	262	370	837
	Factored Total Load					296	315	431	556	695	1200
	Min. End / Int. Bearing (in)					1.7/4.3	1.8/4.5	2.5/6.2	3.2/8.0	4.0/10.0	6.9/17.3
22	Unfactored Load (LL) L/360					60	66	107	157	221	498
	Unfactored Load (TL) L/240					84	93	153	228	322	735
	Factored Total Load					270	287	392	506	633	1093
	Min. End / Int. Bearing (in)					1.6/4.1	1.7/4.3	2.4/5.9	3.1/7.6	3.8/9.6	6.6/16.5
23	Unfactored Load (LL) L/360						58	94	138	194	440
	Unfactored Load (TL) L/240						81	134	200	283	648
	Factored Total Load						262	358	462	578	999
	Min. End / Int. Bearing (in)						1.7/4.1	2.3/5.7	2.9/7.3	3.7/9.1	6.3/15.8
24	Unfactored Load (LL) L/360							83	122	172	390
	Unfactored Load (TL) L/240							117	175	249	574
	Factored Total Load							328	424	530	916
	Min. End / Int. Bearing (in)							2.2/5.4	2.8/7.0	3.5/8.7	6.0/15.1
26	Unfactored Load (LL) L/360							65	97	136	312
	Unfactored Load (TL) L/240							91	137	196	455
	Factored Total Load							279	360	450	779
	Min. End / Int. Bearing (in)							2.0/5.0	2.6/6.4	3.2/8.0	5.6/13.9
28	Unfactored Load (LL) L/360							53	78	110	252
	Unfactored Load (TL) L/240							72	109	156	367
	Factored Total Load							239	309	387	670
	Min. End / Int. Bearing (in)							1.8/4.6	2.4/5.9	3.0/7.4	5.2/12.9
30	Unfactored Load (LL) L/360								64	90	207
	Unfactored Load (TL) L/240								87	126	299
	Factored Total Load								268	336	582
	Min. End / Int. Bearing (in)								2.2/5.5	2.8/6.9	4.8/12.0

* All 16", 18" and 24" beam depths are to be used in multiple member units only.

MULTIPLE MEMBER CONNECTIONS FOR SIDE-LOADED BEAMS: 3100F$_b$ – 2.0E

Verify adequacy of beam in uniform load tables prior to using values listed below.

3100F$_b$-2.0E 1¾" WEST FRASER™ LVL

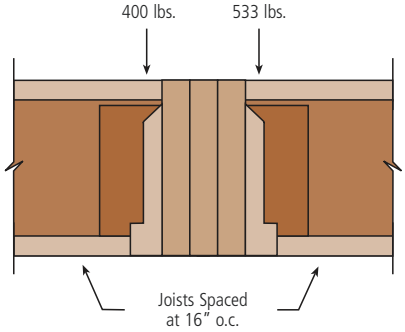
Maximum Factored Uniform Load (PLF) Applied to Either Outside Member			 2-PLY LVL	 3-PLY LVL	 4-PLY LVL*
Connector	**Spacing**	**Rows**	**Nails On One Side or Through Bolts**	**Nails Both Sides or Through Bolts**	**Through Bolts Only**
16d (3½") Common Wire Nails	12" o.c.	2 Rows	885	663	Not Applicable
		3 Rows	1327	995	
	6" o.c.	2 Rows	1770	1326	Not Applicable
		3 Rows	2654	1990	
	4" o.c.	2 Rows	2655	1989	Not Applicable
		3 Rows	3981	2985	
½" A307 Through Bolts	24" o.c.	2 Rows	671	503	448
	12" o.c.	2 Rows	1342	1006	895
	6" o.c.	2 Rows	2684	2012	1790

* 4-ply beams should only be side-loaded when loads are applied to both sides of the member.

1. Nails to be located a minimum of 2" from the top and bottom of the member. Start all nails a minimum of 2½" in from ends.
2. Bolts are to be material conforming to ASTM Standard A307. Bolt holes are to be the same diameter as the bolt, and located 2" from the top and bottom of the member. Washers should be used under head and nut. Start all bolts a minimum of 2½" in from ends.
3. Values listed are for standard term loading.

EXAMPLE (All loads shown are total factored)

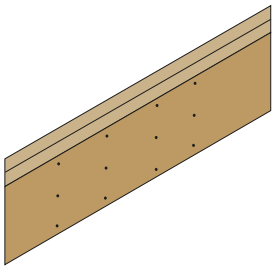
First, convert joist reactions to plf load on each side of the beam by taking the joist reaction (lbs.) divided by the joist spacing (ft.). 400 lbs/(16/12) = 300 plf and 533 lbs/(16/12) = 400 plf. Check factored resistance tables to verify that 3 plys can carry the total factored load of 700 plf. The maximum load applied to either outside member is 400 plf. Use 2 rows of 16d (3½") common wire nails at 12" o.c. (good for 663 plf).



CONNECTION OF MULTIPLE PIECES FOR TOP-LOADED BEAMS

2.0E (1¾" wide pieces)

- Minimum of 2 rows of 16d (3½") nails at 12" o.c. for 5½" through 11⅞" beams
- Minimum of 3 rows of 16d (3½") nails at 12" o.c. for 14" through 24" beams



NOTES


West Fraser™ LVL
3000Fb – 1.9E LVL
West Fraser™ LVL

West Fraser LVL

LVL 3000Fb – 1.9E 1¾" THICK

HEADERS AND BEAMS

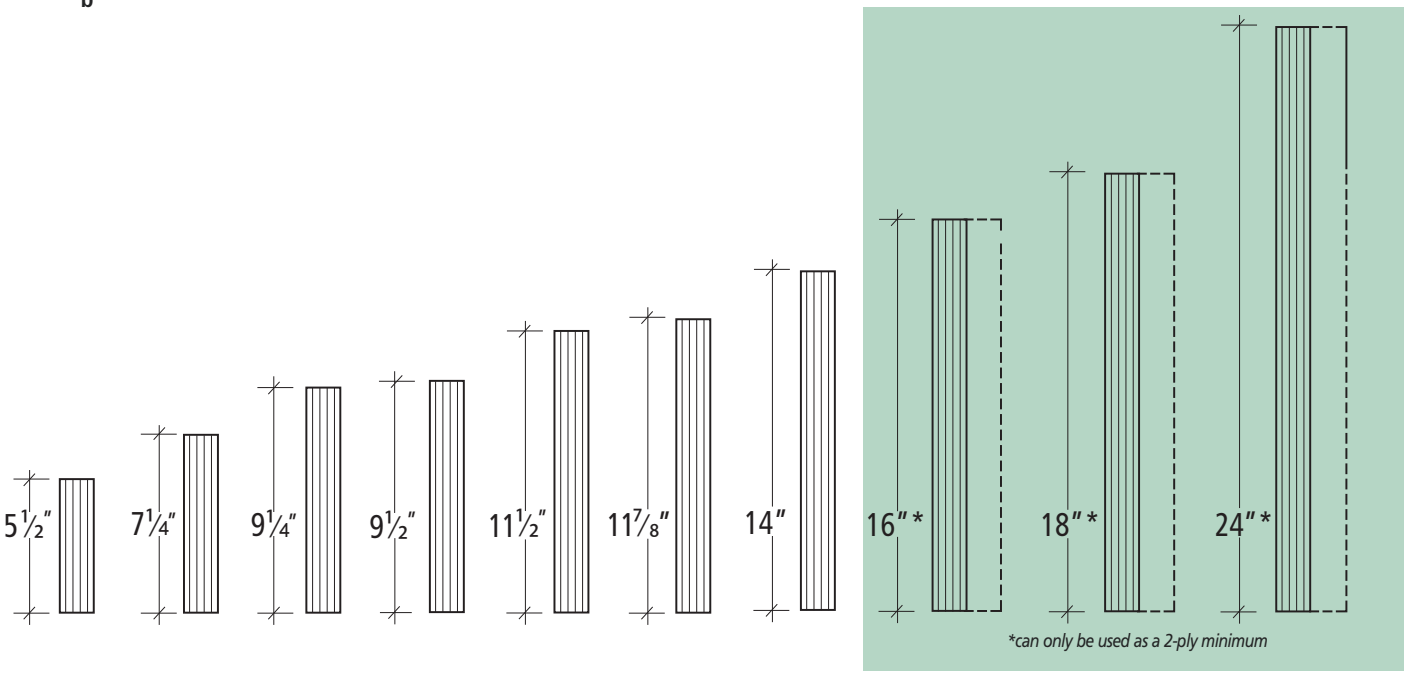
DESIGN PROPERTIES

3000Fb-1.9E 1¾" WEST FRASER™ LVL FACTORED RESISTANCES (STANDARD TERM)

Design Property	Depth									
	5½"	7¼"	9¼"	9½"	11½"	11⅞"	14"	16"	18"	24"
Moment (ft.lbs.)	4079	6827	10751	11299	16132	17126	23277	29855	37184	63568
Shear (lbs.)	3736	4925	6284	6454	7813	8067	9511	10870	12228	16304
Moment of Inertia (in^4)	24	56	115	125	222	244	400	597	851	2016
Weight (lbs./lin.ft.)	2.7	3.6	4.6	4.7	5.7	5.9	7.0	8.0	9.0	12.0

1. Lateral support of beam compression edge is required at intervals of 24" o/c or closer.
2. Lateral support of beam is required at bearing locations.
3. All 16" and greater beam depths are to be used in multiple member units only.

3000Fb -1.9E 1¾" WEST FRASER™ LVL AVAILABLE SIZES*



3000Fb -1.9E WEST FRASER™ LVL SPECIFIED STRENGTHS (STANDARD TERM)

Modulus of Elasticity	E	=	1.9 x 10^6 psi
Bending Stress	Fb	=	5544 psi
Shear (joist)	Fv	=	647 psi
Compression Perpendicular to Grain (joist)	Fc(perp)	=	1300 psi
Compression Parallel to Grain	Fc(para)	=	4000 psi

1. Fb based on 12" depths. For other depths, multiply by (12/d)^(1/7.35).
2. Fc(perp) and E shall not be increased for duration of load.

FACTORED RESISTANCE TABLES

GENERAL NOTES

- Tables are for one-ply 1¾" beams. When properly connected, double the values for two-ply beams, triple for three. Minimum bearing lengths shown for one-ply will be the same for two-ply and three-ply. See page 15 for multiple-ply connection details.
- Resistances shown are the maximum factored and/or unfactored resistances, in pounds per lineal foot, that can be applied to the beam in addition to its own weight.
- Tables are based on uniform loads and the most restrictive of simple or continuous spans and dry-use conditions. Refer to West Fraser's sizing software for other loads or span configurations.
- Lateral support of beam compression edges is required at intervals of 24" o/c or closer.
- Lateral support of beams is required at bearing locations.
- West Fraser™ LVL beams are made without camber; therefore, in addition to complying with the deflection limits of the applicable building code, other deflection considerations, such as long term deflection under sustained loads (including creep), must be evaluated.
- All 16" and deeper beams are to be used in multiple member units only.
- Unfactored total load resistance is limited to a deflection of L/240. Unfactored live load resistance is based on a deflection of L/360. Check local code requirements for other deflection criteria.
- For an unfactored live load deflection limit of L/480, multiply UNFACTORED LOAD L/360 resistance by 0.75.
- Roof must have positive slope in order to prevent ponding.
- Spans of multiple spans must be at least 40% of adjacent span.
- Bearing lengths are based on 1300 psi specified strength for 1.9E Grade materials which cannot be increased for duration of load. Bearing length may need to be increased if support member's allowable bearing stress is less.
- Tables will accommodate beam slopes to a maximum of 2:12.

INSTRUCTIONS FOR USE

1. Determine the factored total load and unfactored total and live load on the beam in pounds per lineal foot (plf).
2. Locate a span that meets or exceeds the required beam span, centre-to-centre of bearing.
3. Scan from left to right within the SPAN row until you find a cell where; (1) the UNFACTORED LOAD L/360 resistance meets or exceeds the unfactored live load, (2) the UNFACTORED LOAD L/240 resistance meets or exceeds the unfactored total load and (3) the FACTORED TOTAL LOAD resistance meets or exceeds the factored total load. All three rows must be checked and satisfied. Where no unfactored resistances are shown, factored total load will control.
4. To size a member for a span not shown, use capacities for the next larger span shown.

FACTORED RESISTANCE TABLE (POUNDS PER LINEAL FOOT)

3000F_b-1.9E West Fraser™ LVL — FLOOR or ROOF (Standard Term)

Span (ft)		1¾" WIDTH									
	Depth	5-1/2"	7-1/4"	9-1/4"	9-1/2"	11-1/2"	11-7/8"	14"	16"	18"	24"
6	Unfactored Load (LL) L/360	290	627	1200	1286	2077	2245	3299	4427		
	Unfactored Load (TL) L/240	433	936	1795	1924						
	Factored Total Load	904	1514	2105	2177	2793	2917	3675	4490	5426	9305
	Min. End / Int. Bearing (in)	1.5/3.7	2.5/6.2	3.5/8.7	3.6/9.0	4.6/11.5	4.8/12.0	6.1/15.1	7.4/18.5	8.9/22.4	15.3/38.3
7	Unfactored Load (LL) L/360	187	409	798	858	1413	1533	2302	3148	4093	
	Unfactored Load (TL) L/240	277	610	1193	1282	2114	2294				
	Factored Total Load	663	1111	1739	1796	2281	2377	2957	3566	4244	6853
	Min. End / Int. Bearing (in)	1.5/3.5	2.1/5.3	3.3/8.4	3.5/8.6	4.4/11.0	4.6/11.4	5.7/14.2	6.9/17.1	8.2/20.4	13.2/32.9
8	Unfactored Load (LL) L/360	127	281	555	598	999	1087	1658	2302	3036	
	Unfactored Load (TL) L/240	188	418	828	892	1493	1625				
	Factored Total Load	507	850	1339	1408	1927	2006	2474	2956	3485	5423
	Min. End / Int. Bearing (in)	1.5/3.5	1.9/4.7	2.9/7.4	3.1/7.7	4.2/10.6	4.4/11.0	5.4/13.6	6.5/16.2	7.7/19.1	11.9/29.8
9	Unfactored Load (LL) L/360	90	201	401	431	729	795	1228	1725	2302	4427
	Unfactored Load (TL) L/240	132	297	596	643	1088	1187	1835			
	Factored Total Load	400	671	1057	1111	1588	1686	2126	2525	2955	4486
	Min. End / Int. Bearing (in)	1.5/3.5	1.7/4.1	2.6/6.5	2.7/6.9	3.9/9.8	4.2/10.4	5.3/13.1	6.2/15.6	7.3/18.3	11.1/27.7
10	Unfactored Load (LL) L/360	66	148	298	321	547	598	932	1321	1779	3515
	Unfactored Load (TL) L/240	97	219	442	477	815	890	1390	1973		
	Factored Total Load	324	543	855	899	1285	1364	1855	2203	2565	3824
	Min. End / Int. Bearing (in)	1.5/3.5	1.5/3.7	2.3/5.9	2.5/6.2	3.5/8.8	3.7/9.4	5.1/12.7	6.1/15.1	7.0/17.6	10.5/26.3
11	Unfactored Load (LL) L/360		112	227	245	420	459	722	1031	1399	2828
	Unfactored Load (TL) L/240		165	336	363	624	683	1075	1538	2090	
	Factored Total Load		448	706	742	1061	1126	1532	1953	2266	3333
	Min. End / Int. Bearing (in)		1.5/3.5	2.1/5.3	2.2/5.6	3.2/8.0	3.4/8.5	4.6/11.6	5.9/14.8	6.8/17.1	10.1/25.2
12	Unfactored Load (LL) L/360		87	177	191	329	360	569	818	1117	2302
	Unfactored Load (TL) L/240		127	261	282	488	534	847	1219	1667	
	Factored Total Load		376	593	623	890	946	1286	1651	2029	2952
	Min. End / Int. Bearing (in)		1.5/3.5	2.0/4.9	2.1/5.1	2.9/7.3	3.1/7.8	4.2/10.6	5.4/13.6	6.7/16.7	9.7/24.3
13	Unfactored Load (LL) L/360		69	140	152	262	287	456	659	905	1894
	Unfactored Load (TL) L/240		100	206	223	388	425	677	980	1348	
	Factored Total Load		320	504	530	758	805	1095	1405	1751	2650
	Min. End / Int. Bearing (in)		1.5/3.5	1.8/4.5	1.9/4.7	2.7/6.8	2.9/7.2	3.9/9.8	5.0/12.5	6.3/15.6	9.5/23.7
14	Unfactored Load (LL) L/360		55	113	122	212	233	371	538	742	1574
	Unfactored Load (TL) L/240		80	165	179	313	343	549	799	1104	2350
	Factored Total Load		275	434	456	653	693	943	1211	1509	2404
	Min. End / Int. Bearing (in)		1.5/3.5	1.7/4.2	1.8/4.4	2.5/6.3	2.7/6.7	3.6/9.1	4.7/11.6	5.8/14.5	9.2/23.1
15	Unfactored Load (LL) L/360		45	93	100	174	191	305	444	615	1321
	Unfactored Load (TL) L/240		64	134	145	255	280	451	658	913	1969
	Factored Total Load		239	378	397	568	603	821	1054	1313	2199
	Min. End / Int. Bearing (in)		1.5/3.5	1.6/3.9	1.6/4.1	2.3/5.9	2.5/6.2	3.4/8.5	4.3/10.9	5.4/13.5	9.1/22.7
16	Unfactored Load (LL) L/360			77	83	144	159	254	371	515	1117
	Unfactored Load (TL) L/240			110	119	211	232	374	548	763	1664
	Factored Total Load			331	348	498	529	720	925	1153	1974
	Min. End / Int. Bearing (in)			1.5/3.6	1.5/3.8	3.2/5.5	2.3/5.8	3.2/7.9	4.1/10.2	5.1/12.7	8.7/21.7
17	Unfactored Load (LL) L/360			64	69	121	133	214	313	435	953
	Unfactored Load (TL) L/240			92	99	176	194	314	461	644	1417
	Factored Total Load			293	308	441	468	637	818	1020	1748
	Min. End / Int. Bearing (in)			1.5/3.5	1.5/3.6	2.1/5.1	2.2/5.5	3.0/7.4	3.8/9.6	4.8/11.9	8.2/20.4
18	Unfactored Load (LL) L/360			54	59	103	113	181	266	371	818
	Unfactored Load (TL) L/240			77	83	148	163	265	391	547	1215
	Factored Total Load			261	274	393	417	568	729	909	1558
	Min. End / Int. Bearing (in)			1.5/3.5	1.5/3.5	1.9/4.9	2.1/5.2	2.8/7.0	3.6/9.0	4.5/11.2	7.7/19.3
19	Unfactored Load (LL) L/360				50	88	96	155	228	319	707
	Unfactored Load (TL) L/240				70	126	138	226	334	469	1049
	Factored Total Load				246	352	374	509	654	815	1397
	Min. End / Int. Bearing (in)				1.5/3.5	1.8/4.6	2.0/4.9	2.7/6.6	3.4/8.5	4.3/10.6	7.3/18.2
20	Unfactored Load (LL) L/360					75	83	134	197	275	615
	Unfactored Load (TL) L/240					107	118	194	287	404	910
	Factored Total Load					317	337	459	589	735	259
	Min. End / Int. Bearing (in)					1.7/4.4	1.9/4.6	2.5/6.3	3.2/8.1	4.0/10.1	6.9/17.3
21	Unfactored Load (LL) L/360					65	72	116	171	240	538
	Unfactored Load (TL) L/240					92	102	167	248	351	795
	Factored Total Load					287	305	415	534	666	1141
	Min. End / Int. Bearing (in)					1.7/4.1	1.8/4.4	2.4/6.0	3.1/7.7	3.8/9.6	6.6/16.5
22	Unfactored Load (LL) L/360					57	63	101	149	210	473
	Unfactored Load (TL) L/240					80	88	145	216	306	697
	Factored Total Load					261	277	378	485	606	1039
	Min. End / Int. Bearing (in)					1.6/3.9	1.7/4.2	2.3/5.7	2.9/7.3	3.7/9.2	6.3/15.7
23	Unfactored Load (LL) L/360						55	89	131	185	418
	Unfactored Load (TL) L/240						76	127	189	268	615
	Factored Total Load						253	345	444	553	949
	Min. End / Int. Bearing (in)						1.6/4.0	2.2/5.4	2.8/7.0	3.5/8.7	6.0/15.0
24	Unfactored Load (LL) L/360							79	116	163	371
	Unfactored Load (TL) L/240							111	166	236	544
	Factored Total Load							316	407	507	871
	Min. End / Int. Bearing (in)							2.1/5.2	2.7/6.7	3.3/8.4	5.7/14.4
26	Unfactored Load (LL) L/360							62	92	130	296
	Unfactored Load (TL) L/240							86	130	185	432
	Factored Total Load							268	345	431	740
	Min. End / Int. Bearing (in)							1.9/4.8	2.5/6.2	3.1/7.7	5.3/13.2
28	Unfactored Load (LL) L/360							50	74	104	240
	Unfactored Load (TL) L/240							68	103	148	348
	Factored Total Load							231	297	370	637
	Min. End / Int. Bearing (in)							1.8/4.4	2.3/5.7	2.8/7.1	4.9/12.3
30	Unfactored Load (LL) L/360								60	85	197
	Unfactored Load (TL) L/240								83	119	283
	Factored Total Load								257	322	553
	Min. End / Int. Bearing (in)								2.1/5.3	2.7/6.6	4.6/11.4

* All 16", 18" and 24" beam depths are to be used in multiple member units only.

MULTIPLE MEMBER CONNECTIONS FOR SIDE-LOADED BEAMS: 3000F_b – 1.9E

Verify adequacy of beam in uniform load tables prior to using values listed below.

3000F_b-1.9E 1¾" WEST FRASER™ LVL

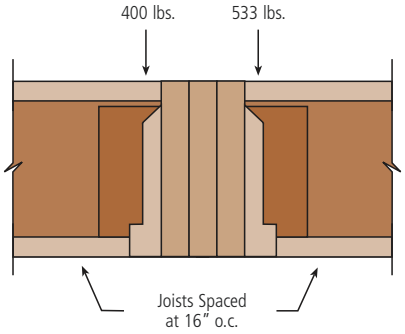
Maximum Factored Uniform Load (PLF) Applied to Either Outside Member			2-PLY LVL	3-PLY LVL	4-PLY LVL*
Connector	**Spacing**	**Rows**	**Nails On One Side or Through Bolts**	**Nails Both Sides or Through Bolts**	**Through Bolts Only**
16d (3½") Common Wire Nails	12" o.c.	2 Rows	827	620	Not Applicable
		3 Rows	1241	930	
	6" o.c.	2 Rows	1654	1240	Not Applicable
		3 Rows	2482	1860	
	4" o.c.	2 Rows	2481	1860	Not Applicable
		3 Rows	3723	2790	
½" A307 Through Bolts	24" o.c.	2 Rows	671	503	448
	12" o.c.	2 Rows	1342	1006	895
	6" o.c.	2 Rows	2684	2012	1790

* 4-ply beams should only be side-loaded when loads are applied to both sides of the member.

1. Nails to be located a minimum of 2" from the top and bottom of the member. Start all nails a minimum of 2½" in from ends.
2. Bolts are to be material conforming to ASTM Standard A307. Bolt holes are to be the same diameter as the bolt, and located 2" from the top and bottom of the member. Washers should be used under head and nut. Start all bolts a minimum of 2½" in from ends.
3. Values listed are for standard term loading.

EXAMPLE (All loads shown are total factored)

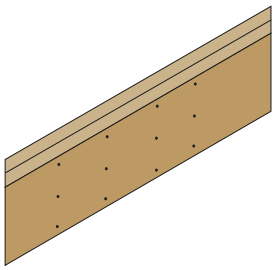
First, convert joist reactions to plf load on each side of the beam by taking the joist reaction (lbs.) divided by the joist spacing (ft.). 400 lbs/(16/12) = 300 plf and 533 lbs/(16/12) = 400 plf. Check factored resistance tables to verify that 3 plys can carry the total factored load of 700 plf. The maximum load applied to either outside member is 400 plf. Use 2 rows of 16d (3½") common wire nails at 12" o.c. (good for 620 plf).



CONNECTION OF MULTIPLE PIECES FOR TOP-LOADED BEAMS

1.9E (1¾" wide pieces)

- Minimum of 2 rows of 16d (3½") nails at 12" o.c. for 5½" through 11⅞" beams
- Minimum of 3 rows of 16d (3½") nails at 12" o.c. for 14" through 24" beams



EVALUATION REPORT

Report Number: 130
Originally Issued: 12/2008
Revised: 01/09/2013
Valid Through: 12/2013

DIVISION: 06—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:
SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE NAIL HOLD-DOWNS (TENSION TIES)

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes

- 2012 International Building Code® (IBC)
- 2012 International Residential Code® (IRC)
- 2009 International Building Code® (IBC)
- 2009 International Residential Code® (IRC)
- 2006 International Building Code® (IBC)
- 2006 International Residential Code® (IRC)

1.2 Evaluated in accordance with

- ICC-ES AC155, Acceptance Criteria for Hold-Downs (Tie-Downs) Attached To Wood Members, Approved June 2010

Property evaluated

- Structural

2.0 USES

Simpson Strong-Tie structural nail hold-down connectors (tension ties) are used as wood framing anchorage, such as to connect wood posts to concrete foundations or to connect an upper–story wood post to a lower-story supporting wood post, in accordance with 2012 (2009) IBC Sections 2304.9.3, 2305.1, 2308.9.3.1, 2308.9.3.2 or 2006 IBC Sections 2304.9.3, 2305.1, 2305.3.2, 2305.3.7, 2305.3.8.2.4 and 2308.9.3.1 and AF&PA SDPWS-2008 (2005) Special Design Provisions for Wind and Seismic Sections 4.3.6.4.2 and 4.3.6.1.2, and as anchorage of concrete and masonry walls to structural wood elements to provide lateral support for the walls as required by 2012 (2009) (2006) IBC Section 1604.8.

When regulated under the IRC, the hold-down connectors may also be used when an engineered design is submitted in accordance with 2012 (2009) (2006) IRC Section R301.1.3 or in alternate braced wall panels per 2012 IRC Sections R602.10.2.2.1, R602.10.6.1, R602.10.6.2 and R602.10.7, 2009 IRC Sections R502.2.2.3, R602.10.1.4.1(2), R602.10.3.2, R602.10.3.3, R602.10.4.4 and R602.10.5.3 or 2006 IRC Sections R602.10.6.1 and R602.10.6.2.

Hold-down connectors may be used as anchorage of concrete and masonry walls to structural wood elements to provide lateral support for the walls in accordance with 2012 (2009) IRC Sections R606.12.2.3 and R611.9.1 or 2006 IRC Sections R606.12.2.2 and R611.8.2.1.

3.0 DESCRIPTION

3.1 Product Information

3.1.1 LTT Nail Hold-downs: LTT Light Tension Ties are nail hold-downs consisting of a steel strap component with 90 degree angle bend at the end and a base plate component installed in the bend, which eliminates the need for a washer to transfer load. These hold-downs have pre-punched holes for installation of fasteners used to connect the hold-down to the wood member. Bodies of the LTT19, LTT20B and LTTI31 are formed from No.16, No.12 and No.18 gage galvanized steel respectively. Base plate component for LTT's is No. 3 gage galvanized steel. See Figure 1 and Table 1 for product dimensions, required fasteners and allowable loads.

3.1.2 HTT Nail Hold-downs: HTT Heavy Tension Ties are single-piece formed nail hold-downs consisting of a steel strap with a four-ply formed seat element for an anchor bolt. The straight-strap portion has pre-punched holes for installation of fasteners used to connect the hold-down to the wood member. HTT is die-formed from No. 11 gage galvanized steel. Bearing plate BP5/8-2 is fabricated from 3/16 inch thickness steel and may be installed with HTT5 as a load transfer washer for additional capacity. See Figure 2 and Table 1 for product dimensions, required fasteners and allowable loads.

3.2 Materials

3.2.1 Steel: LTT and HTT nail hold-downs described in this report are manufactured from ASTM A 653 SS Grade 33 galvanized steel with a minimum yield strength (Fy) of 33,000 psi (227 MPa) and a minimum ultimate tensile strength (Fu) of 45,000 psi (310 MPa). Load transfer base plates of the LTT series and bearing plate BP5/8-2 are fabricated from ASTM A 1011 SS Grade 33 steel having a minimum yield strength of 33,000 psi (227 MPa) and a minimum ultimate strength of 52,000 psi (359 MPa). Base metal thicknesses for the tension ties in this report are as follows:

GAGE	BASE METAL THICKNESS (inches)
3/16 inch	0.1775
No. 3	0.2285
No. 11	0.1105
No. 12	0.0975
No. 16	0.0555
No. 18	0.0445

For SI: 1 inch = 25.4 mm

Hold-downs have a minimum G90 zinc coating specification per ASTM A 653. Some models may also be available with either a G185 zinc coating (denoted by model numbers ending in the letter Z) or with a batch hot-dipped galvanized coating with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2) total for both sides in accordance with ASTM A 123 (denoted by model numbers ending with the letters HDG). Model numbers in this report do not list the Z or HDG ending but the information shown applies.

Lumber treater or holder of this report (Simpson Strong-Tie) should be contacted for recommendations on minimum corrosion resistance of steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

3.2.2 Wood: Wood members connected to hold-downs must be either sawn lumber or engineered lumber. Sawn lumber must have a minimum specific gravity of 0.50 and a maximum moisture content of 19 percent. Engineered lumber must have a minimum equivalent specific gravity of 0.50 and a maximum moisture content of 16 percent. Minimum thickness (depth) of the wood members in the direction of the fastener penetration is 3 inches and the required minimum width of the wood members is 3 ½ inches.

3.2.3 Fasteners

3.2.3.1 Nails: Common nails used with connectors in this report must comply with ASTM F 1667 and have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

FASTENER	SHANK DIAMETER (inches)	FASTENER LENGTH (inches)	*Fyb* (psi)
10d x 1½	0.148	1½	90,000
10d	0.148	3	90,000
16d × 2½	0.162	2 1/2	90,000
16d	0.162	3 ½	90,000

For SI: 1 inch = 25.4 mm, 1 psi = 6.895 kPa

3.2.3.2 Bolts: Machine bolts must comply with ASME Standard B18.2.1 and with ASTM A 307. Minimum bending yield strength (F_{yb}) of the bolt must be 45,000 psi (310 MPa).

3.2.3.3 Threaded Anchor Rods: As a minimum, threaded steel anchor rods must comply with ASTM A 36 or ASTM F 1554 Grade 36.

3.2.3.4 Preservative-treated and fire-retardant-treated wood: Fasteners used in contact with preservative-treated or fire-retardant-treated lumber must comply with 2012 (2009) (2006) IBC Section 2304.9.5 and 2012 (2009) IRC Section R317.3 or 2006 IRC Section R319.3 as applicable. Lumber treater or report holder should be contacted for recommendations on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design

4.1.1 Hold-Down Assembly: Allowable loads shown in Table 1 of this report are for hold-down assemblies consisting of the following components: (1) hold-down device; (2) an anchor bolt/rod attached to the seat of the device; (3) a wood member having minimum specified dimensions and properties; (4) quantity and

size of fasteners used to attach the hold-down device to the wood member; and, in some cases as noted (5) bearing plates or washers. Allowable loads shown in the product tables of this report are based on allowable stress design (ASD) and include the load duration factor (C_D) corresponding with the applicable loads in accordance with the AF&PA NDS-2012 (2005) National Design Specification for Wood Construction.

Where design load combinations include earthquake loads or effects, story drifts of the structure must be determined in accordance with Section 12.8.6 of ASCE 7 (ASCE 7-10 for 2012 IBC) (ASCE 7-05 for 2009 and 2006 IBC) except for those structures analyzed using the Simplified Design Procedure pursuant to Section 12.14.

Deflection of a shear wall restrained from overturning by hold-downs installed in accordance with this report shall be determined in accordance with 2012 IBC Section 2305.3, 2009 IBC Section 2305.1 or 2006 IBC Section 2305.3.1.

Total deflection values, Δ_{all} and $\Delta_{s,}$ at ASD-level and strength-level forces, respectively, for hold-down assemblies shown in Tables 1 of this report, include all sources of hold-down device extension and rotation and anchor rod elongation where the length of the anchor rod is a maximum of 4 ½ inches (152 mm). Contribution of the hold-down anchor rod elongation to the total elongation (deflection) of the hold-down assembly needs to be considered when the actual diameter, length or ASTM steel specification of the anchor rod differs from that described in this report.

Symbol Δ_s as used in this report refers to the symbol d_a in 2012 (2009) (2006) IBC Section 2305.3 and the symbol Δ_a in 2008 (2005) ANSI/AF&PA SDPWS Section 4.3.2.

When hold-downs are fastened to wood having a moisture content greater than 19 percent for sawn lumber or 16 percent for engineered lumber, or where wet service is expected, allowable loads shown in Tables 1 of this report must be adjusted by the wet service factor (C_m) specified in the AF&PA NDS-2012 (2005).

Tabulated allowable loads are for hold-downs connected to wood used under continuously dry interior conditions and where sustained temperatures are 100°F (37.8°C) or less.

When hold-down are fastened to wood that will experience sustained exposure to temperatures exceeding 100°F (37.8°C), allowable loads shown in Tables 1 in this report must be adjusted by the temperature factor (C_t) specified in the AF&PA NDS-2012 (2005).

Design of wood members fastened to LTT and HTT hold-down devices must consider combined stresses due to axial tension and flexural bending induced by eccentricity in the connection. Stresses shall be evaluated at the critical net section.

4.1.2 Anchorage to Concrete or Masonry: Adequate embedment length and anchorage details, including edge and end distances, must be determined in accordance with Chapters 19 or 21 of the IBC, as applicable, for design of anchorage to concrete and masonry structural members except for those structures designed in accordance with the IRC or the conventional light-frame construction provisions of Section 2308 of the IBC.

4.2 Installation: Installation of the Simpson Strong-Tie hold-down connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

4.3 Special Inspection

4.3.1 IBC: A statement of special inspection shall be prepared by the registered design professional in responsible charge and submitted to the building official for approval when required by 2012 IBC Section 1704.3 or 2009 (2006) IBC Section 1705. A statement of responsibility shall be submitted by each responsible contractor to the code official for approval when required by 2012 IBC Section 1704.4, 2009 IBC Section 1709 or 2006 IBC Section 1706.

4.3.2: Periodic special inspection shall be conducted when the hold-downs are components within the main wind-force-resisting system of structures constructed in areas listed in 2012 IBC Section 1705.10, 2009 IBC Section 1706.1 or 2006 IBC Section 1705.4. Special inspection requirements do not apply to structures, or portions thereof, that qualify for an exception pursuant

to 2012 IBC Sections 1704.2, 1705.3 or 1705.10.1, 2009 IBC Sections 1704.1, 1704.4, 1706.2 or 1706.3 or 2006 IBC Sections 1704.1 or 1704.4.

4.3.3: Periodic special inspection for seismic resistance shall be conducted in accordance with 2012 IBC Section 1705.11 or 2009 (2006) Section 1707 where required. Special inspection requirements for seismic resistance do not apply to structures, or portions thereof, that qualify for an exception pursuant to 2012 IBC Sections 1704.2, 1705.11, and 1705.11.2 or 2009 (2006) IBC Sections 1704.1, 1705.3, 1707.3 or 1707.4.

4.3.4: For installations under the IRC, special inspection is not normally required. However, when an engineered design is submitted or required pursuant to 2012 (2009) (2006) IRC Section 301.1.3, periodic special inspection requirements and exemptions are as stated in Sections 4.3.1, 4.3.2 and 4.3.3 of this report as applicable.

5.0 CONDITIONS OF USE

Simpson Strong-Tie nail hold-down connectors described in this report comply with, or are suitable alternatives to, what is specified in those codes listed in Section 1.0 of this report subject to the following conditions:

5.1 Hold-downs must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. Installation instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the building official. Calculations must be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of hold-down connectors with preservative-or-fire-retardant-treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative-or-fire-retardant-treated lumber must be in accordance with Section 3.2.3 of this report.

5.6 Anchorage to concrete or masonry structural members must be provided in accordance with Section 4.1.2 of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with ICC-ES Acceptance Criteria for Hold-Downs (Tie-Downs) Attached to Wood Members (AC155), dated July 2010, inclusive of tests and calculations. Test results are from laboratories in compliance with ISO/IEC 17025.

7.0 IDENTIFICATION

Products described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number and the number of the index evaluation report (ER-102) that identifies products recognized in this report.

IAPMO UES ER-130

Richard Beck, PE, CBO, MCP
Director of Uniform Evaluation Service

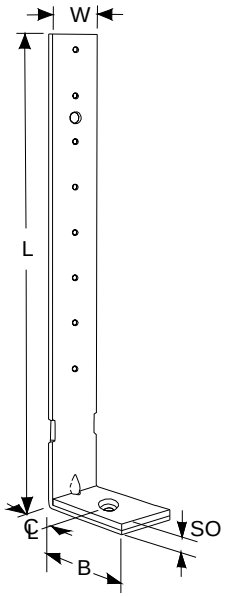
GP Russ Chaney
CEO, The IAPMO Group

TABLE 1: ALLOWABLE LOADS FOR THE LTT AND HTT NAIL HOLD-DOWNS (TENSION TIES)

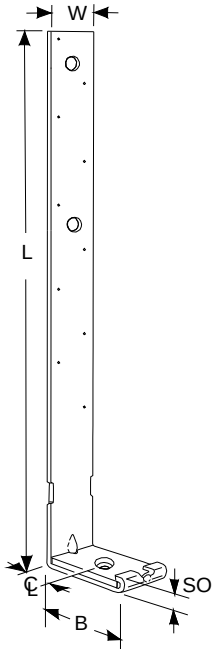
MODEL NO.	DIMENSIONS					FASTENERS		ALLOWABLE TENSION LOADS[5], P_{all} (lbs) C_D = 1.6	DISPLACEMENT Δ AT MAXIMUM LOAD [6,7] (in.)	
	W	L	CL	B	SO	ANCHOR BOLT	FASTENER QUANTITY		Δ_{all}	Δ_s
LTT19	1¾	19⅛	1⅜	2¾	5/16	½, ⅝ or ¾	8-10dx1½	1310	0.180	0.248
							8-10d	1340	0.157	0.233
LTT20B	2	19¾	1½	3⅛	5/16	½, ⅝ or ¾	10-10dx1½	1355	0.195	0.250
							10-10d	1500	0.185	0.250
							2-½" Bolt[9]	1625	0.183	0.250
LTTI31	3¾	31	1⅜	2¾	¼	⅝	18-10dx1½	1350	0.193	0.250
HTT4	2½	12⅜	1⅜	2	7/16	⅝	18-10dx1½	3610	0.086	0.135
							18-16dx2½	4235	0.123	0.201
HTT5	2½	16	1⅜	2	7/16	⅝	26-10dx1½	4350	0.120	0.209
							26-10d	4670	0.116	0.234
							26-16dx2½	5090[10]	0.135	0.250

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

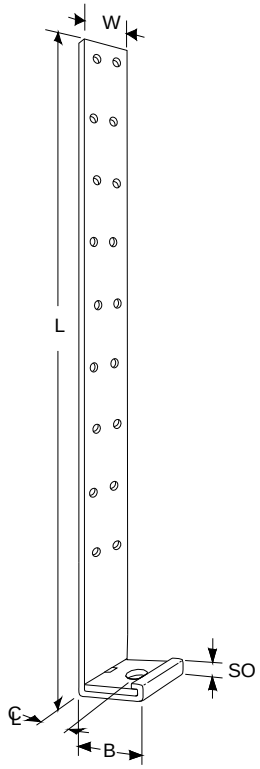
1. Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a minimum of a 3-inch thick wood structural member, or multiple members attached together to be 3-inches or greater in thickness, with the fasteners as specified in Table 1.
2. Allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D = 1.6, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed. Reduce where other load durations govern.
3. When using the basic load combinations in accordance with 2012 (2009) (2006) IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternate basic load combinations in 2012 (2009) (2006) IBC Section 1605.3.2 that includes wind or earthquake loads, the tabulated allowable loads for the hold-down assembly must not be increased by 33⅓ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
4. Anchorage to concrete or masonry must be determined in accordance with Section 4.1.2 of this report.
5. Tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_s deformations.
6. Tabulated displacement values, Δ_{all} and Δ_s, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength level forces respectively.
7. Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report or the actual unbraced length is greater than 4 ½ inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 4 ½ to 18 inches above the concrete, it is permitted to add an additional anchor rod elongation of 0.01 inches to the tabulated hold-down deflection.
8. If a ½ or ⅝ inch diameter anchor bolt is used for the LTT19 or LTT20B, add a standard cut washer to the seat. No additional washer is required for a ¾ inch diameter anchor bolt. See table for specified anchor bolt sizes.
9. Wood member bolts shall be in accordance with Section 3.2.3.2 of this report.
10. Allowable tension load for HTT5 with bearing washer BP5/8-2 is 5295 lbs. (Δ_{all} = 0.126, Δ_s = 0.179).
11. 16d common nails are permitted to substitute for 16d×2½" nails.



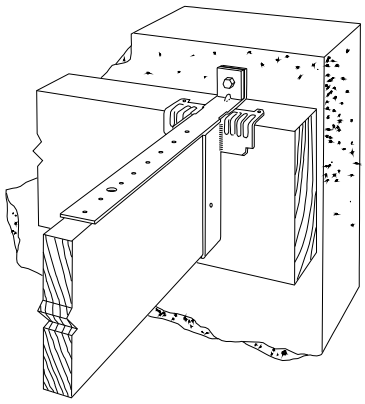
LTT19



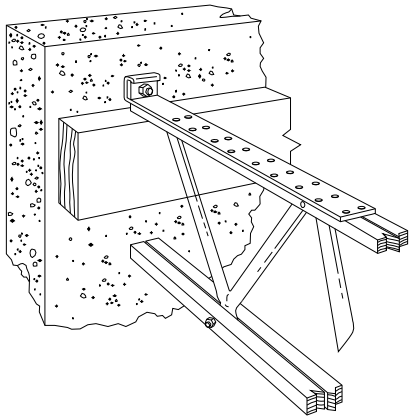
LTT20B



LTTI31

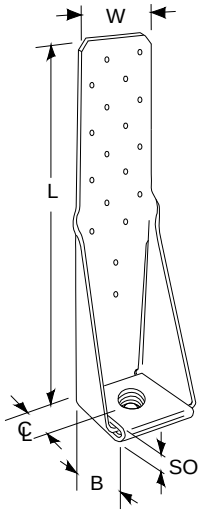


LTT19 Horizontal Installation
(LTT20B Similar)

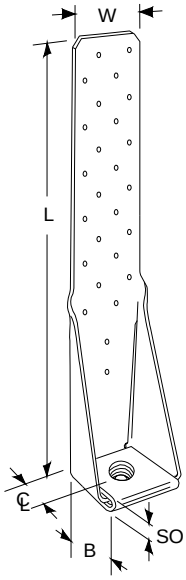


LTTI31 Horizontal Installation

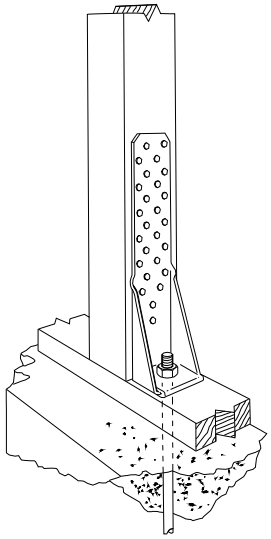
Figure 1 – LTT Nail Hold-Downs



HTT4



HTT5



HTT5 Vertical Typical Installation
(HTT4 Similar)

Figure 2 – HTT Nail Hold-Downs

ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-1161

Issued July 1, 2012

This report is subject to renewal July 1, 2013.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE CONTINUOUS ROD TIE-DOWN SYSTEM UTILIZING SIMPSON STRONG-TIE URS UPLIFT ROD RUNS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code*® (IBC)
- 2012, 2009 and 2006 *International Residential Code*® (IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie continuous rod tie-down system utilizes Simpson Strong-Tie URS uplift rod runs, and is used to resist wind uplift loads applied at the top of wood light-frame walls by hurricane ties or similar devices connecting the roof framing members to the top plate of the wall. The system provides a continuous load path from one end at the top of the wall to the other end that terminates at the foundation or to other resisting elements, in order to resist wind-induced uplift forces from the roof. The system is an alternative to systems designed in accordance with IBC Section 2306. When the system is used in conventional light-frame wood construction, IBC Section 2308.1.1 and IRC Section R301.1.3 apply, and an engineered design must be submitted to the code official for approval in accordance with Section 5.2 of this report.

3.0 DESCRIPTION

3.1 Simpson Strong-Tie Continuous Rod Tie-Down System:

The Simpson Strong-Tie continuous rod tie-down system is a wood light-frame wall system containing Simpson Strong-Tie URS uplift rod runs at specified spacing intervals. The URS uplift rod run components are described in Section 3.2. Descriptions of the wood framing members (not provided by Simpson Strong-Tie) and framing connections that must be used within the system are given in Sections 3.3 and 3.4, respectively. Figure 1 illustrates a typical Simpson Strong-Tie continuous rod tie-down system with Simpson Strong-Tie URS uplift rod runs.

3.2 Simpson Strong-Tie URS Uplift Rod Runs:

Each URS uplift rod run consists of the components described in Sections 3.2.1 through 3.2.4. Use of shrinkage compensating devices, as described in Section 3.2.5, to remove slack from the system by compensating for wood shrinkage and building settlement, is at the option of the registered design professional. The URS uplift rod runs used within the Simpson Strong-Tie continuous rod tie-down system are designated with the model numbers URS3, URS4, URS5, and URS6, and have corresponding component model numbers and sizes as specified in Table 1. At the lower end, each URS uplift rod run must be connected either: (a) to the foundation, through a cast-in-place anchor or other approved concrete/masonry anchor; or (b) to a supporting wood framing member, through appropriately sized bearing plates and nuts, as specified in Table 1. At the top end, each URS uplift rod run must be connected to the wood top plate using the appropriately sized bearing plates and nuts, as specified in Table 1 and as shown in Figure 1. The maximum center-to-center spacing intervals between URS uplift rod runs must be in accordance with Table 4a, 4b, 4c or 4d, as applicable.

3.2.1 Steel Threaded Rods: The steel threaded rods used with the URS uplift rod runs have diameters of $^3/_8$, $^1/_2$, $^5/_8$, and $^3/_4$ inch (9.5, 12.7, 15.9, and 19.1 mm) for the model numbers ATR3/8, ATR1/2, ATR5/8 and ATR3/4, respectively. They extend through all intermediate levels, and are connected to each other by threaded rod couplers where extended length is necessary. The threaded rods are made of ASTM F1554 Grade 36 Class 2A, or ASTM A307 Grade A, steel. Table 2a contains additional specifications and allowable loads for each threaded rod model.

3.2.2 Steel Bearing Plates: Bearing plates must be used to transfer tension load from the building structure to the rods and must be installed on the top of the wood double top plates. When the lower end of the rod terminates above the foundation, the bearing plates must be used to transfer tension load from the URS uplift rod run to a supporting wood framing member. The bearing plates are installed at the bottom of double top plates or the bottom of

a wood beam at the terminating floor level. Table 1 lists appropriate bearing plate model numbers corresponding to specific URS uplift rod runs. The bearing plates are manufactured from ASTM A1011, SS designation, Grade 33 steel. Table 2b provides dimensions, thicknesses and allowable loads for each bearing plate model, and Figure 2b illustrates the plates.

3.2.3 Heavy Hex Nuts: Except where Simpson Ratcheting Take-Up Devices (RTUDs, as described in ESR-2320) are used, heavy hex nuts must be used at the top end (and in some cases, at the lower end) of the threaded rod, to connect the threaded rod to the bearing plates. The nuts have UNC thread and nominal sizes matching the threaded rod with which they are used. The steel heavy hex nuts comply with either ASTM A563 Grade A or higher, or ASTM A194 Grade 2H or higher.

3.2.4 Threaded Rod Couplers: Threaded rod couplers must be used to attach the threaded rod segments end-to-end within the URS uplift rod runs. The threaded rod couplers have UNC thread and nominal sizes matching the threaded rod with which they are used. The couplers comply with ASTM A563, with exceptions, and minimum proof loads as specified in Simpson Strong-Tie's approved quality documentation. The CNW3/8, CNW1/2, CNW5/8 and CNW3/4 models are used with the URS3, URS4, URS5, and URS6 uplift rod runs, respectively. Additionally, transitioning couplers are available for connecting $^{5}/_{8}$-inch (16 mm) threaded rod to $^{1}/_{2}$-inch (13 mm) threaded rod (model number CNW5/8-1/2) and $^{3}/_{4}$-inch (19 mm) threaded rod to $^{5}/_{8}$-inch (16 mm) threaded rod (model number CNW3/4-5/8). Refer to Table 2c for dimensions and allowable loads for each coupler model, and Figure 2c for coupler details.

3.2.5 Shrinkage Compensating Devices: Simpson Strong-tie shrinkage compensating devices, as described in ESR-2320, must be installed within the URS uplift rod runs when shrinkage compensating devices are specified by the registered design professional to remove slack introduced into the system by wood shrinkage and building settlement. The shrinkage compensating devices must be installed in accordance with ESR-2320.

3.3 Wood Framing Members:

Wood framing members used in top plate and wall stud applications must be either sawn dimension lumber complying with IBC Section 2303.1.1 and IRC Section R602.1, or structural composite lumber (SCL) recognized in a current ICC-ES evaluation report, with nominally 2-by-4 [actual dimensions of 1.5 inches by 3.5 inches (38 mm by 89 mm)] or 2-by-6 [actual dimensions of 1.5 inches by 5.5 inches (38 mm by 140 mm)] cross-sectional dimensions. Sawn dimension lumber must have a moisture content of 19 percent or less, both at the time of installation and in service; and an assigned specific gravity of 0.50 or greater, as specified in the ANSI/AF&PA National Design Specification for Wood Construction (NDS). Structural composite lumber must have a moisture content of 16 percent or less, both at the time of installation and in service; and an equivalent specific gravity, as specified in the applicable evaluation report, of 0.50 or greater. Framing members in contact with bearing plates (e.g., top plates and other framing members as applicable) must have a minimum reference compression perpendicular-to-grain design value, $F_{c\perp}$, of 625 psi (4.31 MPa), except where otherwise permitted in the footnotes to Table 2b. Additionally, members used in the top plates and top plate splices must be minimum No. 2 Douglas fir-larch dimension lumber, having minimum *adjusted* bending (F_b'), tension (F_t') and modulus of elasticity (E') design values as specified in the following table:

REQUIRED ADJUSTED DESIGN VALUES OF TOP PLATE FRAMING MEMBERS[1,2]

MEMBER	F_b' (psi)	F_t' (psi)	E' (psi)
2x4	2376	1380	$1.6x10^6$
2x6	2153	1196	$1.6x10^6$

For **SI:** 1 psi = 6895 Pa.

[1]Values include adjustments in accordance with the NDS-specified load duration factor, C_D, size factor, C_F, and flat use factor, C_{fu}, as applicable.
[2]Adjusted design values tabulated above are equivalent to those specified in the NDS for No. 2 Douglas fir–larch dimension lumber, subjected to flatwise bending.

3.4 Framing Connections:

In addition to the code-prescribed connections between wall-framing members, connections between framing members within the continuous rod tie-down system must be in accordance with Sections 3.4.1 and 3.4.2.

3.4.1 Top Plate-to-Stud Connectors: Where connection hardware between the roof framing members and the wall top plate induces eccentric loading about the centerline of the top plate, Simpson Strong-Tie top-plate-to-stud connectors must be installed to prevent top plate rotation, as depicted in Figure 3. The top-plate-to-stud connectors, as described in ESR-2613, must be installed on the same side of the top plate as the roof-to-wall connectors, and must have allowable uplift loads equal to or greater than the loads given in Table 3 of this report. Connector models must be selected and installed in a manner that does not induce significant tension stresses perpendicular to the grain of the wood top plate members.

3.4.2 Top Plate Splice Bending Reinforcement: When the URS uplift rod runs are installed in accordance with Tables 4c and 4d, top plate splice reinforcement must be installed at all locations in which there is a discontinuity in one of the top plate members (i.e., top plate joint) to reinforce the top plate in bending. The splice reinforcement must be attached using Simpson Strong-Tie SDS$^{1}/_{4}$x4$^{1}/_{2}$ screws (described in ESR-2236). For top plate joints that are approximately centered between two adjacent studs in the wall below, reinforcement must be installed as depicted in Figure 4a. For top plate joints that are not centered between two adjacent studs in the wall below, reinforcement must be installed as depicted in Figure 4b.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Strength: The allowable loads shown in the tables of this report are based on Allowable Stress Design (ASD). Allowable tension loads for components of the URS uplift rod runs are given in Tables 2a through 2c. Maximum URS uplift rod run lengths and maximum chord/drag strut loads corresponding to specified URS uplift rod run spacing and design uplift loads on the continuous rod tie-down system, in pounds per linear foot of wall length, are given in Tables 4a through 4d.

Tabulated allowable loads apply to dry conditions in which the equilibrium moisture content of the sawn wood framing members within the continuous rod tie-down system will not exceed 19 percent (16 percent for SCL members), and where sustained temperatures are 100°F (37.8°C) or less.

When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable (ASD) uniform load for uplift along the top of the wall must not be increased for wind or earthquake loading. When using the alternate basic load combinations in IBC Section 1605.3.2

that include wind or earthquake loads, the tabulated ASD uniform load for uplift along the top of the wall must not be increased by $33^1/_3$ percent, nor may the alternative basic load combinations be reduced by a factor of 0.75.

4.1.2 Serviceability: In addition to allowable strength, the tabulated values given for the threaded rods in Table 2a also consider a serviceability limit of 0.18 inch (4.6 mm) of total rod elongation. Tabulated values given for the continuous rod tie-down system in Tables 4a through 4d take into account the following serviceability limits: (a) 0.18 inch (4.6 mm) of total rod elongation along the length of the URS uplift rod run; (b) a bending deflection limit of *L*/240 for the top plate, where *L* is the span of the top plate between adjacent URS uplift rod runs; and (c) 0.25 inch (6.4 mm) of total system deflection between the top plate and the lower end of the URS uplift rod run, including the total elongation of the uplift rod run and bending of the top plate between the uplift rod runs. The contribution of wood shrinkage to the overall deflection of the continuous rod tie-down system must be analyzed by the registered design professional.

4.2 Installation:

Simpson Strong-Tie continuous rod tie-down systems utilizing URS uplift rod runs must be installed in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, the more restrictive governs.

4.3 Special Inspection:

4.3.1 IBC: For installations under the IBC, periodic special inspection must be conducted when the continuous rod tie-down systems utilizing URS uplift rod runs are installed within structures constructed in areas listed in Section 1705.10 of the 2012 IBC, Section 1706.1 of the 2009 IBC or Section 1705.4 of the 2006 IBC, as applicable. Special inspection requirements do not apply to structures, or portions thereof, that qualify for the exceptions under IBC Section 1704.

4.3.2 IRC: For installations under the IRC, periodic special inspection requirements and exemptions are as stated in Section 4.3.1.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie continuous rod tie-down systems utilizing URS uplift rod runs described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The components of the URS uplift rod runs must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Drawings, calculations and other design details for the continuous rod tie-down system, verifying compliance with this report, must be submitted to the code official for approval. Drawings and calculations must be prepared by a registered design professional when required by the statutes of the jurisdiction in which the project is to be constructed.

5.3 The use of URS uplift rod run components in contact with chemically treated wood is subject to the approval of the code official, since the effects of corrosion of metal in contact with preservative- or fire-retardant-treated wood, on the structural performance of the components, are outside the scope of this report.

5.4 Installation of the Simpson Strong-Tie continuous rod tie-down systems utilizing URS uplift rod runs must be limited to dry interior locations.

5.5 The tabulated ASD uniform uplift loads of Simpson Strong-Tie continuous rod tie-down systems correspond to a ten-minute load duration, and must not be further increased by any load duration factor, C_D, greater than 1.0.

5.6 Design of the anchorage of the continuous rod tie-down system is the responsibility of the design professional, and must be performed in accordance with the applicable code.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Continuous Rod Tie-down Runs and Continuous Rod Tie-down Systems Used to Resist Wind Uplift (AC391), dated June 2010 (editorially revised June 2012).

7.0 IDENTIFICATION

The steel threaded rods, steel bearing plates, heavy hex nuts, and threaded rod couplers described in Sections 3.2.1 through 3.2.4 are identified with an adhesive or die-stamped label indicating the name of the report holder (Simpson Strong-Tie), the model number, and the evaluation report number (ESR-1161). The Simpson Strong-Tie shrinkage compensating devices described in Section 3.2.5 are identified in accordance with ESR-2320. The Simpson Strong-Tie framing connectors described in Section 3.4.1 are identified in accordance with ESR-2523 and the Simpson Strong-Tie SDS series wood screws described in Section 3.4.2 are identified in accordance with ESR-2236.

TABLE 1—MODEL NUMBERS OF COMPONENTS WITHIN THE URS UPLIFT ROD RUNS[1]

COMPONENT TYPE	URS MODEL AND CORRESPONDING COMPONENT MODEL NUMBERS			
	URS3	URS4	URS5	URS6
Threaded Rod	ATR 3/8	ATR 1/2	ATR 5/8	ATR 3/4
Bearing Plates	BP 3/8-2	BPRTUD3-4 BP 1/2 BP 1/2-3	BP 5/8-2 BP 5/8-3	BP 3/4 BP 3/4-3
Heavy Hex Nuts	N3	N4	N5	N6
Coupler Nuts	CNW3/8	CNW1/2	CNW5/8	CNW3/4
		CNW5/8-1/2		CNW3/4-5/8
Shrinkage Compensating Devices (Optional)	(See ESR-2320)			

[1] See Section 3.2 for descriptions of each component within the URS uplift rod runs. For dimensions, allowable loads and other specifications of the threaded rods, bearing plates and coupler nuts, see Tables 2a, 2b and 2c, respectively.

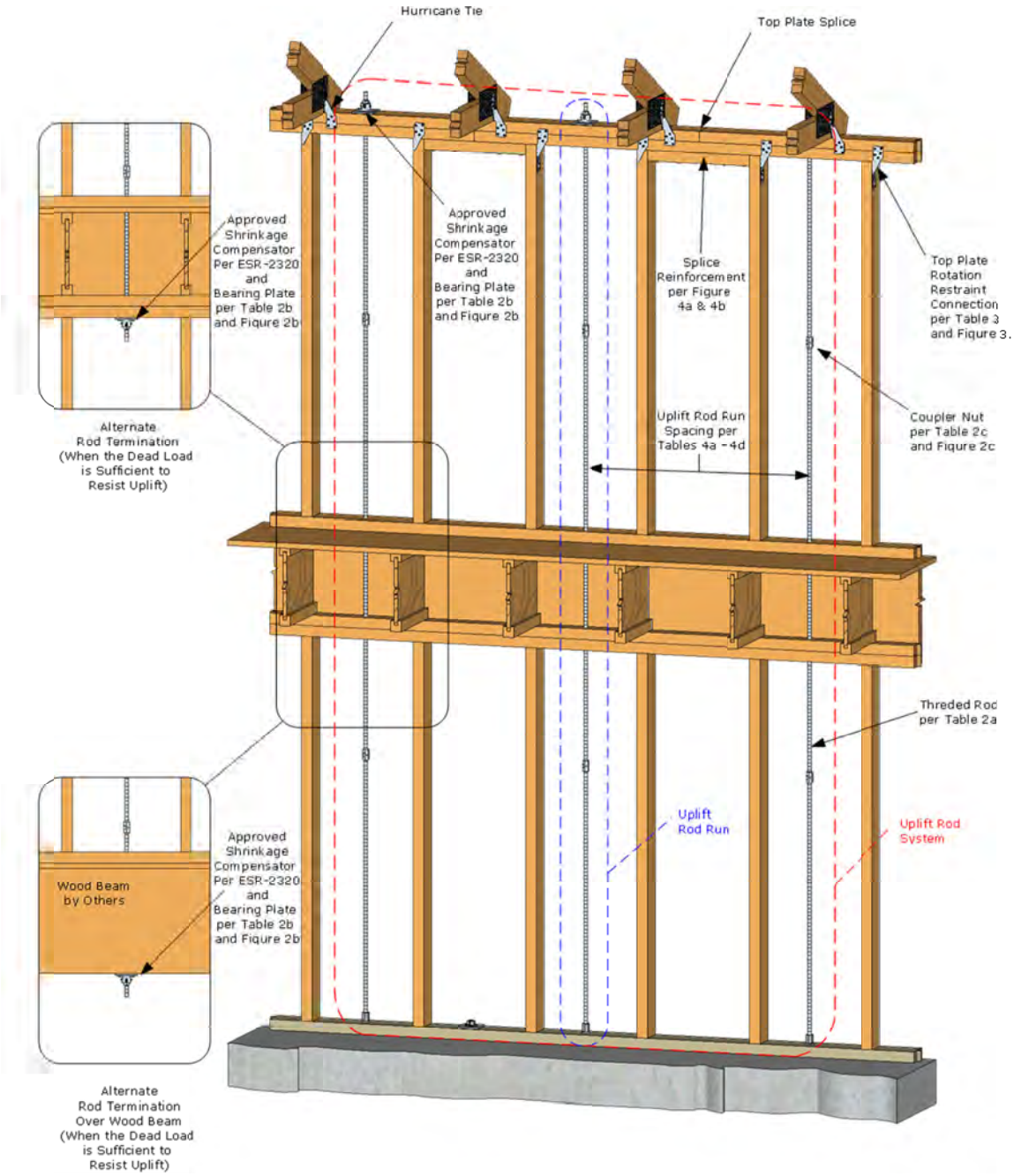


FIGURE 1—TYPICAL INSTALLATION OF URS UPLIFT ROD RUNS

TABLE 2a—ALLOWABLE LOADS FOR THREADED RODS USED IN THE URS[1]

MODEL NO.	GROSS DIA. (inch)	GROSS AREA A_{gross} (in²)	THREADS PER INCH, n	NET AREA A_n (in²)	MIN F_u (ksi)	ALLOWABLE TENSION (lbf)						
						Based on Allowable Stress[1]	Based on 0.18 inch Elongation Limit for Maximum Rod Length of:					
							15 ft	25 ft	35 ft	45 ft	55 ft	65 ft
ATR 3/8	3/8	0.110	16	0.077	58	2,400	2,250	1,350	960	750	610	520
ATR 1/2	1/2	0.196	13	0.142	58	4,270	4,120	2,470	1,760	1,370	1,120	950
ATR 5/8	5/8	0.307	11	0.226	58	6,675	6,550	3,930	2,810	2,180	1,790	1,510
ATR 3/4	3/4	0.442	10	0.334	58	9,610	9,610	5,820	4,160	3,230	2,650	2,240

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N, 1 psi = 6895 Pa

[1] See Section 3.2.1 for additional information regarding ATR threaded rod.

TABLE 2b—ALLOWABLE LOADS FOR BEARING PLATES USED IN THE URS[1]

MODEL NO.[4]	PLATE LENGTH, L (inches)	PLATE WIDTH, W (inches)	DESIGN THICKNESS, t (inches)	BOLT HOLE DIA., D_{hole} (inches)	ALLOWABLE BEARING LOAD[2,3] (lbf)
BPRTUD3-4	3.0	3.0	0.241	9/16	6,100
BP 3/8-2	2.0	2.0	0.1875	7/16	2,855
BP 1/2	2.0	2.0	0.1875	9/16	2,785
BP 1/2-3	3.0	3.0	0.241	9/16	4,430
BP 5/8-2	2.0	2.0	0.1875	11/16	2,695
BP 5/8-3	3.0	3.0	0.241	11/16	5,680
BP 3/4	2.75	2.75	0.3125	13/16	5,005
BP 3/4-3	3.0	3.0	0.241	13/16	5,965

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N, 1 psi = 6895 Pa

[1] See Section 3.2.2 for additional information regarding the bearing plates.
[2] The allowable loads are based on the use of Douglas fir-larch header framing members with an allowable compression perpendicular-to-grain, $F_{c\perp}$, of 625 psi. When the bearing plates bear on wood framing members having an $F_{c\perp}$ of less than 625 psi, the allowable bearing loads must be re-calculated using the $F_{c\perp}$ value specified in the NDS for the species and grade of lumber used.
[3] Allowable bearing loads are not permitted to be increased.
[4] The BPRTUD3-4 must be used with the RTUD3 or RTUD4 take-up device. All other bearing plates listed above must be used with the appropriately sized heavy hex nut, as specified in Table 1.

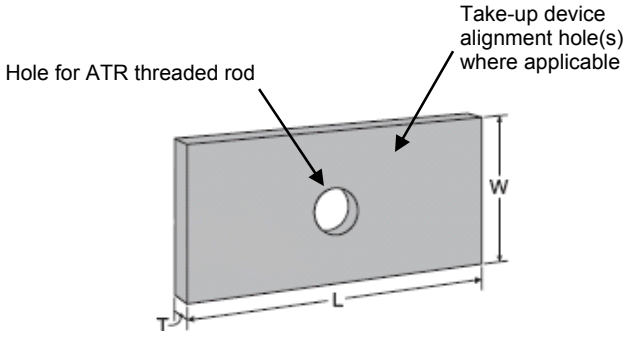


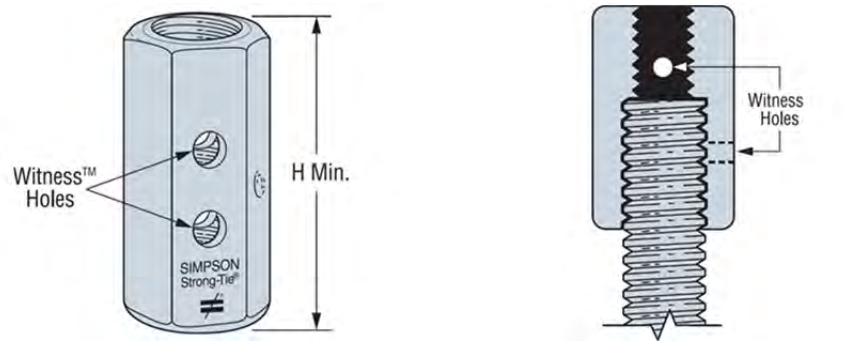
FIGURE 2b—BPRTUD BEARING PLATE
(BP bearing plates are similar but do not have take-up device alignment holes)

TABLE 2c—ALLOWABLE LOADS FOR COUPLER NUTS USED IN THE URS[1,2]

MODEL NUMBER	NOMINAL ROD DIAMETER (inch)	HEIGHT, H Min (inches)	ALLOWABLE TENSION (lbf)
CNW3/8	0.375	1.125	2,400
CNW1/2	0.500	1.500	4,270
CNW5/8	0.625	1.875	6,675
CNW3/4	0.750	2.250	9,610
CNW5/8-1/2	0.625 & 0.500	1.500	4,270
CNW3/4-5/8	0.750 & 0.625	1.750	6,675

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N.

[1] See Section 3.2.4 for additional information regarding the CNW coupler nuts.
[2] Allowable tension loads are not permitted to be increased.



STRAIGHT THROUGH COUPLER NUT **TRANSITION COUPLER NUT**

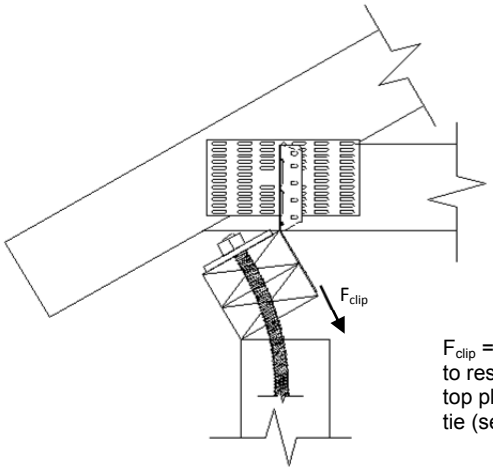
FIGURE 2c—CNW COUPLER NUT

TABLE 3—REQUIRED TOP PLATE ROTATION RESTRAINT CONNECTION FORCE[1]

ROOF UPLIFT (plf)	REQ'D CONNECTOR CAPACITY (lbf)		
	Connector Spacing		
	16 in.	24 in.	32 in.
100	67	100	133
150	100	150	200
200	133	200	267
300	200	300	400
400	267	400	533
500	333	500	667
600	400	600	800

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N

[1] The top plate to stud connection used to restrain top plate rotation must be installed on the same side of the wall as the roof to top plate connection.



F_{clip} = Connection Force required to restrain rotation by connecting top plates to stud with hurricane tie (see footnote 1 to Table 3)

FIGURE 3—TOP PLATE ROTATION RESTRAINT CONNECTION FORCE

TABLE 4a—MAXIMUM LENGTHS OF URS UPLIFT ROD RUNS AND MAXIMUM CHORD/DRAG STRUT LOADS[1,2,3,4]
(Unreinforced Top Plate Splices: Double 2x4 Top Plates)

ROOF UPLIFT ALONG TOP OF WALL	UPLIFT ROD RUN SPACING (inches)	URS MODEL				MAXIMUM CHORD/DRAG STRUT LOAD [8] (lbf)
		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (feet) [System Deflection, Δ (inches)] [5,6,7]				
100 plf	24	65' [0.084"]	65' [0.053"]	65' [0.039"]	65' [0.030"]	5120
	30	65' [0.119"]	65' [0.080"]	65' [0.063"]	65' [0.052"]	4655
	36	65' [0.169"]	65' [0.122"]	65' [0.101"]	65' [0.088"]	4060
	40	65' [0.213"]	65' [0.161"]	65' [0.138"]	65' [0.123"]	3555
	42	65' [0.239"]	65' [0.185"]	65' [0.160"]	65' [0.144"]	3285
	48	23' [0.248"]	43' [0.249"]	65' [0.247"]	65' [0.229"]	2190
150 plf	24	65' [0.126"]	65' [0.079"]	65" [0.058"]	65' [0.045"]	4705
	30	65' [0.179"]	65' [0.120"]	65' [0.094"]	65' [0.077"]	3970
	36	63' [0.248"]	65' [0.183"]	65' [0.152"]	65' [0.132"]	2860
	40	38' [0.248"]	65' [0.242"]	65' [0.207"]	65' [0.184"]	2135
	42	26' [0.250"]	47' [0.249"]	65' [0.240"]	65' [0.217"]	1670
	48	NP	NP	NP	NP	-
200 plf	24	65' [0.168"]	65' [0.105"]	65' [0.077"]	65' [0.059"]	4295
	30	65' [0.238"]	65' [0.161"]	65' [0.125"]	65' [0.103"]	3220
	36	37' [0.249"]	65' [0.244"]	65' [0.202"]	65' [0.175"]	1830
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-
300 plf	24	56' [0.223"]	65' [0.158"]	65' [0.116"]	65' [0.089"]	3205
	30	37' [0.246"]	65' [0.241"]	65' [0.188"]	65' [0.155"]	1585
	36	NP	NP	NP	NP	-
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-
400 plf	24	42' [0.238"]	65' [0.211"]	65' [0.155"]	65' [0.119"]	2285
	30	22' [0.249"]	40' [0.248"]	64' [0.249"]	65' [0.206"]	205
	36	NP	NP	NP	NP	-
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-
500 plf	24	33' [0.249"]	60' [0.249"]	65' [0.184"]	65' [0.142"]	1310
	30	NP	NP	NP	NP	-
	36	NP	NP	NP	NP	-
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-

For **SI:** 1 inch = 25.4 mm, 1 foot = 0.3048 m, 1 pound = 4.45 N, 1 plf = 14.59 N/m

[1] See Sections 4.1.1 and 4.1.2 for design requirements. See Section 3.2 and Figure 1 for descriptions of the URS models.
[2] Wood framing members used within the continuous rod tie-down system must meet the requirements of Section 3.3.
[3] Top plate-to-stud connectors must be installed in accordance with Section 3.4.1, Table 3 and Figure 3.
[4] Anchorage of the URS uplift rod runs is outside the scope of this evaluation report, and must be designed by the registered design professional.
[5] Tabulated system deflection values, Δ, [shown in brackets] do not include deflection contributions due to shrinkage compensating devices (i.e., take-up devices) as described in Section 3.2.5. Refer to ESR-2320 for installation requirements, allowable loads and deflection values of Simpson take-up devices. Total system deflection, including the additional cumulative deflections of any take-up devices, must not exceed 0.250 inches.
[6] Shaded cells indicate URS lengths for which system deflections, Δ, are at least 0.005 inches below the 0.250-inch limit, and rod elongation is at least 0.005 inches below the 0.18-inch limit.
[7] Cells containing "NP" indicate that the URS model is not permitted for the given spacing and roof uplift load.
[8] The "Maximum Chord/Drag Strut Load" is the allowable tension load that may be applied to a top plate acting as a chord or drag strut, simultaneously with the flatwise bending stresses induced by uplift loads. Nailed top plate splice connection assumed.

TABLE 4b—MAXIMUM LENGTHS OF URS UPLIFT ROD RUNS AND MAXIMUM CHORD/DRAG STRUT LOADS[1,2,3,4]
(Unreinforced Top Plate Splices: Double 2x6 Top Plates)

ROOF UPLIFT ALONG TOP OF WALL	UPLIFT ROD RUN SPACING (inches)	URS MODEL				MAXIMUM CHORD/DRAG STRUT LOAD [8] (lbf)
		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (feet) [System Deflection, Δ (inches)] [5,6,7]				
100 plf	30	65' [0.108"]	65' [0.070"]	65' [0.052"]	65' [0.041"]	7455
	36	65' [0.147"]	65' [0.100"]	65' [0.079"]	65' [0.065"]	6790
	40	65' [0.179"]	65' [0.127"]	65' [0.104"]	65' [0.089"]	6275
	42	65' [0.198"]	65' [0.143"]	65' [0.119"]	65' [0.103"]	6000
	48	57' [0.250"]	65' [0.205"]	65' [0.176"]	65' [0.159"]	4965
	60	NP	NP	NP	NP	-
150 plf	30	65' [0.163"]	65' [0.104"]	65' [0.078"]	65' [0.061"]	6695
	36	65' [0.220"]	65' [0.150"]	65' [0.118"]	65' [0.098"]	5695
	40	58' [0.250"]	65' [0.191"]	65' [0.156"]	65' [0.133"]	4805
	42	48' [0.249"]	65' [0.215"]	65' [0.178"]	65' [0.155"]	4405
	48	17' [0.247"]	32' [0.249"]	51' [0.249"]	65' [0.238"]	2915
	60	NP	NP	NP	NP	-
200 plf	30	65' [0.217"]	65' [0.139"]	65' [0.104"]	65' [0.082"]	5940
	36	51' [0.248"]	65' [0.200"]	65' [0.158"]	65' [0.131"]	4490
	40	34' [0.248"]	62' [0.248"]	65' [0.207"]	65' [0.178"]	3405
	42	25' [0.247"]	47' [0.250"]	65' [0.237"]	65' [0.206"]	2880
	48	NP	NP	NP	NP	-
300 plf	24	56' [0.209"]	65' [0.145"]	65' [0.103"]	65' [0.076"]	5910
	30	45' [0.246"]	65' [0.209"]	65' [0.156"]	65' [0.123"]	4315
	36	25' [0.249"]	46' [0.250"]	65' [0.237"]	65' [0.196"]	2305
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-
400 plf	24	42' [0.220"]	65' [0.193"]	65' [0.137"]	65' [0.101"]	4965
	30	30' [0.248"]	55' [0.249"]	65' [0.208"]	65' [0.163"]	2765
	36	NP	NP	NP	NP	-
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-
500 plf	24	33' [0.227"]	61' [0.230"]	65' [0.171"]	65' [0.127"]	3915
	30	20' [0.244"]	38' [0.249"]	60' [0.249"]	65' [0.204"]	1290
	36	NP	NP	NP	NP	-
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-

For **SI:** 1 inch = 25.4 mm, 1 foot = 0.3048 m, 1 pound = 4.45 N, 1 plf = 14.59 N/m

[1] See Sections 4.1.1 and 4.1.2 for design requirements. See Section 3.2 and Figure 1 for descriptions of the URS models.
[2] Wood framing members used within the continuous rod tie-down system must meet the requirements of Section 3.3.
[3] Top plate-to-stud connectors must be installed in accordance with Section 3.4.1, Table 3 and Figure 3.
[4] Anchorage of the URS uplift rod runs is outside the scope of this evaluation report, and must be designed by the registered design professional.
[5] Tabulated system deflection values, Δ, [shown in brackets] do not include deflection contributions due to shrinkage compensating devices (i.e., take-up devices) as described in Section 3.2.5. Refer to ESR-2320 for installation requirements, allowable loads and deflection values of Simpson take-up devices. Total system deflection, including the additional cumulative deflections of any take-up devices, must not exceed 0.250 inches.
[6] Shaded cells indicate URS lengths for which system deflections, Δ, are at least 0.005 inches below the 0.250-inch limit, and rod elongation is at least 0.005 inches below the 0.18-inch limit.
[7] Cells containing "NP" indicate that the URS model is not permitted for the given spacing and roof uplift load.
[8] The "Maximum Chord/Drag Strut Load" is the allowable tension load that may be applied to a top plate acting as a chord or drag strut, simultaneously with the flatwise bending stresses induced by uplift loads. Nailed top plate splice connection assumed.

TABLE 4c—MAXIMUM LENGTHS OF URS UPLIFT ROD RUNS AND MAXIMUM CHORD/DRAG STRUT LOADS[1,2,3,4]
(Reinforced Top Plate Splices: Double 2x4 Top Plates)

ROOF UPLIFT ALONG TOP OF WALL	UPLIFT ROD RUN SPACING (inches)	URS MODEL				MAXIMUM CHORD/DRAG STRUT LOAD [8] (lbf)
		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (feet) [System Deflection, Δ (inches)] [5,6,7]				
100 plf	30	65' [0.104"]	65' [0.066"]	65' [0.048"]	65' [0.037"]	4715
	36	65' [0.138"]	65' [0.092"]	65' [0.070"]	65' [0.057"]	4060
	40	65' [0.166"]	65' [0.114"]	65' [0.091"]	65' [0.076"]	3555
	42	65' [0.182"]	65' [0.128"]	65' [0.103"]	65' [0.088"]	3285
	48	65' [0.240"]	65' [0.178"]	65' [0.150"]	65' [0.132"]	2285
	60	NP	NP	NP	15' [0.250"]	205
150 plf	30	65' [0.157"]	65' [0.098"]	65' [0.072"]	65' [0.055"]	3970
	36	65' [0.207"]	65' [0.137"]	65' [0.106"]	65' [0.086"]	2985
	40	65' [0.249"]	65' [0.172"}	65' [0.136"]	65' [0.114"]	2225
	42	56' [0.248"]	65' [0.192"]	65' [0.155"]	65' [0.131"]	1745
	48	30' [0.249"]	55' [0.250"]	65' [0.225"]	65' [0.198"]	435
	60	NP	NP	NP	NP	-
200 plf	30	65' [0.209"]	65' [0.131"]	65' [0.096"]	65' [0.074"]	3220
	36	56' [0.248"]	65' [0.183"]	65' [0.141"]	65' [0.114"]	1910
	40	41' [0.247"]	65' [0.229"]	65' [0.182"]	65' [0.152"]	900
	42	34' [0.249"]	62' [0.250"]	65' [0.206"]	65' [0.175"]	325
	48	10' [0.247"]	19' [0.249"]	30' [0.249"]	50' [0.249"]	0
	60	NP	NP	NP	NP	-
300 plf	24	56' [0.205"]	65' [0.140"]	65' [0.098"]	65' [0.071"]	3205
	30	45' [0.234"]	65' [0.197"]	65' [0.144"]	65' [0.110"]	1655
	36	30' [0.247"]	55' [0.248"]	65' [0.211"]	65' [0.171"]	0
	40	18' [0.249"]	33' [0.250"]	52' [0.249"]	65' [0.228"]	0
	42	11' [0.246"]	21' [0.249"]	33' [0.248"]	55' [0.250"]	0
	48	NP	NP	NP	NP	-
400 plf	24	42' [0.213"]	65' [0.187"]	65' [0.130"]	65' [0.095"]	2285
	30	33' [0.248"]	60' [0.248"]	65' [0.192"]	65' [0.147"]	215
	36	17' [0.247"]	31' [0.247"]	50' [0.249"]	65' [0.228"]	0
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-
500 plf	24	33' [0.219"]	61' [0.222"]	65' [0.163"]	65' [0.118"]	1310
	30	24' [0.250"]	43' [0.248"]	65' [0.240"]	65' [0.184"]	0
	36	NP	NP	NP	NP	-
	40	NP	NP	NP	NP	-
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-

For **SI:** 1 inch = 25.4 mm, 1 foot = 0.3048 m, 1 pound = 4.45 N, 1 plf = 14.59 N/m

[1] See Sections 4.1.1 and 4.1.2 for design requirements. See Section 3.2 and Figure 1 for descriptions of the URS models.
[2] Wood framing members used within the continuous rod tie-down system must meet the requirements of Section 3.3.
[3] All top-plate splices must be reinforced in accordance with Section 3.4.2 and Figures 4a and 4b. Additionally, top plate-to-stud connectors must be installed in accordance with Section 3.4.1, Table 3 and Figure 3.
[4] Anchorage of the URS uplift rod runs is outside the scope of this evaluation report, and must be designed by the registered design professional.
[5] Tabulated system deflection values, Δ, [shown in brackets] do not include deflection contributions due to shrinkage compensating devices (i.e., take-up devices) as described in Section 3.2.5. Refer to ESR-2320 for installation requirements, allowable loads and deflection values of Simpson take-up devices. Total system deflection, including the additional cumulative deflections of any take-up devices, must not exceed 0.250 inches.
[6] Shaded cells indicate URS lengths for which system deflections, Δ, are at least 0.005 inches below the 0.250-inch limit, and rod elongation is at least 0.005 inches below the 0.18-inch limit.
[7] Cells containing "NP" indicate that the URS model is not permitted for the given spacing and roof uplift load.
[8] The "Maximum Chord/Drag Strut Load" is the allowable tension load that may be applied to a top plate acting as a chord or drag strut, simultaneously with the flatwise bending stresses induced by uplift loads. Nailed top plate splice connection assumed.

TABLE 4d—MAXIMUM LENGTHS OF URS UPLIFT ROD RUNS AND MAXIMUM CHORD/DRAG STRUT LOADS[1,2,3,4]
(Reinforced Top Plate Splices: Double 2x6 Top Plates)

ROOF UPLIFT ALONG TOP OF WALL	UPLIFT ROD RUN SPACING (inches)	URS MODEL				MAXIMUM CHORD/DRAG STRUT LOAD[8] (lbf)
		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (feet) [System Deflection, Δ (inches)][5,6,7]				
100 plf	30	65' [0.099"]	65' [0.060"]	65' [0.043"]	65' [0.031"]	7455
	36	65' [0.127"]	65' [0.080"]	65' [0.059"]	65' [0.046"]	6790
	40	65' [0.149"]	65' [0.097"]	65' [0.074"]	65' [0.059"]	6275
	42	65' [0.162"]	65' [0.107"]	65' [0.083"]	65' [0.067"]	6000
	48	65' [0.205"]	65' [0.143"]	65' [0.115"]	65' [0.097"]	5090
	60	34' [0.247"]	63' [0.249"]	65' [0.217"]	65' [0.195"]	2765
150 plf	30	65' [0.148"]	65' [0.090"]	65' [0.064"]	65' [0.047"]	6695
	36	65' [0.191"]	65' [0.121"]	65' [0.089"]	65' [0.069"]	5695
	40	65' [0.224"]	65' [0.146"]	65' [0.111"]	65' [0.089"]	4930
	42	64' [0.240"]	65' [0.161"]	65' [0.124"]	65' [0.100"]	4405
	48	46' [0.247"]	64' [0.213"]	65' [0.172"]	65' [0.145"]	3075
	60	NP	NP	10' [0.250"]	19' [0.249"]	0
200 plf	30	65' [0.198"]	65' [0.120"]	65' [0.085"]	65' [0.063"]	5940
	36	56' [0.225"]	65' [0.161"]	65' [0.119"]	65' [0.092"]	4490
	40	50' [0.245"]	65' [0.195"]	65' [0.148"]	65' [0.118"]	3495
	42	45' [0.249"]	65' [0.214"]	65' [0.165"]	65' [0.134"]	2995
	48	27' [0.249"]	49' [0.248"]	65' [0.229"]	65' [0.194"]	1150
300 plf	24	56' [0.198"]	65' [0.133"]	65' [0.091"]	65' [0.064"]	5910
	30	45' [0.217"]	65' [0.180"]	65' [0.128"]	65' [0.094"]	4315
	36	37' [0.247"]	65' [0.241"]	65' [0.178"]	65' [0.138"]	2365
	40	27' [0.246"]	50' [0.248"]	65' [0.222"]	65' [0.177"]	845
	42	22' [0.245"]	41' [0.248"]	65' [0.248"]	65' [0.201"]	60
	48	NP	13' [0.247"]	22' [0.250"]	37' [0.249"]	0
400 plf	24	42' [0.204"]	65' [0.178"]	65' [0.122"]	65' [0.086"]	4965
	30	33' [0.226"]	61' [0.229"]	65' [0.170"]	65' [0.126"]	2765
	36	24' [0.247"]	44' [0.248"]	65' [0.237"]	65' [0.184"]	230
	40	15' [0.243"]	29' [0.250"]	46' [0.250"]	65' [0.236"]	0
	42	11' [0.245"]	21' [0.249"]	33' [0.248"]	54' [0.249"]	0
	48	NP	NP	NP	NP	-
500 plf	24	33' [0.208"]	61' [0.211"]	65' [0.152"]	65' [0.107"]	3915
	30	27' [0.243"]	49' [0.243"]	65' [0.213"]	65' [0.157"]	1325
	36	16' [0.245"]	30' [0.249"]	48' [0.250"]	65' [0.230"]	0
	40	8' [0.242"]	16' [0.249"]	25' [0.248"]	42' [0.248"]	0
	42	NP	NP	NP	NP	-
	48	NP	NP	NP	NP	-

For **SI:** 1 inch = 25.4 mm, 1 foot = 0.3048 m, 1 pound = 4.45 N, 1 plf = 14.59 N/m

[1] See Sections 4.1.1 and 4.1.2 for design requirements. See Section 3.2 and Figure 1 for descriptions of the URS models.
[2] Wood framing members used within the continuous rod tie-down system must meet the requirements of Section 3.3.
[3] All top-plate splices must be reinforced in accordance with Section 3.4.2 and Figures 4a and 4b. Additionally, top plate-to-stud connectors must be installed in accordance with Section 3.4.1, Table 3 and Figure 3.
[4] Anchorage of the URS uplift rod runs is outside the scope of this evaluation report, and must be designed by the registered design professional.
[5] Tabulated system deflection values, Δ, [shown in brackets] do not include deflection contributions due to shrinkage compensating devices (i.e., take-up devices) as described in Section 3.2.5. Refer to ESR-2320 for installation requirements, allowable loads and deflection values of Simpson take-up devices. Total system deflection, including the additional cumulative deflections of any take-up devices, must not exceed 0.250 inches.
[6] Shaded cells indicate URS lengths for which system deflections, Δ, are at least 0.005 inches below the 0.250-inch limit, and rod elongation is at least 0.005 inches below the 0.18-inch limit.
[7] Cells containing "NP" indicate that the URS model is not permitted for the given spacing and roof uplift load.
[8] The "Maximum Chord/Drag Strut Load" is the allowable tension load that may be applied to a top plate acting as a chord or drag strut, simultaneously with the flatwise bending stresses induced by uplift loads. Nailed top plate splice connection assumed.

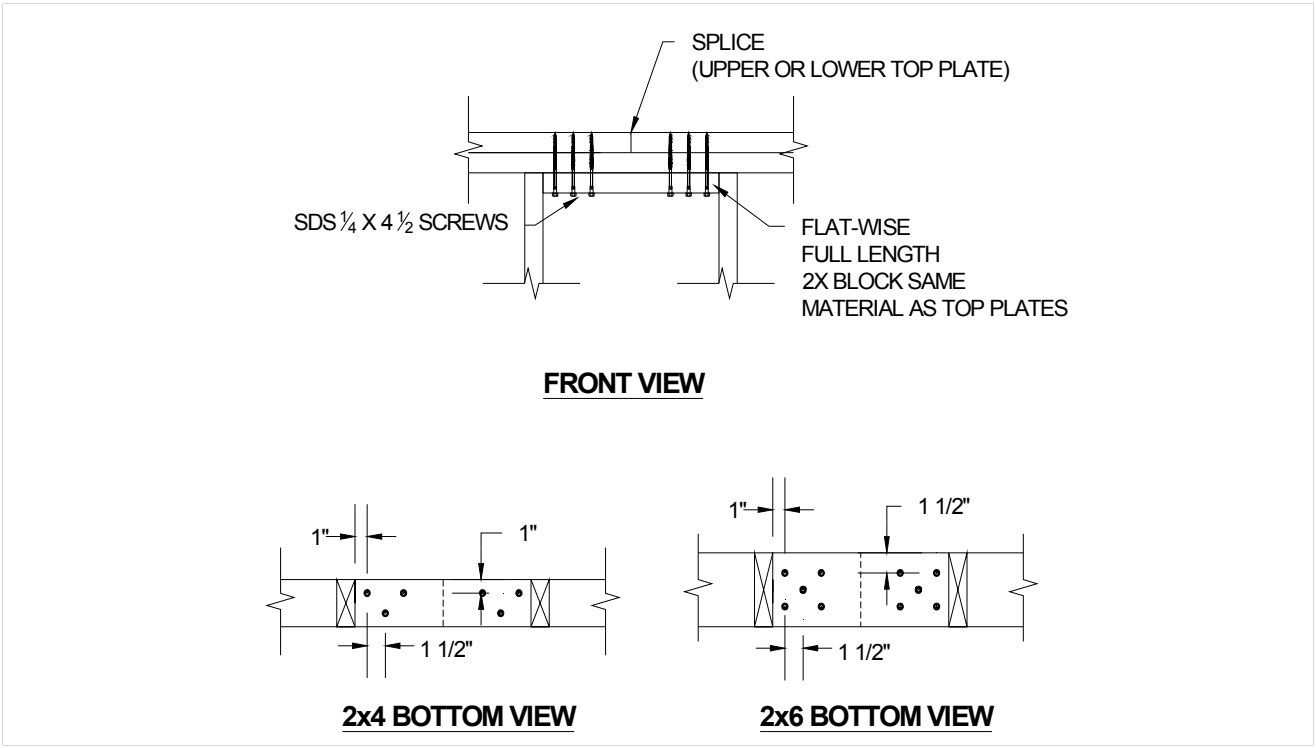


FIGURE 4a—TOP PLATE SPLICE: BENDING REINFORCEMENT (SPLICE BETWEEN STUDS)

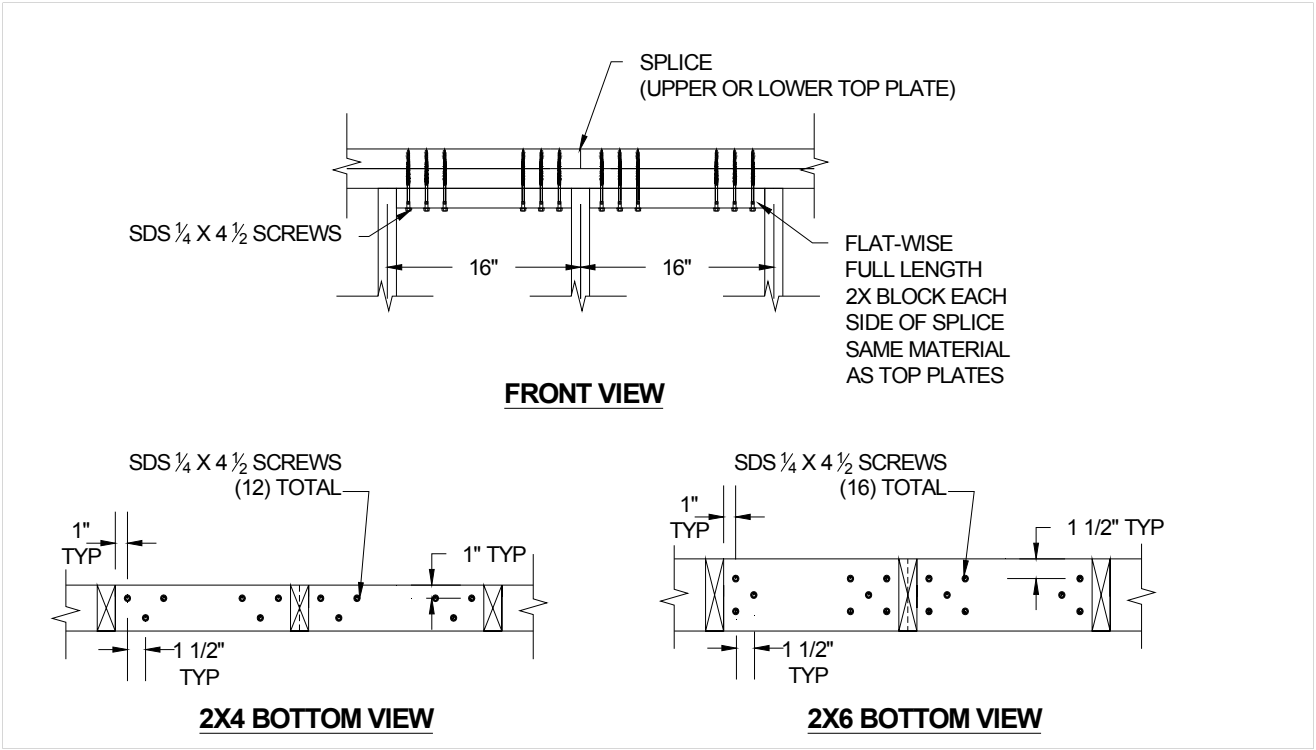


FIGURE 4b—TOP PLATE SPLICE: BENDING REINFORCEMENT (SPLICE CENTERED OVER STUDS)

SHERPA Connection Systems

Assemblyseries
XS-M Series
L-XXL Series
M-XXL CS
Specialscrews
Lockingscrews
Fire protection
CLT-Connector
Column Base
Supplies

Events

PVA Expo Praha
17. - 21.09.2013

Holz Basel
08. - 12.10.2013

Holzbauforum Garmisch
04. - 06.12.2013

Connector	Dimensions	Screws/Pair	charact. Value (GL24h)	Pair/Sales Unit
XS 5	12 x 30 x 50	12 Pcs. 4,5 x 50	5 kN	10
XS 10	12 x 30 x 70	18 Pcs. 4,5 x 50	10 kN	10
XS 15	12 x 30 x 90	21 Pcs. 4,5 x 50	15 kN	10
XS 20	12 x 30 x 110	25 Pcs. 4,5 x 50	20 kN	10
S 5	12 x 40 x 50	12 Pcs. 4,5 x 50	5 kN	10
S 10	12 x 40 x 70	18 Pcs. 4,5 x 50	10 kN	10
S 15	12 x 40 x 90	21 Pcs. 4,5 x 50	15 kN	10
S 20	12 x 40 x 110	25 Pcs. 4,5 x 50	20 kN	10
M 15	14 x 60 x 90	16 Pcs. 6,5 x 65	15 kN	10
M 20	14 x 60 x 110	20 Pcs. 6,5 x 65	20 kN	10
M 25	14 x 60 x 130	23 Pcs. 6,5 x 65	25 kN	10
M 30	14 x 60 x 150	26 Pcs. 6,5 x 65	30 kN	10
M 40	14 x 60 x 170	30 Pcs. 6,5 x 65	40 kN	10

Installation-Instruction

SHERPA connectors can either be screwed on with respect to the flat dimension, or mounted such that they remain invisible. For an invisible connection, it is necessary to mill the connector in, at either the main beam or the supporting beam. This can be done with the help of a manually operated router. Alternatively, it can be done with the help of a cutting centre and a CNC machine.

Caution!

In order to facilitate a smooth assembly process, it is recommended that the connector not be milled in completely. Details can be found in the assembly instructions.

Assemly-Instruction

Manual

All information about the SHERPA Connection system

>> For download

Initial dimensioning

The practical tool for doing the calculations associated with your connection!

>> Open here

Videos

All videos pertaining to SHERPA Connection Systems!

>> Open here

SHERPA Connection Systems GmbH

Assembly Instruction
XS - XXL Series

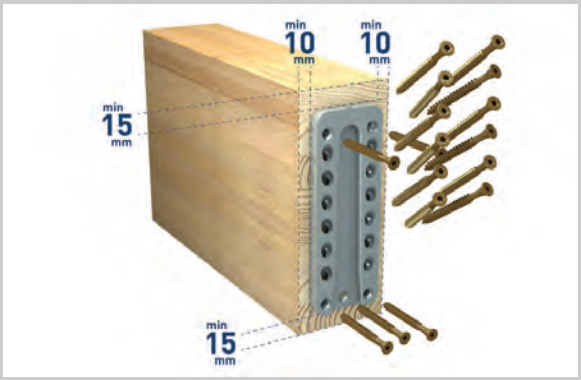
Considering the relevant minimum end and edge distances, the connector part with the larger number of holes has to be mounted to the end-grain member of the connection.

Visible connnection

The connector plates are face-mounted to the main and secondary members and therefore visible.
To ensure a proper fit, it is recommended to pre-drill the positioning screws. The diameter of the pilot hole may not exceed the core diameter of the screw.

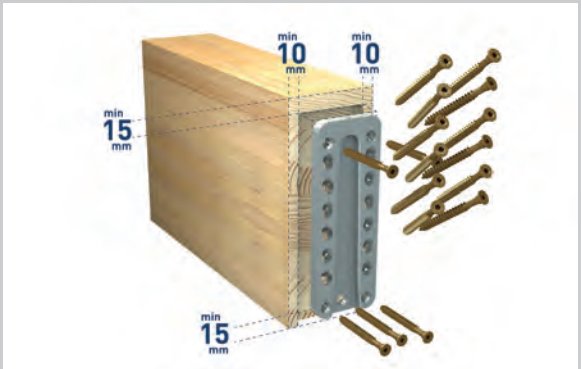
Concealed connection

OPTION 1



Housing depth:
XS- to M- connectors, the housing has to be 1 mm less deep then the total thickness of the installed connector
L- to XXL-connectors, the housing has to be 3mm less deep then the total thickness of the installed connector

OPTION 2



Recommended screw torque
XS - S .....M_T = 1,5 Nm
M .....M_T = 2,5 Nm
L .....M_T = 5,0 Nm
XL - XXL .....M_T = 10,0 Nm
Min.: Screw head is in contact with counter sink

Montageanleitung
XS - XXL Series

Unter Berücksichtigung der entsprechenden Randabstände wird immer die Verbinderplatte mit der größeren Bohrungsanzahl an das Hirnholz aufgeschraubt.

Sichtbare Verbindung

Die Verbinderplatten sind am Haupt- und Nebenträger nur plan aufgeschraubt und somit sichtbar.
Um die Passgenauigkeit zu gewährleisten wird ein Vorbohren der Positionierungsschrauben empfohlen. Dabei darf der Bohrdurchmesser keinesfalls größer sein als der Kerndurchmesser der Schrauben.

Unsichtbare Verbindung

Einfrästiefe:
XS-bis M-Verbinder sind min. 1 mm weniger tief als die Gesamtstärke beider Platten einzufräsen
L-bis XXL-Verbinder sind min. 3 mm weniger tief als die Gesamtstärke beider Platten einzufräsen

Empfohlenes Anzugsdrehmoment
XS - S .....M_T = 1,5 Nm
M .....M_T = 2,5 Nm
L .....M_T = 5,0 Nm
XL - XXL .....M_T = 10,0 Nm
Min.: Schraubenkopf hat Kontakt in Senkung

www.sherpa-connector.com
support@sherpa-connector.com | 0043 (0) 3127 / 20945

Notice de Montage
XS - XXL Series

La platine du connecteur au plus grand nombre de perforations doit être, tout en tenant compte des espaces minimum des bords, fixé sur le bois de bout.

Connexion visible

Les platines de connexions sont visées sur les parties planes des éléments principaux et secondaires et restent ainsi visibles.
Il est recommandé de pré percer la vis de positionnement pour d'avantage de précision. Le diamètre du pré-perçage ne doit en aucun cas dépasser celui de la vis.

Connexion invisible

OPTION 1

Profondeur de fraisage:
Du modèle XS au M le fraisage sera de 1mm inférieur à l'épaisseur du connecteur
Du modèle L au XXL le fraisage sera de 3 mm inférieur à l'épaisseur du connecteur

OPTION 2

Taux de serrage recommandé des vis
XS - S .....M_T = 1,5 Nm
M .....M_T = 2,5 Nm
L .....M_T = 5,0 Nm
XL - XXL .....M_T = 10,0 Nm
Serrage minimum: La vis est en contact de la platine, dans les orifices prévues à cet effet.

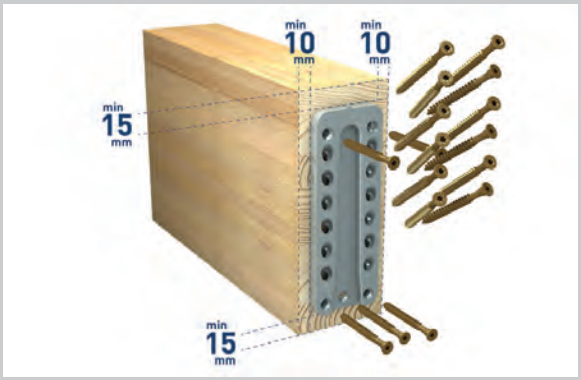
Istruzioni di Montaggio
XS - XXL Series

Osservando le distanze minime dai bordi, ricordiamo che la parte del connettore con il maggior numero di fori deve essere posizionata nel trave di testa.

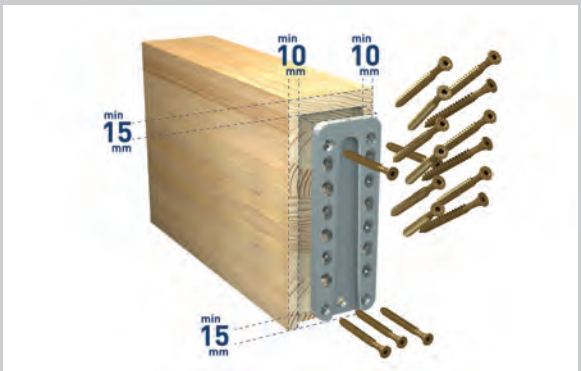
Connessione visibile

Entrambe le parti del connettore sono posizionate a filo del trave principale e del secondario. Si consiglia di effettuare un preforo per la perfetta installazione delle viti ma solo per le viti di posizionamento. In ogni caso il diametro del preforo non dovra' mai essere maggiore del diametro del nocciolo della vite.

Connessione a scomparsa



Profondita' di fresatura:
Per le serie da XS a M deve essere effettuata una fresata di 1mm inferiore allo spessore totale delle due parti del connettore
Per le serie da L a XXL deve essere effettuata una fresata di 3mm inferiore allo spessore totale delle due parti del connettore



Momento di avvitamento
XS - S .....M_T = 1,5 Nm
M .....M_T = 2,5 Nm
L .....M_T = 5,0 Nm
XL - XXL .....M_T = 10,0 Nm
Min.: La testa delle viti deve essere in aderenza alla piastra.

www.sherpa-connector.com
support@sherpa-connector.com | 0043 (0) 3127 / 20945

SHERPA Connection Systems

Assemblyseries
XS-M Series
L-XXL Series
M-XXL CS
Specialscrews
Lockingscrews
Fire protection
CLT-Connector
Column Base
Supplies

Events

PVA Expo Praha
17. - 21.09.2013

Holz Basel
08. - 12.10.2013

Holzbauforum Garmisch
04. - 06.12.2013

Specialscrews	Dimensions	Pair/Sales Unit	Driver
XS- & S-Series	4,5 x 50	200	T 20
M-Series	6,5 x 65	200	T 25
L-Series	8,0 x 100	50	T 30
	8,0 x 120	50	T 40
XL- & XXL-Series	8,0 x 140	50	T 40
	8,0 x 160	50	T 40
	8,0 x 180	50	T 40
	5 x 60	200	T 25
Assemblyseries	8 x 80	50	T 40
	8 x 120	50	T 40

(on enquiry with Zink-Nickel Coating)

Depending on the connector type, the special screws which are stated in the respective approvals, have to be used in order to ensure the listed characteristic load carrying capacities.

These system-screws are in two coating options as either yellow zinc plated or Zinc-Nickel -coated and feature a reinforced screw head. A control of the screws can be done even after the installation of the screws, due to the stamped head.
Furthermore the special screws with a nominal diameter of 8 mm feature a patented half-tip, making them self-tapping and thus reduce the risk of splitting and ensure an optimal bite of the screws.

Manual

All information about the SHERPA Connection system

>> For download

Initial dimensioning

The practical tool for doing the calculations associated with your connection!

>> Open here

Videos

All videos pertaining to SHERPA Connection Systems!

>> Open here

SHERPA Connection Systems GmbH

SHERPA SYSTEM SCREW

ICC-ES Evaluation Report

ESR-2552

Reissued January 1, 2013
This report is subject to renewal March 1, 2014.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® FACE-MOUNT HANGERS FOR STRUCTURAL COMPOSITE LUMBER (SCL), PREFABRICATED WOOD I-JOISTS AND GLULAM BEAMS (ENGINEERED WOOD PRODUCTS)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie® face-mount hangers described in this report are used to support structural composite lumber, prefabricated wood I-joists and glulam beams (i.e., engineered wood products) used in wood construction in accordance with Section 2304.9.3 of the IBC. The face-mount hangers may also be used in structures regulated under the IRC when an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The Simpson Strong-Tie face-mount hangers described in this report are U-shaped hangers that have prepunched holes for the installation of nails or Simpson Strong-Drive SDS screws, depending on the hanger model, into the face of the supporting wood header or beam or ledger.

3.1.1 IUS Series Hangers: The IUS series hangers are formed from No. 18 gage galvanized steel and are used to support prefabricated wood I-joists exclusively to a supporting wood member. See Table 1A for the IUS series hanger model numbers, hanger dimensions, and required fasteners; and Table 1B for allowable loads. See Figure 1 for a drawing of a typical IUS hanger and a typical IUS hanger installation.

3.1.2 U Series Hangers: The U series hangers are formed from No. 16 gage galvanized steel. The hangers are face-nailed to the supporting wood header, and nailed to the supported structural composite lumber or prefabricated wood I-joists with web stiffeners to accept the required size and number of joist nails shown in Table 2. See Table 2 for the U series hanger model numbers, hanger dimensions, required fasteners, and allowable loads. See Figure 2 for a drawing of a typical U series joist hanger.

3.1.3 HU and HUC Series Hangers: The HU and HUC series hangers are formed from No. 14 gage galvanized steel, and are face-nailed to the supporting wood header/beam and nailed to the supported structural composite lumber or prefabricated wood I-joists with web stiffeners. HU hangers having a seat width (W) equal to or greater than $2^{9}/_{16}$ inches (65 mm) are available with concealed flanges and are specified with the model designation HUC. See Table 3A for hanger model numbers, hanger dimensions, and required fasteners (minimum and maximum); and Table 3B for allowable loads based on the minimum and maximum nailing schedules shown in Table 3A. The HU and HUC hangers have triangular and round holes in both the U-shaped portion supporting the wood joist and in the flanges attached to the supporting wood header/beam. The minimum allowable loads are achieved by filling only the round holes with the type and size of nails shown in Table 3A, and the maximum allowable loads are achieved by filling all holes (both the round and triangular) with size of nails shown in Table 3A. See Figure 3a and 3b for drawings of typical HU and HUC hangers, and Figure 3c for a drawing of a typical installation of an HU hanger supporting a prefabricated wood I-joist with approved web stiffeners.

3.1.4 HUS and HUSC Series Hangers: The HUS and HUSC series hangers having a seat width, *W*, of $3^{9}/_{16}$ inches (90 mm) are formed from No. 14 gage galvanized steel. The HUS1.81/10 hanger with a seat width, *W*, of $1^{13}/_{16}$ inches (46 mm) is formed from No. 16 gage galvanized steel. The HUS models having a seat width, *W*, of $3^{9}/_{16}$ inches (90 mm) are available with concealed flanges, which are specified with the model designation HUSC. The hangers have prepunched holes for the

installation of nails that are driven at a 45-degree angle through the joist and into the header, which is described as double shear nailing in the installation instructions. See Table 4 for HUS series hanger models, hanger dimensions, required fasteners, and allowable loads. See Figure 4 for a drawing of a typical HUS hanger.

3.1.5 HHUS Series Hangers: The HHUS series hangers are formed from No. 14 gage galvanized steel. The hangers have pre-punched holes for the installation of nails that are driven at a 45 degree angle through the joist and into the header, which is described as double shear nailing in the installation instructions. See Table 5 for the hanger model numbers, hanger dimensions, required fasteners, and allowable loads. See Figure 5 for a drawing of a typical HHUS hanger.

3.1.6 SUR/L Series Hangers: The SUR/L series hangers are formed from No. 16 gage galvanized steel. The SUR and SUL hangers are identical except they are skewed at 45 degrees to the right (SUR) and the left (SUL), respectively. See Table 6 for hanger models, hanger dimensions, required fasteners, and allowable loads. See Figure 6a for a drawing of a typical SUL hanger and Figure 6b for a typical SUR hanger installation.

3.1.7 HSUR/L Series Hangers: The HSUR/L series hangers are formed from No. 14 gage galvanized steel. The HSUR and HSUL hangers are identical except they are skewed at 45 degrees to the right (HSUR) and the left (HSUL), respectively, and are designed to support prefabricated wood I-joists having approved web stiffeners, and structural composite lumber (SCL). See Table 7 for the hanger model numbers, hanger dimensions, required fasteners, and allowable loads. See Figure 7a for a drawing of a typical HSUR hanger, and Figure 7b for a typical HSUR hanger installation.

3.1.8 MIU Series Joist Hangers: The MIU series hangers are formed from No. 16 gage galvanized steel and are used to support prefabricated wood I-joists or other approved wood members. Other approved wood members must be laterally supported at the ends in accordance with Section 2308.8.2 of the IBC and Section R502.7 of the IRC. See Table 8 for the MIU series hanger model numbers, hanger dimensions, required fasteners, and allowable loads. See Figure 8a for a drawing of a typical MIU hanger and Figure 8b for a drawing of a typical MIU hanger installation.

3.1.9 HGUS Series Hangers: The HGUS series hangers are formed from No. 12 gage galvanized steel and are used to support glulam beams or other approved wood members. Other approved wood members must be laterally supported at the ends in accordance with Section 2308.8.2 of the IBC and Section R502.7 of the IRC. The hangers have prepunched holes for the installation of nails that are driven at a 45-degree angle through the joist and into the header, which is described as double shear nailing in the installation instructions. See Table 9 for the HGUS series hanger model numbers, hanger dimensions, required fasteners and allowable loads. See Figure 9 for a drawing of a typical HGUS hanger.

3.1.10 LGU, MGU, HGU and HHGU Series Hangers: The LGU and MGU series hangers are formed from No. 10 gage galvanized steel; HGU series hangers are formed from No. 7 gage galvanized steel; and HHGU series hangers are formed from No. 3 gage steel. The LGU, MGU, HGU and HHGU series hangers are used to support glulam beams or other approved wood members. Other approved wood members must be laterally supported at the ends in accordance with Section 2308.8.2 of the IBC and Section R502.7 of the IRC. The hangers have pre-punched holes for the installation of Simpson Strong-Drive SDS series wood screws (SDS). See Table 10 for the LGU, MGU, HGU and HHGU series model numbers, hanger dimensions, required fasteners and allowable loads. See Figure 10 for a drawing of the HHGU series hanger and a typical installation detail.

3.1.11 HUCQ Series Hangers: The HUCQ series hangers are formed from No. 14 gage galvanized steel and are used to support glulam beams or other approved wood members. Other approved wood members must be laterally supported at the ends in accordance with Section 2308.8.2 of the IBC and Section R502.7 of the IRC. The hangers have prepunched holes for the installation of Simpson Strong-Drive SDS series wood screws (SDS). See Table 11 for the HUCQ series model numbers, hanger dimensions, required fasteners and allowable loads. See Figure 11 for a drawing of the HUCQ series hanger.

3.2 Materials:

3.2.1 Steel: All hangers described in this report, with the exception of the HGUS and HHGU series hangers, are manufactured from galvanized steel complying with ASTM A653, SS designation, Grade 33, with a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum tensile strength, F_u, of 45,000 psi (310 MPa). The HGUS series hangers are manufactured from galvanized steel complying with ASTM A653, SS designation, Grade 40, with a minimum yield strength, F_y, of 40,000 psi (276 MPa) and a minimum tensile strength, F_u, of 55,000 psi (379 MPa). The HHGU series hangers are manufactured from nongalvanized steel complying with ASTM A1011 SS, Grade 33, with a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum tensile strength, F_u, of 52,000 psi (358 MPa). Base-metal thicknesses for the hangers in this report are as follows:

NOMINAL THICKNESS (gage)	MINIMUM BASE-METAL THICKNESS (inch)
No. 3	0.2285
No. 7	0.1715
No. 10	0.1275
No. 12	0.0975
No. 14	0.0685
No. 16	0.0555
No. 18	0.0444

For **SI:** 1 inch = 25.4 mm.

The galvanized zinc coating conforms to ASTM A924 and ASTM A653 with a G90 designation. Some models (designated with a model number ending with Z) are available with a G185 zinc coating specification in accordance with ASTM A653. Some models (designated with a model number ending with HDG) are available with a hot-dip galvanization, also known as "batch" galvanization, in accordance with ASTM A123, with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides. Model numbers in this report do not include the Z or HDG ending, but the information shown applies. The lumber treater or holder of this report (Simpson Strong-Tie Company) should be contacted for recommendations on minimum corrosion resistance of steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

3.2.2 Wood: Wood headers/beams which the connectors are face nailed to, must be either sawn lumber, glued-laminated lumber, or engineered lumber having a minimum

specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), and having a maximum moisture content of 19 percent (16 percent for engineered lumber) except as noted in Section 4.1. The thickness of the supporting wood member (header) must be equal to or greater than the length of the fasteners specified in the tables in this report, or as required by wood member design, whichever is greater.

Supported wood members that are prefabricated wood I-joists or SCL must be recognized in a current evaluation report, which will specify the allowable shear capacity and allowable reactions at supports for the proprietary engineered wood lumber. When required, web stiffeners for prefabricated wood I-joists must comply with specifications noted in the applicable evaluation report for the I-joists. The hangers described in this evaluation report may support I-joists having a current ICC-ES evaluation report. The evaluation report for the prefabricated wood I-joist must specify a minimum bearing length that is equal to or less than the hanger bearing length. When the hangers are used to support prefabricated wood I-joists, joist end reactions must not exceed the allowable joist end reaction per the I-joist manufacturer's code report. For installation with engineered wood members, minimum allowable fastener spacing and end and edge distances, as specified in the applicable evaluation report for the engineered wood product, must be met.

3.2.3 Fasteners: Nails used for hangers described in this report must comply with ASTM F1667 and have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

FASTENERS	SHANK DIAMETER (inches)	NAIL LENGTH (inches)	F_{yb} (psi)
10d × $1^1/_2$	0.148	$1^1/_2$	90,000
10d	0.148	3	90,000
16d × $2^1/_2$	0.162	$2^1/_2$	90,000
16d	0.162	$3^1/_2$	90,000

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

Some of the joist hangers described in this report are attached to the wood members using Simpson Strong-Drive SDS series wood screws as described in ESR-2236.

Fasteners used in contact with preservative treated or fire retardant treated lumber must comply with IBC Section 2304.9.5, 2012 and 2009 IRC Section R317.3 or 2006 IRC Section R319.3, as applicable. The chemical treatment manufacturer or this report holder (Simpson Strong-Tie Company) should be contacted for recommendations on minimum corrosion resistance of fasteners and connection capacities of fasteners used with the specific proprietary preservative treated or fire retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The tabulated allowable loads shown in this report are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the NDS.

Tabulated allowable loads apply to products connected to wood used under dry conditions and where sustained temperatures are 100ºF (37.8ºC) or less. When products are installed to wood having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected, the allowable loads must be adjusted by the wet service factor, C_M, specified in the NDS. When connectors are installed in wood that will experience sustained exposure to temperatures exceeding 100ºF (37.8ºC), the allowable loads in this report must be adjusted by the temperature factor, C_t, specified in the NDS.

Connected wood members must be analyzed for load-carrying capacity at the connection in accordance with the NDS and the evaluation report for the engineered wood products.

4.2 Installation:

Installation of the connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie face-mount hangers described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of connectors with preservative or fire retardant treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative treated or fire retardant treated lumber must be in accordance with Section 3.2.3 of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Joist Hangers and Similar Devices (AC13), dated October 2010 (editorially revised December 2011).

7.0 IDENTIFICATION

The products described in this report are identified with a stamp or label bearing the Simpson Strong-Tie Company name, the model number, and the number of an index evaluation report (ESR-2523) that is used as an identifier for the products recognized in this report.

TABLE 1A—APPLICABLE MODEL NUMBERS FOR THE IUS SERIES I-JOIST HANGERS[1]

MODEL NO.	DIMENSIONS[2] (Inches)			FASTENERS (Quantity-Type)		MODEL NO.	DIMENSIONS[2] (Inches)			FASTENERS (Quantity-Type)	
	W	H	B	Header	Joist		W	H	B	Header	Joist
IUS1.56/9.5	1 5/8	9 1/2	2	8-10d	—	IUS2.37/16(min)	2 7/16	16	2	14-10d	—
IUS1.56/11.88		11 7/8		10-10d	—	IUS2.37/16(max)				16-10d	—
IUS1.81/9.5	1 7/8	9 1/2	2	8-10d	—	IUS2.56/9.25	2 5/8	9 1/4	2	8-10d	—
IUS1.81/11.88		11 7/8		10-10d	—	IUS2.56/9.5		9 1/2		8-10d	—
IUS1.81/14(min)		14		12-10d	—	IUS2.56/11.88		11 7/8		10-10d	—
IUS1.81/14(max)				14-10d	—	IUS2.56/14(min)		14		12-10d	—
IUS1.81/16(min)		16		14-10d	—	IUS2.56/14(max)				14-10d	—
IUS1.81/16(max)				16-10d	—	IUS2.56/16(min)		16		14-10d	—
IUS2.06/9.5	2 1/8	9 1/2	2	8-10d	—	IUS2.56/16(max)				16-10d	—
IUS2.06/11.88		11 7/8		10-10d	—	IUS3.56/9.5	3 5/8	9 1/2	2	10-10d	—
IUS2.06/14(min)		14		12-10d	—	IUS3.56/11.88		11 7/8		12-10d	—
IUS2.06/14(max)				14-10d	—	IUS3.56/14(min)		14		12-10d	—
IUS2.06/16(min)		16		14-10d	—	IUS3.56/14(max)				14-10d	—
IUS2.06/16(max)				16-10d	—	IUS3.56/16(min)		16		14-10d	—
IUS2.37/9.5	2 7/16	9 1/2	2	8-10d	—	IUS3.56/16(max)				16-10d	—
IUS2.37/11.88		11 7/8		10-10d	—	(This section of the table is intentionally blank)					
IUS2.37/14(min)		14		12-10d	—						
IUS2.37/14(max)				14-10d	—						

For **SI:** 1 inch = 25.4 mm.

[1]Model numbers ending with (min) refer to nails installed into only round holes of the hanger, and the model numbers ending with (max) refer to nails installed into both round and triangle holes of the hanger.
[2]Refer to Figure 1a (this page) for definitions of hanger nomenclature (W, H, B).

TABLE 1B—ALLOWABLE LOADS FOR THE IUS SERIES I-JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)			COMMON NAILS (Quantity-Size)		ALLOWABLE LOADS[2,5] (lbs)			
						Uplift [3,4]	Download		
	W	H	B	Header	Joist	C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
IUS	1 5/8 to 2 5/8	9 1/2 to 16	2	8-10d	—	75	950	1,080	1,165
				10-10d	—	75	1,185	1,345	1,455
				12-10d	—	75	1,420	1,615	1,745
				14-10d	—	75	1,660	1,885	1,980
				16-10d	—	75	1,895	1,980	1,980
IUS	2 11/16 to 3 5/8	9 1/2 to 16	2	10-10d	—	75	1,185	1,345	1,455
				12-10d	—	75	1,420	1,615	1,725
				14-10d	—	75	1,660	1,725	1,725
				16-10d	—	75	1,725	1,725	1,725

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.45 N.

[1]Refer to Figure 1a (this page) for definitions of hanger nomenclature (W, H, B).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[4]Additional uplift capacity is available when installing 2-10dx1 1/2-inch-long nails through the triangular holes that are pre-punched in the U-shaped portion of the hanger and into the stiffened web of the prefabricated wood I-joist. When these additional nails are used, the maximum allowable uplift load is 300 lbs (C_D = 1.6).
[5]The allowable loads are based on the use of prefabricated wood I-joists having flanges with an allowable compression perpendicular-to-grain, $F_{c\perp}$, of 750 psi. When use is to support wood I-joists with flanges having an $F_{c\perp}$ of less than 750 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

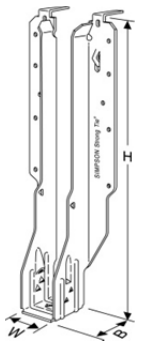


FIGURE 1a—TYPICAL IUS HANGER

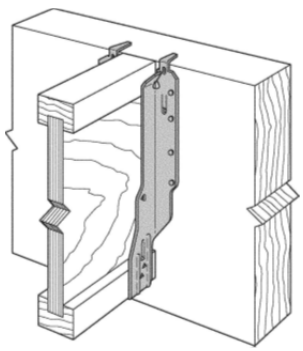


FIGURE 1b—TYPICAL IUS HANGER INSTALLATION (Supported Wood I-joist without Web Stiffeners)

TABLE 2—ALLOWABLE LOADS FOR THE U SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3,4,6] (lbs)						
						Uplift[5]	Download					
	W	H	B	Header[4]	Joist	C_D = 1.6	C_D = 1.0		C_D = 1.15		C_D = 1.25	
							10d	16d	10d	16d	10d	16d
U14	$1^{13}/_{16}$	$10^{1}/_{4}$	2	14	6-10d x $1^{1}/_{2}$	1,110	-	2,015	-	2,285	-	2,465
U310	$2^{9}/_{16}$	$8^{7}/_{8}$	2	14	6-10d x $1^{1}/_{2}$	1,110	1,705	2,015	1,930	2,285	2,075	2,465
U314	$2^{9}/_{16}$	$10^{1}/_{2}$	2	16	6-10d x $1^{1}/_{2}$	1,110	1,945	2,305	2,205	2,615	2,375	2,820
U3510/14	$2^{5}/_{16}$	9	2	14	6-10d x $1^{1}/_{2}$	1,110	-	2,015	-	2,285	-	2,465
U3516/20	$2^{5}/_{16}$	$10^{9}/_{16}$	2	16	6-10d x $1^{1}/_{2}$	1,110	-	2,305	-	2,615	-	2,820
U410	$3^{9}/_{16}$	$8^{3}/_{8}$	2	14	6-10d	1,110	1,705	2,015	1,930	2,285	2,075	2,465
U414	$3^{9}/_{16}$	10	2	16	6-10d	1,110	1,945	2,305	2,205	2,615	2,375	2,820
U3510-2	$4^{3}/_{4}$	$8^{3}/_{4}$	2	14	6-10d	1,110	-	2,015	-	2,285	-	2,465
U3512-2	$4^{3}/_{4}$	$11^{1}/_{4}$	2	16	6-10d	1,110	-	2,305	-	2,615	-	2,820
U610	$5^{1}/_{2}$	$8^{1}/_{2}$	2	14	6-10d	1,110	1,705	2,015	1,930	2,285	2,075	2,465

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 2 (this page) for definitions of hanger nomenclature (W, H, B).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]U series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist.
[4]The quantity of 10d or 16d common nails specified in the "Header" column under "Fasteners" is required to achieve the tabulated allowable loads shown in the Allowable Download columns entitled 10d or 16d.
[5]Allowable uplift loads are for hangers installed with either 10d or 16d common nails into the supporting header/beam, and have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[6]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 750 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

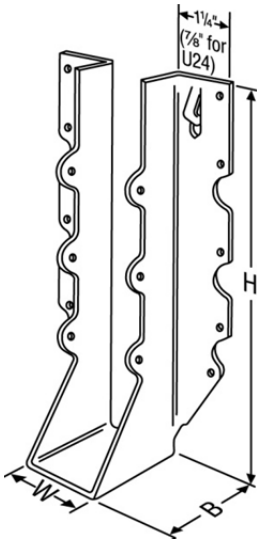


FIGURE 2—U SERIES JOIST HANGER

TABLE 3A—APPLICABLE MODEL NUMBERS FOR THE HU/HUC SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)			FASTENERS[2] (Minimum Quantity-Type)		FASTENERS[2] (Maximum Quantity-Type)	
	W	H	B	Header	Joist	Header	Joist
HU1.81/5	1 13/16	5 3/8	2 1/2	12-16d	4-10d x 1 1/2	16-16d	6-10d x 1 1/2
HU7		6 11/16		12-16d	4-10d x 1 1/2	16-16d	8-10d x 1 1/2
HU9		9 5/16		18-16d	6-10d x 1 1/2	24-16d	10-10d x 1 1/2
HU11		11 1/16		22-16d	6-10d x 1 1/2	30-16d	10-10d x 1 1/2
HU14		14		28-16d	8-10d x 1 1/2	36-16d	14-10d x 1 1/2
HU2.1/9	2 1/8	9	2 1/2	14-16d	6-10d x 1 1/2	18-16d	10-10d x 1 1/2
HU2.1/11		11		16-16d	6-10d x 1 1/2	22-16d	10-10d x1 1/2
HU359	2 3/8	8 15/16	2 1/2	14-16d	6-10d x 1 1/2	18-16d	10-10d x 1 1/2
HU3511		11 1/16		16-16d	6-10d x 1 1/2	22-16d	10-10d x 1 1/2
HU3514		13 1/2		18-16d	8-10d x 1 1/2	24-16d	12-10d x 1 1/2
HU3516/22		14 1/4		20-16d	8-10d x 1 1/2	—	—
HU3524/30		18		18-16d	8-10d x 1 1/2	24-16d	14-10d x 1 1/2
HU310	2 9/16	8 7/8	2 1/2	14-16d	6-10d x 1 1/2	—	—
HU312		10 5/8		16-16d	6-10d x 1 1/2	—	—
HU314		12 3/8		18-16d	8-10d x 1 1/2	—	—
HU316		14 1/8		20-16d	8-10d x 1 1/2	—	—
HU2.75/10	2 3/4	9	2 1/2	14-16d	6-10d x 1 1/2	18-16d	10-10d x 1 1/2
HU2.75/12		10 3/4		16-16d	6-10d x 1 1/2	22-16d	10-10d x 1 1/2
HU2.75/14		13		18-16d	8-10d x 1 1/2	24-16d	14-10d x 1 1/2
HU2.75/16		14 1/16		20-16d	8-10d x 1 1/2	26-16d	14-10d x 1 1/2
HU210-2	3 1/8	8 13/16	2 1/2	14-16d	6-10d	18-16d	10-10d
HU212-2		10 9/16		16-16d	6-10d	22-16d	10-10d
HU216-2		13 7/8		20-16d	8-10d	26-16d	12-10d
HU3.25/10.5		10¼		22-16d	10-10d	—	—
HU3.25/12		11 3/4		24-16d	12-10d	—	—
HU48	3 9/16	6 13/16	2 1/2	10-16d	4-10d	14-16d	6-10d
HU410		8 5/8		14-16d	6-10d	18-16d	10-10d
HU412		10½		16-16d	6-10d	22-16d	10-10d
HU414		12 5/8		18-16d	8-10d	24-16d	12-10d
HU416		13 5/8		20-16d	8-10d	26-16d	12-10d
HU4.12/9	4 1/8	8 5/8	2 1/2	14-16d	6-10d	18-16d	10-10d
HU4.12/11		10 5/16		16-16d	6-10d	22-16d	10-10d
HU4.28/9	4 9/32	9	2 1/2	18-16d	8-10d	—	—
HU4.28/11		11		22-16d	8-10d	—	—
HU4.75/9	4 3/4	9	2 1/2	18-16d	8-10d	—	—
HU4.75/11		11		22-16d	8-10d	—	—
HU3514-2		13 1/4		18-16d	8-10d	—	—
HU3516-2		15 1/4		20-16d	8-10d	26-16d	12-10d
HU3520-2		19 1/4		20-16d	8-10d	26-16d	12-10d
HU310-2	5 1/8	8 7/8	2 1/2	14-16d	6-10d	—	—
HU312-2		10 5/8		16-16d	6-10d	—	—
HU314-2		12 5/8		18-16d	8-10d	—	—
HU5.125/12	5 1/4	10¼	2 1/2	22-16d	8-16d	—	—
HU5.125/13.5		13¼		26-16d	12-16d	—	—
HU5.125/16		13 7/8		26-16d	12-16d	—	—
HU68	5 1/2	5 13/16	2 1/2	10-16d	4-10d	14-16d	6-10d
HU610		7 5/8		14-16d	6-16d	18-16d	8-16d
HU612		9 3/8		16-16d	6-16d	22-16d	8-16d
HU614		11 5/8		18-16d	8-16d	24-16d	12-16d
HU616		12 11/16		20-16d	8-16d	26-16d	12-16d
HU410-2	7 1/8	9 1/8	2 1/2	14-16d	6-16d	18-16d	8-16d
HU412-2		11 1/8		16-16d	6-16d	22-16d	8-16d
HU414-2		13 7/8		20-16d	8-16d	26-16d	12-16d

For **SI:** 1 inch = 25.4 mm.

[1]Refer to Figures 3a and 3b (this page) for definitions of hanger nomenclature (W, H, B).

[2]The Fastener column with "minimum quantity" refers to hangers installed with the designated type of nails into only round pre-punched holes of the hanger, and the Fastener column with "maximum quantity" refers to HU series and HUC series hangers installed with the designated type of nails into both round and triangle pre-punched holes of the hanger. The hanger size and fastener quantity are used to determine allowable loads noted in Table 3B.

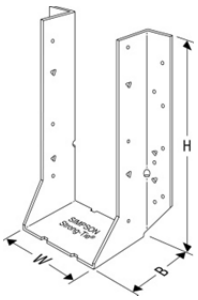


FIGURE 3a—HU SERIES HANGERS

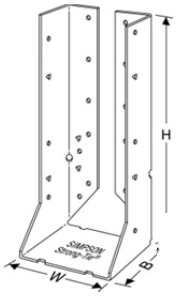


FIGURE 3b—HUC SERIES HANGERS

TABLE 3B—ALLOWABLE LOADS FOR THE HU AND HUC SERIES JOIST HANGERS[1]

MODEL NO.	DIMENSIONS[2] (inches)			FASTENERS (Quantity - Type)		ALLOWABLE LOADS[3,4,6] (lbs)			
						Uplift[5]	Download		
	W	H	B	Header	Joist	$C_D = 1.6$	$C_D = 1.0$	$C_D = 1.15$	$C_D = 1.25$
HU/HUC (Min Nailing)	1 13/16	5 3/8 to 6 11/16	2 1/2	12-16d	4-10d x 1 1/2	610	1,785	2,015	2,165
	2 1/8 to 7 1/8	7 5/8 to 9 1/8	2 1/2	10-16d	4-10d	760	1,490	1,680	1,805
				14-16d	6-10d x 1 1/2	915	2,085	2,350	2,530
				14-16d	6-10d	1,135	2,085	2,350	2,530
				14-16d	6-16d	1,345	2,085	2,350	2,530
	2 1/8 to 7 1/8	9 3/8 to 11 1/8	2 1/2	16-16d	6-10d x 1 1/2	915	2,380	2,685	2,890
				16-16d	6-10d	1,135	2,380	2,685	2,890
				16-16d	6-16d	1,345	2,380	2,685	2,890
	1 13/16 to 5 1/2	9 to 18	2 1/2	18-16d	6-10d x 1 1/2	915	2,680	3,020	3,250
				18-16d	8-10d x 1 1/2	1,515	2,680	3,020	3,250
				18-16d	8-10d	1,515	2,680	3,020	3,250
				18-16d	8-16d	1,795	2,680	3,020	3,250
	2 3/8 to 7 1/8	12 11/16 to 19 1/4	2 1/2	20-16d	8-10d x 1 1/2	1,515	2,975	3,360	3,610
				20-16d	8-10d	1,515	2,975	3,360	3,610
				20-16d	8-16d	1,795	2,975	3,360	3,610
	1 13/16 to 5 1/4	10 1/4 to 11 1/16	2 1/2	22-16d	6-10d x 1 1/2	915	3,275	3,695	3,970
				22-16d	8-10d	1,515	3,275	3,695	3,970
				22-16d	10-10d	1,895	3,275	3,695	3,970
				22-16d	8-16d	1,795	3,275	3,695	3,970
	3 1/4	11 3/4	2 1/2	24-16d	12-10d	2,015	3,570	4,030	4,335
	5 1/4	13 1/4 to 13 7/8	2 1/2	26-16d	12-16d	2,695	3,870	4,365	4,695
	1 13/16	14	2 1/2	28-16d	8-10d x 1 1/2	1,515	4,165	4,420	4,505
HU/HUC (Max Nailing)	1 13/16	5 3/8 to 6 11/16	2 1/2	16-16d	6-10d x 1 1/2	915	2,380	2,685	2,890
				16-16d	8-10d x 1 1/2	1,515	2,380	2,685	2,890
	2 1/8 to 7 1/8	7 5/8 to 9 1/8	2 1/2	14-16d	6-10d	1,135	2,085	2,350	2,530
				18-16d	10-10d x 1 1/2	1,895	2,680	3,020	3,250
				18-16d	10-10d	1,895	2,680	3,020	3,250
				18-16d	8-16d	1,795	2,680	3,020	3,250
	2 1/8 to 7 1/8	9 3/8 to 11 1/8	2 1/2	22-16d	10-10d x 1 1/2	1,895	3,275	3,695	3,970
				22-16d	10-10d	1,895	3,275	3,695	3,970
				22-16d	8-16d	1,795	3,275	3,695	3,970
	1 13/16 to 5 1/2	9 5/16 to 18	2 1/2	24-16d	10-10d x 1 1/2	1,895	3,570	4,030	4,335
				24-16d	12-10d x 1 1/2	2,015	3,570	4,030	4,335
				24-16d	14-10d x 1 1/2	2,015	3,570	4,030	4,335
				24-16d	12-10d	2,015	3,570	4,030	4,335
				24-16d	12-16d	2,695	3,570	4,030	4,335
	2 3/4 to 7 1/8	13 5/8 to 19 1/4	2 1/2	26-16d	14-10d x 1 1/2	2,015	3,870	4,365	4,695
				26-16d	12-10d	2,015	3,870	4,365	4,695
				26-16d	12-16d	2,695	3,870	4,365	4,695
	1 13/16	11 1/16	2 1/2	30-16d	10-10d x 1 1/2	1,895	4,465	4,705	4,810
	1 13/16	14	2 1/2	36-16d	14-10d x 1 1/2	2,015	5,055	5,275	5,420

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

[1]HU hanger series with widths (W) equal to or greater than 2 9/16 inches (65 mm) are available with concealed flanges and are specified as HUC hanger series.
[2]Refer to Figures 3a and 3b (previous page) for definitions of hanger nomenclature (W, H, B).
[3]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[4]HU series and HUC series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[6]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 750 psi for all models except those specific to glulam sizes, which are based on an allowable $F_{c\perp}$ of 650 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi or 650 psi, respectively, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

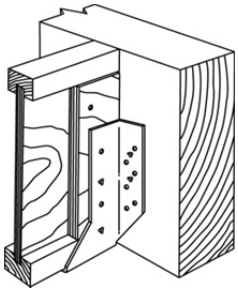


FIGURE 3c—TYPICAL HU HANGER

TABLE 4—ALLOWABLE LOADS FOR THE HUS SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3,6] (lbs)			
						Uplift[5]	Download		
	W	H	B	Header	Joist[4]	C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
HUS46	$3^9/_{16}$	5	2	4-16d	4-16d	1,235	1,065	1,210	1,305
HUS48	$3^9/_{16}$	$6^{15}/_{16}$	2	6-16d	6-16d	1,550	1,595	1,815	1,960
HUS410	$3^9/_{16}$	$8^{15}/_{16}$	2	8-16d	8-16d	2,990	2,125	2,420	2,615
HUS412	$3^9/_{16}$	$10^1/_2$	2	10-16d	10-16d	3,635	2,660	3,025	3,265
HUS1.81/10	$1^{13}/_{16}$	$8^7/_8$	3	30-16d	10-16d	3,000	5,135	5,295	5,400

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 4 (this page) for definitions of hanger nomenclature (W, H, B).
[2]Tabulated allowable load capacities must be selected based on duration of load as permitted by the applicable building code.
[3]HUS hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist.
[4]Joist nails must be driven at a 45 degree angle through the joist into the header/beam (double shear nailing) to achieve the tabulated loads.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[6]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 750 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

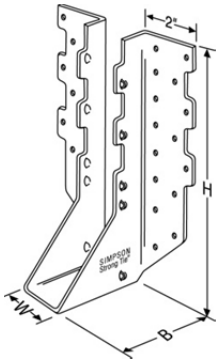


FIGURE 4—HUS JOIST HANGER (see Table 4)

TABLE 5—ALLOWABLE LOADS FOR THE HHUS SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3] (lbs)			
						Uplift[5]	Download		
	W	H	B	Header	Joist[4]	C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
HHUS46	$3^5/_8$	$5^1/_8$	3	14-16d	6-16d	1,550	2,785	3,155	3,405
HHUS48	$3^5/_8$	7	3	22-16d	8-16d	2,000	4,210	4,770	5,140
HHUS410	$3^5/_8$	9	3	30-16d	10-16d	3,735	5,635	6,380	6,880
HHUS5.50/10	$5^1/_2$	9	3	30-16d	10-16d	3,735	5,635	6,380	6,880
HHUS7.25/10	$7^1/_4$	9	$3^5/_{16}$	30-16d	10-16d	3,735	5,635	6,380	6,880

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 5 (this page) for definitions of hanger nomenclature (W, H, B).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]HHUS hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds (334 N) times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist.
[4]Joist nails must be driven at a 45 degree angle through the joist into the header/beam (double shear nailing) to achieve the tabulated loads.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[6]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 750 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

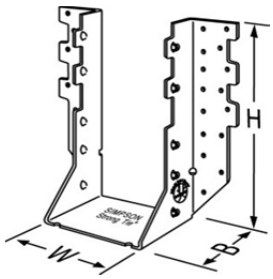


FIGURE 5—HHUS JOIST HANGER (see Table 5)

TABLE 6—ALLOWABLE LOADS FOR THE SUR/SUL SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)					FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,6] (lbs)			
								Uplift[5]	Download		
	W	H	B	A_1	A_2	Header	Joist	C_D=1.6	C_D=1.0	C_D=1.15	C_D=1.25
SUR/L210	$1^{9}/_{16}$	8	2	$1^{1}/_{8}$	$1^{5}/_{16}$	10-16d	10-10d x $1^{1}/_{2}$	1,250	1,440	1,635	1,760
SUR/L214	$1^{9}/_{16}$	10	2	$1^{1}/_{8}$	$1^{5}/_{16}$	12-16d	12-10d x $1^{1}/_{2}$	2,165	1,730	1,960	2,115
SUR/L1.81/9	$1^{13}/_{16}$	9	3	$1^{5}/_{8}$	$2^{5}/_{16}$	12-16d	2-10d x $1^{1}/_{2}$	195[3,4]	1,730	1,960	2,030
SUR/L1.81/11	$1^{13}/_{16}$	11	3	$1^{5}/_{8}$	$2^{5}/_{16}$	16-16d	2-10d x $1^{1}/_{2}$	195[3,4]	2,305	2,615	2,730
SUR/L1.81/14	$1^{13}/_{16}$	$13^{3}/_{4}$	3	$1^{5}/_{8}$	$2^{5}/_{16}$	20-16d	2-10d x $1^{1}/_{2}$	195[3,4]	2,500	2,500	2,500
SUR/L2.06/9	$2^{1}/_{16}$	$9^{1}/_{16}$	$3^{3}/_{16}$	$1^{5}/_{8}$	$2^{1}/_{8}$	14-16d	2-10d x $1^{1}/_{2}$	195[3]	2,015	2,285	2,465
SUR/L2.06/11	$2^{1}/_{16}$	$11^{1}/_{4}$	$3^{3}/_{16}$	$1^{5}/_{8}$	$2^{1}/_{8}$	16-16d	2-10d x $1^{1}/_{2}$	195[3]	2,305	2,615	2,665
SUR/L2.06/14	$2^{1}/_{16}$	$13^{5}/_{8}$	$3^{3}/_{16}$	$1^{5}/_{8}$	$2^{1}/_{8}$	18-16d	2-10d x $1^{1}/_{2}$	195[3]	2,590	2,665	2,665
SUR/L2.1/9	$2^{1}/_{8}$	$9^{1}/_{16}$	$3^{3}/_{16}$	$1^{9}/_{16}$	$2^{1}/_{8}$	14-16d	2-10d x $1^{1}/_{2}$	195[3]	2,015	2,285	2,465
SUR/L2.1/11	$2^{1}/_{8}$	$11^{3}/_{16}$	$3^{3}/_{16}$	$1^{9}/_{16}$	$2^{1}/_{8}$	16-16d	2-10d x $1^{1}/_{2}$	195[3]	2,305	2,615	2,665
SUR/L2.1/14	$2^{1}/_{8}$	$13^{9}/_{16}$	$3^{3}/_{16}$	$1^{9}/_{16}$	$2^{1}/_{8}$	18-16d	2-10d x $1^{1}/_{2}$	195[3]	2,590	2,665	2,665
SUR/L2.37/9	$2^{3}/_{8}$	$8^{15}/_{16}$	$3^{3}/_{16}$	$1^{5}/_{16}$	$2^{1}/_{8}$	14-16d	2-10d x $1^{1}/_{2}$	195[3]	2,015	2,285	2,465
SUR/L2.37/11	$2^{3}/_{8}$	$11^{3}/_{16}$	$3^{3}/_{16}$	$1^{5}/_{16}$	$2^{1}/_{8}$	16-16d	2-10d x $1^{1}/_{2}$	195[3]	2,305	2,615	2,665
SUR/L2.37/14	$2^{3}/_{8}$	$13^{7}/_{16}$	$3^{3}/_{16}$	$1^{5}/_{16}$	$2^{1}/_{8}$	18-16d	2-10d x $1^{1}/_{2}$	195[3]	2,590	2,665	2,665
SUR/L2.56/9	$2^{9}/_{16}$	$8^{13}/_{16}$	$3^{3}/_{16}$	$1^{1}/_{8}$	$2^{1}/_{8}$	14-16d	2-10d x $1^{1}/_{2}$	225[3]	2,015	2,285	2,465
SUR/L2.56/11	$2^{9}/_{16}$	$11^{3}/_{16}$	$3^{3}/_{16}$	$1^{1}/_{8}$	$2^{1}/_{8}$	16-16d	2-10d x $1^{1}/_{2}$	225[3]	2,305	2,615	2,665
SUR/L2.56/14	$2^{9}/_{16}$	$13^{5}/_{16}$	$3^{3}/_{16}$	$1^{1}/_{8}$	$2^{1}/_{8}$	18-16d	2-10d x $1^{1}/_{2}$	225[3]	2,590	2,665	2,665
SUR/L210-2	$3^{1}/_{8}$	$8^{11}/_{16}$	$2^{5}/_{8}$	$1^{7}/_{16}$	$2^{3}/_{8}$	14-16d	6-16d x $2^{1}/_{2}$	1,300	2,015	2,285	2,465
SUR/L214-2	$3^{1}/_{8}$	$12^{11}/_{16}$	$2^{7}/_{16}$	$1^{7}/_{16}$	$2^{3}/_{8}$	18-16d	8-16d x $2^{1}/_{2}$	1,765	2,500	2,500	2,500
SUR/L46	$3^{9}/_{16}$	$4^{3}/_{4}$	$2^{5}/_{8}$	1	$2^{3}/_{8}$	8-16d	4-16d	815	1,150	1,305	1,400
SUR/L410	$3^{9}/_{16}$	$8^{1}/_{2}$	$2^{5}/_{8}$	1	$2^{3}/_{8}$	14-16d	6-16d	1,300	2,015	2,285	2,465
SUR/L414	$3^{9}/_{16}$	$12^{1}/_{2}$	$2^{5}/_{8}$	1	$2^{3}/_{8}$	18-16d	8-16d	1,765	2,500	2,500	2,500

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 6a (this page) for definitions of hanger nomenclature (W, H, B, A1, A2).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]Optional triangle holes may be filled (requires web stiffeners) for additional uplift resistance. When a total of six 10dx$1^{1}/_{2}$" nails are installed into the joist for 9-and 11-inch models, an uplift value of 795 lbs may be used. When a total of eight 10dx$1^{1}/_{2}$" nails are installed into the joist for 14-inch models, an uplift value of 1190 lbs may be used.
[4]Uplift value based on use of LVL joist member. When using an I-joist as the joist member, allowable uplift must be taken as 155 lbs.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[6]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 750 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

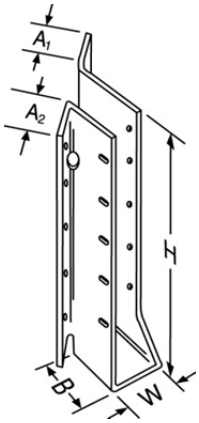


FIGURE 6a—SUL SERIES JOIST HANGER

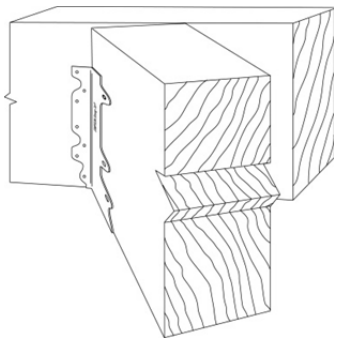


FIGURE 6b—TYPICAL SUR HANGER INSTALLATION

TABLE 7—ALLOWABLE LOADS FOR THE HSUR/HSUL SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)					FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3] (lbs)			
	W	H	B	A_1	A_2	Header	Joist	Uplift[4]	Download		
								$C_D = 1.6$	$C_D = 1.0$	$C_D = 1.15$	$C_D = 1.25$
HSUR/L210-2	3 1/8	8 11/16	2 7/16	1 3/4	2 3/8	20-16d	6-16d x 2 1/2	1,300	2,975	3,360	3,610
HSUR/L214-2	3 1/8	12 11/16	2 7/16	1 3/4	2 3/8	26-16d	8-16d x 2 1/2	1,795	3,870	4,365	4,695
HSUR/L46	3 9/16	4 3/4	2 7/16	1	2 3/16	12-16d	4-16d	815	1,785	2,000	2,000
HSUR/L410	3 9/16	8 1/2	2 7/16	1	2 3/16	20-16d	6-16d	1,300	2,975	3,360	3,610
HSUR/L414	3 9/16	12 1/2	2 7/16	1	2 3/16	26-16d	8-16d	1,795	3,870	4,365	4,695
HSUR/L4.12/9	4 1/8	9	3	1 7/16	2 3/8	12-16d	2-10d x 1 1/2	165[4]	1,785	2,015	2,025
HSUR/L4.12/11	4 1/8	11 1/8	3	1 7/16	2 3/8	16-16d	2-10d x 1 1/2	165[4]	2,380	2,685	2,890
HSUR/L4.12/14	4 1/8	13 3/4	3	1 7/16	2 3/8	20-16d	2-10d x 1 1/2	165[4]	2,975	3,330	3,330
HSUR/L4.12/16	4 1/8	15 3/4	3	1 7/16	2 3/8	24-16d	2-10d x 1 1/2	165[4]	3,330	3,330	3,330
HSUR/L4.28/9	4 5/16	9	3	1 7/16	2 3/8	12-16d	2-10d x 1 1/2	165[4]	1,785	2,015	2,025
HSUR/L4.28/11	4 5/16	11 1/8	3	1 7/16	2 3/8	16-16d	2-10d x 1 1/2	165[4]	2,380	2,685	2,890
HSUR/L4.75/9	4 3/4	8 15/16	2 3/4	1 7/16	2 3/8	12-16d	2-10d x 1 1/2	165[4]	1,785	2,015	2,025
HSUR/L4.75/11	4 3/4	10 15/16	2 3/4	1 7/16	2 3/8	16-16d	2-10d x 1 1/2	165[4]	2,380	2,685	2,890
HSUR/L4.75/14	4 3/4	13 3/4	2 3/4	1 7/16	2 3/8	20-16d	2-10d x 1 1/2	165[4]	2,975	3,330	3,330
HSUR/L4.75/16	4 3/4	15 3/4	2 3/4	1 7/16	2 3/8	24-16d	2-10d x 1 1/2	165[4]	3,330	3,330	3,330
HSUR/L5.12/9	5 1/8	9	2 13/16	1 7/16	2 3/8	12-16d	2-10d x 1 1/2	165[4]	1,785	2,015	2,025
HSUR/L5.12/11	5 1/8	11	2 13/16	1 7/16	2 3/8	16-16d	2-10d x 1 1/2	165[4]	2,380	2,685	2,890
HSUR/L5.12/14	5 1/8	13 3/4	2 13/16	1 7/16	2 3/8	20-16d	2-10d x 1 1/2	165[4]	2,975	3,330	3,330
HSUR/L5.12/16	5 1/8	15 3/4	2 13/16	1 7/16	2 3/8	24-16d	2-10d x 1 1/2	165[4]	3,330	3,330	3,330

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 7a (this page) for definitions of hanger nomenclature (W, H, B, A1, A2).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]When I-joists are the supported member as shown in Figure 7b, each I-joist must have web stiffeners installed in accordance with the I-joist manufacturer's evaluation report, and the minimum required quantity and type of nails, as specified in the column entitled FASTENERS must be nailed directly into the web stiffeners and/or I-joist.
[4]Optional triangular holes may be filled (requires web stiffeners) for additional uplift. When a total of six 10d x 1 1/2" nails are installed into the joist, an uplift value of 565 lbs may be used.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[6]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 750 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

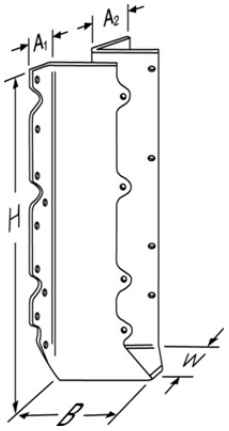


FIGURE 7a—HSUR JOIST HANGER

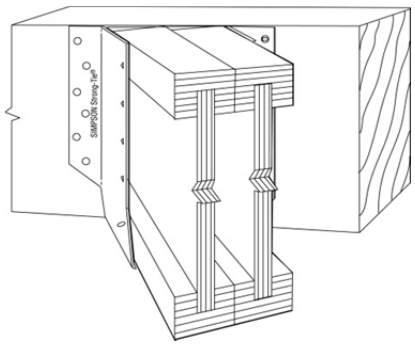


FIGURE 7b—TYPICAL HSUR JOIST HANGER INSTALLATION (Web Stiffeners not shown for Clarity–See Footnote 3 to Table 7)

TABLE 8—ALLOWABLE LOADS FOR THE MIU SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (in.)			FASTENERS[3,4]		ALLOWABLE LOADS (lbs) [2,5,6,7]			
						Uplift[3,4,5]	Download		
	W	H	B	Header	Joist	C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
MIU1.56/7	1 9/16	6 15/16	2 1/2	10-16d	4-10d x 1 1/2	555	1,440	1,635	1,760
MIU1.56/9		8 15/16		16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU1.56/11		11 1/16		20-16d	6-10d x 1 1/2	975	2,880	3,060	3,080
MIU1.56/14		13 7/16		22-16d	6-10d x 1 1/2	975	3,030	3,060	3,080
MIU1.81/7	1 13/16	6 15/16	2 1/2	10-16d	4-10d x 1 1/2	555	1,440	1,635	1,760
MIU1.81/9		8 13/16		16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU1.81/11		11 1/16		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU1.81/14		13 5/16		22-16d	6-10d x 1 1/2	975	3,170	3,530	3,550
MIU1.81/16		15 5/16		24-16d	6-10d x 1 1/2	975	3,455	3,530	3,550
MIU1.81/18		17 5/16		26-16d	6-10d x 1 1/2	975	3,500	3,530	3,550
MIU2.1/11	2 1/8	11 1/16	2 1/2	20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU2.37/7	2 3/8	6 15/16	2 1/2	10-16d	4-10d x 1 1/2	555	1,440	1,635	1,760
MIU2.37/9		9		16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU2.37/11		11 1/16		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU2.37/14		13 1/2		22-16d	6-10d x 1 1/2	975	3,170	3,595	3,875
MIU2.37/16		15 1/2		24-16d	6-10d x 1 1/2	975	3,455	3,920	4,045
MIU2.37/18		17 1/2		26-16d	6-10d x 1 1/2	975	3,745	4,045	4,045
MIU2.37/20		19 1/2		28-16d	6-10d x 1 1/2	975	4,030	4,060	4,060
MIU2.56/9	2 9/16	8 15/16	2 1/2	16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU2.56/11		11 1/16		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU2.56/13		12 1/4		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU2.56/14		13 7/16		22-16d	6-10d x 1 1/2	975	3,170	3,595	3,875
MIU2.56/16		15 7/16		24-16d	6-10d x 1 1/2	975	3,455	3,920	4,045
MIU2.56/18		17 7/16		26-16d	6-10d x 1 1/2	975	3,745	4,045	4,045
MIU2.56/20		19 7/16		28-16d	6-10d x 1 1/2	975	4,030	4,060	4,060
MIU3.12/9	3 1/8	9 1/16	2 1/2	16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU3.12/11		11 1/8		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU3.56/9	3 9/16	8 13/16	2 1/2	16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU3.56/11		11 1/8		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU3.56/14		13 5/16		22-16d	6-10d x 1 1/2	975	3,170	3,595	3,875
MIU3.56/16		15 5/16		24-16d	6-10d x 1 1/2	975	3,455	3,920	4,045
MIU3.56/18		17 5/16		26-16d	6-10d x 1 1/2	975	3,745	4,045	4,045
MIU3.56/20		19 5/16		28-16d	6-10d x 1 1/2	975	4,030	4,060	4,060
MIU4.12/9	4 1/8	9 1/16	2 1/2	16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU4.12/11		11 1/8		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU4.12/14		13 9/16		22-16d	6-10d x 1 1/2	975	3,170	3,595	3,875
MIU4.12/16		15 9/16		24-16d	6-10d x 1 1/2	975	3,455	3,920	4,045
MIU4.28/9	4 5/16	9	2 1/2	16-16d	6-10d x 1 1/2	975	2,305	2,615	2,820
MIU4.28/11		11 1/8		20-16d	6-10d x 1 1/2	975	2,880	3,135	3,135
MIU4.28/14		13 1/2		22-16d	6-10d x 1 1/2	975	3,170	3,595	3,875
MIU4.28/16		15 1/2		24-16d	6-10d x 1 1/2	975	3,455	3,920	4,045

Please refer to next page for continuation of Table 8.

TABLE 8—ALLOWABLE LOADS FOR THE MIU SERIES JOIST HANGERS (Continued)

MODEL NO.	DIMENSIONS[1] (in.)			FASTENERS[3,4]		ALLOWABLE LOADS (lbs)[2,5,6,7]			
						Uplift[3,4,5]	Download		
	W	H	B	Header	Joist	C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
MIU4.75/9	$4^3/_4$	9	$2^1/_2$	16-16d	6-10d x $1^1/_2$	975	2,305	2,615	2,820
MIU4.75/11		$11^1/_{16}$		20-16d	6-10d x $1^1/_2$	975	2,880	3,135	3,135
MIU4.75/14		$13^1/_2$		22-16d	6-10d x $1^1/_2$	975	3,170	3,595	3,875
MIU4.75/16		$15^1/_2$		24-16d	6-10d x $1^1/_2$	975	3,455	3,920	4,045
MIU4.75/18		$17^1/_2$		26-16d	6-10d x $1^1/_2$	975	3,745	4,045	4,045
MIU4.75/20		$19^1/_2$		28-16d	6-10d x $1^1/_2$	975	4,030	4,060	4,060
MIU5.12/7	$5^1/_8$	$6^{15}/_{16}$	$2^1/_2$	10-16d	4-10d x $1^1/_2$	555	1,440	1,635	1,760
MIU5.12/9		$8^{13}/_{16}$		16-16d	6-10d x $1^1/_2$	975	2,305	2,615	2,820
MIU5.12/11		$11^1/_8$		20-16d	6-10d x $1^1/_2$	975	2,880	3,135	3,135
MIU5.12/14		$13^5/_{16}$		22-16d	6-10d x $1^1/_2$	975	3,170	3,595	3,875
MIU5.12/16		$15^5/_{16}$		24-16d	6-10d x $1^1/_2$	975	3,455	3,920	4,045
MIU5.12/18		$17^5/_{16}$		26-16d	6-10d x $1^1/_2$	975	3,745	4,045	4,045
MIU5.12/20		$19^5/_{16}$		28-16d	6-10d x $1^1/_2$	975	4,030	4,060	4,060

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 8a (this page) for definitions of hanger nomenclature (W, H and B).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[4]Total number of joist nails specified in the table must be installed to resist tabulated uplift loads. The bottom two 10dx$1^1/_2$ nails must be installed at a 45 degree angle into the bottom flange of the prefabricated wood I-joist, as shown in the detail in Figure 8b (on this page). These nails are designated as PAN nails.
[5]Web stiffeners must be installed on wood I-joists, with the following exception: An alternate reduced uplift capacity of 230 lbs can be obtained without using web stiffeners and all of the specified joist nails indicated in the table by installing two angled PAN nails at the hanger seat into the bottom flange of the wood I-joist as shown in the detail in Figure 8b (on this page).
[6]For joist members other than prefabricated wood I-joists, lateral support must be provided at the ends in accordance with Section 2308.8.2 of the IBC or Section R502.7 of the IRC.
[7]The tabulated allowable loads are based on the use of prefabricated wood I-joists having flanges with an allowable compression perpendicular-to-grain, $F_{c\perp}$, of 750 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.

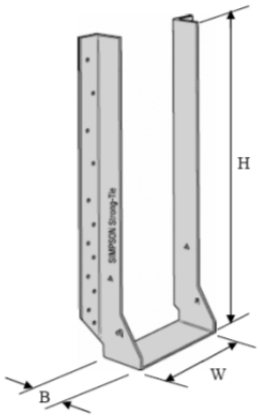


FIGURE 8a—MIU JOIST HANGER

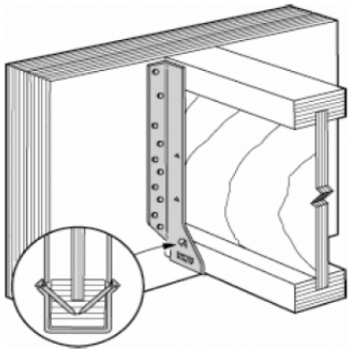


FIGURE 8b—ALTERNATE MIU JOIST HANGER INSTALLATION (See Footnotes 3 and 4 to Table 8)

TABLE 9—ALLOWABLE LOADS FOR THE HGUS SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (Inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,5] (lbs)			
						Uplift[4]	Download		
	W	H	B	Header	Joist[3]	C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
HGUS2.75/10	2 3/4	8 7/8	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS2.75/12	2 3/4	10 7/8	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS2.75/14	2 3/4	12 7/8	4	66-16d	22-16d	5,515	10,100	10,100	10,100
HGUS3.25/10	3 1/4	8 5/8	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS3.25/12	3 1/4	10 5/8	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS46	3 5/8	5 5/16	4	20-16d	8-16d	2,155	4,360	4,885	5,230
HGUS48	3 5/8	7 1/16	4	36-16d	12-16d	3,235	7,460	7,460	7,460
HGUS410	3 5/8	9 1/16	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS412	3 5/8	10 7/16	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS414	3 5/8	12 7/16	4	66-16d	22-16d	5,515	10,100	10,100	10,100
HGUS5.25/10	5 1/4	9 1/16	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS5.25/12	5 1/4	10 5/8	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS5.5/8	5 1/2	6 15/16	4	36-16d	12-16d	3,235	7,460	7,460	7,460
HGUS5.5/10	5 1/2	8 15/16	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS5.5/12	5 1/2	10 1/2	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS5.5/14	5 1/2	12 1/2	4	66-16d	22-16d	5,515	10,100	10,100	10,100
HGUS5.62/10	5 5/8	8 7/8	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS5.62/12	5 5/8	10 7/16	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS5.62/14	5 5/8	12 7/16	4	66-16d	22-16d	5,515	10,100	10,100	10,100
HGUS6.88/10	5 5/8	8 13/16	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS6.88/12	6 7/8	10 13/16	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS6.88/14	6 7/8	12 13/16	4	66-16d	22-16d	5,515	10,100	10,100	10,100
HGUS7.25/8	7 1/4	7 1/4	4	36-16d	12-16d	3,235	7,460	7,460	7,460
HGUS7.25/10	7 1/4	8 5/8	4	46-16d	16-16d	4,095	9,100	9,100	9,100
HGUS7.25/12	7 1/4	10 5/8	4	56-16d	20-16d	5,045	9,600	9,600	9,600
HGUS7.25/14	7 1/4	12 5/8	4	66-16d	22-16d	5,515	10,100	10,100	10,100

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 9 (this page) for definitions of hanger nomenclature (W, H, B).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]Joist nails must be driven at a 45-degree angle through the joist into the header/beam (double shear nailing) to achieve the tabulated loads.
[4]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[5]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 750 psi for all models except those specific to glulam sizes, which are based on an allowable $F_{c\perp}$ of 650 psi. When use is to support members having an $F_{c\perp}$ of less than 750 psi or 650 psi, respectively, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.
[6]For supported members other than glulam beams, lateral support must be provided at the ends in accordance with Section 2308.8.2 of the IBC or Section R502.7 of the IRC.

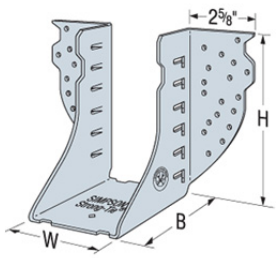


FIGURE 9—HGUS SERIES JOIST HANGER

TABLE 10—ALLOWABLE LOADS FOR THE LGU, MGU, HGU AND HHGU SERIES HANGERS

MODEL No.	DIMENSIONS[1] (inches)					FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,6,7] (lbs)			
								Uplift[5]	Download		
	W	H[4] (min)	B	h_a[3]	a	Header	Joist	C_D=1.6	C_D=1.0	C_D=1.15	C_D=1.25
LGU3.25-SDS	3 1/4	8	4 1/2	7 3/8	3 1/4	16 SDS1/4"x 2 1/2"	12 SDS1/4"x 2 1/2"	5,555	6,720	7,310	7,310
LGU3.63-SDS	3 5/8										
LGU5.25-SDS	5 1/4										
MGU3.63-SDS	3 5/8	9 1/4	4 1/2	8 5/8	4	24 SDS1/4"x 2 1/2"	16 SDS1/4"x 2 1/2"	7,260	9,450	9,450	9,450
MGU5.25-SDS	5 1/4										
MGU5.50-SDS	5 1/2										
MGU5.62-SDS	5 5/8										
MGU7.00-SDS	7										
HGU3.63-SDS	3 5/8	11	5 1/4	10 3/8	4 3/4	36 SDS1/4"x 2 1/2"	24 SDS1/4"x 2 1/2"	9,895	14,145	14,145	14,145
HGU5.25-SDS	5 1/4										
HGU5.50-SDS	5 1/2										
HGU5.62-SDS	5 5/8										
HGU7.00-SDS	7										
HGU7.25-SDS	7 1/4										
HGU9.00-SDS	9										
HHGU5.50-SDS	5 1/2	13	5 1/4	12 3/8	4 3/4	44 SDS1/4"x 2 1/2"	28 SDS1/4"x 2 1/2"	14,550	17,845	17,845	17,845
HHGU5.62-SDS	5 5/8										
HHGU7.00-SDS	7										
HHGU7.25-SDS	7 1/4										
HHGU9.00-SDS	9										

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 10 (this page) for definitions of hanger nomenclature (W, H, B, h_a and a).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]The supporting member (header) height must be at least at high as the flange height, h_a.
[4]The H dimension must be specified. The maximum H dimension is 30 inches.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[6]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 650 psi. When use is to support members having an $F_{c\perp}$ of less than 650 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.
[7]For supported members other than glulam beams, lateral support must be provided at the ends in accordance with Section 2308.8.2 of the IBC or Section R502.7 of the IRC.

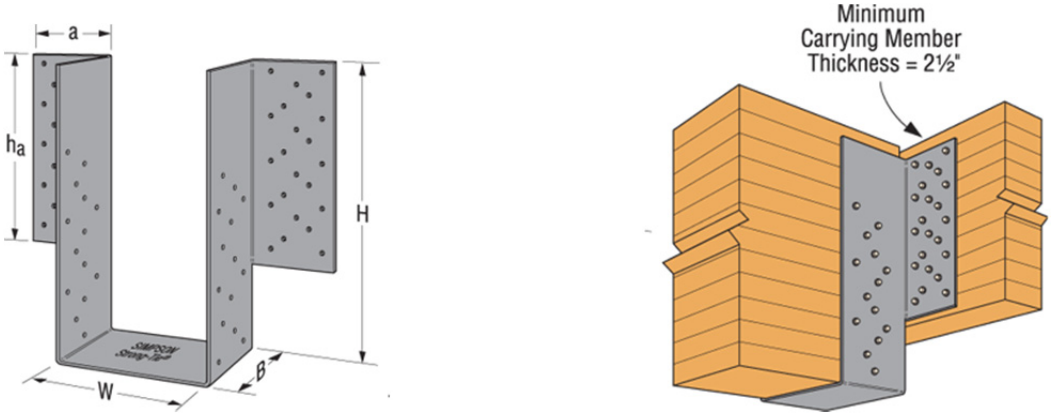


FIGURE 10—DIMENSIONS AND TYPICAL INSTALLATION OF THE LGU, MGU, HGU AND HHGU SERIES HANGERS

TABLE 11—ALLOWABLE LOADS FOR THE HUCQ SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS[1] (inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3,5] (lbs)			
						Uplift[4]	Download		
	W	H	B	Header	Joist	C_D=1.6	C_D=1.0	C_D=1.15	C_D=1.25
HUCQ1.81/9-SDS	$1^{13}/_{16}$	9	3	8-SDS$^1/_4$" x $1^3/_4$"	4-SDS$^1/_4$" x $1^3/_4$"	1,505	2,000	2,300	2,500
HUCQ1.81/11-SDS	$1^{13}/_{16}$	11	3	10-SDS$^1/_4$" x $1^3/_4$"	4-SDS$^1/_4$" x $1^3/_4$"	1,505	2,500	2,875	3,125
HUCQ410-SDS	$3^9/_{16}$	9	3	12-SDS$^1/_4$" x $2^1/_2$"	6-SDS$^1/_4$" x $2^1/_2$"	2,510	4,680	4,955	4,955
HUCQ412-SDS	$3^9/_{16}$	11	3	14-SDS$^1/_4$" x $2^1/_2$"	6-SDS$^1/_4$" x $2^1/_2$"	2,510	5,460	5,560	5,560
HUCQ5.25/9-SDS	$5^1/_4$	9	3	12-SDS$^1/_4$" x $2^1/_2$"	6-SDS$^1/_4$" x $2^1/_2$"	2,510	4,680	4,955	4,955
HUCQ5.25/11-SDS	$5^1/_4$	11	3	14-SDS$^1/_4$" x $2^1/_2$"	6-SDS$^1/_4$" x $2^1/_2$"	2,510	5,460	5,560	5,560
HUCQ610-SDS	$5^9/_{16}$	9	3	12-SDS$^1/_4$" x $2^1/_2$"	6-SDS$^1/_4$" x $2^1/_2$"	2,520	4,680	5,380	5,715
HUCQ612-SDS	$5^9/_{16}$	11	3	14-SDS$^1/_4$" x $2^1/_2$"	6-SDS$^1/_4$" x $2^1/_2$"	2,520	5,315	5,315	5,315

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Refer to Figure 11 (this page) for definitions of hanger nomenclature (W, H, B).
[2]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[3]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable uplift loads must be reduced when other load durations govern.
[4]The allowable loads are based on the use of an engineered wood joist member with an allowable $F_{c\perp}$ of 650 psi. When use is to support members having an $F_{c\perp}$ of less than 650 psi, it must be verified that the combination of bearing capacity and joist nail capacity is adequate.
[5]For supported members other than glulam beams, lateral support must be provided at the ends in accordance with Section 2308.8.2 of the IBC or Section R502.7 of the IRC.

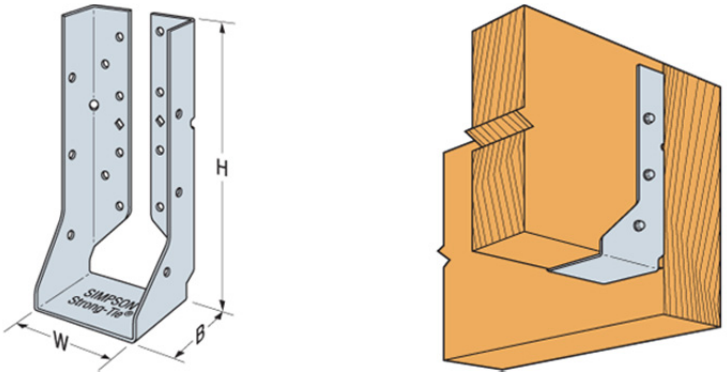


FIGURE 11—DIMENSIONS AND TYPICAL INSTALLATION OF THE HUCQ SERIES HANGERS

ICC EVALUATION SERVICE
Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-2330

Reissued April 1, 2013
This report is subject to renewal May 1, 2014.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® SCREW HOLD-DOWN CONNECTORS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

Simpson Strong-Tie® screw hold-down connectors are used as wood framing anchorage, such as to connect wood posts to concrete foundations or to connect an upper- story wood post to a lower-story supporting wood post, in accordance with IBC Sections 2304.9.3, 2305.1, 2305.3, 2308.9.3.1, and 2308.9.3.2; and 2008 AF&PA SDPWS Sections 4.3.6.4.2 and 4.3.6.1.2; and are used as anchorage of concrete and masonry walls to structural wood elements to provide lateral support for the walls as required by IBC Section 1604.8. The hold-down connectors may also be used in structures regulated under the IRC, when an engineered design is submitted in accordance with Section R301.1.3 of the IRC; or when used in accordance with the prescriptive provisions of 2012 IRC Sections R507.2.3, R602.10.2.2.1, R602.10.6.1, R602.10.6.2, R602.10.6.5 and R602.10.7; or 2009 IRC Sections R502.2.2.3, R602.10.1.4.1(2), R602.10.3.2, R602.10.3.3, R602.10.4.4 and R602.10.5.3.

3.0 DESCRIPTION

3.1 General:

3.1.1 HDU Hold-downs: HDU hold-downs consist of a main structural steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member, and a base plate component that provides a seat for an anchor rod/bolt nut, as shown in Figure 1. The body of the HDU2, HDU4 and HDU5 hold-downs is formed from No. 14 gage galvanized steel; the HDU8 and HDU11 bodies are formed from No. 10 gage galvanized steel; and the HDU14 body is formed from No. 7 gage galvanized steel. The base plate component for all HDU hold-downs is formed from No. 3 gage galvanized steel. See Table 1A for HDU hold-down dimensions and fastener requirements.

3.1.2 HDQ8 and HHDQ Hold-downs: The HDQ8 hold-down consists of a main structural steel component with prepunched holes for installation of SDS wood screws used to connect the HDQ8 hold-down to the wood member, and steel crossbars and a washer for an anchor rod/bolt nut, as shown in Figure 2A. The HHDQ11 and HHDQ14 hold-downs also have a main structural steel component with pre-drilled holes for SDS wood screws used to connect HHDQ hold-downs to the wood member, and have a factory-welded load transfer plate at its base for an anchor rod or bolt. The HDQ8 body is formed from No. 7 gage galvanized steel, and its crossbars are formed from $^3/_8$-inch-thick-by-1-inch-deep (9.5 mm by 25.4 mm) steel bar stock, and the washers are formed from $^3/_8$-inch-thick (9.5 mm) steel plate. The HHDQ bodies are formed from No. 7 gage steel, and the load transfer plates are $^1/_2$-inch-thick (12.7 mm) steel plate. See Table 2A for HDQ8 and HHDQ hold-down dimensions and fastener requirements. See Figure 2B for typical installations of the HDQ8 and HHDQ hold-downs.

3.1.3 PHD Hold-downs: PHD hold-downs consist of a main structural steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member, and a base plate component that provides a seat for an anchor rod/bolt nut, as shown in Figure 3. The PHD2 and PHD5 bodies are formed from No. 14 gage galvanized steel and the PHD6 bodies are formed from No. 12 gage galvanized steel. The base plates are formed from No. 3 gage steel. See Table 3A for PHD hold-down dimensions and required fasteners.

3.1.4 DTT2 Hold-down: The DTT2 hold-down consists of a single-piece formed structural steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member as shown in Figure 4. The DTT2 is formed from No. 14 gage galvanized steel. One steel, plain (flat), standard plate (W) washer conforming to ASTM F844 and ASME B18.22.1, Type A, with a $1^3/_8$-inch (35 mm) outer diameter, is provided with the DTT2 hold-down, and must be installed between the nut and the seat of the hold-down. See Table 4 for product dimensions, required fasteners and allowable loads.

3.1.5 HDC10 Concentric Hold-downs: HDC10 concentric hold-downs consist of a main structural U-shaped steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member, and an aluminum support base component with a hole for a $^{7}/_{8}$-inch-diameter (22.2 mm) anchor bolt used to connect the hold-down to the concrete as shown in Figure 5. The body of the HDC10 hold-downs is formed from No. 10 gage galvanized steel. The aluminum base is die cast from aluminum alloy. One steel, plain (flat), SAE narrow (N) washer conforming to ASTM F844 and ASME B18.22.1, Type A, with a $1^{3}/_{4}$-inch (44.5 mm) outer diameter, is provided with the HDC10 hold-down, and must be installed between the nut and the bottom of the U-shaped steel component of the hold-down. See Tables 5A and 5B for product dimensions, required fasteners and allowable loads.

3.2 Materials:

3.2.1 Steel: The bodies of the HDU, PHD, HDQ8, and HDC10 hold-downs are fabricated from ASTM A653, SS, Grade 33, galvanized steel, having a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum tensile strength, F_u, of 45,000 psi (310 MPa). The load transfer base plates of the HDU and PHD series hold-downs are fabricated from ASTM A 1011, SS, Grade 33 steel, having a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum ultimate strength, F_u, of 52,000 psi (359 MPa). The crossbars and the load transfer washer for the HDQ8 hold-down are fabricated from No. 1018 carbon steel complying with SAE J403, and having a minimum yield strength, F_y, of 54,000 psi (371 MPa) and a minimum tensile strength, F_u, of 64,000 psi (440 MPa). The support base of the HDC10 hold-downs is die cast aluminum.

The bodies of the HHDQ hold-downs are fabricated from ASTM A1011, SS, Grade 33 steel, having a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum ultimate strength, F_u, of 52,000 psi (359 MPa). The load transfer plates for the HHDQ hold-downs are formed from ASTM A 36 steel, having a minimum yield strength, F_y, of 36,000 psi (248 MPa) and a minimum tensile strength, F_u, of 58,000 psi (399 MPa). The DTT2 hold-down is formed from ASTM A653, SS designation, Grade 33 steel.

The galvanized bodies of the HDU, HDQ8, PHD, DTT2, and HDC10 hold-downs have a minimum G90 zinc coating in accordance with ASTM A653. Some models may also be available with either a G185 zinc coating (denoted by model numbers ending in the letter Z) or with a batch hot-dipped galvanized coating (denoted by model numbers ending with the letters HDG) with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides in accordance with ASTM A123. Model numbers shown in this report do not list the -Z or -HDG suffix, but the information shown applies. The HHDQ hold-downs have a painted finish. PHD base plates, HDU base plates and HDQ8 washers and crossbars have a minimum ASTM B633, SC 1, Type I electro galvanized coating.

The lumber treater or the report holder (Simpson Strong-Tie Company) should be contacted for recommendations on minimum corrosion resistance protection of steel hold-down connectors in contact with the specific proprietary preservative-treated or fire-retardant treated lumber. The use of hold-downs in contact with preservative-treated or fire-retardant treated lumber is outside the scope of this report, and is subject to the approval of the code official.

The steel components of the hold-downs described in this report have the following minimum base-metal thicknesses:

NOMINAL THICKNESS	MINIMUM BASE-METAL THICKNESS (in.)
$^{1}/_{2}$ inch	0.4845
$^{3}/_{8}$ inch	0.3600
No. 3 gage	0.2285
No. 7 gage (ASTM A653)	0.1715
No. 7 gage (ASTM A1011)	0.1705
No. 10 gage	0.1275
No. 12 gage	0.0975
No. 14 gage	0.0685

For **SI:** 1 inch = 25.4 mm.

3.2.2 Wood: Wood members with which the hold-downs are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber). The required thickness (depth) of the wood members in the direction of the fastener penetration is specified in Table 1B for HDU hold-down assemblies, Tables 2B and 2D for HDQ8/HHDQ hold-down assemblies, Table 3B for PHD hold-down assemblies, Table 4 for DTT2 hold-down assemblies, and Table 5B for HDC10 hold-down assemblies. Unless noted otherwise, the minimum width of the wood members listed in Tables 1B, 2B, 2D, 3B, 4, and Table 5B is $3^{1}/_{2}$ inches (88.9 mm). Additionally, the wood members used with the HDC hold-downs must have a minimum F_c* of 1550 psi (10.7 MPa), where F_c* is the NDS-specified reference compression design value parallel-to-grain, multiplied by all applicable adjustment factors except C_P.

3.2.3 SDS Wood Screws: Fasteners used with the hold-down assemblies described in Tables 1B, 2B, 2D, 3B, 4, and 5B must be Simpson Strong-Tie SDS wood screws recognized in ESR-2236. Model numbers shown in this report do not include the SDS model number after the hold-down model number (e.g., HDU4-SDS2.5), but the information shown applies. SDS screws used in contact with preservative-treated or fire-retardant-treated lumber must, as a minimum, comply with ESR-2236. The lumber treater or Simpson Strong-Tie Company should be contacted for recommendations on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant-treated lumber.

3.2.4 Threaded Rods: As a minimum, threaded steel rods must comply with ASTM A307 A36 or F1554.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Hold-down Assembly: The allowable loads shown in Tables 1B, 2B, 2D, 3B, and 5B of this report are for hold-down assemblies consisting of the following components: (1) hold-down device; (2) an anchor bolt/rod attached to the seat of the device; (3) a wood member, having minimum specified dimensions and properties; (4) quantity and size of SDS wood screws used to attach the hold-down device to the wood member; and, in some cases as noted, (5) bearing plates or washers. The allowable loads for these assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the National Design Specification (NDS) for Wood Construction. The assembly must have an allowable strength equal to or exceeding the required strength of the assembly under the action of the ASD (Allowable Stress Design) load combinations referenced in the applicable code.

Where design load combinations include earthquake loads or effects, story drifts of the structure must be determined in accordance with Section 12.8.6 of ASCE 7

by using strength-level seismic forces without reduction for ASD. The deflection of a shear wall restrained from overturning by hold-downs installed in accordance with this report is calculated using Equation 23-2 shown in Section 2305.3 of the IBC, or Equation 4.3-1 shown in Section 4.3.2 of ANSI/AF&PA SDPWS-2008 (Special Design Provisions for Wind and Seismic). The total deflection values, Δ_{all} and Δ_s, at ASD-level and strength-level forces, respectively, for hold-down assemblies shown in Tables 1B, 2B, 3B, and 5B of this report, include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation where the unbraced length of the rod is a maximum of 6 inches (152 mm) for assemblies using HDU, HDQ, HHDQ, and PHD hold-downs; and a maximum of 4.5 inches (114 mm) for assemblies using DTT2 hold-downs. The contribution of the hold-down anchor rod elongation to the total elongation (deflection) of the hold-down assembly needs to be considered when the actual diameter, length, or ASTM steel specification of the anchor rod differs from that described in this report.

Please note: When seismic governs, the symbol Δ_s as used in this report for hold-down *assemblies* refers to the symbol d_a in Section 2305.3 of the IBC and to the symbol Δ_a in Section 4.3.2 of ANSI/AF&PA SDPWS-2008.

Tabulated allowable loads are for hold-downs connected to wood used under continuously dry interior conditions, and where sustained temperatures are 100ºF (37.8ºC) or less.

When hold-downs are fastened to wood having a moisture content greater than 19 percent (16 percent for engineered lumber), or where wet service is expected, the allowable loads shown in Tables 1B, 2B, 2D, 3B and 4 of this report must be adjusted by the wet service factor, C_M, specified in the NDS.

When hold-downs are fastened to wood that will experience sustained exposure to temperatures exceeding 100ºF (37.8ºC), the allowable loads shown in Tables 1B, 2B, 2D, 3B, and 5B in this report must be adjusted by the temperature factor, C_t, specified in the NDS.

The design of wood members fastened to the hold-down devices must consider combined stresses due to axial tension or compression, and flexural bending induced by eccentricities in the connection about either or both axes, relative to the centroid of the wood member. Stresses must be evaluated at the critical net section for total combined stress in accordance with the NDS.

The design of hold-downs used in series must account for the cumulative deformation of all hold-downs within that series.

4.1.2 Hold-down Devices Used as Anchorage of Structural Walls: Allowable tensile strengths and strength-level displacements are specified in Table 1C for HDU hold-down devices. Allowable tensile and compressive strengths and corresponding displacements are specified in Table 2C for HDQ8/HHDQ hold-down devices. These values are for the steel anchorage device independent of the SDS screws and anchor rod, and are used when designing structural wall anchorage in accordance with Section 12.11.2.2.2 of ASCE 7. Allowable compression loads of a structural wall anchorage system consisting of HDQ8/HHDQ hold-down devices, wood members, SDS wood screws, and threaded anchor rod, are shown in Table 2D. Axial compression of the anchor rod must be calculated when the actual diameter, length, or ASTM steel specification of the anchor rod differs from that described in the footnotes to Table 2D. The effective length and slenderness ratio of anchor rods subject to axial compression loads must be determined using accepted engineering principles.

4.1.3 Anchorage to Concrete or Masonry: Adequate embedment length and anchorage details, including edge and end distances, must be determined by a registered design professional in accordance with Chapters 19 or 21 of the IBC, as applicable, for design of anchorage to concrete and masonry structural members.

Where design load combinations include earthquake loads or effects, the design strength of anchorage to concrete must be determined in accordance with Section 1909 of the 2012 IBC or Section 1912 of the 2009 or 2006 IBC, except for detached one- and two-family dwellings assigned to Seismic Design Category A, B or C, or located where the mapped short-period spectral response acceleration, S_s, is less than 0.4g.

4.2 Installation:

Installation of the Simpson Strong-Tie hold-down connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

4.3 Special Inspection:

4.3.1 IBC: For compliance with the 2012 or 2009 IBC, a statement of special inspection must be prepared by the registered design professional in responsible charge, and submitted to the code official for approval, where required by Section 1704.3 of the 2012 IBC or Section 1705 of the 2009 IBC. For compliance with the 2006 IBC, a quality assurance plan must be submitted to the code official for approval, where required by Sections 1705 or 1706 of the 2006 IBC. Special inspections for seismic resistance must be conducted as required, and in accordance with the appropriate sections of Chapter 17 of the IBC. Special inspections for anchor bolts in concrete or masonry must be conducted in accordance with Section 1705.3 or 1705.4 of the 2012 IBC; and Section 1704.4 or 1704.5 of the 2009 and 2006 IBC.

4.3.2 IRC: For installations under the IRC, special inspection is not normally required. However, for an engineered design where calculations are required to be signed by a registered design professional, periodic special inspection requirements and exemptions are as stated in Section 4.3.1, as applicable for installations under the IRC.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie hold-down connectors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of steel hold-down connectors with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.3 of this report.

5.6 Anchorage to concrete or masonry structural members must be designed in accordance with Section 4.1.3 of this report.

5.7 No further duration of load increase for wind or earthquake loading is allowed.

5.8 Welded hold-downs (models HHDQ11 and HHDQ14) are manufactured under a quality control program with inspections by Benchmark Holdings, LLC (AA-660).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Hold-downs (Tie-downs) Attached to Wood Members (AC155), dated October 2005 (editorially revised September 2012).

7.0 IDENTIFICATION

The hold-down devices described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of the index evaluation report (ESR-2523) which contains a summary of all the product model numbers in the ICC-ES evaluation reports listed in that report for this manufacturer. The SDS wood screws are identified as described in evaluation report ESR-2236.

TABLE 1A—DIMENSIONS AND FASTENER REQUIREMENTS FOR HDU SERIES HOLD-DOWN CONNECTORS

HOLD-DOWN MODEL NO.	DIMENSIONS (in)					ANCHOR BOLT DIA. (in)	SDS SCREW QUANTITY
	H	W	B	CL	SO		
HDU2	$8^{11}/_{16}$	3	$3^{1}/_{4}$	$1^{1}/_{4}$	$1^{3}/_{8}$	$^{5}/_{8}$	6
HDU4	$10^{15}/_{16}$	3	$3^{1}/_{4}$	$1^{1}/_{4}$	$1^{3}/_{8}$	$^{5}/_{8}$	10
HDU5	$13^{3}/_{16}$	3	$3^{1}/_{4}$	$1^{1}/_{4}$	$1^{3}/_{8}$	$^{5}/_{8}$	14
HDU8	$16^{5}/_{8}$	3	$3^{1}/_{2}$	$1^{1}/_{4}$	$1^{1}/_{2}$	$^{7}/_{8}$	20
HDU11	$22^{1}/_{4}$	3	$3^{1}/_{2}$	$1^{1}/_{4}$	$1^{1}/_{2}$	1	30
HDU14	$25^{21}/_{32}$	3	$3^{1}/_{2}$	$1^{9}/_{16}$	$1^{9}/_{16}$	1	36

For **SI:** 1 inch = 25.4 mm.

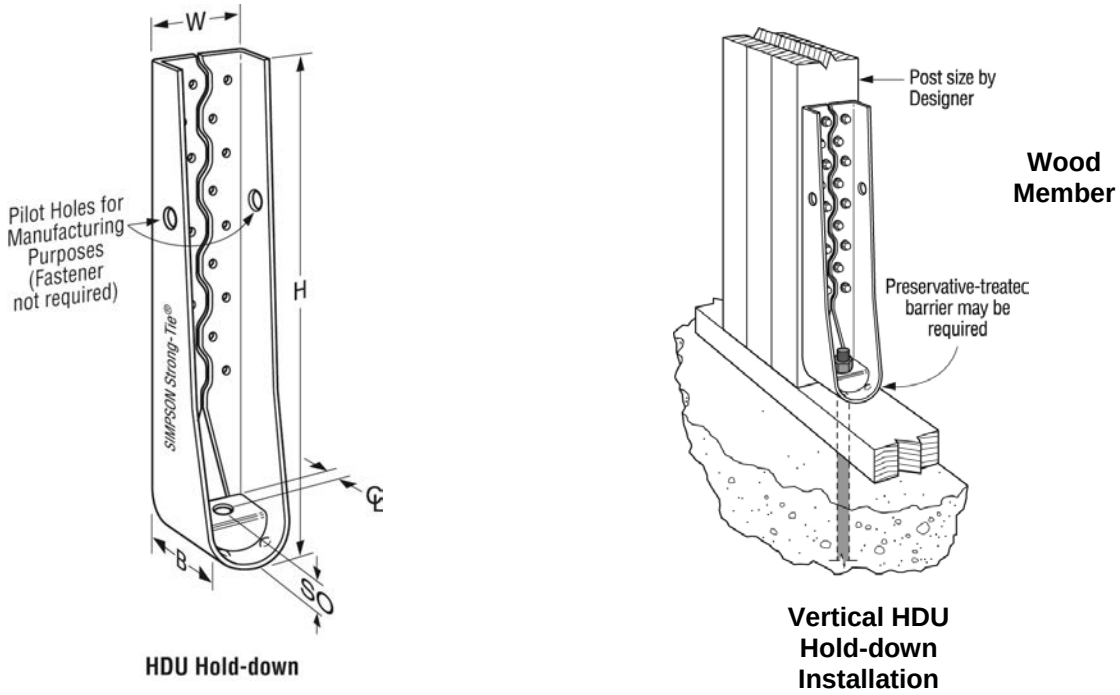


FIGURE 1—HDU SERIES HOLD-DOWNS

TABLE 1B—ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR HDU SERIES HOLD-DOWN ASSEMBLIES[1,2,3,4]

HOLD-DOWN MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE TENSION LOADS[5], P_{all} (lbs) C_D = 1.33 or C_D = 1.6						DISPLACEMENT Δ AT MAXIMUM LOAD[8,9] (in.)	
		Wood Member Thickness[6] (in.)							
		3	3.5	4.5	5.5	7.25	5.5[(7)]	Δ_{all}	Δ_s
HDU2	$^1/_4$x1.5	1,810	1,810	1,810	1,810	1,810	1,810	0.069	0.090
	$^1/_4$x2.5	3,075	3,075	3,075	3,075	3,075	3,075	0.088	0.118
HDU4	$^1/_4$x1.5	3,105	3,105	3,105	3,105	3,105	3,105	0.083	0.108
	$^1/_4$x2.5	4,565	4,565	4,565	4,565	4,565	4,565	0.114	0.154
HDU5	$^1/_4$x1.5	3,960	3,960	3,960	3,960	3,960	3,960	0.109	0.142
	$^1/_4$x2.5	5,645	5,670	5,670	5,670	5,670	5,670	0.115	0.158
HDU8	$^1/_4$x1.5	5,980	5,980	5,980	5,980	5,980	5,980	0.087	0.115
	$^1/_4$x2.5	5,980	6,970	7,870	7,870	7,870	7,870	0.113	0.161
HDU11	$^1/_4$x2.5	—	—	—	9,535	11,175[(10)]	11,175	0.137	0.182
HDU14	$^1/_4$x2.5	—	—	—	—	14,390[(10)]	14,445	0.172	0.239

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table. The quantity of SDS wood screws must comply with Table 1A.
[2]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down assembly must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_s deformations.
[6]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be $3^1/_2$ inches, except as noted.
[7]The minimum width of the wood members must be $5^1/_2$ inches (6x6 nominal).
[8]Tabulated displacement values, Δ_{all} and Δ_s, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength-level forces, respectively.
[9]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 6 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 6 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all}, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_s, to account for anchor rod elongation.
[10]Requires a heavy hex anchor nut to achieve tabulated tension loads.

TABLE 1C—ALLOWABLE TENSION LOADS AND DISPLACEMENTS OF HDU SERIES HOLD-DOWN CONNECTORS[1,2,3]

HOLD-DOWN MODEL NO.	ALLOWABLE TENSION LOAD, P_{all} (lbs)	DISPLACEMENT Δ AT MAX LOAD[4] (in)	
		Δ_{all}	Δ_s
HDU2	3,505	0.081	0.110
HDU4	4,990	0.089	0.117
HDU5	5,670	0.078	0.107
HDU8	9,950	0.131	0.164
HDU11	11,905	0.121	0.157
HDU14	15,905[(5)]	0.124	0.172

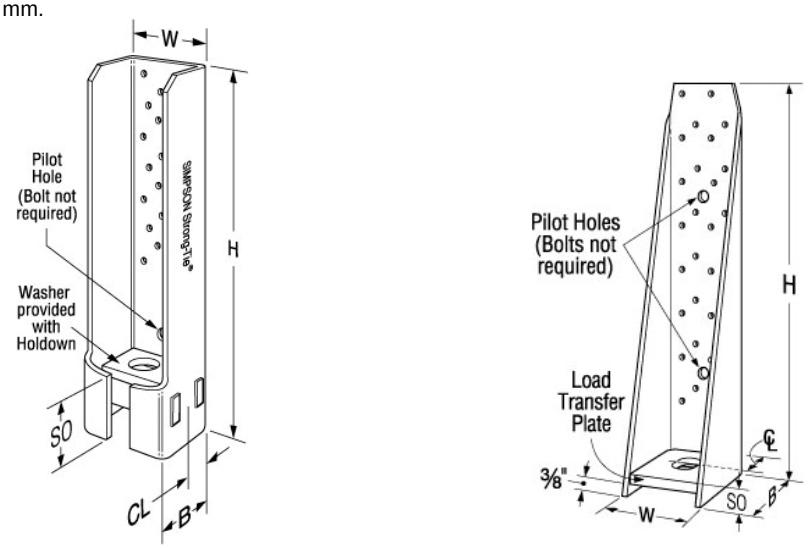
For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]This table lists the allowable tensile strength of the steel hold-down connectors exclusive of fasteners and anchor rods when tested on a steel jig.
[2]Allowable tension loads are applicable for designs complying with Section 12.11.2.2.2 of ASCE 7.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Δ_{all} is the displacement at the tabulated ASD load and Δ_S is displacement at the strength-level load. Tabulated displacement values in Table 1C consist only of deformation of the hold-down (tie-down) device when tested on a steel jig. Other variables contributing to total displacement, d_a, such as fastener slip, wood shrinkage, and anchor bolt/rod elongation, must be checked by the registered design professional. The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[5]Requires a heavy hex anchor nut to achieve tabulated tension loads.

TABLE 2A—DIMENSIONS AND FASTENER REQUIREMENTS FOR HDQ8/HHDQ HOLD-DOWN CONNECTORS

HOLD-DOWN MODEL NO.	DIMENSIONS (in)					ANCHOR BOLT DIA. (in)	SDS SCREW QUANTITY
	H	W	B	CL	SO		
HDQ8	14	$2^{7}/_{8}$	$2^{1}/_{2}$	$1^{1}/_{4}$	$2^{3}/_{8}$	$^{7}/_{8}$	20
HHDQ11	$15^{1}/_{8}$	3	$3^{1}/_{2}$	$1^{1}/_{2}$	$^{7}/_{8}$	1	24
HHDQ14	$18^{3}/_{4}$	3	$3^{1}/_{2}$	$1^{1}/_{2}$	$^{7}/_{8}$	1	30

For **SI:** 1 inch = 25.4 mm.



HDQ8 Hold-down **HHDQ Hold-down**

FIGURE 2A—HDQ8/HHDQ SERIES HOLD-DOWNS

TABLE 2B—ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR HDQ8/HHDQ SERIES HOLD-DOWN ASSEMBLIES[1,2,3,4]

HOLD-DOWN MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE TENSION LOADS[5], P_{all} (lbs) C_D = 1.33 or C_D = 1.6						DISPLACEMENT[8,9] Δ AT MAX LOAD (in)	
		Wood Member Thickness[6] (in.)							
		3	3.5	4.5	5.5	7.25	5.5[(7)]	Δ_{all}	Δ_s
HDQ8	$^{1}/_{4}$x1.5	5,715	5,715	5,715	5,715	5,715	5,715	0.073	0.093
	$^{1}/_{4}$x2.5	5,715	5,715	7,280	7,280	7,280	7,280	0.091	0.121
	$^{1}/_{4}$x3	5,715	7,630	9,230	9,230	9,230	9,230	0.095	0.130
HHDQ11	$^{1}/_{4}$x2.5	—	—	—	11,810	11,810	11,810[(10)]	0.131	0.168
HHDQ14	$^{1}/_{4}$x2.5	—	—	—	—	13,015	13,710[(10)]	0.107	0.144

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table above. The quantity of SDS wood screws must comply with Table 2A.
[2]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads, that tabulated allowable loads for the hold-down assembly must not be increased by $33^{1}/_{3}$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_S deformations.
[6]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be $3^{1}/_{2}$ inches, except as noted.
[7]The minimum width of the wood members must be $5^{1}/_{2}$ inches (6x6 nominal).
[8]Tabulated displacement values, Δ_{all} and Δ_S, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength-level forces, respectively.
[9]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 6 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 6 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all}, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_s, to account for anchor rod elongation.
[10]Requires a heavy hex anchor nut to achieve tabulated tension loads.

TABLE 2C—ALLOWABLE TENSION AND COMPRESSION LOADS AND DISPLACEMENTS FOR HDQ AND HHDQ SERIES HOLD-DOWN CONNECTORS[1,2,3]

MODEL NO.	ALLOWABLE LOAD[4], P_{all} (lbs)		DISPLACEMENT[5] Δ AT MAXIMUM LOAD (in.)			
			Tension		Compression	
	Tension	Compression	Δ_{all}	Δ_s	Δ_{all}	Δ_s
HDQ8	12,200	7,725	0.080	0.101	0.052	0.067
HHDQ11	12,290	9,745	0.053	0.068	0.086	0.120
HHDQ14	14,605[(6)]	11,010[(6)]	0.036	0.052	0.070	0.097

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]This table lists the allowable tensile and compressive strengths of the steel hold-down connectors exclusive of fasteners and anchor rods when tested on a steel jig.
[2]Allowable tension and compression loads are applicable for designs complying with Section 12.11.2.2.2 of ASCE 7.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]The designer must verify that the hold-down anchor bolt is adequate to resist compression forces based on the unbraced length of the anchor bolt.
[5]Δ_{all} is the displacement at the tabulated ASD loads and Δ_S is displacement at strength-level loads. Tabulated displacement values in Table 2C consist only of deformation of the hold-down (tie-down) device when tested on a steel jig. Other variables contributing to total displacement, d_a, such as fastener slip, wood shrinkage, and anchor bolt/rod elongation, must be checked by the registered design professional. The tabulated allowable tension and compression (ASD) loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[6]A heavy hex anchor nut is required to achieve tabulated loads.

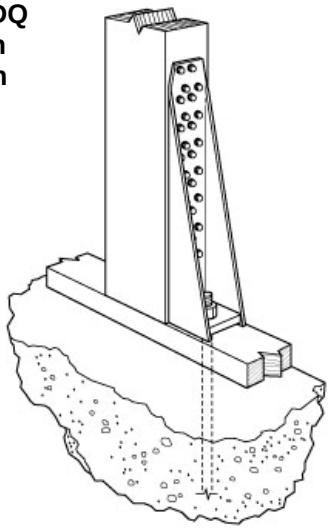
TABLE 2D—ALLOWABLE COMPRESSION LOADS AND DISPLACEMENTS FOR HDQ8/HHDQ SERIES HOLD-DOWN ASSEMBLIES[1,2,3]

MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE COMPRESSION LOADS[4], P_{all} (lbs) C_D = 1.33 or C_D = 1.6						DISPLACEMENT[5,6] Δ AT MAX LOAD (in)	
		Wood Member Thickness[7] (in.)							
		3	3.5	4.5	5.5	7.25	5.5[(8)]	Δ_{all}	Δ_s
HDQ8	$^1/_4$x1.5	5,570	5,570	5,570	5,570	5,570	5,570	0.038	0.045
	$^1/_4$x2.5	5,570	5,570	7,825	7,825	7,825	7,825	0.049	0.075
	$^1/_4$x3	5,570	5,570	8,995	8,995	8,995	8,995	0.053	0.076
HHDQ11	$^1/_4$x2.5	—	—	—	10,860	10,860	10,860[(9)]	0.109	0.143
HHDQ14	$^1/_4$x2.5	—	—	—	—	12,035	12,035[(9)]	0.081	0.110

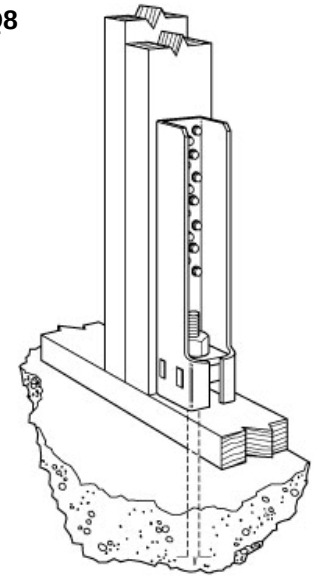
For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

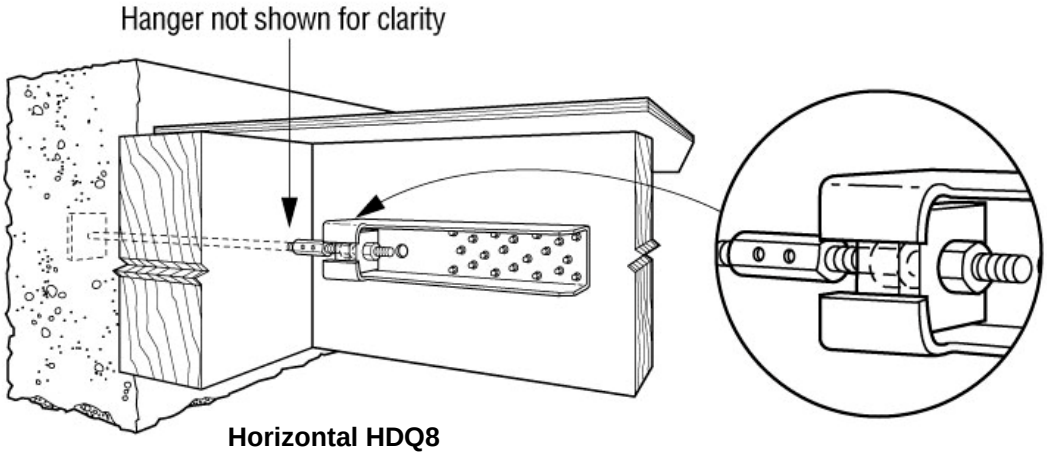
[1]Tabulated allowable compression loads are for a HDQ8 AND HHDQ Series hold-down assemblies consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table. The quantity of SDS wood screws must comply with Table 2A.
[2]Allowable compression loads are applicable for design of anchorage assemblies for structural walls in accordance with Section 12.11 of ASCE 7.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down assemblies must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]The tabulated allowable compression load does not consider the end bearing capacity of the connected wood member.
[5]Δ_{all} is the displacement at the tabulated ASD loads and Δ_S is displacement at strength-level loads. The tabulated allowable tension and compression (ASD) loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[6]The registered design professional must verify that the hold-down anchor bolt is adequate to resist design compression forces based on the unbraced length of the anchor bolt.
[7]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be $3^1/_2$ inches, except as noted.
[8]The minimum width of the wood members must be $5^1/_2$ inches (6x6 nominal).
[9]A heavy hex anchor nut is required to achieve tabulated loads.

Vertical HHDQ Hold-down Installation



Vertical HDQ8 Hold-down Installation





Horizontal HDQ8 Hold-down Installation

FIGURE 2B—TYPICAL INSTALLATIONS OF HDQ8/HHDQ SERIES HOLD-DOWNS

TABLE 3A—DIMENSIONS AND FASTENER REQUIREMENTS FOR PHD SERIES HOLD-DOWN CONNECTORS

MODEL NO.	DIMENSIONS (in)					ANCHOR BOLT DIA (in)	SDS SCREW QUANTITY
	H	W	B	CL	SO		
PHD2	$9^{5}/_{16}$	$2^{7}/_{8}$	$2^{13}/_{16}$	$1^{3}/_{8}$	$1^{3}/_{8}$	$^{5}/_{8}$	10
PHD5	$11^{9}/_{16}$	$2^{7}/_{8}$	$2^{13}/_{16}$	$1^{3}/_{8}$	$1^{3}/_{8}$	$^{5}/_{8}$	14
PHD6	$13^{13}/_{16}$	$2^{15}/_{16}$	$2^{13}/_{16}$	$1^{3}/_{8}$	$1^{3}/_{8}$	$^{7}/_{8}$	18

For **SI:** 1 inch = 25.4 mm.

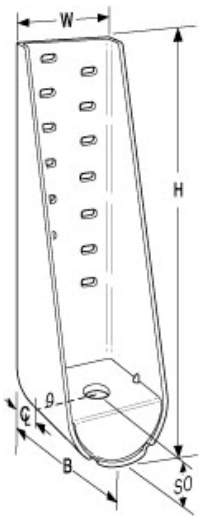
TABLE 3B—ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR PHD SERIES HOLD-DOWN ASSEMBLIES[1,2,3]

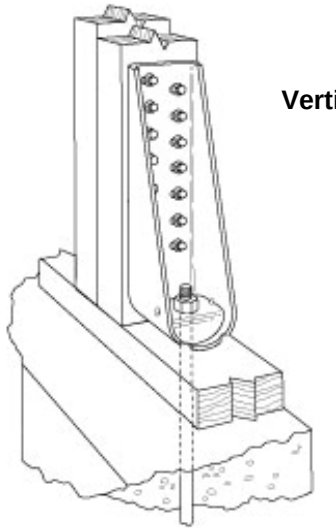
MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE TENSION LOADS, P_{all} (lbs) C_D = 1.33 or C_D = 1.6					DISPLACEMENT[5] Δ AT MAXIMUM LOAD (in)	
		Wood Member Thickness (in)						
		3	3.5	4.5	5.5	7.25	Δ_{all}	Δ_s
PHD2	$^{1}/_{4}$x1.5	2,785	2,785	2,785	2,785	2,785	0.085	0.110
	$^{1}/_{4}$x3.0	3,080	3,080	3,080	3,080	3,080	0.075	0.103
PHD5	$^{1}/_{4}$x1.5	3,395	3,395	3,395	3,395	3,395	0.081	0.107
	$^{1}/_{4}$x3.0	4,545	4,545	4,545	4,545	4,545	0.090	0.124
PHD6	$^{1}/_{4}$x1.5	4,535	4,535	4,535	4,535	4,535	0.069	0.092
	$^{1}/_{4}$x3.0	4,535	5,210	5,210	5,210	5,210	0.094	0.124

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table. The quantity of SDS wood screws must comply with Table 3A.
[2]The allowable tension loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down assembly must not be increased by $33^{1}/_{3}$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]Δ_{all} is the displacement at the tabulated ASD loads and Δ_S is displacement at strength-level loads. The tabulated allowable tension and compression (ASD) loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[6]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 6 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 6 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all} all, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_S, to account for anchor rod elongation.

PHD Hold-down





Vertical PHD Hold-down Installation

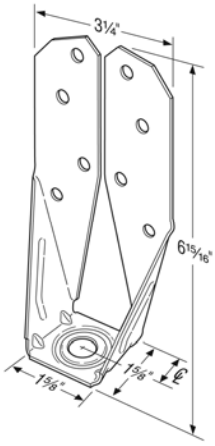
FIGURE 3—PHD SERIES HOLD-DOWNS

TABLE 4—DIMENSIONS, FASTENER REQUIREMENTS, ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR DTT2 SERIES HOLD-DOWN ASSEMBLIES[1,2,3,4,5]

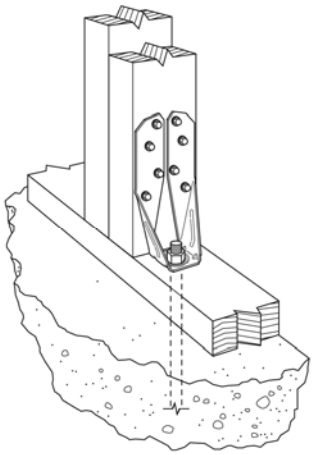
MODEL NO.	DIMENSIONS (inches)				REQUIRED FASTENERS			WOOD MEMBER THICKNESS[6] (inches)	ALLOWABLE TENSION LOADS[7], P_{all} (lbs)		DISPLACEMENT Δ AT MAXIMUM LOAD[8,9]	
					Anchor Bolt Dia.	SDS Screws						
	L	W	CL	B		Qty.	Size		C_D=1.0	C_D=1.6	Δ_{all}	Δ_s
DTT2	$6^{15}/_{16}$	$3^1/_4$	$^{13}/_{16}$	$1^5/_8$	$^1/_2$	8	SDS $^1/_4$ x $1^1/_2$	1.5	1,825	1,825	0.105	0.189
								3.0	2,000	2,145	0.128	0.241

For **SI:** 1 inch = 25.4 mm, 1 lb = 4.45 N.

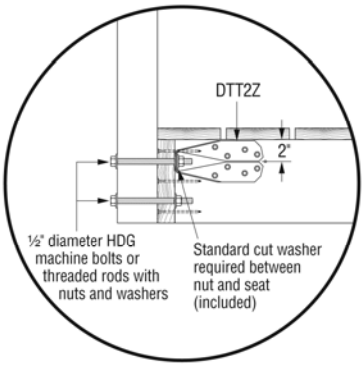
[1]One steel, plain (flat), standard plate (W) washer, as provided with the DTT2 hold-down, must be installed between the nut and the seat of the hold-down.
[2]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the fasteners noted in Table 4.
[3]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factors, C_D, corresponding with a normal duration of load (C_D=1.0) and wind/earthquake loading (C_D=1.6) in accordance with the NDS. No further increase is allowed. Reduce where other load durations govern.
[4]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind or earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads, the tabulated allowable loads for the hold-down assembly must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[5]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[6]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be $3^1/_2$ inches.
[7]The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_S deformations.
[8]Tabulated displacement values, Δ_{all} and Δ_S, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength-level forces, respectively.
[9]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 4.5 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 4.5 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all}, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_s, to account for anchor rod elongation.



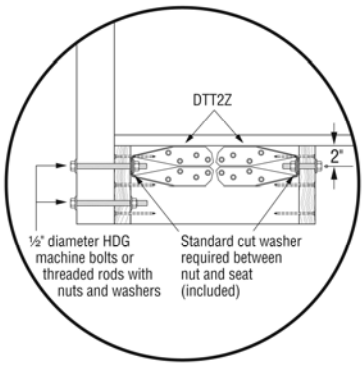
DTT2 Hold-Down



DTT2 Vertical Installation



DTT2 Horizontal Installation



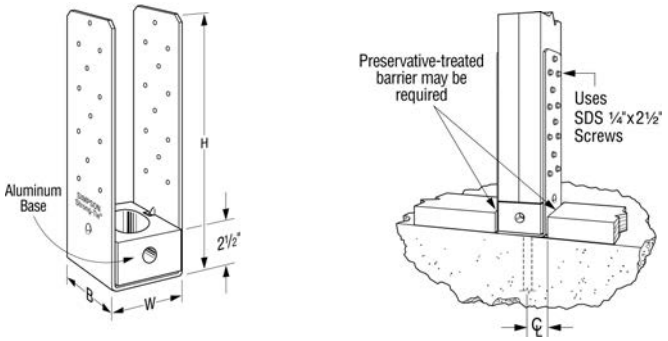
DTT2 Horizontal Installation

FIGURE 4—DTT2 HOLD-DOWN

TABLE 5A—DIMENSIONS AND FASTENER REQUIREMENTS FOR HDC SERIES HOLD-DOWN CONNECTORS

MODEL NO.	DIMENSIONS (inches)				REQUIRED FASTENERS		
	H	W	B	CL	Anchor Bolt Dia. (in)	SDS Screws	
						Qty.	Size
HDC10/22	$14^{3}/_{8}$	$3^{1}/_{8}$	3	$1^{9}/_{16}$	$^{7}/_{8}$	24	SDS $^{1}/_{4}$ x 2.5
HDC10/4	$14^{1}/_{8}$	$3^{9}/_{16}$	3	$1^{13}/_{16}$	$^{7}/_{8}$	24	SDS $^{1}/_{4}$ x 2.5

For **SI:** 1 lbf = 4.45N, 1 inch = 25.4 mm.



HDC10 Hold-Down **HDC10/22 Installation**

FIGURE 5—HDC10 HOLD-DOWN

TABLE 5B—ALLOWABLE TENSION/COMPRESSION LOADS AND DISPLACEMENTS FOR HDC SERIES HOLD-DOWN ASSEMBLES[1,2,3,4,12]

MODEL NO.	POST SIZE[7,9]	TENSION (Uplift)[5] C_D = 1.6			COMPRESSION (Download)[6,7]			
					C_D = 1.0	C_D = 1.6 [(8)]		
		Allowable Tension Load, P_{all} [(10)] (lbs)	Displacement, Δ, at maximum load (in) [(11)]		Allowable Compression Load, P_{all} (lbs)	Allowable Compression Load, P_{all} [(10)] (lbs)	Displacement, Δ, at maximum load (in) [(11)]	
			Δ_{all}	Δ_s			Δ_{all}	Δ_s
HDC10/22	2-2x4	9,135	0.054	0.073	7,070	9,255	0.027	0.034
HDC10/4	4x4	9,135	0.054	0.073	9,600	10,550	0.029	0.036

For **SI:** 1 lbf = 4.45N, 1 inch = 25.4 mm.

[1]One steel, plain (flat), SAE narrow (N) washer, as provided with the HDC10 hold-down, must be installed between the nut and the bottom of the U-shaped steel component of the hold-down.
[2]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, as shown in the table in accordance with the NDS. No further increase is allowed, except as noted in footnote 8, below.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind or earthquake loading. When using the alternate basic load combinations, in IBC Section 1605.3.2 that include wind or earthquake loads, the tabulated allowable loads for the hold-down assembly must not be increased by $33^{1}/_{3}$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]Allowable tension loads are for the hold-down assembly, consisting of the hold-down device attached to a wood structural member with the size and quantity of SDS wood screws noted in Table 5A.
[6]Allowable compression loads are based on the lesser of: a) the allowable compression load based on testing of the hold-down assembly, b) the calculated allowable concrete bearing strength, and c) the calculated bearing capacity of the wood members on the aluminum base.
[7]The wood member(s) must have a minimum F_c* of 1550 psi, where F_c* is the NDS-specified reference compression design value parallel-to-grain, multiplied by all applicable adjustment factors except C_P, and must be installed such that they bear directly upon the aluminum base. The bottom of the HDC10 hold-down must bear directly on concrete having a minimum compressive strength, f'_c, of 2,500 psi.
[8]Allowable compression loads corresponding to a load duration factor of C_D=1.6 are governed by the concrete bearing strength, based on an assumed f'_c of 2,500 psi and a gross bearing area of 9.38 in^2. The allowable compression loads, and the corresponding displacements may be linearly increased for higher concrete compressive strengths, up to maximum values as follows:

Model No.	P_{all} (lbs)	Δ_{all} (in)	Δ_s (in)
HDC10/22	11,315	0.031	0.038
HDC10/4	15,360	0.036	0.047

All other aspects of the foundation design, including but not limited to design for applicable shear and flexural stresses induced by the hold-down, must be considered by the designer.
[9]The cumulative thickness of the wood member(s) (i.e., the dimension parallel to the long axis of the SDS wood screws) must be 3 inches for the HDC10/22, and $3^{1}/_{2}$ inches for the HDC10/4. The minimum width of the wood members must be $3^{1}/_{2}$ inches.
[10]The tabulated allowable (ASD) loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_s deformations.
[11]Tabulated displacement values, Δ_{all} and Δ_s, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, and hold-down device extension or compression, at ASD-level and strength-level forces, respectively.
[12]Due to the possibility of galvanic action, the HDC10 must be limited to covered end-use installations with dry conditions of use.

HRS/ST/PS/HST/HTP/LSTA/LSTI/MST/MSTA/ MSTC/MSTI Strap Ties

Straps are designed to transfer tension loads in a wide variety of applications.

HRS - A 12 gauge strap with a nailing pattern designed for installation on the edge of 2x members. The HRS416Z installs with Simpson Strong-Tie® Strong-Drive® SDS screws.

LSTA and MSTA - Designed for use on the edge of 2x members, with a nailing pattern that reduces the potential for splitting.

LSTI - Light straps that are suitable where pneumatic-nailing is necessary through diaphragm decking and wood chord open web trusses.

MST - Splitting may be a problem with installations on lumber smaller than 3 1/2"; either fill every nail hole with 10dx1 1/2" nails or fill every-other hole with 16d common nails. Reduce the allowable load based upon the size and quantity of fasteners used.

MSTC - High Capacity strap which utilizes a staggered nail pattern to help minimize wood splitting. Nail slots have been countersunk to provide a lower nail head profile.

Finish: PS—HDG; HST3 and HST6—Simpson Strong-Tie® gray paint; all others—galvanized. Some products are available in stainless steel or ZMAX® coating; see Corrosion Information.

Installation: Use all specified fasteners. See General Notes.

Some products may be installed with the Strong-Drive® SD Structural Connector screw - click here for details

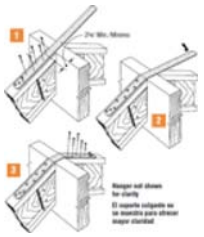
Options: Special sizes can be made to order. Contact Simpson Strong-Tie.

Codes: MSTC and RPS meet code requirements for reinforcing cut members (16 gauge) at top plate and RPS at sill plate.
International Residential Code®- 2000/2006 R602.6.1
International Building Code®- 2000/2006 2308.9.8

See RPS.

Load Tables
Floor-to-Floor Clear Span Table
Gallery of images
Code Reports
Drawings
Catalog Page
Related Categories
Technical Bulletins
Fliers
Help for downloads

INSTALLATION

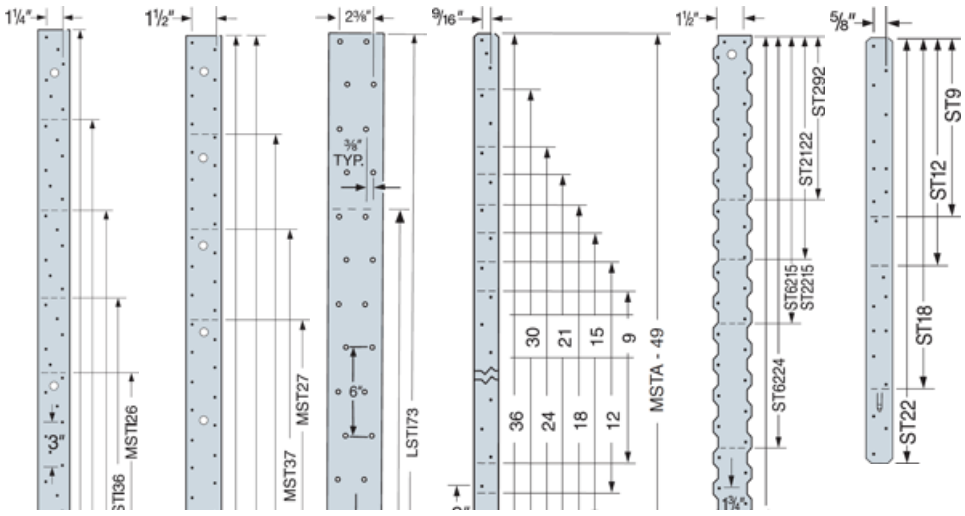


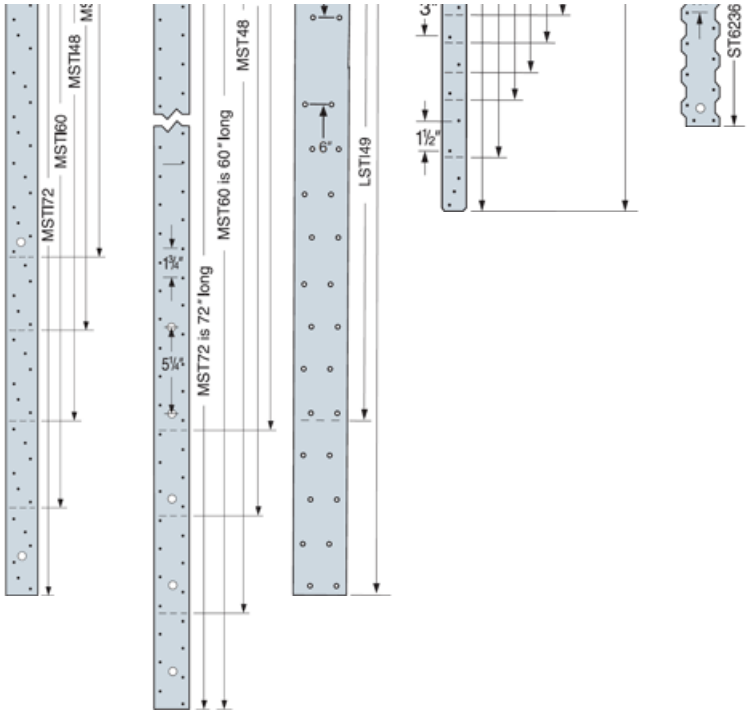
View step-by-step installation instructions

Gallery:

▲top

MSTI | MST | LSTI | LSTA and MSTA (Pilot holes not shown) | ST | ST9, ST12, ST18, ST22



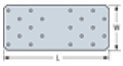


roll over images below to see larger image

MSTC
(MSTC28 shown; MSTC40, MSTC52,

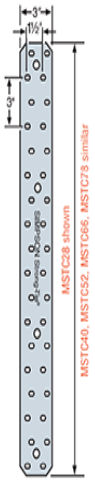
MSTC66, MSTC78 similar)

ST2115



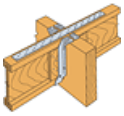
HTP37Z

HST



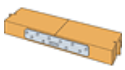
HRS

HRS416Z



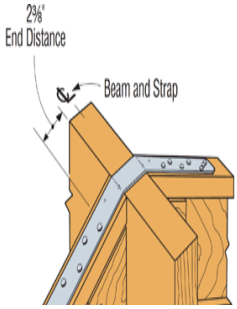
Typical MSTI Installation (MIT hanger shown) LSTI similar

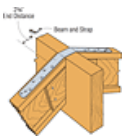
Typical LSTI Installation



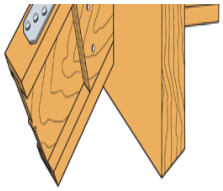
Typical HRS Installation

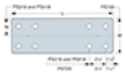
roll over images below to see larger image



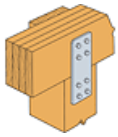


Typical LSTA Installation (hanger not shown)
Bend strap one time only





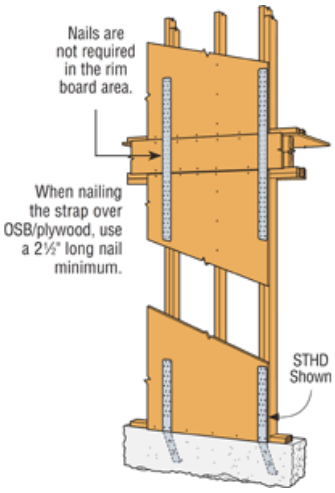
PS



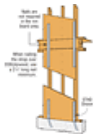
Typical PS720 Installation

Model No.	Material Thickness Gauge	Dim.		Bolts	
		W	L	Qty	Dia
PS218	7 ga	2	18	4	¾
PS418		4	18	4	¾
PS720		6¾	20	8	½

PS strap design loads must be determined by the Designer for each installation. Bolts are installed both perpendicular and parallel-to- grain. Hole diameter in the part may be oversized to accommodate the HDG. Designer must determine if the oversize creates an unacceptable installation.



roll over images below to see larger image



Typical Detail with Strap Installed Over Sheathing

Floor-to-Floor Tie Installation showing a Clear Span

Floor-to-Floor Clear Span Table:

▲top

These models are approved for installation with the Strong-Drive SD Structural-Connector screw.
See the load values below.

Model No.	Clear Span	Fasteners (Total)	Allowable Tension Loads (DF/SP) (160)	Allowable Tension Loads (SPF/HF) (160)
MSTA49	18	26-10d	2020	2020
	16	26-10d	2020	2020
MSTC28	18	12-16d sinkers	1155	995
	16	16-16d sinkers	1540	1325
MSTC40	24	20-16d sinkers	2310	1985
	18	28-16d sinkers	2695	2320
	16	32-16d sinkers	3080	2650
MSTC52	24	36-16d sinkers	3465	2980
	18	44-16d sinkers	4235	3645
	16	48-16d sinkers	4620	3975
MSTC66	30	48-16d sinkers	4780	4120
	24	54-16d sinkers	5380	4640
	18	64-16d sinkers	5860	5495
	16	68-16d sinkers	5860	5840
MSTC78	30	64-16d sinkers	5860	5495
	24	72-16d sinkers	5860	5860
	18	76-16d sinkers	5860	5860
MST37	24	14-16d	1725	1495
	18	20-16d	2465	2135
	16	22-16d	2710	2345
MST48	24	26-16d	3215	2780
	18	32-16d	3960	3425
	16	34-16d	4205	3640
MST60	30	34-16d	4605	3995
	24	40-16d	5240	4700
	18	46-16d	6235	5405
MST72	30	48-16d	6505	5640
	24	54-16d	6730	6345
	18	62-16d	6730	6475

1. Loads include a 60% load duration increase on the fasteners for wind or earthquake loading
2. Install bolts or nails as specified by Designer. Bolt and nail values may not be combined.
3. Allowable bolt loads are based on parallel-to-grain loading and these minimum member thicknesses: MST – 2 1/2"; HST2 and
   HST5 – 4"; HST3 and HST6 – 4 1/2".
4. Use half of the required nails in each member being connected to achieve the listed loads.
5. When installing strap over wood structural panel sheathing, use 2 1/2" long nail minimum.
6. Tension loads apply for uplift as well when installed vertically.
7. NAILS: 16d = 0.162" dia. x 3 1/2" long, 16d Sinker = 0.148" dia. x 3 1/4" long, 10dx1 1/2 = 0.148" dia. x 1 1/2" long. See other nail sizes and information.

Load Tables: See code report listings below ▲top

Load Values with Nails

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These models are approved for installation with the Strong-Drive SD Structural-Connector screw. See the load values below.

Model No.	Ga	Dimensions		Fasteners (Total)	Allowable Tension Loads (DF/SP)	Allowable Tension Loads (SPF/HF)
		W	L		(160)	(160)
LSTA9	20	1¼	9	8-10d	740	635
LSTA12		1¼	12	10-10d	925	795
LSTA15		1¼	15	12-10d	1110	950
LSTA18		1¼	18	14-10d	1235	1110
LSTA21		1¼	21	16-10d	1235	1235
LSTA24		1¼	24	18-10d	1235	1235
ST292		2 5/16	9 5/16	12-16d	1265	1120
ST2122		2 5/16	12 13/16	16-16d	1530	1505
ST2115		¾	16 5/16	10-16d	660	660
ST2215		2 5/16	16 5/16	20-16d	1875	1875
LSTA30	18	1¼	30	22-10d	1640	1640
LSTA36		1¼	36	24-10d	1640	1640
LSTI49		3¾	49	32-10dx1½	2975	2555
LSTI73		3¾	73	48-10dx1½	4205	3830
MSTA9		1¼	9	8-10d	750	645
MSTA12		1¼	12	10-10d	940	810
MSTA15		1¼	15	12-10d	1130	970
MSTA18		1¼	18	14-10d	1315	1130
MSTA21		1¼	21	16-10d	1505	1290
MSTA24		1¼	24	18-10d	1640	1455
MSTA30	16	1¼	30	22-10d	2050	1820
MSTA36		1¼	36	26-10d	2050	2050
MSTA49		1¼	49	26-10d	2020	2020
ST6215		2 5/16	16 5/16	20-16d	2095	1900
ST6224		2 5/16	23 5/16	28-16d	2540	2540
ST9		1¼	9	8-16d	885	760
ST12		1¼	11⅝	10-16d	1105	950
ST18		1¼	17¾	14-16d	1420	1330
ST22		1¼	21⅝	18-16d	1420	1420
MSTC28		3	28¼	36-16d sinkers	3455	2980
MSTC40		3	40¼	52-16d sinkers	4745	4305
MSTC52		3	52¼	62-16d sinkers	4745	4745
HTP37Z		3	7	20-10dx1½	1850	1600
MSTC66	14	3	65¾	76-16d sinkers	5860	5860
MSTC78		3	77¾	76-16d sinkers	5860	5860
ST6236		2 5/16	33 13/16	40-16d	3845	3845
HRS6	12	1⅜	6	6-10d	605	525
HRS8		1⅜	8	10-10d	1010	880
HRS12		1⅜	12	14-10d	1415	1230
MSTI26		2 5/16	26	26-10dx1½	2745	2325
MSTI36		2 5/16	36	36-10dx1½	3800	3220
MSTI48		2 5/16	48	48-10dx1½	5065	4290
MSTI60		2 5/16	60	60-10dx1½	5080	5080
MSTI72		2 5/16	72	72-10dx1½	5080	5080
HRS416Z		3¼	16	16-SDS ¼"x1½"	2835	2305

1. Loads include a 60% load duration increase on the fasteners for wind or earthquake loading
2. 10dx1 1/2" nails may be substituted where 16d sinkers or 10d are specified at 100% of the table loads except where straps are installed over sheathing.
3. 10d commons may be substituted where 16d sinkers are specified at 100% of table loads.
4. 16d sinkers (0.148" dia x 3 1/4" long) or 10d commons may be substituted where 16d commons are specified at 0.84 of the table loads.
5. Use half of the nails in each member being connected to achieve the listed loads.
6. Tension loads apply for uplift when installed vertically.
7. NAILS: 16d = 0.162" dia. x 3 1/2" long, 16d Sinker = 0.148" dia. x 3 1/4" long, 10d = 0.148" dia. x 3" long, 10dx1 1/2 = 0.148" dia. x 1 1/2" long. See other nail sizes and information.

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These models are approved for installation with the Strong-Drive SD Structural-Connector screw. See the load values below.

Model No.	Ga	Dimensions		Fasteners (Total)			Allowable Tension Loads (DF/SP)		Allowable Tension Loads (SPF/HF)	
		W	L	Nails	Bolts		Nails	Bolts	Nails	Bolts
					Qty	Dia	(160)	(160)	(160)	(160)
MST27	12	2 1/16	27	30-16d	4	1/2	3700	2165	3200	2000
MST37		2 1/16	37 1/2	42-16d	6	1/2	5080	3025	4480	2805
MST48		2 1/16	48	50-16d	8	1/2	5310	3675	5190	3410
MST60	10	2 1/16	60	68-16d	10	1/2	6730	4485	6475	4175
MST72		2 1/16	72	68-16d	10	1/2	6730	4485	6475	4175
HST2	7	2 1/2	21 1/4	—	6	5/8	—	5220	—	4835
HST5		5	21 1/4	—	12	5/8	—	10650	—	9870
HST3	3	3	25 1/2	—	6	3/4	—	7680	—	6660
HST6		6	25 1/2	—	12	3/4	—	15470	—	13320

1. Loads include a 60% load duration increase on the fasteners for wind or earthquake loading
2. Install bolts or nails as specified by Designer. Bolt and nail values may not be combined.
3. Allowable bolt loads are based on parallel-to-grain loading and these minimum member thicknesses: MST – 2 1/2"; HST2 and
   HST5 – 4"; HST3 and HST6 – 4 1/2".
4. Use half of the required nails in each member being connected to achieve the listed loads.
5. When installing strap over wood structural panel sheathing, use 2 1/2" long nail minimum.
6. Tension loads apply for uplift as well when installed vertically.
7. NAILS: 16d = 0.162" dia. x 3 1/2" long, 16d Sinker = 0.148" dia. x 3 1/4" long, 10dx1 1/2 = 0.148" dia. x 1 1/2" long. See other nail sizes and information.

Load Values with SD Series Screws

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Model No.	Fasteners (Total)	Allowable Tension Loads (DF/SP)	Allowable Tension Loads (SPF/HF)
		(160)	(160)
LSTA9	8-SD9112	1095	715
LSTA12	10-SD9112	1235	895
LSTA15	12-SD9112	1235	1075
LSTA18	14-SD9112	1235	1235
LSTA21	14-SD9112	1235	1215
LSTA24	14-SD9112	1235	1235
ST292	12-SD10112	1215	1215
ST2122	12-SD10112	1480	1325
ST2115	6-SD10112	660	660
ST2215	14-SD10112	1750	1545
LSTA30	14-SD9112	1640	1255
LSTA36	14-SD9112	1415	1255
LSTI49	16-SD9112	4205	2865
LSTI73	16-SD9112	4205	2865
MSTA9	8-SD9112	1095	715
MSTA12	10-SD9112	1370	895
MSTA15	12-SD9112	1640	1075
MSTA18	14-SD9112	1640	1255
MSTA21	14-SD9112	1640	1255
MSTA24	14-SD9112	1640	1255
MSTA30	16-SD9112	2050	1435
MSTA36	16-SD9112	1970	1435
MSTA49	16-SD9112	2050	1435
ST6215	16-SD10112	2010	1765
ST6224	20-SD10112	2460	2210
ST9	8-SD10112	1105	885
ST12	10-SD10112	1385	1105
ST18	12-SD10112	1420	1325
ST22	12-SD10112	1420	1325
MSTC28	36-SD9112	4735	3225
MSTC40	46-SD9112	4735	4120

MSTC52	42-SD9112	4735	3765
HTP37Z	20-SD9112	2735	1790
MSTC66	44-SD9112	5850	3940
MSTC78	44-SD9112	5850	3940
ST6236	28-SD10112	3590	3090
HRS6	6-SD9112	820	540
HRS8	10-SD9112	1370	895
HRS12	14-SD9112	1915	1255
MSTI26	26-SD9112	3555	2330
MSTI36	36-SD9112	4925	3225
MSTI48	38-SD9112	5070	3405
MSTI60	38-SD9112	5070	3405
MSTI72	60-SD9112	5070	4760
MST27	30-SD10112	4150	3310
MST37	40-SD10112	5070	4415
MST48	52-SD10112	5310	5035
MST60	68-SD10112	6765	6375
MST72	70-SD10112	6765	6375

Code Reports (PDFs):

▼next ▲top

					LEGACY REPORTS		
	IAPMO UES ER	ICC-ES ESR	CITY OF LOS ANGELES	STATE OF FLORIDA	ICC-ES NER	ICC-ES ER	ICC-ES ES
HRS	See specific model numbers for code listings.						
HRS12	ER-124	ESR-3096	RR25489 / RR25910	FL11470 / FL13872			
HRS416Z	No code listing: Please contact us for test data.						
HRS6	ER-124	ESR-3096	RR25489 / RR25910	FL11470 / FL13872			
HRS8	ER-124	ESR-3096	RR25489 / RR25910	FL11470 / FL13872			
HST	See specific model numbers for code listings.						
HST2		ESR-2105 / ESR-2523 *	RR25713	FL10852			
HST3		ESR-2105 / ESR-2523 *	RR25713	FL10852			
HST5		ESR-2105 / ESR-2523 *	RR25713	FL10852			
HST5-4	No code listing. Please contact us for test data.						
HST6		ESR-2105 / ESR-2523 *	RR25713	FL10852			
HST6-41/2	No code listing. Please contact us for test data.						
HTP37Z		ESR-3096	RR25910				
LSTA	See specific model numbers for code listings.						
LSTA12	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTA15	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTA18	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTA21	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTA24	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTA30	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTA36	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTA9	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTI	See specific model numbers for code listings.						
LSTI49	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
LSTI73	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MST	See specific model numbers for code listings.						
MST21/2	No code listing. Please contact us for test data.						
MST27		ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			

MST37		ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MST48		ESR-2105 / ESR-2523 *	RR25713	FL10852			
MST60		ESR-2105 / ESR-2523 *	RR25713	FL10852			
MST72		ESR-2105 / ESR-2523 *	RR25713	FL10852			
MSTA	See specific model numbers for code listings.						
MSTA12	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTA12SS	No code listing: Please contact us for test data.						
MSTA12Z	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MSTA15	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTA15Z	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MSTA18	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTA18SS	No code listing: Please contact us for test data.						
MSTA18Z	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MSTA21	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTA21Z	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MSTA24	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTA24SS	No code listing: Please contact us for test data.						
MSTA24Z	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MSTA30	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTA30Z	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MSTA36	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTA36SS	No code listing: Please contact us for test data.						
MSTA36Z	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25910	FL10852			
MSTA49	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25489 / RR25910	FL10852			
MSTA9	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTAM24Z							
MSTAM36Z							
MSTC	See specific model numbers for code listings.						
MSTC28	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTC40	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTC52	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTC66	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTC78	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTI	See specific model numbers for code listings.						
MSTI26	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTI36	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTI48	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTI60	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
MSTI72	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
PS	See specific model numbers for code listings.						
PS218	No load capacity: Products not tested or submitted because they're not load rated and code approval not required.						
PS418	No load capacity: Products not tested or submitted because they're not load rated and code approval not required.						
PS720	No load capacity: Products not tested or submitted because they're not load rated and code approval not required.						
ST	See specific model numbers for code listings.						
ST12	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST18	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			

ST2115	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST2122	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST22	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST2215	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST292	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST6215	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST6224	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST6236	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			
ST9	ER-124	ESR-2105 / ESR-2523 * / ESR-3096	RR25713 / RR25489 / RR25910	FL10852 / FL13872			

* ESR-2523 is an Index of many of Simpson Strong-Tie Stamped and Welded Cold-formed Steel Products for Wood or Cold-formed Steel Construction

Drawings: To download drawings, right-click or Ctrl-click on the link, then choose "Save Target As..."

▼next ▲top

Download the Simpson Strong-Tie® AutoCAD® Menu, which allows you to insert Ortho views directly into your AutoCAD drawing.

	ORTHOGRAPHIC	PERSPECTIVE
HRS	**None for this model**	**None for this model**
HRS12	HRS12: DWG | DXF	**None for this model**
HRS416Z	HRS416Z: DWG | DXF	HRS416Z: DWG | DXF
HRS6	HRS6: DWG | DXF	**None for this model**
HRS8	HRS8: DWG | DXF	HRS8: DWG | DXF
HST	**None for this model**	**None for this model**
HST2	HST2: DWG | DXF	**None for this model**
HST3	HST3: DWG | DXF	**None for this model**
HST5	**None for this model**	**None for this model**
HST5-4	**None for this model**	**None for this model**
HST6	**None for this model**	**None for this model**
HST6-41/2	**None for this model**	**None for this model**
HTP37Z	HTP37Z: DWG | DXF	HTP37Z: DWG | DXF
LSTA	**None for this model**	Floor to Floor Connections: DWG | DXF LSTA Method 1: DWG | DXF LSTA Method 2: DWG | DXF
LSTA12	LSTA12: DWG | DXF	High Wind-Resistant Construction D133: Load Path Installation Considerations: Cross-Grain Tension: DWG | DXF
LSTA15	LSTA15: DWG | DXF	**None for this model**
LSTA18	LSTA18: DWG | DXF	High Wind-Resistant Construction D45: Stud to Band Joist: DWG | DXF High Wind-Resistant Construction D72: Wall to Pile/Girder: DWG | DXF Floor to Floor Connections: DWG | DXF Pile to Girder Connectors 2: DWG | DXF Stud to Band Joist Connections Version 2: DWG | DXF
LSTA21	LSTA21: DWG | DXF	High Wind-Resistant Construction D58: Header to Wall Framing: DWG | DXF High Wind-Resistant Construction D70: Wall to Pile/Girder: DWG | DXF
LSTA24	LSTA24: DWG | DXF	High Wind-Resistant Construction D111: Gable End to Wall Framing: DWG | DXF
LSTA30	LSTA30: DWG | DXF	**None for this model**
LSTA36	LSTA36: DWG | DXF	High Wind-Resistant Construction D51: Floor to Masonry/Concrete: DWG | DXF
LSTA9	LSTA9: DWG | DXF	**None for this model**
LSTI	**None for this model**	LSTI: DWG | DXF
LSTI49	LSTI49: DWG | DXF	**None for this model**
LSTI73	**None for this model**	**None for this model**
MST	**None for this model**	**None for this model**
MST21/2	**None for this model**	**None for this model**

MST27	MST27: DWG | DXF	**None for this model**
MST37	MST37: DWG | DXF	**None for this model**
MST48	MST48: DWG | DXF	**None for this model**
MST60	MST60: DWG | DXF	**None for this model**
MST72	MST72: DWG | DXF	**None for this model**
MSTA	**None for this model**	High Wind-Resistant Construction D77: Post/Column to Beam: DWG | DXF
MSTA12	**None for this model**	**None for this model**
MSTA12SS	**None for this model**	**None for this model**
MSTA12Z	**None for this model**	**None for this model**
MSTA15	**None for this model**	**None for this model**
MSTA15Z	**None for this model**	**None for this model**
MSTA18	MSTA18: DWG | DXF	**None for this model**
MSTA18SS	**None for this model**	**None for this model**
MSTA18Z	**None for this model**	**None for this model**
MSTA21	**None for this model**	**None for this model**
MSTA21Z	**None for this model**	**None for this model**
MSTA24	MSTA24: DWG | DXF	**None for this model**
MSTA24SS	**None for this model**	**None for this model**
MSTA24Z	**None for this model**	**None for this model**
MSTA30	MSTA30: DWG | DXF	High Wind-Resistant Construction D118: Load Path Installation Considerations: Bulging Floor-to-Floor Straps: DWG | DXF
MSTA30Z	**None for this model**	**None for this model**
MSTA36	MSTA36: DWG | DXF	High Wind-Resistant Construction D46: Stud to Band Joist: DWG | DXF Floor to Floor Connections: DWG | DXF
MSTA36SS	**None for this model**	**None for this model**
MSTA36Z	**None for this model**	**None for this model**
MSTA49	**None for this model**	**None for this model**
MSTA9	**None for this model**	**None for this model**
MSTAM24Z	**None for this model**	**None for this model**
MSTAM36Z	**None for this model**	**None for this model**
MSTC	**None for this model**	**None for this model**
MSTC28	MSTC28: DWG | DXF	**None for this model**
MSTC40	MSTC40: DWG | DXF	**None for this model**
MSTC52	MSTC52: DWG | DXF	**None for this model**
MSTC66	MSTC66: DWG | DXF	**None for this model**
MSTC78	MSTC78: DWG | DXF	**None for this model**
MSTI	**None for this model**	MSTI: DWG | DXF
MSTI26	**None for this model**	**None for this model**
MSTI36	**None for this model**	**None for this model**
MSTI48	**None for this model**	**None for this model**
MSTI60	**None for this model**	**None for this model**
MSTI72	**None for this model**	**None for this model**
PS	**None for this model**	**None for this model**
PS218	PS218: DWG | DXF	**None for this model**
PS418	PS418: DWG | DXF	Pile to Girder Connectors 1: DWG | DXF Pile to Girder Connectors 2: DWG | DXF Stud to Band Joist Connections: DWG | DXF
PS720	PS720: DWG | DXF	High Wind-Resistant Construction D70: Wall to Pile/Girder: DWG | DXF High Wind-Resistant Construction D71: Wall to Pile/Girder: DWG | DXF High Wind-Resistant Construction D72: Wall to Pile/Girder: DWG | DXF PS720: DWG | DXF

ST	**None for this model**	**None for this model**
ST12	ST12: DWG | DXF ST12 front view: DWG | DXF ST12 right view: DWG | DXF	**None for this model**
ST18	ST18: DWG | DXF ST18 front view: DWG | DXF ST18 right view: DWG | DXF	**None for this model**
ST2115	ST2115: DWG | DXF	**None for this model**
ST2122	ST2122: DWG | DXF	**None for this model**
ST22	ST22: DWG | DXF ST22 front view: DWG | DXF ST22 right view: DWG | DXF	**None for this model**
ST2215	ST2215: DWG | DXF	**None for this model**
ST292	ST292: DWG | DXF	**None for this model**
ST6215	ST6215: DWG | DXF	**None for this model**
ST6224	ST6224: DWG | DXF	**None for this model**
ST6236	ST6236: DWG | DXF	**None for this model**
ST9	ST9: DWG | DXF ST9 front view: DWG | DXF ST9 right view: DWG | DXF	**None for this model**

Catalog Pages (PDFs):

▲top

C-2013 (Wood Construction Connectors), page 172-174

Order free catalogs by mail

Related Categories:

▲top

High Wind Resistance (Wood Construction)

Solid Sawn Lumber Connectors (Wood Construction)

Do-It-Yourself Products (Wood Construction)

Holdowns and Tension Ties (Wood Construction)

Straps and Ties (Cold-Formed Steel)

Technical Bulletins (PDFs):

▲top

City of Los Angeles RR Values for Holdowns in Shearwalls and Wall Anchorage Assemblies Expiration extended to 12/31/13

Connector Solutions to Meet the Wall-Bracing Requirements of the 2009 International Residential Code®

LSTA24 and MSTA24 Field-Formed as a Stud-to-Mudsill Anchor

Use of Pneumatically Driven Nails With Simpson Strong-Tie® Connectors

Deck-Tie

Deck-Tie (in French/en Français)

PA Foundation Straps for Uplift Resistance Expiration extended to 12/31/13

Panelized Roof Systems

Fliers (PDFs):

▲top

Strong-Drive® SD Screw for Structural Connectors Expiration extended to 12/31/13

Install Simpson Strong-Tie Connectors with SD Screws Expiration extended to 12/31/13

Uplift Connectors

The Effects of Wind

Flood-Resistant Construction Guide

Stainless-Steel Connectors

Code Compliant Repair and Protection Guide for the Installation of Utilities in Wood Frame Construction Expiration extended to 12/31/13 You can order this flier by mail.

Un Sistema Completo de Conectores para Construcción de Terrazas (en Español)

Need help with downloads?

▲top

USP Stock No.	Ref. No.	Steel Gauge	Dimensions (in) W	Dimensions (in) L	Fastener Schedule[3,7,8] Total Qty[4]	Nails Min Qty[5]	Nails Type	Bolts Min Qty[5]	Bolts Dia.	Allowable Uplift Loads (Lbs.)[1,2] DF-L / SP Nails 160%	DF-L / SP Bolts[6] 160%	S-P-F / HF Nails 160%	S-P-F / HF Bolts[6] 160%	Code Ref.
HRS6	HRS6	12	1-3/8	6	6	6	10d	-- --	-- --	640	-- --	550	-- --	130
HRS8	HRS8	12	1-3/8	8	10	10	10d	-- --	-- --	1065	-- --	920	-- --	
HRS12	HRS12	12	1-3/8	12	14	14	10d	-- --	-- --	1490	-- --	1290	-- --	
KST227	MST27, S/MST27	12	2-1/16	27	34	34	16d	4	1/2	4540	2285	3645	2020	14, F16, R14
KST237	MST37, S/MST37	12	2-1/16	37-1/2	48	48	16d	6	1/2	5140	3240	5140	2875	
KST248	MST48, S/MST48	12	2-1/16	48	62	54	16d	8	1/2	5140	3845	5140	3555	
KSTI226	MSTI26	12	2-1/16	26	26	26	10d x 1-1/2	-- --	-- --	2810	-- --	2245	-- --	
KSTI236	MSTI36	12	2-1/16	36	36	36	10d x 1-1/2	-- --	-- --	3890	-- --	3110	-- --	
KSTI248	MSTI48	12	2-1/16	48	48	48	10d x 1-1/2	-- --	-- --	5140	-- --	4145	-- --	
KSTI260	MSTI60	12	2-1/16	60	60	60	10d x 1-1/2	-- --	-- --	5140	-- --	5140	-- --	
KSTI272	MSTI72	12	2-1/16	72	72	60	10d x 1-1/2	-- --	-- --	5140	-- --	5140	-- --	
HRS416-TZ	HRS416Z	12	3-1/4	16	16	16	WS15-GC	-- --	-- --	2945	-- --	2410	-- --	130
KST260	MST60, S/MST60	10	2-1/16	60	72	64	16d	10	1/2	6720	4910	6720	4390	14, F16,
KST272	MST72, S/MST72	10	2-1/16	72	72	64	16d	10	1/2	6720	4910	6720	4390	

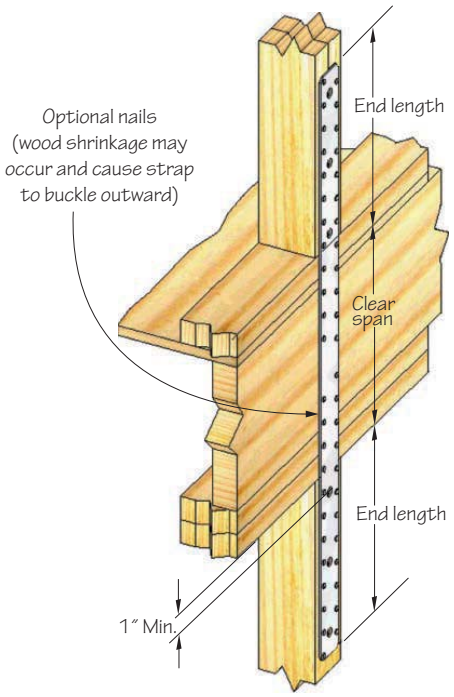
1) Allowable loads have been increased 60% for wind or seismic loads; no further increase shall be permitted.
2) Allowable loads are based on the use of either nails or bolts; nail and bolt values cannot be combined.
3) Minimum nail embedment shall be 1-1/2″ for 10d nails and 1-5/8″ for 16d nails.
4) Total number of nail and/or bolt holes provided in the strap.
5) Minimum quantity of fasteners to be installed with equal fasteners at each end of the connection. Product may have additional nail holes not needed to meet published allowable load of product.
6) Allowable bolt loads are based on parallel-to-grain loading, minimum of 2-1/2″ thick.
7) WS15-GC Wood Screws are 1/4" dia. x 1-1/2" long.
8) NAILS: 10d x 1-1/2 nails are 0.148″ dia. x 1-1/2″ long, 10d nails are 0.148″ dia. x 3″ long, 16d nails are 0.162″ dia. x 3-1/2″ long.
New products or updated product information are designated in red font.

Bolts must be ordered separately. See page 17 for available sizes.

Clear Span Chart

USP Stock No.	Ref. No.	Clear Span	10d x 1-1/2" Fasteners[4] Total[3] Qty	10d x 1-1/2" Fasteners[4] DF-L / SP Uplift 160%[1]	10d Fasteners[2] Total[4] Qty	10d Fasteners[2] DF-L / SP Uplift 160%[1]	16d Fasteners[2] Total[4] Qty	16d Fasteners[2] DF-L / SP Uplift 160%[1]
MSTC28	MSTC28	18	-- --	-- --	12	1150	12	1365
		16	-- --	-- --	16	1535	14	1590
MSTC40	MSTC40	18	-- --	-- --	28	2690	24	2725
		16	-- --	-- --	32	3070	30	3410
MSTC52	MSTC52	18	-- --	-- --	44	4225	38	4315
		16	-- --	-- --	48	4610	42	4715
MSTC66	MSTC66	18	-- --	-- --	62	6015	54	6015
		16	-- --	-- --	64	6015	54	6015
MSTC78	MSTC78	18	-- --	-- --	64	6015	54	6015
		16	-- --	-- --	66	6015	56	6015
KST237	MST37, S/MST37	18	-- --	-- --	-- --	-- --	20	2480
		16	-- --	-- --	-- --	-- --	22	2730
KST248	MST48, S/MST48	18	-- --	-- --	-- --	-- --	32	3970
		16	-- --	-- --	-- --	-- --	34	4215
KST260	MST60, S/MST60	18	-- --	-- --	-- --	-- --	46	6255
		16	-- --	-- --	-- --	-- --	48	6530
KST272	MST72, S/MST72	18	-- --	-- --	-- --	-- --	46	6255
		16	-- --	-- --	-- --	-- --	48	6530
KSTI236	MSTI36	18	14	1410	-- --	-- --	-- --	-- --
		16	16	1615	-- --	-- --	-- --	-- --
KSTI248	MSTI48	18	26	2620	-- --	-- --	-- --	-- --
		16	28	2820	-- --	-- --	-- --	-- --
KSTI260	MSTI60	18	38	3830	-- --	-- --	-- --	-- --
		16	40	4030	-- --	-- --	-- --	-- --
KSTI272	MSTI72	18	50	5040	-- --	-- --	-- --	-- --
		16	52	5240	-- --	-- --	-- --	-- --

1) Allowable loads have been increased 60% for wind or seismic loads; no further increase shall be permitted.
2) Minimum nail embedment shall be 1-1/2″ for 10d nails and 1-5/8″ for 16d nails.
3) Total number of of nail holes provided in the strap.
4) NAILS: 10d x 1-1/2 nails are 0.148″ dia. x 1-1/2″ long, 10d nails are 0.148″ dia. x 3″ long, 16d nails are 0.162″ dia. x 3-1/2″ long.



Typical *KST237* floor-to-floor installation

MP – 18 gauge. Field adjustable from 0° to 135°.

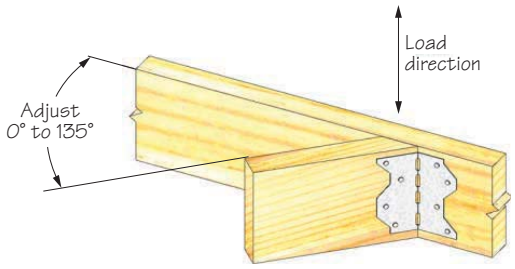
A3 – 18 gauge. Eliminates toenailing and increases strength.

AC – 16 gauge. Features staggered nail patterns which reduces wood splitting and allows installation on both sides of the supported member.

JA – 14 or 16 gauge. Heavier capacity framing angle for joist support.

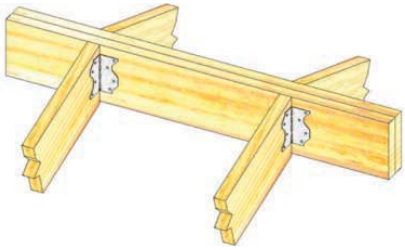
Materials: See chart
Finish: G90 galvanizing; AC7-GC, AC9-GC, MP7-GC, & MP9-GC – Gold Coat
Options: MP3, MP5, MP7, MP9, A3, AC5, AC7, AC9, & JA1 are available Triple Zinc. To order, add *TZ* to stock number, as in **MP5-TZ**.
MP5 & MP7 are available in Stainless Steel. To order, add *SS* to stock number, as in **MP7-SS.**
Codes: ESR-3455, FL820, FL822, FL13285, L.A. City RR 25745, L.A. City RR 25843.

Installation:
• Use all specified fasteners. See Product Notes, page 11.
• MP Framing Angles are fabricated at 100° and may be field adjusted by hand from 0° to 135°. Bend angle only once.

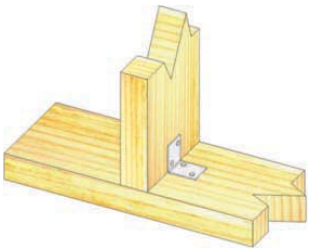


AVAILABLE IN GOLD COAT

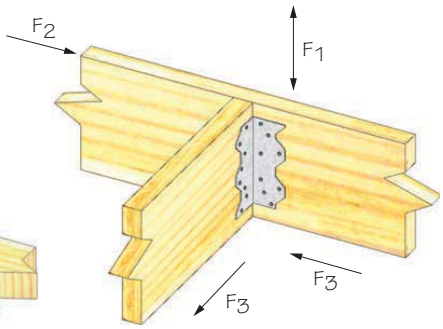
Typical *MP* installation



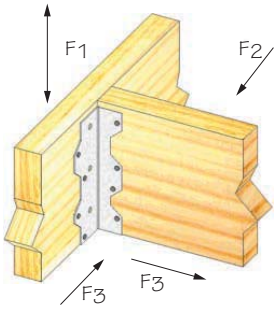
Typical *MP* Rafter Support installation



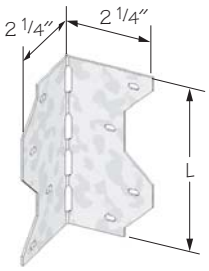
Typical *JA1* installation



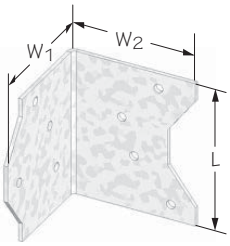
Typical *JA7* installation



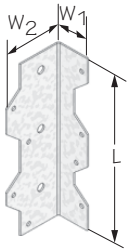
Typical *AC* installation



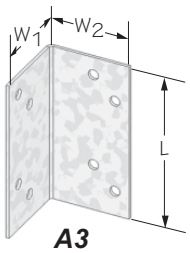
MP



JA3



AC



A3

Angles & Straps

continued on next page

USP Stock No.	Ref. No.	Steel Gauge	Dimensions (in)			Fastener Schedule[2,4,5]				Allowable Loads (Lbs.)[1,3]									Code Ref.
						Header		Joist		Direction of Load	DF-L / SP				S-P-F				
			W1	W2	L	Qty	Type	Qty	Type		100%	115%	125%	160%	100%	115%	125%	160%	
A3	A23, GA1, GA2, L30, S/A23	18	1-7/16	1-7/16	2-3/4	4	10d x 1-1/2	4	10d x 1-1/2	F1	450	515	560	590	390	445	485	495	14, F14, R9
										F2	450	515	560	600	390	445	485	505	
										F3	210	240	260	335	135	155	170	215	
MP3	LS30	18	2-1/4	2-1/4	3-3/8	3	10d	3	10d	F1	340	395	430	485	295	340	370	470	
MP5	LS50, S/LS50	18	2-1/4	2-1/4	4-5/8	4	10d	4	10d	F1	455	525	570	730	390	450	490	625	
MP7	LS70, S/LS70	18	2-1/4	2-1/4	5-7/8	5	10d	5	10d	F1	570	655	715	910	490	565	615	785	14, F16, R14
MP7-GC	-- --					5	N10C-GC	5	N10C-GC										
MP9	LS90	18	2-1/4	2-1/4	6-7/8	6	10d	6	10d	F1	685	785	855	1095	590	675	735	940	
MP9-GC	-- --					6	N10C-GC	6	N10C-GC										
AC5	L50	16	1-5/16	2-3/8	4-7/8	3	10d	3	10d	F1	340	390	425	540	290	335	365	465	14, F14, R9
										F2	340	390	425	540	290	335	365	465	
										F3	155	180	195	250	100	115	125	160	
						3	16d	3	16d	F1	380	440	475	610	325	375	410	520	
										F2	380	440	475	610	325	375	410	525	
										F3	175	205	220	280	115	130	145	185	
AC7	L70	16	1-5/16	2-3/8	6-15/16	4	10d	4	10d	F1	450	520	565	725	390	445	485	620	
										F2	450	520	565	725	390	445	485	620	
										F3	210	240	260	335	135	155	170	215	
						4	16d	4	16d	F1	510	585	635	770	435	500	545	645	
										F2	510	585	635	815	435	500	545	700	
										F3	235	270	295	375	150	175	190	245	
AC7-GC	-- --	16	1-5/16	2-3/8	6-15/16	4	N10C-GC	4	N10C-GC	F1	450	520	565	725	390	445	485	620	
										F2	450	520	565	725	390	445	485	620	
										F3	210	240	260	335	135	155	170	215	
						4	N16C-GC	4	N16C-GC	F1	510	585	635	770	435	500	545	645	
										F2	510	585	635	815	435	500	545	700	
										F3	235	270	295	375	150	175	190	245	
AC9	L90	16	1-5/16	2-3/8	8-7/8	5	10d	5	10d	F1	565	650	705	905	485	560	605	775	
										F2	565	650	705	905	485	560	605	775	
										F3	260	300	325	415	170	195	210	270	
						5	16d	5	16d	F1	635	730	795	1015	545	625	680	870	
										F2	635	730	795	920	545	625	680	775	
										F3	295	340	370	470	190	220	240	305	
JA1	A21	16	1-1/2	1-1/2	1-1/4	2	10d x 1-1/2	2	10d x 1-1/2	F1	245	255	255	255	190	215	215	215	14, F30, R5
										F2	-- --	-- --	-- --	345	-- --	-- --	-- --	290	
										F3	-- --	-- --	-- --	165	-- --	-- --	-- --	140	
JA3	-- --	14	2-1/2	2-1/2	3	4	16d	4	10d x 1-1/2	F1	510	570	590	590	380	440	480	495	
										F2	-- --	-- --	-- --	535	-- --	-- --	-- --	450	
										F3	-- --	-- --	-- --	330	-- --	-- --	-- --	275	
JA5	-- --	14	2-1/2	2-1/2	5	6	16d	6	10d x 1-1/2	F1	760	855	925	950	575	660	720	800	
										F2	-- --	-- --	-- --	1015	-- --	-- --	-- --	855	
										F3	-- --	-- --	-- --	495	-- --	-- --	-- --	415	
JA7	-- --	14	2-1/2	2-1/2	7	8	16d	8	10d x 1-1/2	F1	1015	1140	1230	1525	765	880	960	1225	
										F2	-- --	-- --	-- --	1625	-- --	-- --	-- --	1365	
										F3	-- --	-- --	-- --	550	-- --	-- --	-- --	460	
JA9	-- --	14	2-1/2	2-1/2	9	10	16d	10	10d x 1-1/2	F1	1270	1425	1540	1905	960	1100	1195	1535	
										F2	-- --	-- --	-- --	1645	-- --	-- --	-- --	1380	
										F3	-- --	-- --	-- --	825	-- --	-- --	-- --	695	

1) Allowable loads have been increased 60% for wind and seismic loads; no further increase shall be permitted.
2) Minimum nail embedment shall be 1-1/2″ for 10d and N10C-GC nails; 1-5/8″ for 16d and N16C-GC nails.
3) Loads are shown per angle, and may be doubled if installed in pairs. When using a single angle, joist must be constrained from rotation.
4) For 1-1/2″ lumber, use 0.98 of table load for 10d nails and 0.92 for 16d nails.
5) NAILS: 10d x 1-1/2 nails are 0.148″ dia. x 1-1/2″ long, 10d and N10C-GC nails are 0.148″ dia. x 3″ long, 16d nails are 0.162″ dia. x 3-1/2″ long.
New products or updated product information are designated in red font.

Material Identification and Description

Test specimens were received from the applicant on 25 September 2009. It consisted of two vacuum insulated panels measuring approximately 870mm x 500mm x 8mm thick with no identification mark or label. Only one specimen was tested for thermal characteristics.

Thermal Insulating Characteristics

Preparation and conditioning: No special conditioning was required prior to testing.

Measurement: The test method used was ASTM Designation: C 518-04, Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, Section 4, Volume 04.06, Thermal Insulation, 2007 Book of ASTM Standards.

One of the two test specimens was placed horizontally in a 300 mm x 300 mm Heat Flow Meter apparatus. Due to the uneven surface of the test specimen, neoprene foam pads and thermocouples were used to determine the temperatures at the surfaces of the specimen. Heat flowed vertically through the specimen during the test. Paper backed glass fibre insulation was placed around the perimeter of the plates and specimen to reduce edge heat losses (Figure 1).

Figure 1 – Specimen in the Heat Flow Meter

Results: The results of the test are listed in Table 1 in SI (International System) units. A list of conversion factors is found in the appendix.

Table 1. Test results on a vacuum insulated panel submitted for testing by Panasonic Canada Inc. (ref. 496-95)

Average thickness of tested specimen	L	7.46	mm
Density of specimen	ρ	n/a	kg/m^3
Hot surface temperature	Th	35.1	°C
Cold surface temperature	Tc	13.0	°C
Temperature difference	ΔT	22.1	K
Mean temperature of test	Tm	24.1	°C
Heat flux through the specimen	q	6.76	W / m^2
Thermal conductance of the specimen $C = q / \Delta T$	C	0.306	$W / (m^2 \bullet K)$
Thermal resistance of the specimen $R = \Delta T / q$	R	3.27	$m^2 \bullet K / W$
Thermal conductivity at the tested thickness $\lambda = L/R$	λ	0.00228	W/(m•K)
Thermal resistance per unit thickness $r = R/L$	r	438.2	m•K/W (SI)
R per inch (British units)	**r**	***63***	***°F• ft²•hr/BTU•in***

Appendix

Conversion Factors - SI to British*

Divide		by	to obtain
Length	mm	25.4	inch
Density	kg / m^3	16.01846	lb / ft^3
Heat flux density	W / m^2	3.15460	$BTU / hr \bullet ft^2$
Thermal conductance	$W / m^2 \bullet K$	5.67829	$BTU / hr \bullet ft^2 \bullet °F$
Thermal resistance	$m^2 \bullet K / W$	0.176109	$°F \bullet ft^2 \bullet hr / BTU$
Thermal conductivity	$W / m \bullet K$	0.144228	$BTU \bullet in / hr \bullet ft^2 \bullet °F$
Thermal resistivity	$m \bullet K / W$	6.933466	$°F \bullet ft^2 \bullet hr / BTU \bullet in$

Temperature: (°F) = 1.8 x temperature (°C) + 32

* According to Canadian Metric Practice Guide CAN/CSA Z234.1-00 (R2006)

ICC EVALUATION SERVICE
Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ESR-2642*

Reissued February 1, 2012
This report is subject to renewal February 1, 2014.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 21 00—Thermal Insulation
Section: 07 25 00—Water-Resistive Barriers/Weather Barriers

REPORT HOLDER:

BASF CORPORATION
1703 CROSSPOINT AVENUE
HOUSTON, TEXAS 77054
(713) 383-4554
www.spf.basf.com

EVALUATION SUBJECT:

BASF CORPORATION SPRAY-APPLIED INSULATIONS: SPRAYTITE® (158, 178, 81205 AND 81206); COMFORT FOAM® (158 AND 178) AND WALLTITE® (US AND US-N)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2009 *International Building Code*® (IBC)
- 2009 *International Residential Code*® (IRC)
- 2009 *International Energy Conservation Code*® (IECC)
- Other Codes (see Section 8.0)

Properties evaluated:

- Physical properties
- Surface burning characteristics
- Thermal resistance
- Water vapor transmission
- Attic and crawl space installation
- Air permeability
- Water-resistive barrier
- Fire-resistance-rated construction
- Exterior walls in Types I through IV construction

2.0 USES

SPRAYTITE® (158, 178, 81205 and 81206), COMFORT FOAM® (158 and 178) and WALLTITE® (US and US-N) spray-applied polyurethane foam insulations are used as nonstructural thermal insulating material in Type I, II, III, IV and V construction under the IBC and dwellings under the IRC. See Section 4.7 for use in Type I, II, III, IV and V construction. The insulation is for use in wall cavities, floor/ceiling assemblies, or attic and crawl spaces as described in Section 4.4. Under the IRC, the insulation may be used as air-impermeable insulation when installed in accordance with Section 3.5. When installed in accordance with Section 4.5, the insulation may be used as an alternative to the water-resistive barriers required in IBC Section 1404.2 and IRC Section R703.2. The insulation may be used in fire-resistance-rated wall assemblies when construction is in accordance with Section 4.6.

3.0 DESCRIPTION

3.1 General:

SPRAYTITE® (158, 178, 81025 and 81206), COMFORT FOAM® (158 and 178) and WALLTITE® (US and US-N) are two-component, closed-cell, rigid foam plastic insulations. The insulations are produced in the field by combining an isocyanate component A with a resin component B, resulting in products having a nominal density of 2.0 pcf (32 kg/m^3). SPRAYTITE®, COMFORT FOAM® and WALLTITE® insulations use an A component designated as ELASTOSPRAY® 8000A. Each insulation uses a different proprietary blend for the B component. The insulation components B have a shelf life of three months and components A have a shelf life of nine months when stored in factory-sealed containers at temperatures between 50°F (10°C) and 80°F (27°C) before installation.

3.2 Surface-burning Characteristics:

The insulations have a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E84 at a maximum thickness of 4 inches (102 mm).

Thicknesses of up to 8 inches (203 mm) for wall cavities and 12 inches (305 mm) for ceiling cavities are recognized, based on testing in accordance with NFPA 286, when covered with a minimum $^1/_2$-inch-thick (12.7 mm) gypsum board or an equivalent thermal barrier complying with, and installed in accordance with, the applicable code.

3.3 Thermal Resistance, *R*-values:

The insulations have thermal resistance (*R*-values) at a mean temperature of 75°F (24°C) as shown in Table 1.

3.4 Vapor Retarder:

The insulations have a vapor permeance of less than 1 perm [5.7 x 10^{-11} kg /(m^{2}sPa)], in accordance with ASTM E96, when applied at the following minimum thicknesses, and qualify as Class II vapor retarders:

SPRAYTITE® (158, 81205)	=	3 inches (76 mm)
SPRAYTITE® (178, 81206)	=	1.5 inches (38.1 mm)
COMFORT FOAM® (158)	=	3 inches (76 mm)
COMFORT FOAM® (178)	=	1.5 inches (38.1 mm)
WALLTITE® (US and US-N)	=	1.5 inches (38.1 mm)

***Revised August 2012**

3.5 Air Permeability:

SPRAYTITE® (178 and 81206), COMFORT FOAM® 178 and WALLTITE® (US and US-N) spray-applied polyurethane foam insulations, at a minimum thickness of 1 inch (25.4 mm), are considered air-impermeable insulation in accordance with Section R806.4 of the IRC, based on testing in accordance with ASTM E283.

3.6 ALDOCOAT 800 Intumescent Coating:

ALDOCOAT 800 intumescent coating, manufactured by Aldo Products Company, is a single-component, water-based latex coating supplied in 5-gallon pails and 55-gallon (18.9 and 208 L) drums. The materials have a shelf-life of six months when stored in a factory-sealed container at temperatures of 40°F (4.5°C) and 90°F (32°C).

3.7 NoBurn® Plus Intumescent Coating:

NoBurn® Plus intumescent coating, manufactured by No-Burn, Inc., is a translucent aqueous liquid supplied in 1- and 5-gallon (3.8 and 18.8 L) pails and 55-gallon (208 L) drums. The coating has a shelf life of three years when stored in a factory-sealed container at temperatures between 40°F (4.5°C) and 90°F (32°C).

3.8 SPRAYCOAT™ 1920 Intumescent Coating:

SPRAYCOAT™ 1920 intumescent coating, supplied by BASF Corporation, is a single-component, water-based, liquid-applied, latex intumescent coating. The coating is supplied in 5-gallon (18.8 L) pails and 55-gallon (208-L drums and has a shelf-life of six months when stored in factory-sealed containers at temperatures between 45°F (7.2°C) and 75°F (23.9°C).

3.9 Flame Seal® TB Intumescent Coating:

Flame Seal TB intumescent coating, manufactured by Specialty Products, Inc., is a two-component, four-to-one-by-volume, liquid-applied, water-based polymeric intumescent coating. The coating is supplied in 6-gallon (19-L) pails and 55-gallon (208-L) drums and has a shelf-life of six months when stored in factory-sealed containers at temperatures between 40°F (4°C) and 90°F (32°C). When applied over SPRAYTITE® (178 and 81206,) Comfort Foam 178 and Walltite (US and US-N) insulations, the assembly has a flame spread index of 25 or less and a smoke-developed index of 450 or less, when tested in accordance with ASTM E84.

3.10 DC315 Intumescent Coating:

DC315 intumescent coating, manufactured by International Fireproof Technology Inc., is a single-component, water-based, liquid-applied intumescent coating. The coating is supplied in 5–gallon (19-L) pails and 55-gallon (208-L) drums and has a shelf-life of two years when stored in factory-sealed containers at temperatures between 41°F(5°C) and 95°F (35°C).

4.0 INSTALLATION

4.1 General:

The insulations must be installed in accordance with the manufacturer's published installation instructions, the applicable code and this report. The manufacturer's published installation instructions must be available on the jobsite at all times during installation.

4.2 Application:

The insulation is spray-applied at the jobsite using a volumetric positive displacement pump as recommended in the manufacturer's published installation instructions. The insulation is applied in passes having a minimum thickness of $^1/_2$ inch (12.7 mm) and a maximum thickness of 2 inches (51 mm) per pass, up to the total thickness specified in Sections 3.2, 4.3 and 4.4 of this report. The insulation passes must be allowed to fully expand and be cured for a minimum of 15 minutes prior to application of an additional pass. The insulation must not be used in areas that have a maximum service temperature greater than 180°F (82°C). The foam plastic insulation must not be used in electrical outlet or junction boxes or in contact with rain or water (e.g., rain, condensation, ice, snow). The substrate must be free of moisture, frost or ice, loose scales, rust, oil, and grease or other surface contaminants. The insulation must be protected from the weather during and after application.

4.3 Thermal Barrier:

4.3.1 Application with a Prescriptive Thermal Barrier: The spray-applied insulations must be separated from the interior of the building by an approved thermal barrier of 0.5-inch (12.7 mm) gypsum wallboard or an equivalent 15-minute thermal barrier complying with IBC Section 2603.4 or IRC Section R316.4, as applicable, except where installation is in an attic or crawl space as described in Section 4.4, or when the installation is in sill plates and headers at a total thickness of 3.25 inches (83 mm) or less as permitted by IRC Section R316.5.11. Thicknesses of up to 8 inches (203 mm) for wall cavities and 12 inches (305 mm) for ceiling cavities are recognized, based on testing in accordance with NFPA 286.

4.3.2 Application without a Prescriptive Thermal Barrier: The SPRAYTITE® (178 and 81206,) Comfort Foam 178 and Walltite (US and US-N) insulations may be installed without the 15-minute thermal barrier prescribed in IBC Section 2603.4 and IRC Section R316.4, subject to the following conditions:

a. Flame Seal TB intumescent coating is applied to all foam surfaces at a minimum application of 25 wet mils (1.6 gallons per 100 ft^2).

b. The maximum installed thickness is 8 inches (203 mm) on vertical walls and 12 inches (304 mm) on ceilings.

4.4 Attics and Crawl Spaces:

4.4.1 Application with a Prescriptive Ignition Barrier: When the spray-applied insulations are installed within attics or crawl spaces where entry is made only for service of utilities, an ignition barrier must be installed in accordance with IBC Section 2603.4.1.6 or IRC Sections R316.5.3 and R316.5.4, as applicable. The ignition barrier must be consistent with the requirements for the type of construction required by the applicable code, and must be installed in a manner so that the foam plastic insulation is not exposed.

4.4.2 Application without a Prescriptive Ignition Barrier: The SPRAYTITE® (178 and 81206)**,** COMFORT FOAM® 178 and WALLTITE® (US and US-N) insulations may be installed in attics and crawl spaces as described in this section without the ignition barriers described in IBC Section 2603.4.1.6 and IRC Sections R316.5.3 and R316.5.4, subject to the following conditions:

a. Entry to the attic or crawl space is to service utilities, and no storage is permitted.

b. There are no interconnected attic or crawl space areas.

c. Air in the attic or crawl space is not circulated to other parts of the building.

d. Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, except when air-impermeable insulation is permitted in unvented attics in accordance with Section R806.4 of IRC. Under-floor (crawl space) ventilation is provided when required by IBC Section 1203.3 or IRC Section R408.1, as applicable.

e. Combustion air is provided in accordance with IMC Sections 701.

In attics, the insulation may be spray-applied to the underside of roof sheathing or roof rafters, and/or vertical surfaces provided the assembly conforms to one of the assemblies described in Table 2. In crawl spaces, the insulations may be spray-applied to the underside of floors and/or vertical surfaces provided the assembly conforms to one of the assemblies described in Table 2. When an intumescent coating is used, surfaces to be coated must be dry, clean, and free of dirt, loose debris and any other substances that could interfere with adhesion of the coating. The intumescent coating must be applied to all surfaces in accordance with the respective coating manufacturer's installation instructions. The coating must be applied when ambient and substrate temperatures are above of 50°F (10°C). The insulations may be installed in unvented attics as described in this section in accordance with IRC Section R806.4.

4.4.3 Use on Attic Floors: The SPRAYTITE® (178 and 81206), COMFORT FOAM® 178, and WALLTITE® (US and US-N) insulations may be installed in accordance with this section and Table 2 at a maximum thickness of $9^1/_4$ inches (235 mm) between and over the joists in attic floor. The insulation must be separated from the interior of the building by an approved thermal barrier. The ignition barrier required in IBC Section 2603.4.1.6 and IRC Section R316.5.3 may be omitted.

4.5 Water-resistive Barrier:

The SPRAYTITE® (178 and 81206), COMFORT FOAM® 178, and WALLTITE® (US and US-N) insulations may be used as the water-resistive barrier prescribed in IBC Section 1404.2 and IRC Section R703.2, when installed on exterior walls as described in this section. The insulations must be spray-applied to the exterior side of the sheathing, masonry or other suitable exterior wall substrates to form a continuous layer of 1 inch (25.4 mm) minimum thickness. All construction joints and penetrations must be sealed with SPRAYTITE® (178 and 81206), COMFORT FOAM® 178, or WALLTITE® (US and US-N) insulation.

4.6 Two-hour Fire-resistance-rated Wall Assemblies (Load-bearing):

SPRAYTITE® 158, SPRAYTITE® 81205 or COMFORT FOAM® 158 may be installed on interior load-bearing two-hour fire-resistance-rated walls, provided the system is installed in accordance with the following:

4.6.1 Wood Framing: Two rows on separate plates, 3 inches (76 mm) apart, of minimum 2-by-4 wood studs (No. 2 Douglas fir) spaced a maximum of 16 inches (406 mm) on center.

4.6.2 Wall Finish: Base layer of $^5/_8$-thick (15.9 mm), Type X gypsum wallboard is applied horizontally and fastened to each outer side of a double row of studs with 6d by $1^7/_8$-inch-long (48 mm) coated nails, spaced 2 feet (610 mm) on center. Face layer of $^5/_8$-inch-thick (15.9 mm), Type X gypsum board is applied horizontally and fastened to each outer side of studs over the base layer with 8d by $2^3/_8$-inch-long (60 mm) coated nails, spaced 8 inches (203 mm) on centers. Gypsum wallboard joints must be staggered 24 inches (610 mm) between layers and on opposite sides of the wall.

4.6.3 Insulation: SPRAYTITE® 158, SPRAYTITE® 81205 or COMFORT FOAM® 158 is applied in the stud cavities of both rows at a thickness of 3 inches (76 mm).

4.7 Exterior Walls in Types I, II, III and IV Construction:

SPRAYTITE 81206 and WALLTITE (US and US-N) may be installed in or on exterior walls of buildings of Type I, II, III and IV construction complying with IBC Section 2603.5and as described in this section. The maximum thickness of the foam plastic is 3 inches (76 mm) when installed on the exterior of the sheathing or $3^5/_8$ inches (92.1 mm) when installed in stud cavities. The potential heat of SPRAYTITE® 81206 and WALLTITE® (US and US-N) spray-applied insulations is 1961 Btu/ft^2 (22.3 MJ/m^2) per inch of thickness. The wall assembly must be as described in Table 3 or 4.

5.0 CONDITIONS OF USE

The BASF Corporation spray-applied insulations described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The spray-applied insulations and the intumescent coatings must be installed in accordance with the manufacturer's published installation instructions, this evaluation report and the applicable code. The instructions within this report govern if there are any conflicts between the manufacturer's published installation instructions and this report.

5.2 The spray-applied insulations must be separated from the interior of the building by an approved 15-minute thermal barrier, as described in Section 4.3, except where installation is in an attic or crawl space as described in Section 4.4.

5.3 The spray-applied insulations must not exceed the thicknesses noted in Section 3.2, 4.3 4.4, 4.5, 4.6, or 4.7 as applicable.

5.4 The spray-applied insulations must be protected from the weather during application.

5.5 The spray-applied insulations must be applied by professional spray polyurethane foam installers approved by BASF Corporation or by the Spray Polyurethane Foam Alliance (SPFA) for the installation of spray polyurethane foam insulation.

5.6 Installation in fire-resistance-rated construction must be as described in Section 4.6.

5.7 Use of the insulation in areas where the probability of termite infestation is "very high" must be in accordance with IBC Section 2603.8 or IRC Section R318.4, as applicable.

5.8 Jobsite certification and labeling of the insulation must comply with IRC Sections N1101.4 and N1101.4.1 and IECC Sections 303.1.1 and 303.1.2.

5.9 When used in or on exterior walls of buildings of Type I, II, III and IV construction, the wall assembly must conform to those described in Section 4.7.

5.10 The polyurethane foam plastic insulation components are produced in Houston, Texas under a quality control program with inspections by UL LLC (AA-668).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Spray-applied Foam Plastic Insulation (AC377), dated June 2012, including reports of tests in accordance with Appendix X of AC377.

6.2 Data in accordance with ASTM E119.

6.3 Reports of water vapor transmission tests in accordance with ASTM E96.

6.4 Reports of air leakage testing in accordance with ASTM E283.

6.5 Reports of fire propagation characteristics tests in accordance with NFPA 285.

6.6 Reports of potential heat of foam plastics tests in accordance with NFPA 259.

6.7 Reports of room corner tests in accordance with NFPA 286 and UL 1715.

6.8 Data in accordance with ICC-ES Acceptance Criteria for Foam Plastic Sheathing Panels Used as Water-resistive Barriers (AC71), dated February 2003 (editorially revised March 2011).

7.0 IDENTIFICATION

Each container of components A and B of the polyurethane foam plastic insulation bears a label with the BASF Corporation, name and address, the product name, the product type (A or B component), density, the flame-spread and smoke-developed indices, the evaluation report number (ESR-2642), the shelf life and the date of manufacture. The containers also bear the name of the inspection agency (UL LLC).

Intumescent coatings are identified with the manufacturer's name, the product trade name and use instructions.

8.0 OTHER CODES

8.1 Evaluation Scope:

In addition to the codes referenced in Section 1.0, the products in this report were evaluated for compliance with the requirements of the following codes:

- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)
- 2006 *International Energy Conservation Code*® (2006 IECC)
- 2003 *International Building Code*® (2003 IBC)
- 2003 *International Residential Code*® (2003 IRC)
- 2003 *International Energy Conservation Code*® (2003 IECC)

8.2 Uses:

The products comply with the above-mentioned codes as described in Sections 2.0 through 7.0 of this report, with the following modifications:

- **Application with a Prescriptive Thermal Barrier:** See Section 4.3.1, except the approved thermal barrier must be installed in accordance with Section R314.4 of the 2006 IRC or Section R314.1.2 of the 2003 IRC, as applicable.
- **Application with a Prescriptive Ignition Barrier:** See Section 4.4.1, except an ignition barrier must be installed in accordance with Section R314.2.3 of the 2003 IRC, or Section R314.5.3 or R314.5.4 of the 2006 IRC.
- **Application without a Prescriptive ignition Barrier:** See Section 4.4.2, except that combustion air is provided in accordance with Sections 701 and 703 of the 2006 IECC.
- **Protection against Termites:** See Section 5.7, except use of the insulation in areas where the probability of termite infestation if "very heavy" must be in accordance with Section 320.4 of the 2003 IRC or Section R320.5 of the 2006 IRC.
- **Jobsite Certification and Labeling:** See Section 5.8, except jobsite certification and labeling must comply with Section 102.5.1 of the 2003 IECC, or Sections 102.1.1 and 102.1.11, as applicable, of the 2006 IECC.

TABLE 1—THERMAL RESISTANCE (*R*-VALUES)

SPRAYTITE® (158, 81205); COMFORT FOAM® 158	
THICKNESS (INCHES)	***R*-VALUE (˚F.ft².h/Btu)[1]**
1	6.6
2	13
3	20
3.5	24
4	27
5	34
6	41
7	48
8	54
10	68
11	75
12	82
SPRAYTITE® (178, 81206); COMFORT FOAM® 178 and WALLTITE® (US and US-N)	
1	6.7
2	13
3	20
3.5	24
4	28
5	34
6	41
7	48
8	55
10	69
11	76
12	83

For **SI:** 1 inch = 25.4 mm; 1 ˚F.ft².h/Btu = 0.176 110 ˚K.m²/W.

[1] *R*-values are calculated based on tested *K* values at 1-and 4-inch thicknesses.

[2] *R*-values greater than 10 are rounded to the nearest whole number.

TABLE 2—USE OF INSULATION IN ATTICS AND CRAWL SPACES WITHOUT A PRESCRIPTIVE IGNITION BARRIER

INSULATION TYPE	MAXIMUM THICKNESS (in) (Wall Cavities & Attic Floors)	MAXIMUM THICKNESS (in) (Underside of Roof Sheathing/Rafters & Floors)	INTUMESCENT COATING MINIMUM THICKNESS & TYPE (Applied to all Foam Surfaces)	MINIMUM APPLICATION RATE OF THE INTUMESCENT COATING	TESTS SUBMITTED (AC377)
WALLTITE® US-N WALLTITE® US COMFORT FOAM® 178 SPRAYTITE® 178 and 81206	$9^1/_4$	$11\text{-}^1/_4$	No coating required	NA	Appendix X
WALLTITE® US-N WALLTITE® US COMFORT FOAM® 178 SPRAYTITE® 178 and 81206	$9^1/_4$	$11\text{-}^1/_4$	18 wet mils ALDOCOAT 800	1.12 gal / 100 ft^2	Appendix X
WALLTITE® US-N WALLTITE® US COMFORT FOAM® 178 SPRAYTITE® 178 and 81206	$9^1/_4$	$11\text{-}^1/_4$	12 wet mils of NoBurn Plus	0.75 gal / 100 ft^2	Appendix X
WALLTITE® US-N WALLTITE® US COMFORT FOAM® 178 SPRAYTITE® 178 and 81206	$11^1/_4$	$11\text{-}^1/_4$	14 wet mils of SPRAYCOAT™ 1920	0.88 gal / 100 ft^2	Appendix X
WALLTITE® US-N WALLTITE® US COMFORT FOAM® 178 SPRAYTITE® 178 and 81206	8	12	25 wet mils of Flame Seal TB	1.60 gal / 100 ft^2	UL1715
WALLTITE® US-N WALLTITE® US COMFORT FOAM® 178 SPRAYTITE® 178 and 81206	8	12	20 wet mils of DC315	1.25 gal / 100 ft^2	Appendix X

For **SI:** 1 inch = 25.4 mm; 1 mil = 0.0254 mm; 1 gallon = 3.38 L; 1 ft^2 = 0.93 m^2; NA = not applicable.

TABLE 3—NFPA 285 COMPLYING WALLS—SPF ON EXTERIOR

WALL COMPONENTS	MATERIALS
Base wall system— Use either 1, 2 or 3	1—Concrete wall 2—Concrete masonry wall 3—1 layer of $^5/_8$-inch thick Type X gypsum wallboard on interior, installed over minimum $3^5/_8$ inch depth, minimum No. 20-gage steel studs at a maximum of 24-inches on center with lateral bracing every 4 feet vertically
Floorline firestopping	4 pcf mineral wool (e.g. Thermafiber) friction fit in each wall stud cavity at each floor line.
Cavity insulation— Use either 1, 2, or 3	1—None 2—Fiberglass batt insulation (faced or unfaced) 3—Mineral wool insulation (faced or unfaced)
Exterior sheathing— Use either 1, or 2	1—None 2—Minimum $^1/_2$-inch Type X thick exterior type gypsum sheathing
Exterior Insulation	Maximum 3-inch thickness of SPRAYTITE 81206 or WALLTITE (US & US-N)
Exterior wall covering—Use either 1, 2, 3 or 4	1—Brick —Standard type brick veneer anchors installed maximum 24 inches on center, vertically on each stud —Maximum 2-inch air gap between exterior insulation and brick —Standard nominal 4-inch thick, clay brick 2—Stucco – Minimum $^3/_4$ -inch thick, exterior cement plaster and lath. A secondary water-resistive barrier can be installed between the exterior insulation and the lath. The secondary water-resistive barrier shall not be full-coverage asphalt or butyl-based self-adhered membranes. 3—Minimum 2-inch thick Limestone, natural stone or minimum 1 – $^1/_2$ inch thick cast artificial stone. Any standard non-open-jointed installation technique such as ship-lap, etc. can be used. 4—Terracotta cladding – Use any terracotta cladding system in which the terracotta is minimum $1^1/_4$ inch. Any standard non-open-jointed installation technique such as ship-lap, etc. can be used.

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pcf = 16.01 kg/m^3.

TABLE 4—NFPA 285 COMPLYING WALLS—SPF IN WALL CAVITY

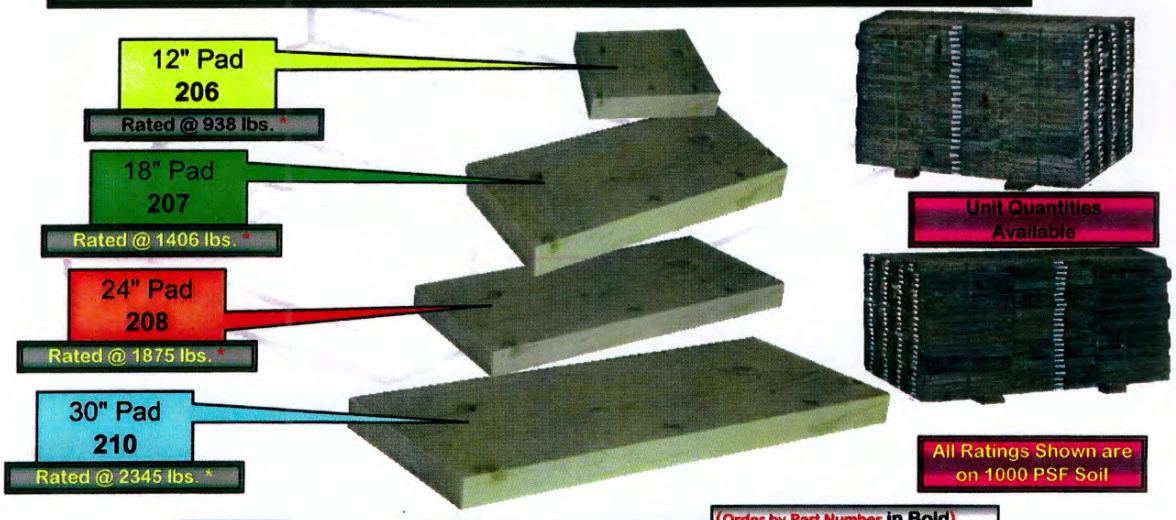
WALL COMPONENTS	MATERIALS
Base wall system— Use either 1, 2 or 3	1—Concrete wall 2—Concrete masonry wall 3—1 layer of $^5/_8$-inch thick Type X gypsum wallboard on interior, installed over minimum $3^5/_8$ inch depth minimum No. 20-gage steel stud at a maximum of 24-inch on center with lateral bracing every 4 feet vertically
Floorline firestopping	4 pcf mineral wool (e.g. Thermafiber) friction fit in each wall stud cavity at each floor line.
Cavity Insulation— Use either 1, 2, 3 or combination of 1 and 2 or combination or 1 and 3	1—Maximum $3^5/_8$ inch thickness of SPRAYTITE 81206 or WALLTITE (US & US-N) applied using exterior gysum sheathing as the substrate and covering the width of the cavity and the inside the steel stud framing flange. 2—Fiberglass batt insulation (faced or unfaced) on the exterior side of the foam plastic 3—Mineral wool insulation (faced or unfaced) on the exterior side of the foam plastic
Exterior sheathing	$^5/_8$-inch thick Type X exterior type gypsum sheathing
Exterior wall covering	Any noncombustible exterior wall covering material. Details of the exterior wall covering must be provided by the report holder, designer or specifier to the code official, with a fire engineering analysis demonstrating that the addition of the wall covering will not negatively affect conformance of the assembly with the requirements of IBC Section 2603.5.

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pcf = 16.01 kg/m^3.

Pressure Treated Wood Pads

2" x 12" Pressure Treated Wood Pads

12" Wood Pad	18" Wood Pad	24" Wood Pad	30" Wood Pad
206- 2 x 12 x 12"	207- 2 x 12 x 18"	208- 2 x 12 x 24"	210- 2 x 12 x 30"

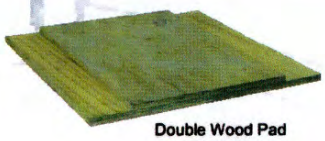


Unit Quantities Available

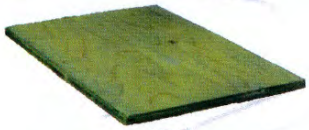
All Ratings Shown are on 1000 PSF Soil

(Order by Part Number in Bold)

3/4" Pressure Treated Plywood Pads

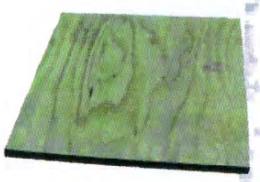


Double Wood Pad
(V-Pad)
268- 1-1/2 x 24 x 24"
Rated @ 4000 lbs. *

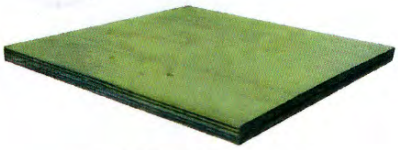


J-Pad
220- 3/4" x 16 x 24
Rated @ 2667 lbs. *

3/4" Pressure Treated Plywood Pads for Seismic Pier

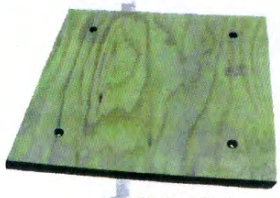


3/4" Plywood Pad
for Seismic Pier
222- 24 x 24 x 3/4"
Rated @ 4000 lbs. *



CP-Seismic 3/4" Plywood
Perimeter Pad
1991- 24 x 24 x 3/4"
Rated @ 4000 lbs. *

3/4" Pressure Treated Plywood Pads for Anchor Pier



3/4" Plywood Pad
foe Anchor Pier
65- 24 x 24 x 3/4"
Rated @ 4000 lbs. *

Pier Tops

(Order by Part Number in Bold)

ScrewJack
244

Safety Top
239

Marriage Top
201

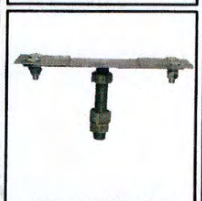
Saddle Top
238

Hallmark Top
144

Safety Top for
"C" - Channel
240

Hallmark Top for
"C" - Channel
142

Hallmark Top for
"J" - Channel
241

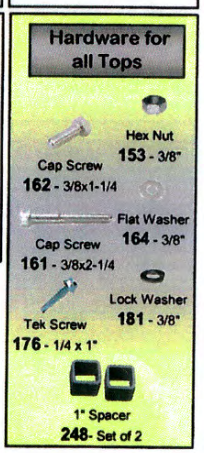


Hallmark Wide Top
145

Long Saddle Top
194

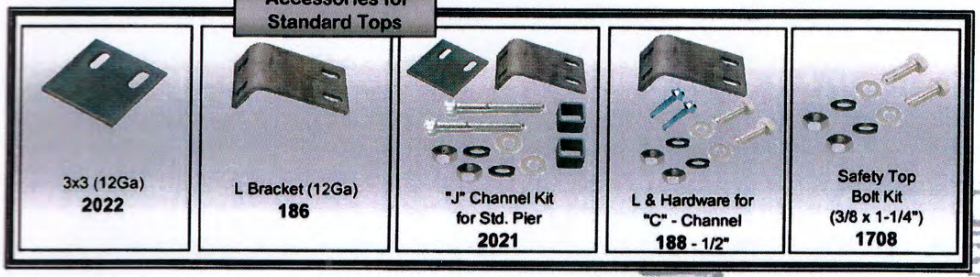
Safety Top
(Wide)
271

Hardware for all Tops



Hex Nut **153** - 3/8"
Cap Screw **162** - 3/8x1-1/4
Flat Washer **164** - 3/8"
Cap Screw **161** - 3/8x2-1/4
Lock Washer **181** - 3/8"
Tek Screw **176** - 1/4 x 1"
1" Spacer **248**- Set of 2

Accessories for Standard Tops



3x3 (12Ga)
2022

L Bracket (12Ga)
186

"J" Channel Kit
for Std. Pier
2021

L & Hardware for
"C" - Channel
188 - 1/2"

Safety Top
Bolt Kit
(3/8 x 1-1/4")
1708

Tops for: Seismic Pier™ Anchor Pier™ Anchor Brace™

Seismic Pier Top Accessories

CP Seismic
Wide Top Kit
256

1/4" 3x3
33

1/4" L Bracket
2134

1/4" "J" Channel Kit
1990

Anchor Brace Top Accessories

Longitudinal Top Kit
1703

Use These Accessories for Both Seismic Piers™ and Anchor Brace™

Anchor Pier™ Tops & Accessories

CP-Anchor Pier
Wide Top Kit - **74**

CP-Anchor Pier Double
"C" Channel Kit
2005

"J" Channel Kit
2006

Gripper Plate
34

Can't Find it?
1-800-653-0387
Call Us, We Can Help

CP Seismic Pier™

The Patented CP-Seismic Pier™ with its versatility, strength, and ease of installation makes it a popular choice with contractors and homeowners. Our CP-Seismic Pier™ is designed for Foundation, Tiedown and E.R.B.S. Systems, designed for ease of installation thus saving valuable labor costs. We offer the CP-Seismic Pier™ with either a Reinforced Concrete Pad, Pressure Treated 3/4" Plywood Pad or Anchor Bolts or for wet or dry concrete installations. Frame attachments available for I-beam, C-Channel, J-Channel and Box Frame installation.

Designed for Foundations, Tie-down or E.R.B.S. Systems

Complete CP Seismic Pier™ with all Components

CP-Seismic Pier
On **Concrete** Pad
112 - 7" Pier
89 - 11"Pier
96 - 18" Pier
104 - 19" Pier

CP-Seismic Pier
On **Plywood** Pad
113- 7" Pier
91- 11"Pier
98 - 18" Pier
105 - 19" Pier

CP-Seismic Perimeter Pier	CP-Seismic Perimeter Pier
On Concrete Pad	On Plywood Pad
1981- 7" Pier	**116**- 7" Pier
90- 11"Pier	**94**- 11"Pier
97 - 18" Pier	**101** - 18" Pier
109 - 19" Pier	**106** - 19" Pier

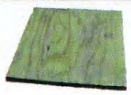
(Order by Part Number in Bold)

Individual Components

CP-Seismic Pier Only
110 - 7"
88 - 11"
95 - 18"

CP-Seismic Base Only
117 - 7"
86 - 11 "or 18"

Concrete CP-Pro Pad
218- 24 x 24 x 3-1/2"



3/4" Plywood Pad
222- 24 x 24 x 3/4"

CP-Seismic 19"
Pier Only
103 - 19"

CP-Seismic 19"
Base Only
102 - 19"

CP-Seismic Pipe
115 - 7"
93 - 11"
100 - 18"

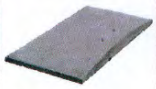
CP-Seismic Pipe
108 - 19"

CP-Seismic Perimeter
Pier Only
114 - 7"
92 - 11"
99 - 18"

CP-Seismic Perimeter
Base Only
1993 - 7"
1992 - 11" or 18"

CP-Seismic 19"
Perimeter Pier Only
107 - 19"

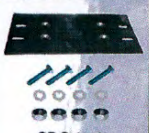
CP-Seismic Perimeter
Base Only
1994 - 19'



Concrete CP-Seismic
Perimeter Pad
85- 32 x 24 x 3-1/2"

CP-Seismic 3/4"
Plywood Perimeter Pad
1991- 24 x 24 x 3/4"

1/4" "J" Channel Kit
1990



CP Seismic
Wide Top Kit
256

Wet Concrete L Bolt
1995

5/8" Concrete
Anchor Bolt
234 - 5/8""

Hardware Kit for 1
Pier w/3x3"s
246 - Concrete
1985 - Plywood
1987 - Pier Only

Hardware Kit for 4
Piers w/3x3"s
1984 - Concrete
1986 - Plywood
1988 - Pier Only

1/4" 3x3
33

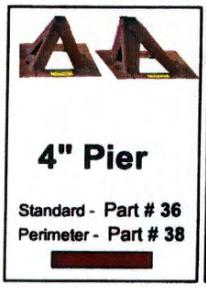
1/4" L Bracket
2134

Can't Find it?
1-800-653-0387
Call Us, We Can Help

CP Standard Piers

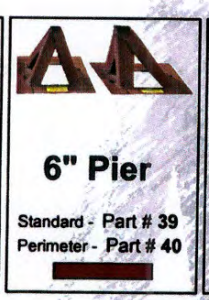
Our standard steel piers are listed and labeled by BSK testing lab. They are rated at 6000lbs. Made from 12ga steel and painted with a rust preventive coating, they are available in sizes from 4 inch through 36 inches in height.

(Order by Part Number in Bold)



4" Pier

Standard - **Part # 36**
Perimeter - **Part # 38**

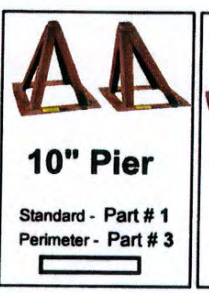


6" Pier

Standard - **Part # 39**
Perimeter - **Part # 40**

8" Pier

Standard - **Part # 41**
Perimeter - **Part # 44**



10" Pier

Standard - **Part # 1**
Perimeter - **Part # 3**

12" Pier

Standard - **Part # 4**
Perimeter - **Part # 5**

14" Pier

Standard - **Part # 6**
Perimeter - **Part # 7**

16" Pier

Standard - **Part # 8**
Perimeter - **Part # 9**

18" Pier

Standard - **Part # 10**
Perimeter - **Part # 12**

20" Pier

Standard - **Part # 13**
Perimeter - **Part # 14**

22" Pier

Standard - **Part # 15**
Perimeter - **Part # 16**

24' Pier

Standard - **Part # 17**
Perimeter - **Part # 18**

26" Pier

Standard - **Part # 19**
Perimeter - **Part # 20**

28" Pier

Standard - **Part # 21**
Perimeter - **Part # 22**

30" Pier

Standard - **Part # 25**
Perimeter - **Part # 26**

32" Pier

Standard - **Part # 27**
Perimeter - **Part # 28**

34' Pier

Standard - **Part # 29**
Perimeter - **Part # 30**

36" Pier

Standard - **Part # 31**
Perimeter - **Part # 32**

Pier Strap
219

Each Pier has a color swatch marked on the corner to indicate it's size.

This Color Bar Corresponds with the color swatch marked on the pier

CENTRAL PIERS,INC.
Fresno,CA. 93706
BSK 01600002 6,000 LBS
3 - 1 Safety Factor
Max Adjustment Not To Exceed 2 Inches.
Do Not Use As A Jacking Device.

Actual Label

All of our Piers have a 3 to 1 Safety factor.
Each Pier has it's own Label Affixed
Each Standard Pier is rated at 6000 LBS
(Perimeter Piers rated at 3000 LBS)

January 26, 2005

Central Piers, Inc.
284 N. Thorne Avenue
Fresno, California 93706

ATTN: Mr. Andy Naze

SUBJECT: **TEST REPORT**
C.P. Seismic Pier, Seismic Perimeter Pier and Foundation Pads

REFERENCE: California Code of Regulations, Title 25, Housing and Community Development, Division 1, Chapter 2, Section 1336.1, Effective July, 2004.

Dear Mr. Naze:

1. Introduction

The following report presents the results of the lateral and vertical load capacity testing program for the C.P. Seismic Pier, Seismic Perimeter Pier and Foundation Pads.

2. Purpose

The purpose of this testing program was to verify the design allowable lateral and vertical capacity for each pier.

3. Test Arrangements

The testing was conducted on the premises of BSK in Fresno, California during the month of December 2004. Complete test data sheets are included in Appendix A.

4. Test Procedure

a. Lateral Load Test - Table Assembly

i. The purpose of the lateral load test on the table assembly is to determine the lateral capacity of each pier. For the lateral load tests, the pier was bolted to a steel testing table.

ii. The piers were tested at various heights in order to cover a range of possible installations. The height of the stand, as tested, in listed on each data sheet.

iii. The loads were applied in the directions indicated by the force arrows (F1,F2,F3) as illustrated on each data sheet.

iv. The load was applied with a Central Pneumatic 20 ton hydraulic ram. The applied load was measured with a Load Cell, Model #1100386-50, Serial # 31477.

v. A zero reference point was established from which to measure displacements. The load was recorded at the Failure point. Failure was determined to be 3 inches of deflection or 2 inches of vertical uplift of the pier or pad.

b. Vertical Load

a. The purpose of the vertical load test was to determine the capacity of the C.P. Seismic Perimeter Piers to support a vertical load.

b. The testing apparatus consisted of a Boldwin Universal Compression Machine . The pier was centered in the apparatus. The Max Load (FN) Was recorded at failure. Tests were repeated for the 11 inch base thru the 19 inch base height.

c. The vertical capacity of the C.P. Seismic Pier and Foundation Pads was previously established. The previous test results are attached in Appendix B.

5. Test Results and Conclusions

5.1 December 2004 Test Results

The results of the testing performed by our firm (BSK Fresno Office) are summarized below. In accordance with Title 25, the allowable design capacity is determined by taking ⅔ of the final loads. Complete load test results are presented in Appendix A and are summarized as follows:

C.P. SEISMIC **STANDARD** PIER -TEST RESULTS							
Base Height (in)	Pier Height (in)	Direction of Load (F1, F2, Fn)	Test #1 (lbs)	Test #2 (lbs)	Test #3 (lbs)	Average Load (lbs)	Design Capacity (lbs)
7	9.75	F1 (Strong)	6000	6245	6145	6130	4087
		F2 (Weak)	6190	6200	6355	6248	4165
11	17.5	F1 (Strong)	4590	4505	4075	4390	2927
		F2 (Weak)	3005	2740	2875	2873	1916
18	22.75	F1 (Strong)	3305	3050	3255	3203	2136
		F2 (Weak)	2,205	2195	2420	2273	1516
19	33.75	F1 (Strong)	1500	1550	1610	1553	1036
		F2 (Weak)	1540	1440	1405	1462	974

C.P. SEISMIC **PERIMETER** PIER - TEST RESULTS							
Base Height (in)	Pier Height (in)	Direction of Load (F1, F2, F3, Fn)	Test #1 (lbs)	Test #2 (lbs)	Test #3 (lbs)	Average Load (lbs)	Design Capacity (lbs)
11	17.5	F1 (Strong)	3450	3680	3785	3638	2426
		F2 (Strong)	4310	4380	4420	4370	2913
		F3 (Weak)	4660	5590	4110	4787	3191
		Fn (Vertical)	24221	24161	21837	23406	15604
18	22.75	F1 (Strong)	2580	2560	2765	2635	1756
		F2 (Strong)	2740	2300	2730	2590	1727
		F3 (Weak)	2555	3525	3310	3130	2087
		Fn (Vertical)	20,818	24,627	18,487	21,311	14,207
19	33.75	F1 (Strong)	1725	1800	1780	1768	1179
		F2 (Strong)	1705	1505	1635	1615	1077
		F3 (Weak)	2300	2265	2185	2250	1500
		Fn (Vertical)	19,489	18,679	18,761	18,976	12,651

5.2 Previous Test Result Summary

The vertical capacity of the C.P. Seismic Pier was previously tested by Certified Testing and Consulting Services (CTC). The test results are summarized below in order to provide a comprehensive test report. The test data sheets are attached in Appendix B.

C.P. SEISMIC PIER - VERTICAL LOAD TEST RESULTS					
Pad Type	Test #1 (lbs)	Test #2 (lbs)	Test #3 (lbs)	Average Load (lbs)	Design Capacity (lbs)
Concrete	16,000	16,000	16,000	16,000	10,667
Plywood	16,000	18,000	15,600	16,533	11,022

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office.

Sincerely,

BSK ASSOCIATES,

REGISTERED PROFESSIONAL ENGINEER
MICHAEL J. FEIST
No. 52261
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

Michael J. Feist, P.E
Senior Civil Engineer

Michael Shwiyhat, E.I.T
Laboratory Manager

Attachments: Appendix A - December 2004 Test Data Sheets
Appendix B - March 2003 CTC Test Data Sheets

CENTRAL PIERS INC. PRODUCTS TESTING
CP SEISMIC PERIMETER

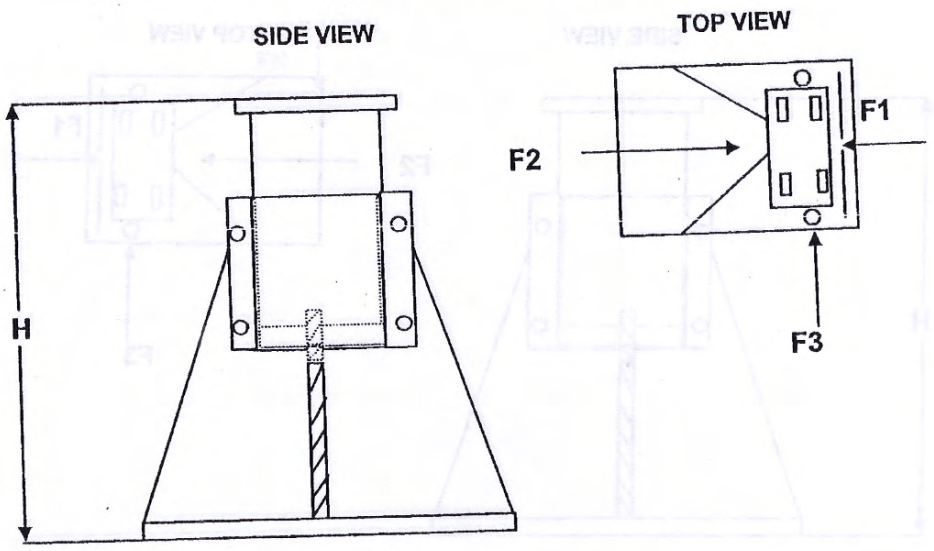


FIGURE NUMBER 1

SUMMARY OF TEST RESULTS

DATE OF TEST: 12/14/2004
PRODUCTS: 18" CP SEISMIC PERIMETER
ACTUAL HEIGHT (H): 22-3/4"
DIRECTION OF FORCE: IN THE DIRECTION OF F2 (LATERAL)

SPECIMEN NUMBER	MAX. LOAD, LBS	DISPLACEMENT, IN (@ THE MAX. LOAD)
1	2,740	3.0
2	2,300	3.0
3	2,730	3.0
AVERAGE	2,590	3.0

Remarks:

BSK

MPI Approved Products List

MPI # 144 X-Green™ Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 2)

Note: Requires a properly-prepared Level 4 drywall finish (i.e. assuming no critical lighting conditions). See "Standard Specification for Application and Finishing of Gypsum Board – ASTM C 840". A white or colored latex paint with low odor characteristics and a VOC of less than 10 grams per liter. For use in areas such as hospitals and other occupied buildings where the odor and VOC levels of conventional latex products would preclude their use.

[MPI's most stringent environmental standard. Products in this category must meet the appropriate MPI performance standard, MPI Green Performance Standard 2 (GPS-2), as well as the requirements for CHPS (Collaborative for High Performance Schools).]

MPI VOC Ranges (grams/L)	E3 <11 g/l	E2 g/l	E1 g/l	E '0' - outside range, n/a - unavailable

EPR - Environmental/Performance Rating (VOC & Relative Performance of Category+Gloss & Appropriate Specified Use). ✔ meets GPS-1, ✔ meets MPI GPS-2 for Standard Category: Interior Architectural Non-Flat Intermediate/Top Coats ✔ meets RG (OTC or EC) ✔ meets LEED (excluding LEED for schools)

Listing Mfr	Label	Product Name	Code				EPR	GPS-1	GPS-2
Akzo Nobel (US)	Glidden Professional	Diamond 450 No VOC Interior Velvet Matte Paint	7100	E3	✔	✔	4.5	✔	✔
Akzo Nobel (US)	Glidden Professional	Lifemaster No VOC Interior Eggshell Paint	9300	E3	✔	✔	4.5	✔	✔
Benjamin Moore	Natura	Waterborne Interior Eggshell	513/K513	E3	✔	✔	4.5	✔	✔
PPG	PPG	SPEEDHIDE zero Interior Zero VOC Latex Eggshell	6-4310	E3	✔		4.5	✔	✔
PPG	Pure Performance	Interior Eggshell Latex	9-300XI	E3	✔	✔	4.5	✔	✔
PPG	Speedhide Zero	Interior Zero VOC Latex Eggshell	6-4310XI	E3	✔	✔	4.5	✔	✔
Sherwin-Williams	Harmony	Interior Latex Eg-Shel	B09W00551/B09WQ8551	E3	✔	✔	4.5	✔	✔
Sherwin-Williams	ProMar 200 Zero VOC	Interior Latex Low Sheen	B24W02651/B24WQ2651	E3	✔	✔	4.5	✔	✔
Southern Diversified Prod.	American Pride	American Pride Interior Latex Eggshell	AP 101	E3		✔	4.5	✔	✔
Southern Diversified Prod.	Mythic	Mythic Interior Latex Eggshell	MP101	E3	✔	✔	4.5	✔	✔
Vista Paint	Vista CareFree Earth Coat	Carefree Earth Coat Velva Sheen	6200	E3		✔	4.5	✔	✔

MATERIALS

Extruded vinyl profiles comply with the performance requirements of AAMA 303-97. Colour is White.

FRAME

All frames are assembled utilizing fusion-welded technology for added strength and durability. Frame jamb depth is 3-1/4" (83mm), and the exterior wall thickness is 0.065 of an inch. Frames come standard with an accessory groove to accommodate exterior mouldings and with an open integrated 1/2-3/4" return. A closed version is also available for replacement purposes.

SASH

Sash is 2-1/4" (nominal) or (54.61mm) thick, and is assembled utilizing fusion-welded technology for added strength and durability ans is shadow groove cleaned.

GLAZING

3/4" (19mm) insulating glass consists of two lites of glass sealed around a warm edge spacer. All insulating glass units comply with the performance requirements of the IGMAC in accordance with either CAN/CGSB-12.8-97.

GLAZING OPTIONS

3/4" (19mm) insulated glass available in clear, Low-E with Argon, tinted, frosted, or other specialty insulating glass as specified. All glass is available tempered. Up to 7/8" insulating available as an option.

WEATHER-STRIPPING

Pile weatherstrip applied along the full perimeter of operating sash. Double row of co-extruded weatherstrips meet AAMA 701 or AAMA 702. Weatherstrip along full perimeter of the frame.

HARDWARE

Sash pivot on concealed hinges with sliding steel reinforced nylon shoes in an integral frame track. Steel concealed locking system is standard. Encore™ dual arm roto-operator has removable polycarbonate cover, die cast zinc bash and hardened steel worm gears and arms. Hinges and roto-operator arms feature E-Gard coating system. One locking lever is located on each side jamb.

INTERIOR INSECT SCREENS

Charcoal fiberglass screen cloth (18” x 16” mesh) set in white painted roll formed aluminium frame fitted to the inside of the window. Insect screens are intended to allow air and light in and to keep insects out. They are not intended to keep anyone or anything from falling through an open window. For safety screens or other security devices contact your local building supply retailer.

GRILLES

Removable, 5/8”, all vinyl rectangular grilles.

Vinyl SDL (Simulated Divided Lite) - 7/8” (23mm), or 2” (58mm) vinyl false mullion permanently applied on both sides of the insulating glass, with or without spacer bar.

Internal Grilles (Grilles between the Glass) - Georgian, pencil bar, square or flat mounted between the glass panes suspended within the air cavity.

INSTALLATION

Installation per JELD-WEN Installation Method for All Vinyl Windows. See www.jeld-wen.com/resources for instructions.

PERFORMANCE

CSA-Certified - (rated and labeled in accordance with CSA) certification program
NFRC Certified - (rated and labeled in accordance with NFRC)

Quick SPEC Guide

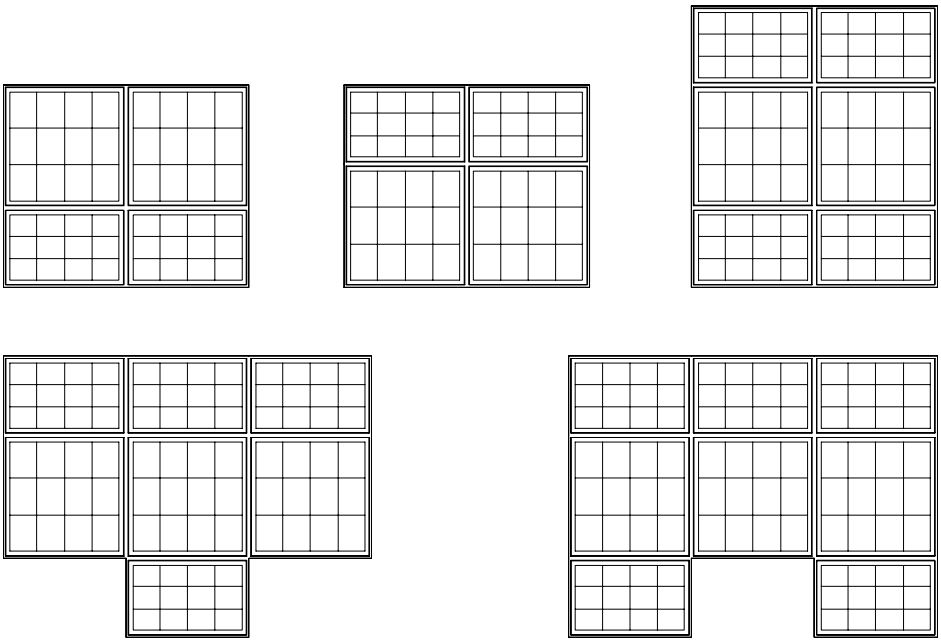
Specification	Standard features	Optional features Some options may require additional lead times. Consult your JELD-WEN Sales Representative.
Colour	White	Painted exterior - white interior A-06 Maize A-34 Savanna A-42 Hickory A-43 Cashmere A-44 Mist Blue A-51 Sumac A-53 Arcadian A-71 Dark Clay A-72 Canyon Clay A-74 Sandalwood A-75 Wicker A-79 Tan CL-025 Clay IV-050 Almond
Size	- Width: 20 3/4" to 50" - Height: 13 3/4" to 42"	• Any size with minimum and maximum parameters
Frame	• Exterior accessory groove • Open frame 1/2-3/4" return	
Exterior Trim	• Exterior accessory groove	#401 - Exterior finish trim #411 - 1" x 2" brickmould with nailing flange (no 'J' channel) #412 - 1" x 2" brickmould with 'J' channel and nailing flange #413 - 1" x 2" brickmould #414 - 1 5/16" extension with brickmould, 'J' channel and nailing flange (for 4 9/16" frame) #415 - 2 5/8" extension #422 - Brickmould and nailing flange (no 'J' channel) #423 - Brickmould, 'J' channel and nailing flange **(integral)** #426 - Brickmould #427 - 1 5/16" extension **(integral)** #428 - 1 5/16" exterior finish trim and nailing flange #569 - 1" x 3 1/2" brickmould with nailing flange (no 'J' channel) #570 - 1" x 3 1/2" brickmould with 'J' channel and nailing flange #571 - 1" x 3 1/2" brickmould finish trim #210 - Adaptor for sill expander (in 16 foot lengths only) not installed #211 - 3 3/4" sill expander (in 16 foot lengths only) not installed
Glazing	• Insulating Clear with warm edge spacer	- Low-E - Satin - Bronze - Grey - Frosted (pinhead Morocco) - Gluechip - Laminated - All glass available tempered
Hardware	• Rotogear operator • Folding handle	
Hardware Colour	• White	
Screens	• Fiberglass	

Quick SPEC Guide

Specification	Standard features	Optional features Some options may require additional lead times. Consult your JELD-WEN Sales Representative.
Screen Frame Colour	• White	
Grilles		• 5/8" all vinyl removable grilles • 5/8" white internal Georgian (grilles between the glass) • 7/8" SDL (simulated divided lite) with or without spacer bar • 2" false mullion with or without spacer bar **Georgian** 5/8" Light oak/White 5/8" Dark oak/White 5/8" Amber oak/White 5/8" Cherry/White 5/8" Black/White 5/8" Ivory/White 5/8" Wicker/White 5/8" Sablon/White 5/8" Clay 5/8" Clay/White 5/8" Brown/White 5/8" Commercial brown/White 5/8" Brass 1" White **Pencil Bar** White Brass Grey Pewter **Square** Black Pewter White Brass **Flat** 5/8" Ivory/White 5/8" White 5/8" Clay/White 5/8" Clay 1" White
Jamb Depth	• 3 1/4"	• Closed interior frame • Vinyl clad interior jamb extension up to 8 7/8" • Natural interior jamb extension up to 4 3/4" clear or finger jointed pine

MULTIPLE ASSEMBLIES

All vinyl awning windows may be mulled above, below, or beside other vinyl awning windows, or other vinyl window products. Factory assembled mulls are limited in height (99"), width (150"), and a total area (60 square feet).



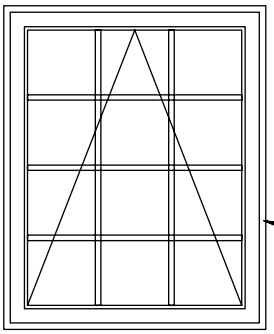
ELEVATION DRAWINGS UTILIZE A LIMITED NUMBER OF PROJECTED LINES TO PRODUCE A RUDIMENTARY DRAWING INTENDED TO BE USED IN A SMALL GRAPHICAL SCALE. ELEVATIONS ARE VIEWED PERPENDICULAR FROM THE EXTERIOR OF THE STRUCTURE. IF MORE DIMENSIONS ARE NEEDED, USE THE SECTION DRAWINGS FOR MORE COMPLETE DEPICTIONS.

Height:

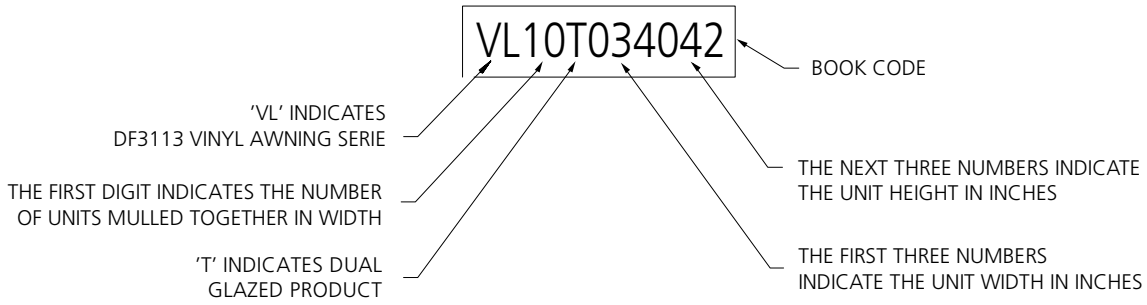
Rough Opening	42 3/4" - 1086mm
Frame Size	42" - 1067mm
Glass Size	35 5/8" - 905mm

Width:

Rough Opening	34 3/4" - 883mm
Frame Size	34" - 864mm
Glass Size	27 5/8" - 702mm



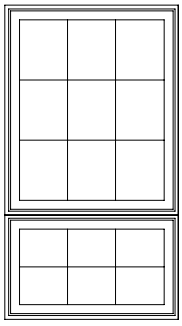
OUTSIDE OF FRAME



GENERAL AWNING NOTES

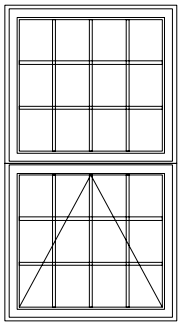
1. VINYL AWNING UNITS ARE AVAILABLE AS OPERATING OR STATIONARY UNITS.
2. UNIT ELEVATIONS ARE SHOWN WITHOUT EXTERIOR TRIM.

AWNING PICTURE COMBINATIONS



VL10BT042070

INDICATES A TOP FIXED SASH COMBINATION, UNLESS SPECIFIED, LOWER UNIT IS ALWAYS 23" IN HEIGHT



VL10CT038070

INDICATES A TOP FIXED SASH COMBINATION, SPLIT HALF/HALF

MATERIALS

Extruded vinyl profiles comply with the performance requirements of AAMA 303-97. Colour is White.

FRAME

All frames are assembled utilizing fusion-welded technology for added strength and durability. Frame jamb depth is 3-1/4" (83mm), and the exterior wall thickness is 0.065 of an inch. Frames come standard with an accessory groove to accommodate exterior mouldings and with an open integrated 1/2-3/4" return. A closed version is also available for replacement purposes.

SASH

Sash is 2-1/4" (nominal) or (54.61mm) thick, and is assembled utilizing fusion-welded technology for added strength and durability and is shadow groove cleaned.

GLAZING

3/4" (19mm) insulating glass consists of two lites of glass sealed around a warm edge spacer. All insulating glass units comply with the performance requirements of the IGMAC in accordance with either CAN/CGSB-12.8-97.

GLAZING OPTIONS

3/4" (19mm) insulated glass available in clear, Low-E with Argon, tinted, frosted, or other specialty insulating glass as specified. All glass is available tempered. Up to 7/8" insulating available as an option.

WEATHER-STRIPPING

Pile weatherstrip applied along the full perimeter of operating sash. Double row of co-extruded weatherstrips meet AAMA 701 or AAMA 702. Weatherstrip along full perimeter of the frame.

HARDWARE

Casements utilize dual arm operator with corrosion resistant coating and a multipoint lock with single actuating handle. Some smaller units will utilize a single arm dyad operator. Operator cover is Encore hardware by Truth with folding handle.

INTERIOR INSECT SCREENS

Charcoal fiberglass screen cloth (18" x 16" mesh) set in white painted roll formed aluminium frame fitted to the inside of the window. Insect screens are intended to allow air and light in and to keep insects out. They are not intended to keep anyone or anything from falling through an open window. For safety screens or other security devices contact your local building supply retailer.

GRILLES

Removable, 5/8", all vinyl rectangular grilles.

Vinyl SDL (Simulated Divided Lite) - 7/8" (23mm), or 2" (58mm) vinyl false mullion permanently applied on both sides of the insulating glass, with or without spacer bar between the glass panes.

Internal Grilles (Grilles between the Glass) - Georgian, pencil bar, square or flat mounted between the glass panes suspended within the air cavity.

INSTALLATION

Installation per JELD-WEN Installation Method for All Vinyl Windows. See www.jeld-wen.com/resources for instructions.

PERFORMANCE

CSA-Certified - (rated and labeled in accordance with CSA) certification program
NFRC Certified - (rated and labeled in accordance with NFRC)

Quick SPEC Guide

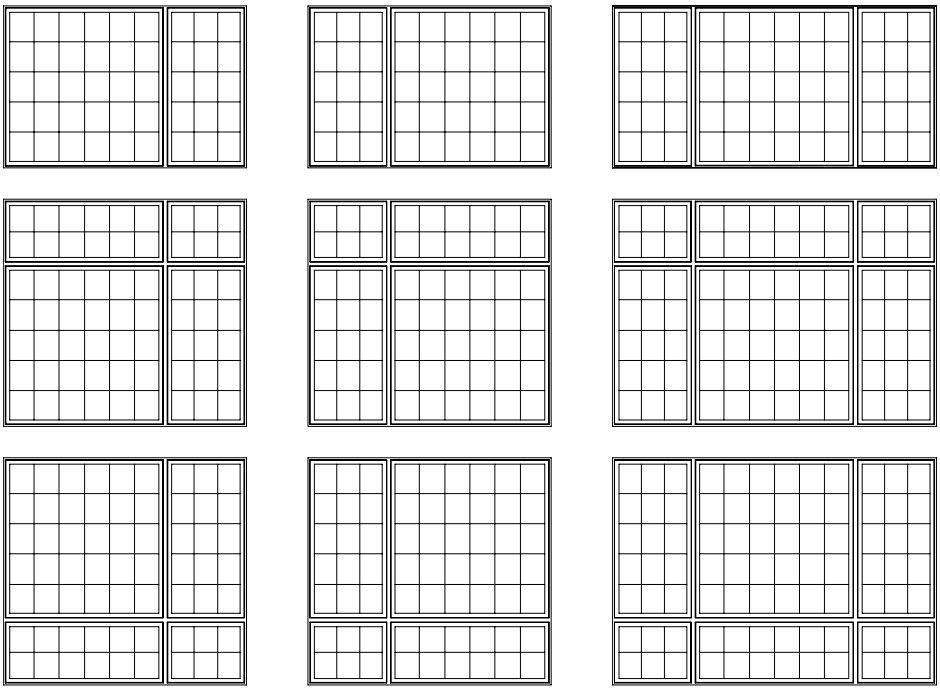
Specification	Standard features	Optional features Some options may require additional lead times. Consult your JELD-WEN Sales Representative.
Colour	White	Painted exterior - white interior A-06 Maize A-34 Savanna A-42 Hickory A-43 Cashmere A-44 Mist Blue A-51 Sumac A-53 Arcadian A-71 Dark Clay A-72 Canyon Clay A-74 Sandalwood A-75 Wicker A-79 Tan CL-025 Clay IV-050 Almond
Size	- Width: 16" to 36" - Height: 12" to 78"	• Any size with minimum and maximum parameters
Frame	• Exterior accessory groove • Open frame 1/2-3/4" return	
Exterior Trim	• Exterior accessory groove	#401 - Exterior finish trim #411 - 1" x 2" brickmould with nailing flange (no 'J' channel) #412 - 1" x 2" brickmould with 'J' channel and nailing flange #413 - 1" x 2" brickmould #414 - 1 5/16" extension with brickmould, 'J' channel and nailing flange (for 4 9/16" frame) #415 - 2 5/8" extension #422 - Brickmould and nailing flange (no 'J' channel) #423 - Brickmould, 'J' channel and nailing flange **(integral)** #426 - Brickmould #427 - 1 5/16" extension **(integral)** #428 - 1 5/16" exterior finish trim and nailing flange #569 - 1" x 3 1/2" brickmould with nailing flange (no 'J' channel) #570 - 1" x 3 1/2" brickmould with 'J' channel and nailing flange #571 - 1" x 3 1/2" brickmould finish trim #210 - Adaptor for sill expander (in 16 foot lengths only) not installed #211 - 3 3/4" sill expander (in 16 foot lengths only) not installed
Glazing	• Insulating Clear with warm edge spacer	- Low-E - Satin - Bronze - Grey - Frosted (pinhead Morocco) - Gluechip - Laminated - All glass available tempered
Hardware	• Dual arm operator • Multipoint locking system • Folding handle	
Hardware Colour	• White	
Screens	• Fiberglass	

Quick SPEC Guide

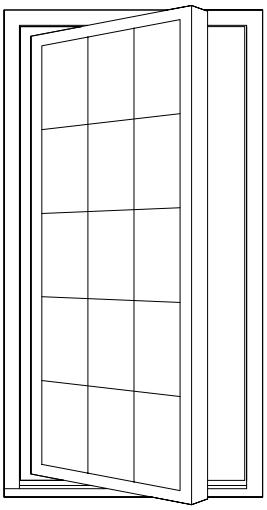
Specification	Standard features	Optional features Some options may require additional lead times. Consult your JELD-WEN Sales Representative.
Screen Frame Colour	• White	
Grilles		• 5/8" all vinyl removable grille • 5/8" white internal Georgian (grilles between the glass) • 7/8" SDL (simulated divided lite) with or without spacer bar • 2" false mullion with or without spacer bar **Georgian** 5/8" Light oak/White 5/8" Dark oak/White 5/8" Amber oak/White 5/8" Cherry/White 5/8" Black/White 5/8" Ivory/White 5/8" Wicker/White 5/8" Sablon/White 5/8" Clay 5/8" Clay/White 5/8" Brown/White 5/8" Commercial brown/White 5/8" Brass 1" White **Pencil Bar** White Brass Grey Pewter **Square** Black Pewter White Brass **Flat** 5/8" Ivory/White 5/8" White 5/8" Clay/White 5/8" Clay 1" White
Jamb Depth	• 3 1/4"	• Closed interior frame • Vinyl clad interior jamb extension up to 8 7/8" • Natural interior jamb extension up to 4 3/4" clear or finger jointed pine

MULTIPLE ASSEMBLIES

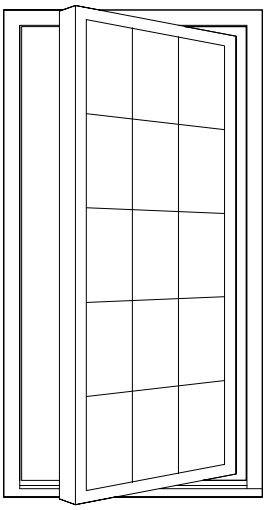
All vinyl casement windows may be mulled above, below, or beside other vinyl casement windows, or other vinyl window products. Factory assembled mulls are limited in height (99"), width (150"), and a total area (60 square feet).



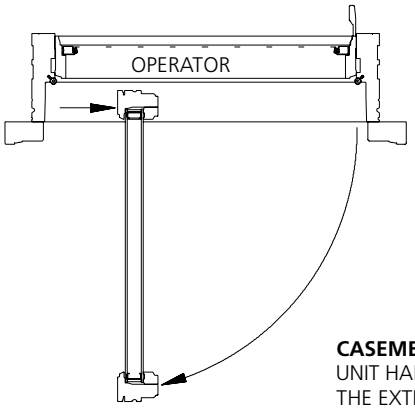
Handing & Operation

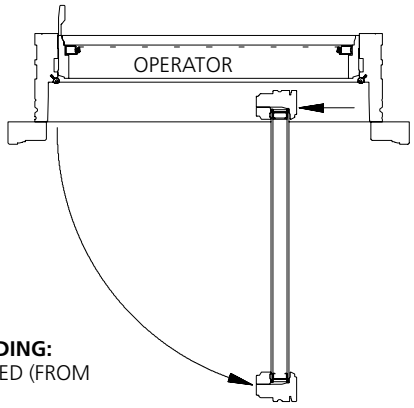


LEFT HAND



RIGHT HAND





CASEMENT UNIT HANDING:
UNIT HANDING IS DEFINED (FROM THE EXTERIOR) AS THE DIRECTION THE SASH OPENS.

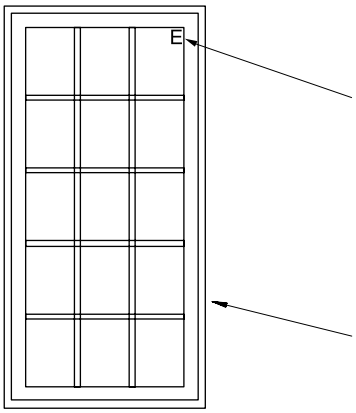
ELEVATION DRAWINGS UTILIZE A LIMITED NUMBER OF PROJECTED LINES TO PRODUCE A RUDIMENTARY DRAWING INTENDED TO BE USED IN A SMALL GRAPHICAL SCALE. ELEVATIONS ARE VIEWED PERPENDICULAR FROM THE EXTERIOR OF THE STRUCTURE. IF MORE DIMENSIONS ARE NEEDED, USE THE SECTION DRAWINGS FOR MORE COMPLETE DEPICTIONS.

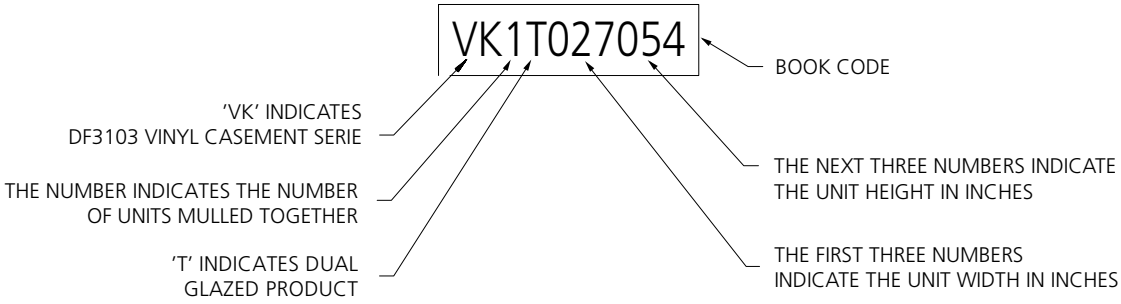
Height:

Rough Opening	54 3/4" - 1391mm
Frame Size	54" - 1372mm
Glass Size	47 5/8" - 1210mm

Width:

Rough Opening	27 3/4" - 705mm
Frame Size	27" - 686mm
Glass Size	20 5/8" - 524mm





GENERAL CASEMENT NOTES

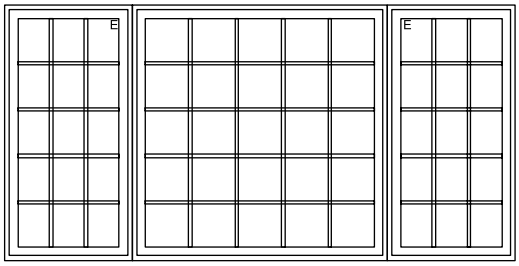
1. ALL VINYL CASEMENT UNITS ARE AVAILABLE AS OPERATING OR STATIONARY UNITS.
2. UNIT ELEVATIONS ARE SHOWN WITHOUT EXTERIOR TRIM.

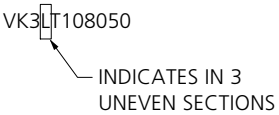
ELEVATION SYMBOL LEGEND:

E BASIC UNIT CLEAR OPENING EXCEEDS 15" IN WIDTH, 15" IN HEIGHT & A MINIMUM OF 3.77 SQ. FT. UNOBSTRUCTED OPENING BASED ON CANADIAN NBC

E* BASIC UNIT CLEAR OPENING REQUIRES EGRESS HINGES TO EXCEED 15" IN WIDTH, 15" IN HEIGHT & A MINIMUM, OF 3.77 SQ. FT. UNOBSTRUCTED OPENING BASED ON CANADIAN NBC

CASEMENT PICTURE COMBINATIONS





Cardinal CG - Double Pane

Outer	Inner	Visble Light		Solar Energy			Damage Function			Uvalue - ½"		
		Trans	Exterior	Trans	Exterior	SHGC	UV	Krochman	ISO CIE	100% Air	90% Argon	COG ER
Clear	Clear	82%	15%	73%	13%	0.78	58%	61%	75%	0.481	0.455	67.8
Clear	LoE 180	79%	15%	60%	21%	0.69	29%	42%	63%	0.306	0.260	57.7
LoE 180	Clear	79%	15%	60%	21%	0.65	29%	42%	63%	0.306	0.260	57.7
LoE^{2} 240	Clear	40%	14%	21%	31%	0.25	16%	24%	35%	0.302	0.256	57.4
LoE^{2} 272	Clear	72%	11%	38%	35%	0.41	16%	33%	55%	0.297	0.250	57.2
LoE^{2} 270	Clear	70%	12%	34%	39%	0.37	14%	31%	53%	0.295	0.248	57.0
LoE^{3} 366	Clear	65%	11%	25%	44%	0.27	5%	21%	43%	0.290	0.242	56.8
LoE 180	i81	71%	22%	53%	24%	0.59	36%	38%	56%	0.241	0.209	53.9
LoE^{2} 272	i81	64%	16%	35%	37%	0.38	15%	30%	48%	0.235	0.202	53.6
LoE^{2} 270	i81	63%	17%	31%	41%	0.34	14%	28%	46%	0.233	0.200	53.5
LoE^{3} 366	i81	58%	15%	22%	46%	0.25	5%	18%	37%	0.230	0.196	53.3

• Values are center of glass calculated using the Window 5.2 Computer program

	LoE 180	LoE^{2} 240	LoE^{2} 270	LoE^{2} 272	LoE^{3} 366
NFRC Emissivity	0.068	0.057	0.037	0.042	0.022

Cardinal CG - Triple Pane

Outer	Middle Coating #4	Inner LoE #5 i81 #6	Visble Light		Solar Energy			Damage Function			Uvalue - $^{1}/_{2}$"	ER w/1/2" AS	Interior Glass Surface Temperature- $^{1}/_{2}$"	
			Trans	Exterior	Trans	Exterior	SHGC	UV	Krochman	ISO CIE	90% Argon	Value	Winter (°F)	Summer (°F)
Clear	Clear	Clear	75%	21%	63%	17%	0.70	48%	52%	67%	0.288	45	54	92
LoE 180	Clear	LoE 180	69%	20%	47%	25%	0.56	13%	29%	50%	0.132	56	62	94
LoE^{2} 272	Clear	LoE 180	63%	15%	32%	37%	0.37	8%	24%	44%	0.129	46	62	87
LoE^{2} 270	Clear	LoE 180	62%	16%	29%	40%	0.33	7%	23%	43%	0.128	43	62	85
LoE^{3} 366	Clear	LoE 180	57%	14%	21%	46%	0.25	2%	16%	36%	0.126	39	62	83
LoE^{2} 272	Clear	LoE^{2} 272	57%	13%	26%	37%	0.35	5%	21%	40%	0.124	45	63	93
LoE^{2} 270	Clear	LoE^{2} 270	55%	15%	22%	41%	0.31	4%	19%	37%	0.123	43	63	92
LoE^{3} 366	Clear	LoE^{3} 366	47%	13%	16%	45%	0.24	<1%	11%	27%	0.118	39	63	91
LoE 180	LoE 180	i81	63%	26%	42%	27%	0.50	12%	26%	45%	0.116	54	56	108
LoE^{2} 270	LoE 180	i81	56%	21%	26%	42%	0.30	7%	21%	38%	0.112	43	56	93
LoE^{2} 272	LoE 180	i81	57%	20%	29%	38%	0.34	8%	22%	40%	0.113	45	56	96
LoE^{3} 366	LoE 180	i81	51%	18%	19%	47%	0.22	2%	14%	32%	0.111	39	56	89
LoE^{2} 272	LoE^{2} 272	i81	51%	16%	23%	38%	0.30	5%	19%	35%	0.110	44	56	102
LoE^{2} 270	LoE^{2} 270	i81	49%	18%	20%	42%	0.26	4%	17%	33%	0.108	42	56	100
LoE^{3} 366	LoE^{3} 366	i81	42%	15%	14%	46%	0.19	<1%	10%	24%	0.105	38	57	98

• All glass is 3mm
• Values are center of glass calculated using the Window 5.2 Computer program
• Calculations made under standard ASHRAE conditions

ER calculations are for COG only, and assume no air loss.

eclipsall energy corp.

NRG 60M

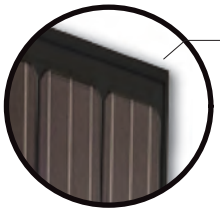
250W – 275W

Quality Without Compromise

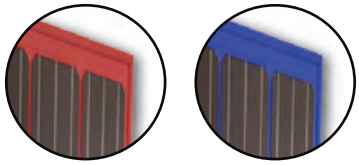
At Eclipsall, we've made a company wide commitment to quality and we meet that commitment every day. At our state-of-the-art facility located in Toronto, our dedication to superior quality and performance extends to every aspect of our operation. We use Tier 1 European manufacturing technology to produce best-in-class solar modules. We offer 100% defect detection and flash testing with output sorting, again ensuring maximum performance and quality. Combine this with superior performance, a flexible range of product options and features, an industry leading 25 year linear performance warranty and you have it – a superior solar module from a company that prides itself on delivering only the best.

Product Options

Eclipsall NRG modules are available in various frame and backsheet colour options*



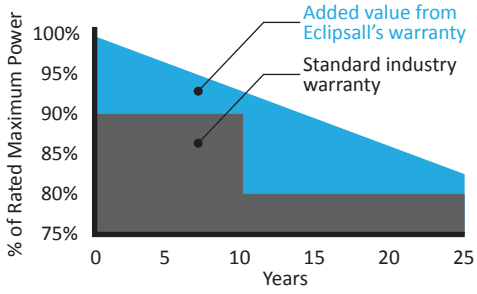
NEW! Featuring black on black



*coloured frame, no frame, clear backsheet, solid coloured backsheet, glass on glass

Industry Leading Warranty

Eclipsall provides a 25-year linear performance guarantee



Superior Performance

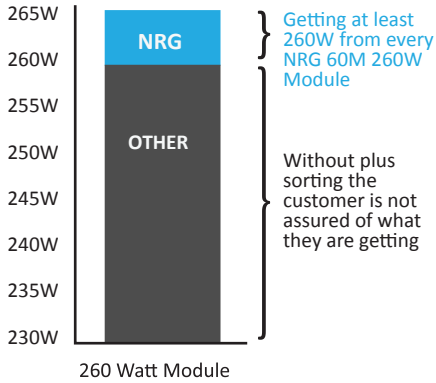
- Module efficiency up to 17%
- Positive power tolerance range 0 to +5W maximizing value per watt
- 3 bus bar design provides higher power output and increased performance

Product Features

- 4mm anti-reflective solar glass* on all panels to provide greater strength, and to reduce solar energy lost from sunlight reflection and improve light transmittance
- Impact and load tested to 5400Pa
- 2mm thick anodized aluminum frame with low profile weather-edge providing easier run-off for rain, snow and debris

*Regular low iron tempered glass available upon request

Positive Power Sorting



www.eclipsall.com

PROUDLY MADE IN: Ontario

NRG 60M Technical Data

Electrical Data

Type		NRG60 250M	NRG60 255M	NRG60 260M	NRG60 265M	NRG60 270M	NRG60 275M
Rated Maximum Power at STC - Pmax(W)		250W	255W	260W	265W	270W	275W
Maximum Power Voltage - Vmp(V)		30.32	30.37	30.42	30.54	30.6	30.68
Maximum Power Current - Imp(A)		8.26	8.41	8.53	8.68	8.83	8.96
Open Circuit Voltage - Voc(V)		37.38	37.60	37.81	37.99	38.18	38.29
Short Circuit Current - Isc(A)		8.79	8.83	8.85	8.88	8.91	8.93
Operating Temperature		-40 to +85°C					
Max System Voltage		1000V (IEC) / 600V (UL)					
Fuse rating		15A					
Power Tolerance		0 to +5W					
Temperature Coefficients	Pmax	-0.484 %/°C					
	Voc	-0.363 %/°C					
	Isc	0.047 %/°C					

'Note: Power specification under standard test conditions (STC) of irradiance of 1000 W/m2, spectrum AM = 1.5, and module temp of 25°C

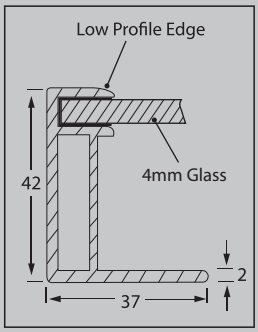
Module Design

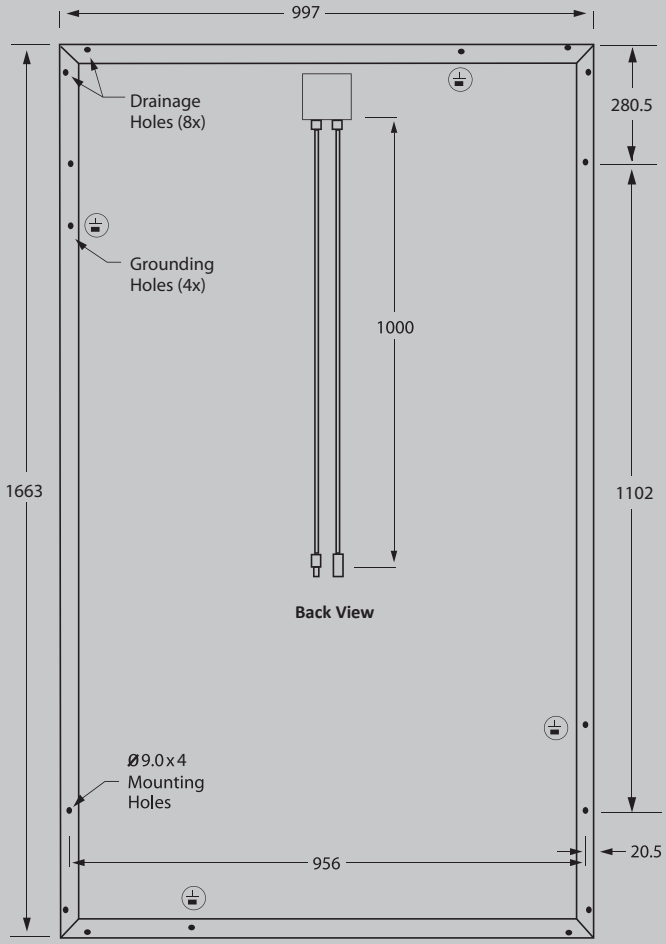
Cell Type	Mono-crystalline, 3 Bus Bar
Cell Configuration	60 (156 x 156mm)
Dimensions (LxWxH)	1663 x 997 x 42mm
Weight	22kg
Frame	Extruded & Anodized Aluminum Profile
Solar Glass	4mm, Anti-Reflective Glass*
Encapsulation	Glass - EVA - Solar Cells - EVA - Backsheet
Backsheet	Dupont™ Tedlar® MultiLayer Composite Film
Junction Box	Tyco or Amphenol
Bypass Diodes	3 (SL1515)
Cable	4mm² (12 AWG), 1000mm length
Rear Connection	SOLARLOK or MC4
Static Surface Load (Front/Back)	2400Pa
Max Surface Load (Heavy Snow)	5400Pa
Certifications	ANSI/UL 1703, ULC/ORD C-1703, IEC 61215, IEC 61730, UL 1703:2002 R4.08
Module Efficiency	Up to 17%
Packaging (modules per pallet)	25 or as specified

Note: All modules manufactured by Eclipsall will undergo flash testing and will be sorted accordingly
*Regular low iron tempered glass available upon request

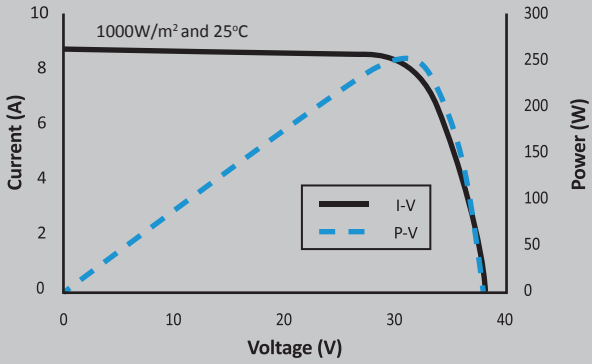
Dimensions

Frame Cross-Section





I-V and P-V Curve



Notes:

All dimensions in mm.

For more details, see installation manual.

Specifications and design subject to change without notice.

Eclipsall Energy Corporation
5900 Finch Avenue East
Toronto, Ontario, Canada M1B 5X7
Tel: (416) 716-3390
info@eclipsall.com

www.eclipsall.com

2013-06-04

Microinverter

Installation Manual

Models:

S215NA3250	/	S215NA3250 – T
S215NA2240	/	S215NA2240 – T
S190NA3250	/	S190NA3250 – T
S190NA2240	/	S190NA2240 – T

Contact Information:

SPARQ Systems Incorporated
116 Barrie Street
Kingston, Ontario
CANADA
K7L 3J9

P: 1-613-533-3438
E: support@sparqsys.com
W: www.sparqsys.com

FCC Compliance:

This product has been tested and was found to be compliant with the accepted limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If the equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Changes or modifications not expressly approved by the party responsible for compliance may void the user's authority to operate the equipment.

Revision Table:

Version	Date
Version 1.0	January, 21, 2011
Version 1.1	March 25, 2011
Version 1.2	June 1, 2011
Version 1.3	September 2, 2011
Version 1.4	November 11, 2011
Version 1.5	November 25, 2011
Version 1.6	December 9, 2011
Version 1.7	April 11, 2012

TABLE OF CONTENTS

This page intentionally left blank.

IMPORTANT SAFETY INFORMATION

READ THIS FIRST

SAVE THESE INSTRUCTIONS: This manual contains important instructions for the SPARQ microinverter that should be followed during installation and maintenance of the unit to reduce the risk of electric shock, and to ensure the safe installation and operation of the SPARQ microinverter. A failure to properly follow these instructions may result in personal injury, property damage, and/or loss of warranty coverage.

The information in this manual are guidelines to installing your system. As always, you must respect National Electrical Code, ANSI/NFPA 70, Canadian Electrical Code, and/or the electrical regulations of your local area.

This manual is intended to be used by a certified installer or electrician and is applicable for the following models:

- S215NA3250 / S215NA3250 - T
- S215NA2240 / S215NA2240 - T
- S190NA3250 / S190NA3250 - T
- S190NA2240 / S190NA2240 - T

This manual contains important instructions for installation and maintenance of the SPARQ Microinverter. To reduce risk of electrical shock and to ensure safe installation and operation of the system, the following safety symbols appear throughout this document to indicate dangerous conditions and important safety instructions.

WARNING: This indicates a situation where failure to follow instructions and/or improper equipment utilization may cause bodily harm.

NOTE: This indicates helpful information to the installer that can be used during installation.

IMPORTANT: This indicates important information that requires special attention. Please follow these instructions closely.

WARNING

- Perform all electrical installations in accordance with all local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70, and Canadian Electrical Code.
  - System grounding is the responsibility of the installer, who must follow Sections 690.41, 690.42, and 690.43 of the National Electric Code, and ANSI/NFPA 70. It must also comply with the requirements of Canadian Electrical Code, Part 1.
  - The microinverter must be earth grounded in accordance with national and/or local electrical laws
- Be aware that only qualified personnel (certified installers or electricians) shall install or replace the SPARQ Microinverter.
- Do not attempt to repair the SPARQ Microinverter; it contains no user-serviceable parts. If a microinverter fails, please return the unit to your distributor for maintenance. Tampering with or opening the microinverter will void the warranty.
- Before installing or using the SPARQ Microinverter, please read all instructions on the microinverter.
- The system AC circuit breaker must be disconnected before connecting or disconnecting the SPARQ Microinverter.
- Be aware that while handling the microinverter the casing acts as a heat sink and after extended use can reach temperatures

of 70°C (158°F) or higher. These temperatures may cause burns.

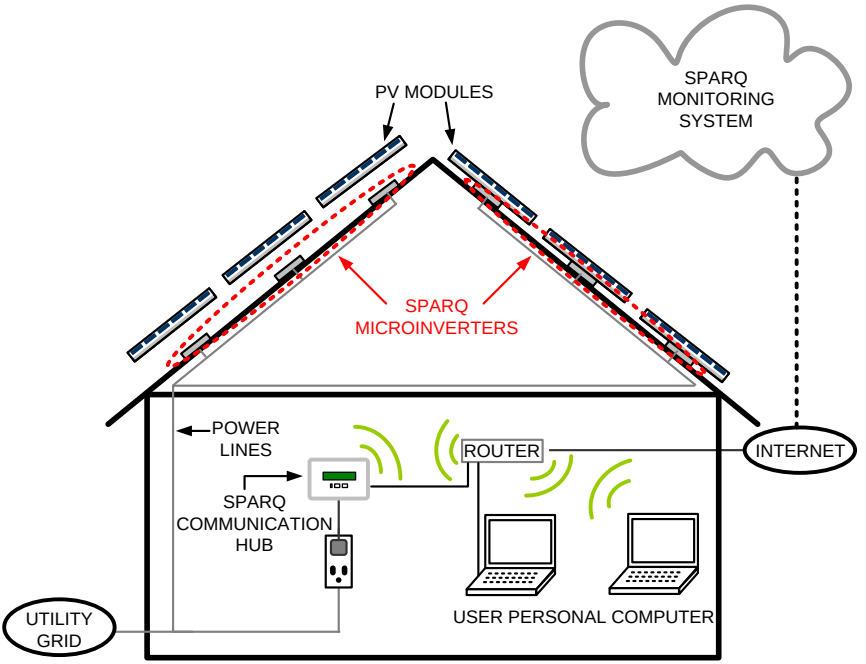
- An installation test and approval from the local utility company must be performed before grid connection. This includes inspection of wiring and confirming that local and national requirements and regulations are followed. These tests should be performed only by qualified installers and electricians.
- Models S215NA3250, S190NA3250 and respective tapped models must operate and be stored in a location with an ambient temperature between -40°C and 65°C (-40°F to 149°F). Low voltage models (S215NA2240, S190NA2240, and respective tapped models) must operate and be stored in a location with an ambient temperature between -40°C and 60°C (-40°F to 140°F).

NOTE: For the warranty terms and conditions, please see page 20.

1 INTRODUCTION

SPARQ's software-based microinverters eliminate unreliable components to provide 25 years of hassle-free operation. SPARQ Microinverters have lifetimes that match PV panels – an industry first.

So how does the SPARQ energy system work for you?



The figure above depicts a typical SPARQ system setup. In this setup, the wireless-enabled communication hub model (CH120M12) is depicted. For the wired communication hub model (CH120M11), communication between the hub and the user's personal computer can only be achieved through a wired connection.

1.1 What is the SPARQ Microinverter?

The SPARQ Microinverter is a device that is connected to a photovoltaic (PV) panel to convert the DC output of the panel into grid-compliant AC power. PV systems that use SPARQ Microinverters produce an optimal energy harvest by employing proprietary maximum power point tracking methods (MPPT). The SPARQ Microinverter is a 'plug-

and-play' device and is auto-grid configurable worldwide, so it is very easy and safe to install. For your safety, a Ground Fault Detection Indicator (GFDI) is incorporated to protect the system in the event that a ground fault occurs during operation.

The SPARQ Microinverter unit is light, compact, and efficient. It is designed to have a lifetime matching that of the photovoltaic module. The result is high-quality power generation and excellent system availability. In addition, the microinverters are very robust and deliver excellent performance even under adverse conditions such as snow, dust, shade and low-light conditions.

1.2 How can the system performance be monitored?

Monitoring is done using the SPARQ Communication Hub. The Communication Hub enables the user to quickly view the performance of every component of their SPARQ energy system. The hub achieves this by polling the status of every microinverter at regular intervals. The hub gathers, processes, and displays the information to the hub's LCD screen and on its internal website (http://sparqch/).

The hub also functions as a link between the microinverter(s) and the SPARQ Monitoring System through the internet. The hub transfers detailed performance data to the remote SPARQ Monitoring System every 5 minutes. The SPARQ monitoring system gathers, analyzes, and displays detailed graphical and numerical performance data from each microinverter.

Once configured, the SPARQ Monitoring System automatically collects data from each PV module so that you can view detailed real-time performance information regarding any PV module in your system. Information such as energy production, operational status, power output etc. can be easily reviewed at a glance. The monitoring system keeps a database of historical performance data of all the panels associated with a particular site. The information is presented graphically for easy understanding. The monitoring system also allows the user to calculate the monetary savings the PV system has provided.

2 SPARQ MICROINVERTER INSTALLATION

2.1 Preparation

Before installing the microinverter, please make sure that the following minimum site requirements are met:

- Outdoor-rated AC Junction box
- AC distribution box
- Appropriate grounding conductor
- Phillips screwdriver
- Sockets, wrenches for mounting hardware
- Suitable racking system (for PV modules)
- Tapped AC bus line (for tapped models)
- AC interconnect cable (for tapped models)
- Protective end caps

Check the shipping box for the following items:

- Grounding hardware (2 locking washers, 1 hexagonal nut, and 1 bolt)
- Mounting hardware (2 washers, 2 bolts)

2.2 PV module and Microinverter Compatibility

SPARQ Microinverters are compatible with PV modules where the MPPT voltage range falls within the microinverter model-specific voltage range. The microinverters are designed to use a split-phase 240V single phase connection.

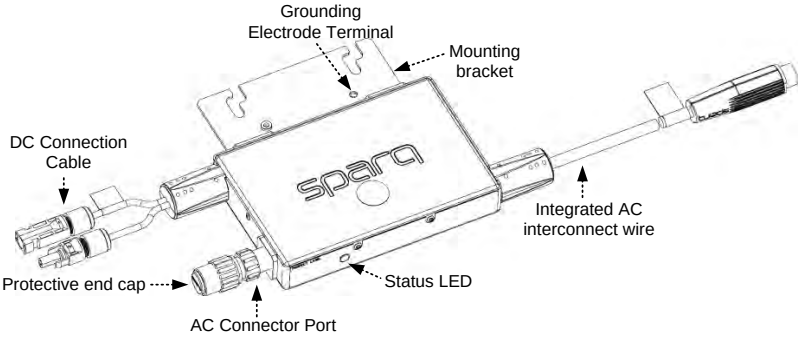
The electrical properties of the microinverters are summarized in the following table:

Model Number	PV MPPT Voltage Range	Maximum Power Output	Maximum Microinverters per AC branch
S215NA3250	32V-50V	215W	13
S215NA3250-T	32V-50V	215W	*
S215NA2240	22V-40V	215W	13
S215NA2240-T	22V-40V	215W	*
S190NA3250	32V-50V	190W	15
S190NA3250-T	32V-50V	190W	*
S190NA2240	22V-40V	190W	15
S190NA2240-T	22V-40V	190W	*

*Depends on the wire gauge selected.

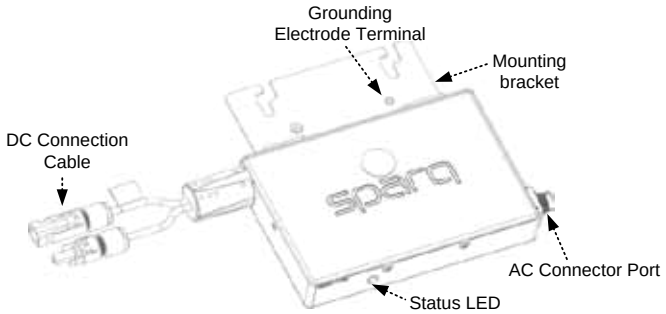
To ensure that the microinverter can be attached to a PV module, select the correct connector type for both the microinverter and the PV module. All models are compatible with Amphenol H4 Locking DC connectors, Tyco Solarlok®, MC4 Locking DC connectors.

Daisy Chain Microinverter:



*note: the microinverter may differ slightly from the drawing

Tapped Connection Microinverter:



*note: the microinverter may differ slightly from the drawing

2.3 Installation Procedure Overview

There are three steps to the successful installation of your SPARQ Microinverter system.

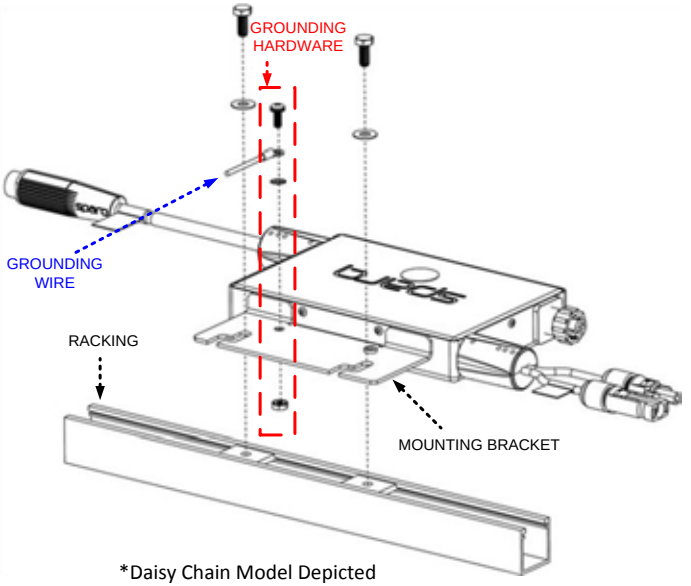
1. Mount the SPARQ Microinverter to the racking
2. DC connection (PV module connection)
3. AC Connection

WARNING: Before installation, ensure that the system is disconnected from the utility and that the AC junction box is not energized! **There is a risk of shock and injury if this is not followed.**

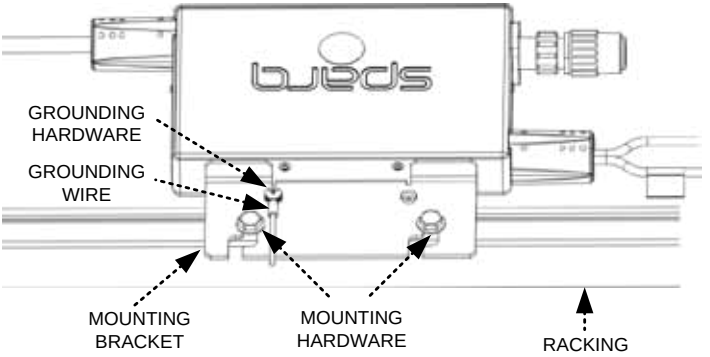
IMPORTANT: Daisy Chain connections and tapped models cannot be used in the same branch.

2.4 Mounting the SPARQ Microinverter

1. Ensure that the system is not connected to AC power.
2. Install the grounding hardware and attach grounding wire.
3. Mount the microinverter onto the racking.



*Daisy Chain Model Depicted



*Daisy Chain Model Depicted

WARNING: Do not exceed the maximum number of microinverters in series in one branch. For the Daisy Chain models, the maximum number of microinverters per branch is indicated on the microinverter label and in the table on page 5. For Tapped models, the maximum number of microinverters is dependent on the wire gauge and microinverter model that is selected.

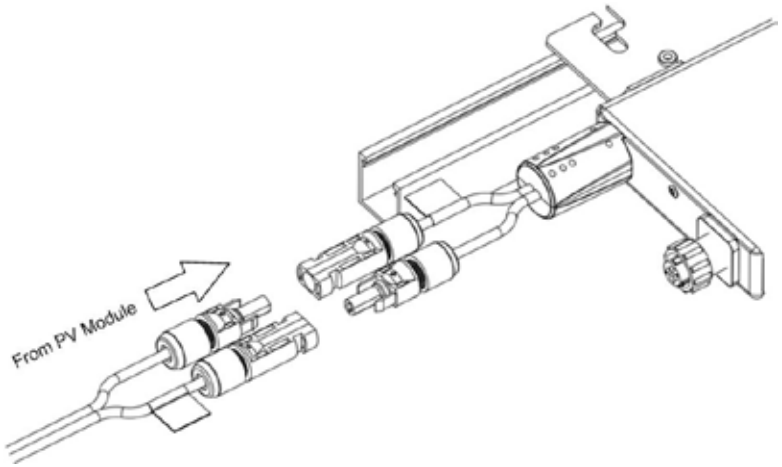
IMPORTANT: Ensure that there is a gap (at least 10mm) on both the top and bottom of the microinverter.

NOTE: For Daisy Chain models, the microinverter should be oriented with the AC cable facing the next microinverter in the string.

2.5 DC Connection (Connecting the Microinverter and the PV Module)

To connect the mounted microinverter to the PV module please follow these steps:

1. Install the PV modules on the racking (follow the PV module installation guide).
2. Cover the PV module with an opaque material (to prevent the module from producing power).
3. Connect the male end of the microinverter DC connector cable to the female end of the PV module connector cable. Connect the female end of the microinverter DC connector cable to the male end of the PV module connector cable. (See diagram.)



*Daisy Chain Model Depicted

WARNING:

- Never disconnect any DC cables under load.
- An opaque cover must cover the PV modules at all times until the system setup is completed.
- Before disconnecting any of the wires, the AC system circuit breaker must be disconnected

2.6 AC Connection

There are two different ways to wire your microinverter, depending on the model.

- Tapped Connection (for the models with the "-T" suffix)
- Daisy Chain Connection

Tapped Connection microinverter models require an external AC interconnect wire to complete the AC connection. The Daisy Chain Connection microinverter models, on the other hand, have an integrated AC interconnect wire built into the package.

WARNING:

- A protective end cap must be used for any unused AC connectors.
- Make sure the junction box is not connected to the utility grid when working with the AC wires.

2.6.1 Daisy Chain Connection

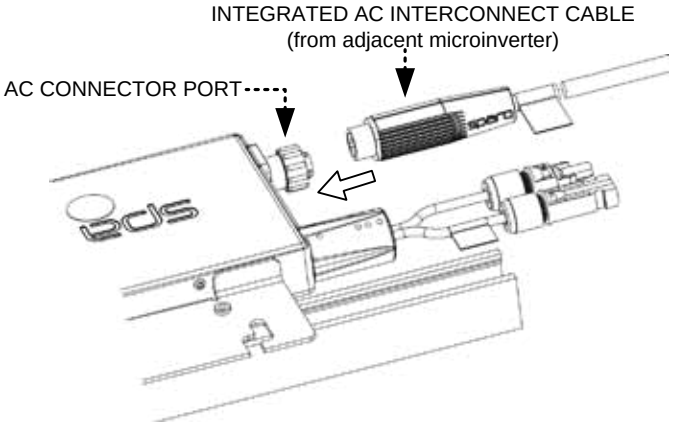
In a Daisy Chain connection, adjacent microinverters are connected to each other through the integrated AC interconnect cable.

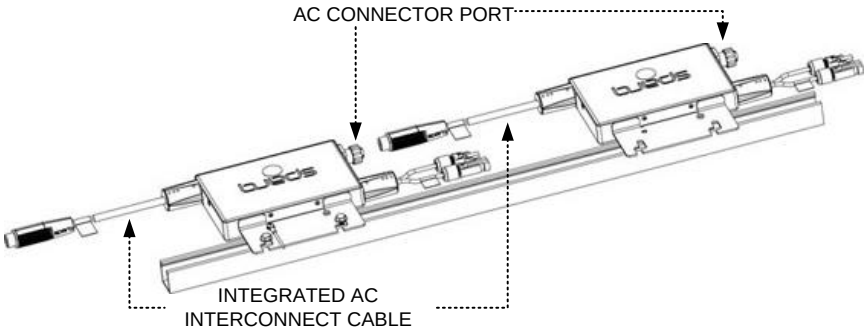
WARNING:

- Any unused integrated AC interconnect cable must be covered with a protective end cap.
- Any unused AC connector port must be covered with a protective end cap.

IMPORTANT: The first microinverter in the branch must be connected to a junction box.

1. Using the AC interconnect cable, connect each microinverter in the branch together.



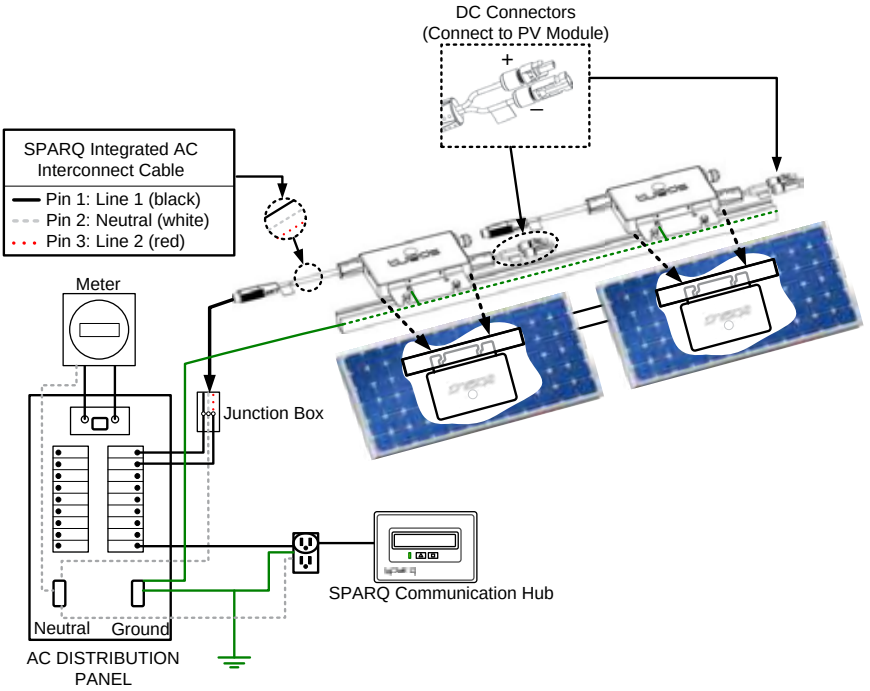


WARNING: Make sure the final microinverter AC connector port is covered with a protective end cap.

2. Ensure the junction box is not energized and connect the male end of the first microinverter to the junction box.

WARNING: Make sure the junction box is not energized (connected to the grid).

Daisy Chain Connection Overall Wiring Diagram:



2.6.2 Tapped Connection

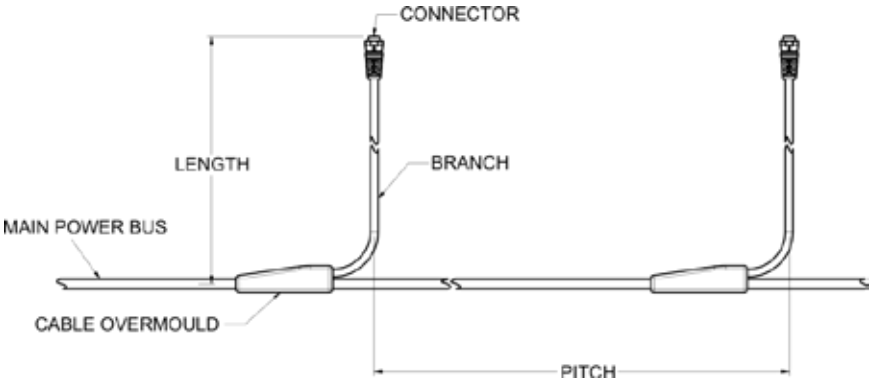
In a Tapped Connection, a long wire (i.e. AC tapped racking wire) is attached to the racking such that it spans the length of the branch. The microinverters are then attached to the connectors on that wire.

1. Measure the required length of the tapped racking cable, and purchase the necessary length.

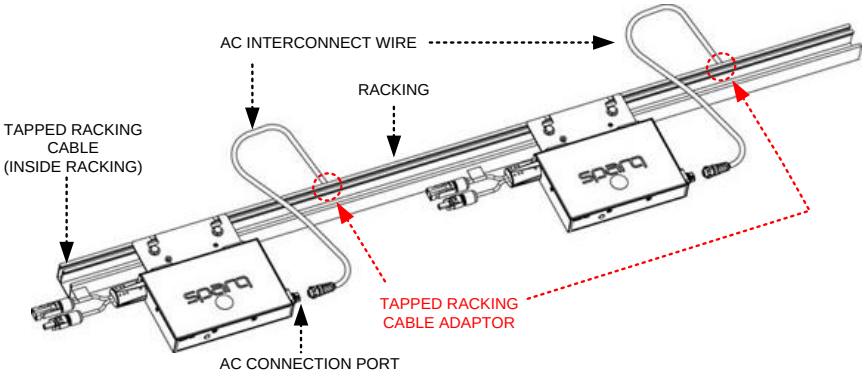
IMPORTANT: Measure from farthest microinverter to the junction box.

NOTE: Different lengths for the tapped racking wire are available depending on the installer's needs.

2. Secure the AC tapped racking cable to the racking.



3. Connect the AC interconnect cable from each microinverter to the adaptor on the AC tapped racking cable.

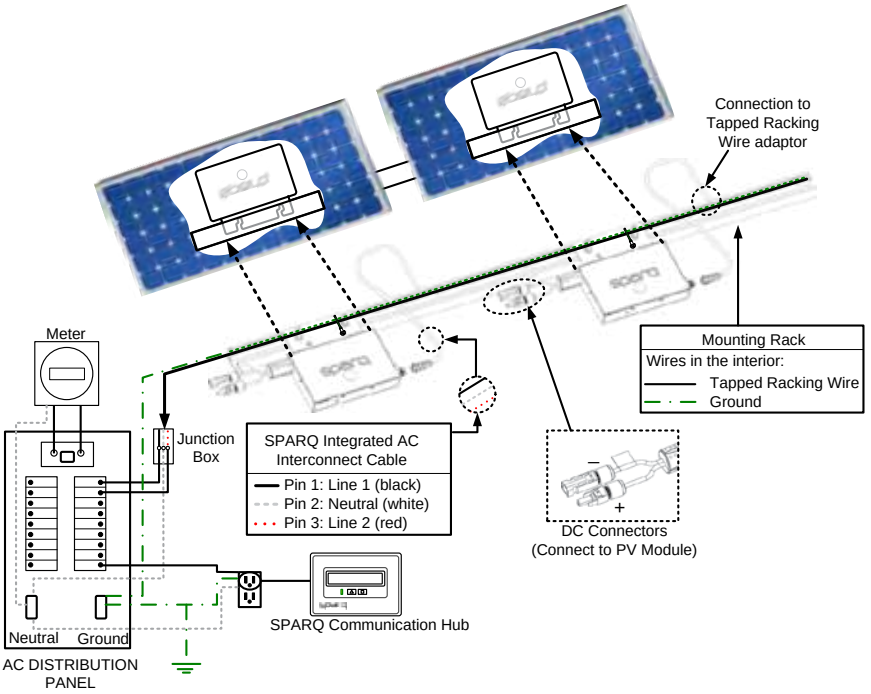


WARNING:

- Make sure any unused AC connectors are covered by the protective seals.

4. Make sure the junction box is not connected to the grid and connect the end of the AC cable to the junction box.

Tapped Connection Overall Wiring Diagram:



2.7 Generating Power

For your safety, please go through the following checklist and ensure that all the steps have been properly completed before turning on your SPARQ energy system.

Checklist:

- ☐ Ensure any unused AC connections have been covered with a protective end cap or protective seals for tapped models.
- ☐ Check all connections to make sure they are fully connected and no wires are damaged or pinched.
- ☐ Confirm all microinverters are grounded using a grounding wire or by using the appropriate grounding washer for your racking.
- ☐ Ensure that all PV modules and microinverters are securely fastened to the racking.
- ☐ Make sure you comply with National Electrical Code, ANSI/NFPA 70, and Canadian Electrical Code during installation—such as including main AC system circuit breaker, where local or national code requires.

Turning on the SPARQ Energy System:

1. Remove opaque cover from PV modules.
2. Turn on the main AC circuit breaker to connect your system to the grid.

WARNING:

- Connection of your system to the utility grid MUST be completed by a certified installer or electrician only.
- Before connecting the SPARQ microinverter to the utility grid, confirmation from the utility company is required.
- It is the responsibility of the installer to install all relevant apparatus to connect to the utility grid and to comply with National Electrical Code, ANSI/NFPA 70, and the Canadian Electrical Code. The installer must also complete all safety checks required before connecting the system.

3 TROUBLESHOOTING

LED Indicators			Possible Solution
Interval	**LED Status**	**Meaning**	
Startup	Solid GREEN	Startup process (normal)	N/A
Startup	LED OFF	If LED is OFF after applying DC and AC power, this indicates a failure in the microinverter startup	Please check: 1. The DC connection to the solar panel 2. Any possible shading of solar panel
Post-Startup	Flashing GREEN	Operational and is producing power (normal)	N/A
Post-Startup	Flashing RED	Not producing power due to islanding	Please check the AC connection. Ensure that there is a solid connection to the grid. Also make sure the grid voltage and frequency at the point of connection is in the range.
Post-Startup	Solid RED	Not producing power due to protection. Can be caused by: • Under/over voltage protection • Over current protection	Please contact SPARQ for support
Post-Startup	Amber	Ground fault detector	Please contact SPARQ for support

WARNING: No attempt should be made to repair the SPARQ Microinverter; there are no user serviceable parts. By opening the microinverter you risk voiding your warranty. If the device fails please contact SPARQ customer service.

4 DISCONNECTING THE SYSTEM

1. Turn OFF the AC circuit breaker for each of the branch circuits.
2. Cover the PV modules with an opaque cover and confirm that the status LED on the microinverter is off. Disconnect the DC connectors.
3. Disconnect the AC connectors for each microinverter.
4. Disconnect ground wiring.
5. Remove each microinverter from the racking.

WARNING:

- Before disconnecting any of the wires, the appropriate AC circuit breaker must be turned off.
- Do not disconnect DC wires under load.

5 WARRANTY INFORMATION

SPARQ Systems Inc. ("SPARQ") has developed a highly reliable microinverter, designated as S215NA3250(-T), S215NA2240(-T), S190NA3250(-T) or S190NA2240 ("Microinverter"), that is designed to withstand normal operating conditions when used for its originally intended purpose in compliance with the SPARQ User Manual supplied with the originally shipped system. The SPARQ limited warranty ("Limited Warranty") covers defects in workmanship and materials of the SPARQ Microinverter ("Defective Product") for a period of twenty-five (25) years from the date of original purchase of such Microinverter at point of sale to the originally installed end user location (the "Warranty Period"). During the Warranty Period, the warranty is transferable to a different owner as long as the Microinverter remains installed at the originally installed end user location.

During the Warranty Period, if SPARQ establishes, through inspection, the existence of a defect that is covered by the Limited Warranty, SPARQ will, at its option, either (1) repair or replace the Defective Product free of charge, or (2) provide a credit or refund to the owner of the system at the originally installed end user location in an amount not to exceed the then-current price of a "like kind" microinverter(s) that is available for purchase by the system owner at the time of the Limited Warranty claim, or (b) the original cost of the SPARQ Microinverter that is subject to a Limited Warranty claim.

If SPARQ elects to repair or replace the Defective Product, SPARQ will, at its option, use new and/or reconditioned parts in repairing or replacing the Defective Product. SPARQ reserves the right to use parts or products of original or improved design in the repair or replacement of Defective Product. If SPARQ repairs or replaces a Defective Product, the Limited Warranty continues on the repaired or replacement product for the remainder of the original Warranty Period or ninety (90) days from the date of SPARQ's return shipment of the repaired or replacement product, whichever is later. The Limited Warranty covers both parts and labor necessary to repair the Defective Product (if SPARQ elects to repair the Defective Product), but does not include labor costs related to (i) uninstalling the Defective Product or (ii) if applicable, re-installing a repaired or replacement product. To the extent applicable, the Limited Warranty also covers the costs of shipping a repaired or replacement product from SPARQ, via a non-expedited freight carrier selected by SPARQ, to locations within Canada and the United States (including Alaska and Hawaii), but not to other locations outside Canada or the United States. The Limited Warranty does not cover, and SPARQ will not be responsible for, shipping damage or damage caused by mishandling by the freight carrier and any such damage is the responsibility of the freight carrier.

SPARQ Microinverters are designed to withstand normal operating conditions and typical wear and tear when used for their original intent and in compliance with the

installation and operating instructions supplied with the original equipment. The Limited Warranty does not apply to, and SPARQ will not be responsible for, any defect in or damage to any SPARQ Microinverter: (1) that has been misused, neglected, tampered with, altered, or otherwise damaged, either internally or externally; (2) that has been improperly installed, operated, handled or used, including use under conditions for which the product was not designed, use in an unsuitable environment, or use in a manner contrary to the SPARQ Microinverter User Manual or applicable laws or regulations; (3) that has been subjected to fire, water, generalized corrosion, biological infestations, acts of God, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the SPARQ Microinverter specifications, including high input voltage from generators or lightning strikes; (4) that has been subjected to incidental or consequential damage caused by defects of other components of the solar system; or (5) if the original identification markings (including trademark or serial number) of such Microinverter have been defaced, altered, or removed. The Limited Warranty does not cover costs related to the removal, installation or troubleshooting of the customer's electrical systems. The Limited Warranty does not extend beyond the original cost of the SPARQ Microinverter.

THE LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY GIVEN BY SPARQ AND, WHERE PERMITTED BY LAW, IS MADE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF TITLE, QUALITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OR WARRANTIES AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN MANUALS OR OTHER DOCUMENTATION. IN NO EVENT WILL SPARQ BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, COSTS OR EXPENSES HOWEVER ARISING, WHETHER IN CONTRACT OR TORT, INCLUDING WITHOUT LIMITATION ANY ECONOMIC LOSSES OF ANY KIND, ANY LOSS OR DAMAGE TO PROPERTY, OR ANY PERSONAL INJURY.

To the extent any implied warranties are required under applicable law to apply to the SPARQ Microinverter, such implied warranties shall be limited in duration to the Warranty Period, to the extent permitted by applicable law. Some provinces and states do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply. This Limited Warranty gives the customer specific legal rights, and the customer may have other rights that may vary from state to state or province to province.

ENERGY RECOVERY VENTILATOR

Venmar AVS ERV EKO 1.5

Part no. 43911

84 to 140 CFM (0.4 in. w.g.) 53 to 105 CFM (0.4 in. w.g.)
67 to 120 CFM (0.4 in. w.g.) 40 to 80 CFM (0.4 in. w.g.)

VB0136

A NEW ERA BEGINS WITH THE ERV EKO 1.5 ULTRA-EFFICIENT AND ENVIRONMENTALLY-FRIENDLY ENERGY RECOVERY VENTILATOR

The ERV EKO 1.5 has been designed to be one of the most energy-efficient ERV air exchangers available on the market. Its innovative design incorporates high performance ECM* motors which consume significantly less electricity. ERVs are ideal for LEED®-certified residential projects and other energy-efficient homes because they recover the heat or coolness of the indoor air while helping to maintain comfortable moisture levels inside the home.

- Perfect for drier homes using humidifiers in heating season and air conditioning during cooling season
- Compact footprint allows an easy fit in restricted spaces
- No drain required**
- State-of-the-art ECM motors provide significant electrical consumption savings
- 6" metal ports located on top of unit to simplify installation and provide a cleaner appearance
- Integrated pressure taps and balancing dampers to quickly measure and balance the air-flow
- Faster and easier installation of insulated flexible ducts with practical straps
- Homeshield™ defrosting system (no negative pressure)
- ENERGY STAR® qualified: Ideal for high performance small to mid-size homes

*Electronically Commutated Motor.
**For most climate zones.

REPAIRS AND MAINTENANCE

The ERV EKO 1.5 high output ECM* motors are permanently lubricated. The electronic circuit board eliminates electromechanical parts, reducing repair time to a minimum.

WARRANTY

The ERV EKO 1.5 unit is protected by a 5-year warranty on all parts, including the energy recovery core.

Available at:

Controls

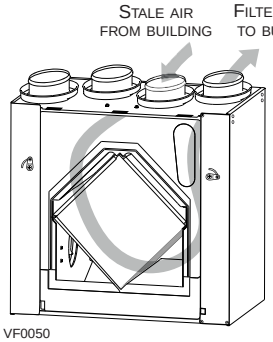
- This unit is very simple to operate. Once it is installed, press on its push button, located under the unit, to activate it. Press once for low speed, once again for high speed, and once more to stop it
- The following main controls are available:
  - Altitude programmable digital control with Smart mode — no. 40440
  - Deco-Touch digital control — no. 40395
- Also, one to 5 of the following optional controls can be added:
  - 20/40/60-min. Push-Button Timer — no. 03364
  - 60-min. Mechanical Timer — no. 00910

Options

- Complete line of registers and diffusers
- Electric duct heater

Homeshield™ Defrosting System

The ERV EKO 1.5 uses a unique defrosting method. No negative pressure is created by air exhausted to the outside, as the air is recirculated into the house, helping to prevent any backdraft.



VF0050

OUTSIDE TEMPERATURE		DEFROST CYCLE DEFROSTING MIN./ OPERATING MIN.
°C	°F	
WARMER THAN -10	WARMER THAN 14	NO DEFROST
-10 TO -27	14 TO -17	7/25
-27 & LESS	-17 & LESS	10/22

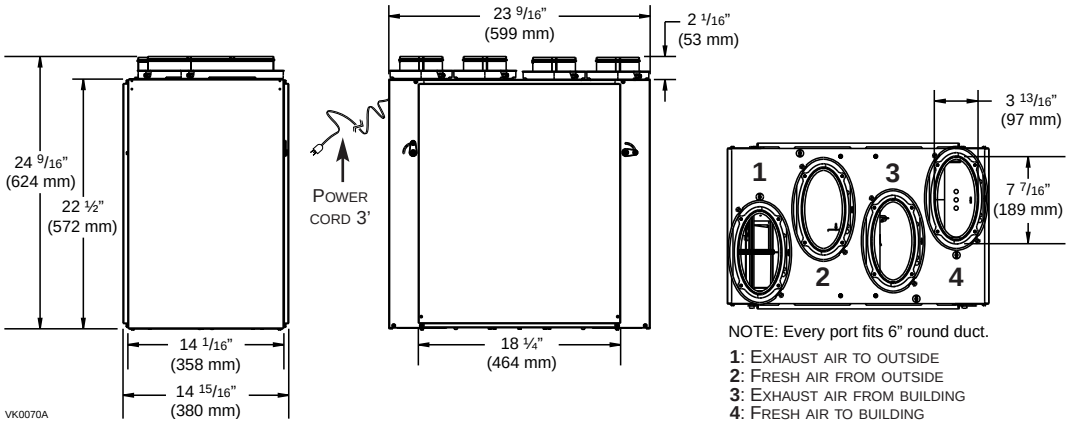
Energy Recovery Core

Dimensions: 10" x 10" x 14.25"
(25.4 cm x 25.4 cm x 36.2 cm)
Exchange surface: 110 ft² (10.2 m²)
Weight: 20 lb (9.1 kg)
Material: Polymerized paper
Type: Cross Flow
Warranty: 5 year

Requirements and Standards

- Complies with the UL 1812 requirements regulating the installation of Energy Recovery Ventilators
- Complies with the CSA C22.2 no. 113 Standard applicable to ventilators
- Complies with CSA C444 requirements regulating the installation of Energy Recovery Ventilators
- Technical data was obtained from published results of tests relating to CSA C439 Standards
- HVI certified and ENERGY STAR® qualified

Dimensions and Service Clearances: Venmar ERV EKO 1.5



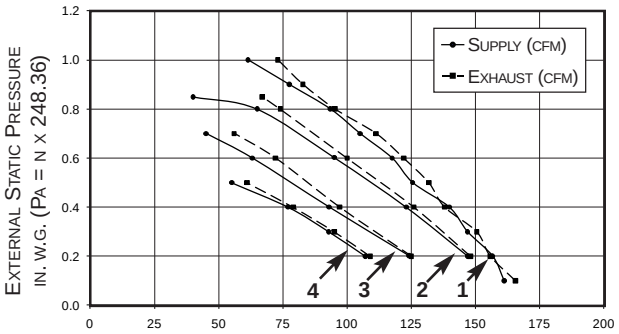
NOTE: Every port fits 6" round duct.

1: EXHAUST AIR TO OUTSIDE
2: FRESH AIR FROM OUTSIDE
3: EXHAUST AIR FROM BUILDING
4: FRESH AIR TO BUILDING

Ventilation Performance

EXT. STATIC PRESSURE		NET SUPPLY AIR FLOW			GROSS AIR FLOW					
					SUPPLY			EXHAUST		
PA	IN. W.G.	L/S	CFM	M³/H	L/S	CFM	M³/H	L/S	CFM	M³/H
25	0.1	76	161	274	77	163	277	78	166	282
50	0.2	74	157	267	75	158	268	74	156	265
75	0.3	69	147	250	70	149	253	71	150	255
100	0.4	66	140	238	67	142	241	65	138	234
125	0.5	59	125	212	60	127	216	62	132	224
150	0.6	55	117	199	56	119	202	58	122	207
175	0.7	50	105	178	50	107	182	53	111	189
200	0.8	44	93	158	45	95	161	45	95	161
225	0.9	37	77	131	37	79	134	39	83	141
250	1.0	29	61	104	29	62	105	34	73	124

Fan Curve according to Speed



GROSS AIR FLOW
CFM (L/S = CFM X 0.4719) (M³/H = L/S X 3.6)

SPEED RANGE **1**: 84 TO 140 CFM
SPEED RANGE **2**: 67 TO 120 CFM
SPEED RANGE **3**: 53 TO 105 CFM
SPEED RANGE **4**: 40 TO 80 CFM

Energy Performance

SUPPLY TEMPERATURE		NET AIR FLOW		POWER CONSUMED WATTS	SENSIBLE RECOVERY EFFICIENCY	APPARENT SENSIBLE EFFECTIVENESS	LATENT/RECOVERY MOISTURE TRANSFER
°C	°F	L/S	CFM				
HEATING							
0	32	24	52	24	67	73	0.59
0	32	31	65	30	67	72	0.55
0	32	39	83	36	65	71	0.52
0	32	57	122	60	62	67	0.46
-25	-13	33	70	39	60	75	0.61
35	95	24	51	24	52*	71	0.51

*Total recovery efficiency

NOTE: All specifications are subject to change without notice.

Specifications and Ratings

- Model: ERV EKO 1.5
- Part number: 43911
- Total assembled weight (including polymerized paper core: 65 lb (29.5 kg)
- Oval shaped ports; fit 6" round ducts
- Drains: Optional
- Core filters: 2 washable Merv 7
  9.2" x 14.25" x 3.8"
  (23.4 cm x 36.2 cm x 9.6 cm)
- Housing: Pre-painted steel
- Insulation: Expanded polystyrene
- Mounting: Suspension by chains & springs
- Supply & Exhaust blower motors:
  2 ECM motors
  - Protection type: Thermally protected
  - Insulation class: B
- Speed control on unit:
  - Low and high speed
  - Other modes available with Altitude or Deco-Touch main control
- Energy recovery core:
  - Heat exchange surface area:
    110 ft² (10.2 m²)
  - Type: Cross flow
  - Material: Polymerized paper
- Unit electrical characteristics:

Volts	Frequency	Amperes	Watts
120	60 Hz	1.3	90

PROJECT:	REMARKS
LOCATION:	
MODEL NO.:	
QTY.:	
SUBMITTED BY: DATE:	

Residential Product Group, 550 Lemire Blvd., Drummondville, QC, Canada J2C 7W9 - Tel.: 1-800-567-3855 Fax: 1-800-567-1715

www.venmar.ca

SPECIFICATION CATALOG

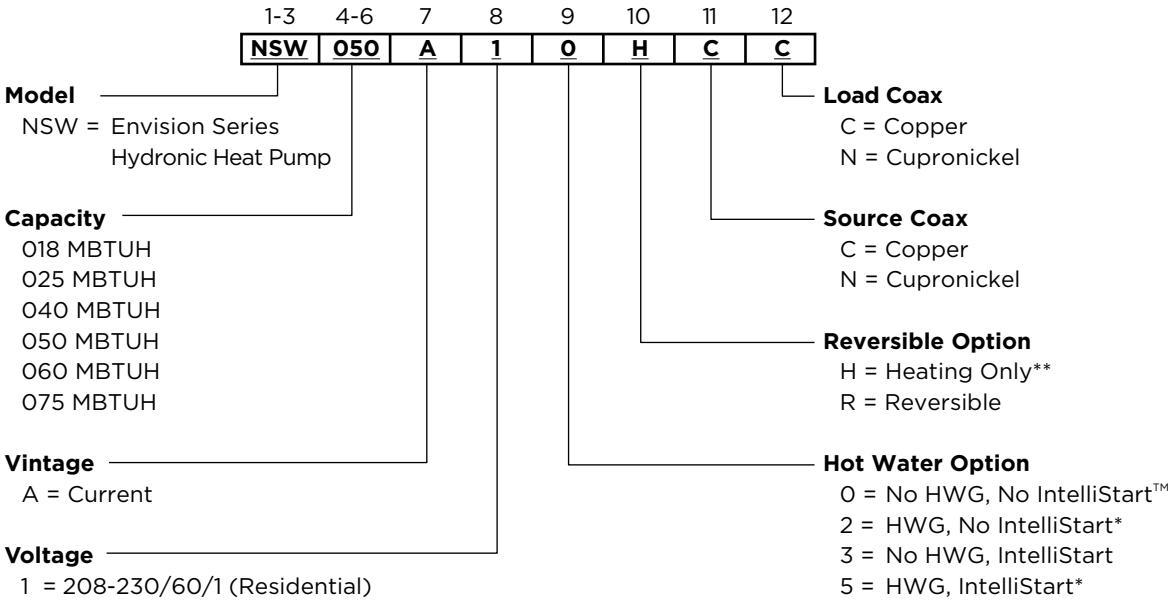
ENVISION™

GEOTHERMAL HYDRONIC HEAT PUMP
1.5 TO 6 TONS

WaterFurnace®
Smarter from the Ground Up™

Table of Contents

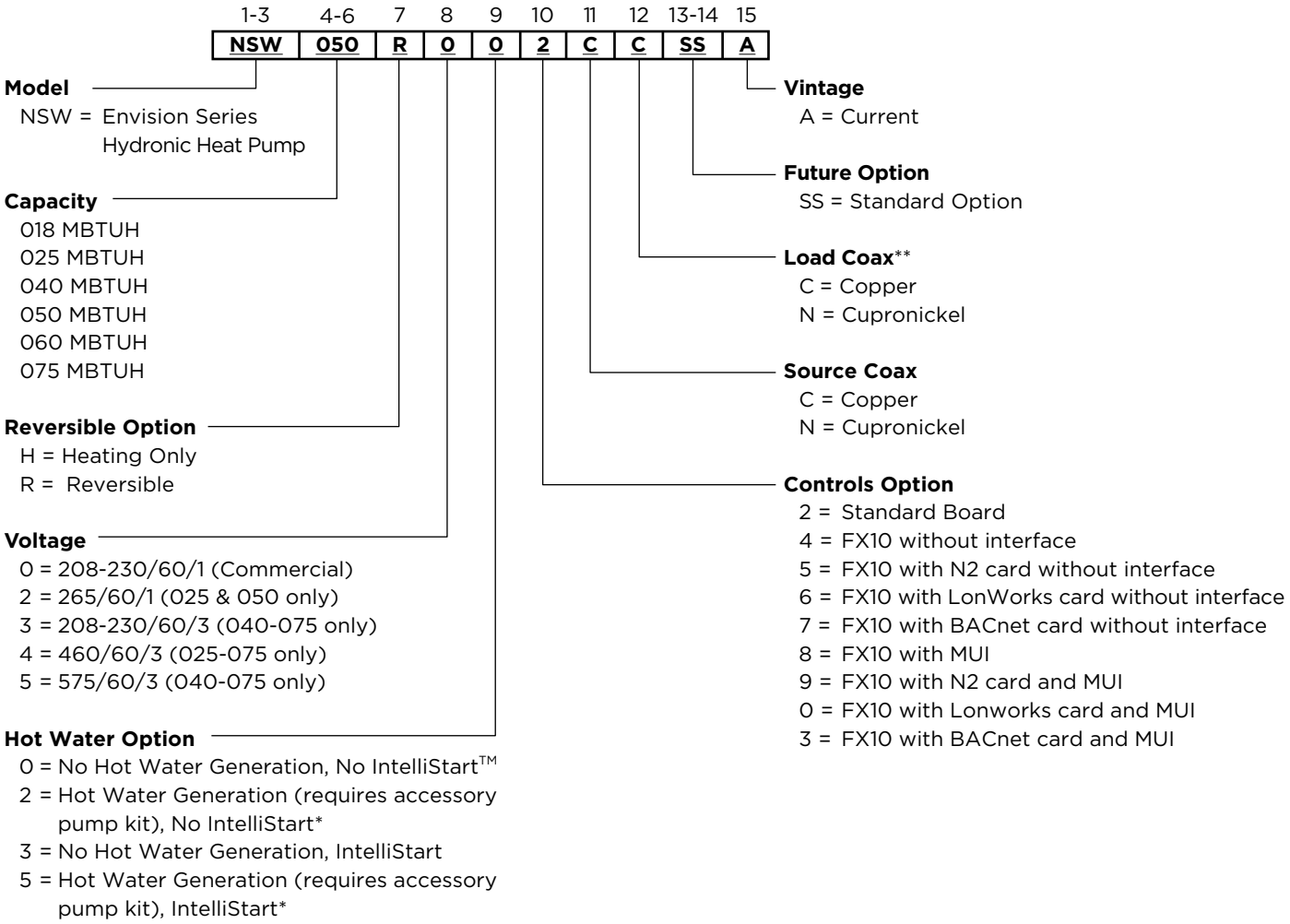
Model Nomenclature - Residential (silver cabinet)



NOTES: *Available on 040, 050, 060, and 075 only. HWG requires field installed external pump kit.
**NSW018 and NSW025 heating only models are available only with copper double wall vented load coax for potable water.

All Envision Series product is Safety listed under UL1995 thru ETL and performance tested in accordance with standard AHRI/ISO 13256-2. AHRI does not currently certify water-to-water products under AHRI/ISO 13256-2.

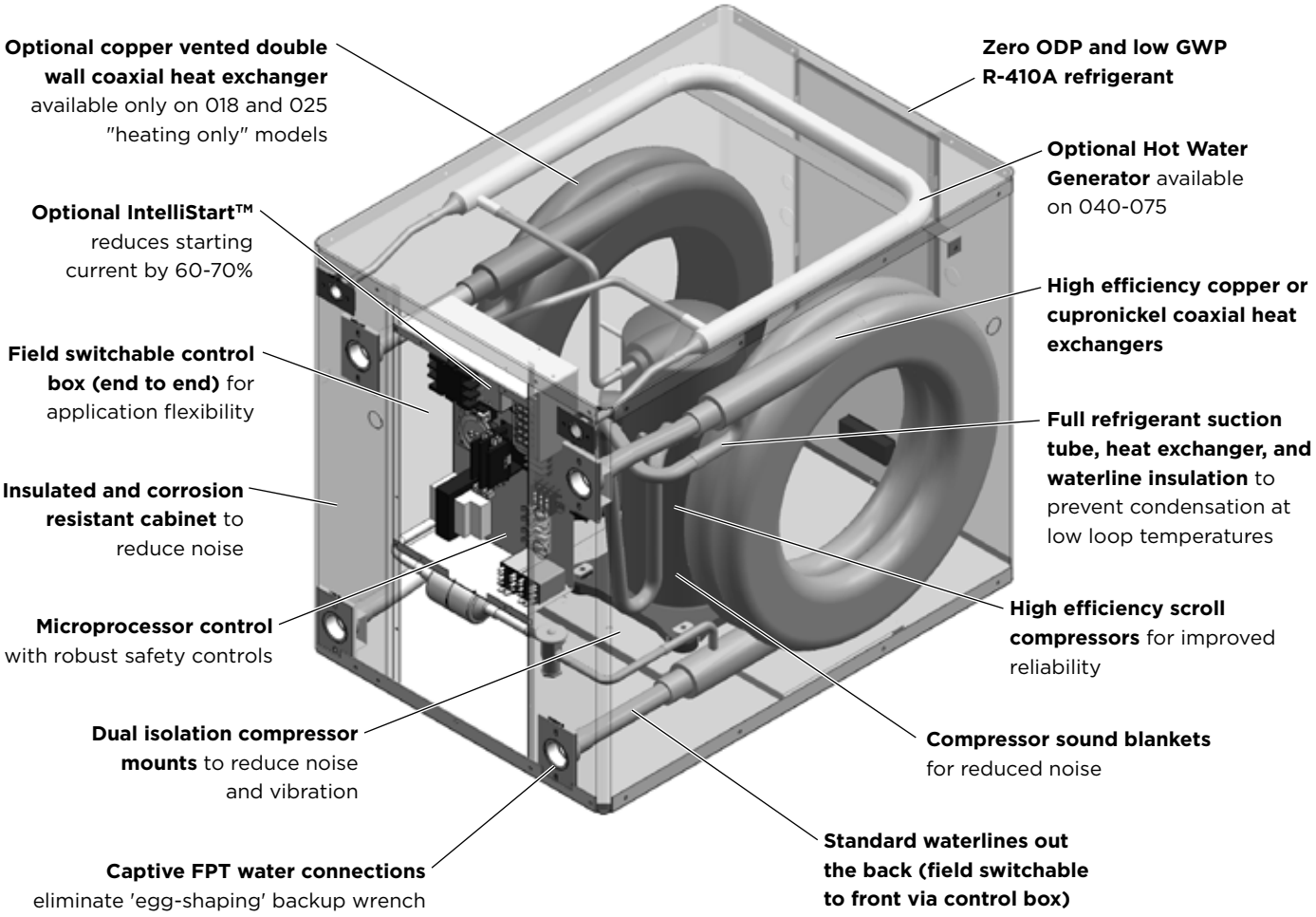
Model Nomenclature - Commercial (white cabinet)



NOTES: *Available on 040, 050, 060, and 075 only. HWG requires field installed external pump kit.
**NSW018 and NSW025 heating only models are available only with copper double wall vented load coax for potable water.

The Envision Series

NSW Features



The Envision Series cont.

High Efficiency

The Envision Series are the highest efficiency units available. Large oversized water-to-refrigerant heat exchangers and scroll compressors provide extremely efficient operation. This efficiency means the Envision Series requires less loop than any product on the market. This can mean significant savings on commercial and residential projects.

Operating Efficiencies

- Environmentally friendly R-410A refrigerant reduces ozone depletion.
- An optional hot water generator is available on NSW040, NSW050, NSW060, and NSW075 to generate hot water at considerable savings while improving overall system efficiency.
- High-stability bidirectional expansion valve provides superior performance.
- Efficient scroll compressors operate quietly.
- Oversized coaxial tube water-to-refrigerant heat exchanger increases efficiency.

Standard Features

- Single phase is available.
- Heavy gauge cabinet
- Quiet scroll compressors in all models
- All interior cabinet surfaces are insulated with 1/2˝ [12.7mm] thick 1-1/2lb [681g] density, surface coated, acoustic type glass fiber insulation.
- Optional IntelliStart™ to reduce starting current
- Field switchable control box
- Ultra-compact cabinet
- Multi-density laminate lined compressor blanket designed to completely surround the compressor on all six sides and suppress low frequency noise.
- Multi-density steel laminate compressor 'mass' base plate designed to suppress low frequency compressor noise.

Product Quality

- Heavy-gauge steel cabinets, with rounded corners, are finished with a durable polyester powder coat paint for long lasting beauty and service.
- The front access panel of each unit is made of a high-density non-metallic material.
- All refrigerant brazing is performed in a nitrogen atmosphere.
- The NSW018H and NSW025H are available with load side copper vented double wall coaxial heat exchangers.
- Coaxial heat exchangers, refrigerant suction lines, hot water generator, and all water pipes are fully insulated to reduce condensation problems in low temperature operation.
- Computer controlled deep vacuum and refrigerant charging system.
- All joints are leak detected for maximum leak rate of less than 1/4 oz. per year.
- Computer bar code equipped assembly line ensures all components are correct.
- All units are computer run-tested with water to verify both function and performance.
- Safety features include high- and low-pressure refrigerant controls to protect the compressor; hot water high-limit hot water generator pump shutdown.

Easy Maintenance and Service Advantages

- Removable compressor access panels.
- Integrated temperature controls with digital readout and user interface.
- Quick attach wiring harnesses are used throughout for fast servicing.
- High and low pressure refrigerant service ports.

Options and Accessories

- Optional hot water generator with externally mounted pump and water heater plumbing connector.
- Closed loop, source side, circulating pump kit
- Closed loop, load side, circulating pump kit
- Water connection kits
- Geo-Storage Tank (80-120 Gal.)
- IntelliStart™
- HydroZone, tank control with outdoor reset

Application Flexibility

- Designed to operate with entering source temperature of 25°F and leaving load temperatures of 40°F to 130°F. See the capacity tables to see allowable operating conditions per model.
- Source side flow rates as low as 1.5 GPM/ton for well water, 50°F [10°C] min. EWT.
- Dedicated heating and heat pump models available.
- Dedicated non-reversible models are shipped as heating only; field convertible to cooling only.
- Modularized unit design and primary/secondary controls for optimum capacity matching and staging.
- Stackable for space conservation (to a maximum 3 units high).
- Compact size allows installation in confined spaces.
- Front or rear plumbing connections.
- Control Panel location is reversible.

Inside the Envision Series

Refrigerant

Envision products all feature zero ozone depletion and low global warming potential R-410A refrigerant.

Cabinet

All units are constructed of corrosion resistant galvanized sheet metal with silver metallic powder coat paint rated for more than 1000 hours of salt spray. Lift-out access panels provide access to the compressor section from two sides.

Compressors

High efficiency R-410A scroll compressors are used on every model. Scrolls provide both the highest efficiency available and great reliability.

Electrical Box

The control panel is "field" movable from front to back for ease of application. Separate knockouts for low voltage, and two for power on, front and back, allow easy access to the control box. Large 75VA transformer assures adequate controls power for accessories.

Water Connections

Flush mount FPT water connection fittings allow one wrench leak-free connections and do not require a backup wrench. Factory installed water line thermistors can be viewed through the microprocessor interface tool.

Thermostatic Expansion Valve

All Envision models utilize a balanced port bidirectional thermostatic expansion valve (TXV) for refrigerant metering. This allows precise refrigerant flow in a wide range of entering water variation (20 to 120°F [-7 to 49°C]) found in geothermal systems. The TXV is located in the compressor compartment for easy access.

Water-to-Refrigerant Heat Exchanger Coil

Large oversized coaxial refrigerant-to-water heat exchangers provide unparalleled efficiency. The coaxes are designed for low pressure drop and low flow rates. All coaxes are pressure rated to 450 psi water side and 600 psi on the refrigerant side. Refrigerant-to-water heat exchangers will be coated with ThermaShield to prevent condensation in low temperature loop operation.

Service Connections and Serviceability

Two Schrader service ports are provided for each unit. The suction side and discharge side ports are for field charging and servicing access. All valves are 7/16” SAE connections.

4-Way Reversing Valve

Envision units feature a reliable all-brass pilot operated refrigerant reversing valve. The reversing valve operation is limited to change of mode by the control to enhance reliability.

IntelliStart™

The optional IntelliStart single phase soft starter will reduce the normal start current (LRA) by 60-70%. This allows the heat pump to go off-grid. Using IntelliStart also provides a substantial reduction in light flicker, reduces start-up noise, and improves the compressor's start behavior. IntelliStart is available in a field retrofit kit or as a factory installed option for all Envision and Synergy3D units.

Water Quality

General

NSW water-to-water heat pumps may be successfully applied in a wide range of residential and light commercial applications. It is the responsibility of the system designer and installing contractor to ensure that acceptable water quality is present and that all applicable codes have been met in these installations.

Water Treatment

Do not use untreated or improperly treated water. Equipment damage may occur. The use of improperly treated or untreated water in this equipment may result in scaling, erosion, corrosion, algae or slime. The services of a qualified water treatment specialist should be engaged to determine what treatment, if any, is required. The product warranty specifically excludes liability for corrosion, erosion or deterioration of equipment.

The heat exchangers and water lines in the units are copper or cupronickel tube. There may be other materials in the building's piping system that the designer may need to take into consideration when deciding the parameters of the water quality.

If an antifreeze or water treatment solution is to be used, the designer should confirm it does not have a detrimental effect on the materials in the system.

Contaminated Water

In applications where the water quality cannot be held to prescribed limits, the use of a secondary or intermediate heat exchanger is recommended to separate the unit from the contaminated water.

The following table outlines the water quality guidelines for unit heat exchangers. If these conditions are exceeded, a secondary heat exchanger is required. Failure to supply a secondary heat exchanger where needed will result in a warranty exclusion for primary heat exchanger corrosion or failure.

Water Quality Guidelines

Material		Copper	90/10 Cupro-Nickel	316 Stainless Steel
pH	**Acidity/Alkalinity**	7- 9	7 - 9	7 - 9
Scaling	Calcium and Magnesium Carbonate	(Total Hardness) less than 350 ppm	(Total Hardness) less than 350 ppm	(Total Hardness) less than 350 ppm
Corrosion	Hydrogen Sulfide	Less than .5 ppm (rotten egg smell appears at 0.5 PPM)	10 - 50 ppm	Less than 1 ppm
	Sulfates	Less than 125 ppm	Less than 125 ppm	Less than 200 ppm
	Chlorine	Less than .5 ppm	Less than .5 ppm	Less than .5 ppm
	Chlorides	Less than 20 ppm	Less than125 ppm	Less than 300 ppm
	Carbon Dioxide	Less than 50 ppm	10 - 50 ppm	10- 50 ppm
	Ammonia	Less than 2 ppm	Less than 2 ppm	Less than 20 ppm
	Ammonia Chloride	Less than .5 ppm	Less than .5 ppm	Less than .5 ppm
	Ammonia Nitrate	Less than .5 ppm	Less than .5 ppm	Less than .5 ppm
	Ammonia Hydroxide	Less than .5 ppm	Less than .5 ppm	Less than .5 ppm
	Ammonia Sulfate	Less than .5 ppm	Less than .5 ppm	Less than .5 ppm
	Total Dissolved Solids (TDS)	Less than 1000 ppm	1000-1500 ppm	1000-1500 ppm
	LSI Index	+0.5 to -.05	+0.5 to -.05	+0.5 to -.05
Iron Fouling (Biological Growth)	Iron, Fe^{2}+ (Ferrous) Bacterial Iron Potential	< .2 ppm	< .2 ppm	< .2 ppm
	Iron Oxide	Less than 1 ppm. Above this level deposition will occur.	Less than 1 ppm. Above this level deposition will occur.	Less than 1 ppm. Above this level deposition will occur.
Erosion	Suspended Solids	Less than 10 ppm and filtered for max of 600 micron size	Less than 10 ppm and filtered for max of 600 micron size	Less than 10 ppm and filtered for max of 600 micron size
	Threshold Velocity (Fresh Water)	< 6 ft/sec	< 6 ft/sec	< 6 ft/sec

Grains = PPM divided by 17 • mg/l is equivalent to PPM

2/8/08

Standard Board - Control Features

Anti Short Cycle Time

The anti short cycle time consists of a three minute minimum “off” time plus a randomly chosen 0-2 minute additional “off” delay. The random delay is chosen by the control after each compressor shut down. The 3-5 minute startup delay is applied after all compressor shutdowns and also to system startups due to ac power interruption.

Safety Controls

The control board receives separate signals for a high pressure switch for safety, low pressure switch to prevent loss of charge damage, and a low suction temperature for freeze detection. Upon a 30-second measurement of the fault (immediate for high pressure), compressor operation is suspended and the fault will be shown on the display.

Setpoint Temperature Ranges

In Primary mode, the heating temperature setpoint range is adjustable from 60°F (15.5°C) to 130°F (54.4°C) with an adjustable deadband range of 1° - 15°F. The cooling setpoint temperature is adjustable from 0° (-17.7°C) to 85°F (29.4°C) with a fixed non-adjustable deadband of 5°F.

Load Pump Control

There are two options for controlling the load pump, Pump Sampling (PS) or Continuous Pump (C), and these are selectable in the service Menu.

Pump Sampling (PS)
In Primary Mode, the control operates on a 10 minute sample cycle in which the load pump is turned on and run to obtain a meaningful sample of the temperature the load is presenting. If the water temperature measured after the pump has been on for PS minutes (selected and adjusted from the Service Menu) is outside the user selectable deadband amount, dB (also selected and adjusted from the Service Menu), the compressor is turned on and Heating or Cooling is initiated. If the water temperature is within the deadband of the set point when sampled, the pump shuts off and is idle for (10 – PS) minutes when it starts another PS minute sample period. For example, if the PS setting is two minutes, the pump will run for 2 minutes before sampling the load temperature. If the water temperature is within the selected dead band temperature of the set point, the pump will shut off for 10 – 2 = 8 minutes before beginning another pump sampling cycle. Heating deadband is selectable in the Service Menu while the Cooling deadband is non-adjustable and fixed at 5°F.

Continuous Pump Mode (C)
If continuous pump mode (PS=C In Service Menu) is selected, the control will respond immediately to a recognized call or termination of call for heat or cool subject to minimum run times and anti short cycle delays.

Test Mode

Connection of a jumper wire from chassis ground to P3 will place the control in the test mode. This shortens most timing delays for faster troubleshooting. In the Primary Mode the control will respond immediately if a demand is present. The anti-short cycle delay is replaced by a 10 second pump and compressor on delay. Minimum compressor run time becomes 15 seconds. Test mode will remain in effect for a maximum of 15 minutes at any one time should the jumper remain in place.

Fault Conditions

There are two classes of faults, retry faults and no retry faults. Retry faults allow the system to try 2 additional times to establish operation before displaying the fault condition and entering lockout. No-Retry Faults prevent compressor operation for the duration of the fault. If the fault activity ceases while the system is inactive, the fault code is cleared from the display and operation is permitted.

Retry Faults
High pressure, low pressure and freeze detection faults are retried twice before locking the unit out and displaying the fault condition.

High Pressure (HP)
Compressor operation will be disabled immediately when the normally closed high-pressure switch is opened momentarily (set at 600 psi). The LED display shall read “HP” only when the control has completed two retries, and is in lockout. The pump continues to operate throughout the retry period.

Low Pressure (LP)
Compressor operation will be disabled when the normally closed low-pressure switch (set at 40 psi) has opened for 30 continuous seconds (if the bypass period has been satisfied). The Low Pressure switch is bypassed (ignored) for two minutes after startup. The LED display shall read “LP” only when the control has completed two retries, and is in lockout. The pump continues to operate throughout the retry period.

Freeze Detection (FP)
Compressor and loop pumps will be disabled if the control senses that the refrigerant loop temperature drops below the FP value (set in the service menu) for 30 continuous seconds (if the bypass period has been satisfied). If the compressor and the loop pump outputs are disabled because of this condition, the LED display shall read “FP.” There is a two (2) minute by-pass timer for the freeze detection at compressor start up.

No-Retry Faults
High Temperature, Water Temperature Probe Open, Water Temperature Probe Closed and Brown Out faults prevent compressor operation for the duration of the

Standard Board - Control Features cont.

fault. If the fault activity ceases while the system is inactive, the fault code is cleared from the display and operation is permitted.

High Temperature
Compressor operation will be disabled when the control senses an entering load side water temperature of 130° F regardless of mode.

Water Temperature Probe Open (PO)
Compressor and pump operation will be disabled when the control senses that the water probe is open or has infinite resistance. The LED display shall read "PO."

Water Temperature Probe Closed (HC)
Compressor and pump operation will be disabled when the control senses that the water probe is closed or has no resistance. The LED display shall read "HC."

Freeze Detection Probe Open (dO)
Compressor and pump operation will be disabled when the control senses that the freeze detection probe is open or has infinite resistance. The LED display shall read "dO."

Freeze Detection Probe Closed (dC)
Compressor and pump operation will be disabled when the control senses that the freeze detection probe is closed or has no resistance. The LED display shall read "dC."

Brown-Out (B0)
All operation will be disabled when the control voltage falls below 18VAC for 10-15 continuous seconds.

Resetting Lockouts

To reset any lockout condition, place the unit into the standby mode for at least 5 seconds. After the lockout has been reset, the fault display will be turned off. Cycling control power will also clear the display. Non-Retry Faults must be cleared for the display and lockout to clear.

Power Down (power outage)

The controller will store its Service Menu settings and current Mode selection in non-volatile memory so that these settings are retained through any power outage. Current operating conditions are not stored and the controller must evaluate its current conditions.

External Control

Primary Mode

In dedicated heating or cooling units, the unit is controlled by the internal controller. Compressor output is determined by the entering load-side water temperature.

The secondary output will be energized if two conditions occur:

1. The initial temperature is greater than **IC** away from the set point.
2. The change in temperature in a given period of time ***P*** is less than ***d***.

In a reversible unit, the unit is controlled by the internal controller. Compressor output is determined by the entering load-side water temperature. For reversible units, the jumper wire must be positioned across **terminals** 6 and 7, (factory default set to this position). Reversible units do not have a secondary output.

NOTES: SL in the configuration menu must be set to **0**, (factory default). All parameters should be checked for each application on primary unit, (refer to the parameter table).

WARNING: Reversible units cannot be staged.

Secondary Mode

In dedicated heating or cooling units, secondary mode allows the unit to be controlled by an external source. Compressor output is determined by the Y1 input only.

The secondary output will be energized after the following condition occurs:

1. The change in temperature in a given period of time ***P*** is less than ***d***.

In reversible units, secondary mode allows the unit to be controlled by an external source. Compressor output is determined by the Y1 input and the reversing valve is determined by the O input. In reversible units, the jumper wire must be positioned across terminals 5 and 6. Reversible units do not have a secondary input.

NOTES: SL in the configuration menu must be set to **1**. ***P*** and ***d*** must be setup for each secondary unit.

Standard Control - Panel Configuration

The control panel allows you to access the service menu on the unit. The control panel has three 7-segment LED screens that display the:

- Water temperature
- Configuration menu

There are six (6) LED indicators that indicate when the SECONDARY OUTPUT is active or the unit is on one of the following modes:

- Standby Mode
- Heating Mode
- Cooling Mode
- Primary (Master) Mode

The control panel has both UP and DOWN (arrow) buttons and a MODE button. The UP and DOWN buttons allow you to change the set point or scroll through the configuration menu. The MODE button allow you to change mode as well as enter and exit parameters while in configuration mode.

Control Panel Configuration

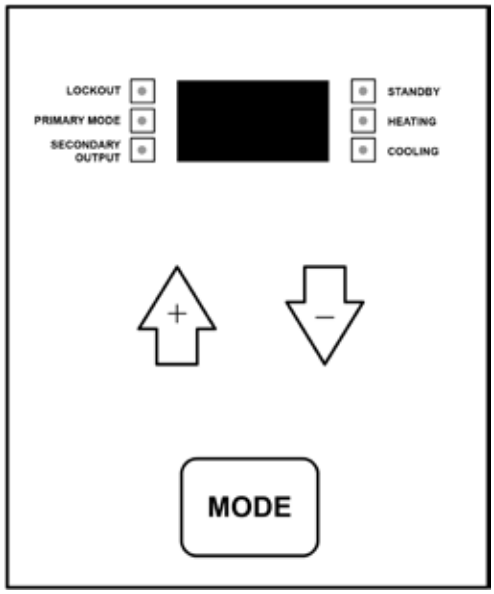
The configuration menu allows you to properly set and adjust all of the unit's operating parameters to fit your application.

To enter configuration mode and configure parameters, follow these procedures:

1. Hold down both the UP and DOWN buttons simultaneously for five seconds, or until the LED screen displays "**LC**".
2. Press the UP or DOWN arrow until "**50**" is displayed.
3. Press the MODE button. The screen should display "**SC**" to indicate the controller is in configuration mode.
4. Once in configuration mode, press the UP or DOWN arrow to scroll through the menu.
5. Press the MODE button to enter the parameter. (Refer to the parameter table below for a list of configurable parameters.)
6. Once in the parameter, press the UP or DOWN arrow to change the parameter.
7. Press the MODE button to return to the main menu.

NOTE: The controller will exit the configuration mode after 30 seconds if no key is pressed.

Control Panel



Changing the Setpoint

1. Pressing the UP or DOWN arrow once will display the setpoint.
2. The setpoint will flash.
3. When the setpoint is flashing, the **UP** and **DOWN** arrow will change the setpoint by one degree.
4. In Primary mode, the heating temperature setpoint range is adjustable from 60°F (15.5°C) to 130°F (54.4°C) with an adjustable deadband range of 1° - 15°F. The cooling setpoint temperature is adjustable from 0° (-17.7°C) to 85°F (29.4°C) with a fixed non-adjustable deadband of 5°F.

Standard Control - Panel Configuration cont.

Remote Aquastat Secondary Mode (Y1)

In secondary mode the compressor output is determined by an external aquastat. The compressor shall engage 10 seconds after the Y1 call has been received. The compressor shall de-activate 10 seconds after the Y1 has been removed. The secondary output is controlled by a Derivative Controller. If the change in the water temperature is less than a selected value (d) in a selected period of time (P), the secondary output shall activate.

Parameter Functions and Settings

Parameter	Function	Description	Factory Setting	Range	Increments
SC	Calibrate the Water Sensor	This will allow the temperature displayed to be adjusted to match a temperature reading from an external source.	0°	-9° to 10°	1
dB	Dead Band (Heating)	This parameter is used to determine when the compressor should be activated. If the temperature is below the setpoint minus the dB value (in heating mode) then the compressor will activate. The cooling deadband is fixed at 5°F and non-adjustable.	1°F	1° to 15°	1
CF	Celsius/ Fahrenheit Selection	This parameter selects the units for which the temperature will be displayed.	F	F or C	N/A
FP	Freeze Detection	There are three settings for this parameter; OL, CL, and P. OL is the open loop setting which corresponds to 32°F (0°C). CL is the closed loop setting which is 15°F (-10°C). P is the process setting which is 5°F (-15°C).	32°F	P,CL,OL	N/A
SL	Primary/ Secondary Setting	Primary mode utilizes an internal aquastat to determine the activity of the compressor. In secondary mode the compressor output is determined by an external aquastat.	0 (Primary)	0 or 1	1 = Secondary 0 = Primary
IC	Initial Condition	This parameter is used to determine the state of the secondary output of the primary unit. If the actual water temperature is greater than the IC value away from the set point, the secondary output will be activated.	10°	0° to 20°	1°
d	Derivative	This parameter is used to determine the state of the secondary output of the primary and secondary unit. If the change in temperature is less than the d value the secondary output will activate.	1°F	0° to 5°	1°
P	Period	This determines how often the derivative will be calculated.	5 min	1 to 5 min	1 min
PS	Pump Sampling Time Selection	This parameter determines how long the pump is activated before the controller takes a sample of the water temperature. The range of this parameter is from 1 to 5 minutes and is factory set to 3 minutes. The pump can also be set to run continuously when PS is set to C.	3 min	1 to 5 min or C	1 min
Fd	Freeze Detection Display	This displays the current temperature of the freeze detection sensor.	N/A	0° to 130°	N/A

Optional Controls

FX10 Control

The FX10 control provides unparalleled capability in several areas including performance monitoring, energy management, and service diagnosis, and then communicates it all thru standard DDC protocols like N2, Lon and BACnet (MS/TP @ 19,200 Baud Rate).

The most unique feature is integrating the FX10 into the Envision Series as both the heat pump and DDC controller providing both a cost advantage and providing features not typically found on WLHP controls. This integration allows heat pump monitoring sensors, status and service diagnosis faults to be communicated thru the DDC direct to the building automation system (BAS), giving building supervisors detailed and accurate information on every piece of equipment without removing an access panel!

Control	General Description	Application	Display/Interface	Protocol
FX10 	The FX10 microprocessor control is self contained control featuring LP, LOC, HP, LWT, and condensate overflow fault modes can be displayed on BAS system. Optional handheld Medium User Interface (MUI) Control can be used for additional setup or servicing. Program customization is possible.	Cannot be integrated with centralized building automation systems.Software can be customized for specific projects.	Optional Medium User Interface (MUI) can be used as a field service tool.	Standalone
FX10 w/N2 	FX10 Control functions as both unitary heat pump control and DDC communication, therefore detail operational and fault information is available to BAS. Other features are same as FX10 with addition of Johnson Controls N2 compatibility.	Same as FX10 with Johnson Controls N2 BAS compatibility.	Optional Medium User Interface (MUI) can be used as a field service tool.	Johnson Controls N2 network
FX10 w/LonWorks 	FX10 Control functions as both unitary heat pump control and DDC communication, therefore detail operational and fault information is available to BAS. Other features are same as FX10 with addition of LonWorks compatibility.	Same as FX10 with LonWorks BAS compatibility.	Optional Medium User Interface (MUI) can be used as a field service tool.	LonWorks
FX10 w/BACnet 	FX10 Control functions as both unitary heat pump control and DDC communication, therefore detail operational and fault information is available to BAS. Other features are same as FX10 with addition of BACnet compatibility.	Same as FX10 with BACnet BAS compatibility. Due to communication speed, no more than 40 units should be connected to a single trunk of the network.	Optional Medium User Interface (MUI) can be mounted or used as field service tool.	BACnet - MS/TP (19,200 Baud Rate)

Optional Controls - FX10 cont.

FX10 Advanced Control Overview

- The Johnson Controls FX10 board is specifically designed for commercial heat pumps and provides control of the entire unit as well as input ports for Open N2, LonTalk, BACnet (MS/TP @ 19,200 Baud Rate) communication protocols as well as an input port for a user interface. The user interface can be used to aid in diagnostics and unit setup and is optional on all NSW units. A 16-pin low voltage terminal board provides terminals for common field connections. The FX10 Control provides:
- Operational sequencing
- High and low-pressure switch monitoring
- General lockout
- Freeze Detection Temperature Sensing
- Lockout mode control
- Emergency shutdown mode
- Random start and short cycle protection

Short Cycle Protection

Allows a minimum compressor “off” time of five minutes and a minimum “on” time of two minutes.

Random Start

A delay of 1 to 120 seconds is generated after each power-up to prevent simultaneous startup of all units within a building after the release from an unoccupied cycle or power loss.

Emergency Shutdown

A field-applied dry contact can be used to place the control into emergency shutdown mode. During this mode, all outputs on the board are disabled.

Freeze Detection Temperature Limit

Field selectable for 15°F or 30°F (-9° or -0.56°C)

Installation Options

- Standalone controlled by standard aqua stat
- Integrated into BAS by adding communication module

Accessory Outputs

Quantity 2. Cycled with the compressor. Field selectable for normally open (factory default) or normally closed through the building automation system or user interface.

User Interface

4 x 20 backlit LCD

Main FX 10 Board

Optional Plug-in Communication Modules - (compatible with standard BAS protocols)

- Open N2
- LonTalk
- BACnet (MS/TP @ 19,200 Baud Rate, 30 unit max per trunk line)

Display

One local display is optional on all NSW units. Up to 2 displays, either 1 local and 1 remote, or 2 remote. (A 2-display configuration requires identical displays.) Local display can be up to 3 meters from the controller, power supply, and data communication. Remote display can be up to 300 meters from the controller. Remote display must be independently powered with data communication done via 3 pole shielded cable.

Control Timing & Fault Recognition Delays

Lead compressor “ON” delay (not applicable for single compressor models)	90 seconds
Minimum compressor “ON” time (except for fault condition)	2 minutes
Short cycle delay	5 minutes
Random start delay	0-120 seconds
High pressure fault	<1 second
Low pressure fault	30 seconds
Freeze detection fault	0-30 seconds
Low pressure/freeze fault bypass	2 minutes

NOTES: Refer to Submittal Data SD1981, Application Guide AGFX10, or BACnet Protocol Implementation Conformance Statement for more information.

Optional Controls - FX10 cont.

FX10 Microprocessor and BAS System

The FX10 is a microprocessor based control that not only monitors and controls the heat pump but also can communicate any of this information back to the building automation system (BAS). This means that not only does the control monitor the heat pump at the unit you can also monitor and control many of the features over the BAS. This clearly puts the FX10 in a class of its own.

The control will enumerate all fault conditions (HP, LP, LOC, and Freeze Detection) over a BAS as well as display them on a medium user interface (MUI). HP, LP, and Freeze Detection faults can all be reset over a BAS. A Loss Of Charge fault can not be reset or bypassed until the problem has been corrected. A MUI is invaluable as a service tool for the building service team.

The unit can be commanded to run by applying Y1, Y2, and O commands to the terminal board or commanded through a BAS. The control board is wired with quick connect harnesses for easy field change out of a faulty control board. An alarm history can be viewed through the MUI and will be held in memory until the unit is power cycled.

The FX10 control has unused analog and digital inputs for field installed items such as water temperature or current status switches. The control has unused binary and PWM outputs that can be commanded over the BAS for field use. A Medium User Interface (MUI) for control setup and advanced diagnostics is standard on all NSW units.

Standard Features

- Anti Short Cycle
- High Pressure Protection
- Low Pressure Protection
- Freeze Detection
- Loss of Charge Detection
- Random Start
- Display for diagnostics
- Reset Lockout at disconnect or through BAS
- 2 Accessory outputs
- Optional BAS add-on controls

DDC Operation and Connection

Other optional network protocol boards that can be added to the FX10 are:

- Johnson Control N2
- LonWorks
- BACnet
  - MS/TP @ 19,200 Baud rate
  - Limit devices to 40 on a single trunk line.

Control and Safety Feature Details

Emergency Shutdown

The emergency shutdown mode can be activated by a command from a facility management system or a closed contact on BI-2. The default state for the emergency shutdown data point is off. When the emergency shutdown mode is activated, all outputs will be turned off immediately and will remain off until the emergency shutdown mode is de-activated. The first time the compressor starts after the emergency shutdown mode has been de-activated, there will be a random start delay present.

Lockout Mode

Lockout mode can be activated by any of the following fault signals: refrigerant system high pressure, refrigerant system low pressure, or freeze detection. When any valid fault signal remains continuously active for the length of its recognition delay, the controller will go into fault retry mode, which will turn off the compressor. After the compressor short cycle delay, the compressor will attempt to operate once again. If three consecutive faults occur in 60 minutes, the unit will go into lockout mode, turning off the compressor, enabling the alarm output until the controller is reset. If the control faults due to the low pressure input being open during the pre-compressor startup check, the control will go into lockout mode immediately, disabling the compressor from starting and enabling the alarm output. The lockout condition can be reset by powering down the controller, by a command from the BAS, or by holding the ESC and Return keys on the user interface for 5 seconds.

Optional Controls - FX10 cont.

NSW Freeze Detection

The freeze detection sensor will monitor the liquid refrigerant temperature entering the water coil in the heating mode. If the temperature drops below the freeze detection trip point for the recognition delay period, the condition will be recognized as a fault. The freeze detection trip point will be factory set for 30°F and will be field selectable for 15°F by removing a jumper wire on BI-4 for the source and BI-5 for the load. The freeze detection fault condition will be bypassed for 2 minutes at normal compressor startup to allow the refrigeration circuit to stabilize. If the freeze detection sensor becomes unreliable at any time compressor operation will immediately be suspended until the problem is corrected. This will be displayed as an alarm on the BAS and the MUI. This alarm will be reported as “Water Low Temp Limit”.

High Pressure

The high-pressure switch shall be a normally closed (NC) switch that monitors the systems refrigerant pressure. If the input senses the high-pressure switch is open it must disable the compressor output immediately and count the fault. The compressor minimum on time does not apply if the high-pressure switch opens. The compressor will not restart until the compressor short cycle time delay has been satisfied.

Low Pressure

The low-pressure switch shall be a normally closed (NC) switch that monitors the systems refrigerant pressure. The input shall be checked 5 seconds before compressor start up and then ignored for the first 2 minutes after the compressor output (BO-2) is enabled. If the switch is open continuously for 30 seconds during compressor operation the compressor output (BO-2) will be disabled. The compressor will not restart until the compressor short cycle time delay has been satisfied.

Alarm Outputs

The alarm output will be enabled when the control is in the lockout mode and will be disabled when the lockout is reset.

Test Mode

By holding the ESC and down arrow keys on the MUI for 5 seconds will put the control into test mode. In test mode the random start delay and the compressor fixed on delay time will both be shortened to 5 seconds and the reversing valve will be allowed to cycle without shutting down the compressor. If an MUI is connected to the control LED 8 will flash and the words “Test Mode Enabled” will be shown on the LCD display when the control is in test mode. Test mode will be disabled after a power cycle, 30 minute timeout, or by holding the ESC and Up arrow keys on the MUI.

Sequence of Operation

Power Fail Restart

When the controller is first powered up, the outputs will be disabled for a random start delay. The delay is provided to prevent simultaneous starting of multiple heat pumps. Once the timer expires, the controller will operate normally.

Random Start Delay

This delay will be used after every power failure, as well as the first time the compressor is started after the control exits the unoccupied mode or the emergency shutdown mode. The delay should not be less than 1 second and not longer than 120 seconds. If the control is in test mode the random start delay will be shortened to 5 seconds.

Compressor Minimum On Delay

The compressor minimum on delay will ensure that the compressor output is enabled for a minimum of two (2) minutes each time the compressor output is enabled. This will apply in every instance except in the event the high pressure switch is tripped or emergency shutdown then the compressor output will be disabled immediately.

Compressor Minimum Off Delay Time

The compressor minimum time delay will ensure that the compressor output will not be enabled for a minimum of five (5) minutes after it is disabled. This allows for the system refrigerant pressures to equalize after the compressor is disabled.

Heating Cycle

The control will run the unit in heating mode when there is no command on the O/B terminal on the terminal board.

Cooling Cycle

The control will run the unit in cooling mode when there is a command on the O/B terminal on the terminal board.

MUI Alarm History Reporting

If a fault occurs the fault will be recorded in history for display on the medium user interface in the History Menu. Each fault type will be displayed in the history menu with a number between 0 and 3. A reading of 3+ will mean that fault has occurred more than three times in the past. The history menu can be cleared with a power cycle only. Alarm date and time are not included in the history.

Optional Controls - FX10 cont.

Inputs and Outputs Configuration

Field Selectable Options

Load and Source Freeze Detection Setpoint
The freeze detection setpoint input allows you to adjust the freeze detection setpoint for either the load or source sides of the heat pump. When the jumper is installed on BI-5 the load freeze detection setpoint is factory set for 30°F. When the jumper on BI-5 is removed the load freeze detection setpoint will be 15°F. When the jumper is installed on BI-4 the source freeze detection setpoint is factory set for 30°F. When the jumper on BI-4 is removed the source freeze detection setpoint will be 15°F. **NOTE: Piping circuit must be antifreeze protected to the set levels or the warranty will be voided.**

Accessory Output
The Accessory Outputs will be energized 90 seconds prior to the compressor output being energized. When the compressor output is turned off the accessory outputs will be deactivated immediately. The outputs are selectable for normally open or normally closed operation through the Medium User Interface or through the Building Automation System.

Control Accessories

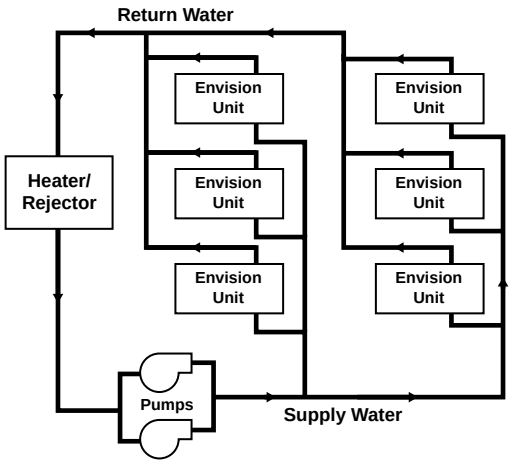
- A99 Sensor
- MUI (LCD User interface) for diagnostics and commissioning
- MUIK3 - Panel Mount, Portable
- MUIK4 - Wall Mount

Envision Application Notes

The Closed Loop Heat Pump Concept

The basic principle of a water source heat pump is the transfer of heat into water from the space during cooling, or the transfer of heat from water into the space during heating. Extremely high levels of energy efficiency are achieved as electricity is used only to move heat, not to produce it. Using a typical WaterFurnace Envision Series, one unit of electricity will move four to five units of heat.

When multiple water source heat pumps are combined on a common circulating loop, the ultimate in energy efficiency is created: The WaterFurnace units on cooling mode are adding heat to the loop which the units in heating mode can absorb, thus removing heat from the area where cooling is needed, recovering and redistributing that heat for possible utilization elsewhere in the system. In modern commercial structures, this characteristic of heat recovery from core area heat generated by lighting, office equipment, computers, solar radiation, people or other sources, is an important factor in the high efficiency and low operating costs of WaterFurnace closed source heat pump systems.



In the event that a building's net heating and cooling requirements create loop temperature extremes, Envision Series units have the extended range capacity and versatility to maintain a comfortable environment for all building areas. Excess heat can be stored for later utilization or be added or removed in one of three ways; by ground-source heat exchanger loops: plate heat exchangers connected to other water sources, or conventional cooler/ boiler configurations. Your WaterFurnace representative has the expertise and computer software to assist in determining optimum system type for specific applications.

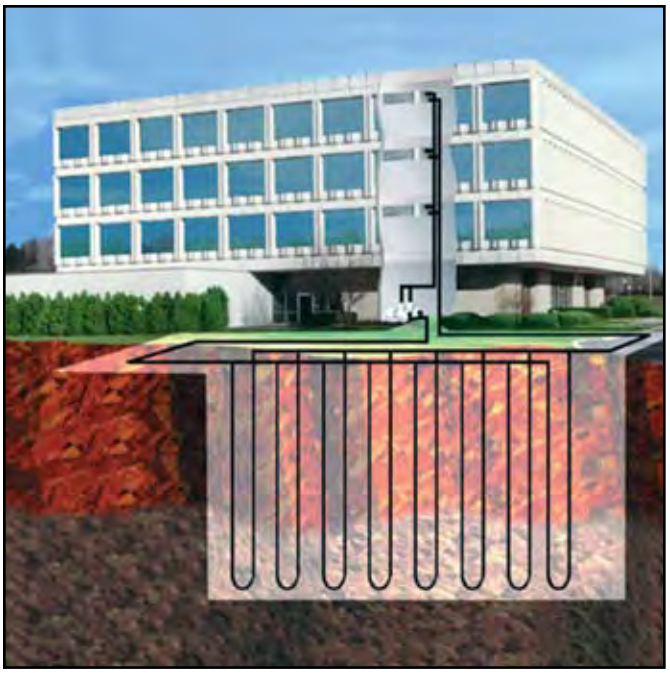
The Closed Loop Advantage

A properly applied water source heat pump system offers many advantages over other systems. First costs are low because units can be added to the loop on an "as needed basis"- perfect for speculative buildings. Installed costs are low since units are self-contained and can be located adjacent to the occupied space. Maintenance can be done on individual units without system shut-down. Conditions remain comfortable since each unit operates separately, allowing cooling in one area and heating in another. Tenant spaces can be finished and added as needed. Power billing to tenants is also convenient since each unit can be individually metered: each pays for what each uses. Nighttime and/or weekend uses of certain areas are possible without heating or cooling the entire facility. A decentralized system also means if one unit should fault, the rest of the system will continue to operate normally, as well as eliminating air cross-contamination problems and expensive high pressure duct systems requiring an inefficient electric resistance reheat mode.

The Envision Approach

There are a number of proven choices in the type of Envision Series system which would be best for any given application. Most often considered are:

Closed Loop/Ground Source Vertical



• ***Closed Loop/Ground-Source Systems*** utilize the stable temperatures of the earth to maintain proper water source temperatures (via vertical or horizontal closed loop heat exchangers) for Envision Series extended range heat pump system. Sizes range from a single unit through many hundreds of units. When net cooling requirements cause

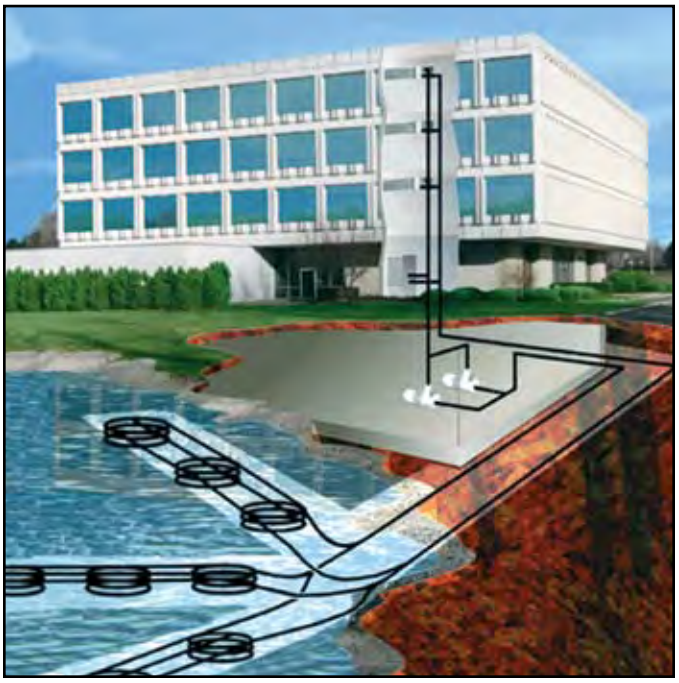
Envision Application Notes cont.

closed loop water temperatures to rise, heat is dissipated into the cooler earth through buried high strength plastic pipe "heat exchangers." Conversely if net space heating demands cause loop heat absorption beyond that heat recovered from building core areas, the loop temperature will fall causing heat to be extracted from the earth.

Because auxiliary equipment such as a fossil fuel boiler and cooling tower are not required to maintain the loop temperature, operating and maintenance costs are very low. Ground-source systems are most applicable in residential and light commercial buildings where both heating and cooling are desired, and on larger envelope dominated structures where core heat recovery will not meet overall heating loads. Both vertical and horizontally installed closed-loops can be used. The land space required for the "heat exchangers" is 100-250 sq. ft./ton on vertical (drilled) installations and 750-1500 sq. ft./ton for horizontal (trenched) installations. Closed loop heat exchangers can be located under parking areas or even under the building itself.

On large multi-unit systems, sizing the closed loop heat exchanger to meet only the net heating loads and assisting in the summer with a closed circuit cooling tower may be the most cost effective choice.

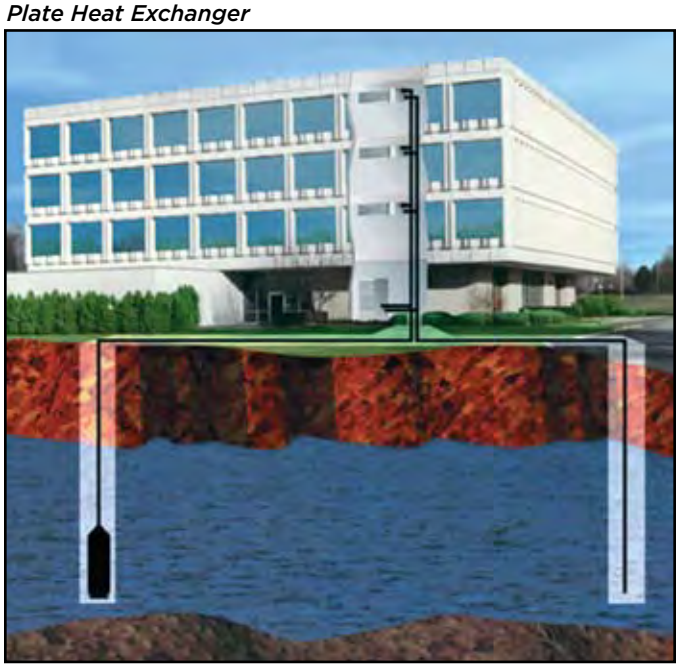
Closed Loop/Ground Source Surface Water



• ***Closed Loop/Ground-Source Surface Water Systems*** also utilize the stable temperatures of Surface Water to maintain proper water source temperatures for Envision Series extended range heat pump systems. These systems have all of the advantages of horizontal and vertical closed loop systems.

In cooling dominated structures, the ground-source surface water systems can be very cost effective especially where local building codes require water retention ponds for short term storage of surface run-off. Sizing requirements for the surface water is a minimum of 500 sq. ft./ton of surface area at a minimum depth of 8 feet. WaterFurnace should be contacted when designs for heating dominated structures are required.

Closed Loop/Ground Water Plate Heat Exchanger



• ***Closed Loop/Ground Water Plate Heat Exchanger Systems*** utilize lake, ocean, well water or other water sources to maintain closed loop water temperatures in multi-unit Envision systems. A plate frame heat exchanger isolates the units from any contaminating effects of the water source, and allows periodic cleaning of the heat exchanger during off peak hours.

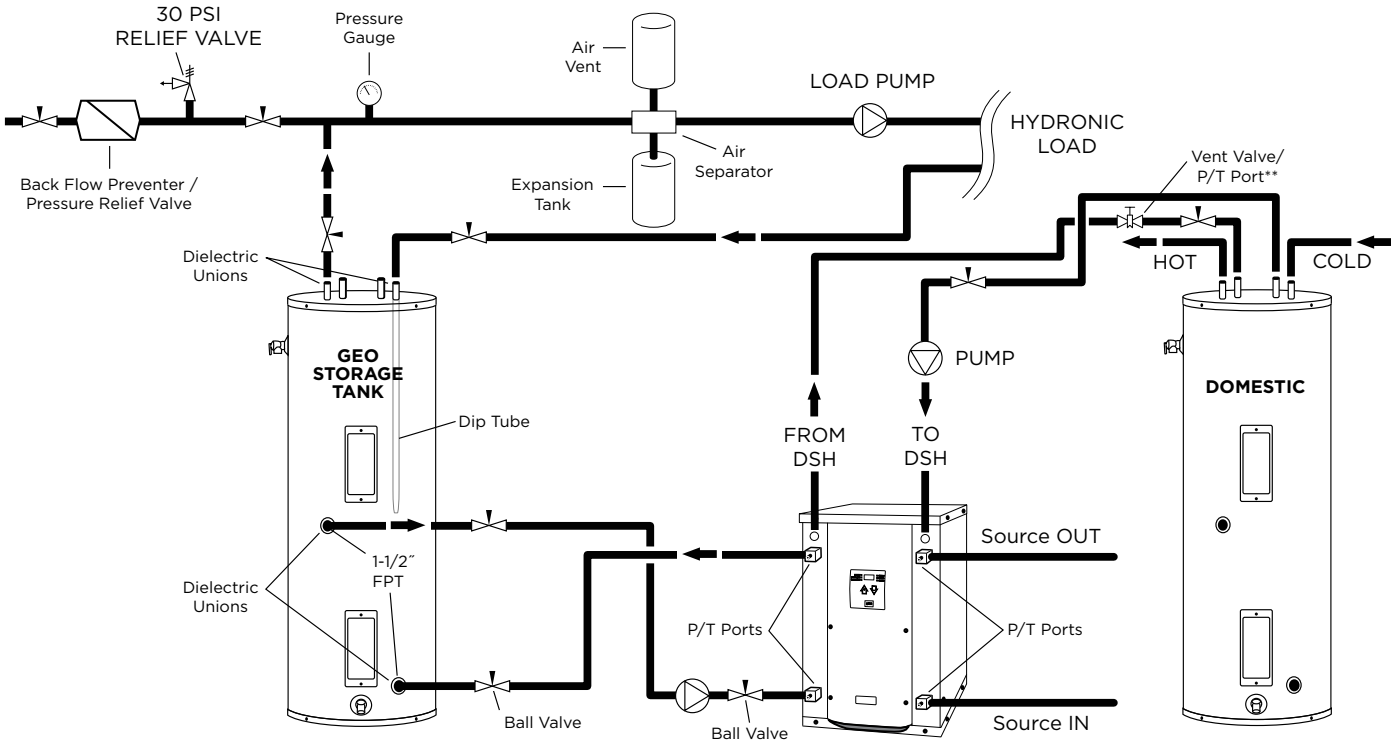
Operation and benefits are similar to those for ground-source systems. Closed loop plate heat exchanger systems are applicable in commercial, marine, or industrial structures where the many benefits of a water source heat pump system are desired, regardless of whether the load is heating or cooling dominated.

Envision Application Notes cont.

Closed Loop
Cooler - Boiler

• ***Closed Loop /Cooler-Boiler Systems*** utilize a closed heat recovering loop with multiple water source heat pumps in the more conventional manner. Typically a boiler is employed to maintain closed loop temperatures above 60°F and a cooling tower to maintain loop temperatures below 90°F. These systems are applicable in medium to large buildings regardless of whether the load is heating or cooling dominated.

NSW Typical Application Piping



NOTES:
* A 30 PSI pressure relief valve (Part No: SRV30) should be used in hydronic applications.
** Vent valve or P/T port at highest point in return line prior to ball valve.

Envision Application Notes cont.

Heating with hot water is versatile because there are many ways of distributing the heat through the building. The options range from heavy cast iron radiators seen in older buildings to modern, baseboard-style convection radiation, and from invisible radiant floor heating to forced air systems using fan coil units.

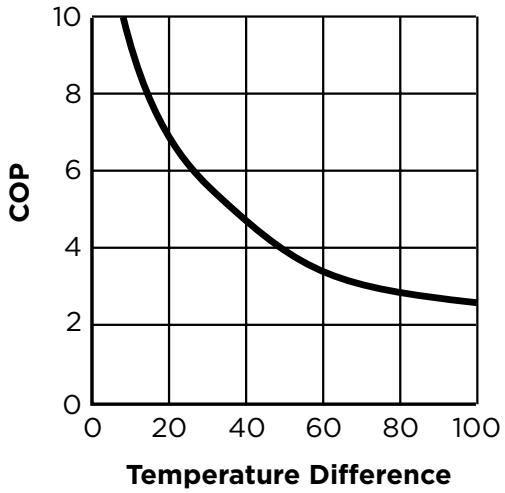
A boiler is often used to make domestic hot water and to heat swimming pools or hot tubs.

The various distribution systems have all been used successfully with a geothermal heat pump system. When designing or retrofitting an existing hydronic heating system, however, the water temperature produced by the heat pump is a major consideration.

In general, heat pumps are not designed to produce water above 130°F. The efficiency decreases as the temperature difference (ΔT) between the heat load (generally the earth loop) and the supply water (to the distribution system) increases. Figure 1 illustrates the effect of source and load temperatures on the system. The heating capacity of the heat pump also decreases as the temperature difference increases.

When using the various types of hydronic heat distribution systems, the temperature limits of the geothermal system must be considered. In new construction, the distribution system can easily be designed with the temperature limits in mind. In retrofits, care must be taken to address the operating temperature limits of the existing distribution system.

Figure 1: As the ΔT increases, the Coefficient of Performance (COP) decreases. When the system produces 130°F water from a 30°F earth loop, the ΔT is 100°F, and the COP is approximately 2.5. If the system is producing water at 90°F, the ΔT is 60°F and the COP rises to about 3.8, an increase of over 50%.



Baseboard Radiation

In existing systems, baseboard radiation is typically designed to operate with 160° to 240°F water or steam. Baseboard units are typically copper pipe with aluminum fins along the length of the pipe, as shown in Figure 2. A decorative cover is normally fitted over the fin tube.

The operation of a baseboard radiation system depends on setting up a convection current in the room: air is warmed by the fin tube, rises and is displaced by cool air.

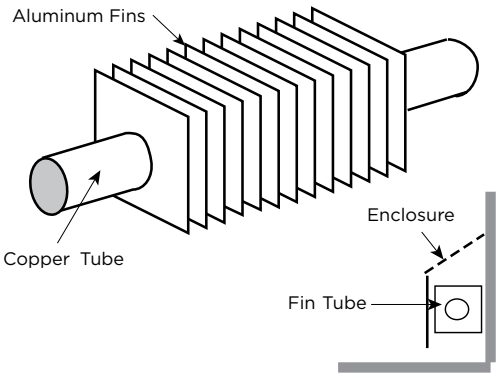
The heating capacity of a baseboard system is a factor of the area of copper tube and fins exposed to the air and the temperature difference between the air and the fin tube. The velocity and volume of water flowing through the baseboard affects the temperature of the copper and fins. Baseboard units are normally rated in heat output/ length of baseboard at a standard water temperature and flow. Manufacturers can provide charts which will give the capacities at temperatures and flows below the standard. Figure 3 shows approximate heating capacities for fin tube radiation using water from 100 to 130°F water.

Baseboards are available using two or three fin tubes tiered above one another in the same cabinet. With the additional surface area, the air can be heated enough to set up a convection current with water temperatures as low as 110° to 130°F (see Figure 3).

It is important to ensure that the heat output of the system is adequate to meet the heat loss of the room or building at the temperatures the geothermal system is capable of producing.

Baseboard radiation is limited to space heating. Cooling is typically provided by a separate, forced air distribution system.

Figure 2: Baseboard radiators are typically constructed of copper tube with closely spaced aluminum fins attached to provide more surface area to dissipate heat. Some of the factors affecting the amount of heat given off by fin tube radiators are the water temperature, water velocity, air temperature, and fin spacing and size.



Envision Application Notes cont.

The heating capacity (Btuh/linear foot) of baseboard radiators drop as the water temperature is reduced. The heating capacity of most baseboard radiators is rated using 200°F water, 65°F air temperature. Listed in Figure 3 is the range of heating capacities of baseboard radiators at the standard temperatures and the range of capacities when the temperatures are reduced to the operating range of a heat pump system. Some of the factors that affect the capacity of a radiator are:

- Size of the fins - range from 2.75" x 3" to 4" x 4"
- Fin spacing - 24 to 48/foot
- Diameter of copper tube - range from .75" to 2"
- Fin material - aluminum or steel
- Configuration and height of the enclosure
- Height unit is mounted from the floor
- Water flow through the radiator

Generally, the smaller fins with fewer fins/foot will have lower heating capacity. Larger copper tube diameter and aluminum fins will have a higher capacity. Higher water flow will increase capacity. Adding a second fin tube to the same enclosure will increase the capacity by 50 to 60%. Adding two fin tubes will increase the capacity by 75 to 80%.

Figure 3: Heating output per linear foot

Average Water Temp.	Entering Air Temperatures		
	55°F	**65°F**	**70°F**
110°F	190-380	**160-320**	150-300
120°F	240-480	**205-410**	195-390
130°F	295-590	**265-532**	245-490

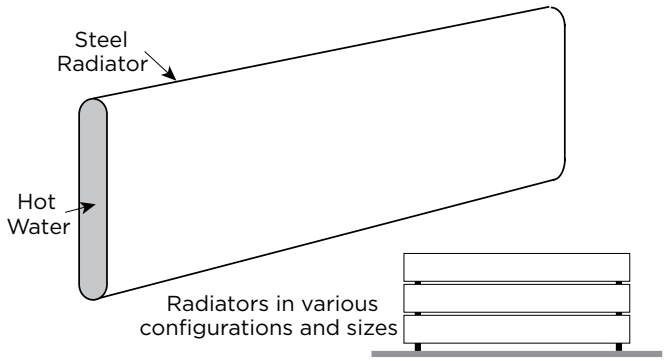
Cast Iron Radiation

Retrofit applications for hydronic/geothermal heat pump systems are often required to work with existing cast iron radiators or their replacements (see Figure 4). Typically, cast iron radiator systems operate with water temperatures of 125° to 160°F.

These temperatures are higher than geothermal water-to-water heat pumps are capable of providing. Cast iron radiators can work with geothermal systems, provided the heat output of the radiators will meet the maximum heat loss of the building at the lower temperatures.

If the insulation of the building has been upgraded since the original installation, it is possible that the lower temperatures will be able to meet the reduced heat loss of the building.

Figure 4: Baseboard System



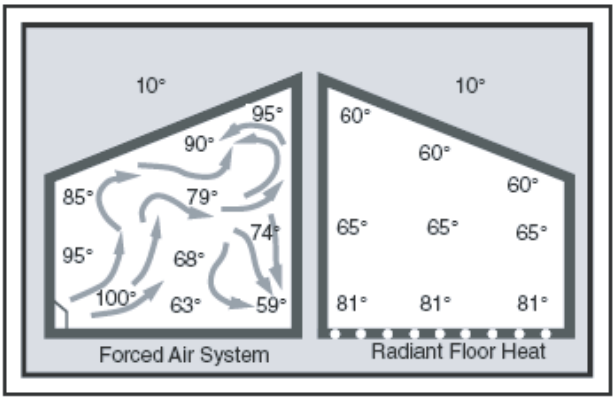
Radiant Floor Heating

Radiant floor heating has been the system of choice in many parts of Europe for some time. Manufacturers have developed tubing designed for installation in concrete floors and raised wood floors.

Floor heating systems have several benefits in residential, commercial and industrial heating applications. In a building with a radiant floor heating system, the entire floor acts as a heat source for the room. People feel comfortable with lower air temperatures if their feet are warm. Typically the space will feel comfortable with air temperatures as low as 65°F. Since the heat loss of a building is directly related to the temperature difference (ΔT) between the inside and outside, a lower ΔT means the heat loss is lower.

Air temperatures in a room with a forced air heating system tend to be warmer nearer to the ceiling than the floor (see Figure 5). The hot air rises and creates a greater pressure imbalance between the inside and outside. The infiltration increases, resulting in a higher heat loss. Air temperatures in a room with radiant floor heating tend to be warmer at the floor than the ceiling, helping to cut down on infiltration in the building. The energy savings in a building with radiant floor heating can range from 10 to 20%.

Figure 5: Temperature Comparison



Envision Application Notes cont.

A floor heat system can be designed to heat a building with water temperatures as low as 90°F.

Figure 1 shows how a geothermal system operates more efficiently with a lower ΔT between the source and the load. With only a 60°F temperature difference, a geothermal heat pump will operate at COPs over 4, about 20% higher than a forced air geothermal system in the same installation.

Some of the factors affecting the heating capacity of a floor heating system are as follows:

- The type of finish flooring
- The spacing of the pipe
- The water flow through the pipe
- The temperature of the supply water
- The floor material (wood, concrete or poured Gypcrete™)
- Insulation value under the floor
- The piping layout

The spacing of the pipe in residential applications can vary from 4" to 12". If the spacing is too large, the temperature of the floor can vary noticeably. In industrial applications, variation in the floor temperature is not as important, and the spacing is related directly to the heat output required.

Radiant floor heating systems work well with geothermal heat pump systems. For efficient operation, the system must be designed with the lowest possible water temperatures.

There are some drawbacks with a radiant floor heating system. Air conditioning is only possible by adding a second system using forced air. This can add substantial cost to an installation where air conditioning is also needed. A separate air handling system is needed to clean the air or to introduce fresh air.

Industrial buildings, especially those with high ceilings and large overhead doors, have an advantage with a radiant floor heating system. Heat is stored in the concrete floor, and when a door is opened, the stored heat is immediately released to the space. The larger the ΔT between the air in the space and the floor, the quicker the floor releases its heat to the space.

Maintenance garages benefit from radiant floor heating systems. Cold vehicles brought into the garage are warmed from underneath. The snow melts off the vehicle and dries much more quickly than when heated from above.

Some pipe manufacturers include an oxygen diffusion barrier in the pipe to prevent oxygen diffusion through the pipe. Good system design and careful installation, however, will eliminate virtually all of the problems encountered with air in the system. Like earth loop design, it is important to design the system to facilitate flushing the air initially and ensuring that the flows can be balanced properly.

Fan Coil Units and Air Handlers

Fan coil units, air handlers, force flow units, etc. are all basically a hot water radiator or coil (usually copper piping with aluminum fins) with a fan or blower to move the air over the coil (see Figure 6). The term "fan coil units" typically applies to smaller units that are installed in the zone or area in which heating (or cooling) is needed. They are available in many different configurations, sizes and capacities. Fan coil units are designed to be connected to a ductwork system and can be used to replace a forced air furnace. Other units are designed for use without ductwork and are mounted in a suspended ceiling space with only a grill showing in place of a ceiling tile. Some can be mounted on a wall under a window, projecting 8" to 10" into the room or even flush to the wall surface, mounted between wall studs. Some are available with or without finished, decorative cabinets. For industrial applications, inexpensive "unit heaters" are available, with only a coil and an axial fan. Fan coil units and unit heaters are normally available with air handling capacities of 200 to 2,000 cfm.

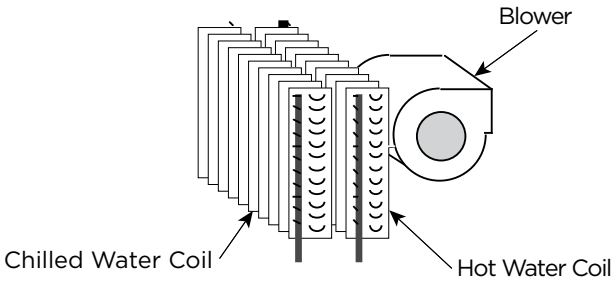
The term "air handler" normally applies to larger units, mounted in mechanical rooms, mechanical crawl spaces or rooftops. They typically have an air handling capacity of over 2,000 cfm and are available for capacities of up to 50,000 cfm. Air handlers are typically built for a specific installation and are available with many different types of heating and cooling coils. They can include additional coils for heating make-up air, dehumidification and exhaust air heat recovery.

Fan coils and air handlers typically have one or two coils and a blower. Air is heated by hot water circulated through the hot water coil. Chilled water is circulated through the coil if air conditioning is needed. Blowers can be provided to fit various applications, with or without duct-work. Unit heaters typically use axial fans in applications where ductwork is not needed.

Fan coil units and air handlers are used in many different applications. They have been used to heat buildings using water temperatures as low as 90° to 100°F. New systems can be designed to operate very efficiently with a geothermal system.

Envision Application Notes cont.

Figure 6: Fan Coils



Cooling with a Hydronic System

Cooling a building with an existing radiant hydronic heating system can be a challenge. If baseboard, cast iron radiators or a radiant floor heating system is cooled lower than the dew point, condensation will form on the floor or drip off the radiators.

There is generally minimal or no ductwork for ventilation in existing buildings with radiant hydronic heat. Typically, cooling is provided with separate units where it is needed. This is often done using through-the-wall or window air conditioners, ductless split air conditioning units, or rooftop units.

A water-to-water heat pump system can provide water to ducted or unducted fan coil units. The system can provide chilled water to cool the building, as well as hot water for the heating system when needed.

A limited amount of cooling can be done by circulating chilled water through the piping in the floor. This can be effective in buildings with high solar loads or lighting loads, where much of the heat gain is radiant heat being absorbed by the floor. Cooling fresh air used for ventilation as it is brought into the building, using a chilled water coil, can sometimes provide the additional cooling needed. Care must be taken to avoid cooling the floor below the dew point because condensation may form on the floor.

Buildings with fan coil units and air handlers can generally be easily retrofitted for cooling. Often it is simply a matter of adding a cooling coil to the existing air handlers and fan coil units. Water-to-water heat pumps can provide hot water for the heating coils as well as chilled water for the air conditioning.

Controls

The control of a mechanical system determines how it functions. For the building to work efficiently and comfortably, the building owner or manager must understand what the system is doing and how to control it.

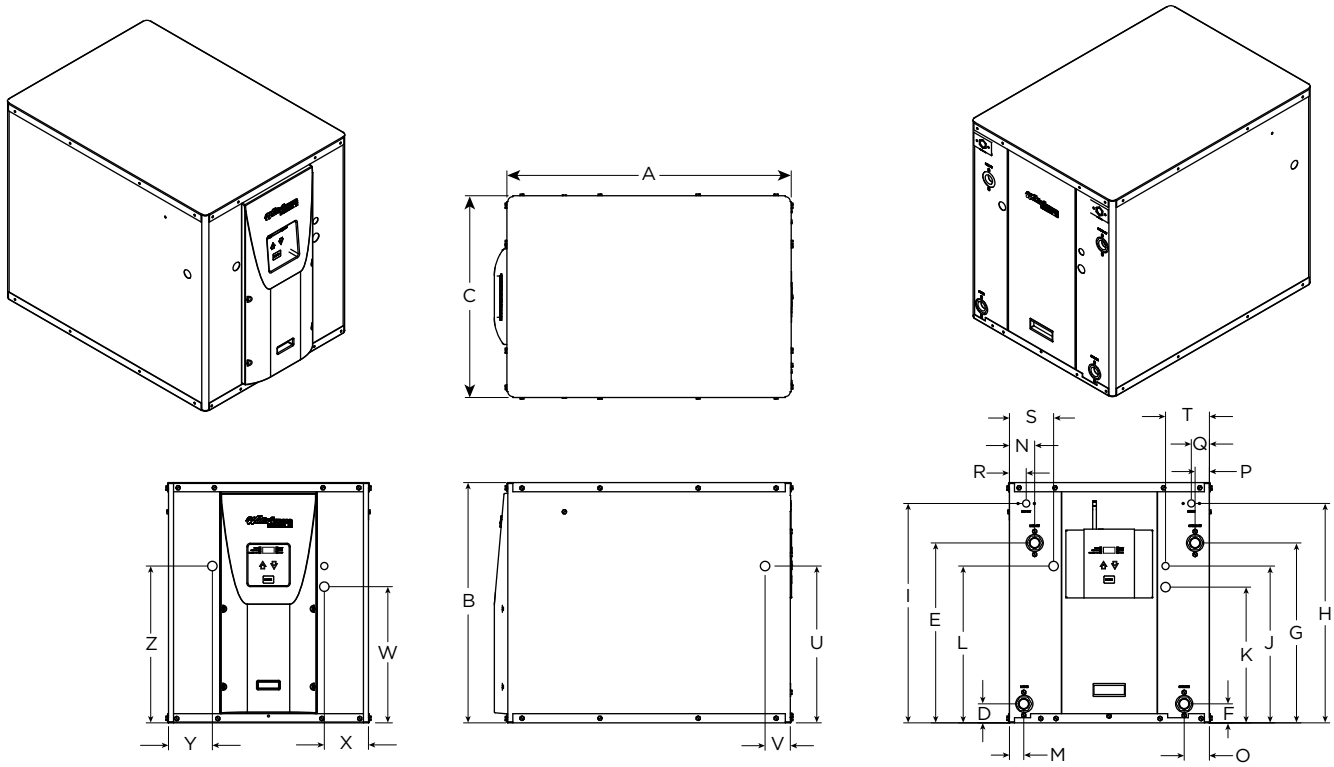
As Figure 1 shows, the efficiency of a heat pump is a factor of the difference in temperature between the source and the load. The heat loss or heat gain of a building varies with the weather and the use of the building. As the outdoor temperature decreases, the heat loss of the building increases. When the ventilation system is started up, the heating or cooling loads increase. As the occupancy increases, lighting or the solar gain increases, and the cooling load increases. At times the building may require virtually no heating or cooling.

With hydronic heating and cooling distribution equipment, whether it is baseboard radiation, fan coil units or radiant floor heating, the output of the equipment is directly related to the temperature and velocity of the water flowing through it. Baseboard radiation puts out approximately 50% less heat with 110°F water than with 130°F water. The same is true with fan coil units and radiant floor heating.

If a system is designed to meet the maximum heat loss of a building with 130°F water, it follows that if the heat loss is 50% lower when the outdoor temperature is higher and the building has high internal gains because of lighting and occupancy, the lower heat loss can be met with 110°F water. This greatly increases the COP of the heat pumps.

The same control strategy is equally effective in cooling. During peak loads, water chilled to 40°F may be needed; at other times 55°F water will provide adequate cooling. Significant increases in the EER can be achieved. Latent loads must always be considered when using warmer water.

Physical Elements



NOTE: Plastic front panel extends 1.4" (3.56 cm) beyond front of cabinet.

6/18/09

Physical Data

Model	018	025	040	050	060	075
Compressor (1 each)	Scroll					
Factory Charge R410a, oz [kg]	44.0 [1.25]	54.0 [1.53]	62 [1.76]	68 [1.93]	104 [2.95]	110 [3.12]
Coax & Piping Water Volume - gal [l]	.52 [1.97]	.89 [3.38]	1.0 [3.94]	1.4 [5.25]	1.6 [6.13]	1.6 [6.13]
Weight - Operating, lb [kg]	191 [86.6]	225 [102.1]	290 [131.5]	325 [147.4]	345 [156.5]	345 [156.5]
Weight - Packaged, lb [kg]	206 [93.4]	240 [108.9]	305 [138.3]	340 [154.2]	360 [163.3]	360 [163.3]

6/29/09

Dimensional Data

Model		Overall Cabinet			Water Connections									Electrical Knockouts		
														J	K	L
		A	B	C	D	E	F	G	H	I				1/2" cond	3/4" cond	3/4" cond
		Depth	Height	Width	Load Liquid In	Load Liquid Out	Source Liquid In	Source Liquid Out	HWG In	HWG Out	Load Water FPT	Source Water FPT	HWG Water FPT	Low Voltage	Ext Pump	Power Supply
018	in.	23.5	26.1	17.5	10.0	22.2	10.0	22.2	-	-	1"	1"	-	16.0	14.2	14.2
	cm.	59.7	66.3	44.5	25.4	56.4	25.4	56.4	-	-	25.4 mm	25.4 mm	-	40.6	36.1	36.1
025	in.	23.5	26.1	17.5	10.0	22.2	10.0	22.2	-	-	1"	1"	-	16.0	14.2	14.2
	cm.	59.7	66.3	44.5	25.4	56.4	25.4	56.4	-	-	25.4 mm	25.4 mm	-	40.6	36.1	36.1
040	in.	31.0	26.2	22.0	2.1	19.6	2.1	19.6	23.9	23.9	1"	1"	1/2 "	17.1	14.8	17.1
	cm.	78.7	66.5	55.9	5.3	49.8	5.3	49.8	60.7	60.7	25.4 mm	25.4 mm	12.7 mm	43.4	37.6	43.4
050	in.	31.0	26.2	22.0	2.2	20.6	2.2	20.6	23.9	23.9	1-1/4"	1-1/4"	1/2 "	17.1	14.8	17.1
	cm.	78.7	66.5	55.9	5.6	52.3	5.6	52.3	60.7	60.7	31.8 mm	31.8 mm	12.7 mm	43.4	37.6	43.4
060 & 075	in.	31.0	26.2	22.0	2.4	23.0	2.4	23.0	20.6	20.6	1-1/4"	1-1/4"	1/2"	17.1	14.8	17.1
	cm.	78.7	66.5	55.9	6.1	58.4	6.1	58.4	52.3	52.3	31.8 mm	31.8 mm	12.7 mm	43.4	37.6	43.4

Model		Water Connections										Electrical Knockouts			
		M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
		Load Liquid In	Load Liquid Out	Source Liquid In	Source Liquid Out	HWG In	HWG Out	Power Supply	Low Voltage	Side Power Supply	Side Power Supply	Ext Pump	Ext Pump	Power Supply	Power Supply
018	in.	1.9	1.9	1.9	1.9	-	-	2.4	2.4	14.9	2.6	2.1	1.8	1.9	4.1
	cm.	4.8	4.8	4.8	4.8	-	-	6.1	6.1	37.8	6.6	5.3	4.4	4.8	10.4
025	in.	1.9	1.9	1.9	1.9	-	-	2.4	2.4	14.9	2.6	2.1	1.8	1.9	4.1
	cm.	4.8	4.8	4.8	4.8	-	-	6.1	6.1	37.8	6.6	5.3	4.4	4.8	10.4
040	in.	1.6	2.8	2.8	1.6	2.0	1.8	4.8	4.8	17.1	2.8	14.9	4.8	4.8	17.1
	cm.	4.1	7.0	7.0	4.1	5.1	4.6	12.2	12.2	43.4	7.0	37.8	12.2	12.2	43.4
050	in.	1.8	3.6	3.6	1.8	2.1	1.8	4.8	4.8	17.1	2.8	14.9	4.8	4.8	17.1
	cm.	4.6	9.1	9.1	4.6	5.3	4.6	12.2	12.2	43.4	7.1	37.8	12.2	12.2	43.4
060 & 075	in.	1.8	4.0	4.0	1.8	4.2	1.4	4.8	4.8	17.1	2.8	14.9	4.8	4.8	17.1
	cm.	4.6	10.2	10.2	4.6	10.7	3.6	12.2	12.2	43.4	7.1	37.8	12.2	12.2	43.4

9/11/09

Electrical Data

Model	Rated Voltage	Voltage Min/Max	Compressor			Load Pump	Source Pump	Total Unit FLA	Min Ckt Amp	Maximum Fuse/HACR
			RLA	LRA	LRA*					
018	208-230/60/1	197/254	10.3	51.0	17.9	1.8	5.4	17.5	20.1	30
025	208-230/60/1	197/254	13.5	61.0	21.4	1.8	5.4	20.7	24.1	35
	265/60/1	239/292	10.9	58.0	-	-	-	10.9	13.6	20
	460/60/3	414/506	4.5	27.0	-	-	-	4.5	5.6	10
040	208-230/60/1	197/254	20.0	115.0	40.3	1.8	5.4	27.2	32.2	50
	208-230/60/3	197/254	12.8	95.0	-	-	-	12.8	16.0	25
	460/60/3	414/506	6.4	45.0	-	-	-	6.4	8.0	10
	575/60/3	518/632	5.4	38.0	-	-	-	5.4	6.8	10
050	208-230/60/1	197/254	26.4	134.0	46.9	1.8	5.4	33.6	40.2	60
	265/60/1	239/292	19.9	130.0	-	-	-	19.9	24.9	40
	208-230/60/3	197/254	16.0	110.0	-	-	-	16.0	20.0	35
	460/60/3	414/506	7.8	52.0	-	-	-	7.8	9.8	15
	575/60/3	518/632	5.7	38.9	-	-	-	5.7	7.1	10
060	208-230/60/1	197/254	30.1	145.0	50.8	1.8	5.4	37.3	44.8	70
	208-230/60/3	197/254	17.3	120.0	-	-	-	17.3	120.0	35
	460/60/3	414/506	9.6	70.0	-	-	-	9.6	70.0	20
	575/60/3	518/632	8.0	53.0	-	-	-	8.0	53.0	15
075	208-230/60/1	197/254	26.9	145.0	50.8	1.8	5.4	34.1	40.8	60
	208-230/60/3	197/254	22.4	190.0	-	-	-	22.4	28.0	50
	460/60/3	414/506	12.2	87.0	-	-	-	12.2	15.3	25
	575/60/3	518/632	9.6	62.0	-	-	-	9.6	12.0	20

7/22/2009

NOTES: All fuses type "D" time delay (or HACR circuit breaker in USA).
Source pump amps shown are for up to a 1/2 HP pump.
Load pumps amps shown are for small circulators.
*LRA with optional IntelliStart installed (208-230/1/60).

Antifreeze Correction

Catalog performance can be corrected for antifreeze use. Please use the following table and note the example given.

Antifreeze Type	Antifreeze % by wt	Heating		Cooling		Pressure Drop
		Load	Source	Load	Source	
EWT - °F [°C]		**80 [26.7]**	**30 [-1.1]**	**50 [10.0]**	**90 [32.2]**	**30 [-1.1]**
Water	0	1.000	1.000	1.000	1.000	1.000
Ethylene Glycol	10	0.990	0.973	0.976	0.991	1.075
	20	0.978	0.943	0.947	0.979	1.163
	30	0.964	0.917	0.921	0.965	1.225
	40	0.953	0.890	0.897	0.955	1.324
	50	0.942	0.865	0.872	0.943	1.419
Propylene Glycol	10	0.981	0.958	0.959	0.981	1.130
	20	0.967	0.913	0.921	0.969	1.270
	30	0.946	0.854	0.869	0.950	1.433
	40	0.932	0.813	0.834	0.937	1.614
	50	0.915	0.770	0.796	0.922	1.816
Ethanol	10	0.986	0.927	0.945	0.991	1.242
	20	0.967	0.887	0.906	0.972	1.343
	30	0.944	0.856	0.869	0.947	1.383
	40	0.926	0.815	0.830	0.930	1.523
	50	0.907	0.779	0.795	0.911	1.639
Methanol	10	0.985	0.957	0.962	0.986	1.127
	20	0.969	0.924	0.929	0.970	1.197
	30	0.950	0.895	0.897	0.951	1.235
	40	0.935	0.863	0.866	0.936	1.323
	50	0.919	0.833	0.836	0.920	1.399

WARNING: Gray area represents antifreeze concentrations greater than 35% by weight and should be avoided due to the extreme performance penalty they represent.

Antifreeze Correction Example

Antifreeze solution is propylene glycol 20% by weight for the source and methanol 10% for the load. Determine the corrected heating at 30°F source and 80°F load as well as pressure drop at 30°F for an Envision Series NSW050. Also, determine the corrected cooling at 90°F source and 50°F load.

The corrected heating capacity at 30°F/80°F would be:

46,700 MBTUH x 0.913 x 0.985 = 41,998 MBTUH

The corrected cooling capacity at 90°F/50°F would be:

44,200 x 0.969 x 0.962 = 41,202 MBTUH

The corrected pressure drop at 30°F and 15 GPM would be:

5.2 psi x 1.270 = 6.60 psi

AHRI/ISO 13256-2 Performance Ratings

English (IP) Units

Model	Capacity Modulation	Flow Rate		Water Loop Heat Pump				Ground Water Heat Pump			
				Cooling 86°F Source 53.6°F Load		Heating 68°F Source 104°F Load		Cooling 59°F Source 53.6°F Load		Heating 50°F Source 104°F Load	
		Load Gpm	Source Gpm	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP
018	Single	5	5	16,400	14.0	22,200	4.5	18,800	22.9	18,500	3.7
025	Single	7	7	23,700	13.6	32,800	4.6	26,700	21.2	27,100	3.8
040	Single	10	10	35,900	15.5	47,900	4.8	40,900	23.4	39,100	3.9
050	Single	15	15	49,800	13.9	65,000	4.4	55,600	21.6	54,200	3.7
060	Single	18	18	55,400	13.6	78,000	4.7	62,500	20.6	63,200	3.8
075	Single	19	19	66,000	12.3	93,100	4.2	74,100	18.0	77,100	3.5

Model	Capacity Modulation	Flow Rate		Ground Loop Heat Pump			
				Cooling 77°F Source 53.6°F Load		Heating 32°F Source 104°F Load	
		Load Gpm	Source Gpm	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP
018	Single	5	5	17,300	16.6	14,700	2.9
025	Single	7	7	24,700	15.8	22,000	3.0
040	Single	10	10	37,700	17.5	30,500	3.1
050	Single	15	15	51,500	16.4	44,200	3.1
060	Single	18	18	58,000	15.7	50,100	3.0
075	Single	19	19	68,400	14.0	61,500	2.9

7/13/09

NOTES: All ratings based upon 208V operation.
Rated in accoradance with, but not certified by, AHRI.
AHRI does not currently certify water-to-water products under AHRI/ISO 13256-2.
EnergyStar does not currently recognize water-to-water products.

Pressure Drop

Model	GPM	Pressure Drop (psi)				
		30°F	60°F	80°F	100°F	120°F
018R*	3.0	0.5	0.4	0.4	0.3	0.3
	4.0	1.1	0.9	0.9	0.8	0.8
	5.0	1.6	1.4	1.4	1.3	1.3
	6.0	2.1	1.9	1.9	1.8	1.8
025R*	4.0	1.0	0.9	0.9	0.8	0.8
	5.5	2.2	2.0	1.9	1.8	1.7
	7.0	3.3	3.0	2.9	2.7	2.6
	8.5	4.8	4.5	4.4	4.2	4.1
040H/R	5.0	0.9	0.6	0.6	0.5	0.5
	7.5	2.3	2.1	2.0	1.9	1.8
	10.0	3.7	3.5	3.3	3.2	3.0
	12.5	5.0	4.7	4.4	4.2	4.0
050H/R	8.0	1.7	1.4	1.4	1.3	1.3
	11.5	3.6	3.4	3.2	3.0	2.8
	15.0	5.6	5.4	5.0	4.6	4.2
	18.5	8.3	8.1	7.6	7.2	6.8
060H/R	9.0	1.4	1.1	1.0	1.0	0.9
	13.5	4.2	3.9	3.5	3.1	2.7
	18.0	6.9	6.7	6.0	5.2	4.5
	22.5	10.7	10.5	10.0	9.4	8.7
075H/R	10.0	3.2	3.0	2.8	2.7	2.5
	14.5	5.5	5.3	5.1	4.9	4.7
	19.0	7.9	7.6	7.3	7.1	6.8
	23.5	11.5	11.3	11.0	10.8	10.5

7/13/09

NOTES: Temperatures are Entering Water Temperatures
*Domestic water heating units source side pressure drop and reversible units load and source pressure drop.

NSW Vented Only Load Side

Model	GPM	Pressure Drop (psi)			
		60°F	80°F	100°F	120°F
018H	3.0	0.5	0.4	0.4	0.3
	4.0	1.4	1.3	1.2	1.2
	5.0	2.2	2.1	2.1	2.0
	6.0	3.0	2.9	2.9	2.8
025H	4.0	1.3	1.3	1.2	1.2
	5.5	3.0	2.9	2.8	2.7
	7.0	4.6	4.4	4.3	4.1
	8.5	6.7	6.5	6.4	6.2

7/13/09

NOTES: Temperatures are Entering Water Temperatures
Double wall vented coax for heating potable water

Reference Calculations

Heating Calculations:	Cooling Calculations:
$LWT = EWT - \frac{HE}{GPM \times C^*}$	$LWT = EWT + \frac{HR}{GPM \times C^*}$
$HE = C^* \times GPM \times (EWT - LWT)$	$HR = C^* \times GPM \times (LWT - EWT)$

NOTE: * C = 500 for pure water, 485 for brine.

Legends and Notes

Abbreviations and Definitions

ELT = entering load fluid temperature to heat pump
SWPD = source coax water pressure drop
LLT = leaving load fluid temperature from heat pump
PSI = pressure drop in pounds per square inch
LGPM = load flow in gallons per minute
FT HD = pressure drop in feet of head
LWPD = load coax water pressure drop
LWT = leaving water temperature
EWT = entering water temperature
Brine = water with a freeze inhibiting solution
kW = kilowatts
EST = entering source fluid temperature to heat pump
HE = heat extracted in MBTUH
LST = leaving source fluid temperature from heat pump
HC = total heating capacity in MBTUH
COP = coefficient of performance, heating [HC/kW x 3.413]
EER = energy efficiency ratio, cooling
TC = total cooling capacity in MBTUH
HR = heat rejected in MBTUH

Notes to Performance Data Tables

The following notes apply to all performance data tables:

- Three flow rates are shown for each unit. The lowest flow rate shown is used for geothermal open loop/well water systems with a minimum of 50°F EST. The middle flow rate shown is the minimum geothermal closed loop flow rate. The highest flow rate shown is optimum for geothermal closed loop systems and the suggested flow rate for boiler/tower applications.
- Entering water temperatures below 40°F assumes 15% antifreeze solution.
- Interpolation between ELT, EST, and GPM data is permissible.
- Operation in the gray areas is not recommended.

NSW018 - Performance Data

Cooling Capacity

Source		Load Flow-3 GPM							Load Flow-4 GPM						Load Flow-5 GPM					
EST °F	Flow GPM	ELT °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F
30	3	50	37.8	17.8	0.60	19.8	29.7	43.6	40.1	18.1	0.61	20.1	29.8	43.8	42.5	18.3	0.61	20.4	30.0	44.0
		70	56.8	19.3	0.59	21.3	32.5	44.6	59.3	19.4	0.60	21.5	32.6	44.8	61.9	19.6	0.60	21.6	32.7	44.9
		90	75.8	20.7	0.59	22.7	35.3	45.6	78.6	20.8	0.59	22.8	35.4	45.7	81.4	20.9	0.59	22.9	35.4	45.7
		110	94.7	22.2	0.58	24.2	38.3	46.6	97.8	22.2	0.58	24.2	38.3	46.6	100.8	22.2	0.58	24.2	38.3	46.6
	4	50	37.7	18.0	0.58	19.9	30.9	40.9	40.0	18.2	0.58	20.2	31.2	41.1	42.4	18.4	0.59	20.4	31.5	41.2
		70	56.7	19.3	0.57	21.3	33.8	41.7	59.3	19.5	0.57	21.4	34.0	41.8	61.9	19.6	0.58	21.6	34.1	41.9
		90	75.8	20.7	0.56	22.6	36.7	42.4	78.6	20.8	0.56	22.7	36.8	42.5	81.4	20.9	0.57	22.8	36.9	42.5
		110	94.9	22.0	0.56	23.9	39.6	43.2	97.9	22.1	0.56	23.9	39.7	43.2	100.9	22.1	0.56	24.0	39.8	43.2
	5	50	37.6	18.1	0.56	20.0	32.3	38.3	40.0	18.3	0.56	20.2	32.7	38.3	42.4	18.5	0.56	20.4	33.0	38.4
		70	56.7	19.3	0.55	21.2	35.2	38.7	59.3	19.5	0.55	21.4	35.5	38.8	61.9	19.7	0.55	21.5	35.8	38.9
		90	75.9	20.6	0.54	22.4	38.1	39.2	78.6	20.7	0.54	22.5	38.3	39.3	81.4	20.8	0.54	22.7	38.6	39.4
		110	95.0	21.8	0.53	23.6	41.1	39.7	98.0	21.9	0.53	23.7	41.3	39.8	100.9	22.0	0.53	23.8	41.5	39.8
50	3	50	38.4	16.9	0.80	19.6	22.9	63.4	40.5	17.3	0.80	20.0	23.3	63.8	42.7	17.8	0.80	20.5	23.7	64.1
		70	56.3	19.9	0.80	22.6	26.5	65.5	58.9	20.2	0.80	22.9	26.8	65.8	61.5	20.6	0.80	23.3	27.2	66.0
		90	74.3	22.9	0.80	25.6	30.1	67.6	77.3	23.1	0.79	25.8	30.4	67.8	80.4	23.4	0.79	26.1	30.7	67.9
		110	92.2	25.9	0.80	28.6	33.8	69.7	95.7	26.1	0.79	28.8	34.0	69.8	99.2	26.2	0.79	28.9	34.2	69.9
	4	50	38.3	17.0	0.77	19.6	22.0	60.8	40.5	17.4	0.77	20.0	22.6	61.0	42.6	17.8	0.77	20.5	23.1	61.2
		70	56.3	19.9	0.77	22.5	26.0	62.4	58.9	20.3	0.76	22.9	26.5	62.6	61.5	20.6	0.76	23.2	27.0	62.8
		90	74.3	22.9	0.76	25.5	30.2	64.0	77.3	23.1	0.76	25.7	30.5	64.2	80.4	23.4	0.76	25.9	30.9	64.3
		110	92.2	25.9	0.75	28.4	34.4	65.7	95.7	26.0	0.75	28.6	34.6	65.7	99.2	26.1	0.75	28.7	34.8	65.8
	5	50	38.2	17.1	0.75	19.7	24.7	58.1	40.4	17.5	0.75	20.0	25.3	58.3	42.6	17.9	0.74	20.4	25.9	58.4
		70	56.3	20.0	0.74	22.5	28.8	59.3	58.9	20.3	0.73	22.8	29.2	59.4	61.5	20.6	0.73	23.1	29.7	59.5
		90	74.3	22.9	0.72	25.4	33.0	60.5	77.3	23.1	0.72	25.6	33.3	60.5	80.4	23.3	0.72	25.8	33.6	60.6
		110	92.3	25.8	0.71	28.2	37.3	61.6	95.8	25.9	0.71	28.3	37.5	61.7	99.3	26.1	0.71	28.5	37.7	61.7
70	3	50	39.1	15.9	0.99	19.3	16.1	83.3	41.0	16.6	0.99	19.9	16.7	83.7	42.9	17.2	0.99	20.6	17.4	84.1
		70	55.9	20.5	1.00	23.9	20.5	86.4	58.5	21.0	1.00	24.4	21.1	86.8	61.1	21.5	0.99	24.9	21.7	87.1
		90	Operation not recommended																	
		110																		
	4	50	39.0	16.0	0.97	19.3	16.6	80.6	40.9	16.6	0.96	19.9	17.3	80.9	42.9	17.3	0.96	20.5	18.1	81.3
		70	55.9	20.6	0.96	23.8	21.4	83.1	58.5	21.1	0.96	24.3	22.0	83.4	61.1	21.6	0.95	24.8	22.6	83.7
		90	Operation not recommended																	
		110																		
	5	50	38.9	16.1	0.94	19.3	17.1	78.0	40.9	16.7	0.93	19.9	18.0	78.2	42.9	17.3	0.92	20.4	18.8	78.4
		70	55.8	20.7	0.92	23.8	22.4	79.8	58.5	21.1	0.92	24.2	23.0	80.0	61.1	21.6	0.91	24.7	23.7	80.2
		90	Operation not recommended																	
		110																		
90	3	50	40.4	14.0	1.30	18.4	11.8	102.7	42.1	14.5	1.30	19.0	12.3	103.0	43.8	15.1	1.30	19.5	12.7	103.4
		70	57.4	18.3	1.30	22.7	15.3	105.6	59.8	18.7	1.30	23.2	15.7	105.9	62.1	19.2	1.30	23.6	16.1	106.2
		90	Operation not recommended																	
		110																		
	4	50	40.3	14.1	1.27	18.4	11.2	100.1	42.0	14.6	1.26	19.0	11.6	100.4	43.8	15.2	1.26	19.5	12.0	100.7
		70	57.3	18.4	1.26	22.7	14.6	102.5	59.7	18.9	1.26	23.1	15.0	102.7	62.0	19.3	1.26	23.6	15.4	103.0
		90	Operation not recommended																	
		110																		
	5	50	40.2	14.3	1.24	18.5	12.6	97.6	42.0	14.8	1.23	18.9	13.2	97.8	43.7	15.3	1.23	19.4	13.7	98.0
		70	57.2	18.6	1.22	22.7	16.6	99.4	59.6	19.0	1.21	23.1	17.1	99.5	62.0	19.4	1.21	23.5	17.5	99.7
		90	Operation not recommended																	
		110																		
110	3	50	41.7	12.1	1.60	17.6	7.6	122.1	43.2	12.5	1.61	18.0	7.8	122.4	44.7	12.9	1.61	18.4	8.0	122.6
		70	59.0	16.1	1.60	21.5	10.0	124.8	61.0	16.5	1.60	21.9	10.3	125.1	63.1	16.8	1.61	22.3	10.5	125.3
		90	Operation not recommended																	
		110																		
	4	50	41.6	12.3	1.57	17.6	7.8	119.7	43.1	12.7	1.57	18.0	8.1	119.9	44.6	13.1	1.57	18.4	8.3	120.1
		70	58.8	16.3	1.56	21.6	10.5	121.9	60.9	16.6	1.56	22.0	10.7	122.1	63.0	17.0	1.56	22.3	10.9	122.3
		90	Operation not recommended																	
		110																		
	5	50	41.5	12.4	1.53	17.6	8.1	117.3	43.0	12.8	1.53	18.0	8.4	117.4	44.6	13.2	1.53	18.4	8.6	117.6
		70	58.7	16.5	1.51	21.6	10.9	118.9	60.8	16.8	1.51	22.0	11.1	119.1	62.9	17.2	1.51	22.4	11.4	119.2
		90	Operation not recommended																	
		110																		

8/20/09

NSW018 - Performance Data cont.

Heating Capacity

Source		Load Flow-3 GPM							Load Flow-4 GPM						Load Flow-5 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	4	60	Operation not recommended																	
		80																		
		100																		
		120																		
	5	60	69.8	14.2	0.90	11.1	4.62	20.4	67.4	14.3	0.88	11.3	4.76	20.3	65.9	14.4	0.86	11.5	4.91	20.3
		80	89.4	13.7	1.21	9.6	3.31	21.1	87.1	13.8	1.19	9.7	3.38	21.0	85.7	13.9	1.17	9.9	3.46	20.9
		100	109.1	13.2	1.53	8.0	2.53	21.7	106.8	13.3	1.51	8.1	2.58	21.6	105.5	13.3	1.49	8.3	2.63	21.6
		120	128.7	12.7	1.84	6.4	2.02	22.4	126.6	12.8	1.82	6.5	2.05	22.3	125.3	12.8	1.80	6.7	2.08	22.3
30	3	60	70.4	15.1	0.91	12.0	4.86	21.8	68.3	15.2	0.90	12.1	4.96	21.7	66.3	15.2	0.88	12.2	5.06	21.6
		80	90.0	14.5	1.22	10.4	3.48	22.9	88.0	14.6	1.21	10.5	3.55	22.8	86.0	14.6	1.19	10.6	3.61	22.7
		100	109.6	14.0	1.54	8.7	2.66	24.0	107.7	14.0	1.52	8.8	2.71	23.9	105.8	14.1	1.49	9.0	2.76	23.8
		120	129.2	13.4	1.85	7.1	2.12	25.1	127.4	13.5	1.83	7.2	2.16	25.0	125.6	13.5	1.80	7.4	2.20	24.9
	4	60	70.7	15.5	0.91	12.4	5.02	23.2	68.6	15.6	0.89	12.6	5.14	23.2	66.5	15.7	0.88	12.7	5.26	23.1
		80	90.2	14.9	1.22	10.7	3.58	24.2	88.2	15.0	1.20	10.9	3.66	24.1	86.2	15.0	1.18	11.0	3.75	24.0
		100	109.8	14.3	1.53	9.0	2.73	25.1	107.9	14.3	1.50	9.2	2.79	25.0	105.9	14.4	1.48	9.3	2.85	24.9
		120	129.4	13.7	1.85	7.4	2.17	26.0	127.5	13.7	1.81	7.5	2.21	25.9	125.6	13.7	1.78	7.6	2.26	25.8
	5	60	70.9	15.9	0.90	12.8	5.18	24.7	68.8	16.1	0.89	13.0	5.32	24.6	66.7	16.2	0.87	13.2	5.46	24.5
		80	90.5	15.2	1.21	11.1	3.68	25.4	88.4	15.3	1.19	11.3	3.78	25.3	86.4	15.4	1.16	11.5	3.89	25.3
		100	110.0	14.6	1.53	9.4	2.80	26.1	108.0	14.6	1.49	9.5	2.87	26.1	106.0	14.7	1.46	9.7	2.95	26.0
		120	129.6	13.9	1.84	7.6	2.21	26.9	127.6	13.9	1.80	7.8	2.27	26.8	125.7	13.9	1.75	7.9	2.33	26.7
50	3	60	73.5	19.7	0.90	16.6	6.46	38.6	70.9	19.8	2.74	10.4	4.71	42.8	68.2	20.0	4.59	4.3	2.97	47.1
		80	93.0	18.9	1.21	14.7	4.58	39.9	90.4	19.0	2.43	10.7	3.48	42.7	87.9	19.1	3.65	6.6	2.37	45.4
		100	112.4	18.1	1.52	12.9	3.48	41.2	110.0	18.1	2.12	10.9	2.85	42.5	107.5	18.2	2.71	9.0	2.21	43.8
		120	131.9	17.3	1.84	11.0	2.76	42.4	129.5	17.3	1.80	11.1	2.82	42.3	127.2	17.4	1.77	11.3	2.88	42.2
	4	60	73.9	20.2	0.89	17.1	6.62	40.7	71.2	20.4	1.81	14.2	3.31	42.7	68.5	20.6	2.72	11.3	2.22	44.8
		80	93.3	19.3	1.21	15.2	4.69	41.7	90.7	19.5	1.80	13.3	3.16	43.0	88.1	19.6	2.40	11.4	2.40	44.4
		100	112.7	18.4	1.52	13.2	3.55	42.8	110.2	18.5	1.80	12.4	3.02	43.4	107.7	18.6	2.08	11.5	2.63	44.0
		120	132.1	17.6	1.83	11.3	2.81	43.8	129.7	17.6	1.80	11.5	2.87	43.7	127.3	17.7	1.76	11.7	2.94	43.6
	5	60	74.2	20.7	0.89	17.7	6.83	42.7	71.5	21.0	0.87	18.0	7.12	42.6	68.7	21.2	0.85	18.3	7.41	42.4
		80	93.6	19.8	1.20	15.6	4.82	43.5	90.9	19.9	1.17	15.9	4.99	43.4	88.3	20.1	1.15	16.2	5.17	43.3
		100	112.9	18.8	1.52	13.6	3.64	44.4	110.4	18.9	1.48	13.9	3.75	44.3	107.8	19.0	1.45	14.1	3.87	44.2
		120	132.3	17.9	1.83	11.6	2.86	45.2	129.8	17.9	1.79	11.8	2.94	45.1	127.4	18.0	1.75	12.0	3.02	45.1
70	3	60	76.6	24.2	0.88	21.2	8.06	55.4	73.4	24.5	4.59	8.8	4.46	64.0	70.2	24.7	8.30	-3.6	0.87	72.5
		80	95.9	23.2	1.19	19.1	5.69	56.9	92.8	23.4	3.65	10.9	3.41	62.5	89.7	23.5	6.11	2.7	1.13	68.2
		100	115.2	22.1	1.51	17.0	4.30	58.3	112.2	22.3	2.72	13.0	2.99	61.1	109.2	22.4	3.93	9.0	1.67	63.8
		120	134.5	21.1	1.82	14.9	3.40	59.8	131.6	21.2	1.78	15.1	3.48	59.6	128.7	21.2	1.74	15.3	3.57	59.5
	4	60	77.1	24.9	0.88	21.8	8.27	58.1	73.8	25.2	2.72	15.9	2.71	62.2	70.5	25.5	4.56	9.9	1.64	66.4
		80	96.3	23.7	1.19	19.6	5.82	59.3	93.1	23.9	2.41	15.7	2.91	62.0	90.0	24.2	3.62	11.8	1.96	64.8
		100	115.5	22.6	1.51	17.4	4.39	60.5	112.5	22.7	2.09	15.6	3.18	61.8	109.4	22.9	2.68	13.7	2.50	63.1
		120	134.7	21.5	1.82	15.2	3.45	61.7	131.8	21.5	1.78	15.4	3.54	61.6	128.9	21.6	1.74	15.7	3.64	61.4
	5	60	77.5	25.5	0.88	22.5	8.49	60.7	74.2	25.9	0.85	22.9	8.93	60.5	70.8	26.2	0.82	23.4	9.36	60.3
		80	96.7	24.3	1.19	20.2	5.96	61.7	93.5	24.5	1.16	20.6	6.20	61.5	90.2	24.8	1.13	21.0	6.45	61.4
		100	115.8	23.0	1.51	17.9	4.48	62.6	112.7	23.2	1.47	18.2	4.63	62.5	109.6	23.4	1.43	18.5	4.78	62.4
		120	135.0	21.8	1.82	15.6	3.51	63.6	132.0	21.9	1.78	15.8	3.61	63.5	129.1	22.0	1.74	16.1	3.70	63.4
90	3	60	79.6	28.5	0.88	25.5	9.49	72.5	75.6	28.4	0.85	25.5	9.84	72.5	71.6	28.2	0.81	25.4	10.20	72.5
		80	98.6	27.1	1.18	23.0	6.70	74.2	94.9	27.1	1.15	23.1	6.92	74.1	91.1	27.0	1.11	23.2	7.14	74.0
		100	Operation not recommended																	
		120																		
	4	60	80.1	29.2	0.88	26.2	9.72	75.7	76.0	29.0	0.85	26.1	10.05	75.7	71.9	28.8	0.81	26.0	10.40	75.8
		80	99.0	27.7	1.19	23.6	6.84	77.1	95.2	27.6	1.15	23.7	7.05	77.0	91.4	27.6	1.11	23.8	7.28	77.0
		100	Operation not recommended																	
		120																		
	5	60	80.5	29.9	0.88	26.9	9.96	78.9	76.3	29.6	0.85	26.7	10.28	79.0	72.1	29.3	0.81	26.5	10.60	79.1
		80	99.4	28.2	1.19	24.2	6.97	80.0	95.5	28.2	1.15	24.2	7.19	80.0	91.6	28.1	1.11	24.3	7.42	80.0
		100	Operation not recommended																	
		120																		

8/19/09

NSW018 DHW - Performance Data cont.

Heating Capacity

Source		Load Flow-3 GPM							Load Flow-4 GPM						Load Flow-5 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	4	60	Operation not recommended																	
		80																		
		100																		
		120																		
	5	60	70.0	14.5	0.97	11.2	4.38	20.4	67.6	14.7	0.95	11.4	4.52	20.3	66.1	14.8	0.93	11.6	4.66	20.2
		80	89.7	14.1	1.30	9.7	3.19	21.0	87.4	14.3	1.28	9.9	3.27	20.9	85.9	14.4	1.26	10.1	3.36	20.8
		100	109.5	13.8	1.62	8.2	2.48	21.6	107.2	13.9	1.60	8.4	2.54	21.5	105.8	14.0	1.58	8.6	2.59	21.5
		120	129.2	13.4	1.95	6.7	2.01	22.2	127.0	13.5	1.93	6.9	2.05	22.1	125.6	13.6	1.91	7.1	2.09	22.1
30	3	60	70.4	15.2	0.97	11.9	4.59	21.8	68.4	15.4	0.95	12.1	4.74	21.7	66.4	15.5	0.93	12.3	4.88	21.5
		80	90.2	14.9	1.30	10.4	3.35	22.8	88.2	15.0	1.28	10.6	3.43	22.7	86.2	15.1	1.26	10.8	3.52	22.6
		100	110.0	14.5	1.63	9.0	2.61	23.8	108.0	14.7	1.61	9.2	2.67	23.7	106.1	14.8	1.59	9.3	2.72	23.6
		120	129.8	14.2	1.96	7.5	2.12	24.8	127.8	14.3	1.94	7.7	2.16	24.7	125.9	14.4	1.92	7.8	2.20	24.6
	4	60	70.7	15.6	0.97	12.3	4.71	23.3	68.6	15.8	0.95	12.5	4.86	23.2	66.6	15.9	0.93	12.7	5.01	23.1
		80	90.4	15.2	1.30	10.8	3.43	24.1	88.4	15.3	1.28	11.0	3.51	24.0	86.4	15.5	1.26	11.2	3.60	23.9
		100	110.2	14.8	1.63	9.2	2.66	25.0	108.2	14.9	1.61	9.4	2.71	24.9	106.2	15.0	1.59	9.6	2.77	24.8
		120	129.9	14.4	1.96	7.7	2.15	25.8	127.9	14.5	1.94	7.9	2.19	25.7	126.0	14.6	1.92	8.0	2.23	25.6
	5	60	71.0	16.0	0.97	12.7	4.83	24.8	68.9	16.2	0.95	12.9	4.98	24.7	66.7	16.3	0.93	13.1	5.14	24.6
		80	90.7	15.5	1.30	11.1	3.50	25.4	88.6	15.7	1.28	11.3	3.59	25.3	86.5	15.8	1.26	11.5	3.68	25.3
		100	110.4	15.1	1.63	9.5	2.71	26.1	108.3	15.2	1.61	9.7	2.76	26.0	106.3	15.2	1.58	9.8	2.82	25.9
		120	130.0	14.6	1.96	7.9	2.18	26.7	128.0	14.7	1.94	8.0	2.22	26.7	126.1	14.7	1.91	8.2	2.26	26.6
50	3	60	73.4	19.6	0.98	16.2	5.87	38.9	70.8	19.8	0.95	16.5	6.10	38.7	68.2	20.0	0.93	16.8	6.33	38.5
		80	93.0	18.9	1.31	14.4	4.23	40.1	90.5	19.1	1.28	14.7	4.37	39.9	87.9	19.3	1.25	15.0	4.51	39.7
		100	112.5	18.3	1.64	12.7	3.26	41.3	110.1	18.4	1.61	12.9	3.35	41.1	107.6	18.6	1.58	13.2	3.44	41.0
		120	132.1	17.6	1.97	10.9	2.62	42.5	129.7	17.7	1.94	11.1	2.68	42.4	127.4	17.9	1.91	11.3	2.74	42.2
	4	60	73.8	20.1	0.98	16.7	6.03	40.9	71.1	20.3	0.95	17.0	6.26	40.7	68.5	20.5	0.93	17.3	6.49	40.5
		80	93.3	19.4	1.31	14.9	4.34	41.9	90.7	19.5	1.28	15.2	4.47	41.7	88.1	19.7	1.25	15.4	4.61	41.6
		100	112.8	18.6	1.64	13.0	3.33	42.9	110.3	18.8	1.61	13.3	3.41	42.8	107.8	18.9	1.58	13.5	3.50	42.6
		120	132.3	17.9	1.97	11.2	2.66	43.9	129.9	18.0	1.94	11.4	2.72	43.8	127.5	18.1	1.91	11.6	2.78	43.7
	5	60	74.2	20.6	0.98	17.3	6.18	42.9	71.4	20.8	0.95	17.6	6.43	42.7	68.7	21.1	0.93	17.9	6.68	42.6
		80	93.6	19.8	1.31	15.3	4.44	43.7	91.0	20.0	1.28	15.6	4.58	43.6	88.3	20.1	1.25	15.9	4.72	43.5
		100	113.1	19.0	1.64	13.4	3.39	44.5	110.5	19.1	1.61	13.6	3.48	44.4	107.9	19.2	1.58	13.8	3.57	44.3
		120	132.5	18.2	1.97	11.5	2.70	45.3	130.0	18.3	1.94	11.6	2.76	45.2	127.5	18.3	1.91	11.8	2.82	45.1
70	3	60	76.4	23.9	0.98	20.6	7.15	55.9	73.2	24.2	0.95	20.9	7.46	55.6	70.1	24.4	0.92	21.3	7.77	55.4
		80	95.8	22.9	1.31	18.5	5.12	57.3	92.7	23.2	1.28	18.8	5.30	57.1	89.6	23.4	1.25	19.1	5.49	56.9
		100	115.1	22.0	1.65	16.3	3.91	58.8	112.2	22.2	1.61	16.7	4.03	58.6	109.2	22.3	1.57	17.0	4.16	58.3
		120	134.4	21.0	1.98	14.2	3.11	60.2	131.6	21.2	1.94	14.5	3.20	60.0	128.8	21.3	1.90	14.8	3.28	59.8
	4	60	76.9	24.6	0.98	21.2	7.34	58.4	73.6	24.8	0.95	21.6	7.66	58.2	70.4	25.1	0.92	22.0	7.99	58.0
		80	96.2	23.5	1.31	19.0	5.24	59.6	93.0	23.7	1.28	19.3	5.43	59.4	89.9	23.9	1.25	19.7	5.62	59.3
		100	115.4	22.5	1.65	16.8	3.99	60.8	112.4	22.6	1.61	17.1	4.11	60.7	109.4	22.8	1.57	17.4	4.24	60.5
		120	134.7	21.4	1.98	14.6	3.17	62.0	131.8	21.5	1.94	14.9	3.25	61.9	128.9	21.6	1.90	15.1	3.33	61.7
	5	60	77.3	25.2	0.98	21.9	7.53	61.0	74.0	25.5	0.95	22.3	7.88	60.8	70.6	25.8	0.92	22.7	8.22	60.7
		80	96.5	24.1	1.31	19.6	5.37	61.9	93.3	24.3	1.28	19.9	5.56	61.8	90.1	24.5	1.25	20.2	5.76	61.7
		100	115.8	22.9	1.65	17.3	4.08	62.9	112.7	23.1	1.61	17.6	4.20	62.8	109.6	23.2	1.57	17.8	4.32	62.6
		120	135.0	21.8	1.98	15.0	3.23	63.8	132.0	21.9	1.94	15.2	3.30	63.7	129.0	21.9	1.90	15.4	3.38	63.6
90	3	60	Operation not recommended																	
		80																		
		100																		
		120																		
	4	60																		
		80																		
		100																		
		120																		
	5	60																		
		80																		
		100																		
		120																		

8/19/09

NSW025 - Performance Data

Cooling Capacity

Source		Load Flow-4 GPM							Load Flow-5.5 GPM						Load Flow-7 GPM					
EST °F	Flow GPM	ELT °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F
30	4	50	36.6	25.9	0.96	29.2	27.0	45.0	39.3	26.7	0.96	30.0	27.8	45.5	41.9	27.5	0.96	30.8	28.6	45.9
		70	55.5	28.0	0.96	31.3	29.2	46.1	58.5	28.6	0.96	31.8	29.7	46.4	61.4	29.1	0.96	32.3	30.3	46.7
		90	74.5	30.2	0.96	33.4	31.4	47.2	77.7	30.4	0.96	33.7	31.7	47.4	81.0	30.6	0.96	33.9	31.9	47.5
		110	93.4	32.3	0.96	35.6	33.6	48.3	96.9	32.3	0.96	35.5	33.6	48.3	100.5	32.2	0.96	35.5	33.5	48.3
	5.5	50	36.9	25.4	0.93	28.6	27.3	41.6	39.5	26.2	0.93	29.3	28.1	41.9	42.1	26.9	0.93	30.1	28.9	42.3
		70	56.0	27.1	0.93	30.3	29.2	42.4	58.9	27.6	0.93	30.7	29.7	42.6	61.7	28.1	0.93	31.2	30.2	42.8
		90	75.2	28.8	0.93	31.9	31.0	43.1	78.3	29.0	0.93	32.2	31.3	43.2	81.4	29.2	0.93	32.4	31.5	43.3
		110	94.3	30.5	0.93	33.6	32.9	43.8	97.7	30.4	0.93	33.6	32.9	43.8	101.0	30.4	0.93	33.6	32.9	43.8
	7	50	37.2	24.9	0.90	28.0	27.7	38.2	39.7	25.6	0.90	28.7	28.4	38.4	42.3	26.3	0.90	29.4	29.2	38.7
		70	56.5	26.1	0.90	29.2	29.1	38.6	59.3	26.6	0.90	29.7	29.7	38.7	62.0	27.1	0.90	30.1	30.2	38.9
		90	75.9	27.4	0.89	30.4	30.6	39.0	78.8	27.6	0.89	30.6	30.9	39.0	81.8	27.8	0.89	30.9	31.2	39.1
		110	95.3	28.6	0.89	31.6	32.1	39.3	98.4	28.6	0.89	31.6	32.1	39.3	101.6	28.6	0.89	31.6	32.1	39.3
50	4	50	37.3	24.6	1.24	28.8	21.2	64.8	39.8	25.4	1.24	29.6	21.8	65.2	42.3	26.2	1.24	30.4	22.5	65.7
		70	55.4	28.3	1.25	32.6	24.0	66.8	58.3	29.0	1.25	33.3	24.5	67.2	61.2	29.7	1.25	34.0	25.0	67.5
		90	73.4	32.1	1.26	36.4	26.7	68.8	76.8	32.7	1.26	37.0	27.1	69.1	80.2	33.3	1.26	37.6	27.5	69.4
		110	91.5	35.9	1.27	40.2	29.4	70.7	95.3	36.4	1.27	40.7	29.7	71.0	99.1	36.9	1.27	41.2	29.9	71.3
	5.5	50	37.5	24.3	1.20	28.4	20.3	61.5	39.9	25.1	1.20	29.2	21.0	61.9	42.4	25.9	1.20	30.0	21.6	62.2
		70	55.7	27.8	1.20	31.9	23.1	63.0	58.5	28.5	1.20	32.6	23.7	63.3	61.4	29.2	1.20	33.3	24.3	63.6
		90	73.9	31.3	1.21	35.4	25.9	64.4	77.2	31.8	1.21	35.9	26.4	64.7	80.5	32.4	1.21	36.5	26.8	64.9
		110	92.1	34.7	1.21	38.9	28.7	65.9	95.8	35.2	1.21	39.3	29.1	66.1	99.5	35.7	1.21	39.8	29.4	66.3
	7	50	37.6	24.1	1.16	28.0	22.0	58.3	40.0	24.9	1.16	28.8	22.8	58.5	42.4	25.7	1.16	29.6	23.5	58.7
		70	56.0	27.2	1.16	31.2	24.5	59.2	58.8	27.9	1.16	31.9	25.1	59.4	61.6	28.6	1.16	32.5	25.8	59.6
		90	74.3	30.4	1.16	34.3	27.1	60.1	77.5	30.9	1.16	34.9	27.5	60.3	80.7	31.5	1.16	35.4	28.0	60.4
		110	92.7	33.6	1.16	37.5	29.6	61.0	96.3	34.0	1.16	37.9	29.9	61.2	99.9	34.4	1.16	38.3	30.2	61.3
70	4	50	38.0	23.2	1.51	28.4	15.4	84.6	40.4	24.0	1.52	29.2	15.8	85.0	42.7	24.8	1.52	30.0	16.3	85.5
		70	55.2	28.6	1.53	33.9	18.7	87.5	58.1	29.5	1.54	34.8	19.2	87.9	61.0	30.4	1.54	35.7	19.7	88.4
		90	72.4	34.1	1.55	39.4	22.0	90.3	75.9	35.0	1.56	40.3	22.5	90.8	79.4	36.0	1.56	41.3	23.1	91.3
		110	Operation not recommended																	
	5.5	50	38.0	23.2	1.47	28.2	15.8	81.4	40.3	24.1	1.47	29.1	16.4	81.8	42.7	25.0	1.47	30.0	17.0	82.1
		70	55.3	28.5	1.48	33.5	19.3	83.6	58.2	29.4	1.48	34.4	19.9	84.0	61.1	30.3	1.48	35.3	20.5	84.3
		90	72.6	33.7	1.49	38.8	22.7	85.8	76.1	34.7	1.49	39.7	23.3	86.2	79.5	35.6	1.49	40.7	23.9	86.5
		110	Operation not recommended																	
	7	50	38.0	23.2	1.42	28.0	16.3	78.3	40.3	24.2	1.42	29.0	17.1	78.5	42.6	25.1	1.41	29.9	17.8	78.8
		70	55.4	28.3	1.42	33.1	19.9	79.8	58.3	29.2	1.42	34.1	20.6	80.0	61.1	30.1	1.41	35.0	21.3	80.3
		90	72.8	33.4	1.42	38.2	23.5	81.3	76.2	34.3	1.42	39.1	24.2	81.5	79.6	35.2	1.42	40.0	24.8	81.8
		110	90.2	38.5	1.42	43.3	27.1	82.8	94.2	39.4	1.42	44.2	27.7	83.0	98.2	40.2	1.42	45.0	28.3	83.3
90	4	50	39.3	20.9	1.93	27.4	11.6	104.1	41.4	21.5	1.94	28.1	12.0	104.5	43.5	22.2	1.94	28.8	12.3	104.9
		70	56.3	26.6	1.96	33.3	14.5	107.2	59.0	27.4	1.97	34.1	14.9	107.6	61.7	28.3	1.97	35.0	15.3	108.0
		90	Operation not recommended																	
		110																		
	5.5	50	39.2	20.9	1.88	27.3	11.1	101.1	41.3	21.6	1.88	28.0	11.5	101.4	43.4	22.4	1.88	28.8	11.9	101.7
		70	56.3	26.7	1.89	33.1	14.1	103.4	59.0	27.5	1.90	34.0	14.5	103.8	61.7	28.3	1.90	34.8	14.9	104.1
		90	Operation not recommended																	
		110																		
	7	50	39.2	21.0	1.83	27.2	12.3	98.0	41.3	21.7	1.83	28.0	12.8	98.2	43.4	22.5	1.83	28.7	13.3	98.5
		70	56.2	26.8	1.83	33.0	15.6	99.7	58.9	27.6	1.83	33.8	16.1	100.0	61.6	28.4	1.83	34.6	16.6	100.2
		90	Operation not recommended																	
		110																		
110	4	50	40.5	18.5	2.35	26.5	7.9	123.7	42.3	19.1	2.36	27.1	8.1	124.0	44.2	19.6	2.36	27.7	8.3	124.3
		70	57.3	24.6	2.39	32.7	10.3	126.9	59.8	25.4	2.40	33.5	10.6	127.3	62.3	26.2	2.40	34.4	10.9	127.7
		90	Operation not recommended																	
		110																		
	5.5	50	40.4	18.6	2.30	26.4	8.1	120.7	42.3	19.2	2.30	27.0	8.3	120.9	44.2	19.8	2.30	27.6	8.6	121.2
		70	57.2	24.9	2.31	32.8	10.8	123.3	59.7	25.6	2.32	33.5	11.1	123.6	62.2	26.4	2.32	34.3	11.4	123.9
		90	Operation not recommended																	
		110																		
	7	50	40.4	18.7	2.24	26.3	8.3	117.8	42.2	19.3	2.24	26.9	8.6	117.9	44.1	19.9	2.24	27.5	8.9	118.1
		70	57.0	25.2	2.24	32.8	11.3	119.7	59.6	25.9	2.24	33.5	11.6	119.9	62.2	26.6	2.24	34.2	11.9	120.1
		90	Operation not recommended																	
		110																		

8/20/09

NSW025 - Performance Data cont.

Heating Capacity

Source		Load Flow-4 GPM							Load Flow-5.5 GPM						Load Flow-7 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	5.5	60	Operation not recommended																	
		80																		
		100																		
		120																		
	7	60	71.0	21.4	1.28	17.0	4.90	20.0	68.1	21.5	1.26	17.2	5.02	19.9	66.4	21.6	1.23	17.4	5.15	19.9
		80	90.6	20.5	1.70	14.7	3.54	20.7	87.7	20.7	1.67	14.9	3.62	20.6	86.1	20.8	1.65	15.1	3.70	20.5
		100	110.1	19.7	2.12	12.4	2.72	21.3	107.4	19.8	2.09	12.7	2.77	21.3	105.9	19.9	2.06	12.9	2.83	21.2
		120	129.7	18.8	2.54	10.1	2.17	22.0	127.1	19.0	2.51	10.4	2.21	21.9	125.6	19.1	2.48	10.6	2.26	21.9
30	4	60	71.4	22.2	1.29	17.8	5.04	20.8	69.1	22.4	1.26	18.1	5.21	20.7	66.7	22.6	1.23	18.4	5.38	20.5
		80	91.0	21.4	1.71	15.6	3.67	22.0	88.7	21.6	1.68	15.9	3.78	21.8	86.4	21.8	1.64	16.2	3.88	21.7
		100	110.6	20.6	2.12	13.4	2.84	23.1	108.4	20.8	2.09	13.6	2.91	23.0	106.2	20.9	2.06	13.9	2.98	22.8
		120	130.2	19.8	2.54	11.1	2.28	24.3	128.1	20.0	2.51	11.4	2.33	24.1	125.9	20.1	2.47	11.7	2.38	24.0
	5.5	60	71.8	22.9	1.29	18.4	5.19	22.6	69.3	23.0	1.26	18.7	5.35	22.5	66.8	23.2	1.23	19.0	5.53	22.4
		80	91.3	21.9	1.71	16.1	3.76	23.5	88.9	22.1	1.68	16.4	3.87	23.4	86.6	22.3	1.64	16.7	3.98	23.3
		100	110.8	21.0	2.12	13.7	2.90	24.5	108.6	21.2	2.09	14.1	2.97	24.4	106.3	21.4	2.06	14.4	3.05	24.2
		120	130.3	20.1	2.54	11.4	2.31	25.4	128.2	20.3	2.51	11.7	2.37	25.3	126.0	20.5	2.47	12.1	2.43	25.2
	7	60	72.1	23.5	1.29	19.1	5.34	24.4	69.6	23.7	1.26	19.3	5.50	24.3	67.0	23.8	1.23	19.6	5.67	24.2
		80	91.6	22.4	1.71	16.6	3.85	25.1	89.1	22.6	1.68	16.9	3.96	25.0	86.7	22.8	1.64	17.2	4.07	24.9
		100	111.0	21.4	2.12	14.1	2.95	25.8	108.7	21.6	2.09	14.5	3.03	25.7	106.4	21.9	2.06	14.8	3.12	25.6
		120	130.5	20.3	2.54	11.6	2.34	26.6	128.3	20.6	2.51	12.1	2.41	26.5	126.2	20.9	2.47	12.5	2.48	26.3
50	4	60	75.2	29.4	1.31	24.9	6.55	37.2	71.9	29.5	1.27	25.1	6.79	37.1	68.7	29.5	1.23	25.3	7.03	37.0
		80	94.5	28.2	1.74	22.3	4.74	38.5	91.4	28.3	1.69	22.5	4.89	38.4	88.3	28.3	1.65	22.7	5.04	38.3
		100	113.9	27.0	2.16	19.6	3.65	39.9	111.0	27.1	2.11	19.9	3.75	39.7	108.0	27.2	2.06	20.1	3.85	39.6
		120	133.3	25.9	2.59	17.0	2.91	41.2	130.5	25.9	2.54	17.3	2.99	41.1	127.7	26.0	2.48	17.5	3.07	41.0
	5.5	60	75.7	30.4	1.31	25.9	6.79	39.6	72.3	30.4	1.27	26.1	7.02	39.5	69.0	30.5	1.23	26.3	7.25	39.5
		80	95.0	29.1	1.74	23.2	4.90	40.7	91.8	29.1	1.69	23.4	5.04	40.6	88.6	29.2	1.65	23.6	5.19	40.6
		100	114.3	27.7	2.16	20.4	3.76	41.8	111.3	27.8	2.11	20.6	3.86	41.7	108.2	27.9	2.06	20.9	3.96	41.6
		120	133.6	26.4	2.59	17.6	2.99	42.9	130.7	26.5	2.54	17.9	3.06	42.8	127.8	26.6	2.48	18.2	3.15	42.7
	7	60	76.2	31.5	1.32	27.0	6.98	42.1	72.7	31.4	1.27	27.1	7.23	42.0	69.2	31.4	1.23	27.2	7.48	42.0
		80	95.4	30.0	1.74	24.0	5.02	42.9	92.1	30.0	1.69	24.2	5.18	42.9	88.8	30.0	1.65	24.4	5.34	42.8
		100	114.7	28.5	2.17	21.1	3.83	43.8	111.5	28.5	2.11	21.3	3.95	43.7	108.4	28.6	2.06	21.6	4.06	43.6
		120	133.9	27.0	2.59	18.1	3.04	44.7	131.0	27.1	2.54	18.4	3.13	44.6	128.0	27.3	2.48	18.8	3.22	44.5
70	4	60	78.9	36.6	1.33	32.1	8.06	53.5	74.8	36.5	1.28	32.1	8.37	53.4	70.7	36.4	1.23	32.2	8.67	53.4
		80	98.1	35.0	1.77	29.0	5.81	55.0	94.2	35.0	1.71	29.1	6.00	55.0	90.3	34.9	1.65	29.3	6.20	54.9
		100	117.3	33.5	2.20	25.9	4.45	56.6	113.5	33.4	2.14	26.1	4.59	56.5	109.8	33.4	2.07	26.3	4.73	56.4
		120	136.4	31.9	2.64	22.9	3.54	58.2	132.9	31.9	2.57	23.1	3.65	58.1	129.4	31.9	2.49	23.4	3.75	57.9
	5.5	60	79.6	38.0	1.34	33.4	8.34	56.6	75.3	37.9	1.28	33.5	8.65	56.6	71.1	37.7	1.23	33.5	8.98	56.6
		80	98.7	36.3	1.77	30.2	6.00	57.9	94.7	36.2	1.71	30.3	6.19	57.9	90.6	36.1	1.65	30.4	6.40	57.8
		100	117.8	34.5	2.21	27.0	4.58	59.2	114.0	34.5	2.14	27.2	4.72	59.1	110.1	34.4	2.07	27.3	4.87	59.0
		120	136.9	32.8	2.64	23.7	3.63	60.5	133.3	32.8	2.57	24.0	3.74	60.4	129.6	32.8	2.49	24.3	3.85	60.3
	7	60	80.3	39.4	1.34	34.8	8.61	59.7	75.9	39.2	1.29	34.8	8.95	59.7	71.5	39.0	1.23	34.8	9.29	59.7
		80	99.3	37.5	1.77	31.4	6.19	60.7	95.1	37.3	1.71	31.5	6.40	60.7	91.0	37.2	1.65	31.6	6.61	60.7
		100	118.3	35.5	2.21	28.0	4.72	61.8	114.4	35.5	2.14	28.2	4.86	61.7	110.4	35.4	2.07	28.3	5.01	61.7
		120	137.3	33.6	2.64	24.6	3.73	62.8	133.6	33.6	2.57	24.8	3.84	62.7	129.9	33.6	2.49	25.1	3.95	62.6
90	4	60	82.7	44.0	1.37	39.3	9.41	69.7	77.7	43.7	1.31	39.2	9.79	69.8	72.8	43.4	1.25	39.1	10.17	69.8
		80	101.6	41.9	1.80	35.7	6.80	71.6	96.9	41.7	1.73	35.8	7.07	71.6	92.2	41.5	1.66	35.9	7.33	71.5
		100	Operation not recommended																	
		120																		
	5.5	60	83.5	45.5	1.38	40.8	9.66	73.6	78.2	44.8	1.32	40.3	9.96	73.8	73.0	44.1	1.26	39.8	10.30	73.9
		80	102.3	43.2	1.81	37.0	6.99	75.2	97.4	42.8	1.74	36.8	7.22	75.2	92.5	42.4	1.66	36.7	7.46	75.2
		100	Operation not recommended																	
		120																		
	7	60	84.2	47.0	1.39	42.3	9.91	77.6	78.7	45.9	1.33	41.4	10.16	77.8	73.2	44.8	1.26	40.5	10.42	78.1
		80	102.9	44.5	1.82	38.3	7.18	78.7	97.8	43.8	1.74	37.9	7.38	78.8	92.7	43.2	1.67	37.5	7.59	79.0
		100	Operation not recommended																	
		120																		

8/19/09

NSW025 DHW - Performance Data cont.

Heating Capacity

Source		Load Flow-4 GPM							Load Flow-5.5 GPM						Load Flow-7 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	5.5	60	Operation not recommended																	
		80																		
		100																		
		120																		
	7	60	71.1	21.6	1.40	16.8	4.52	20.0	68.1	21.7	1.39	17.0	4.59	20.0	66.4	21.8	1.37	17.1	4.66	20.0
		80	90.8	20.9	1.84	14.6	3.33	20.7	87.9	21.1	1.79	14.9	3.44	20.6	86.2	21.2	1.74	15.2	3.56	20.5
		100	110.4	20.3	2.29	12.5	2.60	21.3	107.6	20.4	2.20	12.9	2.72	21.2	106.0	20.5	2.11	13.3	2.85	21.1
		120	130.1	19.6	2.73	10.3	2.10	22.0	127.4	19.8	2.61	10.9	2.22	21.8	125.9	19.9	2.48	11.4	2.35	21.6
30	4	60	71.7	22.7	1.41	17.9	4.72	20.8	69.2	22.8	1.38	18.0	4.83	20.7	66.7	22.8	1.35	18.2	4.95	20.6
		80	91.4	22.1	1.86	15.7	3.48	21.9	89.0	22.1	1.77	16.1	3.67	21.7	86.5	22.2	1.68	16.4	3.87	21.5
		100	111.0	21.4	2.31	13.5	2.72	23.0	108.7	21.5	2.16	14.1	2.93	22.7	106.3	21.5	2.00	14.7	3.15	22.4
		120	130.7	20.8	2.76	11.4	2.21	24.1	128.4	20.9	2.55	12.2	2.42	23.7	126.2	20.9	2.33	12.9	2.63	23.3
	5.5	60	72.0	23.3	1.42	18.4	4.81	22.6	69.4	23.3	1.38	18.6	4.94	22.5	66.9	23.4	1.35	18.8	5.08	22.5
		80	91.6	22.5	1.87	16.2	3.54	23.5	89.1	22.6	1.80	16.5	3.68	23.4	86.7	22.7	1.73	16.8	3.84	23.2
		100	111.2	21.8	2.32	13.9	2.76	24.4	108.9	21.9	2.21	14.3	2.90	24.2	106.5	22.0	2.11	14.8	3.05	24.0
		120	130.9	21.1	2.77	11.7	2.24	25.3	128.6	21.2	2.63	12.2	2.36	25.1	126.3	21.3	2.50	12.7	2.50	24.8
	7	60	72.3	23.8	1.42	19.0	4.91	24.4	69.7	23.9	1.39	19.2	5.06	24.4	67.1	24.0	1.35	19.4	5.21	24.3
		80	91.9	23.0	1.87	16.6	3.60	25.1	89.3	23.1	1.83	16.9	3.70	25.0	86.8	23.2	1.79	17.1	3.80	25.0
		100	111.4	22.2	2.32	14.3	2.80	25.8	109.0	22.3	2.27	14.5	2.88	25.7	106.6	22.4	2.22	14.8	2.95	25.6
		120	131.0	21.4	2.77	11.9	2.26	26.5	128.7	21.5	2.72	12.2	2.32	26.4	126.4	21.6	2.66	12.5	2.38	26.3
50	4	60	75.2	29.5	1.47	24.4	5.85	37.4	71.9	29.5	1.42	24.7	6.06	37.3	68.7	29.6	1.38	24.9	6.27	37.2
		80	94.6	28.3	1.92	21.7	4.28	38.8	91.5	28.4	1.84	22.1	4.48	38.6	88.4	28.5	1.77	22.4	4.68	38.4
		100	114.0	27.1	2.38	19.0	3.32	40.2	111.0	27.2	2.27	19.5	3.50	40.0	108.1	27.4	2.16	20.0	3.68	39.7
		120	133.4	25.9	2.84	16.2	2.66	41.6	130.5	26.1	2.69	16.9	2.83	41.3	127.7	26.3	2.55	17.6	2.99	40.9
	5.5	60	75.6	30.3	1.47	25.3	6.03	39.8	72.3	30.4	1.43	25.5	6.25	39.8	69.0	30.5	1.38	25.7	6.48	39.7
		80	95.0	29.0	1.93	22.4	4.41	41.0	91.8	29.1	1.86	22.8	4.58	40.9	88.6	29.2	1.80	23.1	4.77	40.7
		100	114.3	27.7	2.38	19.6	3.41	42.1	111.3	27.9	2.30	20.0	3.55	41.9	108.3	28.0	2.21	20.5	3.71	41.8
		120	133.6	26.4	2.84	16.7	2.72	43.3	130.8	26.6	2.74	17.3	2.85	43.0	127.9	26.8	2.63	17.8	2.99	42.8
	7	60	76.1	31.2	1.48	26.1	6.13	42.3	72.7	31.3	1.43	26.4	6.38	42.2	69.2	31.4	1.38	26.6	6.63	42.2
		80	95.3	29.8	1.94	23.2	4.48	43.2	92.1	29.9	1.88	23.5	4.64	43.1	88.8	30.0	1.83	23.8	4.80	43.0
		100	114.6	28.3	2.39	20.2	3.45	44.1	111.5	28.5	2.33	20.6	3.57	43.9	108.5	28.7	2.27	21.0	3.69	43.8
		120	133.9	26.9	2.85	17.2	2.76	44.9	131.0	27.2	2.78	17.7	2.85	44.8	128.1	27.4	2.72	18.1	2.95	44.7
70	4	60	78.7	36.2	1.52	31.0	6.98	54.0	74.7	36.3	1.46	31.3	7.29	53.9	70.7	36.3	1.40	31.5	7.60	53.8
		80	97.8	34.5	1.98	27.7	5.09	55.7	94.0	34.6	1.92	28.1	5.29	55.5	90.2	34.7	1.85	28.4	5.49	55.4
		100	116.9	32.7	2.45	24.4	3.92	57.4	113.3	33.0	2.38	24.8	4.07	57.2	109.8	33.2	2.31	25.3	4.21	57.0
		120	136.0	31.0	2.91	21.1	3.12	59.1	132.6	31.3	2.84	21.6	3.24	58.9	129.3	31.6	2.76	22.2	3.35	58.6
	5.5	60	79.3	37.4	1.53	32.2	7.16	57.1	75.2	37.5	1.47	32.4	7.48	57.0	71.0	37.5	1.41	32.7	7.82	56.9
		80	98.3	35.5	1.99	28.7	5.22	58.5	94.4	35.7	1.93	29.1	5.43	58.3	90.5	35.8	1.86	29.5	5.64	58.2
		100	117.3	33.6	2.45	25.2	4.01	59.9	113.7	33.9	2.38	25.7	4.16	59.7	110.0	34.1	2.31	26.2	4.32	59.5
		120	136.3	31.7	2.92	21.8	3.19	61.3	132.9	32.1	2.84	22.4	3.31	61.0	129.5	32.4	2.77	23.0	3.43	60.8
	7	60	79.9	38.6	1.54	33.3	7.34	60.2	75.6	38.7	1.48	33.6	7.69	60.1	71.4	38.7	1.41	33.9	8.04	60.0
		80	98.8	36.5	2.00	29.7	5.35	61.2	94.8	36.7	1.93	30.1	5.57	61.1	90.9	36.9	1.86	30.5	5.80	61.0
		100	117.8	34.5	2.46	26.1	4.11	62.3	114.0	34.8	2.39	26.6	4.27	62.2	110.3	35.0	2.32	27.1	4.43	62.0
		120	136.7	32.4	2.92	22.4	3.25	63.4	133.2	32.8	2.85	23.1	3.38	63.2	129.8	33.2	2.77	23.7	3.51	63.0
90	4	60	Operation not recommended																	
		80																		
		100																		
		120																		
	5.5	60																		
		80																		
		100																		
		120																		
	7	60																		
		80																		
		100																		
		120																		

8/18/09

NSW040 - Performance Data

Cooling Capacity

Source		Load Flow-5 GPM							Load Flow-7.5 GPM						Load Flow-10 GPM					
EST °F	Flow GPM	ELT °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F
30	5	50	34.0	38.7	1.38	43.4	28.0	47.9	37.8	39.8	1.39	44.5	28.7	48.4	41.6	40.9	1.39	45.6	29.4	48.8
		70	54.5	37.5	1.27	41.8	29.4	47.2	58.3	38.0	1.25	42.3	30.4	47.4	62.0	38.6	1.23	42.8	31.4	47.6
		90	75.1	36.2	1.17	40.2	31.1	46.6	78.8	36.2	1.12	40.0	32.6	46.5	82.5	36.2	1.06	39.9	34.1	46.4
		110	95.6	35.0	1.06	38.6	33.0	45.9	99.3	34.5	0.98	37.8	35.3	45.6	103.0	33.9	0.90	37.0	37.7	45.2
	7.5	50	34.5	37.7	1.32	42.2	28.6	43.2	38.2	38.6	1.33	43.1	29.1	43.5	41.9	39.4	1.33	43.9	29.6	43.8
		70	55.1	36.2	1.23	40.4	29.6	42.6	58.7	36.7	1.21	40.8	30.3	42.8	62.3	37.1	1.19	41.2	31.2	42.9
		90	75.7	34.7	1.13	38.6	30.7	42.1	79.3	34.8	1.09	38.5	31.9	42.1	82.8	34.9	1.05	38.5	33.1	42.0
		110	96.3	33.2	1.04	36.7	32.1	41.6	99.8	32.9	0.98	36.2	33.7	41.4	103.3	32.6	0.92	35.7	35.6	41.2
	10	50	34.9	36.7	1.26	41.0	29.1	38.5	38.5	37.3	1.27	41.6	29.5	38.6	42.2	37.9	1.27	42.2	29.8	38.7
		70	55.6	34.9	1.18	38.9	29.7	38.0	59.1	35.3	1.17	39.3	30.3	38.1	62.6	35.7	1.16	39.6	30.9	38.2
		90	76.3	33.2	1.09	36.9	30.3	37.6	79.7	33.3	1.07	37.0	31.2	37.6	83.1	33.5	1.04	37.1	32.1	37.6
		110	97.1	31.4	1.01	34.8	31.1	37.2	100.3	31.4	0.97	34.7	32.4	37.1	103.5	31.3	0.93	34.5	33.7	37.1
50	5	50	35.3	35.7	1.76	41.7	21.6	67.2	38.6	37.4	1.76	43.4	22.6	67.9	41.9	39.2	1.76	45.2	23.5	68.6
		70	53.4	40.2	1.73	46.1	24.5	69.0	57.3	41.5	1.72	47.4	25.5	69.5	61.2	42.8	1.71	48.6	26.4	70.1
		90	71.5	44.8	1.71	50.6	27.4	70.9	76.0	45.6	1.69	51.4	28.5	71.2	80.4	46.4	1.66	52.1	29.5	71.5
		110	89.6	49.4	1.68	55.1	30.4	72.7	94.7	49.7	1.65	55.3	31.7	72.8	99.7	50.1	1.62	55.6	33.0	72.9
	7.5	50	39.1	35.3	1.69	41.0	20.9	62.8	38.8	36.9	1.68	42.6	21.9	63.3	42.1	38.5	1.68	44.2	22.9	63.8
		70	57.8	39.2	1.65	44.8	23.7	64.0	58.7	40.3	1.64	45.9	24.5	64.4	61.4	41.5	1.63	47.1	25.4	64.7
		90	76.5	43.0	1.62	48.6	26.5	65.2	77.8	43.8	1.60	49.2	27.3	65.4	80.8	44.5	1.59	49.9	28.1	65.7
		110	95.2	46.9	1.59	52.3	29.5	66.5	95.4	47.2	1.56	52.5	30.2	66.5	100.2	47.5	1.54	52.7	30.9	66.6
	10	50	42.8	34.9	1.61	40.4	23.0	58.3	38.9	36.4	1.61	41.9	23.8	58.6	42.2	37.9	1.61	43.3	24.7	58.9
		70	62.1	38.1	1.57	43.5	25.3	59.0	60.1	39.1	1.57	44.5	26.1	59.2	61.7	40.2	1.56	45.5	26.9	59.4
		90	81.5	41.3	1.54	46.5	27.6	59.6	79.6	41.9	1.52	47.1	28.4	59.7	81.2	42.6	1.51	47.7	29.1	59.8
		110	100.8	44.5	1.50	49.6	30.0	60.2	96.2	44.7	1.48	49.7	30.8	60.3	100.7	44.9	1.46	49.9	31.5	60.3
70	5	50	36.6	32.6	2.14	39.9	15.2	86.5	39.4	35.0	2.14	42.3	16.4	87.4	42.3	37.4	2.13	44.7	17.6	88.4
		70	52.3	43.0	2.19	50.5	19.6	90.8	56.3	45.0	2.20	52.5	20.5	91.6	60.3	47.0	2.20	54.5	21.4	92.5
		90	68.0	53.3	2.25	61.0	23.7	95.2	73.2	55.0	2.26	62.7	24.4	95.8	78.3	56.6	2.26	64.3	25.0	96.5
		110	Operation not recommended																	
	7.5	50	36.5	32.9	2.05	39.8	16.0	82.3	39.4	35.2	2.04	42.2	17.2	83.1	42.2	37.6	2.04	44.5	18.5	83.8
		70	56.9	42.1	2.08	49.2	20.2	85.3	58.7	44.0	2.08	51.1	21.2	85.9	60.5	45.9	2.08	52.9	22.1	86.5
		90	73.9	51.4	2.11	58.6	24.3	88.4	76.4	52.7	2.12	59.9	24.9	88.8	78.8	54.1	2.12	61.3	25.5	89.3
		110	Operation not recommended																	
	10	50	36.4	33.1	1.96	39.8	16.9	78.2	39.3	35.5	1.95	42.1	18.2	78.7	42.2	37.8	1.94	44.4	19.5	79.2
		70	61.5	41.2	1.97	48.0	20.9	79.9	61.1	43.0	1.96	49.7	21.9	80.2	60.8	44.7	1.96	51.4	22.8	80.6
		90	79.8	49.4	1.98	56.1	24.9	81.6	79.6	50.5	1.98	57.2	25.5	81.8	79.4	51.6	1.97	58.3	26.1	82.0
		110	86.3	57.5	1.99	64.3	28.9	83.3	92.1	58.0	1.99	64.8	29.1	83.4	97.9	58.5	1.99	65.3	29.4	83.5
90	5	50	38.0	29.1	2.74	38.4	11.4	105.8	40.6	30.9	2.74	40.3	12.2	106.6	43.2	32.8	2.74	42.2	13.0	107.4
		70	53.8	39.2	2.80	48.8	15.0	110.1	57.5	41.1	2.81	50.7	15.7	110.9	61.1	43.0	2.81	52.6	16.4	111.7
		90	69.6	49.4	2.86	59.1	18.4	114.4	74.3	51.3	2.87	61.1	19.0	115.2	79.0	53.3	2.88	63.1	19.6	116.0
		110	Operation not recommended																	
	7.5	50	41.0	29.2	2.65	38.3	11.0	101.8	40.6	31.1	2.64	40.1	11.8	102.4	43.2	33.0	2.64	42.0	12.5	103.0
		70	57.9	38.9	2.68	48.1	14.5	104.9	59.6	40.8	2.68	49.9	15.2	105.5	61.2	42.7	2.68	51.8	15.9	106.1
		90	74.9	48.6	2.71	57.9	17.9	108.0	77.0	50.5	2.71	59.7	18.6	108.6	79.2	52.3	2.71	61.6	19.3	109.2
		110	Operation not recommended																	
	10	50	43.9	29.4	2.55	38.1	12.5	97.9	40.5	31.3	2.54	40.0	13.4	98.2	43.1	33.3	2.54	41.9	14.3	98.6
		70	62.0	38.7	2.56	47.4	16.2	99.8	61.7	40.5	2.55	49.2	17.0	100.1	61.3	42.3	2.54	51.0	17.8	100.5
		90	80.1	47.9	2.56	56.6	19.8	101.7	79.8	49.6	2.56	58.4	20.6	102.0	79.4	51.4	2.55	60.1	21.3	102.4
		110	Operation not recommended																	
110	5	50	39.5	25.5	3.34	36.9	7.6	125.2	41.8	26.9	3.35	38.3	8.0	125.8	44.2	28.2	3.35	39.6	8.4	126.3
		70	55.4	35.5	3.41	47.1	10.4	129.4	58.7	37.3	3.42	48.9	10.9	130.2	61.9	39.1	3.42	50.8	11.4	130.9
		90	Operation not recommended																	
		110																		
	7.5	50	39.4	25.6	3.24	36.7	7.9	121.4	41.8	27.0	3.24	38.1	8.3	121.8	44.1	28.5	3.24	39.5	8.8	122.2
		70	59.0	35.8	3.28	46.9	10.9	124.5	60.4	37.6	3.28	48.8	11.5	125.1	61.9	39.5	3.28	50.7	12.1	125.7
		90	Operation not recommended																	
		110																		
	10	50	39.4	25.7	3.14	36.4	8.2	117.5	41.7	27.2	3.14	37.9	8.7	117.8	44.1	28.7	3.13	39.4	9.2	118.1
		70	62.6	36.1	3.14	46.8	11.5	119.6	62.2	38.0	3.14	48.7	12.1	120.0	61.8	39.9	3.13	50.6	12.8	120.4
		90	Operation not recommended																	
		110																		

8/20/09

NSW040 - Performance Data cont.

Heating Capacity

Source		Load Flow-5 GPM							Load Flow-7.5 GPM						Load Flow-10 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	7.5	60	Operation not recommended																	
		80																		
		100																		
		120																		
	10	60	72.2	29.7	1.83	23.5	4.76	20.2	68.2	29.7	1.78	23.6	4.89	20.1	66.1	29.6	1.72	23.7	5.04	20.1
		80	91.9	28.8	2.42	20.6	3.50	20.8	87.9	28.8	2.36	20.7	3.58	20.7	85.9	28.7	2.29	20.9	3.67	20.7
		100	111.5	28.0	3.00	17.7	2.73	21.3	107.7	27.9	2.94	17.9	2.78	21.3	105.7	27.8	2.87	18.0	2.84	21.3
		120	131.2	27.1	3.59	14.8	2.21	21.9	127.4	27.0	3.52	15.0	2.25	21.9	125.5	26.9	3.44	15.2	2.29	21.9
30	5	60	72.7	30.9	1.84	24.6	4.92	19.8	69.5	30.8	1.79	24.7	5.06	19.8	66.3	30.7	1.73	24.8	5.20	19.8
		80	92.4	30.0	2.42	21.8	3.64	21.0	89.3	30.0	2.36	21.9	3.73	21.0	86.2	29.9	2.30	22.0	3.81	20.9
		100	112.0	29.2	2.99	19.0	2.85	22.2	109.0	29.1	2.93	19.1	2.91	22.1	106.0	29.0	2.86	19.3	2.97	22.1
		120	131.7	28.3	3.57	16.1	2.32	23.4	128.7	28.3	3.50	16.3	2.37	23.3	125.8	28.2	3.43	16.5	2.41	23.2
	7.5	60	73.3	32.3	1.84	26.0	5.14	22.1	70.0	32.2	1.78	26.1	5.29	22.1	66.6	32.2	1.73	26.3	5.46	22.0
		80	92.8	31.0	2.43	22.7	3.74	23.1	89.6	31.0	2.36	23.0	3.85	23.0	86.4	31.1	2.29	23.2	3.97	22.9
		100	112.3	29.8	3.02	19.5	2.90	24.0	109.2	29.9	2.94	19.9	2.98	23.9	106.2	30.0	2.86	20.2	3.07	23.9
		120	131.8	28.6	3.61	16.3	2.32	25.0	128.9	28.7	3.52	16.7	2.39	24.9	125.9	28.9	3.43	17.1	2.46	24.8
	10	60	73.9	33.6	1.84	27.3	5.35	24.4	70.4	33.6	1.78	27.5	5.54	24.3	66.9	33.6	1.72	27.7	5.72	24.3
		80	93.2	32.0	2.44	23.7	3.85	25.1	89.9	32.1	2.37	24.1	3.99	25.0	86.6	32.2	2.29	24.4	4.12	25.0
		100	112.6	30.5	3.04	20.1	2.94	25.9	109.5	30.7	2.95	20.6	3.05	25.8	106.4	30.9	2.86	21.1	3.16	25.6
		120	131.9	28.9	3.64	16.5	2.33	26.6	129.0	29.2	3.54	17.1	2.42	26.5	126.1	29.5	3.43	17.8	2.52	26.3
50	5	60	76.9	41.1	1.88	34.7	6.37	35.7	72.7	40.8	1.81	34.7	6.61	35.7	68.4	40.6	1.74	34.6	6.84	35.7
		80	96.3	39.5	2.47	31.1	4.67	37.2	92.2	39.3	2.39	31.1	4.82	37.2	88.1	39.1	2.30	31.2	4.97	37.1
		100	115.6	37.9	3.06	27.4	3.61	38.7	111.7	37.7	2.96	27.6	3.72	38.6	107.8	37.6	2.87	27.8	3.84	38.5
		120	134.9	36.3	3.65	23.8	2.90	40.2	131.2	36.2	3.54	24.1	2.99	40.1	127.5	36.2	3.44	24.4	3.08	39.9
	7.5	60	77.7	43.0	1.86	36.6	6.77	38.9	73.2	42.7	1.80	36.5	6.95	38.9	68.7	42.3	1.74	36.4	7.15	38.9
		80	96.9	41.1	2.46	32.7	4.89	40.1	92.7	40.9	2.38	32.7	5.03	40.0	88.4	40.7	2.30	32.8	5.18	40.0
		100	116.1	39.1	3.06	28.7	3.75	41.3	112.1	39.1	2.97	29.0	3.86	41.2	108.0	39.0	2.87	29.2	3.98	41.1
		120	135.4	37.2	3.66	24.7	2.98	42.4	131.5	37.3	3.55	25.2	3.08	42.3	127.7	37.4	3.44	25.6	3.19	42.2
	10	60	78.5	44.9	1.84	38.6	7.14	42.0	73.8	44.5	1.79	38.4	7.29	42.1	69.1	44.1	1.74	38.2	7.43	42.1
		80	97.6	42.6	2.45	34.3	5.08	42.9	93.1	42.5	2.38	34.3	5.23	42.9	88.7	42.3	2.30	34.4	5.37	42.9
		100	116.7	40.4	3.07	30.0	3.85	43.8	112.5	40.4	2.97	30.3	3.99	43.8	108.3	40.4	2.87	30.6	4.13	43.7
		120	135.8	38.2	3.68	25.6	3.03	44.7	131.9	38.4	3.56	26.3	3.16	44.6	128.0	38.6	3.44	26.9	3.29	44.5
70	5	60	81.2	51.3	1.92	44.7	7.83	51.5	75.8	50.9	1.83	44.6	8.16	51.6	70.4	50.4	1.74	44.5	8.49	51.7
		80	100.2	48.9	2.52	40.3	5.69	53.4	95.1	48.6	2.42	40.4	5.91	53.4	90.0	48.3	2.31	40.4	6.13	53.3
		100	119.2	46.6	3.12	35.9	4.37	55.2	114.4	46.4	3.00	36.1	4.54	55.1	109.5	46.2	2.88	36.4	4.70	55.0
		120	138.2	44.2	3.72	31.5	3.48	57.0	133.7	44.2	3.59	31.9	3.61	56.8	129.1	44.1	3.45	32.3	3.75	56.7
	7.5	60	82.1	53.7	1.88	47.3	8.37	55.6	76.5	53.1	1.81	46.9	8.58	55.7	70.8	52.5	1.75	46.5	8.82	55.8
		80	101.1	51.1	2.49	42.6	6.00	57.1	95.7	50.7	2.40	42.5	6.18	57.1	90.4	50.3	2.31	42.4	6.38	57.1
		100	120.0	48.5	3.11	37.9	4.57	58.5	115.0	48.3	2.99	38.1	4.73	58.4	109.9	48.1	2.88	38.3	4.90	58.4
		120	138.9	45.9	3.72	33.2	3.61	59.9	134.2	45.9	3.58	33.6	3.75	59.8	129.5	45.9	3.45	34.1	3.90	59.6
	10	60	83.1	56.1	1.84	49.8	8.93	59.7	77.2	55.4	1.80	49.2	9.04	59.9	71.3	54.6	1.75	48.6	9.14	60.0
		80	102.0	53.2	2.47	44.8	6.32	60.8	96.4	52.8	2.39	44.6	6.47	60.8	90.8	52.3	2.31	44.4	6.62	60.8
		100	120.8	50.4	3.09	39.8	4.77	61.8	115.5	50.2	2.99	40.0	4.93	61.8	110.3	50.0	2.88	40.2	5.09	61.7
		120	139.6	47.5	3.72	34.8	3.74	62.8	134.7	47.6	3.58	35.4	3.90	62.7	129.8	47.7	3.44	36.0	4.06	62.6
90	5	60	85.4	61.5	1.99	54.7	9.05	67.4	78.5	59.0	1.88	52.5	9.20	68.3	71.6	56.4	1.77	50.4	9.34	69.2
		80	104.5	59.4	2.56	50.7	6.79	69.1	97.8	56.7	2.44	48.3	6.80	70.1	91.1	53.9	2.32	46.0	6.80	71.0
		100	Operation not recommended																	
		120																		
	7.5	60	86.2	63.7	2.01	56.8	9.30	72.6	79.0	60.4	1.89	53.9	9.37	73.5	71.8	57.1	1.77	51.0	9.44	74.3
		80	105.5	61.9	2.58	53.1	7.03	73.8	98.4	58.3	2.45	49.9	6.97	74.7	91.3	54.7	2.33	46.8	6.90	75.6
		100	124.8	60.1	3.15	49.3	5.59	75.0	117.8	56.2	3.01	45.9	5.47	76.0	110.8	52.4	2.88	42.6	5.33	76.9
		120	Operation not recommended																	
	10	60	87.1	65.8	2.02	58.9	9.54	77.9	79.5	61.8	1.90	55.3	9.55	78.6	71.9	57.7	1.77	51.7	9.55	79.3
		80	106.5	64.3	2.59	55.4	7.27	78.6	99.0	59.9	2.46	51.5	7.13	79.4	91.5	55.6	2.33	47.6	7.00	80.2
		100	125.9	62.7	3.16	51.9	5.82	79.3	118.4	58.1	3.02	47.8	5.62	80.2	111.0	53.4	2.88	43.6	5.43	81.0
		120	Operation not recommended																	

8/17/09

NSW050 - Performance Data

Cooling Capacity

Source		Load Flow-8 GPM							Load Flow-11.5 GPM						Load Flow-15 GPM					
EST °F	Flow GPM	ELT °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F
30	8	50	35.8	55.2	1.98	61.9	27.9	46.0	38.8	57.0	2.00	63.8	28.6	46.4	41.9	58.8	2.01	65.7	29.3	46.9
		70	54.6	59.8	2.01	66.6	29.8	47.2	58.0	61.0	2.02	67.8	30.3	47.5	61.5	62.2	2.02	69.1	30.7	47.8
		90	73.4	64.3	2.03	71.3	31.6	48.4	77.2	64.9	2.04	71.9	31.9	48.5	81.0	65.5	2.04	72.5	32.2	48.7
		110	92.2	68.9	2.06	75.9	33.4	49.6	96.4	68.9	2.06	75.9	33.5	49.6	100.5	68.9	2.05	75.9	33.6	49.6
	11.5	50	35.9	54.6	1.90	61.1	28.8	42.1	39.0	56.3	1.92	62.8	29.3	42.5	42.0	57.9	1.94	64.5	29.8	42.8
		70	55.0	58.1	1.92	64.6	30.3	42.9	58.4	59.1	1.93	65.7	30.7	43.1	61.7	60.2	1.94	66.9	31.0	43.3
		90	74.2	61.5	1.93	68.1	31.8	43.6	77.8	62.0	1.94	68.6	32.0	43.8	81.4	62.6	1.94	69.2	32.3	43.9
		110	93.3	64.9	1.95	71.6	33.3	44.4	97.2	64.9	1.95	71.5	33.4	44.4	101.1	64.9	1.94	71.5	33.5	44.4
	15	50	36.1	54.1	1.82	60.3	29.7	38.3	39.1	55.6	1.85	61.8	30.1	38.5	42.2	57.0	1.87	63.4	30.5	38.7
		70	55.5	56.4	1.83	62.6	30.9	38.6	58.7	57.3	1.84	63.6	31.1	38.7	62.0	58.3	1.86	64.6	31.4	38.9
		90	74.9	58.6	1.83	64.9	32.0	38.9	78.3	59.1	1.84	65.4	32.2	39.0	81.8	59.6	1.84	65.9	32.3	39.1
		110	94.3	60.9	1.84	67.2	33.1	39.2	98.0	60.9	1.84	67.2	33.2	39.2	101.6	60.9	1.83	67.1	33.3	39.2
50	8	50	36.7	51.5	2.53	60.2	21.7	65.5	39.5	53.5	2.53	62.2	22.4	66.0	42.4	55.5	2.54	64.2	23.1	66.5
		70	54.6	59.9	2.58	68.7	24.4	67.7	57.9	61.5	2.59	70.4	24.9	68.1	61.3	63.1	2.60	72.0	25.5	68.5
		90	72.4	68.3	2.64	77.3	26.9	69.9	76.3	69.5	2.65	78.5	27.3	70.2	80.3	70.7	2.65	79.8	27.7	70.6
		110	90.2	76.7	2.70	85.9	29.4	72.1	94.7	77.5	2.71	86.7	29.6	72.4	99.2	78.3	2.71	87.5	29.8	72.6
	11.5	50	39.8	51.6	2.43	59.9	21.3	61.9	39.6	53.4	2.44	61.7	21.9	62.2	42.4	55.2	2.45	63.6	22.5	62.6
		70	58.3	58.9	2.47	67.4	23.9	63.4	58.2	60.3	2.48	68.8	24.4	63.7	61.5	61.7	2.48	70.2	24.9	64.0
		90	76.8	66.3	2.51	74.8	26.4	64.9	76.8	67.3	2.51	75.8	26.8	65.1	80.6	68.3	2.52	76.9	27.1	65.4
		110	95.3	73.6	2.55	82.3	28.9	66.5	95.4	74.2	2.55	82.9	29.1	66.6	99.7	74.8	2.55	83.5	29.3	66.7
	15	50	42.9	51.7	2.33	59.7	23.5	58.2	39.6	53.3	2.35	61.3	24.0	58.4	42.5	54.9	2.36	63.0	24.5	58.7
		70	62.0	58.0	2.35	66.0	25.8	59.1	58.4	59.2	2.36	67.2	26.2	59.2	61.7	60.4	2.37	68.5	26.5	59.4
		90	81.2	64.2	2.37	72.3	28.0	59.9	77.2	65.0	2.38	73.1	28.2	60.1	80.9	65.9	2.38	74.0	28.5	60.2
		110	100.3	70.5	2.39	78.6	30.2	60.8	96.0	70.9	2.39	79.1	30.3	60.9	100.2	71.4	2.40	79.5	30.5	60.9
70	8	50	37.7	47.9	3.07	58.4	15.6	85.0	40.2	50.1	3.07	60.5	16.3	85.6	42.8	52.2	3.07	62.7	17.0	86.2
		70	54.5	60.1	3.16	70.9	19.0	88.3	57.9	62.1	3.17	72.9	19.6	88.8	61.2	64.0	3.17	74.9	20.2	89.3
		90	71.4	72.3	3.25	83.4	22.2	91.5	75.5	74.1	3.26	85.2	22.7	92.0	79.6	75.9	3.27	87.0	23.2	92.4
		110	Operation not recommended																	
	11.5	50	37.5	48.6	2.96	58.7	16.4	81.6	40.1	50.6	2.96	60.6	17.1	82.0	42.8	52.5	2.96	62.6	17.7	82.4
		70	54.6	59.8	3.02	70.1	19.8	83.9	57.9	61.5	3.02	71.8	20.4	84.3	61.3	63.3	3.03	73.6	20.9	84.6
		90	71.7	71.0	3.08	81.5	23.1	86.2	75.8	72.5	3.09	83.1	23.5	86.5	79.8	74.0	3.10	84.6	23.9	86.9
		110	Operation not recommended																	
	15	50	37.3	49.3	2.84	59.0	17.4	78.1	40.0	51.1	2.85	60.8	17.9	78.4	42.7	52.8	2.85	62.5	18.5	78.6
		70	54.7	59.5	2.87	69.3	20.7	79.5	58.0	61.0	2.88	70.8	21.2	79.7	61.4	62.5	2.89	72.3	21.6	79.9
		90	72.0	69.8	2.91	79.7	24.0	81.0	76.1	71.0	2.92	80.9	24.3	81.1	80.1	72.1	2.92	82.1	24.7	81.3
		110	89.4	80.0	2.94	90.0	27.2	82.4	94.1	80.9	2.95	91.0	27.4	82.5	98.8	81.8	2.96	91.9	27.6	82.6
90	8	50	38.9	43.0	3.93	56.4	11.8	104.5	41.3	44.7	3.94	58.1	12.2	105.0	43.6	46.4	3.95	59.9	12.7	105.4
		70	56.0	54.5	4.02	68.2	14.5	107.6	59.0	56.2	4.04	70.0	14.9	108.0	62.0	58.0	4.05	71.8	15.4	108.5
		90	73.0	66.0	4.12	80.0	17.1	110.6	76.7	67.8	4.13	81.9	17.5	111.1	80.4	69.5	4.15	83.7	17.9	111.6
		110	Operation not recommended																	
	11.5	50	38.8	43.6	3.81	56.6	11.5	101.2	41.2	45.2	3.81	58.2	11.8	101.5	43.6	46.8	3.82	59.8	12.2	101.8
		70	55.9	54.7	3.87	67.9	14.1	103.4	59.0	56.3	3.88	69.6	14.5	103.8	62.0	57.9	3.89	71.2	14.9	104.1
		90	73.0	65.9	3.93	79.3	16.8	105.7	76.8	67.5	3.95	81.0	17.1	106.1	80.5	69.1	3.96	82.7	17.4	106.4
		110	Operation not recommended																	
	15	50	38.6	44.2	3.68	56.8	13.0	97.8	41.1	45.7	3.69	58.2	13.4	98.0	43.5	47.1	3.69	59.7	13.8	98.2
		70	55.8	55.0	3.72	67.7	15.9	99.3	58.9	56.5	3.72	69.2	16.3	99.5	62.0	57.9	3.73	70.7	16.7	99.7
		90	73.0	65.8	3.75	78.6	18.7	100.8	76.8	67.3	3.76	80.1	19.1	101.0	80.6	68.7	3.77	81.6	19.4	101.2
		110	Operation not recommended																	
110	8	50	40.2	38.0	4.79	54.3	7.9	124.0	42.3	39.3	4.81	55.7	8.2	124.4	44.4	40.6	4.82	57.1	8.4	124.7
		70	57.4	48.8	4.89	65.5	10.0	126.9	60.1	50.4	4.91	67.1	10.3	127.3	62.9	51.9	4.93	68.7	10.5	127.7
		90	Operation not recommended																	
		110																		
	11.5	50	40.1	38.6	4.66	54.4	8.3	120.8	42.2	39.8	4.67	55.7	8.5	121.0	44.4	41.0	4.68	57.0	8.8	121.3
		70	57.2	49.7	4.72	65.8	10.5	123.0	60.0	51.2	4.74	67.3	10.8	123.3	62.8	52.6	4.75	68.9	11.1	123.6
		90	Operation not recommended																	
		110																		
	15	50	39.9	39.1	4.52	54.5	8.7	117.5	42.1	40.3	4.53	55.7	8.9	117.7	44.3	41.4	4.53	56.9	9.1	117.8
		70	57.0	50.5	4.56	66.1	11.1	119.1	59.8	51.9	4.57	67.5	11.4	119.3	62.7	53.4	4.58	69.0	11.7	119.5
		90	Operation not recommended																	
		110																		

8/20/09

NSW050 - Performance Data cont.

Heating Capacity

Source		Load Flow-8 GPM							Load Flow-11.5 GPM						Load Flow-15 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	11.5	60	Operation not recommended																	
		80																		
		100																		
		120																		
	15	60	71.3	43.9	2.50	35.4	5.15	20.1	67.9	44.0	2.50	35.4	5.16	20.1	66.0	44.0	2.49	35.5	5.18	20.1
		80	91.0	42.6	3.41	31.0	3.66	20.7	87.6	42.6	3.37	31.1	3.71	20.7	85.9	42.6	3.33	31.3	3.75	20.7
		100	110.6	41.3	4.32	26.6	2.80	21.3	107.4	41.3	4.25	26.8	2.85	21.3	105.7	41.3	4.17	27.0	2.90	21.3
		120	130.3	40.0	5.23	22.2	2.24	22.0	127.2	40.0	5.12	22.5	2.29	21.9	125.5	39.9	5.01	22.8	2.33	21.9
30	8	60	71.8	45.7	2.36	37.6	5.67	20.3	69.0	45.8	2.43	37.5	5.53	20.3	66.3	45.8	2.49	37.3	5.39	20.4
		80	91.4	44.4	3.31	33.1	3.92	21.5	88.8	44.4	3.33	33.0	3.91	21.5	86.1	44.4	3.34	33.0	3.89	21.5
		100	111.1	43.0	4.27	28.5	2.96	22.7	108.5	43.0	4.23	28.6	2.98	22.6	105.9	43.0	4.19	28.7	3.01	22.6
		120	130.7	41.7	5.22	23.9	2.34	23.8	128.2	41.7	5.13	24.1	2.38	23.8	125.7	41.6	5.04	24.4	2.42	23.7
	11.5	60	72.2	47.2	2.50	38.6	5.53	22.4	69.3	47.2	2.49	38.7	5.56	22.4	66.5	47.3	2.48	38.8	5.59	22.4
		80	91.7	45.5	3.41	33.9	3.92	23.4	89.0	45.6	3.37	34.1	3.96	23.3	86.3	45.6	3.33	34.2	4.01	23.3
		100	111.3	43.9	4.31	29.2	2.98	24.3	108.7	43.9	4.25	29.4	3.03	24.2	106.0	43.9	4.18	29.6	3.08	24.2
		120	130.9	42.3	5.22	24.5	2.37	25.2	128.4	42.3	5.13	24.8	2.42	25.1	125.8	42.2	5.03	25.0	2.46	25.1
	15	60	72.5	48.6	2.64	39.6	5.39	24.6	69.6	48.7	2.56	40.0	5.59	24.5	66.7	48.8	2.47	40.4	5.79	24.5
		80	92.0	46.7	3.50	34.8	3.91	25.2	89.2	46.8	3.41	35.1	4.02	25.2	86.4	46.8	3.32	35.5	4.13	25.1
		100	111.5	44.8	4.36	29.9	3.01	25.9	108.9	44.8	4.27	30.2	3.08	25.8	106.2	44.8	4.17	30.6	3.15	25.8
		120	131.1	42.9	5.22	25.1	2.41	26.6	128.5	42.9	5.12	25.4	2.45	26.5	125.9	42.8	5.02	25.7	2.50	26.5
50	8	60	75.1	58.8	2.56	50.0	6.65	37.1	71.6	58.6	2.54	50.0	6.72	37.1	68.0	58.5	2.52	49.9	6.80	37.1
		80	94.5	56.3	3.47	44.4	4.71	38.5	91.1	56.2	3.42	44.6	4.80	38.5	87.7	56.2	3.36	44.7	4.88	38.5
		100	113.9	53.9	4.39	38.9	3.58	40.0	110.6	53.8	4.30	39.2	3.66	39.9	107.4	53.8	4.21	39.4	3.74	39.8
		120	133.2	51.4	5.30	33.3	2.83	41.4	130.2	51.4	5.18	33.7	2.91	41.3	127.1	51.5	5.06	34.2	2.98	41.2
	11.5	60	75.7	61.0	2.64	52.0	6.78	39.8	72.0	60.8	2.58	52.0	6.91	39.9	68.3	60.5	2.51	51.9	7.06	39.9
		80	95.0	58.1	3.53	46.1	4.83	41.0	91.5	57.9	3.44	46.2	4.93	41.0	87.9	57.8	3.36	46.3	5.04	41.0
		100	114.2	55.2	4.41	40.2	3.67	42.1	110.9	55.1	4.31	40.4	3.75	42.1	107.6	55.0	4.21	40.6	3.83	42.0
		120	133.5	52.4	5.30	34.3	2.89	43.3	130.3	52.3	5.18	34.6	2.96	43.2	127.2	52.3	5.06	35.0	3.03	43.1
	15	60	76.3	63.3	2.72	54.0	6.79	42.6	72.4	62.9	2.61	54.0	7.03	42.6	68.6	62.5	2.51	53.9	7.27	42.6
		80	95.4	59.9	3.58	47.7	4.89	43.4	91.8	59.6	3.47	47.8	5.03	43.4	88.2	59.4	3.36	47.9	5.17	43.4
		100	114.6	56.6	4.44	41.5	3.72	44.3	111.2	56.4	4.32	41.7	3.82	44.3	107.7	56.2	4.20	41.9	3.91	44.2
		120	133.7	53.3	5.30	35.2	2.94	45.2	130.5	53.2	5.18	35.5	3.01	45.1	127.3	53.1	5.05	35.8	3.07	45.1
70	8	60	78.5	71.8	2.76	62.4	7.62	53.9	74.1	71.5	2.65	62.5	7.92	53.9	69.8	71.2	2.54	62.5	8.21	53.9
		80	97.6	68.2	3.63	55.8	5.50	55.6	93.5	68.1	3.51	56.1	5.69	55.5	89.3	67.9	3.39	56.3	5.87	55.5
		100	116.7	64.7	4.51	49.3	4.20	57.3	112.8	64.6	4.37	49.7	4.34	57.2	108.9	64.6	4.23	50.2	4.47	57.1
		120	135.7	61.1	5.38	42.7	3.33	59.0	132.1	61.2	5.23	43.4	3.43	58.8	128.4	61.3	5.08	44.0	3.54	58.7
	11.5	60	79.3	74.9	2.78	65.4	7.90	57.3	74.7	74.3	2.66	65.2	8.18	57.3	70.1	73.7	2.55	65.0	8.48	57.3
		80	98.2	70.7	3.64	58.3	5.69	58.6	93.9	70.3	3.52	58.3	5.86	58.6	89.6	69.9	3.39	58.3	6.04	58.6
		100	117.2	66.6	4.51	51.2	4.32	60.0	113.1	66.3	4.37	51.4	4.44	59.9	109.1	66.1	4.24	51.6	4.57	59.9
		120	136.1	62.4	5.38	44.0	3.40	61.4	132.3	62.4	5.23	44.5	3.49	61.3	128.6	62.3	5.08	45.0	3.59	61.2
	15	60	80.1	77.9	2.79	68.4	8.18	60.6	75.3	77.1	2.67	67.9	8.47	60.7	70.5	76.2	2.55	67.5	8.76	60.7
		80	98.9	73.2	3.65	60.7	5.87	61.7	94.4	72.5	3.52	60.5	6.04	61.7	89.9	71.9	3.39	60.3	6.21	61.7
		100	117.6	68.4	4.52	53.0	4.44	62.7	113.5	68.0	4.38	53.1	4.56	62.7	109.3	67.6	4.24	53.1	4.68	62.7
		120	136.4	63.7	5.38	45.3	3.47	63.8	132.6	63.5	5.23	45.7	3.56	63.7	128.7	63.3	5.08	46.0	3.65	63.7
90	8	60	81.9	84.9	2.85	75.2	8.73	70.6	76.5	82.8	3.51	70.8	7.21	71.7	71.1	80.7	4.16	66.5	5.68	72.9
		80	100.6	80.1	3.71	67.4	6.32	72.6	95.6	78.7	4.09	64.8	5.70	73.3	90.6	77.4	4.47	62.2	5.08	74.0
		100	119.4	75.2	4.58	59.6	4.82	74.6	114.8	74.7	4.68	58.7	4.68	74.9	110.2	74.1	4.77	57.8	4.55	75.1
		120	Operation not recommended																	
	11.5	60	82.3	86.6	2.86	76.9	8.89	74.9	76.8	84.1	3.12	73.5	7.91	75.6	71.2	81.6	3.38	70.1	7.08	76.4
		80	101.1	81.8	3.72	69.0	6.43	76.5	95.9	80.2	3.84	67.1	6.12	76.9	90.8	78.6	3.95	65.1	5.83	77.3
		100	119.8	76.9	4.59	61.2	4.91	78.0	115.1	76.2	4.56	60.7	4.90	78.1	110.4	75.5	4.52	60.1	4.90	78.3
		120	Operation not recommended																	
	15	60	82.8	88.3	2.86	78.5	9.05	79.2	77.0	85.4	2.73	76.1	9.19	79.5	71.3	82.5	2.59	73.7	9.33	79.9
		80	101.5	83.4	3.73	70.7	6.55	80.3	96.2	81.6	3.58	69.3	6.68	80.5	91.0	79.7	3.43	68.0	6.81	80.7
		100	120.2	78.6	4.61	62.8	5.00	81.4	115.4	77.7	4.44	62.6	5.14	81.4	110.6	76.9	4.26	62.3	5.28	81.4
		120	Operation not recommended																	

8/19/09

NSW060 - Performance Data

Cooling Capacity

Source		Load Flow-9 GPM							Load Flow-13.5 GPM						Load Flow-18 GPM					
EST °F	Flow GPM	ELT °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F
30	9	50	36.0	61.1	2.23	68.7	27.4	45.7	39.1	64.5	2.25	72.1	28.7	46.5	42.2	67.8	2.26	75.5	30.0	47.3
		70	54.4	68.1	2.26	75.9	30.1	47.4	58.0	70.6	2.28	78.4	31.0	48.0	61.6	73.1	2.29	80.9	32.0	48.5
		90	72.8	75.2	2.30	83.0	32.7	49.0	76.9	76.8	2.31	84.7	33.3	49.4	81.0	78.5	2.31	86.4	33.9	49.8
		110	91.2	82.2	2.33	90.2	35.3	50.7	95.8	83.0	2.34	91.0	35.5	50.8	100.4	83.8	2.34	91.8	35.8	51.0
	13.5	50	36.1	60.5	2.14	67.8	28.3	41.7	39.2	64.0	2.15	71.3	29.7	42.3	42.3	67.5	2.17	74.8	31.2	42.9
		70	54.8	66.1	2.16	73.5	30.6	42.8	58.4	68.6	2.17	76.0	31.7	43.2	61.9	71.1	2.18	78.5	32.7	43.6
		90	73.6	71.8	2.18	79.2	33.0	43.8	77.5	73.3	2.18	80.7	33.6	44.1	81.4	74.8	2.19	82.2	34.2	44.4
		110	92.3	77.4	2.20	84.9	35.3	44.9	96.6	77.9	2.20	85.4	35.4	45.0	101.0	78.4	2.20	85.9	35.6	45.1
	18	50	36.3	59.9	2.05	66.9	29.2	37.7	39.3	63.5	2.06	70.5	30.8	38.1	42.3	67.1	2.07	74.2	32.4	38.5
		70	55.3	64.1	2.05	71.1	31.2	38.1	58.7	66.6	2.06	73.6	32.3	38.4	62.1	69.1	2.07	76.1	33.4	38.7
		90	74.3	68.4	2.06	75.4	33.2	38.6	78.1	69.7	2.06	76.7	33.8	38.8	81.9	71.0	2.06	78.1	34.4	38.9
		110	93.4	72.6	2.06	79.6	35.2	39.1	97.5	72.8	2.06	79.8	35.3	39.1	101.6	73.0	2.06	80.0	35.4	39.2
50	9	50	36.8	57.4	2.86	67.2	21.4	65.4	39.8	60.2	2.87	70.0	22.4	66.0	42.8	63.0	2.88	72.8	23.3	66.7
		70	54.3	68.3	2.93	78.3	24.6	67.9	58.0	70.6	2.94	80.7	25.3	68.5	61.6	72.9	2.95	83.0	26.0	69.0
		90	71.8	79.3	3.00	89.5	27.6	70.5	76.2	81.1	3.01	91.3	28.1	70.9	80.5	82.8	3.02	93.2	28.6	71.3
		110	89.3	90.2	3.07	100.7	30.5	73.1	94.4	91.5	3.08	102.0	30.8	73.4	99.4	92.8	3.10	103.3	31.1	73.7
	13.5	50	36.9	57.3	2.75	66.6	20.9	61.5	39.8	60.2	2.75	69.6	21.9	62.0	42.8	63.1	2.76	72.5	22.9	62.5
		70	54.7	66.9	2.79	76.4	24.0	63.2	58.2	69.2	2.80	78.8	24.7	63.6	61.8	71.5	2.81	81.1	25.5	64.0
		90	72.5	76.6	2.83	86.2	27.0	65.0	76.7	78.2	2.84	87.9	27.5	65.3	80.8	79.9	2.85	89.7	28.0	65.6
		110	90.3	86.2	2.88	96.0	30.0	66.8	95.1	87.3	2.89	97.1	30.2	67.0	99.9	88.3	2.90	98.2	30.5	67.2
	18	50	36.9	57.2	2.63	66.1	23.1	57.6	39.8	60.2	2.64	69.2	24.3	57.9	42.8	63.2	2.64	72.2	25.4	58.3
		70	55.0	65.5	2.65	74.5	25.9	58.5	58.5	67.8	2.66	76.9	26.8	58.8	62.0	70.1	2.66	79.2	27.6	59.1
		90	73.1	73.9	2.67	83.0	28.7	59.5	77.1	75.4	2.68	84.6	29.2	59.7	81.2	77.0	2.68	86.2	29.8	59.9
		110	91.2	82.2	2.69	91.4	31.5	60.5	95.8	83.1	2.70	92.2	31.7	60.6	100.4	83.9	2.71	93.1	31.9	60.7
70	9	50	37.7	53.7	3.49	65.6	15.4	85.0	40.5	56.0	3.50	67.9	16.0	85.6	43.3	58.2	3.50	70.1	16.6	86.1
		70	54.3	68.5	3.60	80.8	19.1	88.5	58.0	70.6	3.61	82.9	19.6	89.0	61.7	72.7	3.62	85.0	20.1	89.5
		90	70.9	83.4	3.70	96.0	22.5	92.0	75.5	85.3	3.72	98.0	22.9	92.4	80.0	87.2	3.73	99.9	23.4	92.9
		110	Operation not recommended																	
	13.5	50	37.6	54.1	3.35	65.5	16.1	81.3	40.4	56.4	3.35	67.8	16.8	81.7	43.3	58.8	3.36	70.2	17.5	82.1
		70	54.5	67.7	3.42	79.4	19.8	83.7	58.1	69.8	3.43	81.5	20.4	84.1	61.8	71.9	3.44	83.6	20.9	84.5
		90	71.4	81.4	3.49	93.3	23.3	86.2	75.8	83.2	3.50	95.2	23.7	86.5	80.3	85.1	3.52	97.1	24.2	86.8
		110	Operation not recommended																	
	18	50	37.5	54.4	3.21	65.4	16.9	77.5	40.4	56.9	3.21	67.8	17.7	77.8	43.2	59.3	3.21	70.3	18.5	78.0
		70	54.7	66.9	3.24	77.9	20.6	78.9	58.3	69.0	3.25	80.1	21.2	79.2	61.9	71.1	3.26	82.2	21.8	79.4
		90	71.8	79.3	3.28	90.5	24.2	80.4	76.2	81.2	3.29	92.4	24.7	80.6	80.5	83.0	3.30	94.2	25.1	80.8
		110	89.0	91.8	3.31	103.1	27.7	81.8	94.1	93.3	3.33	104.7	28.0	82.0	99.1	94.8	3.35	106.2	28.3	82.2
90	9	50	39.1	47.6	4.48	62.8	11.5	104.4	41.6	49.5	4.48	64.7	11.9	104.8	44.1	51.4	4.49	66.7	12.4	105.3
		70	55.8	61.8	4.58	77.4	14.5	107.7	59.2	63.7	4.59	79.4	14.9	108.2	62.5	65.6	4.61	81.4	15.3	108.6
		90	72.6	76.1	4.68	92.0	17.3	111.1	76.7	78.0	4.70	94.0	17.7	111.5	80.8	79.9	4.73	96.1	18.0	112.0
		110	Operation not recommended																	
	13.5	50	39.0	48.0	4.32	62.7	11.1	100.8	41.5	49.9	4.32	64.6	11.5	101.1	44.1	51.9	4.33	66.6	12.0	101.4
		70	55.9	61.6	4.38	76.5	14.1	103.2	59.2	63.6	4.40	78.6	14.5	103.5	62.5	65.5	4.41	80.6	14.9	103.9
		90	72.8	75.2	4.45	90.4	16.9	105.6	76.8	77.2	4.47	92.5	17.3	106.0	80.9	79.2	4.49	94.6	17.6	106.3
		110	Operation not recommended																	
	18	50	38.9	48.4	4.16	62.5	12.6	97.2	41.5	50.4	4.16	64.5	13.1	97.4	44.0	52.4	4.16	66.5	13.7	97.6
		70	55.9	61.4	4.19	75.7	15.7	98.7	59.2	63.4	4.20	77.7	16.2	98.9	62.5	65.5	4.21	79.8	16.7	99.1
		90	73.0	74.4	4.22	88.8	18.8	100.2	77.0	76.5	4.24	90.9	19.3	100.4	81.0	78.6	4.25	93.1	19.7	100.7
		110	Operation not recommended																	
110	9	50	40.5	41.4	5.46	60.0	7.6	123.8	42.7	43.0	5.47	61.6	7.9	124.1	44.9	44.5	5.48	63.2	8.1	124.5
		70	57.4	55.1	5.55	74.0	9.9	127.0	60.3	56.8	5.58	75.9	10.2	127.4	63.3	58.6	5.61	77.7	10.4	127.8
		90	Operation not recommended																	
		110																		
	13.5	50	40.4	41.9	5.29	59.9	7.9	120.3	42.6	43.4	5.29	61.5	8.2	120.6	44.9	45.0	5.30	63.0	8.5	120.8
		70	57.3	55.5	5.35	73.7	10.4	122.7	60.3	57.3	5.36	75.6	10.7	123.0	63.2	59.2	5.38	77.5	11.0	123.3
		90	Operation not recommended																	
		110																		
	18	50	40.3	42.3	5.11	59.7	8.3	116.8	42.6	43.9	5.11	61.3	8.6	117.0	44.8	45.4	5.11	62.8	8.9	117.2
		70	57.2	55.9	5.14	73.4	10.9	118.4	60.2	57.8	5.15	75.4	11.2	118.6	63.2	59.8	5.16	77.4	11.6	118.9
		90	Operation not recommended																	
		110																		

8/20/09

NSW060 - Performance Data cont.

Heating Capacity

Source		Load Flow-9 GPM							Load Flow-13.5 GPM						Load Flow-18 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	13.5	60	Operation not recommended																	
		80																		
		100																		
		120																		
	18	60	71.1	48.3	2.93	38.3	4.83	20.6	67.4	48.6	2.86	38.8	4.98	20.6	65.6	48.9	2.79	39.4	5.14	20.5
		80	90.8	47.3	3.93	33.9	3.53	21.1	87.3	47.6	3.85	34.4	3.62	21.1	85.5	47.8	3.76	35.0	3.72	21.0
		100	110.6	46.3	4.93	29.5	2.75	21.6	107.1	46.5	4.83	30.0	2.82	21.6	105.4	46.8	4.74	30.6	2.89	21.5
		120	130.4	45.3	5.93	25.1	2.24	22.1	126.9	45.5	5.82	25.6	2.29	22.1	125.2	45.7	5.71	26.2	2.35	22.0
30	9	60	71.5	50.1	2.94	40.1	4.99	20.8	68.7	50.5	2.87	40.7	5.17	20.7	65.8	50.9	2.79	41.4	5.35	20.5
		80	91.3	49.3	3.95	35.9	3.66	21.8	88.5	49.7	3.86	36.5	3.77	21.6	85.7	50.0	3.77	37.1	3.89	21.5
		100	111.1	48.6	4.95	31.7	2.87	22.7	108.4	48.8	4.85	32.3	2.95	22.6	105.6	49.0	4.74	32.8	3.03	22.5
		120	131.0	47.8	5.96	27.5	2.35	23.7	128.2	48.0	5.84	28.0	2.41	23.6	125.5	48.1	5.72	28.6	2.46	23.5
	13.5	60	71.9	52.1	3.0	42.0	5.17	22.9	68.9	51.8	2.87	42.0	5.29	22.9	65.9	51.6	2.8	42.0	5.41	22.8
		80	91.7	50.9	4.0	37.4	3.77	23.7	88.7	50.8	3.86	37.6	3.86	23.6	85.8	50.7	3.8	37.8	3.95	23.5
		100	111.4	49.7	5.0	32.8	2.94	24.4	108.6	49.8	4.84	33.2	3.01	24.3	105.7	49.8	4.7	33.7	3.08	24.3
		120	131.1	48.6	6.0	28.2	2.39	25.2	128.4	48.8	5.83	28.9	2.45	25.1	125.6	49.0	5.7	29.5	2.51	25.0
	18	60	72.4	54.1	2.97	44.0	5.34	25.0	69.2	53.2	2.88	43.3	5.41	25.0	66.0	52.2	2.79	42.7	5.48	25.1
		80	92.0	52.5	3.96	39.0	3.88	25.5	89.0	52.0	3.86	38.8	3.95	25.6	85.9	51.4	3.76	38.6	4.01	25.6
		100	111.7	50.9	4.96	34.0	3.01	26.1	108.7	50.8	4.84	34.2	3.07	26.1	105.8	50.6	4.72	34.5	3.14	26.1
		120	131.3	49.3	5.95	29.0	2.43	26.7	128.5	49.6	5.82	29.7	2.50	26.6	125.7	49.8	5.69	30.4	2.56	26.5
50	9	60	75.1	66.0	3.0	55.7	6.34	37.2	71.4	66.2	2.92	56.2	6.62	37.1	67.6	66.3	2.8	56.7	6.90	37.0
		80	94.6	63.9	4.0	50.2	4.66	38.5	91.0	64.1	3.89	50.8	4.83	38.4	87.4	64.3	3.8	51.4	4.99	38.2
		100	114.1	61.7	5.0	44.7	3.63	39.8	110.6	62.0	4.86	45.4	3.74	39.6	107.1	62.3	4.7	46.1	3.86	39.4
		120	133.7	59.6	6.0	39.3	2.93	41.0	130.3	60.0	5.83	40.1	3.02	40.8	126.9	60.3	5.7	40.9	3.11	40.6
	13.5	60	75.8	68.8	3.1	58.4	6.61	40.1	71.8	68.5	2.93	58.5	6.84	40.1	67.8	68.2	2.8	58.5	7.09	40.0
		80	95.2	66.2	4.0	52.5	4.81	41.1	91.4	66.1	3.90	52.8	4.96	41.0	87.6	66.1	3.8	53.2	5.13	41.0
		100	114.6	63.7	5.0	46.6	3.72	42.1	111.0	63.8	4.87	47.2	3.84	42.0	107.3	64.0	4.7	47.8	3.96	41.9
		120	134.0	61.1	6.0	40.6	2.98	43.1	130.5	61.5	5.85	41.5	3.08	42.9	127.1	61.9	5.7	42.4	3.18	42.8
	18	60	76.4	71.6	3.1	61.1	6.79	43.0	72.2	70.8	2.95	60.7	7.01	43.0	68.0	70.0	2.8	60.4	7.24	43.1
		80	95.7	68.6	4.1	54.7	4.93	43.7	91.7	68.2	3.92	54.8	5.09	43.7	87.8	67.8	3.8	54.9	5.25	43.7
		100	115.0	65.6	5.1	48.4	3.79	44.5	111.3	65.6	4.89	48.9	3.92	44.4	107.5	65.6	4.7	49.4	4.06	44.3
		120	134.3	62.6	6.0	42.0	3.03	45.2	130.8	63.0	5.87	43.0	3.15	45.1	127.3	63.4	5.7	44.0	3.26	45.0
70	9	60	78.8	81.9	3.12	71.3	7.69	53.7	74.1	81.8	2.98	71.6	8.07	53.6	69.4	81.7	2.83	72.0	8.46	53.5
		80	98.0	78.4	4.06	64.5	5.65	55.2	93.5	78.5	3.92	65.1	5.88	55.1	89.0	78.6	3.78	65.7	6.10	54.9
		100	117.2	74.9	5.01	57.8	4.38	56.8	112.9	75.2	4.87	58.6	4.54	56.6	108.7	75.6	4.72	59.4	4.69	56.4
		120	136.4	71.4	5.95	51.1	3.52	58.3	132.3	72.0	5.81	52.1	3.63	58.1	128.3	72.5	5.67	53.1	3.75	57.8
	13.5	60	79.6	85.5	3.1	74.8	7.97	57.4	74.6	85.1	3.00	74.9	8.33	57.3	69.7	84.8	2.8	75.0	8.73	57.3
		80	98.7	81.6	4.1	67.5	5.81	58.6	94.0	81.5	3.95	68.0	6.04	58.5	89.3	81.4	3.8	68.5	6.29	58.4
		100	117.8	77.6	5.1	60.3	4.48	59.8	113.4	77.8	4.91	61.1	4.65	59.6	108.9	78.1	4.7	61.9	4.83	59.5
		120	136.9	73.7	6.0	53.0	3.57	61.0	132.7	74.2	5.86	54.2	3.71	60.8	128.6	74.8	5.7	55.4	3.86	60.6
	18	60	80.4	89.1	3.17	78.3	8.24	61.0	75.2	88.5	3.02	78.2	8.62	61.0	70.1	87.8	2.86	78.0	8.99	61.1
		80	99.4	84.7	4.16	70.5	5.97	61.9	94.5	84.5	3.98	70.9	6.23	61.9	89.6	84.2	3.80	71.2	6.49	61.8
		100	118.4	80.3	5.14	62.7	4.57	62.8	113.8	80.5	4.95	63.6	4.77	62.7	109.2	80.6	4.75	64.4	4.98	62.6
		120	137.4	75.9	6.13	55.0	3.63	63.7	133.1	76.5	5.91	56.3	3.80	63.6	128.8	77.0	5.69	57.6	3.96	63.4
90	9	60	82.4	97.7	3.26	86.6	8.78	70.2	76.5	95.2	3.09	84.7	9.04	70.6	70.6	92.7	2.92	82.7	9.30	71.0
		80	101.4	93.2	4.25	78.7	6.42	72.0	95.9	91.9	4.06	78.0	6.65	72.1	90.4	90.5	3.86	77.4	6.87	72.3
		100	Operation not recommended																	
		120																		
	13.5	60	82.8	99.7	3.3	88.4	8.89	74.9	76.8	96.7	3.11	86.1	9.12	75.3	70.7	93.7	2.9	83.7	9.37	75.7
		80	101.8	95.3	4.3	80.6	6.52	76.3	96.2	93.5	4.08	79.6	6.72	76.4	90.5	91.8	3.9	78.6	6.94	76.6
		100	120.8	90.9	5.3	72.8	5.04	77.6	115.6	90.4	5.05	73.1	5.24	77.5	110.3	89.9	4.8	73.4	5.46	77.5
		120	Operation not recommended																	
	18	60	83.3	101.6	3.31	90.3	8.99	79.7	77.1	98.2	3.13	87.5	9.22	80.0	70.8	94.7	2.94	84.7	9.44	80.3
		80	102.3	97.3	4.31	82.6	6.61	80.5	96.5	95.2	4.10	81.2	6.81	80.7	90.7	93.1	3.89	79.8	7.00	80.9
		100	121.3	93.0	5.31	74.9	5.13	81.4	115.9	92.2	5.08	74.9	5.33	81.4	110.5	91.4	4.85	74.9	5.53	81.4
		120	Operation not recommended																	

8/19/09

NSW075 - Performance Data

Cooling Capacity

Source		Load Flow-10 GPM							Load Flow-14.5 GPM						Load Flow-19 GPM					
EST °F	Flow GPM	ELT °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F	LLT °F	TC MBTUH	Power kW	HR MBTUH	EER	LST °F
30	10	50	34.7	74.0	3.14	84.7	23.6	47.5	37.9	77.8	3.19	88.7	24.4	48.3	41.1	81.6	3.24	92.7	25.2	49.1
		70	52.4	85.1	3.29	96.4	25.9	49.9	56.3	88.0	3.34	99.3	26.3	50.5	60.2	90.8	3.38	102.3	26.8	51.1
		90	70.2	96.3	3.45	108.0	27.9	52.3	74.7	98.1	3.49	110.0	28.1	52.7	79.2	99.9	3.53	112.0	28.3	53.1
		110	87.9	107.4	3.60	119.7	29.8	54.7	93.0	108.3	3.64	120.7	29.8	54.9	98.2	109.1	3.67	121.6	29.7	55.1
	14.5	50	34.7	74.1	3.01	84.4	24.6	43.3	37.9	77.8	3.05	88.2	25.5	43.9	41.2	81.4	3.09	91.9	26.3	44.5
		70	52.9	83.1	3.12	93.8	26.6	44.9	56.6	85.8	3.16	96.6	27.2	45.3	60.4	88.5	3.20	99.4	27.7	45.8
		90	71.0	92.2	3.24	103.2	28.5	46.5	75.3	93.8	3.27	105.0	28.7	46.8	79.6	95.5	3.30	106.8	28.9	47.1
		110	89.1	101.2	3.35	112.6	30.2	48.1	94.0	101.9	3.38	113.4	30.2	48.2	98.9	102.6	3.41	114.2	30.1	48.3
	19	50	34.7	74.2	2.88	84.0	25.8	39.1	37.9	77.7	2.91	87.6	26.7	39.5	41.2	81.2	2.94	91.2	27.6	39.9
		70	53.3	81.1	2.95	91.2	27.5	39.9	57.0	83.6	2.98	93.8	28.1	40.2	60.7	86.1	3.01	96.4	28.6	40.5
		90	71.8	88.1	3.03	98.4	29.1	40.7	76.0	89.6	3.05	100.0	29.4	40.8	80.1	91.1	3.07	101.6	29.6	41.0
		110	90.4	95.0	3.10	105.6	30.6	41.5	95.0	95.5	3.12	106.1	30.6	41.5	99.6	96.0	3.14	106.7	30.6	41.6
50	10	50	35.8	68.9	3.94	82.3	18.5	67.0	38.8	72.3	3.99	85.9	19.2	67.7	41.8	75.6	4.03	89.4	19.8	68.4
		70	52.9	83.0	4.16	97.2	21.0	70.0	56.6	85.8	4.21	100.2	21.4	70.6	60.4	88.6	4.26	103.1	21.8	71.3
		90	70.0	97.0	4.38	112.0	23.2	73.1	74.5	99.3	4.44	114.5	23.4	73.6	79.0	101.6	4.49	116.9	23.6	74.1
		110	87.1	111.1	4.60	126.8	25.2	76.1	92.3	112.9	4.66	128.8	25.2	76.5	97.6	114.6	4.72	130.7	25.3	77.0
	14.5	50	35.7	69.3	3.78	82.2	18.3	62.9	38.7	72.6	3.82	85.6	19.0	63.5	41.8	75.9	3.86	89.0	19.7	64.0
		70	53.2	81.7	3.95	95.2	20.7	65.1	56.8	84.4	3.99	98.0	21.1	65.5	60.5	87.1	4.04	100.9	21.6	66.0
		90	70.6	94.1	4.12	108.2	22.9	67.2	75.0	96.3	4.17	110.5	23.1	67.6	79.3	98.4	4.22	112.7	23.3	67.9
		110	88.0	106.6	4.29	121.2	24.9	69.3	93.1	108.1	4.34	122.9	24.9	69.6	98.1	109.6	4.40	124.6	24.9	69.9
	19	50	35.6	69.7	3.63	82.0	20.3	58.9	38.7	72.9	3.66	85.4	21.1	59.3	41.7	76.2	3.69	88.7	21.8	59.6
		70	53.4	80.5	3.74	93.2	22.5	60.1	57.1	83.0	3.78	95.9	23.0	60.4	60.7	85.6	3.81	98.6	23.5	60.7
		90	71.2	91.3	3.86	104.4	24.6	61.3	75.4	93.2	3.90	106.5	24.9	61.6	79.7	95.1	3.94	108.6	25.1	61.8
		110	89.0	102.1	3.97	115.6	26.6	62.5	93.8	103.3	4.02	117.0	26.6	62.7	98.6	104.6	4.07	118.5	26.6	62.9
70	10	50	36.8	63.8	4.74	80.0	13.5	86.5	39.6	66.7	4.78	83.0	13.9	87.1	42.4	69.6	4.82	86.1	14.4	87.7
		70	53.3	80.8	5.03	98.0	16.1	90.2	57.0	83.6	5.08	101.0	16.5	90.8	60.6	86.4	5.14	104.0	16.8	91.4
		90	69.8	97.8	5.31	115.9	18.4	93.9	74.3	100.5	5.38	118.9	18.7	94.5	78.8	103.3	5.45	121.9	18.9	95.1
		110	Operation not recommended																	
	14.5	50	36.7	64.5	4.56	80.0	14.1	82.6	39.5	67.4	4.59	83.1	14.7	83.1	42.4	70.4	4.63	86.1	15.2	83.5
		70	53.4	80.3	4.78	96.6	16.8	85.3	57.1	83.0	4.83	99.5	17.2	85.7	60.7	85.8	4.88	102.4	17.6	86.2
		90	70.2	96.1	5.00	113.2	19.2	87.9	74.6	98.7	5.07	116.0	19.5	88.4	79.0	101.2	5.13	118.7	19.7	88.8
		110	Operation not recommended																	
	19	50	36.6	65.1	4.37	80.0	14.9	78.7	39.4	68.1	4.40	83.1	15.5	79.0	42.3	71.1	4.43	86.2	16.0	79.4
		70	53.6	79.8	4.53	95.2	17.6	80.3	57.2	82.5	4.57	98.1	18.0	80.6	60.8	85.1	4.62	100.9	18.4	80.9
		90	70.5	94.4	4.68	110.4	20.2	82.0	74.9	96.8	4.75	113.0	20.4	82.3	79.2	99.2	4.81	115.6	20.6	82.5
		110	87.5	109.1	4.84	125.6	22.5	83.6	92.6	111.2	4.92	127.9	22.6	83.9	97.7	113.2	5.00	130.3	22.6	84.1
90	10	50	38.3	56.8	6.04	77.4	10.1	106.0	40.8	59.2	6.08	79.9	10.5	106.5	43.3	61.5	6.12	82.4	10.8	107.0
		70	54.9	73.1	6.36	94.8	12.3	109.5	58.2	75.5	6.41	97.3	12.6	110.1	61.6	77.8	6.46	99.9	12.9	110.6
		90	71.6	89.4	6.68	112.2	14.2	113.1	75.7	91.8	6.74	114.8	14.5	113.7	79.8	94.1	6.81	117.4	14.7	114.2
		110	Operation not recommended																	
	14.5	50	38.1	57.5	5.82	77.4	9.9	102.2	40.7	59.9	5.85	79.9	10.2	102.6	43.2	62.4	5.88	82.4	10.6	103.0
		70	54.9	73.2	6.07	93.9	12.1	104.8	58.2	75.5	6.11	96.4	12.4	105.2	61.6	77.9	6.16	98.9	12.6	105.6
		90	71.7	88.8	6.32	110.4	14.0	107.5	75.8	91.1	6.38	112.9	14.3	107.9	79.9	93.4	6.43	115.3	14.5	108.2
		110	Operation not recommended																	
	19	50	38.0	58.3	5.60	77.4	11.2	98.4	40.6	60.7	5.63	79.9	11.6	98.7	43.1	63.2	5.65	82.5	12.0	99.0
		70	54.9	73.3	5.79	93.0	13.5	100.1	58.2	75.6	5.82	95.4	13.9	100.4	61.5	77.9	5.85	97.9	14.2	100.6
		90	71.8	88.3	5.97	108.6	15.7	101.8	75.9	90.4	6.01	110.9	16.0	102.0	80.0	92.6	6.06	113.3	16.2	102.3
		110	Operation not recommended																	
110	10	50	39.7	49.8	7.34	74.9	6.8	125.4	42.0	51.6	7.38	76.8	7.0	125.8	44.2	53.4	7.41	78.7	7.2	126.2
		70	56.5	65.4	7.69	91.6	8.5	128.9	59.5	67.3	7.74	93.7	8.7	129.3	62.5	69.2	7.78	95.8	8.9	129.7
		90	Operation not recommended																	
		110																		
	14.5	50	39.6	50.6	7.09	74.8	7.1	121.8	41.8	52.5	7.11	76.7	7.4	122.1	44.1	54.4	7.14	78.7	7.6	122.4
		70	56.4	66.1	7.37	91.2	9.0	124.4	59.4	68.0	7.40	93.3	9.2	124.7	62.4	69.9	7.44	95.3	9.4	125.0
		90	Operation not recommended																	
		110																		
	19	50	39.4	51.4	6.83	74.7	7.5	118.1	41.7	53.4	6.85	76.7	7.8	118.3	44.0	55.3	6.87	78.7	8.0	118.5
		70	56.2	66.7	7.04	90.8	9.5	119.9	59.3	68.7	7.07	92.8	9.7	120.1	62.3	70.7	7.09	94.9	10.0	120.3
		90	Operation not recommended																	
		110																		

8/20/09

NSW075 - Performance Data cont.

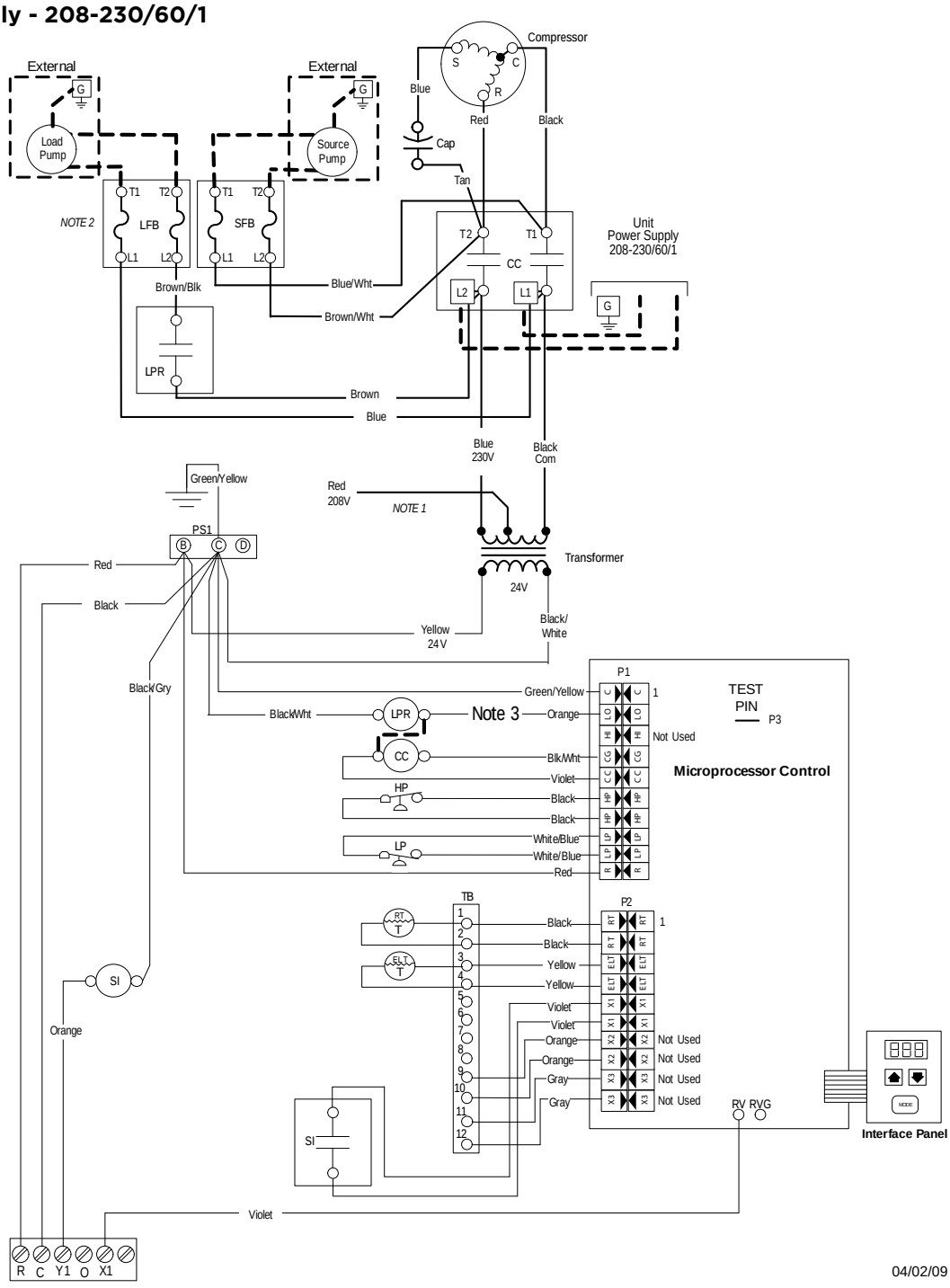
Heating Capacity

Source		Load Flow-10 GPM							Load Flow-14.5 GPM						Load Flow-19 GPM					
EST °F	Flow GPM	10 °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F	LLT °F	HC MBTUH	Power kW	HE MBTUH	COP	LST °F
25	14.5	60	Operation not recommended																	
		80																		
		100																		
		120																		
	19	60	72.1	58.8	3.90	45.5	4.42	20.1	68.4	58.9	3.78	46.0	4.57	20.0	66.4	59.0	3.66	46.5	4.72	19.95
		80	91.8	57.4	5.11	40.0	3.29	20.7	88.2	57.5	4.97	40.6	3.39	20.6	86.2	57.6	4.82	41.1	3.50	20.5
		100	111.6	56.1	6.32	34.5	2.60	21.3	108.0	56.1	6.15	35.1	2.67	21.2	106.1	56.1	5.98	35.7	2.75	21.1
		120	131.3	54.7	7.53	29.0	2.13	21.9	127.8	54.7	7.34	29.7	2.18	21.8	125.9	54.7	7.14	30.3	2.24	21.7
30	10	60	72.6	61.1	3.90	47.8	4.59	20.1	69.6	61.2	3.79	48.3	4.74	20.0	66.7	61.3	3.68	48.7	4.88	20.0
		80	92.3	59.7	5.12	42.3	3.42	21.3	89.4	59.8	4.99	42.8	3.52	21.2	86.5	59.9	4.85	43.3	3.61	21.1
		100	112.0	58.4	6.35	36.7	2.69	22.4	109.2	58.4	6.19	37.3	2.77	22.3	106.3	58.4	6.03	37.9	2.84	22.2
		120	131.8	57.0	7.57	31.2	2.21	23.6	129.0	57.0	7.39	31.8	2.26	23.4	126.2	57.0	7.20	32.4	2.32	23.3
	14.5	60	73.1	63.5	3.9	50.1	4.74	22.2	70.0	63.6	3.82	50.5	4.88	22.2	66.9	63.7	3.7	51.0	5.03	22.1
		80	92.7	61.7	5.2	44.1	3.51	23.2	89.7	61.8	5.02	44.6	3.60	23.1	86.7	61.9	4.9	45.2	3.71	23.0
		100	112.4	59.9	6.4	38.1	2.75	24.1	109.4	60.0	6.23	38.7	2.82	24.0	106.5	60.1	6.1	39.4	2.90	23.9
		120	132.0	58.2	7.6	32.1	2.24	25.0	129.2	58.2	7.43	32.8	2.29	24.9	126.3	58.3	7.2	33.5	2.36	24.8
	19	60	73.6	65.8	3.95	52.3	4.88	24.3	70.4	65.9	3.84	52.8	5.03	24.3	67.2	66.0	3.73	53.3	5.18	24.2
		80	93.1	63.6	5.19	45.9	3.59	25.0	90.0	63.7	5.05	46.5	3.70	25.0	86.9	63.8	4.92	47.1	3.80	24.9
		100	112.7	61.5	6.43	39.5	2.80	25.7	109.7	61.6	6.27	40.2	2.88	25.6	106.7	61.7	6.10	40.8	2.96	25.6
		120	132.2	59.3	7.67	33.1	2.27	26.4	129.3	59.4	7.48	33.9	2.33	26.3	126.5	59.5	7.29	34.6	2.39	26.2
50	10	60	76.7	81.0	4.2	66.7	5.60	36.2	72.7	81.0	4.02	67.3	5.85	36.1	68.8	81.0	3.9	67.8	6.10	36.0
		80	96.1	78.2	5.4	59.6	4.17	37.7	92.3	78.2	5.24	60.3	4.34	37.6	88.5	78.3	5.1	61.0	4.50	37.4
		100	115.5	75.3	6.7	52.5	3.28	39.2	111.9	75.4	6.46	53.3	3.39	39.0	108.2	75.5	6.3	54.2	3.51	38.8
		120	134.9	72.5	7.9	45.4	2.66	40.6	131.4	72.6	7.69	46.4	2.75	40.4	127.9	72.8	7.5	47.3	2.84	40.2
	14.5	60	77.4	84.5	4.2	70.1	5.86	39.1	73.3	84.4	4.07	70.5	6.08	39.1	69.2	84.3	3.9	71.0	6.32	39.0
		80	96.7	81.1	5.5	62.4	4.35	40.3	92.8	81.1	5.29	63.1	4.50	40.2	88.8	81.2	5.1	63.7	4.66	40.1
		100	116.0	77.7	6.7	54.8	3.39	41.5	112.2	77.9	6.51	55.7	3.51	41.4	108.5	78.0	6.3	56.5	3.63	41.2
		120	135.3	74.4	8.0	47.2	2.74	42.7	131.7	74.6	7.73	48.2	2.83	42.5	128.1	74.8	7.5	49.3	2.93	42.3
	19	60	78.1	87.9	4.3	73.4	5.98	42.0	73.8	87.8	4.11	73.8	6.19	42.0	69.5	87.7	4.0	74.1	6.40	42.0
		80	97.3	84.0	5.5	65.2	4.42	42.9	93.2	84.1	5.33	65.9	4.58	42.9	89.1	84.1	5.2	66.5	4.74	42.8
		100	116.5	80.2	6.8	57.1	3.44	43.8	112.6	80.3	6.55	58.0	3.57	43.7	108.7	80.5	6.3	58.9	3.69	43.6
		120	135.7	76.3	8.0	48.9	2.77	44.7	132.0	76.6	7.77	50.1	2.87	44.6	128.3	76.9	7.5	51.2	2.98	44.4
70	10	60	80.8	100.9	4.48	85.6	6.60	52.3	75.9	100.8	4.26	86.3	6.96	52.2	70.9	100.7	4.03	86.9	7.32	52.1
		80	99.9	96.6	5.74	77.0	4.93	54.1	95.2	96.6	5.50	77.8	5.16	54.0	90.5	96.6	5.26	78.7	5.39	53.8
		100	119.0	92.2	7.00	68.3	3.86	55.9	114.5	92.4	6.74	69.4	4.02	55.7	110.0	92.6	6.48	70.4	4.18	55.5
		120	138.1	87.9	8.26	59.7	3.12	57.7	133.9	88.2	7.99	60.9	3.24	57.4	129.6	88.5	7.71	62.2	3.36	57.2
	14.5	60	81.7	105.5	4.5	90.0	6.84	56.0	76.6	105.2	4.32	90.5	7.14	56.0	71.4	105.0	4.1	91.0	7.48	55.9
		80	100.7	100.5	5.8	80.8	5.09	57.5	95.8	100.5	5.55	81.5	5.30	57.4	90.9	100.5	5.3	82.3	5.53	57.2
		100	119.7	95.6	7.0	71.5	3.97	58.9	115.1	95.7	6.79	72.6	4.13	58.7	110.4	95.9	6.5	73.7	4.31	58.6
		120	138.7	90.6	8.3	62.2	3.19	60.3	134.3	91.0	8.02	63.6	3.32	60.1	129.9	91.4	7.7	65.0	3.46	59.9
	19	60	82.7	110.0	4.55	94.5	7.08	59.7	77.3	109.7	4.38	94.7	7.35	59.7	71.9	109.3	4.20	95.0	7.62	59.7
		80	101.5	104.4	5.82	84.6	5.26	60.8	96.4	104.4	5.60	85.2	5.47	60.7	91.3	104.3	5.39	85.9	5.67	60.7
		100	120.4	98.9	7.09	74.7	4.09	61.9	115.6	99.1	6.83	75.8	4.26	61.8	110.8	99.3	6.57	76.9	4.43	61.7
		120	139.2	93.3	8.36	64.8	3.27	63.0	134.7	93.8	8.06	66.3	3.42	62.8	130.2	94.3	7.76	67.8	3.56	62.6
90	10	60	84.8	120.1	4.74	103.9	7.42	68.6	78.6	117.4	4.45	102.2	7.75	68.9	72.4	114.6	4.16	100.4	8.07	69.3
		80	103.7	114.9	6.02	94.4	5.59	70.5	97.9	113.2	5.71	93.7	5.82	70.7	92.1	111.5	5.39	93.1	6.06	70.8
		100	Operation not recommended																	
		120																		
	14.5	60	85.3	122.8	4.77	106.5	7.55	73.4	79.0	119.5	4.49	104.2	7.80	73.7	72.6	116.2	4.22	101.8	8.08	74.0
		80	104.2	117.6	6.07	96.8	5.67	74.9	98.3	115.4	5.76	95.8	5.88	75.0	92.3	113.3	5.44	94.7	6.10	75.2
		100	123.2	112.4	7.38	87.2	4.46	76.4	117.6	111.4	7.02	87.4	4.65	76.4	112.0	110.4	6.67	87.7	4.85	76.3
		120	Operation not recommended																	
	19	60	85.9	125.4	4.79	109.1	7.67	78.2	79.3	121.6	4.53	106.1	7.88	78.5	72.8	117.8	4.27	103.2	8.08	78.8
		80	104.8	120.2	6.13	99.3	5.75	79.2	98.6	117.7	5.81	97.9	5.95	79.4	92.5	115.2	5.49	96.4	6.15	79.5
		100	123.7	115.0	7.46	89.5	4.51	80.3	118.0	113.8	7.08	89.6	4.72	80.3	112.2	112.5	6.70	89.7	4.92	80.3
		120	Operation not recommended																	

8/19/09

Wiring Schematics - Residential

NSW Heating Only - 208-230/60/1



04/02/09

Legend

- Factory low voltage wiring
- Factory line voltage wiring
- Field low voltage wiring
- Field line voltage wiring
- Optional block
- Quick connect terminal
- Screw terminal - field connection
- Fuse

CC - Compressor contactor
RV - Reversing Valve output
ELT - Entering Load Side Water Temperature
HP - High pressure switch
LP - Low pressure switch
LPR - Load Pump Relay
RT - Refrigerant Liquid line Temperature
SI - Slave Input relay
RC - Reversing Valve Coil
LFB - Load Pump Fuse Block
SFB - Source Pump Fuse Block

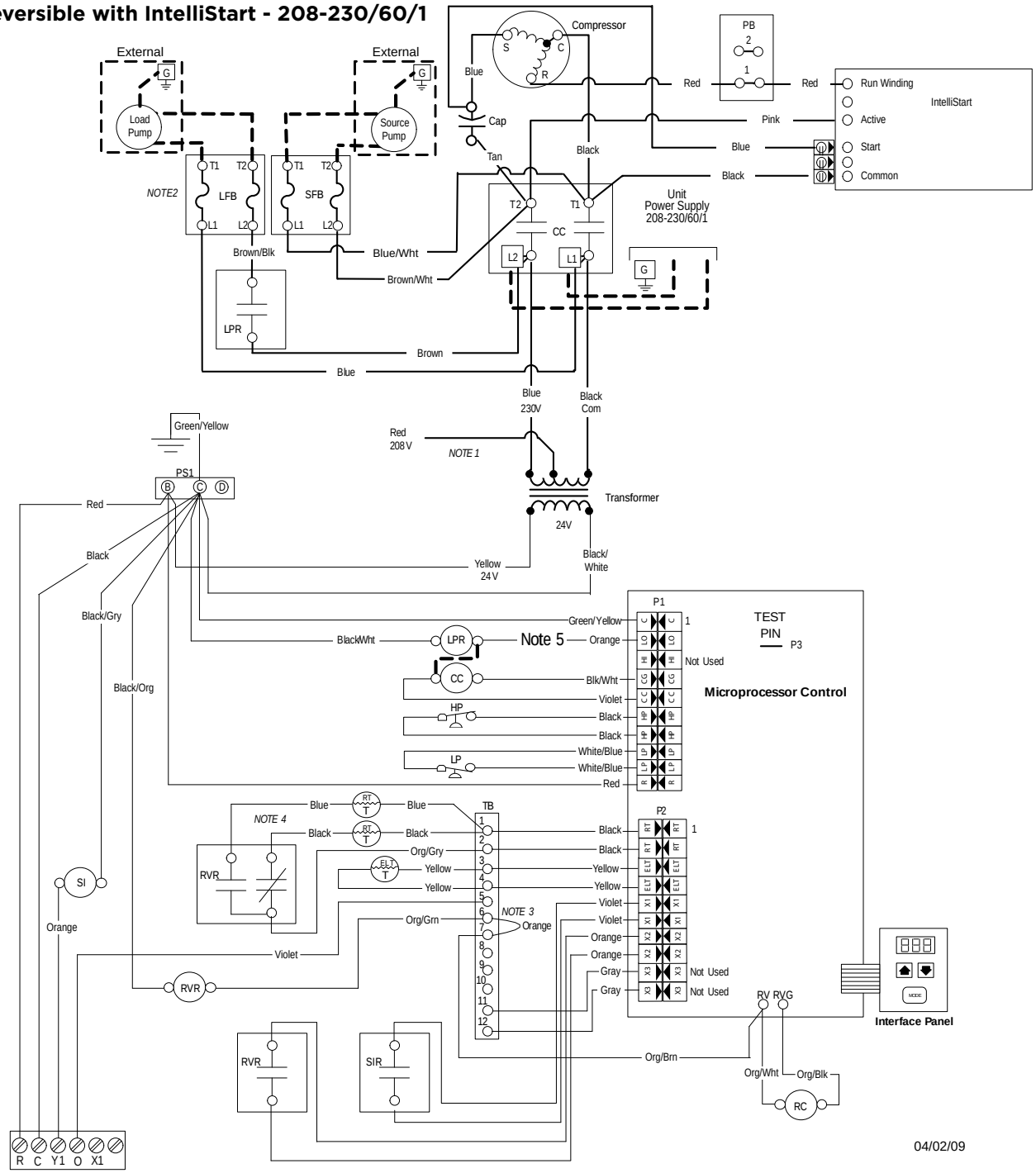
- L1 — Field wire lug
- Ground
- Relay Contacts - N.O., N.C.
- P 2 3 1 — Polarized connector

- Switch - High pressure
- Switch - Low pressure
- Relay coil
- Capacitor
- T — Thermistor

Notes:
1. Taped and wire tied off
2. 3AG10 Amp fuse
3. For cycle load pump with a geo storage tank. Remove the orange wire from the LPR relay coil and install a jumper between the LPR relay coil and the comp contactor coil as shown in the schematic above.

Wiring Schematics - Residential cont.

NSW Reversible with IntelliStart - 208-230/60/1



Legend

- Factory low voltage wiring
- Factory line voltage wiring
- Field low voltage wiring
- Field line voltage wiring
- Optional block
- Quick connect terminal
- Screw terminal - field connection
- Fuse

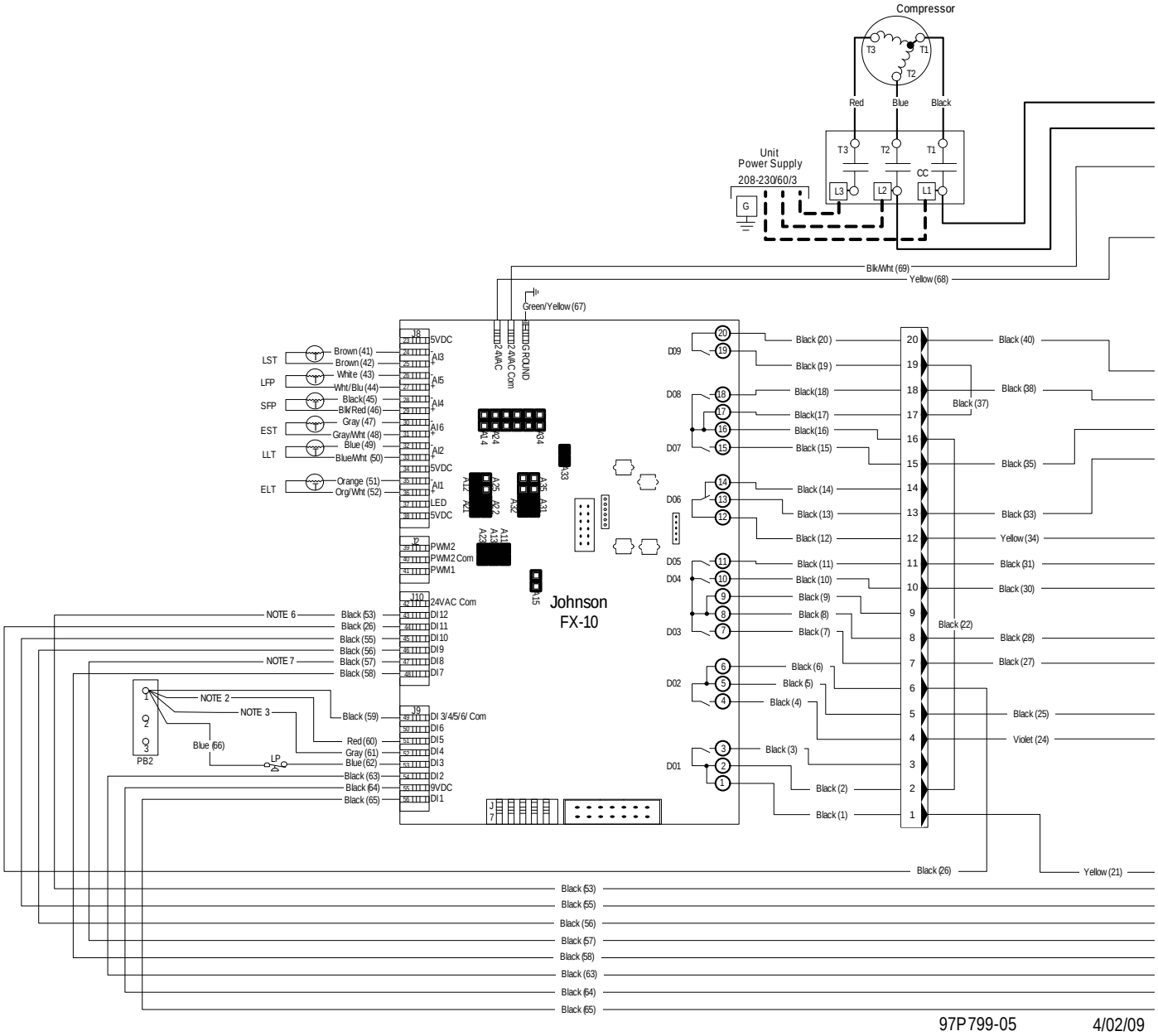
CC -	Compressor Contactor
RV -	Reversing Valve Output
ELT -	Entering Load Side Water Temperature
HP -	High Pressure Switch
LP -	Low Pressure Switch
LPR -	Load Pump Relay Contacts
RT -	Refrigerant Liquid Line Temperature
SIR -	Slave Input Relay
RC -	Reversing Valve Coil
LFB -	Load Pump Fuse Block
SFB -	Source Pump Fuse Block
RVR -	Reversing Valve Relay

- L1 — Field wire lug
- Ground
- Relay Contacts - N.O., N.C.
- P 2 3 1 — Polarized connector
- Switch - High pressure
- Switch - Low pressure
- Relay coil
- Capacitor
- T — Thermistor

Notes:
1. Taped and wire tied off
2. 3AG 10 Amp fuse
3. Move jumper wire to 5 and 6 for reversible secondary unit.
4. Black Thermistor - Source Coax Blue Thermistor - Load Coax
5. For cycle load pump with a geo storage tank. Remove the orange wire from the LPR relay coil and install a jumper between the LPR relay coil and the comp contactor coil as shown in the schematic above.

Wiring Schematics - Commercial

NSW Heating Only - 208-230/60/3



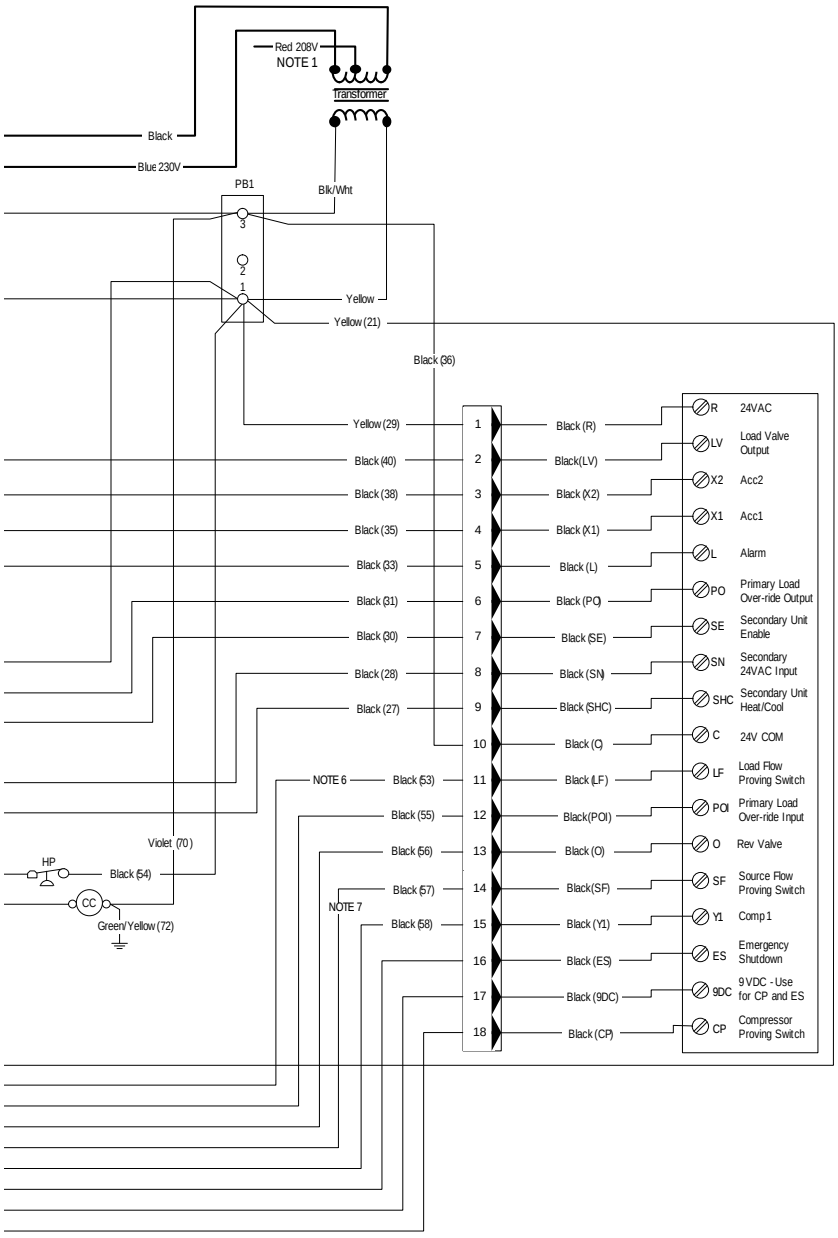
Legend

Factory low voltage wiring Factory line voltage wiring Field low voltage wiring Field line voltage wiring Optional block Field Zone Sensor Wiring	Internal junction Field wire lug Ground Relay Contacts- N.O., N.C. Thermistor Relay coil	Switch - High pressure Switch - Low pressure Open Jumper Closed Jumper Polarized connector	CC - Compressor contactor CP - Compressor Proving ELT - Entering Load Water Temp ES - Emergency Shutdown EST - Entering Source Water Temp HP - High pressure switch LFP - Load Freeze Protection LFS - Load Flow Proving Switch LLT - Leaving Load Water Temp LP - Low pressure switch LST - Leaving Source Water Temp RV - Reversing Valve coil SFP - Source Freeze Protection SFS - Source Flow Proving Switch TB - Terminal Board

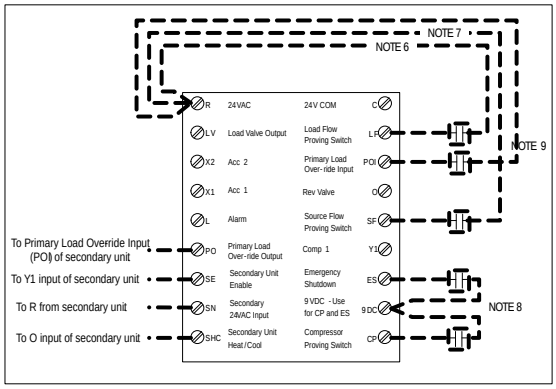
Notes:
1 - Switch Blue and Red wires for 208V operation
2 - Disconnect for 15 degree load side freeze detection
3 - Disconnect for 15 degree source side freeze detection
4 - Acc 1 and ACC 2 outputs are cycled with the compressor.
5 - R, C, Y1, and O inputs are for use with an aqua stat.
6 - If no flow proving switch is being used on the load side, the LF terminal on the terminal board must be jumpered to the R terminal for the unit to operate.
7 - If no flow proving switch is being used on the source side, the SF terminal on the terminal board must be jumpered to the R terminal for the unit to operate.
8 - A closed contact will enable the emergency shutdown input (ES) and the compressor proving input (CP).
9 - Primary over-ride input (POI) on a primary unit must be wired to R through a normally open contact. If the POI input is on a secondary unit connect the Primary Over-ride output (PO) from the primary unit to the POI terminal on the secondary unit.
10 - Apply 24VAC to the O terminal for cooling.

Wiring Schematics - Commercial cont.

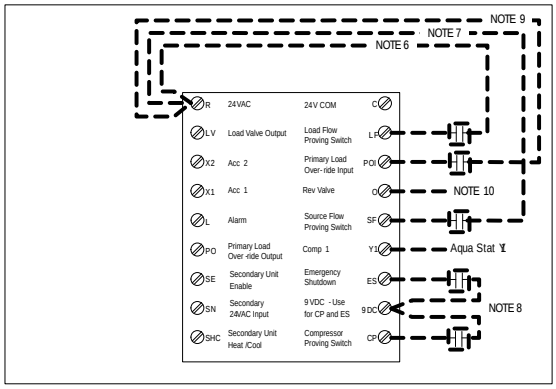
NSW Heating Only - 208-230/60/3



TB
Field Connection Diagram
(For units using Set Point control mode with or without a secondary unit)



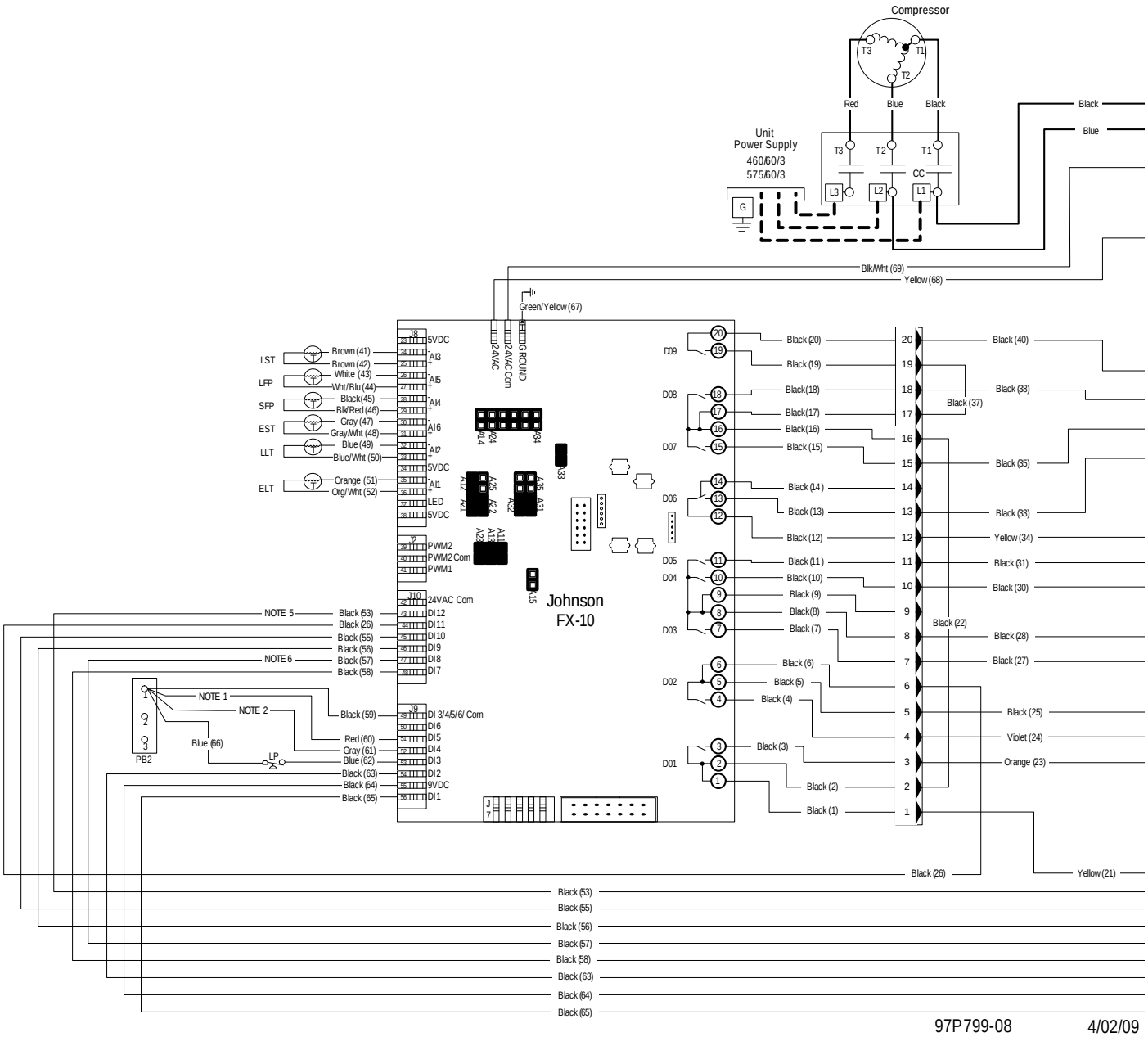
TB
Field Connection Diagram
(For units using aqua stat control mode.)



97P799-05 4/02/09

Wiring Schematics - Commercial cont.

NSW Reversible - 575/460/3

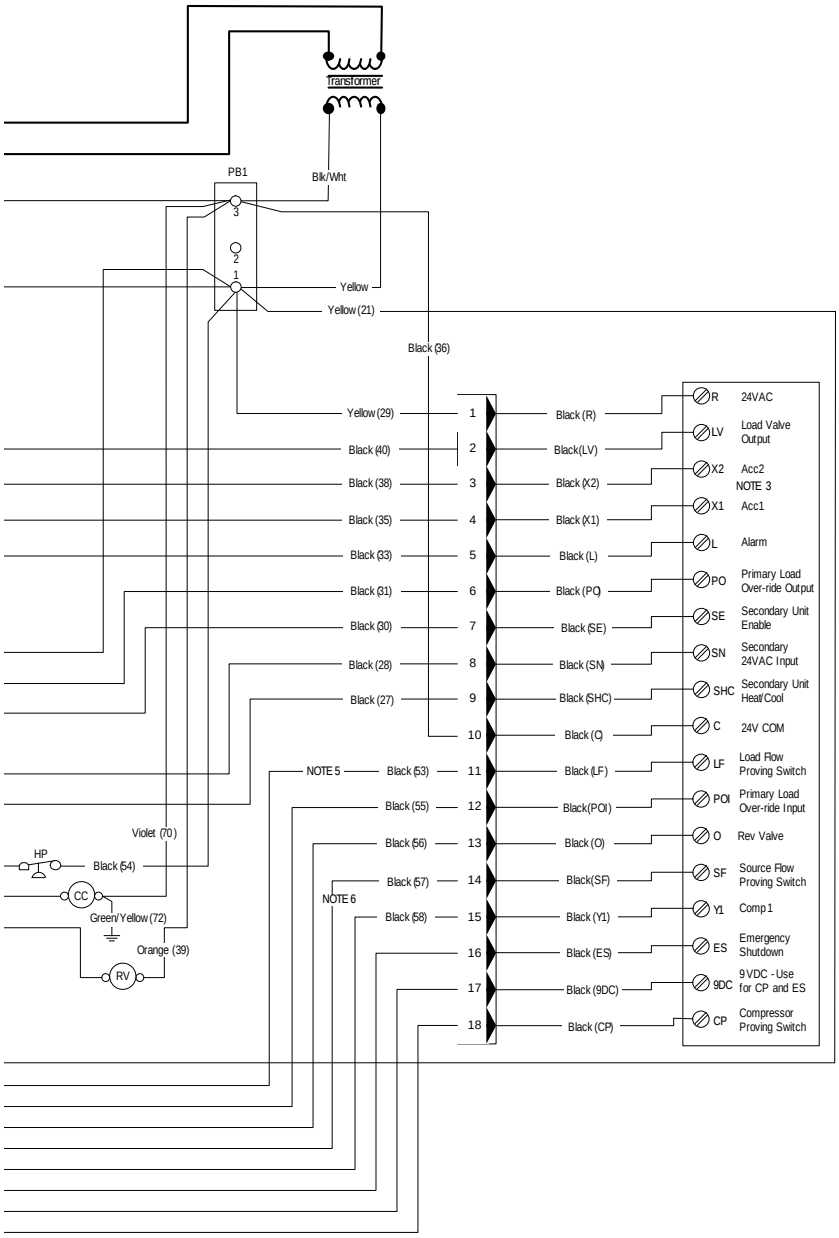


Legend

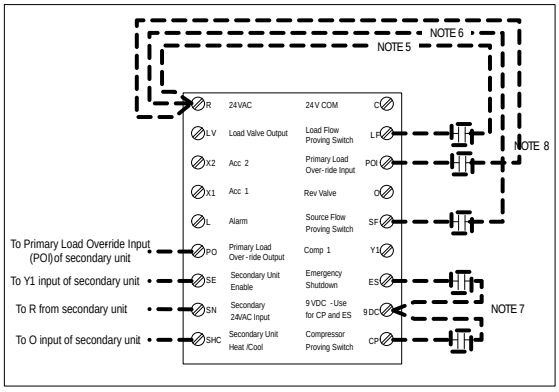
Factory low voltage wiring Factory line voltage wiring Field low voltage wiring Field line voltage wiring Optional block Field Zone Sensor Wiring	Internal junction Field wire lug Ground Relay Contacts- N.O., N.C. Thermistor Relay coil	Switch - High pressure Switch - Low pressure Open Jumper Closed Jumper Polarized connector	CC - Compressor contactor CP - Compressor Proving ELT - Entering Load Water Temp ES - Emergency Shutdown EST - Entering Source Water Temp HP - High pressure switch LFP - Load Freeze Protection LFS - Load Flow Proving Switch LLT - Leaving Load Water Temp LP - Low pressure switch LST - Leaving Source Water Temp RV - Reversing Valve coil SFP - Source Freeze Protection SFS - Source Flow Proving Switch TB - Terminal Board	Notes: 1 - Disconnect for 15 degree load side freeze detection 2 - Disconnect for 15 degree source side freeze detection 3 - Acc 1 and ACC 2 outputs are cycled with the compressor. 4 - R, C, Y1, and O inputs are for use with an aqua stat. 5 - If no flow proving switch is being used on the load side, the LF terminal on the terminal board must be jumpered to the R terminal for the unit to operate. 6 - If no flow proving switch is being used on the source side, the SF terminal on the terminal board must be jumpered to the R terminal for the unit to operate. 7 - A closed contact will enable the emergency shutdown input (ES) and the compressor proving input (CP). 8 - Primary over-ride input (POI) on a primary unit must be wired to R through a normally open contact. If the POI input is on a secondary unit connect the Primary Over-ride output (PO) from the primary unit to the POI terminal on the secondary unit. 9 - Apply 24VAC to the O terminal for cooling.

Wiring Schematics - Commercial cont.

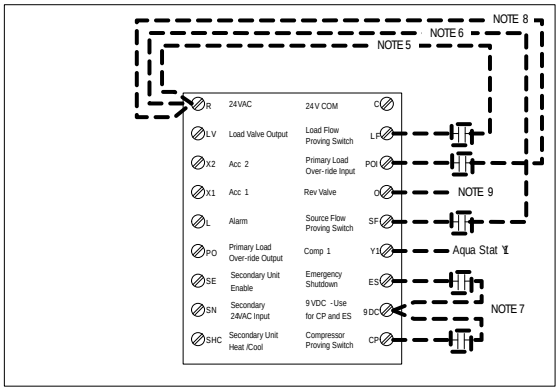
NSW Reversible - 575/460/3



TB
Field Connection Diagram
(For units using Set Point control mode
with or without a secondary unit)



TB
Field Connection Diagram
(For units using aqua stat control
mode.)



97P799-08 4/02/09

Accessories and Options

IntelliStart™

IntelliStart is a single phase compressor soft starter which reduces the normal start current (LRA) by 60-70%. It should be used in applications that require low starting amps, reduced compressor start-up noise, off-grid, and improved start-up behavior. IntelliStart is available as a factory installed option or a field installed kit (**IS60RKL** or **IS60RKS**).

Water Connection Kits (Field Installed)

Water connection kits are available to facilitate loop side and load side water connections.

- **CKEW1** - The key 1 inch fittings needed for NSW018-NSW040 water side connections (see IM1470)
- **CKEW3** - The key 1 ¼ inch fittings needed for NSW050-NSW075 water side connections (see IM1470)
- **HKC8S** - 1 inch x 24 inch stainless steel braided hose kit
- **HKC10S** - 1 ¼ inch x 24 inch stainless steel braided hose kit

Earth Loop Pump Kit (Field Installed)

A specially designed one or two-pump module provides all liquid flow, fill and connection requirements for independent single unit systems (230/1/60 only). The one-pump module (FC1-FPT or FC1-GL) is capable of 25 feet of head at 16.0 GPM, while the two-pump module (FC2-FPT or FC1-GL) is capable of 50 feet of head at 16.0 GPM.

Hot Water Generator (Factory Installed, NSW040, NSW050, NSW060, and NSW075 Only)

An optional heat reclaiming hot water generator coil constructed of vented double-wall copper construction suitable for potable water is available. The coil is factory mounted inside the unit. A DPK5 pump kit (230/1/60) is required (field installed), which includes a DHW tank connection and a temperature limit pump shutoff.

Load-side Pump Kit (Field Installed)

Four (4) load pump kits are available to provide all liquid flow requirements for independent single unit systems (230/1/60 only). WaterFurnace part number **24P501A04** (Grundfos UP15-42B7) and **EWPK2** (Grundfos UP26-64BF) are bronze body pumps. Bronze body pumps should be used when water conditions exist that are not compatible with cast iron or for applications such as domestic water heating. WaterFurnace part number EWPK1 and EWPK3 come with a cast iron body pump (Grundfos UP26-99F) that can be used for hydronic heating applications.

Calculate the system pressure drop then refer to the pump curves in figures 7 and 8 to select the proper pump. All four (4) of the WaterFurnace pump kits can be used for hydronic heating applications as long as they meet the flow requirements. If the flow requirements are outside the pump curve, an alternate pump will need to be obtained to maintain the necessary flow.

- **24P501A04** - UP15-42B7 bronze volute, ¾ inch sweat connection
- **EWPK1** - UP26-99F cast iron volute, 1 inch FPT flange connection
- **EWPK2** - UP26-64BF bronze volute, 1 inch FPT flange connection
- **EWPK3** - UP26-99F cast iron volute, 1-¼ inch FPT flange connection

HydroZone Tank Controller

Tank controller (**HZC**) that adds outdoor reset with warm weather shutdown, setpoint control, process control, and management of four compressor outputs for our water-to-water systems.

HCU

This is used in conjunction with the HydroZone to control the Geo-Storage tank electric heating element.

Figure 7: UP15-42B7, UP26-64BF, and UP26-99F Single Pump Curve

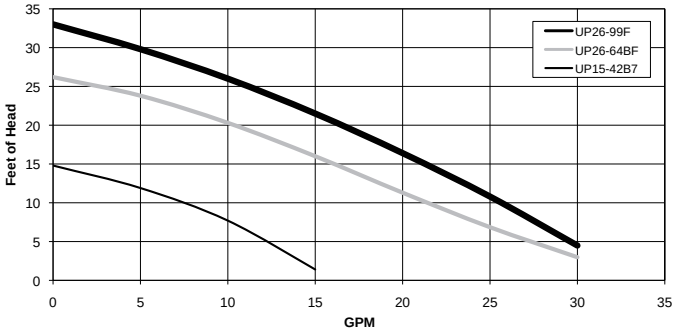
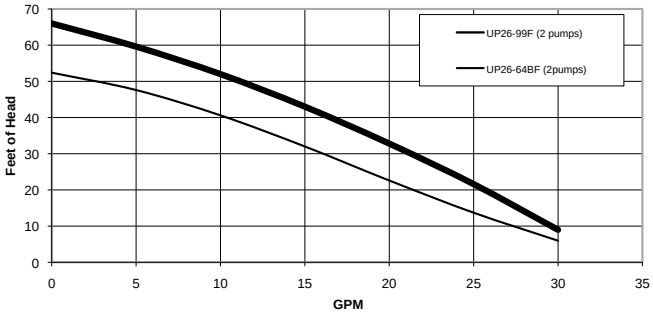
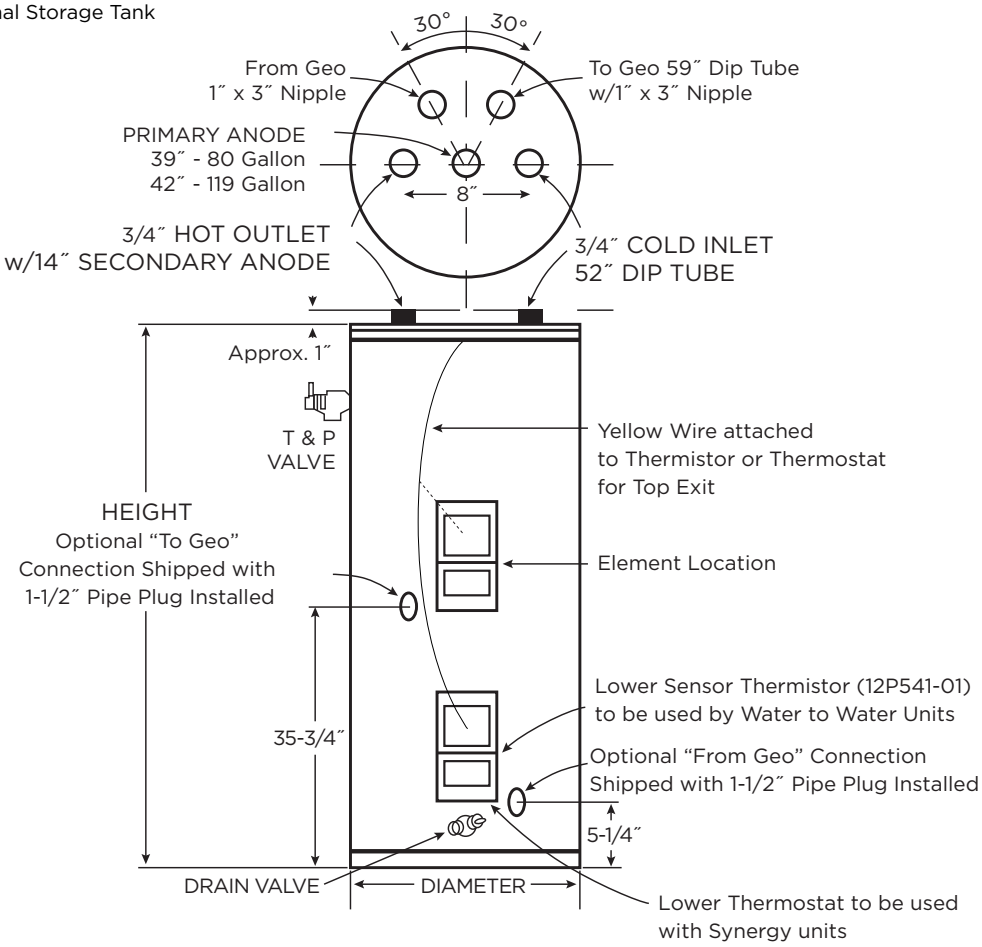


Figure 8: UP26-64BF and UP26-99F Two Pump Curve



Accessories and Options cont.

Figure 9: Geothermal Storage Tank



MODEL NUMBER	GALLON CAPACITY	ELEMENT WATTAGE (240 VOLT)	NUMBER OF ELEMENTS	R VALUE	DIMENSIONS IN INCHES		APPROX. SHIPPING WEIGHT (lbs.)
					HEIGHT	DIAMETER	
GEO-STORAGE-80	80	4500	1	16	63-1/4	24	204
GEO-STORAGE-120	119	4500	1	16	63-1/4	28	311

Engineering Guide Specifications

General

The liquid source water-to-water heat pump shall be a single packaged heating only or reverse-cycle heating/cooling unit. Dedicated non-reversing heating only units shall be easily field convertible to cooling only units. The unit shall be listed by a nationally recognized safety-testing laboratory or agency, such as ETL Testing Laboratory, Underwriters Laboratory (UL), or Canadian Standards Association (CSA). The unit shall be rated in accordance with Air Conditioning, Heating, and Refrigeration Institute/International Standards Organization (AHRI/ISO) and Canadian Standards Association (CSA-US). The liquid source water-to-water heat pump unit, as manufactured by WaterFurnace International, Fort Wayne, Indiana, shall be designed to operate with source liquid temperatures between 30°F [1.1°C] and 110°F [43.3°C] in cooling, and between 25°F [-6.7°C] and 90°F [32.2°C] in heating.

Casing and Cabinet

The cabinet shall be fabricated from heavy-gauge galvanized steel and finished with corrosion-resistant powder coating. This corrosion protection system shall meet the stringent 1,000 hour salt spray test per ASTM B117. The interior shall be insulated with 1/2″ thick, multi-density, coated glass fiber for noise suppression.

All units shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. All factory-installed wiring passing through factory knockouts and openings shall be protected from sheet metal edges at openings by plastic ferrules. The control box shall be field switchable from front to back for improved application flexibility with quick attach low voltage harnesses. The control box is shipped standard on the opposite end of the water connections.

Refrigerant Circuit

All units shall utilize the non-ozone depleting and low global warming potential refrigerant R410A. All units shall contain a sealed refrigerant circuit including a hermetic motor-compressor, bidirectional thermostatic expansion valve, finned tube air-to-refrigerant heat exchanger, reversing valve, coaxial tube water-to-refrigerant heat exchanger, optional hot water generator coil, and service ports. An optional vented double wall load coaxial water-to-refrigerant heat exchanger is available on 018 and 025.

Compressors shall be high-efficiency scroll type designed for heat pump duty and mounted on vibration isolators. The compressor shall be double isolation mounted using selected durometer grommets to provide vibration free compressor mounting. The compressor mounting bracket shall be acoustically deadened galvanized steel to prevent vibration transmission to the cabinet. A high density sound attenuating blanket shall be factory installed around the compressor to reduce sound. Compressor motors shall be single-phase PSC with overload protection.

The coaxial water-to-refrigerant heat exchanger shall be designed for low water pressure drop and constructed of a convoluted copper (cupronickel option) inner tube and a steel outer tube. Refrigerant-to-water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 600 PSIG (4135 kPa) working refrigerant pressure and 450 PSIG (3101 kPa) working water pressure. The thermostatic expansion valve shall provide proper superheat over the entire liquid temperature range with minimal “hunting.” The valve shall operate bidirectionally without the use of check valves.

Option: Cupronickel refrigerant-to-water heat exchanger shall be of copper-nickel inner water tube and steel refrigerant outer tube design, rated to withstand 600 PSIG (4135 kPa) working refrigerant pressure and 450 PSIG (3101 kPa) working water pressure. Water lines shall also be of cupronickel construction.

Option: Hot Water Generator (available on 040-075) - Internal double wall vented hot water generator coil refrigerant to water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 600 PSIG (4135 kPa) working refrigerant pressure and 450 PSIG (3101 kPa) working water pressure.

Option: Vented double wall water-to-refrigerant heat exchange (available on 018 and 025) - Internal vented double wall water-to-refrigerant coaxial heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 600 PSIG (4136 kPA) working refrigerant pressure and 450 PSIG (3101 kPA) water pressure.

Piping and Connections

Supply and return water connections shall be 1 inch [25.4 mm] for the NSW018-NSW040, 1 1/4 inch [31.75 mm] for the NSW050-NSW075, and all hot water generator water connections shall be 1/2 inch [12.7 mm] FPT copper fittings. The FPT fittings shall be fixed to the cabinet by use of a captive fitting, which eliminates the need for backup pipe wrenches.

Engineering Guide Specifications cont.

Electrical

A control box shall be located within the unit compressor compartment and shall contain a 75VA transformer with a built-in circuit breaker, 24 volt activated compressor contactor, terminal block for thermostat wiring and solid-state controller for complete unit operation. Electromechanical operation WILL NOT be accepted. Units shall be name-plated for use with time delay fuses or HACR circuit breakers. Unit controls shall be 24 volt and provide heating or cooling as required by the remote thermostat/sensor.

A standard microprocessor-based controller that interfaces with an electronic thermostat to monitor and control unit operation shall be provided. The control shall provide operational sequencing, high and low pressure switch monitoring, freeze detection, hot water limit thermistor sensing, lockout mode control, hot water and loop pump control, LED status and fault indicators, fault memory, field selectable options and accessory output. The control shall provide fault retry three times before locking out to limit nuisance trips. Anti short-cycle protection shall be integral to the control.

A detachable terminal block with screw terminals will be provided for field control wiring. All units shall have knockouts for entrance of low and line voltage wiring.

Option: A FX10 microprocessor-based controller that interfaces with an electronic thermostat to monitor and control unit operation. The control shall provide operational sequencing, high, low, and loss of charge pressure monitoring, freeze detection, lockout mode control, LED status and fault indicators, fault memory, field selectable options and accessory output. The control shall communicate all mode, status, fault and lockout codes to the front end system for fast and accurate equipment diagnosis. The control shall provide fault retry three times before locking out to limit nuisance trips.

Optional FX10 microprocessor control communication protocols: N2, LonWorks, BACnet

Optional IntelliStart™ (compressor Soft Starter) shall be factory installed for use in applications that require low starting amps, reduced compressor start-up noise, off-grid, and improved start-up behavior. IntelliStart shall reduce normal starting current by 60% on 208/60/1 units.

Accessories

Hose Kits – Automatic Balancing and Ball Valves with 'Y' strainer (field-installed)

WaterFurnace P/N - HHK81S (1 in. hose kit for 018-040)
HHK100S (1 1/4 in. hose kit for 050-075)

A flexible steel braid hose featuring Kevlar® reinforced EPDM core with ANSI 302/304 stainless steel outer braid and fire rated materials per ASTM E 84-00 (NFPA 255, ANSI/UL 723 & UBC 8-1). Ball valve at one end; swivel connector with adapter at the other end (swivel to adapter connection via fiber or EPDM gasket). Swivel connection provides union between heat pump and piping system. The hoses feature brass fittings, stainless steel ferrules. A "y" strainer is provided on one end for fluid straining and integral "blowdown" valve.. A full port ball valve shall be provided with integral P/T (pressure/temperature) port on supply hose and automatic balancing valve with integral P/T ports and full port ball valve on return hose.

Specifications:

- Temperature range of 35°F [2°C] to 180°F [82°C].
- Max. working pressure of 400 psi [2756 kPa] for 1/2″ and 3/4″ hose kits; max. working pressure of 350 psi [2413 kPa] for 1″ and 1-1/4″ hose kits.
- Minimum burst pressure of four times working pressure.

Notes

Notes

Notes

Manufactured by
WaterFurnace International, Inc.
9000 Conservation Way
Fort Wayne, IN 46809
www.waterfurnace.com

Product:	**Envision Series NSW**
Type:	Geothermal Hydronic Heat Pump
Size:	1.5-6 Tons
Document:	Specification Catalog

EnerWorks High Performance Commercial Collectors

PRODUCT DESCRIPTION

- High-performance flat-plate collectors
- Selective absorber coating and serpentine tube configuration
- Collectors, pipe connectors and mounting components designed for quick installation in modules of up to 10 side-by-side collectors. Internal header simplifies plumbing
- Optional sheet-metal flashing kit available for installations on sloped roofs. Flashing covers pipe connections and provides a "clean" look. Flashing easily slides into slot on side of collector frame. (Note: flashing not recommended for collectors mounted on racks due to wind loads)
- Modules can be mounted on sloped roofs, and on racks for flat roofs, ground, or walls

KEY FEATURES AND BENEFITS

- EnerWorks collectors are designed and assembled in North America using best available components from the USA, Canada and Europe
- All components are of the highest quality, assembled in a partly-automated, quality-monitored process
- Each collector is leak-tested
- Major components assembled using RGS7700 silicone, an adhesive used in highrise curtain-wall window manufacturing. Adhesive is resistant to very high and very low temperatures, is strong, and remains flexible under all operating conditions
- Serpentine copper tubing fixed to aluminum absorber sheet using unique laser stitch, cold-welding technology, thoroughly tested for strength, thermal shock and corrosion-resistance
- Internal spacing between glass and absorber carefully optimized for best performance with minimum panel thickness
- Collector shipped with reflective foil cover to prevent overheating during installation and commissioning
- Collectors have undergone extensive testing and exceed SRCC and CSA requirements

PRODUCT TECHNICAL SPECIFICATIONS

- Size, excluding connections 46.25" wide x 96.25" long x 3.25" thick (1175 mm x 2445 mm x 83 mm). Header tubes extend 0.375" (9.5 mm) past frame 47" (1194 mm) gross width
- Gross area 30.93 ft^2 (2.873 m^2), net aperture area 28.97 ft^2 (2.691 m^2)
- Dry weight 111 lb (50.5 kg), operational weight (fluid and mounting + connecting hardware) 115 lb (52.2 kg); fluid content 0.502 US gallons (1.9 L)
- Pressure rating: 6.9 bar / 100 psi
- Serpentine tube: copper, 0.393" (10 mm) OD x 0.354" (9 mm) ID, silver-soldered to internal header tube
- Header tube: 0.866" (22 mm) OD, 0.787" (20 mm) ID – top and bottom
- Connection: brass flange suitable for V-clamps
- **Collector connectors:** flexible, bellow-type, 321 stainless steel; allow thermal expansion of header tube, and easy removal of individual collectors
- **Glazing:** low-iron, tempered glass, textured to limit reflection and maximize transmittance. Average transmittance: 91%. Glass thickness 0.125" (3.2 mm)
- Steel frame 0.040" (1 mm) thick
- Galvalume® corrosion-resistant, mill-painted on both sides with AKZO Nobel Polydure® 1000 baked polyester based coating system originally developed for roofing applications
- **Outside color:** "Medium Bronze PS4W41387", a neutral dark brown hue to blend with most roof colors; special pigmentation confers durability under prolonged, extreme UV exposure
- Inside color is off-white that reflects radiation back to reduce heat loss
- Manufactured using high-precision roll-forming technology for high stiffness and low weight
- Single strip of steel, folded in rectangular shape with ends joined using "toggle-lock" crimping process and rounded corners to prevent injury
- Mounting points, 2 on each side of collector, are via "nut-sert" riveted nuts, having internal threads, 5/16–18" (7.9375–7.05 mm) UNC, coated with zinc yellow dichromate; nuts are spaced 48" (1219 mm) apart on long edges and 44" (1118 mm) apart on short edges.
- Glazing caps made out of the same material as frame to protect long edges of glass
- EPDM rubber grommets at header/frame penetration prevent thermal-bridging
- **Absorber:** aluminum sheet, 0.020" (0.5 mm) thick
- Top coating is Miro-Therm® selective optical coating 150 nanometer thick, applied by physical vapor deposition "air-to-air" process in three layers: an anti-reflective top layer, a metal oxide middle layer for high absorption properties, and an infrared retentive/ reflective bottom layer to reduce IR losses
- Optical properties: absorptance $\alpha = 0.94 \pm 0.02$; emittance $\varepsilon = 0.05 \pm 0.02$ at 212°F (100°C)
- Deep, dark blue in color, selective coating's weathering capability conforms to Standard ISO CD 12952.2 (Task X), and to EN12975 and Solar Keymark standards
- Chromium coating on back of absorber prevents galvanic corrosion between aluminium absorber and copper tube
- **Back insulation:** 1.375" (35 mm) mineral fiber
- Mineral fiber is fire-resistant – good up to 1200°F (650°C), safe to handle, and does not shrink at any temperature
- Conforms to CAN/ULC S702.2 standard for dimensional, thermal properties, density and fire-retardant properties
- Surface burning characteristics: Flame Spread 5, Smoke Developed 0
- Low water-absorption < 0.01%; insulating properties not affected when wet
- R-value is 5.8 (R 4.2/inch)
- Outer weather and puncture protection by 0.016" (0.4 mm)-thick, textured aluminum sheet
- Frame edge insulation is 1" (25 mm) iso-cyanurate foam having R-value of 7
- Unique "Hook" brackets used in conjunction with standard strut channels for efficient, easy and fast installation
- Brackets have tabs that "hook" into channel, allowing installers to position and secure collector without supporting its weight
- Mounting brackets and hardware coated for corrosion protection
- Space between collectors only 3" (76 mm) for efficient use of space

SRCC quadratic efficiency equation in SI units:

$\eta = 0.7622 - 3.2787\ (Ti - Ta)/I - 0.0129\ (Ti - Ta)^2/I$

Linear Y-Intercept is 0.7683; Slope is -4.0348 W/(m^2.°C)

SRCC quadratic efficiency equation in IP units:

$\eta = 0.7622 - 0.5778\ (Ti - Ta)/I - 0.0013\ (Ti - Ta)^2/I$

Linear Y-Intercept is 0.7683; Slope is -0.711 Btu/(hr.ft^2. °F)

Incident Angle Modifier (IAM), for $0° \leq \theta \leq 60°$

Quadratic fit $K\alpha\tau = 1.0 + 0.0566(1/\cos\theta) - 0.2167(1/\cos\theta)^2$

Linear fit $K\alpha\tau = 1.0 - 0.17(1/\cos\theta)$

CSA quadratic efficiency equation (average of two collectors tested) in SI units is:

$\eta = 0.694 - 3.875\ (Ti - Ta)/I - 0.0011\ (Ti - Ta)^2/I$

Linear Y-Intercept is 0.695; Slope is -3.9448 W/(m^2.°C)

Nominal thermal power at 1100 W/m^2 or 348.7 Btu/hr.ft^2 solar radiation perpendicular to collector plane is 2.06 kW^{TH} or 7,029 Btu/hr

Collector stagnation temperature under 1100 W/m^2 and 68 °F (20 °C) is 405°F (207°C)

CERTIFIED SOLAR COLLECTOR

SUPPLIER:
EnerWorks, Inc.
969 Juliana Drive
Woodstock, ON N4V 1C1 Canada
www.enerworks.com

BRAND:	Commercial Collector
MODEL:	COL-4X8-NL-SG1-SH10US
COLLECTOR TYPE:	Glazed Flat Plate
CERTIFICATION #:	2006006A
Original Certification:	September 14, 2006
Expiration Date:	May 08, 2018

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™), an ANSI accredited and EPA recognized Certification Body, in accordance with SRCC OG-100, Operating Guidelines and Minimum Standards for Certifying Solar Collectors, and has been certified by the SRCC. This award of certification is subject to all terms and conditions of the Program Agreement and the documents incorporated therein by reference. This document must be reproduced in its entirety.

COLLECTOR THERMAL PERFORMANCE RATING

Kilowatt-hours (thermal) Per Panel Per Day				Thousands of Btu Per Panel Per Day			
Climate -> Category (Ti-Ta)	High Radiation (6.3 kWh/m².day)	Medium Radiation (4.7 kWh/m².day)	Low Radiation (3.1 kWh/m².day)	Climate -> Category (Ti-Ta)	High Radiation (2000 Btu/ft².day)	Medium Radiation (1500 Btu/ft².day)	Low Radiation (1000 Btu/ft².day)
A (-5 °C)	13.4	10.1	6.9	A (-9 °F)	45.9	34.6	23.4
B (5 °C)	12.4	9.1	5.8	B (9 °F)	42.3	31.1	19.9
C (20 °C)	10.7	7.5	4.3	C (36 °F)	36.5	25.5	14.6
D (50 °C)	7.5	4.4	1.5	D (90 °F)	25.5	14.9	5.1
E (80 °C)	4.3	1.6	0.0	E (144 °F)	14.6	5.5	0.0

A- Pool Heating (Warm Climate) **B**- Pool Heating (Cool Climate) **C**- Water Heating (Warm Climate)
D- Space & Water Heating (Cool Climate) **E**- Commercial Hot Water & Cooling

COLLECTOR SPECIFICATIONS

Gross Area:	2.873 m²	30.92 ft²	**Dry Weight:**	50 kg	111 lb
Net Aperture Area:	2.691 m²	28.96 ft²	**Fluid Capacity:**	1.9 liter	0.5 gal
Absorber Area:	0.000 m²	0.00 ft²	**Test Pressure:**	517 kPa	75 psi

TECHNICAL INFORMATION				**Tested in accordance with:** ISO 9806		
ISO Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta]						
SI UNITS:	$\eta = 0.762 - 3.27870(P/G) - 0.01290(P^2/G)$	**Y Intercept:**	0.768	**Slope:**	-4.035 W/m².°C
IP UNITS:	$\eta = 0.762 - 0.57785(P/G) - 0.00126(P^2/G)$	**Y Intercept:**	0.768	**Slope:**	-0.711 Btu/hr.ft².°F

Incident Angle Modifier								**Test Fluid:**	Propylene glycol	
θ	10	20	30	40	50	60	70	**Test Mass Flow Rate:**	0.0184 kg/(s m²)	14.75 lb/(hr ft²)
Kτα	1.00	1.00	1.00	1.00	0.96	0.84	0.31	**Impact Safety Rating:** 0		

REMARKS:

Technical Director

www.solar-rating.org ♦ 400 High Point Drive, Suite 400 ♦ Cocoa, Florida 32926 ♦ (321) 213-6037 ♦ Fax (321) 821-0910

CERTIFIED SOLAR COLLECTOR

SUPPLIER:
EnerWorks, Inc.
969 Juliana Drive
Woodstock, ON N4V 1C1 Canada
www.enerworks.com

BRAND:	Commercial Collector
MODEL:	COL-4X8-NL-SG1-SH10US
COLLECTOR TYPE:	Glazed Flat Plate
CERTIFICATION #:	2006006A
Original Certification:	September 14, 2006
Expiration Date:	May 08, 2018

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™), an ANSI accredited and EPA recognized Certification Body, in accordance with SRCC OG-100, Operating Guidelines and Minimum Standards for Certifying Solar Collectors, and has been certified by the SRCC. This award of certification is subject to all terms and conditions of the Program Agreement and the documents incorporated therein by reference. This document must be reproduced in its entirety.

ADDITIONAL INFORMATION (click here to return to the rating page)			
Test Lab:	Bodycote	Test Report Date:	May 08, 2006
Test Report Number:	06-08-9133-2	Test Location:	indoors

SOLAR COLLECTOR CONSTRUCTION DETAILS					
Gross Length:	0.000 m	**Gross Width:**	0.000 m	**Gross Depth:**	0.000 mm

COLLECTOR MATERIALS					
Outer Cover:	Glass sheet	**Enclosure back:**	Steel	**Back Insulation:**	Fiber, None
Inner Cover:	Glass Tube	**Enclosure side:**	Steel	**Side Insulation:**	Foam, None
Absorber Description:		**Flow Pattern:**			
Riser Tube:	Copper	**Fin:**			
Absorber Coating:	Selective	**Tube to fin connection**			

GLAZING	Outer Cover	Inner Cover
Material:	Glass sheet	Glass Tube
Surface Characteristics:	Smooth	
Thickness:	3.2 mm	
Transmissivity:	High (equal to or greater than 90%)	
Length:	0.100 m	
Width:	0.100 m	
Tube Glazing to Header Enclosure Seal:	EPDM gasket	

ABSORBER:				**Absorber Coating:**	Selective
Header Material:		**Header OD:**		**Header Wall:**	
Riser Tube Material:	Copper	**Riser Tube OD:**		**Riser Tube Wall Thickness:**	
Fin Material:		**Fin Thickness:**	0.00 mm		

www.solar-rating.org ♦ 400 High Point Drive, Suite 400 ♦ Cocoa, Florida 32926 ♦ (321) 213-6037 ♦ Fax (321) 821-0910

Certification #: 2006006A
Supplier: EnerWorks, Inc.
Brand Name: Commercial Collector
Model Number: COL-4X8-NL-SG1-SH10US

Flow Pattern:					
Number of Riser Tubes:	0	**Tube Spacing:**		**Number of times each riser crosses the absorber:**	0
Length of Flow Path:	0.00 m	**Riser to Fin/Plate Bond:**			

INSULATION:					
Location	**Type**	**Thickness**	**Location**	**Type**	**Thickness**
Back – Top Layer:	Fiber	43.2 mm	**Sides – Inner Layer:**	Foam	25.4 mm
Back – Bottom Layer:	None		**Sides – Outer Layer:**	None	
Enclosure Fastening Methods:					

Power Output per Collector(W) **[Ti-Ta, G = 1000 W/m²]**				
0	**10**	**30**	**50**	**70**

PRESSURE DROP				
Flow	**ΔP**		**Flow**	**ΔP**
ml/s	**Pa**		**gpm**	**in H_20**
20	14184		0.32	57.1
50	42171		0.79	169.7
80	78210		1.27	314.8

www.solar-rating.org ♦ 400 High Point Drive, Suite 400 ♦ Cocoa, Florida 32926 ♦ (321) 213-6037 ♦ Fax (321) 821-0910

1. Product data

MAGNA

The MAGNA ranges of circulator pumps are specially designed for

- heating systems
- domestic hot-water systems (stainless-steel pump housing).

Fig. 1 MAGNA pump

Features and benefits

The MAGNA variable-speed wet rotor circulator is powerful, reliable, intelligent, and energy efficient.

MAGNA incorporates a permanent-magnet rotor, a revolutionary design pioneered by Grundfos.

MAGNA is easy to install, simple to operate, and a good choice for the replacement market. MAGNA is the smart choice with an array of useful features and benefits:

- Integrated variable speed drive
- proportional-pressure duty
- constant-pressure duty
- constant-curve duty
- max. or min. curve duty
- parallel connection of two pumps (requires additional expansion module).
- no external motor protection required
- Short flange-to-flange length for easier replacements
- low noise level
- safe selection
- low energy consumption (all MAGNA pumps are high efficiency with permanent magnet (PM) motors. Energy class "A" in European energy labeling schedule)
- patented AUTO*ADAPT* function ensures further energy savings
- long life and no maintenance
- external control and monitoring enabled via optional expansion modules.

Applications

Heating systems

- Main loop
- Mixing loops
- Heating surfaces.

The MAGNA circulator pumps are designed for circulating liquids in heating systems with variable flows where it is desirable to optimize the setting of the pump duty point. The pumps are also suitable for domestic hot-water systems.

To ensure correct operation, it is important that the sizing range of the system falls within the duty range of the pump.

The MAGNA is especially suitable for installation in existing systems where the differential pressure of the pump is too high in periods with reduced flow demand. The pump is also suitable for new systems where automatic adjustment of pump head to actual flow demand is required without using expensive bypass valves or the like.

Furthermore, the pump is suitable for application in systems with hot-water priority where an external contact can immediately force the pump to operate according to the max. curve.

Pumped liquids

MAGNA is suitable for thin, clean, non-aggressive and non-explosive liquids, not containing any solid particles, fibers or mineral oil.

If the pump is installed in a heating system, the water should meet the requirements of accepted standards on water quality in heating systems.

In domestic hot-water systems, the pump should be used only for water with a degree of hardness lower than 17 grains/gallon (14°dH). The pump must **not** be used for the transfer of flammable liquids such as diesel oil and petrol.

If the pump is not used during periods of frost, necessary steps must be taken to prevent frost bursts. Additives with a density and/or kinematic viscosity higher than those/ that of water will reduce the hydraulic performance.

Whether a pump is suitable for a particular liquid, depends on a number of factors of which the most important are lime content, pH value, temperature and content of solvents, oils, etc.

Type key

MAGNA

Example	MAGNA	40	-120	(F)	(N)	280
MAGNA						
Nominal diameter of suction and discharge ports (mm)						
Maximum head [dm]						
Flange connection						
N: Single-head pump housing of stainless steel						
Port-to-port [mm]						

Performance range, MAGNA

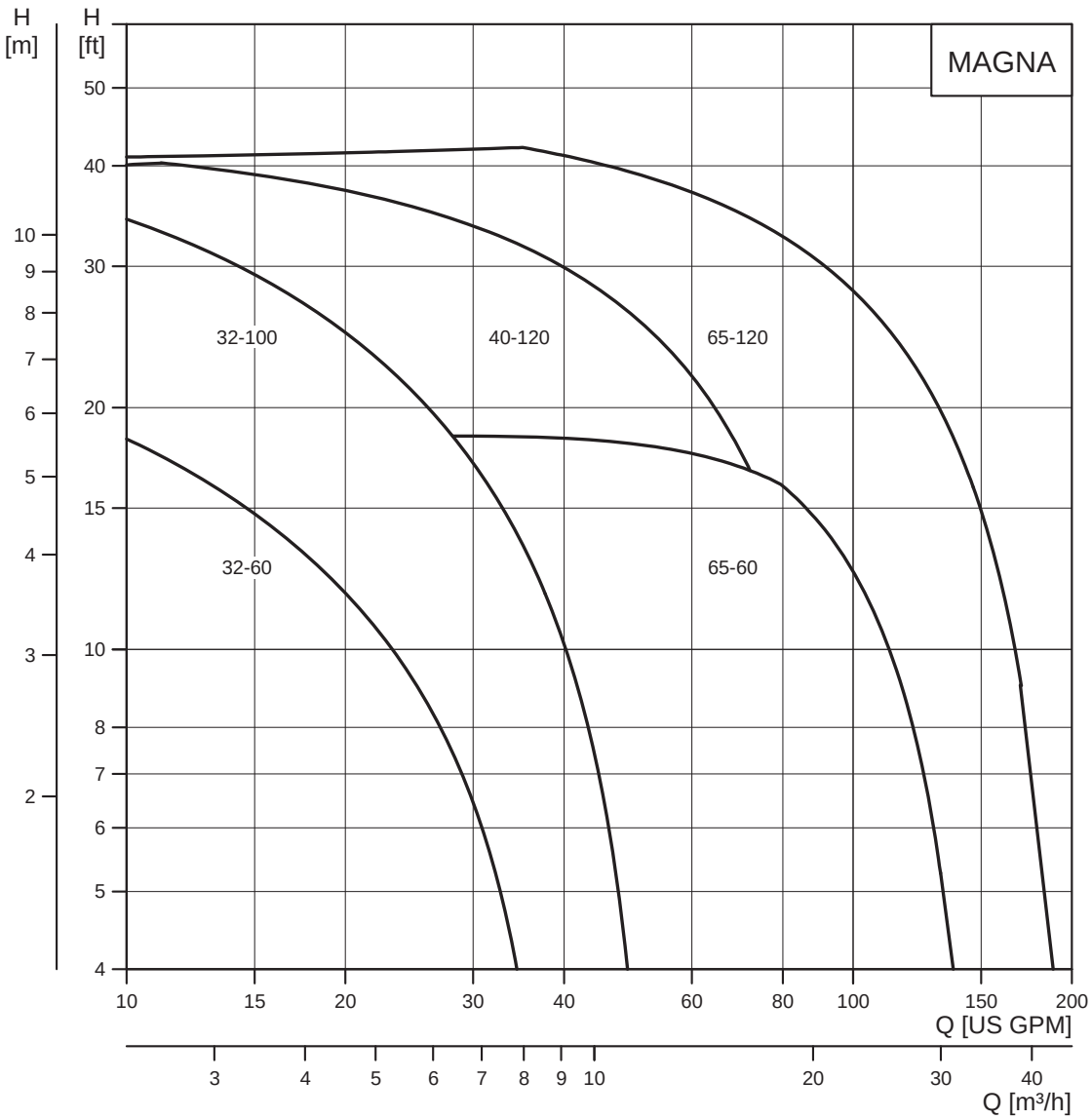


Fig. 2 Performance range

2. Product range

Product range

Pump type	Supply voltage [V]	Port-to-port length		Nominal pipe connection		Flange connection		
		[inch]	[mm]	[inch]	[mm]	GF15/26	GF 40/43	GF 53
MAGNA 32-60 F (N)	1 x 208 - 230	6 ½	165	1.25	32	●		
MAGNA 32-100 F	1 x 208 - 230	6 ½	165	1.25	32	●		
MAGNA 40-120 F (N)	1 x 230	8 ½	216	1.5	40	●	●	
MAGNA 65-60 F (N)	1 x 230	11 ½	292	2.5	65			●
MAGNA 65-120 F (N)	1 x 230	11 ½	292	2.5	15			●

Pump selection

Pump size

Selection of pump size should be based on

- required maximum flow
- maximum head loss in the system.

Operating conditions

The operating conditions should be within published pump limits. When selecting a MAGNA pump, the following limitations shall be considered:

- liquid temperature and ambient conditions
- minimum inlet pressure
- maximum operating pressure.

Communication

The requirements for external control or monitoring of the pump should be considered, such as access to:

- speed control of pump or change of setpoint
- reading of pump data
- start/stop, fault indication or forced control to max. or min. curve.

Control mode

In general, Grundfos recommends:

- The factory setting which is suitable for most installations
- Proportional-pressure control in systems with relatively great head losses
- Constant-pressure control in systems with relatively small head losses.

3. Operating conditions

General recommendations

MAGNA	
Water in heating systems	Water quality according to local standards
Domestic hot water	Degree of hardness up to 17 grains / gallon (14 d°H).
Water containing glycol	Max. 50 % glycol. Viscosity ≤ 0.3785 ft^2/hr (10 mm^2/s).

Liquid temperature

Application	MAGNA
General	+35 °F to +200 °F (+2 to +95 °C)
Domestic hot-water systems	+35 to +140 °F (+2 to +60 °C)

To avoid condensation in the terminal box and the stator, the liquid temperature must always be higher than the ambient temperature.

Ambient conditions

Ambient temperature during operation	+32 to +95 °F (0 to +35 °C)
Ambient temperature during storage/transport	–40 to +140 °F (–40 to +60 °C)
Relative air humidity	Maximum 95 %

Maximum operating pressure

Pump type	Max. operating pressure [psi (bar)]	mPa
MAGNA 32-60 F	145 (10)	1.0
MAGNA 32-100 F	145 (10)	1.0
MAGNA 40-120 F	175 (12)	1.2
MAGNA 65-60 F	175 (12)	1.2
MAGNA 65-120 F	175 (12)	1.2

Minimum inlet pressure

The following relative minimum pressures must be available at the pump inlet during operation:

Pump type	Liquid temperature	
	167 °F / 75 °C	**194 °F / 90 °C**
	Inlet pressure [psi / bar]	
MAGNA 32-60 F	1.45 / 0.10	5 / 0.35
MAGNA 32-100 F	1.45 / 0.10	5 / 0.35
MAGNA 40-120 F	2.2 / 0.15	6.5 / 0.45
MAGNA 65-60 F	2.2 / 0.15	6.5 / 0.45
MAGNA 65-120 F	2.2 / 0.15	17.5 / 1.2

Note: Actual inlet pressure + pump pressure against a closed valve must be lower than the maximum permissible system pressure.

Electrical data

MAGNA

Pump type	Single-phase MAGNA 32-60, 32-100	Single-phase MAGNA 40-120, 65-60, 65-120
Enclosure class	IP44 (IEC 85)	IP44 (IEC 85)
Insulation class	F	F
External start/stop input	External potential-free switch.★ Screened cable. Maximum contact load: 5 V, 10 mA.	External potential-free switch. Screened cable. Maximum contact load: 5 V, 10 mA.
Setpoint signals	GENI module★	GENI module★
Signal output	Internal potential-free changeover contact.★ Screened cable. Maximum contact load: 250 VAC, 2 A. Minimum contact load: 5 VDC, 1 mA.	Internal potential-free changeover contact. Screened cable. Maximum contact load: 250 VAC, 2 A. Minimum contact load: 5 VDC, 1 mA.
Bus input	GENI module★ • LON via GENIbus and G10 modules.	GENI module★ LON module★
Supply voltage	1 x 208-230 V - 10 % / + 6 %, 50/60 Hz, PE	1 x 230 V - 10 % / + 6 %, 50/60 Hz, PE
	The pump requires no external motor protection.	

★ Expansion module

Sound pressure level

Pump type	Single-phase MAGNA 32-60, 32-100	Single-phase MAGNA 40-120, 65-60, 65-120
Sound pressure level	≤ 32 dB(A)	≤ 38 dB(A)

4. Functions

Functions

	Single-phase MAGNA 32-60, 32-100	Single-phase MAGNA 40-120, 65-60, 65-120
Control modes (factory setting)		
AUTO*ADAPT*★★	●	●
Proportional pressure control	●	●
Constant pressure control	●	●
Additional control and operating modes		
Constant curve duty	●	●
Min. or max. curve duty	●	●
Automatic night-time duty	●	●
Additional operating modes of twin-head pumps		
Alternating operation★★	●	●
Standby operation	●	●
Readings and settings on the pump		
Operating indication	●	●
Flow indication	●	●
Setpoint	●	●
Control mode	●	●
Fault indication	●	●
Communication		
Wireless remote control, R100	●	●
External digital input/output	❍	●
External analog input	❍	❍
BUS via GENIbus protocol, RS-485	❍	❍
BUS via LonTalk® protocol, FTT 10	❍★	❍

● Function incorporated.

❍ Expansion module required.

★ G10-Lon interface required.

★★ Not recommended for air conditioning systems.

Control modes (factory setting)

The pumps have been factory-set to

- AUTO*ADAPT*.

The setpoint is factory-set to approximately half of the maximum pump head.

The factory setting is suitable for most installations.

AUTO*ADAPT*

During operation, the pump automatically reduces the factory-set setpoint and adjusts it to the actual system characteristic.

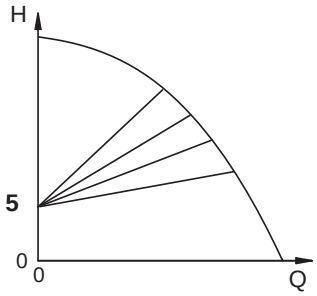


Fig. 3 AUTO*ADAPT* control

Note: Manual setting of the setpoint is not possible.

When the control mode AUTO*ADAPT* has been activated, the pump will start at H_{set1}, corresponding to 50% of its maximum head, and then adjust its performance to A_1, see fig. 4.

When the pump registers a lower pressure on the max. curve, A_2, the AUTO*ADAPT* function automatically selects a correspondingly lower control curve, H_{set2}.

If the radiator valves close, the pump adjusts its performance to A_3.

A_1:	Original duty point.
A_2:	Lower registered pressure on the max. curve.
A_3:	New duty point after AUTO*ADAPT* control.
H_{set1}:	Original setpoint setting.
H_{set2}:	New setpoint after AUTO*ADAPT* control.
$H_{fac.}$:	MAGNA xx-60: 11.5 ft MAGNA xx-100, 18 ft MAGNA xx-120: 23 ft
H_{auto_min}:	A fixed value of 5 ft

The AUTO*ADAPT* control mode is a form of proportional-pressure control where the control curves have a fixed origin, H_{auto_min}.

The AUTO*ADAPT* control mode is developed specifically for heating applications.

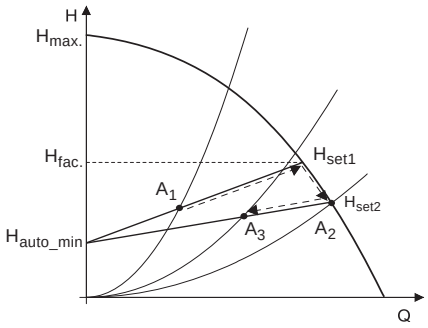


Fig. 4 AUTO*ADAPT*

Additional control and operating modes

Grundfos offers additional control and operating modes to meet specific demands.

The functions available depend on the pump type and the expansion module chosen, see overview of functions on page 10.

Proportional-pressure control

The pump head is changed continuously in accordance with the flow demand in the system.

The head against a closed valve is half the setpoint.

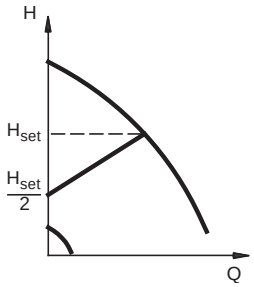
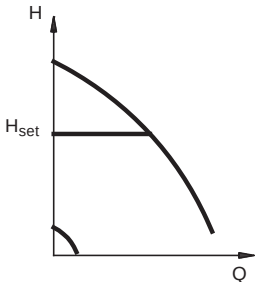


Fig. 5 Proportional-pressure control

The proportional-pressure control is recommended in systems with relatively great head losses.

Constant-pressure control

The pump head is kept constant, independent of the water requirement.



TM00 4489 0995

Fig. 6 Constant-pressure control

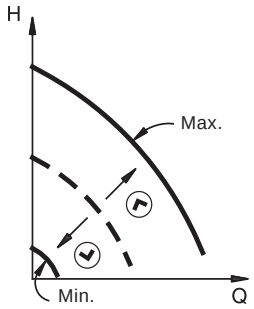
The constant-pressure control is recommended in systems with relatively small head losses.

Constant-curve duty

Requires the use of an R100 remote control.

The pump can be set to operate according to a constant curve like an uncontrolled pump.

If an external controller is installed, the pump is able to change from one constant curve to another, depending on the value of the external signal.

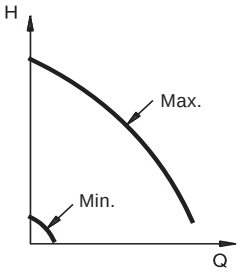


TM03 0551 0205

Fig. 7 Constant-curve duty

Max. or min. curve duty

The pump can be set to operate according to the max. or min. curve, like an uncontrolled pump.



TM00 5547 4596

Fig. 8 Max. or min. curves

The **max. curve** mode can be used in periods in which a maximum flow is required. This operating mode is for instance suitable for hot-water priority.

The **min. curve** mode can be used in periods in which a minimum flow is required. This operating mode is for instance suitable for manual night-time duty.

Temperature influence

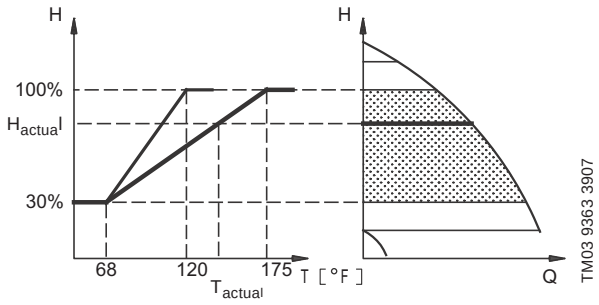
Temperature influence function is available with constant and proportional control mode.

To be set with the R100 remote control.

When temperature influence function is activated the setpoint for head will be reduced according to the liquid temperature.

The temperature influence limits can be set to 120 °F (50 °C) or 175 °F (80 °C). The temperature limits are not adjustable.

These temperature limits are called Tmax. The setpoint is reduced in relation to the head set (= 100 %) according to the characteristics below.



TM03 9363 3907

Fig. 9 Temperature influence

In the above example, Tmax. = 175 °F (80 °C) has been selected. The actual liquid temperature Tactual causes the setpoint for head to be reduced from 100 % to Hactual.

The temperature influence function requires:

- Proportional- or constant-pressure control mode.
- The pump must be installed in the supply side pipe.
- System with supply pipe temperature control.

Temperature influence is suitable in:

- systems with variable flows (e.g. two-pipe heating systems), in which the activation of the temperature influence function will ensure a further reduction of the pump performance in periods with small heating demands and consequently a reduced supply pipe temperature.
- systems with almost constant flows (e.g. one-pipe heating systems and radiant floor heating systems), in which variable heating demands cannot be registered as changes in the head as is the case with two-pipe heating systems. In such systems, the pump performance can only be adjusted by activating the temperature influence function.

Selection of Tmax.

In systems with a supply pipe temperature of:

- up to and including +131 °F (55 °C), select Tmax. = +120 °F (50 °C),
- above +131 °F (+55 °C), select Tmax. = +175 °F (+80 °C).

Automatic night-time duty

When automatic night-time duty has been selected, the pump will change automatically between normal duty and night-time duty. Changeover between normal duty and night-time duty takes place as a result of the supply pipe temperature measured by an integrated temperature sensor.

The automatic changeover to night-time duty takes place when the temperature sensor registers a supply pipe temperature drop of more than 18-27 °F (10-15 °C) within approx. 2 hours. The required temperature drop is a minimum of 18-27 °F (10-15 °C).

Changeover to normal duty takes place without a time lag when the temperature has increased by approx. 18 °F (10 °C).

Additional operating modes two pumps in parallel

The following operating modes are available for two pumps in parallel if both pumps are equipped with optional GENI module:

Alternating operation

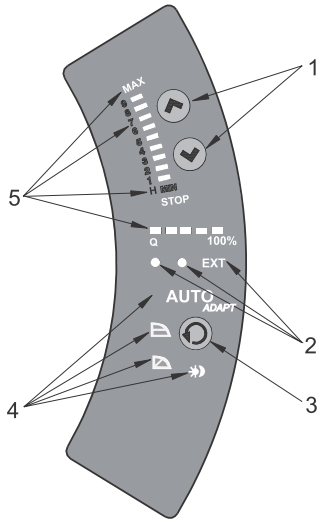
Pump operation alternates every 24 hours. If the duty pump stops due to a fault, the other pump starts.

Standby operation

One pump operates continuously. In order to prevent seizing-up, the standby pump starts at a fixed frequency (every 24 hours) and runs for a short period. If the duty pump stops due to a fault, the standby pump starts.

Readings and settings on the pump

The control panel on the pump control box/terminal box incorporates the basic functions for readings and settings.



TM03 8752 4509

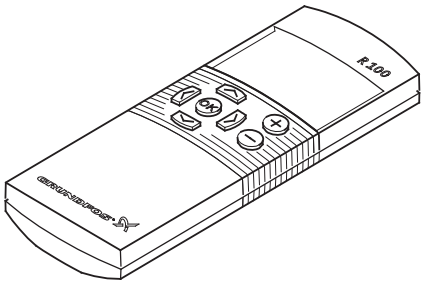
Fig. 10 MAGNA control panel

Pos.	Description
1	Buttons for setting of head
2	• Indicator lights for operating and fault indication and • symbol for indication of external control
3	Button for selection of control mode: AUTO*ADAPT,* proportional pressure, constant pressure and automatic night-time duty
4	Light symbols for indication of control mode and night-time duty
5	Light fields for indication of head, flow and operating mode

Communication

MAGNA pump enables communication via

- wireless remote control, R100
- connection to an external alarm device
- digital input/output
- analog input.



TM00 4498 2802

Fig. 11 R100 remote control

MAGNA is designed for wireless communication with the Grundfos R100 remote control.

The R100 offers additional possibilities of setting and status displays for the pump.

The R100 can be used for the following functions:

- reading of operating data
- reading of fault indications
- setting of control mode
- setting of 1/3 ft (0.1 m) head increments
- selection of external setpoint signal
- allocation of pump number making it possible to distinguish between pumps in connection with parallel operation via bus
- selection of function for digital input.

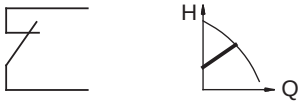
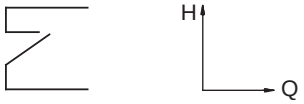
MAGNA has various inputs and outputs for external signals for forced-control functions. Some functions may require an expansion module, see *Expansion modules for MAGNA*.

Digital input

The function of the digital input is selected with the R100 remote control.

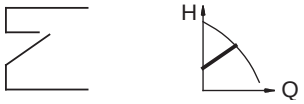
External start/stop

The pump can be started or stopped via the digital input, see fig. 19, terminals 7 and 8. Expansion module required for MAGNA 32-100.

Start/stop	
	Normal duty
	Stop

External forced max. or min curve

The pump can be forced to operate on the max. or min curve via the digital input. Use of the digital input for forced max. or min. curve requires installation of the expansion module, GENI module.

Max. curve	
	Normal duty
	Max. curve

Min. curve	
	Normal duty
	Min. curve

Digital output

The MAGNA pumps incorporate a signal relay with a potential-free changeover contact for external fault indication.

MAGNA 32-60*, 32-100*

The function of the signal relay can be changed from "Fault" to "Ready" or "Operating" or "Ready" mode with the R100.

These pumps require expansion modules.

The functions of the signal relay are as shown in the table below:

*Expansion module required for 32-60, 32-100.

Signal relay	Fault signal
	Not activated: • The electricity supply has been switched off. • The pump has not registered a fault.
	Activated: • The pump has registered a fault.
Signal relay	**Operating signal**
	Not activated: • The pump has been set to stop. • The pump has registered a fault and is unable to run.
	Activated: • The pump is running. • The pump has registered a fault, but is unable to run.
Signal relay	**Ready signal**
	Not activated: • The pump has been set to stop. • The pump has registered a fault and is unable to run.
	Activated: • The pump is ready to run or is running.

MAGNA 40-120, 65-60, 65-120

The function of the signal relay can be changed from "Fault" to "Operating" mode with the R100.

The functions of the signal relay are as shown in the table below:

Signal relay	Fault signal
	Not activated: • The electricity supply has been switched off. • The pump has not registered a fault.
	Activated: • The pump has registered a fault.
Signal relay	**Operating signal**
	Not activated: • The pump has been set to stop. • The pump has registered a fault and is unable to run.
	Activated: • The pump is running. • The pump has registered a fault, but is unable to run.

Analog input

External analog control

Use of the analog input requires installation of the expansion module, GENI module.

Control of setpoint or speed via an external 0-10 V signal.

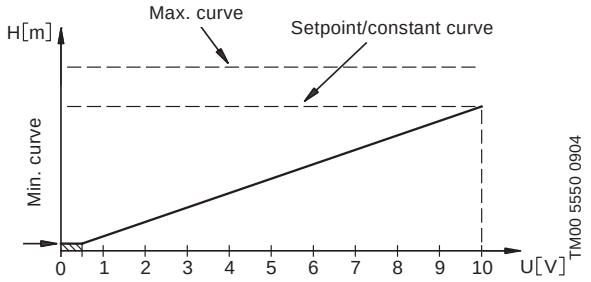


Fig. 12 Example of 0-10 V control

The analog input enables the following control modes:

In **constant-curve mode**, the pump is able to change from one constant curve to another depending on the value of the external signal.

The internal controller is **inactive** in this mode.

In **pressure control mode**, the setpoint can be set externally within the range from the setpoint to the min. curve.

The internal controller is **active** in this mode.

At an input voltage lower than 0.5 V, the pump will operate according to the min. curve.

Bus communication via GENIbus

The bus enables control and monitoring of the pumps from a GRUNDFOS Pump Management System 2000, to a building management system (BMS) or another external control system.

TM03 2394 4005

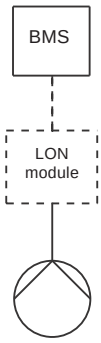
Fig. 13 Example of single-pump operation

Pump type	Requires	See section
MAGNA	GENI module	Accessories

Bus communication via LON

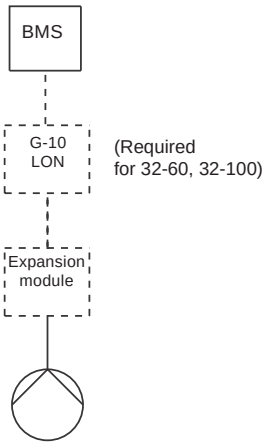
Via the bus input and optional LON module the pump can be connected to a building management sysetm (BMS) based on LonWorks® technology, and thus be linked to other units based on this communication standard.

MAGNA pump type	GENI module	LON module	G10-LON
32-60	●		●
32-100	●		●
65-60		●	
40-120		●	
65-120		●	



TM03 8747 2407

Fig. 14 Example of single-pump operation 40-120, 65-60, 65-120



TM03 3041 0106

Fig. 15 Example of single-pump operation 32-60, 32-100

Functions of expansion modules

Pump type	Inputs/outputs incorporated	With expansion module	Function
MAGNA 32-60, 32-100	—	Relay module	• Start/Stop • Signal relay
		GENI module	• Start/Stop • Max. curve • Min. curve • 0-10 V analog input • Signal relay • Duty/Standby for two pumps in parallel • GENIbus
MAGNA 40-120 MAGNA 65-60 MAGNA 65-120	Start/stop Signal relay	GENI module	• Max. curve • Min. curve • 0-10 V analog input • Duty/Standby for two pumps in parallel • GENIbus
		LON module	• LonTalk® protocol, FTT10

5. Construction

The MAGNA is of the canned-rotor type. The pump and motor form an integral unit without shaft seal and with only two gaskets for sealing. The bearings are lubricated by the pumped liquid.

The pump features are

- controller integrated in the terminal box
- control panel on the terminal box
- terminal box prepared for optional modules
- differential-pressure and temperature detection
- cast-iron or stainless-steel pump housing
- no external motor protection required.

Motor and electronic controller

The **single-phase MAGNA** motor is a 4- or 8-pole, synchronous, permanent-magnet motor (PM motor). This motor type has higher efficiency than a conventional asynchronous squirrel-cage motor.

Pump speed is controlled by an integrated frequency converter.

Pump connections

MAGNA 32-60, 32-100:Two bolt oval flange.
Matches GF 15/26.

MAGNA 40-120: Two bolt oval combination flange.
Matches GF15/26 and GF 40/43.

MAGNA 65-60 and 65-120: GF53, 4 bolt Non ANSI flange. Can be connected to GF53, 2", 2.5" and 3" counter flanges.

Paint

Enamel paint.
Color: Grundfos Red (NCS40-50R)

Material specification

MAGNA

Pos.	Component	Material	EN	AISI/ASTM
1	Terminal box	Aluminium/composite		
2	Stator housing	Aluminium AlSi 10Cu_2		
	O-rings	EPDM rubber		
3	Outer bearing ring	Aluminium oxide Al_2O_3		
	Rotor can	Stainless steel	1.4301 or 1.4401	304 or 316
4	Shaft	Stainless steel	1.4401	316
5	Thrust bearing	Carbon MY 106		
6	Bearing plate	Stainless steel	1.4301	304
	Inner bearing ring	Aluminium oxide Al_2O_3		
7	Impeller	Stainless steel	1.4301	304
8	Pump housing	Cast iron or stainless steel	EN-GJL250 1.4308	A48 CL35 CF8

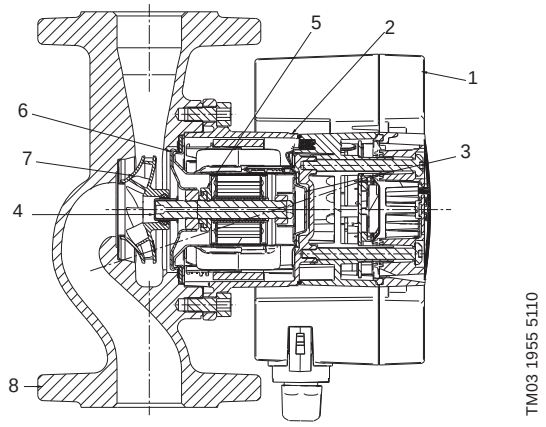


Fig. 16 MAGNA 32-60, 32-100

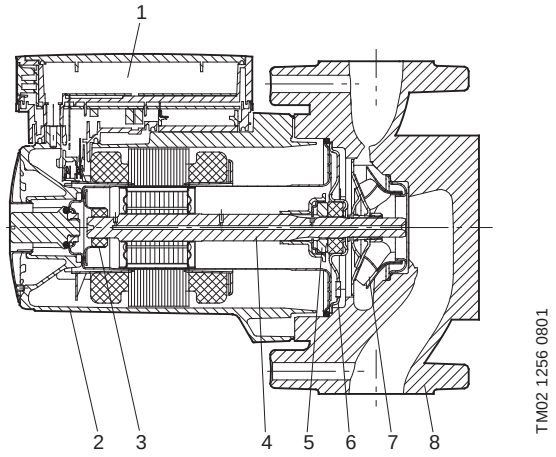


Fig. 17 MAGNA 40-120, 65-60 and 65-120

6. Installation

Mechanical installation

MAGNA is for indoor installation. The pump shaft shall be installed horizontally.

MAGNA may be installed in horizontal as well as vertical pipes as long as the pump shaft is parallel to the ground. Pump shaft shall not be installed vertically.

Arrows on the pump housing indicate the liquid flow direction through the pump. The liquid flow direction can be horizontal or vertical, depending on the terminal box position.

The terminal box can be turned to various positions. This is described in the installation and operating instructions.

The pump must be installed in such a way that strain from the pipework is not transferred to the pump housing.

The pump may be suspended direct in the pipes, provided the pipework can support the pump. If not, the pump must be installed on a mounting bracket or base plate.

To ensure cooling of motor and electronics, the following must be observed:

- Place the pump in such a way that sufficient cooling is ensured.
- The temperature of the cooling air must not exceed 140 °F (40 °C.)

Electrical connection

The electrical connection and protection should be carried out in accordance with local regulations.

- The pump must be connected to an external mains switch.
- The pump must always be correctly grounded.
- The pump requires no external motor protection. The motor incorporates thermal protection against slow overloading and blocking (IEC 34-11: TP 211).
- When the pump is switched on via the mains, the pump will start after approx. 5 seconds.

Note: The number of starts and stops via the mains supply must not exceed 4 times per hour.

The pump mains connection must be made as shown in the diagrams on the following pages.

Cables

Use screened cables (0.25-1.5 mm^2) for external on/off switch, digital input, sensor and setpoint signals.

- All cables used must be heat-resistant up to at least 185 °F (+85 °C).
- All cables used must be installed in accordance with NEC, local codes and regulations.

Wiring diagram

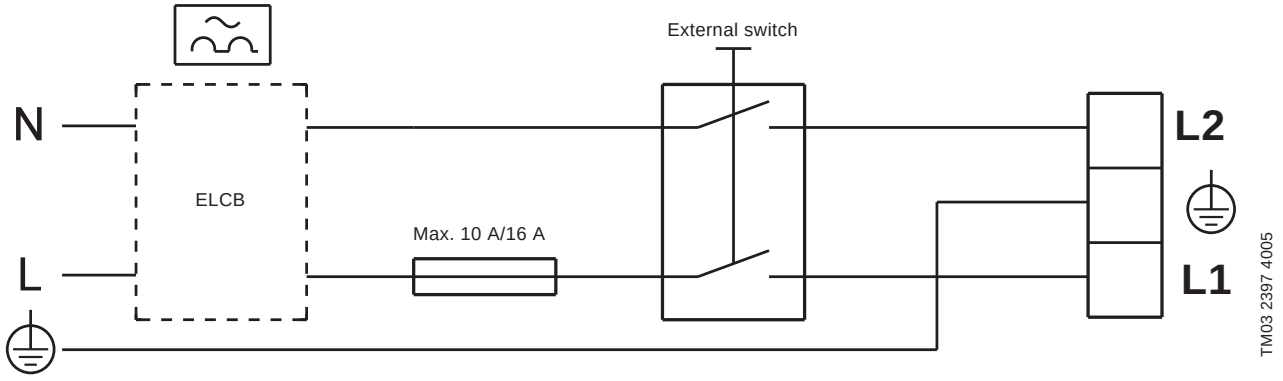


Fig. 18 1 x 230 V +/-10%, 50/60 Hz

Additional protection

If the pump is connected to an electric installation where an earth-leakage circuit breaker (ELCB) is used as an additional protection, the earth-leakage circuit breaker must be marked with the following symbols.

The earth-leakage circuit breaker must trip out when earth fault currents with DC content (pulsating DC) occur.

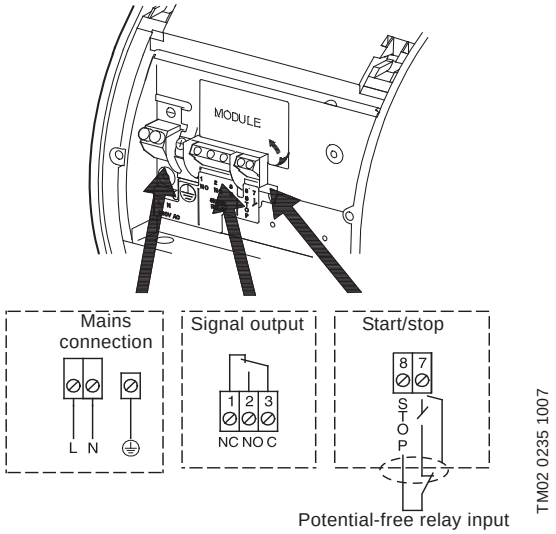


Fig. 19 MAGNA 40-120, 65-120, 65-60, mains connection

Note: If no external on/off switch is connected, the connection across terminals STOP and ⏄ should be maintained.

Two pumps in parallel

Two pumps plumbed in parallel can communicate each other with the help of optional GENI module. The modules have to be connected to each other with a wire.

Wiring diagrams:

- Master pump, see fig. 20.
- Slave pump, see fig. 21.

Operating modes:

Alternating operation

Pump operation alternates every 24 hours. If the duty pump stops due to a fault, the other pump will start.

Standby operation

One pump is operating continuously. In order to prevent seizing-up, the other pump will start at a fixed frequency and run for a short period. If the duty pump stops due to a fault, the other pump will start.

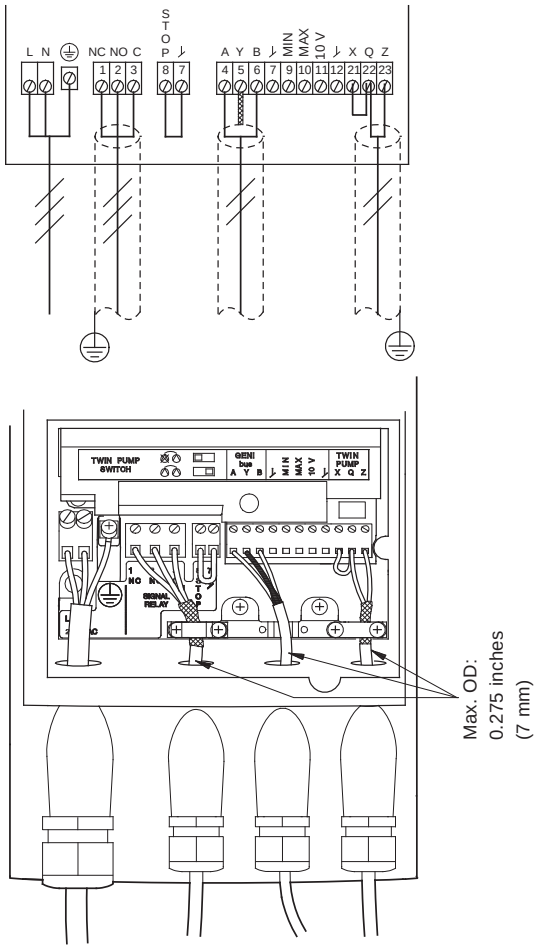


Fig. 20 Two pumps in parallel, master

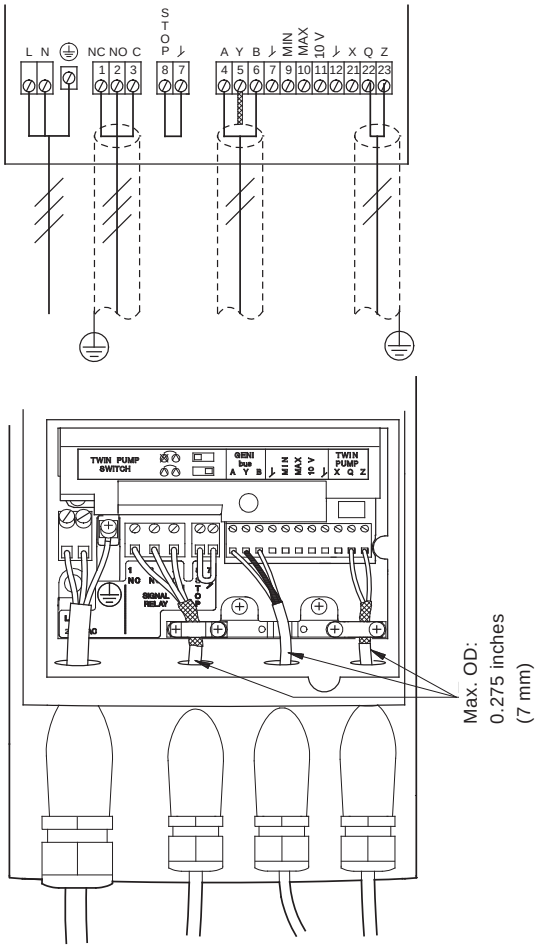


Fig. 21 Two pumps in parallel, slave

Examples of connections

Connection to external controllers

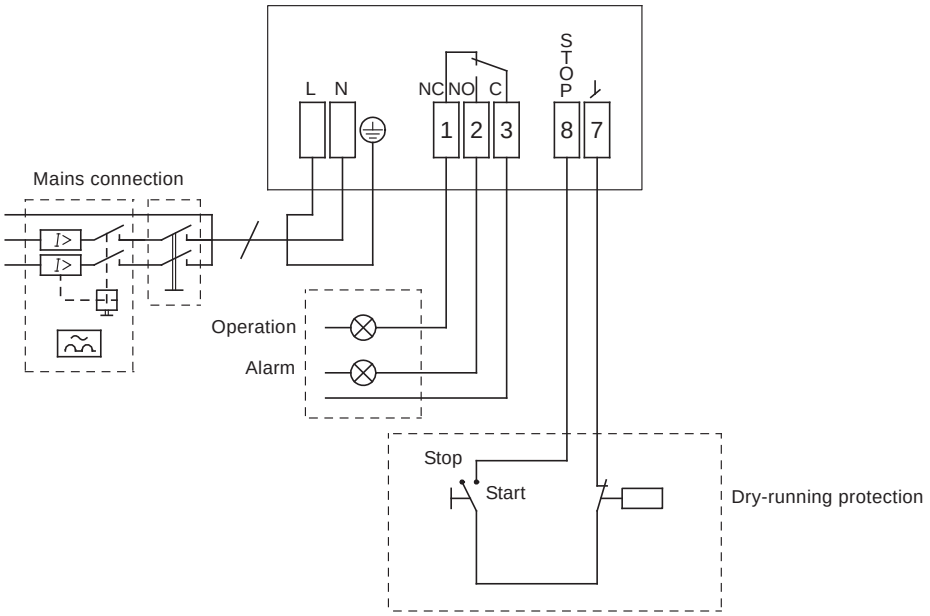


Fig. 22 Example of MAGNA pump

Connection to external controllers

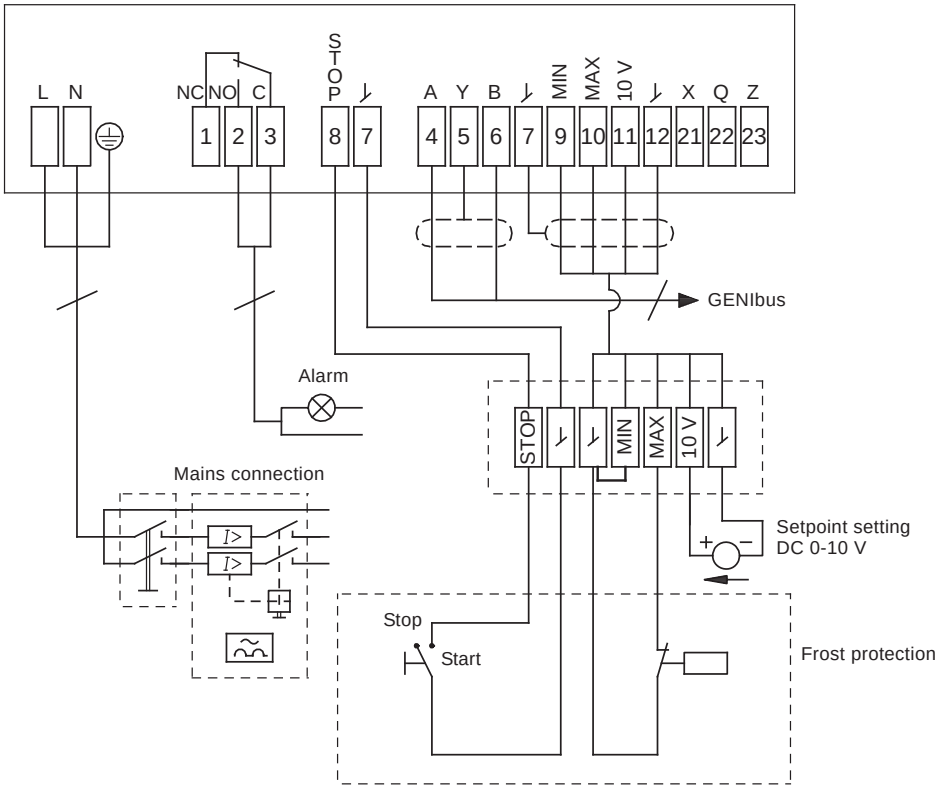


Fig. 23 Example of MAGNA pump with GENI module

7. Curve conditions

Curve conditions

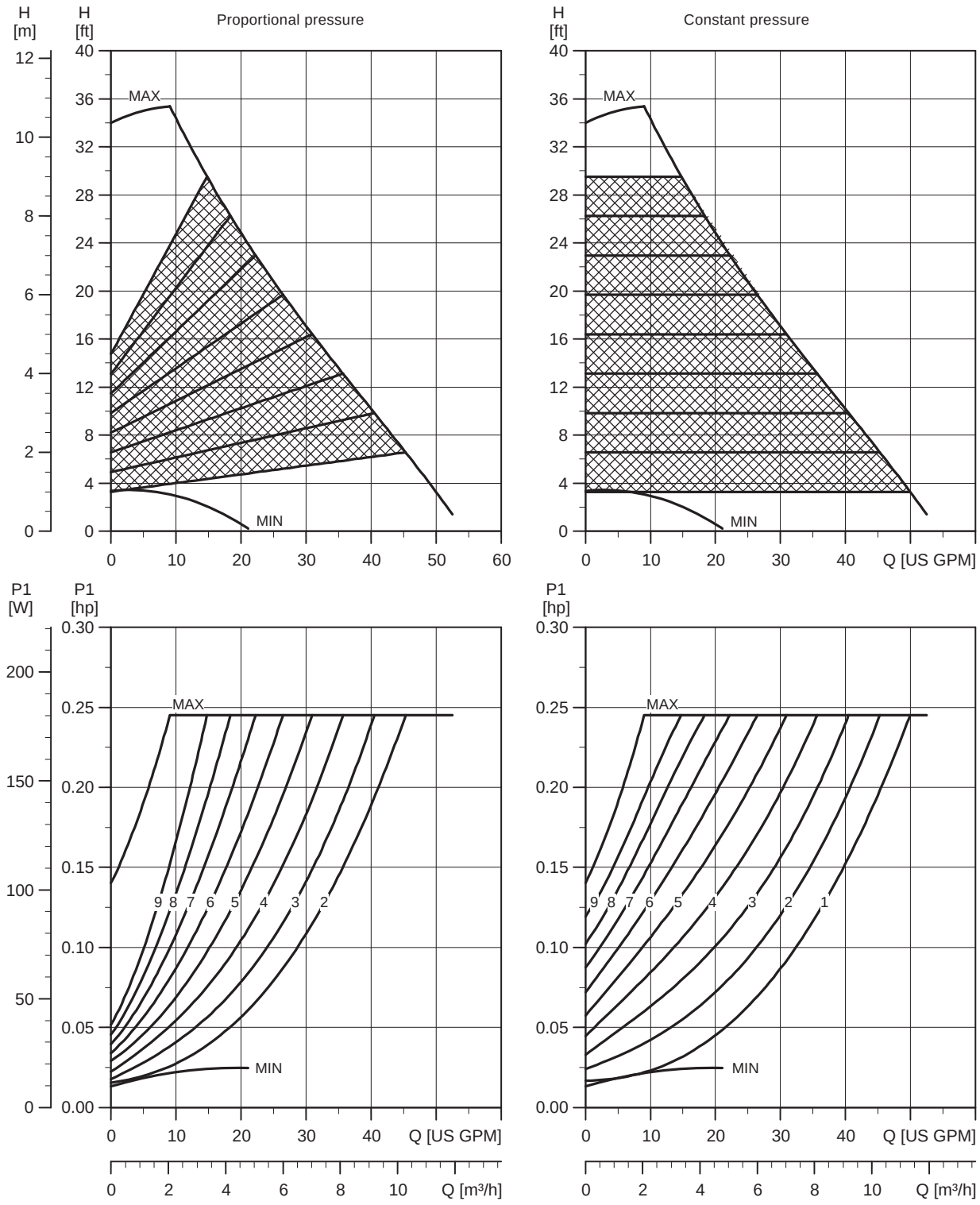
The guidelines below apply to the performance curves on pages 24 to 32:

- The **bold** parts of the curves show the **recommended** performance range.
- Test liquid: Airless water.
- All curves show average values and **should not be used as guarantee curves.** If a stated minimum performance is required, individual measurements must be made.
- MAGNA has been tested at 140 °F (60 °C.) The conversion between head H [ft] and pressure [psi] has been made for water at 140 °F (60 °C) SG= 0.983. For liquids with other specific gravities, e.g. hot water, the discharge pressure is proportional to the specific gravities.

The pumps should not be used at a minimum flow rate lying outside the areas indicated by the bold-faced curves due to danger of pump overheating.

Note: Within MAGNA's performance range, the constant- and proportional-pressure curves can be set in steps of 3.3 ft (1 m) head on the control panel and 0.33 ft (0.1 m) head with the R100.

MAGNA 32-100 F

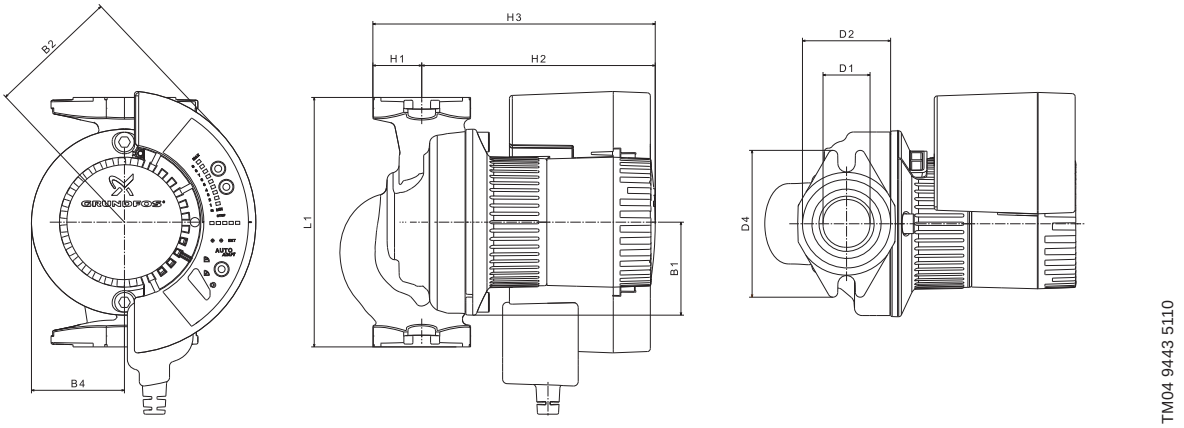


TM04 9409 4110

Electrical data

U_n [V]		P_1 [W]	$I_{1/1}$ [A]
1 x 208 - 230	Min.	10	0.1 A
	Max.	180	1.37 - 1.23 A

MAGNA 32-100 F is also available with stainless-steel housing, type N.



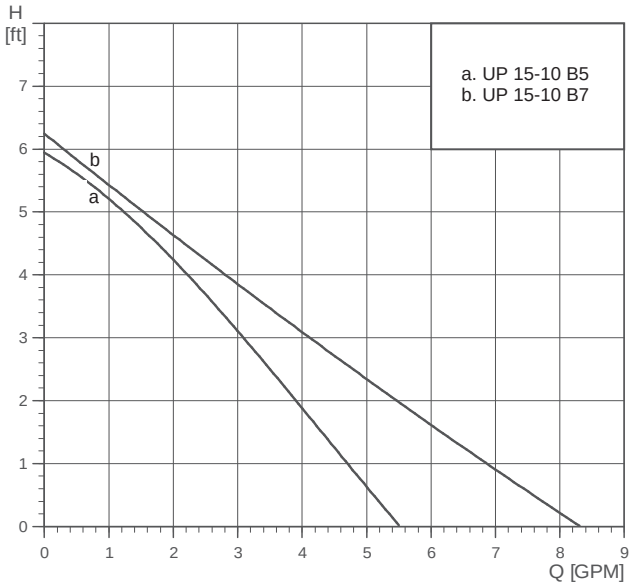
TM04 9443 5110

Dimensions

Pump type		Dimensions									
		L1	B1	B2	B4	H1	H2	H3	D1	D2	D4
MAGNA 32-100 F	[in]	6 1/2	2 3/8	3 3/8	2 3/8	1 1/4	6 1/8	7 3/8	1 1/4	2 1/4	3 7/8
	[mm]	165	61.5	86.9	61.5	32.3	154.5	186.8	31.1	58.5	97.1

Weights

Pump type	Weights [lb (kg)]
	Gross
MAGNA 32-100 F	13 (6)



TM03 8424 1507

Flow range:	0-8.2 gpm
Head range:	0-6.2 feet
Motors:	2-pole, single-phase
Max. liquid temperature:	220 °F (104 °C)
Min. liquid temperature:	36 °F (2 °C)
Max. system pressure:	145 psi (10 bar)

Note: If the UP pump is equipped with a timer, the maximum liquid temperature is 150 °F (66 °C).

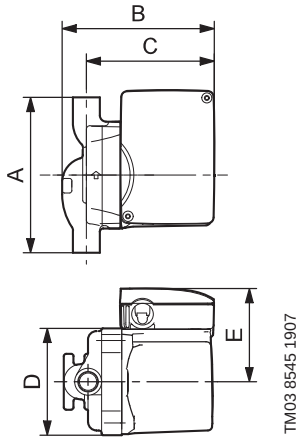
Model	Volts	Amps	Watts	Hp	Capacitor
UP 15-10 B5 and B7	115	0.22	25	1/25	2µF/400 V

Approvals

c UL US LISTED

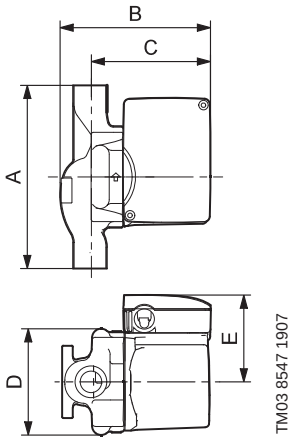
CLASSIFIED UL WATER QUALITY ANSI / NSF61

UP 15-10 B5 and UP 15-10 B5/LC



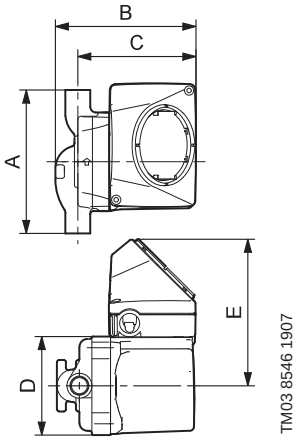
TM03 8545 1907

UP 15-10 B7 and UP 15-10 B7/LC



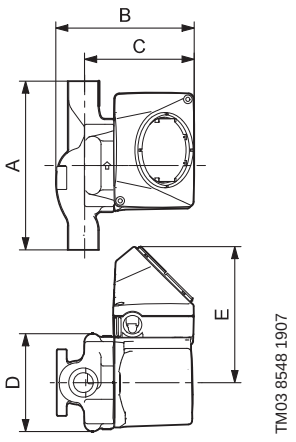
TM03 8547 1907

UP 15-10 B5/TLC



TM03 8546 1907

UP 15-10 B7/TLC

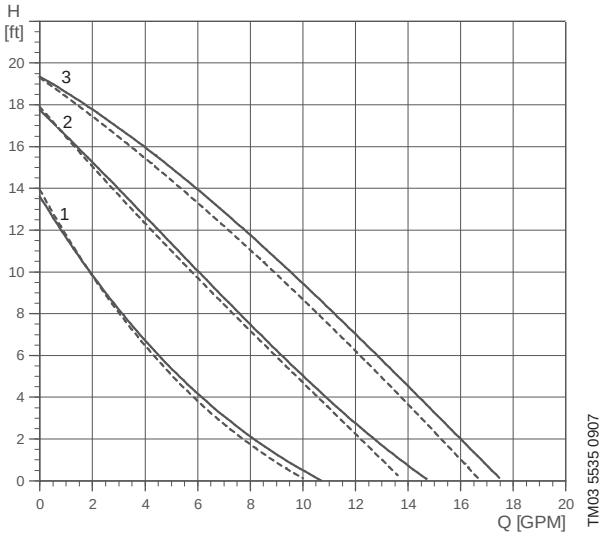


TM03 8548 1907

Model type	Product number	Dimensions [inches]						Connection type and size	Shipping weight [lbs]
		A	B	C	D	E	F		
UP 15-10 B5	59896213	5	4 11/16	4	4	3 1/2	-	1/2" sweat	6
UP 15-10 B5/LC	59896214	5	6 3/16	5 1/2	4	3 1/2	4	1/2" sweat	6.5
UP 15-10 B5/TLC	59896215	5	6 3/16	5 1/2	4	3 1/2	4	1/2" sweat	6.5
UP 15-10 B7	59896226	6 3/8	5 1/8	4	3 13/16	3 1/4	-	3/4" sweat	6.7
UP 15-10 B7/LC	59896209	6 3/8	6 5/8	5 1/2	3 13/16	3 1/4	4	3/4" sweat	7.5
UP 15-10 B7/TLC	59896210	6 3/8	6 5/8	5 1/2	3 13/16	3 1/4	4	3/4" sweat	7.5

Note: LC/TLC models have a 6 ft (1.8 m), 3-prong power cord.
Dimensions in inches unless otherwise noted.

Technical data

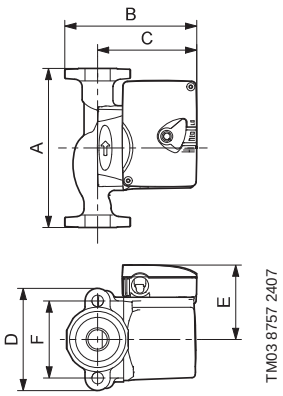


Flow range:	0-17 gpm
Head range:	0-19.5 feet
Motors:	2-pole, single-phase
Max. liquid temperature:	230 °F (110 °C)
Min. liquid temperature:	36 °F (2 °C)
Max. system pressure:	145 psi (10 bar)

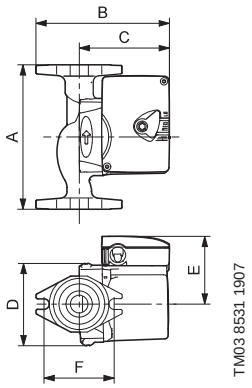
Model	Spd	Volts	Amps	Watts	Hp	Capacitor
UPS 15-58 FC/FRC	3	115	0.75	87	1/25	10µF/180 V
	2		0.66	80	1/25	
	1		0.55	60	1/25	

———	Without check valve
- – – -	With check valve

UPS 15-58 FC



UPS 15-58 FRC



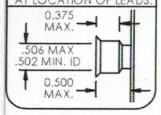
Approvals

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.

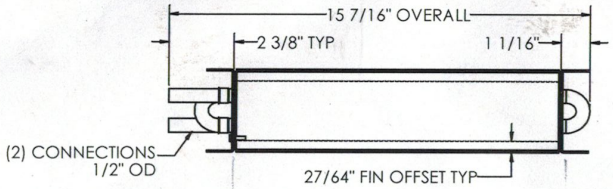
Cut 20
Remain 10" - 8m

FLARE DETAIL:
(2) TUBES EXPANDED AT LOCATION OF LEADS.

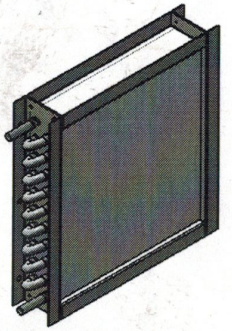


CSA FILE No: LR54641
UL FILE No: SA6697
MODEL DESIGNATION: CSA CD16
UL CD18

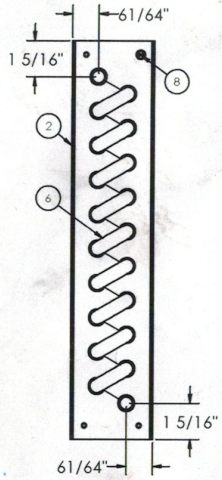
REVISIONS				
REV. NO.	DESCRIPTION	DATE	REVISED BY	APPROVED BY
X	Initial Check-in	06/08/2013		



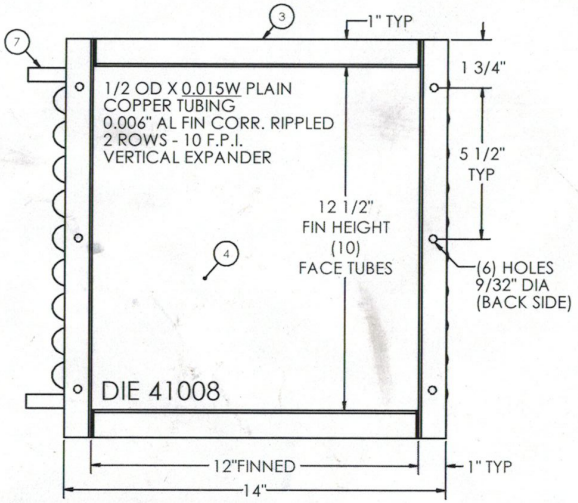
AIRFLOW



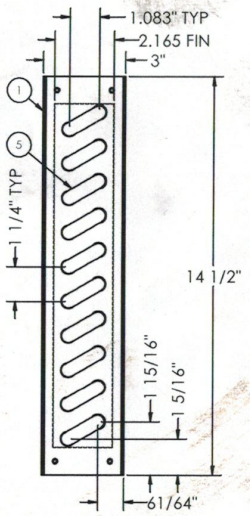
ISOMETRIC VIEW



HEADER END



BC9093A001



HAIRPIN END

QTY: 20 - .020W

1

Rgd

LENGTH : 13 3/8"

ITEM NO.	QTY.	DESCRIPTION	PART NUMBER	ITEM NO.	QTY.	DESCRIPTION	PART NUMBER
1	1	END PLATE (0.063 AL)	BS15101A002	6	9	RETURN BEND 1/2 OD X 0.020W,1.25 C-C	AR1048
2	1	END PLATE (0.063 AL)	BS15101A001	7	2	CONNECTION 1/2 OD	BT2744A022
3	2	TOP & BOTTOM PLATE (0.063 AL)	BS15102A001	8	8	SCREW TAPPING #8x1/2" SLOTTED HEX	SA1035
4	120	FIN 0.006 AL (AA1013)	FA41802B10CR06	9	2	CAP TO FIT 1/2 OD	JA1007
5	10	HAIRPIN 1/2 OD X 0.015 W	BT12198A065				

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. DECIMAL ± .XXX FRACTIONAL ± 1/32 ANGLES ± 1°

PROPRIETARY AND CONFIDENTIAL

DO NOT SCALE DRAWING

DRAWN JL AUG 06/13
CHECKED FP AUG 06/13
THIRD ANGLE PROJECTION

CANCOIL THERMAL CORPORATION
991, JOHN F. SCOTT ROAD
KINGSTON ONTARIO K7L 4V3
(613) 541-1235 (613) 541-1239 FAX

QUEENS

MODEL DESIGNATION: 4WS2B-10TX12(41008,PCRA)
CUSTOMER PART NO.
SIZE DWG. NO. BC9093X REV X-00
SCALE: 1:1 CAD FILE NAME: BC9093.SLDPRT SHEET 1 OF 1

1/2" x

Micro800™ Family of PLCs

Allen-Bradley

Featuring Allen-Bradley Connected Components Workbench™
Programming and Configuration Software

LISTEN.
THINK.
SOLVE.®

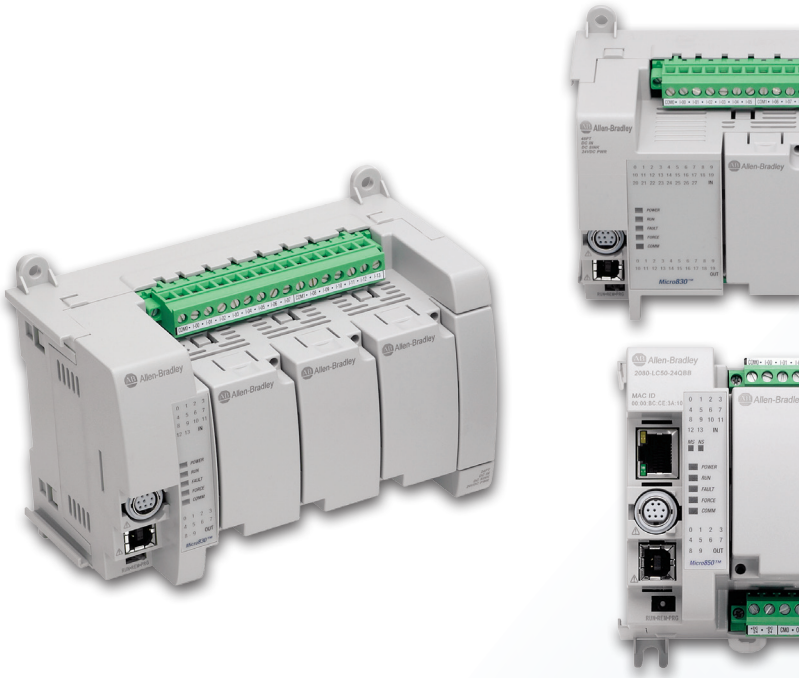
Allen-Bradley • Rockwell Software

Rockwell Automation

Micro800 PLCs and Connected Components Workbench Software

As a machine builder, are you looking to save money on acquisition costs and machine assembly time?

The next generation of micro programmable logic controllers (PLCs) from Rockwell Automation is your answer. The Allen-Bradley Micro800 PLC family, together with the Connected Components Workbench software, sets a new global standard for convenience and ease of use, while providing just enough control capability to match your lower-end application requirements. With a wide range of network interface devices, finding the right controller to fit your communication needs is easy.



Convenience and Connectivity

- Entire family shares common components and accessories
- Easy programming with embedded USB port
- Serial and Ethernet communications

Just Enough Control

- Wide range of small-size controllers (from 10-48pts) – designed for low cost, standalone machines
- Plug-in modules personalize the Micro800 controller, so you pay only for the capabilities you need

Easy to Install and Maintain

- IEC 61131-3 standard instructions
- User Defined Function Blocks for sharing and reuse of code
- Removable terminal blocks for easy installation and maintenance (select form factors)

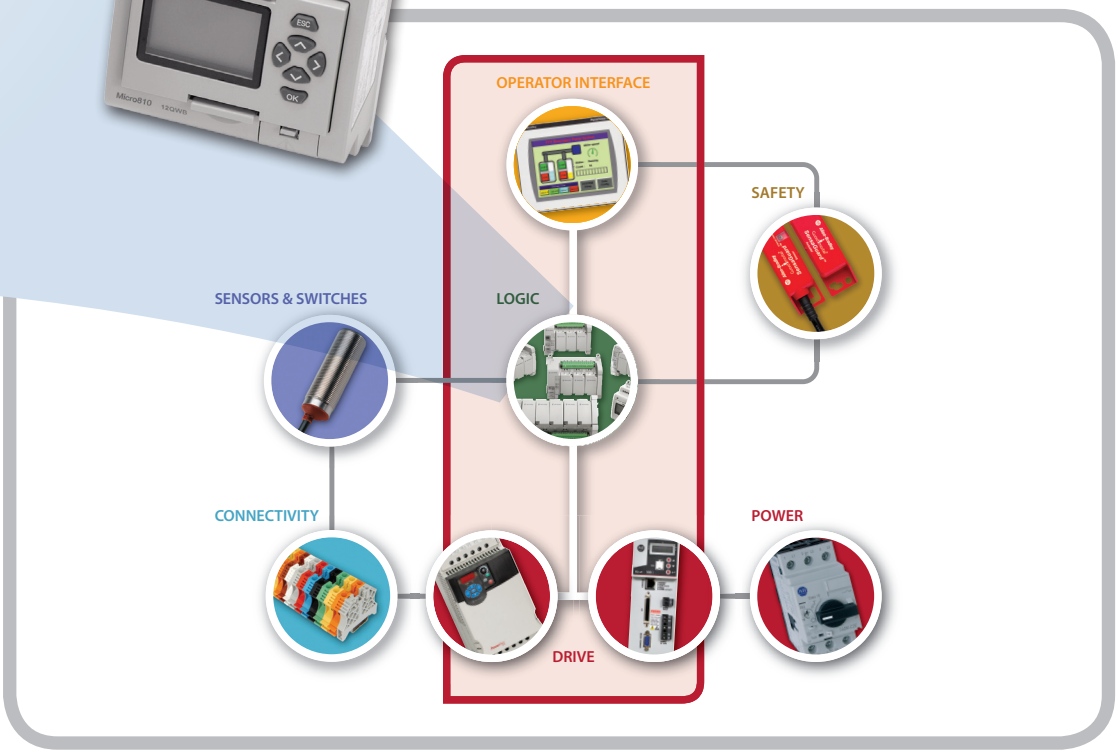
One Software

- Connected Components Workbench software is used for PLC programming, HMI and Drives configuration
- A common user experience helps reduce the learning curve through ease of use
- Download the Standard edition software for free
- Available in Chinese, English, French languages. Additional languages such as German, Italian and Spanish will be available soon

Part of the Connected Components Bundle

- *Connected Components Accelerator Toolkits make selection and application easy
  - Panel layout, Bill of Materials and Wiring Diagrams using E-Tools
- Preferred compatibility within the bundle of components
- Reduced supply chain costs
  - Source everything from your local Allen-Bradley Distributor

* For more information on Connected Components Accelerator Toolkits, visit http://www.rockwellautomation.com/components/connected/ccat.html



Micro810 and Micro830 Controllers

Micro810

- The Micro810 controller functions as a smart relay with high current relay outputs, in addition to the programming capabilities of a micro PLC
- 12-pt form factor provides:
  - 8A outputs eliminates the need for external relays
  - DC models allow 4 inputs to function as four 0-10V analog inputs
  - Program download via USB programming port (adapter required)
  - Optional 1.5" local LCD for monitoring/modifying application data. It also functions as a backup memory module.
  - Configure and run core smart relay function blocks without a PC (LCD required)
  - Built-in Real Time Clock for applications such as Lighting Control and Alarming
- As part of the Micro800 family, the Micro810 controller shares the same instruction set including advanced features such as PID and floating point data types which are not commonly found in a smart relay

Smart Relay Micro PLC

Flexible Micro PLC with Simple Motion

Micro830

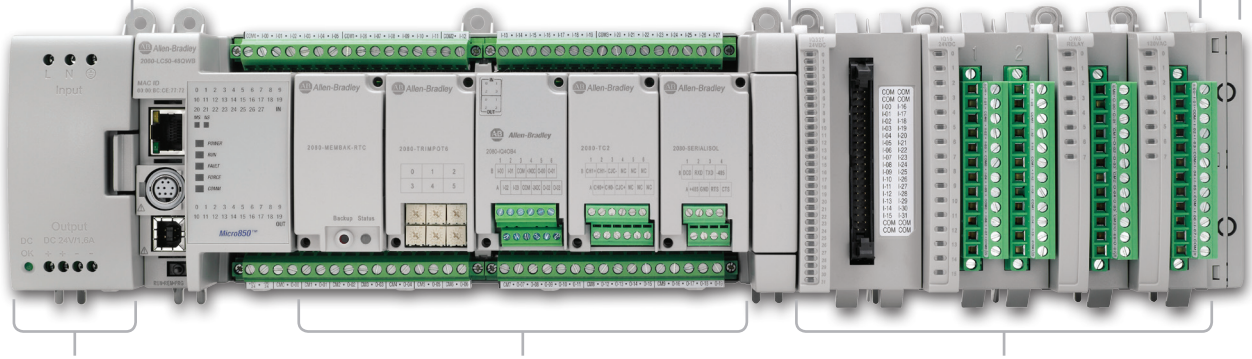
- The Micro830 controller is designed with flexibility to address a wide range of standalone machine control applications with support for up to 5 plug-in modules
- Different controller types sharing same form factor and accessories
  - Form factor based on number of I/O points embedded in the base: 10, 16, 24, or 48
  - Up to a maximum of 88 digital I/O (with 48-pt model)
  - Up to a maximum of 20 analog inputs (with 48-pt model)
- Includes built-in support for up to 3 axes of motion on 24V DC output models
  - Up to three 100KHz Pulse Train Outputs (PTO) for low cost wiring to steppers and servo drives
  - Up to six 100KHz High-Speed Counter inputs (HSC)
  - Single axis moves supported via Motion Function Blocks
  - Basic motion instructions include Home, Stop, MoveRelative, MoveAbsolute, MoveVelocity
  - TouchProbe instruction for registering exact position of an axis based upon an asynchronous event
- Embedded Communications
  - USB port for program download
  - Non-isolated serial port (RS232/485) for communications to HMI, bar code readers, modems

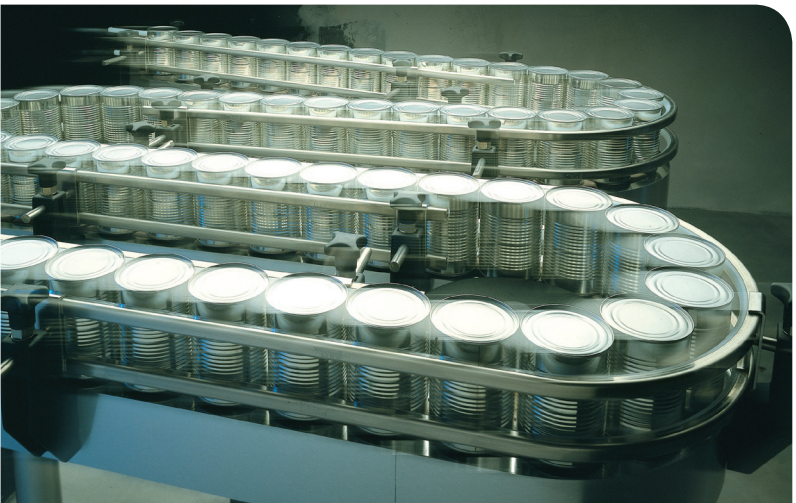
Micro850 Controller

Micro850

- The Micro850 controller is equipped with the same form factor, plug-in support, instruction/data size and motion capabilities as the 24-pt and 48-pt Micro830 controllers
- Designed for larger standalone machine applications that require more I/O or higher performance analog I/O than supported by Micro830
- Embedded Ethernet port for higher performance connectivity compared to HMI
- EtherNet/IP™ (server mode only) for Connected Components Workbench programming, RTU applications and HMI connectivity. (Client capability to initiate a message will be supported in a future release)
- Support up to four Micro850 Expansion I/O modules
- Up to a maximum of 132 I/O points (with 48-pt model)

Expandable Micro PLC with Ethernet



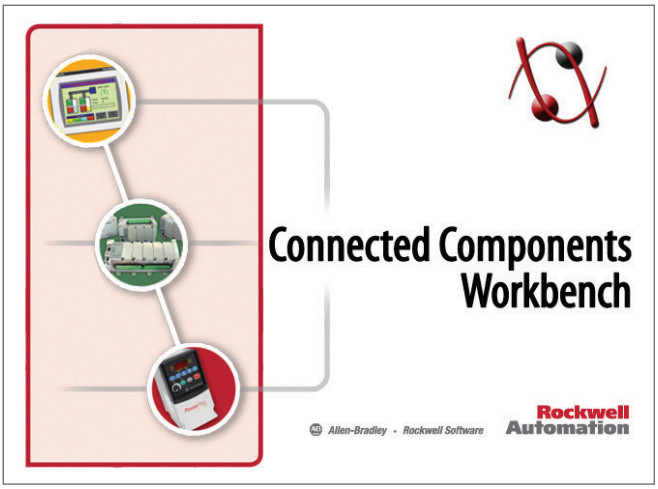


Micro850 controllers empower maximum customization and flexibility with plug-in and expansion I/O modules

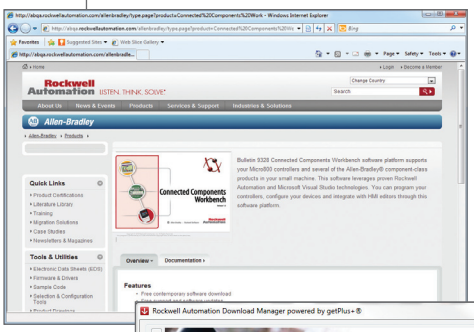
Connected Components Workbench Software

Connected Components Workbench is a new software platform supporting not only your Micro800 controllers, but also Allen-Bradley component-class drives, HMI and motion products in your small machine.

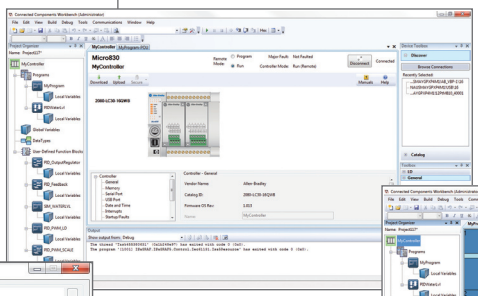
- Based on proven Rockwell Automation and Microsoft Visual Studio technology
- Controller programming, drives configurator, and integration with HMI editor



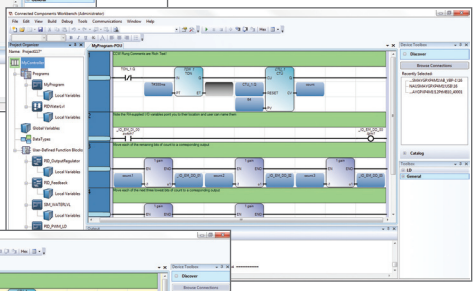
Easy to Acquire and Install
Free IEC 61131-3 standard software download helps minimize time to start machine development

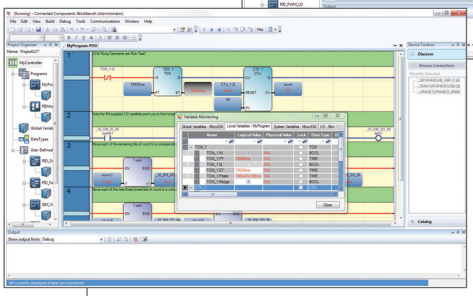


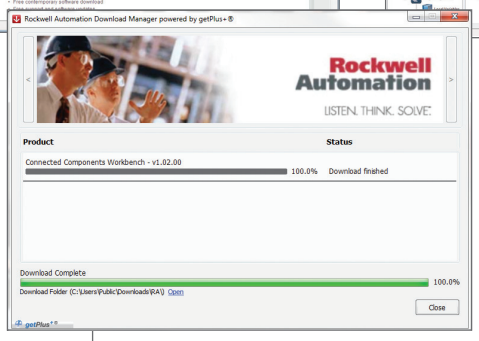
Easy to Configure
Common, easy configuration helps reduce time to commission machine controls



Easy to Program
Choice of programming languages with user defined function block support (ladder diagram, function block diagram, structured text) optimizes how you choose to control your machine

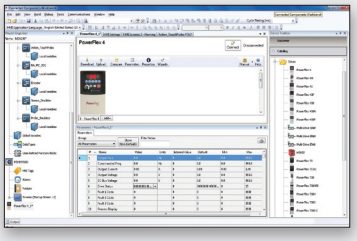






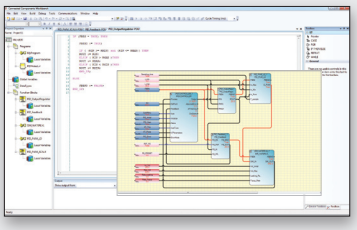
Easy to Update
Free standard software updates and limited free support minimize time consuming maintenance work

Easy to Test / Deploy
Robust debug features help reduce machine commissioning and maintenance times



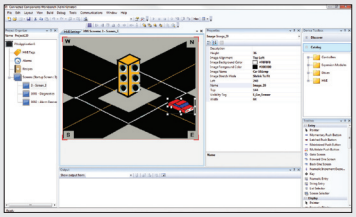
Device Configuration

- Common environment for:
  - Micro800 controllers
  - PowerFlex 4-class and 7-class drives
  - PanelView Component operator interface
- Simple connectivity to select devices via standard USB communication
- Graphical controller configuration rather than property dialog(s)



Programming

- Extensive use of Microsoft and IEC-61131 standards
- Value add through sample code from Rockwell Automation and partners via user defined function blocks
- Structured Text, Ladder Diagram and Function Block editors that support symbolic addressing



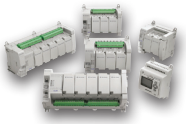
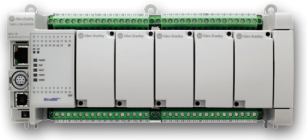
Visualization

- PanelView Component software runs within Connected Components Workbench for better user experience
- Using CIP support, Micro800 variable names can be directly referenced which results in less complexity and time-saving benefits
- Features include unicode language switching, alarm messages and history, and basic recipe capability

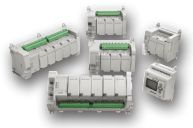
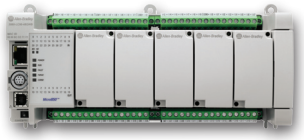
Specifications	Connected Components Workbench Software
	Standard
Controllers Supported	All Micro800 controllers
Programming languages	Ladder Diagram, Function Block Diagram, Structured Text
User Defined Function Blocks	Edit and Deploy
Device configuration	Supported
Delivery	Download for FREE or available on DVD (9328-SO001D-EN-C), orderable from Connected Components Workbench web page at: http://ab.rockwellautomation.com/Programmable-Controllers/Connected-Components-Workbench-Software

PC Specifications	Connected Components Workbench Software
	Standard
Processor	1.6 GHz CPU minimum 2.2 GHZ or higher CPU recommended
OS Supported	Windows XP and Windows 7
HD Disk Space required	2.5 GB
RAM	2048 MB minimum 4096 MB recommended
Optical drives	DVD
Video requirements	1024 x 768 minimum resolution 1280 x 1024 recommended

Micro800 PLC Family Overview Specifications

Bulletin 2080	Micro810	Micro830				Micro850	
							
Unit I/O	12pt	10pt	16pt	24pt	48pt	24pt	48pt
Embedded Communications	USB (with adapter)	USB, RS232/485	USB, RS232/485	USB, RS232/485	USB, RS232/485	USB, Ethernet, RS232/485	USB, Ethernet, RS232/485
Instructions/Data	2Ksteps/2Kbytes	4Ksteps/8Kbytes	4Ksteps/8Kbytes	10Ksteps/20Kbytes	10Ksteps/20Kbytes	10Ksteps/20Kbytes	10Ksteps/20Kbytes
Plug-in Modules	None	2	2	3	5	3	5
Catalog Number	**2080-LC10-12QWB*, 2080-LC10-12DWD**	**2080-LC30-10QWB**	**2080-LC30-16QWB**	**2080-LC30-24QWB**	**2080-LC30-48QWB**	**2080-LC50-24QWB**	**2080-LC50-48QWB**
Input - 12/24V [1]	8	6	10	14	28	14	28
Output - Relay	4	4	6	10	20	10	20
HSC[3]	–	2 HSC	2 HSC	4 HSC	6 HSC	4 HSC	6 HSC
Catalog Number	**2080-LC10-12QBB**	**–**	**–**	**2080-LC30-24QBB**	**2080-LC30-48QBB**	**2080-LC50-24QBB**	**2080-LC50-48QBB**
Input - 12/24V [1]	8	–	–	14	28	14	28
Output - 12/24V SOURCE	4	–	–	10	20	10	20
Motion Axis[2]/HSC[3]	–	1 PTO/2 HSC	1 PTO/2 HSC	2 PTO/4 HSC	3 PTO/6 HSC	2 PTO/4 HSC	3 PTO/6 HSC
Catalog Number	**–**	**2080-LC30-10QVB**	**2080-LC30-16QVB**	**2080-LC30-24QVB**	**2080-LC30-48QVB**	**2080-LC50-24QVB**	**2080-LC50-48QVB**
Input - 12/24V [1]	–	6	10	14	28	14	28
Output - 12/24 V SINK	–	4	6	10	20	10	20
Motion Axis[2]/HSC[3]	–	1 PTO/2 HSC	1 PTO/2 HSC	2 PTO/4 HSC	3 PTO/6 HSC	2 PTO/4 HSC	3 PTO/6 HSC
Catalog Number	**2080-LC10-12AWA**	**–**	**2080-LC30-16AWB**	**–**	**2080-LC30-48AWB**	**2080-LC50-24AWB**	**2080-LC50-48AWB**
Input - 120/240V AC	8 (120/240V AC)	–	10 (120V AC only)	–	28 (120V AC only)	14 (120V AC only)	28 (120V AC only)
Output - Relay	4	–	6	–	20	10	20
Base Unit							
Power Supply	Embedded 120/240V AC and 12/24V DC	Base Unit has embedded 24V DC Power Supply Optional External 120/240V AC via Cat. No. 2080-PS120-240VAC					
I/O							
Base Digital I/O (In/Out)	12 (8/4)	10 (6/4)	16 (10/6)	24 (14/10)	48 (28/20)	24 (14/10)	48 (28/20)
Base Analog I/O channels	Four of 24V DC digital inputs can be configured as 0-10V Analog inputs	Via Plug-In Modules				Via Plug-In Modules or with Expansion I/O modules	
Maximum Digital I/O	12	26	32	48	88	132	
Expansion I/O Modules	None	None				4	

1) 12/24V DC and 24V AC supported
2) Each Pulse Train Output Axis is shared with 2 HSC inputs so if max number of PTO is configured then number of HSC is zero
3) 2-wire High Speed Counter shown, divide by 2 to get number of 4-wire HSCs
*) Last letter of catalog number indicates Input Power: A=120/240V AC, B=24V DC, D=12V DC

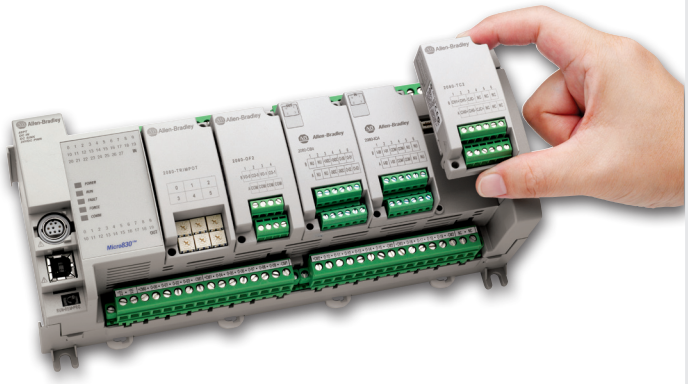
Bulletin 2080	Micro810	Micro830				Micro850	
							
Unit I/O	12pt	10pt	16pt	24pt	48pt	24pt	48pt
Additional Functions (Plug-In Modules)							
Isolated RS232/485	–	Via Plug-in, refer to Micro800 Plug-in Modules Specifications table for more details					
2/4-ch Analog	–						
RTD/TC	–						
Trim Potentiometer	–						
Back-up Memory Module	–						
High Precision Real-Time Clock	–						
Additional Functions							
Embedded Real-Time Clock	Yes	No				No	
LCD	Optional 1.5" Local	–				–	
Programming							
Software	Connected Components Workbench software						
IEC 61131-3 Languages	Ladder Diagram, Function Block, Structured Text						
User Defined Function Blocks	Yes						
Motion Instructions	No	Yes					
Floating Point Math	32-bit and 64-bit						
PID Loop Control	Yes						
Embedded Serial Port Protocols	N/A	Modbus RTU Master/Slave, ASCII, CIP					
Environmentals							
Certifications	c-UL-us CL1DIV2, CE, C-Tick, KC	c-UL-us CL1DIV2, CE, C-Tick, KC					
Temperature Range	0°…55°C	-20°…65°C (supports outdoor RTU applications) Condensation not allowed					
Dimensions (HxWxD, mm)	90 x 75 x 60	90 x 100 x 80	90 x 100 x 80	90 x 145 x 80	90 x 230 x 80	90 x 145 x 80	90 x 230 x 80

See online catalog for complete specifications

Micro800 Plug-In Modules

Change the "Personality" of the Base Unit Controller with Space-saving Plug-in Modules

- Extend the functionality of embedded I/O without increasing the footprint of your controller
- Increase communication functionality
- Utilize Encompass™ Product Partners' expertise to add enhanced capabilities with tighter integration to the controller
- Plug-in flexibility applies to Micro830 and Micro850 controllers

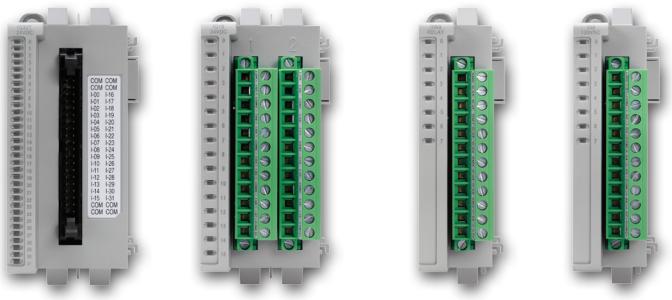


Plug-Ins

- **Analog Input/Output** (2-channel / 4-channel, non-isolated)
  - Up to 20 Analog inputs
- **Digital Input/Output**
  Up to a total of 88 digital I/O points on a 48-pt controller
- **Resistance Temperature Detector/Thermocouple** (2-channel, non-isolated)
  - Makes temperature control possible when used with PID
- **Trim Potentiometer** (6-channel, analog input)
  - Low cost method of adding six analog presets for speed, position and temperature control. Allows simple tuning or adjustment of system without PC.
- **Serial Port RS232/485** (isolated)
  - Address even the most intensive serial communications tasks with CIP, Modbus RTU and ASCII protocol support. Up to five additional serial ports.
- **Micro830/850 Backup Memory with High Accuracy Real-Time Clock**
  - Can be used to clone/update Micro800 application code
  - Adds precision real-time clock function without needing to calibrate or update

Micro850 Expansion I/O Modules

- The Micro850 Expansion I/O module snaps firmly to the right side of Micro850 controller with removable terminal blocks for ease of installation, maintenance and wiring
- High density digital and analog I/Os to reduce space consumption
- Isolated and higher resolution analog, RTD, and TC (than plug-in modules) for more accuracy



Micro800 Plug-in Modules Specifications

Plug-in Modules		
Category	Catalog Number	Description
Digital I/O	2080-IQ4	4-pt Digital Input, 12/24VDC, Sink/Source, Type3
	2080-OB4	4-pt Digital Output, 12/24VDC, Source
	2080-OV4	4-pt Digital Output, 12/24VDC, Sink
	2080-OW4I	4-pt Relay Output, Individually Isolated, 2A
	2080-IQ4OB4	8-pt Combo: 4-pt Digital Input, 12/24VDC, Sink/Source, Type3, and 4-pt Digital Output, 12/24VDC, Source
	2080-IQ4OV4	8-pt Combo: 4-pt Digital Input, 12/24VDC, Sink/Source, Type3, and 4-pt Digital Output, 12/24VDC, Sink
Analog I/O	2080-IF4	4-ch Analog Input, 0-20 mA, 0-10V, non-isolated 12-bit
	2080-IF2	2-ch Analog Input, 0-20 mA, 0-10V, non-isolated 12-bit
	2080-OF2	2-ch Analog Output 0-20 mA, 0-10V, non-isolated 12-bit
Communications	2080-SERIALISOL	RS232/485 isolated serial port
Specialty	2080-TRIMPOT6	6-ch Trimpot Analog Input
	2080-RTD2	2-ch RTD, non-isolated, ±1.0 °C
	2080-TC2	2-ch TC, non-isolated, ±1.0 °C
Backup Memory	2080-MEMBAK-RTC	Memory Backup and High Accuracy RTC

Plug-in Module Development by Encompass Product Partners

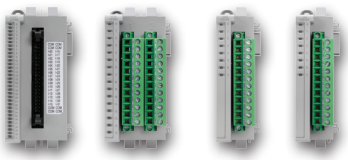
ProSoft® TECHNOLOGY

SPECTRUM CONTROLS

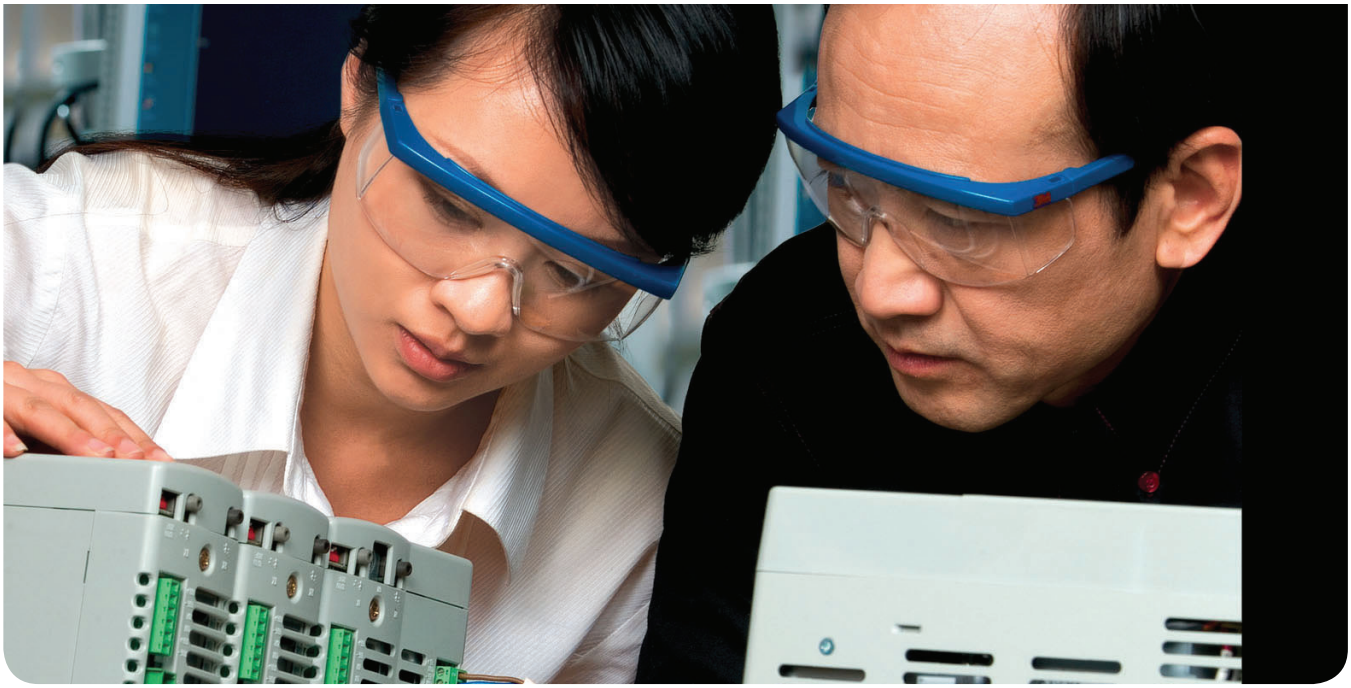
HARDY PROCESS SOLUTIONS Measurement • Automation • Productivity

Plug-in Modules Developed by Encompass Product Partners		
Function	Catalog Number	For more information
SMS	ILX800-SMSG	www.prosoft-technology.com
Universal Analog Input/ High Current Current Relay Output	2080sc-IF4u	www.spectrumcontrols.com
	2080sc-OW2IHC	
Weigh Scale Interface	HI2080-WS	www. hardysolutions.com

Micro850 Expansion I/O Modules Specifications



Expansion I/O Modules		
Category	Catalog Number	Description
Digital I/O	2085-IQ16	16-pt Digital Input, 12/24VDC, Sink/Source
	2085-IQ32T	32-pt Digital Input, 12/24VDC, Sink/Source
	2085-OV16	16-pt Digital Output, 12/24VDC, Sink
	2085-OB16	16-pt Digital Output, 12/24VDC, Source
	2085-OW8	8-pt Relay output, 2A
	2085-OW16	16-pt Relay output, 2A
	2085-IA8	8-pt 120 VAC input
	2085-IM8	8-pt 240 VAC input
	2085-OA8	8-pt 120/240 VAC output
Analog I/O	2085-IF4	4-ch Analog Input, 0 ~ 20mA, -10V ~ +10V, isolated, 14-bit
	2085-IF8	8-ch Analog Input, 0 ~ 20mA, -10V ~ +10V, isolated, 14-bit
	2085-OF4	4-ch Analog Output, 0 ~ 20mA, -10V ~ +10V, isolated, 12-bit
Specialty	2085-IRT4	4-ch RTD and TC , isolated, ±0.5 °C
Bus Terminator	2085-ECR	End Cap Terminator



Visit our website for the most up-to-date product information, downloads and tools:
http://ab.rockwellautomation.com/Programmable-Controllers/Micro800

Rockwell Automation offers a breadth of quality Allen-Bradley® components to fit your specific needs.
In order to assist you with your component selection, we offer a variety of configuration and selection tools.

Local Distributor
Contact your local distributor today.
http://www.rockwellautomation.com/distributor/

On-Line Product Directory
Our extensive product portfolio is designed to improve your processes through every stage of your manufacturing cycle.
http://www.rockwellautomation.com/products/

Product Selection Toolbox
Our powerful range of product selection and system configuration tools assist you in choosing and applying our products.
http://www.rockwellautomation.com/en/e-tools/

Catalogs
Within our catalogs you'll find an extensive selection of essential Allen-Bradley component products.
http://www.ab.com/catalogs/

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 2080-BR001B-EN-P - August 2012
Supersedes Publication 2080-BR001A-EN-P – March 2011

The new degree of comfort.™

Solaraide™ tanks with multi-port connections are available as electric backup water heaters and as storage tanks for solar water heating systems

Features & Benefits

- Connection ports on the top, right and left side fit more installations and reduce SKUs
- Two well insulated models to choose from…a storage tank or a high efficiency 4500 Watt backup electric water heater
- Electric backup model provides at least 40-gallons of stored hot water

Easy Installation and Maintenance

- Collector feed and return fittings conveniently located on front of tank for easy installation
- A special 1/2" NPT opening is provided for installation of a “probe type” thermostat
- Durable brass drain valve for easy maintenance

Tank Design & Construction

- Cold water inlet brings cold water to tank bottom to prevent mixing with heated water
- Rheemglas® tank lining resists corrosion and prolongs tank life
- Anode rod equalizes aggressive action for prolonged tank life
- Temperature and pressure relief valve included
- Electric backup model has automatic temperature control and over heat protection

Warranty

- 6-Year limited tank and parts warranty*

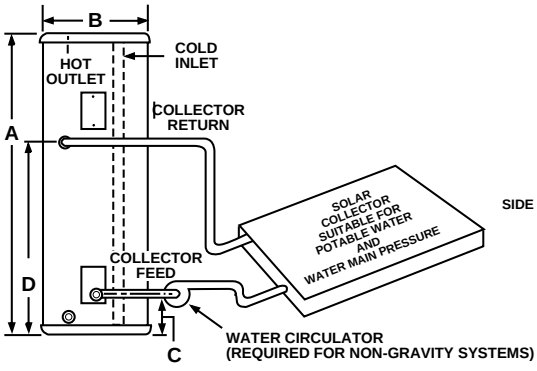
*See Residential Warranty Certificate for complete information

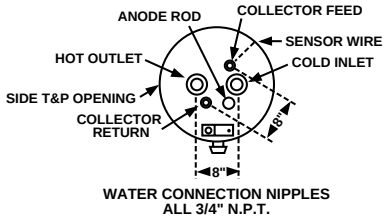
Units meet or exceed ANSI requirements and have been tested according to D.O.E. procedures. Units meet or exceed the energy efficiency requirements of NAECA, ASHRAE standard 90, ICC Code and all state energy efficiency performance criteria.

This unit uses the potable water within the tank for circulation through the solar system.

Solaraide Tanks

80- and 120-Gallon Capacities
Electric WHs and Storage Tanks
Connection Ports: Top & Sides





DESCRIPTION				ROUGHING IN DIMENSIONS (SHOWN IN INCHES)					ENERGY INFO.
TYPE	GAL. CAP.	MODEL NUMBER	ELEMENT WATTAGE UPPER	HEIGHT A	DIAMETER B	HEIGHT TO COLLECTOR FEED C	HEIGHT TO COLLECTOR RETURN D	APPROX. SHIP WT. (LBS.)	APPROX. R-FACTOR
TALL	80	81VR80U-1	4500 W*	58-3/4	24-1/2	3	38-1/4	192	R-17.3
	80	81VR80U-T	Storage Only	58-3/4	24-1/2	3	38-1/4	192	R-17.3
	120	81VR120U-1	4500 W*	62	28-1/4	3-3/4	38-1/2	336	R-16.7
	120	81VR120U-T	Storage Only	62	28-1/4	3-3/4	38-1/2	336	R-16.7

*Heaters furnished with standard 240 volt AC, single phase non-simultaneous wiring and 4500 watt heating element.
If heating elements of different wattages than those shown are demanded by zone requirements, they must be specifically requested.
Solaraide models meet all current requirements for solar storage tanks.
The tanks are Rheemglas lined and are designed to operate up to 150 PSI.

In keeping with its policy of continuous progress and product improvement, Rheem reserves the right to make changes without notice.

Rheem Water Heating • 101 Bell Road
Montgomery, Alabama 36117-4305 • www.rheem.com

Rheem Canada Ltd./Ltée • 125 Edgeware Road, Unit 1
Brampton, Ontario L6Y 0P5 • www.rheem.com

PRINTED IN U.S.A. 12/11 WP FORM NO. 101-1 Rev. 17

Zone Valve Nomenclature

ZONE2	15	N	-10	+ZONE24NC	-S
Valve Zone2 = 2-way Zone3 = 3-way	**Valve Size** 15 = ½” 20 = ¾” 25 = 1”	**End Fitting** N = NPT Female Connection S = Sweat Connection	**C_V Valve** -10 = 1.0 -25 = 2.5 -35 = 3.5 -50 = 5.0 -80 = 8.0	**Actuator Type** 24NC = 24 Volt Normally Closed 24NO = 24 Volt Normally Open 120NC = 120 Volt Normally Closed 120NO = 120 Volt Normally Open	-S = Built-in Auxiliary Switch

Ordering Example

1 Choose the valve.

ZONE215N-10+ **ZONE24NC** **-S** **+Tagging (if needed)**

2 Choose the actuator.

Set-Up

- 24 = 24 VAC
- -S = Built-in Auxiliary Switch
- **NC** = Normally Closed

3 Does order require tagging?

Tagging:
Valves may be tagged per customer specification. ($10.00 charge per tag)

Example:
FCU-1

Part number for tagging:
99981-00101

4 Complete Ordering Example: ZONE215N-10+ZONE24NC-S

Control Valve Product Range

Zone Valve Product Range
2-way and 3-way

2-way								
	Valve Nominal Size		Type		Suitable Actuators			
C_V	Inches	DN [mm]	NPT	Sweat	Normally Closed		Normally Open	
1	½	15	ZONE215N-10	ZONE215S-10	Zone	Zone (with Switch)	Zone	Zone (with Switch)
2.5	½	15	ZONE215N-25	ZONE215S-25				
3.5	½	15	ZONE215N-35	ZONE215S-35				
3.5	¾	20	ZONE220N-35	ZONE220S-35				
5	¾	20	ZONE220N-50	ZONE220S-50				
8	1	25	ZONE225N-80	ZONE225S-80				

3-way						
	Valve Nominal Size		Type		Suitable Actuators	
C_V	Inches	DN [mm]	NPT	Sweat	Normally Closed	
1	½	15	ZONE315N-10	ZONE315S-10	Zone	Zone (with Switch)
2.5	½	15	ZONE315N-25	ZONE315S-25		
3.5	½	15	ZONE315N-35	ZONE315S-35		
3.5	¾	20	ZONE320N-35	ZONE320S-35		
5	¾	20	ZONE320N-50	ZONE320S-50		
8	1	25	ZONE325N-80	ZONE325S-80		

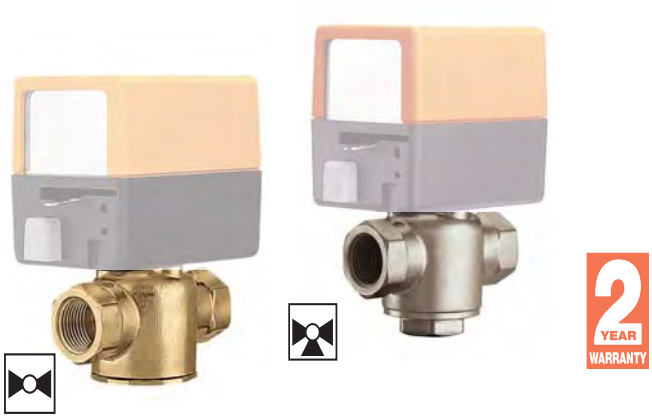
Applications
- Fan coil units and baseboards where fail safe operation or 2-wire control is required
- Hydronic systems with variable or constant flow

Mode of Operation
Zone valves provide a convenient way to create individual zones or equipment isolation in a hydronic system. Utilizing one pump along with multiple zone valves, flow can be started, stopped, or diverted through the system to provide individual room or area comfort control and energy savings.

Product Features
Zone valve is designed to fit in compact areas where on/off control is required using 24 VAC or 120 VAC.

Actuator Specifications	
Control type	On/Off, Diverting
Manual override	all versions
Electrical connection	6" [15cm] wire lead 120 V; 18" [45 cm] wire lead 24 V

Valve Specifications	
Service	chilled or hot water, 50% glycol
Flow characteristic	
Two-way	On/Off
Three-way	On/Off, Diverting
Sizes	½", ¾" and 1"
Type of end fitting	NPT female ends or sweat
Materials	
Body	forged brass
Stem	stainless steel
Seals	EPDM
Pressure rating	300 psi
Media temp range	32°F to 212°F [0°C to 100°C]
Close off pressure	20-75 psi
Leakage	ANSI Class III 0.1%
Cv rating	see product chart for values



Application

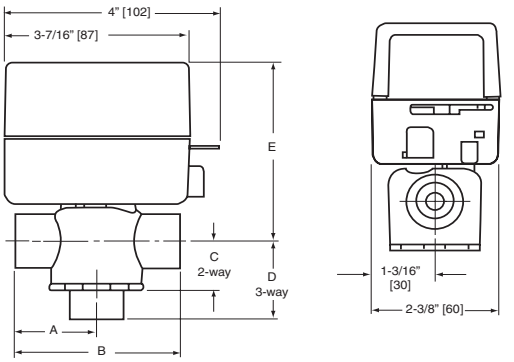
This valve is typically used on fan coil units, baseboards or other hydronic applications where fail-safe operation or 2-wire control is required. This valve is suitable for use in a hydronic system with variable or constant flow.

This valve is designed to fit in compact areas where on/off or control is required using 24 VAC or 120 VAC.

Technical Data	
Service	chilled or hot water, 50% glycol
Flow characteristic two-way three-way	 on/off on/off diverting
Sizes	½", ¾", and 1"
Type of end fitting	female, NPT or Sweat
Materials: Body Stem Seals	 forged brass stainless steel EPDM
Body pressure rating	300 psi
Media temp. range	32°F to 212°F [0°C to 100°C]
Close off pressure	20-75 psi
Leakage	Class III 0.1%
C_v rating	1.0-8.0

Dimensions

D098



Connection Size and type	A in.(mm)	B in.(mm)	C in.(mm)	D in.(mm)	E in.(mm)
1/2" sweat	1-5/16" [34]	2-5/8" [38]	15/16" [24]	1-5/16" [34]	3-1/2" [89]
3/4" sweat	1-3/8" [35]	2-3/4" [70]	15/16" [24]	1-1/2" [38]	3-1/2" [89]
1" sweat	1-11/16" [43]	3-3/8" [86]	15/16" [24]	1-9/16" [39]	3-11/16" [93]
1/2" NPT	1-7/16" [36]	2-7/8" [72]	15/16" [24]	1-1/4" [32]	3-1/2" [89]
3/4" NPT	1-9/16" [39]	3-1/16" [92]	15/16" [24]	1-1/4" [43]	3-11/16" [93]
1" NPT	1-13/16" [46]	3-5/8" [92]	15/16" [24]	1-11/16" [43]	3-11/16" [93]

For Commercial Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Series GLV
Bronze Globe Valves

Sizes ¼" - 2" (8 - 50mm)

Series GLV Bronze Globe Valves are ideal for general service on water, steam, oil or compressed gas applications. This Series features threaded IPS bonnet, rising stem, bronze disc and bronze body.

Features

- Threaded IPS bonnet
- Rising stem
- Bronze disc
- Bronze body
- ¼" - 2" (8 - 50mm) threaded end connections

Materials List

Part	Material
*Body	ASTM B-584
*Bonnet	ASTM B-584
Stem	Brass
*Disc	ASTM B-584
Lock Nut	Brass
Packing Nut	Brass
Gland	Brass
Gland Packing	Teflon®
Hand Wheel	Cast Iron
Wheel Nut	Brass
Name Plate	Aluminum

*Bronze: ASTM B-584 / UNS-C84400

Pressure — Temperature

- 125psi (8.6 bar) WSP to 353ºF
- 200psi (13.8 bar) WOG non-shock

Specifications

Valve shall be manufactured using ASTM B-584 bronze and be pressure rated to 125psi WSP, 200psi WOG non-shock. Valve shall have threaded bonnet, rising stem and bronze disc. Valve shall be a Watts Series GLV.

SIZE (DN)		Dimensions						Weight	
		A		C		K			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kg*
¼	8	1 13/16	41	2 15/16	74	2	50	.71	.32
⅜	10	1 13/16	41	2 15/16	74	2	50	.71	.32
½	15	1 15/16	49	2 15/16	74	2 5/16	58	.74	.34
¾	20	2 ¼	57	3 ⅛	79	2 ½	64	1.25	.57
1	25	2 5/16	58	3 ¾	95	2 13/16	71	1.93	.88
1 ¼	32	2 15/16	74	4 ⅛	105	3 ½	89	2.33	1.06
1 ½	40	3 5/16	84	4 ¾	121	3 ⅝	92	4.20	1.90
2	50	3 ⅞	98	5 ½	140	4 ⅛	105	5.50	2.50

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.

ISO 9001-2000 CERTIFIED

U.S. GREEN BUILDING COUNCIL MEMBER

WATTS®

A Watts Water Technologies Company

USA: 815 Chestnut St., No. Andover, MA 01845-6098; www.watts.com
Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscanada.ca

For Residential Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

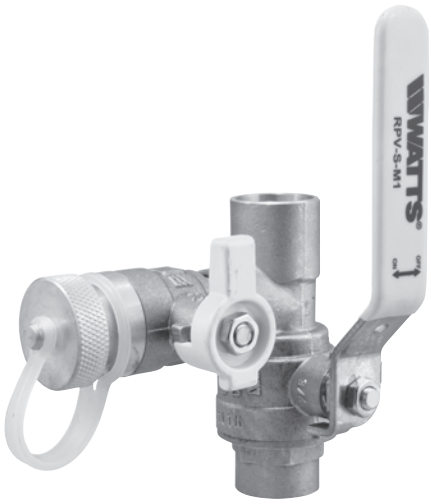
Approval _____ Representative _____

Series RPVM1

Residential Purge, Drain and Balancing Valves

Sizes: ¾" – 1¼" (20 – 32mm)

Series RPVM1 Residential Purge, Drain and Balancing Valves provide a unique and low cost solution for start-up purging, balancing and draining of hydronic heating loops. Using a rugged, dual-ball valve design, the small and compact RPVM1 facilitates high volume purging, accurate balancing, tight shutoff and hose connection for draining and purging.



¾" RPVM1-S

Features

- One-piece construction – no extra assembly required
- ½" ball valve purge port
- Positive shutoff dual-ball valve design – tight seal on balance port maximizes purging
- Cast purge port handle

Models

RPVM1-S solder inlet x solder outlet, ¾", 1", 1¼"

RPVM1-ST solder inlet x female NPT outlet, ¾", 1", 1¼"

Specifications

A purge, drain and balancing valve shall be installed where indicated on the plans. The valve shall facilitate high volume purging, accurate balancing, tight shutoff and hose connection for draining and purging. The valve shall feature a dual-ball valve design. The valve shall be a Watts Series RPVM1.

Materials

Body: Brass

Ball: Plated brass

Seats: Virgin PTFE

Pressure – Temperature

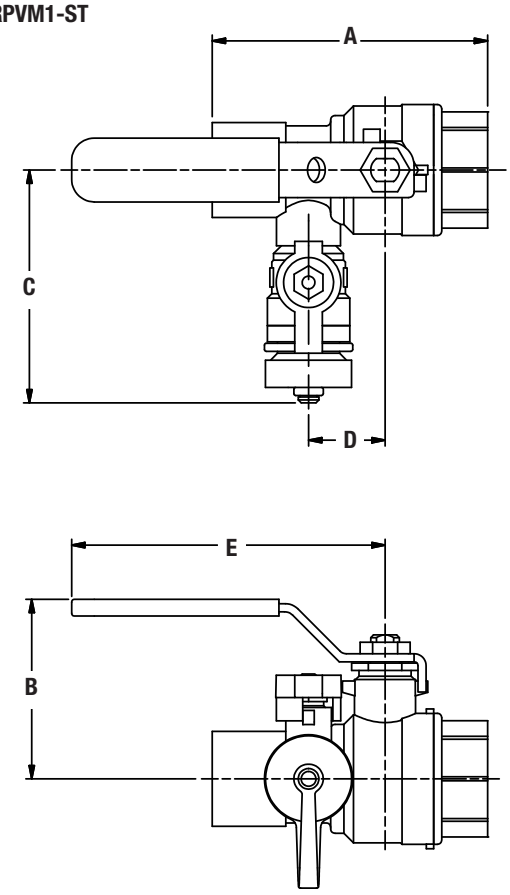
Maximum Inlet Temperature: 250°F (121°C)

Maximum Working Pressure: 50psi (344 kPa)

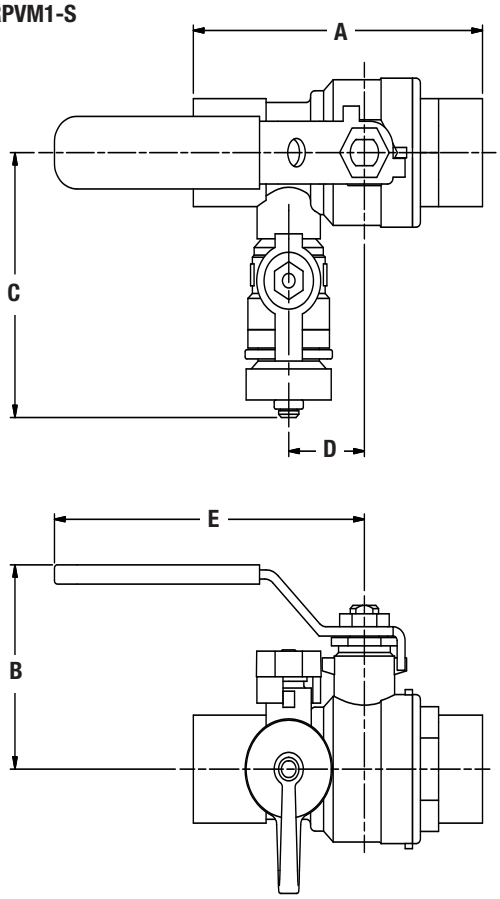
WATTS®

Dimensions – Weights

RPVM1-ST



RPVM1-S



MODEL	CONNECTIONS				DIMENSIONS										WEIGHT	
			Size		A		B		C		D		E			
	inlet	*outlet*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
RPVM1-S	solder	solder	¾"	20	3 5/16	84	2 1/16	52	3 3/16	81	7/8	22	4	102	1.0	0.5
RPVM1-S	solder	solder	1"	25	4	102	2 7/16	62	3 3/16	81	1 1/16	27	4 1/4	108	1.5	0.7
RPVM1-S	solder	solder	1¼"	32	4 3/8	111	2 9/16	65	3 5/16	84	1 3/16	30	4 1/4	108	2.0	0.9
RPVM1-ST	solder	FPT	¾"	20	3 1/8	79	2 1/16	52	3 1/4	83	7/8	22	4	102	1.1	0.5
RPVM1-ST	solder	FPT	1"	25	3 3/4	95	2 7/16	62	3 3/16	81	1 1/16	27	4 1/4	108	1.6	0.7
RPVM1-ST	solder	FPT	1¼"	32	4 1/8	105	2 1/2	64	3 5/16	84	1 3/16	30	4 1/4	108	2.0	0.9

USA: No. Andover, MA • Tel: (978) 688-1811 • Fax: (978) 794-1848 • www.watts.com

Canada: Burlington, ON • Tel: (905) 332-4090 • Fax: (905) 332-7068 • www.wattscanada.ca

For Commercial and Industrial Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Series B6000, B6001

2-Piece, Standard Port, Bronze Ball Valves

Sizes: ¼" – 4" (8 – 100mm)

Series B6000, B6001 2-Piece, Standard Port, Bronze Ball Valves feature a blowout proof pressure retaining stem. The B6000, B6001's standard port orifice ensures minimal pressure drop, while Durafill® and Uniseal® seats and chrome plated brass ball provide lasting service for a wide range of liquids and gases.

Features

- Durafill® (carbon/glass filled PTFE) seats for sizes ¼" – ½" (8 – 15mm) and 1¼" – 4" (32 – 100mm) and Uniseal® (enhanced PTFE) seats for sizes ¾" & 1" (20 & 25mm) for lasting service for a wide range of liquids and gases
- Chrome plated brass ball is wiped clean during each operation of the valve
- Minimal pressure drop due to large ports
- Blowout proof, pressure retaining stem
- ¼" – 3" (8 – 80mm) pressure rated at 600psi (41 bars) WOG non-shock; 150psi (10 bars) WSP. 4" (100mm) pressure rated at 400psi (28 bars) WOG non-shock; 125psi (8.6 bars) WSP (over 150psi steam requires SS trim)
- High cycle life reinforced PTFE stem packing seal and thrust washer
- Vinyl insulator on heavy duty, zinc-plated, carbon steel handles
- Quarter-turn open or close operation
- Low operating torque
- Adjustable stem packing gland
- Each valve factory tested

Models

B6000 ¼" – 4" (8 – 100mm) threaded NPT end connections

B6001 ⅜" – 3" (10 – 80mm) solder end connections*

Specifications

A 2-piece standard port bronze ball valve to be installed as indicated on the plans. The valve must have a blowout proof pressure retaining stem, Durafill® seats (¼" – ½" & 1¼" – 4") or Uniseal® seats (¾" & 1"), reinforced PTFE stem packing seal, and chrome plated brass ball. Valves with top loaded stems or valves without adjustable packing are not acceptable. Pressure rating no less than 600psi (41 bars) WOG non-shock; 150psi (10 bars) WSP for ¼" – 3" and 400psi (28 bars) WOG non-shock; 125psi (8.6 bars) WSP for 4". Valve must conform to MSS-SP-110 and shall be a Watts Regulator Company Series B6000 (threaded) or B6001 (solder).

Durafill® is a registered trademark of Cargill, Limited.

Uniseal® is a registered trademark of Uniseal, Incorporated.

BAA/ARRA Compliant**

****This product complies with the Buy American Act and The American Recovery and Reinvestment Act. For more information, visit watts.com.**

Options

Suffix	
01/VT-	Virgin Teflon® seat material
SS-	316 stainless steel ball and stem
LH-	Locking lever handle
OV-	High profile safety oval handle
OVLH-	Oval locking handle
RH-	Round Handle
SH-	Stainless steel handle and nut
BS-	Balancing stop
XH-	Extended handle
TH-	Tee handles ¼"-2" (8-50mm)
GS-	Ground Washer
CC-	¾" (20mm) hose thread outlet. Hose thread outlet has cap & chain. Inlet sizes: ½" and ¾" (15-20mm) NPT. Also ½" and ¾" (15-20mm) solder inlet connection
SE-	Safety Exhaust (Max pressure rating: 175psi)
SC-	Rough chrome ¼"-2" (8-50mm)
Z15-	Less lever and nut
04-	Mineral filled PTFE seats and seals (available only with 316SS ball and stem)
U.L.-	UL approved as follows:

- Flammable Liquids (YRBX)
- Compressed Gas (YQNZ)
- Fire Protection (HNFX)
- LP Gas (YSDT)
- Natural/Manufactured Gas (YRPV)
- For #1/#2 Fuel Oils (MHKZ)

Pressure – Temperature

Temperature Range: 0°F – 450°F (-18°C – 232°C) @ 50psi (3.4 bars)

Pressure Range:

¼" – 3" (8 – 80mm),
600psi (41 bars) WOG non-shock; 150psi (10 bars) WSP

4" (100mm),
400psi (28 bars) WOG non-shock; 125psi (8.6 bars) WSP

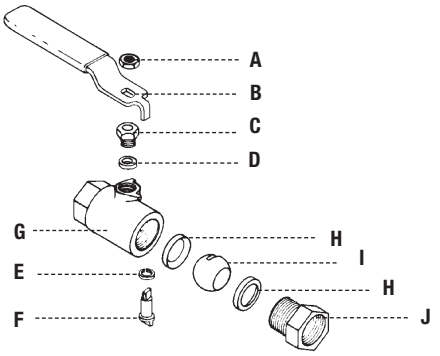
Use stainless steel trim (option SS) for steam pressures over 150psi (10 bars).

*This valve is designed to be soft soldered into lines without disassembly, using a low temperature solder 420°F (216°C). Other solders such as 95/5 tin antimony 460°F (238°C) or 96/4 tin silver 420°F (216°C) can be used, however extreme caution must be used to prevent seat damage. Higher temperature solders will damage the seat material. ANSI B.16.18 states that the maximum operating pressure of 50-50 solder connections is 200 psi (14 bars) at 100°F (38°C) and decreases with higher temperatures.

Apply heat with the flame directed **AWAY** from the center of the valve body. Excessive heat can harm the seats. After soldering, the packing nut may have to be tightened.

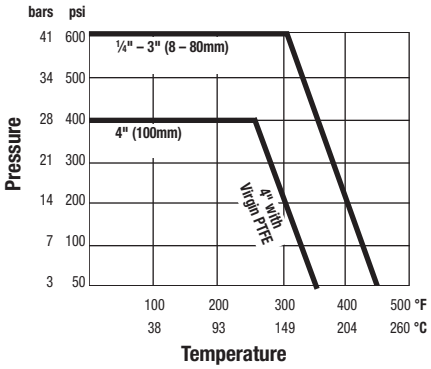
WATTS®

Materials



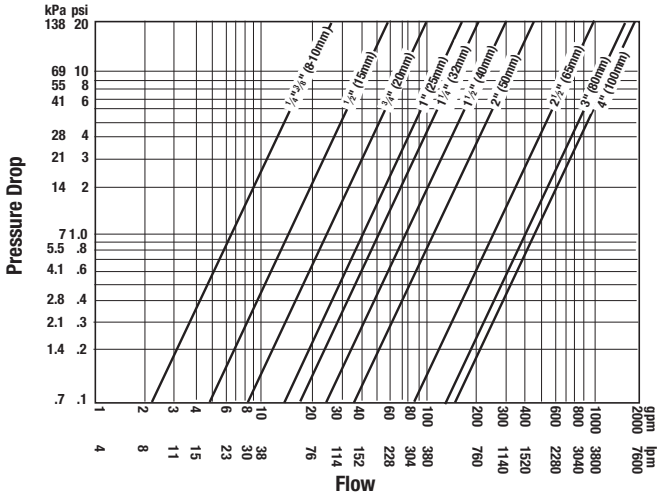
A	**Handle Nut**	Zinc Plated Carbon Steel
B	**Handle**	Zinc Plated Carbon Steel with Vinyl Insulator
C	**Packing Nut**	Brass ASTM B16, C36000
D	**Stem Packing**	Glass Reinforced PTFE
E	**Thrust Washer**	Glass Reinforced PTFE
F	**Stem**	Brass ASTM B16, C36000
G	**Body**	Cast Bronze ASTM B584, C84400
H	**Seats**	Durafill® (¼" – ½" & 1¼" – 4") Uniseal® (¾" & 1")
I	**Ball**	Chrome Plated Brass ASTM B16, C36000
J	**Adapter**	Brass ASTM B16, C36000
K	**Body Seals**	PTFE (1¼" – 4" only) - Not shown

Valve Seat Rating

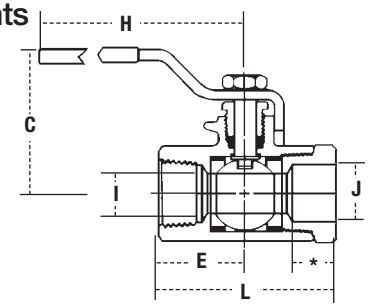


SIZE (DN)		C_V RATING	OPERATING TORQUE	
In.	*mm*		*in./lbs.*	*Nm*
¼	8	6	60	6.8
⅜	10	6	60	6.8
½	15	15	60	6.8
¾	20	25	90	10.2
1	25	40	150	16.9
1¼	32	50	175	19.8
1½	40	75	200	22.6
2	50	110	250	28.2
2½	65	260	500	56.5
3	80	400	600	67.8
4	100	450	800	90.4

Pressure Drop vs. Flow



Dimensions — Weights



B6000

SIZE DN		DIMENSIONS														WEIGHTS	
		C Center to Handle		E Center to End		H Radius of Handle		I Ball Orifice		J Dia. Solder Connection		L End to End		* Depth Solder Connection			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kg.*
¼	8	1¾	45	1 1/16	27	3 1/16	78	⅜	10	-	-	2 1/16	52	-	-	0.6	0.3
⅜	10	1¾	45	1 1/16	27	3 1/16	78	⅜	10	-	-	2 1/16	52	-	-	0.6	0.3
½	15	1¾	45	1 1/16	27	3¾	95	½	13	-	-	2¼	58	-	-	0.6	0.3
¾	20	2	51	1 7/16	36	3¾	95	11/16	17	-	-	2 13/16	72	-	-	1.0	0.5
1	25	2¼	57	1 11/16	43	4½	114	⅞	22	-	-	3 7/16	87	-	-	1.6	0.7
1¼	32	2½	64	1 15/16	49	3 13/16	97	1	25	-	-	3⅞	99	-	-	2.2	1.0
1½	40	3	76	2⅛	54	5½	140	1¼	32	-	-	4¼	108	-	-	3.2	1.5
2	50	3 5/16	84	2 7/16	62	5½	140	1½	38	-	-	4 13/16	122	-	-	4.9	2.2
2½	65	4	102	3 3/16	81	8⅛	206	2	51	-	-	6½	165	-	-	13.2	5.9
3	80	4¼	108	3 7/16	87	8⅛	206	2½	64	-	-	6 13/16	173	-	-	17.5	7.9
4	100	4 13/16	122	3⅞	98	11	279	3	76	-	-	7 11/16	195	-	-	29.3	13.3

B6001

⅜	10	1½	38	1 1/16	27	3¾	95	⅜	10	½	13	2 5/16	58	⅜	9	0.5	0.2
½	15	1¾	44	1 1/16	27	3¾	95	½	13	⅝	16	2⅜	60	½	13	0.6	0.3
¾	20	2	51	1 7/16	36	3¾	95	11/16	17	⅞	22	3 5/16	84	¾	19	1.1	0.5
1	25	2¼	57	1¾	44	4½	114	⅞	22	1⅛	28	3¾	95	⅞	22	1.4	0.6
1¼	32	2½	64	2¼	57	3 13/16	97	1	25	1⅜	35	4½	114	1	25	2.0	0.9
1½	40	3	76	2½	64	5½	140	1¼	32	1⅝	41	5	127	1 1/16	27	3.3	1.5
2	50	3 5/16	84	3⅛	80	5½	140	1½	38	2⅛	54	6¼	159	1 5/16	34	5.2	2.4
2½	65	4	102	3 11/16	93	8⅛	206	2	51	2⅝	67	7⅝	194	1 7/16	36	13.2	6.0
3	80	4¼	108	4 1/16	103	8⅛	206	2½	64	3⅛	80	8 3/16	208	1 11/16	43	15.6	7.1

* See Solder Instructions on front.

WATTS®

A Watts Water Technologies Company

U.S. GREEN BUILDING COUNCIL MEMBER

ISO 9001-2008 CERTIFIED

USA: No. Andover, MA • Tel. (978) 688-1811 • Fax: (978) 794-1848 • www.watts.com
Canada: Burlington, ONT. • Tel. (905) 332-4090 • Fax: (905) 332-7068 • www.wattscanada.ca

For Health Hazard Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Series 009

Reduced Pressure Zone Assemblies

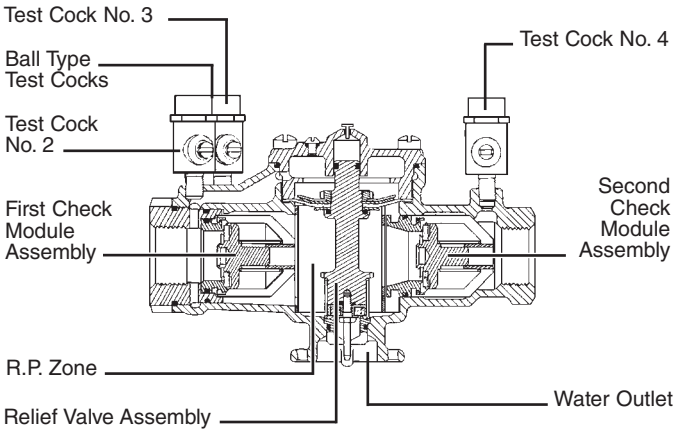
Sizes: ¼" – 3" (8 – 80mm)

Series 009 Reduced Pressure Zone Assemblies are designed to protect potable water supplies in accordance with national plumbing codes and water authority requirements. This series can be used in a variety of installations, including the prevention of health hazard cross connections in piping systems or for containment at the service line entrance.

This series features two in-line, independent check valves, captured springs and replaceable check seats with an intermediate relief valve. Its compact modular design facilitates easy maintenance and assembly access. Sizes ¼" – 1" (8 – 25mm) shutoffs have tee handles.

½" (15mm) 009QT

2" (50mm) 009M2QTHC



Features

- Single access cover and modular check construction for ease of maintenance
- Top entry - all internals immediately accessible
- Captured springs for safe maintenance
- Internal relief valve for reduced installation clearances
- Replaceable seats for economical repair
- Bronze body construction for durability ¼" – 2" (8 – 50mm)
- Fused epoxy coated cast iron body 2½" and 3" (65 and 80mm)
- Ball valve test cocks — screwdriver slotted ¼" – 2" (8 – 50mm)
- Large body passages provides low pressure drop
- Compact, space saving design
- No special tools required for servicing

Specifications

A Reduced Pressure Zone Assembly shall be installed at each potential health hazard location to prevent backflow due to backsiphonage and/or backpressure. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access bronze cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting. The assembly shall meet the requirements of: USC Manual 8th Edition†; ASSE Std. 1013; AWWA Std. C511; CSA B64.4. Shall be a Watts Regulator Co. Series 009.

Now Available
WattsBox Insulated Enclosures.
For more information, send for literature ES-WB.

IMPORTANT: *INQUIRE WITH GOVERNING AUTHORITIES FOR LOCAL INSTALLATION REQUIREMENTS*

†Does not indicate approval status. Refer to Page 2 for approved sizes & models.

WATTS®

Available Models: ¼" – 2" (8 – 50mm)

Suffix:

QT – quarter-turn ball valves
S – bronze strainer
LF – without shutoff valves
AQT – elbow fittings for 360° rotation ¾" – 2" (20 – 50mm) only
PC – internal Polymer Coating
LH – locking handle ball valves (open position)
SH – stainless steel ball valve handles
HC – 2½" inlet/outlet fire hydrant fitting (2" valve)

Prefix:

C – clean and check strainer ¾" – 1" (20 – 25mm) only
U – union connections (see ES-U009)

Available Models: 2½" – 3" (65 – 80mm)

Suffix:

NRS – non-rising stem resilient seated gate valves
OSY – UL/FM outside stem and yoke resilient seated gate valves
S-FDA – FDA epoxy coated strainer
QT-FDA – FDA epoxy coated quarter-turn ball valve shutoffs
LF – without shutoff valves
S – cast iron strainer

Note: The installation of a drain line is recommended. When installing a drain line, an air gap is necessary (see ES-AG).

Materials: ¼" – 2" (8 – 50mm)

Bronze body construction, silicone rubber disc material in the first and second check plus the relief valve. Replaceable polymer check seats for first and second checks. Removable stainless steel relief valve seat. Stainless steel cover bolts.

Standardly furnished with NPT body connections. For optional bronze union inlet and outlet connections, specify prefix U (½" – 2"(15 – 50mm)). Series 009QT furnished with quarter turn, full port, resilient seated, bronze ball valve shutoffs.

Materials: 2½" and 3" (65 – 80mm)

- (FDA approved) Epoxy coated cast iron unibody with bronze seats
- Relief valve with stainless steel seat and trim
- Bronze body ball valve test cocks

Pressure / Temperature

Series 009 ¼" – 2" (8 – 50mm) Suitable for supply pressure up to 175psi (12 bar). Water temperature: 33°F – 180°F (0.5°C – 75°C).

Sizes 2½" and 3" (65 and 80mm) are suitable for supply pressures up to 175psi (12.1 bar) and water temperature at 110°F (43°C) continuous, 140°F (60°C) intermittent.

Standards

USC Manual 8th Edition†
ASSE No. 1013
AWWA C511-92
CSA B64.4
IAPMO File No. 1563.

†Does not indicate approval status. See below for approved models.

Approvals

ASSE, AWWA, CSA, IAPMO

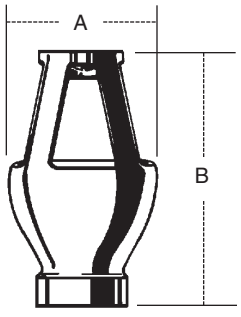
Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

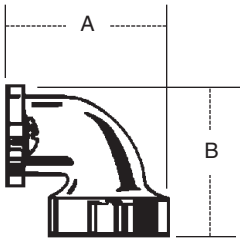
Approval models QT, AQT, PC, NRS, OSY.

UL Classified ¾" – 2" (20 – 50mm)
(LF models only except 009M3LF)
2½" and 3" (65 and 80mm) with OSY gate valves.

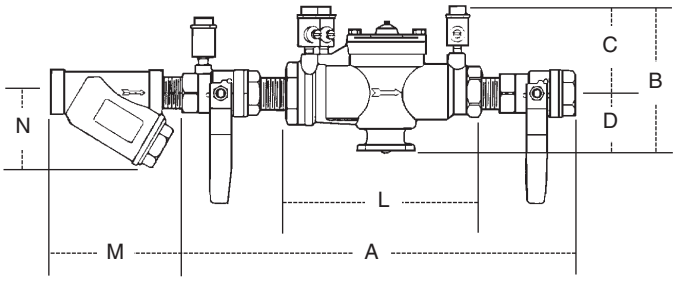
Air Gaps and Elbows

MODEL		DRAIN OUTLET		DIMENSIONS				WEIGHT	
	for 909, 009 and 993 sizes			A		B			
		in.	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
909AG-A	¼"–½" 009, ¾" 009M2/M3	½	13	2⅜	60	3⅛	79	.625	.28
909AG-C	¾"–1" 009/909, 1"–1½" 009M2	1	25	3¼	83	4⅞	124	1.50	.68
909AG-F	1¼"–2" 009M1, 1¼"–3" 009/909, 2" 009M2, 4"–6" 993	2	51	4⅜	111	6¾	171	3.25	1.47
909AG-K	4"–6" 909, 8"–10" 909M1	3	76	6⅜	162	9⅝	243	6.25	2.83
909AG-M	8"–10" 909	4	102	7⅜	187	11¼	394	15.50	7.03
909EL-A	¼"–½" 009, ¾" 009M2/M3	–	–	–	–	–	–	–	–
909EL-C	¾"–1" 009/909,	–	–	2⅜	60	2⅜	60	.38	.17
* 909EL-F	1¼"-2" 009M1, 1¼"–2" 009/909, 2" 009M2, 4"–6" 993	–	–	3⅝	92	3⅝	92	2	.91
* 909EL-H Vertical	2½"–3" 009/909	–	–	–	–	–	–	–	–





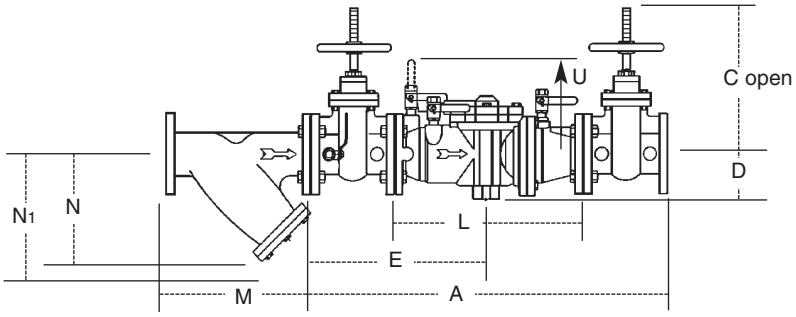
Dimensions and Weight: ¼" – 2" (8 – 50mm) 009

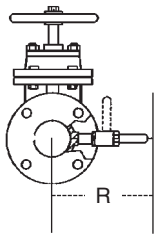


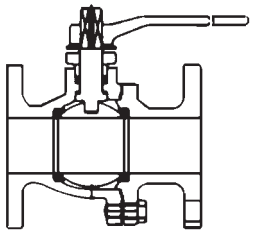
Suffix HC – Fire Hydrant Fittings dimension 'A' = 25" (637mm)
009 ¼" – 2"

SIZE (DN)		DIMENSIONS (APPROX.)										STRAINER DIMENSIONS				WEIGHT	
		A		B		C		D		L		M		N			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kg.s*
¼	8	10	250	4⅝	117	3⅜	86	1¼	32	5½	140	2⅜	60	2½	64	5	2
⅜	10	10	250	4⅝	117	3⅜	86	1¼	32	5½	140	2⅜	60	2½	64	5	2
½	15	10	250	4⅝	117	3⅜	86	1¼	32	5½	140	2¾	70	2¼	57	5	2
¾	20	10¾	273	5	127	3½	89	1½	38	6¾	171	3 3/16	81	2¾	70	6	3
1	25	14½	368	5½	140	3	76	2½	64	9½	241	3¾	95	3	76	12	5
1¼	32	17⅜	441	6	150	3½	89	2½	64	11⅜	289	4 7/16	113	3½	89	15	6
1½	40	17⅞	454	6	150	3½	89	2½	64	11⅛	283	4⅞	124	4	102	16	7
2	50	21⅜	543	7¾	197	4½	114	3¼	83	13½	343	5 15/16	151	5	127	30	13

Dimensions and Weight: 2½" and 3" (65 and 80mm) 009







Watts G-4000 Series
QT – Ball Valves

STRAINER SIZE		DIMENSIONS (approx.)						WEIGHT	
		M		N		N1†			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
2½	65	10	254	6½	165	9¾	248	28	12.7
3	80	10⅛	257	7	178	10	254	34	15.4

†Clearance for servicing

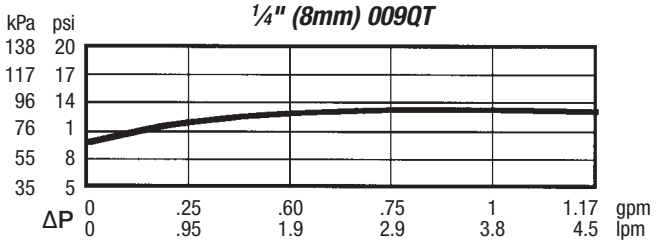
MODEL	SIZE DN		DIMENSIONS (APPROX.)														WEIGHT	
			A		C		D		E		L		R		U			
	in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
009LF	2½	65	—	—	—	—	4½	114	—	—	18⅛	460	—	—	10⅝	270	76	34.5
009OSY	2½	65	33¼	845	15⅞	403	4½	114	16⅜	416	18⅛	460	7¾	197	10⅝	270	166	75.3
009NRS	2½	65	33¼	845	11⅜	289	4½	114	16⅜	416	18⅛	460	7¾	197	10⅝	270	161	73.0
009QT	2½	65	33¼	845	6	152	4½	114	16⅜	416	18⅛	460	7¾	197	10⅝	270	150	68.0
009LF	3	80	—	—	—	—	4½	114	—	—	18⅛	460	—	—	10⅝	270	76	34.5
009OSY	3	80	34¼	870	18½	470	4½	114	16⅝	422	18⅛	460	8¾	222	10⅝	270	198	89.8
009NRS	3	80	34¼	870	12¾	324	4½	114	16⅝	422	18⅛	460	8¾	222	10⅝	270	191	86.6
009QT	3	80	34¼	870	7	178	4½	114	16⅝	422	18⅛	460	8¾	222	10⅝	270	158	71.7

Capacity

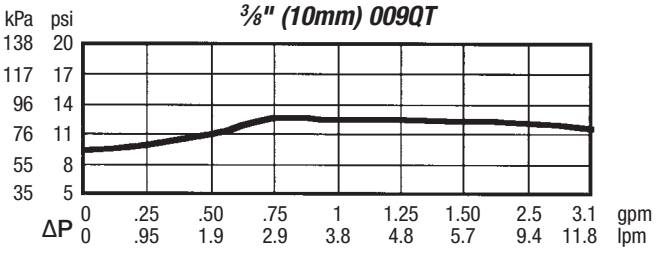
Performance as established by an independent testing laboratory.

*Typical maximum system flow rate (7.5 feet/sec., 2.3 meters/sec.)

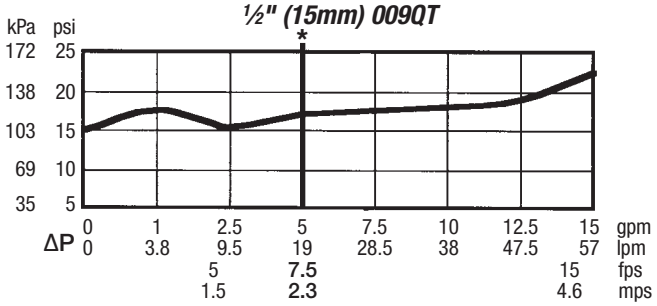
¼" (8mm) 009QT



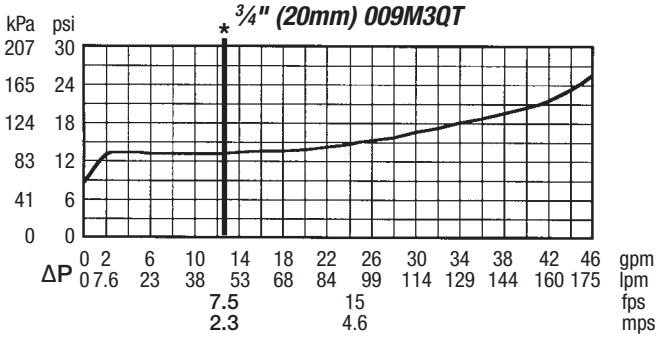
⅜" (10mm) 009QT



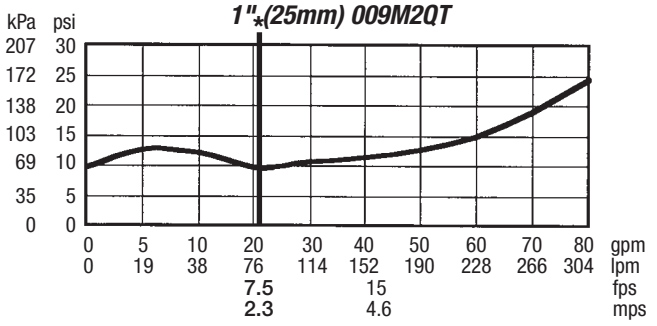
½" (15mm) 009QT



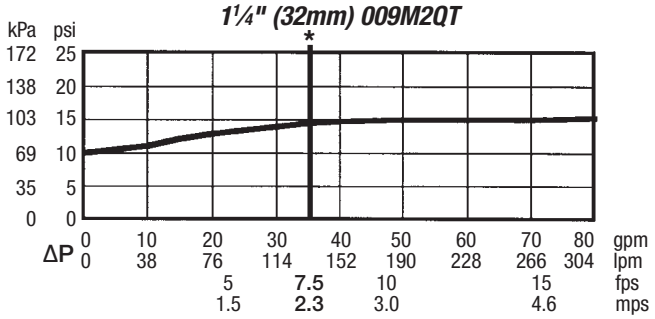
¾" (20mm) 009M3QT



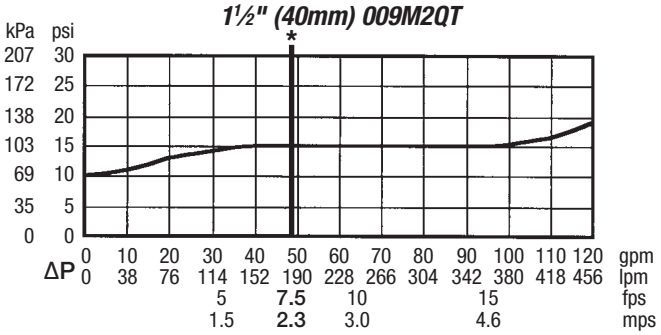
1"*(25mm) 009M2QT



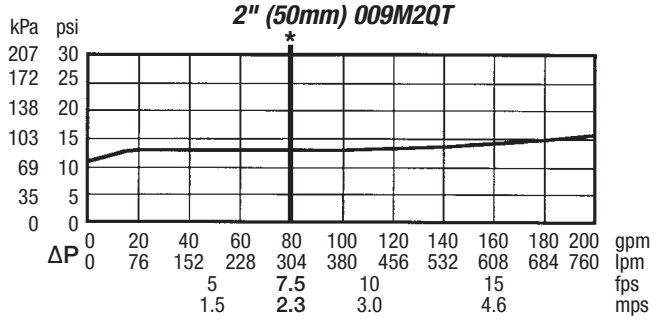
1¼" (32mm) 009M2QT



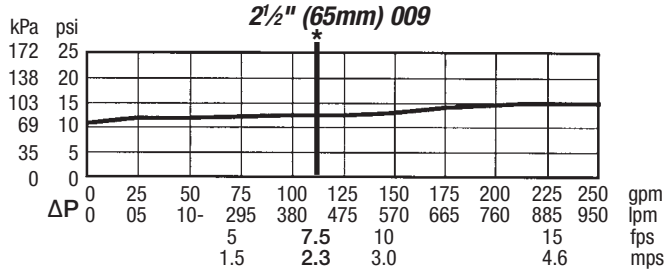
1½" (40mm) 009M2QT



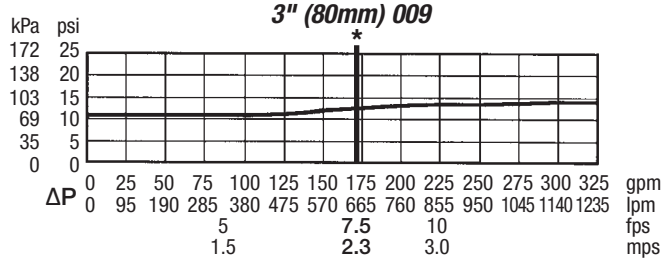
2" (50mm) 009M2QT



2½" (65mm) 009



3" (80mm) 009



WATTS®

A Watts Water Technologies Company

ISO 9001-2008 CERTIFIED

USA: No. Andover, MA • Tel. (978) 688-1811 • Fax: (978) 794-1848 • www.watts.com
Canada: Burlington, ONT. • (905) 332-4090 • Fax: (905) 332-7068 • www.wattscanada.ca

For Liquid and Steam Service

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Series 17
In-line Bronze Single Union Strainers

17

Sizes: ¾" – 1" (20 -25mm)

Series 17 In-line Bronze Single Union Strainers are designed to protect system components from dirt, rust and other damaging debris in the piping system. This series is ideal for quick removal from equipment for cleaning or where feed line separation is required.

Features

- Bronze body
- Single union end
- Buna-N union seal
- NPT threaded female end connections

Pressure – Temperature

Maximum Working Pressure:

250psi (17.2 bar) WOG @ 180ºF (82ºC)

50psi (345kPa) WSP @ 280ºF (138ºC)

Specifications

An in-line bronze strainer to be installed as indicated on the plans. The strainer must have a single union end and NPT threaded female end connections. Strainer shall be rated to 250psi (17.2 bar) WOG @ 180ºF (82ºC); 50psi (345 kPa) WSP @ 280ºF (138ºC). Strainer shall be a Watts Regulator Company Series 17.

Materials

Body: Cast Bronze

Union Seal: Buna-N

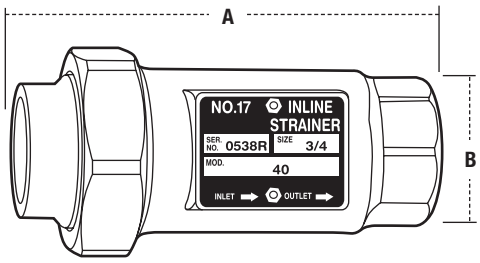
Screen: 40 Mesh* Stainless Steel

*Consult factory for additional screen options.

		Sizes	
		¾"	1"
Flow-gpm	10	.4	.3
	20	1.5	1.0
	30	3.8	2.4
	40	6.0	4.0
	50	8.9	6.0
	60	NR	8.1
		(psi)	

Performance Data

SIZE (DN)		10gpm		20gpm		30gpm		40gpm		50gpm		60gpm	
in.	*mm*	*psi*	*kPa*	*psi*	*kPa*	*psi*	*kPa*	*psi*	*kPa*	*psi*	*kPa*	*psi*	*kPa*
¾	20	0.4	2.8	1.5	10.3	3.8	26.2	6.0	41.4	8.9	61.4	–	–
1	25	0.3	2.1	1.0	6.9	2.4	16.5	4.0	27.6	6.0	41.4	8.1	55.8



Dimensions — Weights

SIZE (DN)		DIMENSIONS				WEIGHT	
		A		B			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
¾	20	4⅜	111	2⅜	60	1.8	0.7
1	25	4⅜	111	2⅜	60	1.8	0.7

ISO 9001-2000 CERTIFIED

U.S. GREEN BUILDING COUNCIL MEMBER

WATTS®

Water Safety & Flow Control Products

USA: 815 Chestnut St., No. Andover, MA 01845-6098; www.watts.com
Canada: 5435 North Service Rd., Burlington, ONT. L7L 5H7; www.wattscanada.ca

The Home Depot. More saving. More doing. ™

$276.00

Price and availability may vary by store.

****Valid only on date printed***

SIEMENS
32/64 Circuit 100Amp Panel With Surge Protection And Breaker Assortment

Model: XP32100SP | Store SKU: 1000102187

OVERVIEW

32/64 Circuit 100Amp Service Entrance Loadcentre With Main Breaker, Surge Protection, And Breaker Assortment - 1-Qsa2020Spd, 1-Q115Af, 12-Q115, 1-Q230, 1-Q240. Included Breakers Equals 12- 1P 15A 120V, 1- 1P 15A 120V Arc Fault, 2-20A 120V, 1- 2P 30A 240V, 1- 2P 40A 240V.

- COMPLETE RESIDENTIAL SURGE PROTECTION
- 32 CIRCUITS EXPANDABLE TO 64
- COMBO FLUSH OR SURFACE MOUNT

WARRANTY INFORMATION

1 YEAR FROM DATE OF INSTALL WWW.SIEMENS.CA

SPECIFICATIONS

Assembled Depth (In Inches)	3.75 In.	CSA Certified	Yes
Assembled Height (In Inches)	27.13	Item Depth	29.50 In.
Assembled Weight (In LBS)	27.40 Lbs.	Item Height	4.50 In.
Assembled Width (In Inches)	13.13	Item Weight	28.40 Lbs.

Country of Origin	Canada	Item Width	15.00 In.

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

$77.50

Price and availability may vary by store.

****Valid only on date printed***

SIEMENS
15 Amp Arc Fault Circuit Interrupter, Full Module 10,000 A.I.C. 120V

Model: Q115AFP | Store SKU: 1000106755

OVERVIEW

An Arc-Fault Circuit Interrupter (AFCI) is a device intended to mitigate the effects of arcing faults by functioning to de-energize t circuit when an arc-fault is detected. Arc-Faults occur anywhere in the home's electrical system as a result of: worn electrical insulation or damaged wire, misapplied or damaged plug-in application cords and equipment, loose electrical connections, accidentally piercing electrical cable behind drywalls with drill bit, nail or screw, hammering electrical cable too tightly against studs during installation or pushing furniture against cords plugged into outlets.

- Designed to detect dangerous arc faults which are potential fire hazards in your home
- The National Electrical Code requires AFCIs to be installed on all bedroom circuits for new homes
- Functions as a traditional overload and short circuit protector while monitoring arc-faults
- Easily replace any single-pole 15 Amp circuit breaker in a Load Centre for added protection
- Consider adding protection to older homes where arcing can occur in aging wiring systems

WARRANTY INFORMATION

Goods sold hereunder are covered by a warranty against defects in material and workmanship provided the goods and servi are subjected to normal use and service. The applicable warranty period is twelve (12) months from the date of installation o

SPECIFICATIONS

Amps	15 A	Item Depth	1.25 In.
Assembled Depth (In Inches)	1.25 In.	Item Height	7.25 In.

Assembled Height (In Inches)	7.25	Item Weight	0.45 Lbs.
Assembled Weight (In LBS)	0.45 Lbs.	Item Width	5 In.
Assembled Width (In Inches)	5	Quantity	1
Country of Origin	Canada	Types	arc fault
CSA Certified	Yes	Voltage	120 V
Days to Ship	1 d		

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

$43.53

Price and availability may vary by store.

****Valid only on date printed***

SIEMENS

Quad Type Q (2 Outer 1-Pole 15Amp & 1 Inner 2-Pole 15 Amp) Circuit Breaker, 10,000 A.i.c. 120/240V

Model: Q21515CTNC | Store SKU: 1000406293

OVERVIEW

If you're doing a renovation and find that your breaker box is running out of room, use this space-saver to double your circuits. Simply replace a single pole 15 Amp breaker and a two pole 15 Amp breaker with this one to expand it into two 15 Amp single pole circuits and a two pole 15 Amp circuit. Each 15 Amp circuit could be used for general 110V applications such as lighting and receptacles.

- Circuit breaker is thermal magnetic, quick-make quick-break, trip free, plug-in construction
- Simple plug-in installation to the panel. No bolts required.
- Works with all Siemens LoadCentre Panels
- Reliable protection
- Use this space-saver to double the number of useable circuits
- 'Insta-Wire' speeds your installation with every turn

WARRANTY INFORMATION

Goods sold hereunder are covered by a warranty against defects in material and workmanship provided the goods and servi are subjected to normal use and service. The applicable warranty period is twelve (12) months from the date of installation o

SPECIFICATIONS

Amps	15 A	Item Depth	3 In.

Assembled Depth (In Inches)	3 In.	Item Height	3.13 In.
Assembled Height (In Inches)	3.13	Item Weight	0.79 Lbs.
Assembled Weight (In LBS)	0.79 Lbs.	Item Width	2 In.
Assembled Width (In Inches)	2	Maximum Voltage	240 V
Country of Origin	Canada	Quantity	1
CSA Certified	Yes	Types	breaker
Days to Ship	1 d	Voltage	240 V

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

$43.53

Price and availability may vary by store.

****Valid only on date printed***

SIEMENS

Quad Type Q (2 Outer 1-Pole 15Amp & 1 Inner 2-Pole 20 Amp) Circuit Breaker, 10,000 A.I.C. 120/240V

Model: Q21520CTNC | Store SKU: 1000406294

OVERVIEW

If you're doing a renovation and find that your breaker box is running out of room, use this space-saver to double your circuits. Simply replace a single pole 15 Amp breaker and a two pole 20 Amp breaker with this one to expand it into two 15 Amp single pole circuits and a two pole 20 Amp circuit. Each 15 Amp circuit could be used for general 110V applications such as lighting and receptacles and the 20Amp could be used for an air conditioner or a heater.

- Circuit breaker is thermal magnetic, quick-make quick-break, trip free
- Simple plug-in installation to the panel. No bolts required.
- Works with all Siemens LoadCentre Panels
- Reliable protection
- Use this space-saver to double the number of useable circuits
- 'Insta-Wire' speeds your installation with every turn

WARRANTY INFORMATION

Goods sold hereunder are covered by a warranty against defects in material and workmanship provided the goods and servi are subjected to normal use and service. The applicable warranty period is twelve (12) months from the date of installation o

SPECIFICATIONS

Amps	20 A	Item Depth	3 In.

Assembled Depth (In Inches)	3 In.	Item Height	3.13 In.
Assembled Height (In Inches)	3.13	Item Weight	0.79 Lbs.
Assembled Weight (In LBS)	0.79 Lbs.	Item Width	2 In.
Assembled Width (In Inches)	2	Maximum Voltage	240 V
Country of Origin	Canada	Quantity	1
CSA Certified	Yes	Types	breaker
Days to Ship	1 d	Voltage	240 V

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

$45.86

Price and availability may vary by store.

****Valid only on date printed***

SIEMENS
Quad Type Q (2 Outer 1-Pole 15Amp & 1 Inner 2-Pole 30 Amp) Circuit Breaker, 10,000 A.I.C. 120/240V

Model: Q21530CTNC | Store SKU: 1000406295

OVERVIEW

If you're doing a renovation and find that your breaker box is running out of room, use this space-saver to double your circuits. Simply replace a single pole 15 Amp breaker and a two pole 30 Amp breaker with this one to expand it into two 15 Amp single pole circuits and a two pole 30 Amp circuit. Each 15 Amp circuit could be used for general 110V applications such as lighting and receptacles and the 30Amp could be used for a dryer, water heater or a pony panel switch.

- Circuit breaker is thermal magnetic, quick-make quick-break, trip free
- Simple plug-in installation to the panel. No bolts required.
- Works with all Siemens LoadCentre Panels
- Reliable protection
- Use this space-saver to double the number of useable circuits
- 'Insta-Wire' speeds your installation with every turn

WARRANTY INFORMATION

Goods sold hereunder are covered by a warranty against defects in material and workmanship provided the goods and servi are subjected to normal use and service. The applicable warranty period is twelve (12) months from the date of installation o

SPECIFICATIONS

Amps	30 A	Item Depth	3 In.

Assembled Depth (In Inches)	3 In.	Item Height	3.13 In.
Assembled Height (In Inches)	3.13	Item Weight	0.79 Lbs.
Assembled Weight (In LBS)	0.79 Lbs.	Item Width	2 In.
Assembled Width (In Inches)	2	Maximum Voltage	240 V
Country of Origin	Canada	Quantity	1
CSA Certified	Yes	Types	breaker
Days to Ship	1 d	Voltage	240 V

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

$45.86

Price and availability may vary by store.

****Valid only on date printed***

SIEMENS

Quad Type Q (2 Outer 1-Pole 15Amp & 1 Inner 2-Pole 40 Amp) Circuit Breaker, 10,000 A.I.C. 120/240V

Model: Q21540CTNC | Store SKU: 1000406296

OVERVIEW

If you're doing a renovation and find that your breaker box is running out of room, use this space-saver to double your circuits. Simply replace a single pole 15 Amp breaker and a two pole 40 Amp breaker with this one to expand it into two 15 Amp single pole circuits and a two pole 40 Amp circuit. Each 15 Amp circuit could be used for general 110V applications such as lighting and receptacles and the 40Amp could be used for a stove, electric range or a pony panel switch.

- Circuit breaker is thermal magnetic, quick-make quick-break, trip free
- Simple plug-in installation to the panel. No bolts required.
- Works with all Siemens LoadCentre Panels
- Reliable protection
- Use this space-saver to double the number of useable circuits
- 'Insta-Wire' speeds your installation with every turn

WARRANTY INFORMATION

Goods sold hereunder are covered by a warranty against defects in material and workmanship provided the goods and servi are subjected to normal use and service. The applicable warranty period is twelve (12) months from the date of installation o

SPECIFICATIONS

Amps	40 A	Item Depth	3 In.

Assembled Depth (In Inches)	3 In.	Item Height	3.13 In.
Assembled Height (In Inches)	3.13	Item Weight	0.79 Lbs.
Assembled Weight (In LBS)	0.79 Lbs.	Item Width	2 In.
Assembled Width (In Inches)	2	Maximum Voltage	240 V
Country of Origin	Canada	Quantity	1
CSA Certified	Yes	Types	breaker
Days to Ship	1 d	Voltage	240 V

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

~~$18.68~~

$17.68

Save $1.00

Price and availability may vary by store.

ONLINE INVENTORY

Currently on back order.
Reserve purchase now,
quantity may be limited.
ESTIMATED DELIVERY TIME: 7 - 12 DAYS

FREE RETURNS

Valid only on date printed

HALO
Remodel Housing for Non Insulated Ceilings 4-Inch Aperture

Model: H99RT | Internet/Cat: 919250 | Store SKU: 1000144605

3.6 out of 5

OVERVIEW

The H99RT is designed for remodeling applications in non-insulated ceilings. This is our most popular aperture size, it acce a wide range of trim styles and finishes (lamps and trims sold separately). It also features an integral thermal protector to gu against misuse or improper lamping. This shallow housing is only 5-1/2 inches in height, allows for use in minimum 2 x 6 in joist construction. The four pre-installed remodel clips easily secure the housing to any 1/2-5/8 inch thick hard ceiling materia

- Fully assembled
- Accepts a wide variety of Halo 4 Inch trims and R20 & PAR20 lamps (sold separately)
- Quick connects connectors pre-Installed and Slide-n-Slide™ wire traps for non-metallic house wire
- Thermally protected
- cUL Listed

WARRANTY INFORMATION

1-year limited warranty. For complete warranty details please contact us at 1-800-955-4908

SPECIFICATIONS

Insulation Contact	Non-insulation contact	Assembled Width (In Inches)	8
Lights Source	Halogen	Country of Origin	Mexico

Size	4	Item Depth	5.25 In.
Usage	Remodel	Item Height	5.5 In.
Assembled Depth (In Inches)	5.25 In.	Item Weight	1.83 Lbs.
Assembled Height (In Inches)	5.5	Item Width	8 In.
Assembled Weight (In LBS)	1.83 Lbs.		

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

$39.98

Price and availability may vary by store.

ONLINE INVENTORY

10 available
ESTIMATED DELIVERY TIME: 2 - 6 DAYS

FREE RETURNS

Valid only on date printed

CREE
EcoSmart CR4 LED Recessed Light with Integrated Trim

Model: ECO-575L-CA | Internet/Cat: 984545 | Store SKU: 1000709123

5 out of 5

OVERVIEW

Powered with Cree Truwhite Technology, the EcoSmart LED Downlight uses a revolutionary new way to generate white light v LEDs.

- Delivers high efficiency with beautiful light characteristics and color accuracy, while maintaining color consistency ove the life of the product
- Just 10.5 Watts and uses 85% less energy than a 65 Watt equivalent
- Easily dimmable with most widely available standard incandescent dimmers. It dims down to 5% with no special dimmers to buy

ADDITIONAL INFORMATION

WARRANTY INFORMATION

For more information please contact 1-800-628-0525.

SPECIFICATIONS

Assembled Depth (In Inches)	8.75 In.	ECO Options Approved	Yes
Assembled Height (In Inches)	5.75	Energy Star Compliant	Yes
Assembled Weight (In LBS)	1.5 Lbs.	Item Depth	8.75 In.
Assembled Width (In Inches)	9.25	Item Height	5.75 In.
Country of Origin	China	Item Weight	1.5 Lbs.
CSA Certified	No	Item Width	9.25 In.

Need help? CALL 1 800 628-0525

The Home Depot. More saving. More doing. ™

$26.98

Price and availability may vary by store.

****Valid only on date printed***

LEVITON - DECORA
Decora Preset Digital Countdown Timer 60 Minutes 20A, in White

Model: LTB60-742 | Store SKU: 1000742640

OVERVIEW

Leviton Timers add contemporary styling to any home. Built to the highest performance standards, Decora Preset Digital Countdown Timer - 60 Minutes provide a long lasting and reliable service life.

- Four preset buttons plus an OFF button permit timed control of lights and appliances. Green LEDs indicate time elaps
- Single Pole or 3-way with Vizia + Switch Remote
- Four Preset Buttons for 10-20-30-60 Minutes
- 120VAC, 60Hz, 1800W Incandescent, 20A Resistive/Inductive, Single Pole 3-Way or More Locations
- White assembled on device, ivory and light almond included.
- White

ADDITIONAL INFORMATION

ECO OPTIONS

WARRANTY INFORMATION

Manufacturer Warranty: 5-Year Limited 1-800-469-7890

SPECIFICATIONS

Assembled Depth (In Inches)	1.62 In.	ECO Options Approved	Yes
Assembled Height (In Inches)	4.50	Item Depth	2.75 In.
Assembled Weight (In LBS)	0.30 Lbs.	Item Height	6.87 In.
Assembled Width (In Inches)	2.75	Item Weight	0.40 Lbs.
Country of Origin	China	Item Width	5.62 In.
CSA Certified	Yes		

Need help? CALL 1 800 628-0525

Air King Ventilation Products®

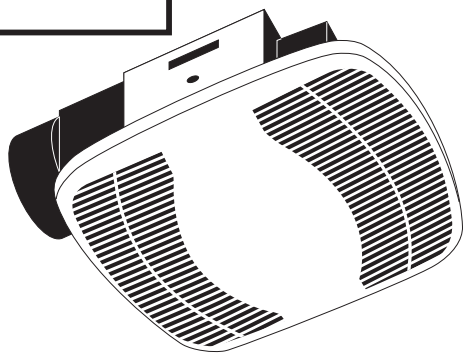
SPECIFICATIONS

BFQ50

EXHAUST FANS

HVI® 2100 CERTIFIED

50 CFM/0.5 Sones @ 0.10" SP., 28.1 Watts
38 CFM @ 0.25" SP.



Acceptable for use over tub or shower when installed in a GFCI protected branch circuit.

- **Grill**
  White, polymeric grill secured in place with torsion springs; easily removed if necessary, dimensions - 10" x 10".

- **Blower Wheel**
  One piece polymeric wheel $5^{1}/_{8}$" diameter, $2^{3}/_{8}$" wide, with 48 fins.

- **Motor**
  Heavy duty, permanently split capacitor, plug-in, 4 pole motor, life time lubrication, thermally protected, suitable for continuous operation. Rated 120 volts, 60 hz.

- **Fan Housing**
  PC/ABS polymeric, dimensions $8^{1}/_{2}$" x $9^{1}/_{8}$" x $4^{3}/_{4}$".

- **Duct Collar**
  Plastic collar for 4" duct connection, comes complete with built in non-metallic back draft damper for quiet operation.

- **Ventilating Area**
  For bathrooms up to 45 sq. ft. For other rooms up to 60 sq. ft.

- **Single Pack Shipping Info**
  Box Dim: 11" x 12" x 6"
  UPC: 0-8316225021-6
  Shipping Weight: $5^{1}/_{4}$ lbs.

- **Unit Mounting**
  Designed to mount in ceilings with at least 6" of clearance. The unit is mounted directly to the joist using a separate lock-in bracket (included with unit). The housing will mount through drywall thickness up to $^{3}/_{4}$", with a rough-in opening of $8^{1}/_{2}$" x $9^{1}/_{8}$".

EXPANDED PERFORMANCE

	Static Pressure (inches of w.g.)								*Sones @ .1 SP*	*Sones @ .25 SP*	*Fan Speed RPM*	*Power Watts*	*Amps*
	0	0.05	0.1	0.125	0.15	0.2	0.25	0.3					
Air Flow - CFM	56	53	50	48	47	42	38	29	0.5	0.5	1225	28.1	0.3

PROJECT		**ARCHITECT**	
LOCATION		**ENGINEER**	
CONTRACTOR		**SUBMITTED BY**	**DATE**

FAN NUMBER	MODEL NUMBER	CFM	IN W.C.	RPM	WATTS	AMPS	SONES	QTY	OPTIONAL EQUIPMENT & REMARKS

c UL us

ENERGY STAR

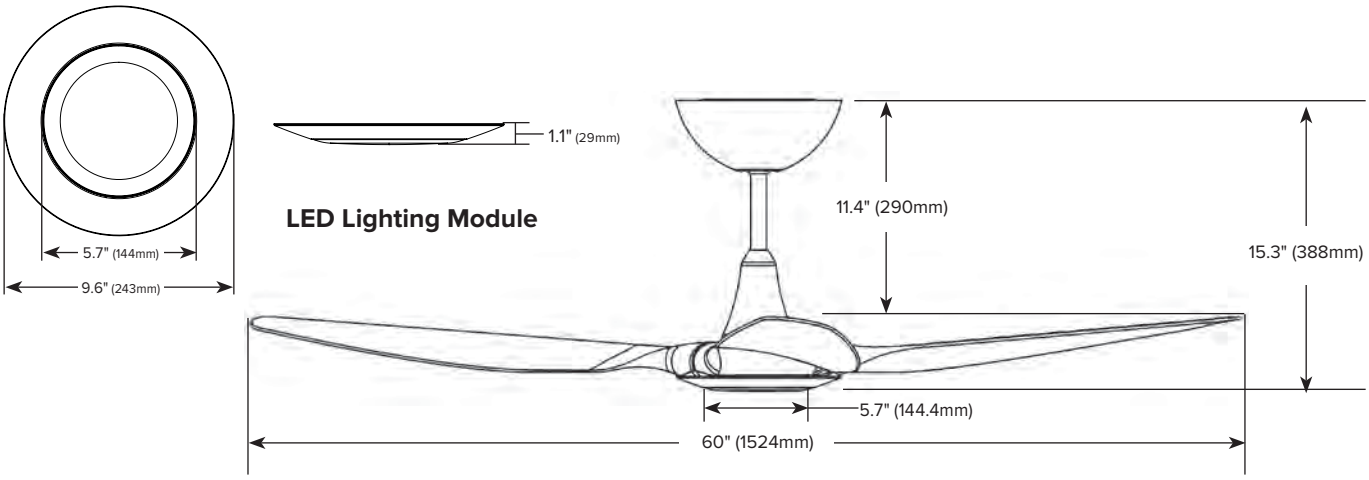
U.S.: 820 Lincoln Avenue
West Chester, Pennsylvania 19380-4466
Tel: (610) 692-7400 • 877-304-3785
Fax: (610) 696-8048

Canada: 8 Edvac Drive
Brampton, Ontario L6S 5P2
Tel: (905) 456-2033 • 800-250-8767
Fax: (905) 456-1015

Updated 8-12

Technical Specifications

HAIKU™
POETRY IN MOTION



Technical Specifications

Model	Haiku®
Model number	K3150-X2-07
Fan diameter	60" (1524mm)
Motor and assembly finishes	Black or white
Airfoil material	Matrix composite
Airfoil finishes	Black or white
Number of airfoils	3
Motor type	EC motor with a digital inverter drive
Controller included	Yes, remote
Controller features	Fan on/off
	Sleep mode
	Off timer
	Whoosh® mode
	Reverse
	LED light on/off
Mount and drop tube	14.9" (378mm)
Hanging weight	14.1 lb. (6.4kg) (fan only)
Number of fan speeds	7
Operating voltage	100–240 VAC, 1Φ
Operating frequency	50–60 Hz
RPM (min/max)	35/175 RPM
Amps (min/max)	0.05/0.363 A
Watts (min/max)	2/30 W (fan only)
Ambient operational temperature range	32–120°F (0–49°C)
Environment	UL listed for dry or damp (covered outdoor) locations
Fan mode indicator	LED display (not visible with light kit)
Warranty*	Limited lifetime

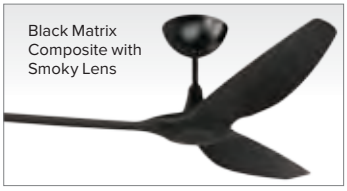
* See Haiku warranty in installation guide for complete details

Optional Accessories

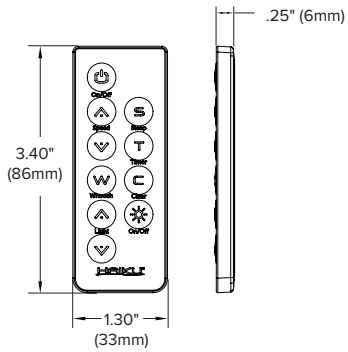
Haiku LED Lighting Module

Specifications	
Operating voltage	12V (+/- 0.5V)
Operating current	1.6 Adc (100% PWM)
Maximum input power	20 W
Operating temperature	32–104°F (0–40°C)
Nominal lumen output	1500Lm
Dimming range	0-100%
Operating life expectancy	50,000 hrs
Included lenses	Smoky and clear

Color Options



Controller



855-MY HAIKU (855-694-2458) | WWW.HAIKUFAN.COM

3128438

BIG ASS FANS
No Equal.

CAUTION LED LIGHT
NEVER STARE DIRECTLY INTO LED LIGHTS. DOING SO MAY CAUSE PERMANENT DAMAGE TO YOUR EYES.

May be protected by one or more of the following patents: U.S. Pat. Nos. D612476 and D614757 | ANSI/UL STD 507 | Can/CSA C22.2 NO 113
An ISO 9001:2008 certified company. HF400-0-K3150-A0-03/13-01-00

PRICE LIST

C10-11-109

canplas®

ABS DWV FITTINGS

JULY 1, 2011

SUPERSEDES C10-11-108 (APRIL 1, 2011)

Our website pricing is the current list price and may vary from our printed price list.
Please visit our website for up-to-date information.

www.canplasplumbing.com 1-800-461-5300

PRICE LIST C10-11-109 **JULY 1, 2011**

TERMS AND CONDITIONS OF SALE

TERMS
Cash discount 2% 15 days, net 30. The cash discount is allowed on merchandise only. Prices are subject to change and each order will be priced on the basis of prices in effect at the time of order. All orders are subject to approval of our office in Ontario, Canada. Possession of this price list does not necessarily constitute an offer by the Company to sell to the holder on the basis of the terms described hereon.

MINIMUM ORDER
$250.00 net.

TAXES
Any and all sales, manufacturers' taxes and/or other charges levied or imposed by any governmental authority, foreign or domestic, upon any merchandise sold or contacted to be sold shall be paid by Customer and added to the purchase price unless satisfactory and appropriate tax exception certificates are supplied to the Seller.

OVERDUE INVOICES
Interest charged at a rate of 1.5% per month on all overdue invoices.

FREIGHT
$4000.00 net for prepaid freight.
All shipments are F.O.B. seller's factory or authorized warehouse.
Prepaid orders will be shipped via the most economical route of our choice. If the Customer selects a route with a higher rate, the difference will be charged to the Customer.

WEBSITE
Our website pricing is the current list price and may vary from our printed price list. Please visit www.canplasplumbing.com for up-to-date information.
Prices and product availability are subject to change without notice.
While we try to ensure accuracy, we reserve the right to correct any errors in pricing or descriptions, and to cancel or refuse to accept any order based on an incorrect price or description. Such corrections may be made even after an order is accepted.

SHIPPING RESPONSIBILITY
Canplas' responsibility ceases when the carrier signs for the shipment in good order. We cannot be responsible for loss or damage to goods in transit, or delays or carriers in delivering shipments or for damages resulting from such delays as those caused by fire, explosion, act of God, strike or other difference with workmen, shortage of material or labor, delays in transportation, government restrictions, war, riot, civil commotion or cause beyond our control. Where shortage or damage is apparent, details should be noted by the carrier on the freight bill at the time of delivery. In case of concealed damage, carrier should be called at once to inspect the damaged shipment. Do not return damaged goods.

RETURNED GOODS
A Returned Goods Authorization Form issued by Canplas must accompany goods which are returned. We reserve the right to refuse the return of any item that is not a regular stock item with Canplas. On items that are acceptable for credit, a restocking charge of twenty-five percent (25%) will be assessed against the credit to cover our handling, and/or inspecting or repackaging. Freight on returned goods will be the responsibility of the customer unless the reason for the return is due to defective goods. All goods returned must be in a saleable condition.

WARRANTY
Seller's products are carefully inspected for manufacturing defects, however, it is not always possible to detect hidden defects. Said products are warranted only to the extent that Seller will replace without charge, products proven to have manufacturing defects within 6 months of the date of delivery thereof and provided Seller has been given an opportunity to inspect the product alleged to be defective and the installation or use thereof. NO WARRANTY IS INCLUDED AGAINST ANY EXPENSE FOR REMOVAL, REINSTALLATION OR OTHER CONSEQUENTIAL DAMAGES ARISING FROM ANY DEFECT. THE WARRANTIES SET OUT ABOVE ARE THE ONLY WARRANTIES MADE BY SELLER AND ARE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

CANPLAS INDUSTRIES LTD. reserves the right to change the aforementioned TERMS AND CONDITIONS OF SALE without notice.

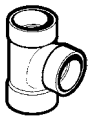
CAUTION
The Seller does not recommend the use of thermoplastic piping systems for transport or storage of compressed air or other compressed gases or the testing of such systems with compressed air or other compressed cases, in exposed, above ground locations. Use of plastic piping products in exposed compressed gas systems voids our warranty for the products so used. For further information, contact your Canplas representative.

OTHER
In addition to sizes listed in this price list, other sizes may be available upon request.

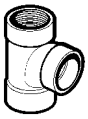
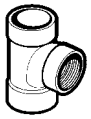
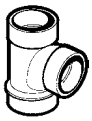
TABLE OF CONTENTS Page

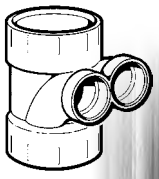
PRICE LIST C10-11-109 **JULY 1, 2011**

TEES

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
SANITARY TEE - H x H x H					
	102150	3600	50	1¼	13.87
	102151	2880	90	1½	7.44
	102125	2880	40	1½ x 1¼ x 1½	24.67
	102132††	2880	40	1½ x 1½ x 1¼	14.45
	102137††	2520	35	1½ x 1¼ x 1¼	46.98
	102152	1440	45	2	16.14
	102128	1680	35	2 x 1½ x 1½	11.68
	102127	1800	25	2 x 1½ x 2	21.44
	102133	1800	25	2 x 2 x 1¼	44.45
	102126	1600	50	2 x 2 x 1½	11.61
	102153	360	20	3	30.86
	102135	810	45	3 x 3 x 1¼	69.73
	102131	800	25	3 x 3 x 1½	21.44
	102130	640	20	3 x 3 x 2	24.93
	102154	216	12	4	73.75
	102134	360	20	4 x 4 x 2	64.10
	102136	270	15	4 x 4 x 3	76.67
	102144	90	5	6 x 6 x 4	293.51
	102156	72	3	6 x 6 x 6	322.02

†† Fitting uses bushing

SANITARY TEE - H x FPT x H					
	102182-1	630	35	3 x 3 x 2	66.53
SANITARY TEE - H x H x FPT					
	102152-2	1120	35	2	35.22
SANITARY TEE, Street - Spg x H x H					
	105151	2880	90	1½	20.18
	105153	360	20	3	49.15
	105154	216	12	4	132.13
	105131	800	25	3 x 3 x 1½	33.97
	105130L	640	20	3 x 3 x 2	42.33
	105134	360	20	4 x 4 x 2	140.95
	105144	90	5	6 x 6 x 4	488.65
	105156	54	3	6	536.08

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
HORIZONTAL TWIN TEE					
	103750	480	15	3x3x1½x1½	181.00

- **material**
  - Injection molded in ABS (Black) and PVC (White).
- **function**
  - To provide two 1½" connections to a 3" tee on the same side.
- **features**
  - 3" tee with two side by side 1½" sanitary hub connections.
  - Compact design.
- **benefits**
  - Eliminates the need to stack two 3" x 1½" tees on top of each other, avoiding complicated installations.
  - Perfect application for back to back fixtures such as sinks and bathtubs.
- **approvals**
  - The Horizontal Twin Tee meets ASTM D2468 and D1784 standards. IAPMO and CSA approval pending.

SANITARY TEE, with Left Side Inlet - H x H x H x H					
	102147L	320	10	3 x 3 x 3 x 1½	66.50
	102148L	320	10	3 x 3 x 3 x 2	66.50
SANITARY TEE, with Right Side Inlet - H x H x H x H					
	102147R	320	10	3 x 3 x 3 x 1½	66.50
	102148R	320	10	3 x 3 x 3 x 2	66.50
SANITARY TEE, with Right & Left Side Inlets - H x H x H x H x H					
	102147LR	180	10	3x3x3x1½x1½	175.87
	102148LR	180	10	3x3x3x2x2	163.55

ABS DWV FITTINGS

PRICE LIST C10-11-109 **JULY 1, 2011**

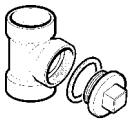
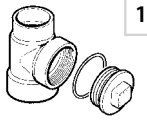
TEES Continued

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
DOUBLE SANITARY TEE - H x H x H x H					
	102187	1080	15	1½	22.95
	102186	720	10	2	34.59
	102188	960	20	2 x 2 x 1½ x 1½	39.38
	102188-2††		20	2 x 1½ x 1½ x 1½	37.95
	102184	240	5	3	54.86
	102189	480	15	3 x 3 x 1½ x 1½	47.98
	102181	480	15	3 x 3 x 2 x 2	50.05
	102191	180	10	4 x 4 x 3 x 3	105.37
	102185	144	8	4	216.29

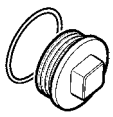
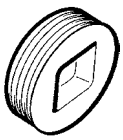
†† Fitting uses bushing

DOUBLE SANITARY TEE, with Side Inlet - H x H x H x H x H					
	102163L	180	10	3x3x3x3x1½	214.47

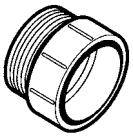
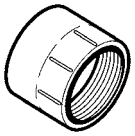
CLEANOUTS

CLEANOUT TEE with Plug & O-ring - H x H					
	102114A	2400	50	1½	19.86
	102115A	1440	45	2	31.91
	102116A	480	15	3	52.40
	102117A	270	15	4	115.77
	102118A	72	4	6	391.40
REDUCING LINE CLEANOUT with Plug & O-ring - H x H					
	102107A	270	15	4 x 3 x 4	58.81

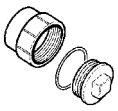
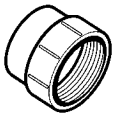
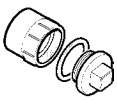
CLEANOUT PLUGS

CLEANOUT PLUG, with O-ring - MPT					
	103050	18720	130	1¼	8.94
	103051	14400	100	1½	6.24
	103052	10800	150	2	8.03
	103053	3600	25	3	11.27
	103054	2520	35	4	22.98
	103057	960	20	6	97.15
COUNTERSUNK PLUG - MPT					
	103062	21600	150	2	17.83
	103063	7200	50	3	21.86
	103064	4320	60	4	22.98
	103066	720	10	6	97.15

ADAPTERS

MALE ADAPTER - MPT x H					
	102870	9000	125	1¼	7.25
	102860		100	1¼ x 1½	6.00
	102871	9000	125	1½	4.85
	102872	5760	80	2	10.95
	102873	2160	30	3	18.86
	102874	1080	15	4	55.51
	102876	240	5	6	227.50
FEMALE ADAPTER - H x FPT					
	102890	9000	125	1¼	8.27
	102891	7200	100	1½	5.52
	102892	5400	75	2	10.78
	102893	1440	30	3	19.57
	102894	800	25	4	46.17
	102896		8	6	189.20

CLEANOUT ADAPTERS

FITTING CLEANOUT ADAPTER, with Plug and O-ring - Spg x FPT					
	103700A	7200	100	1¼	16.29
	103701A	6480	90	1½	12.82
	103702A	3600	50	2	20.07
	103703A	1440	30	3	30.40
	103704A	800	25	4	64.04
	103706A	270	15	6	249.22
FITTING CLEANOUT ADAPTER - Spg x FPT					
	103700-1	7200	100	1¼	7.77
	103701-1	7200	100	1½	6.72
	103702-1	4320	60	2	13.12
	103703-1	1680	35	3	20.48
	103704-1		25	4	35.17
	103706-1		15	6	162.07
TUBE END CLEANOUT, with Plug & O-ring - H x FPT					
	102890A	7200	100	1¼	18.56
	102891A	5400	75	1½	13.71
	102892A	3600	50	2	20.17
	102893A	1440	30	3	35.90
	102894A	640	20	4	77.70

canplas®

PermOseal® 4" x 3" Reducing Line Cleanout with Test Membrane

- No more glued in Test plates
- No more mechanical test plugs or test balls

"New innovative test membrane from Canplas enables mess-free removal of the test membrane after a water test.

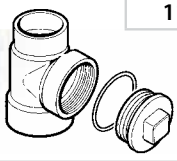
By puncturing the PVC membrane with a utility knife, wastewater is drained slowly, avoiding the typical torrent of wastewater mess with other test methods.

Simply remove the membrane with a knife after the system is fully drained."

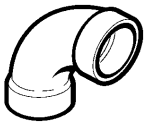
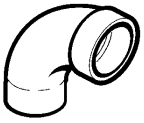
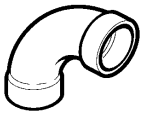
4"x3" ABS Line Cleanout Tee with Test Membrane:

canplas® Exclusive!

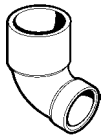
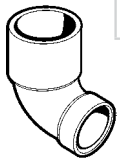
REDUCING LINE CLEANOUT WITH TEST MEMBRANE H x H with Plug & O-ring				
112107AT	270	15	4 x 3 x 4	115.41



90˚ ELBOWS

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
1/4 BEND (90°) - H x H					
	102250	5400	75	1¼	11.72
	102251	4000	125	1½	5.15
	102252	2400	50	2	8.21
	102253	640	20	3	22.15
	102254	360	20	4	47.06
	102256	72	4	6	235.58
1/4 BEND (90°), LONG TURN - H x H					
	102221	2400	50	1½ x 2	10.70
	102250L	4680	65	1¼	11.84
	102251L	3520	110	1½	6.67
	102252L	1600	50	2	9.13
	102253L	480	15	3	22.68
	102254L	270	15	4	56.07
1/4 BEND, Street (90°), LONG TURN - Spg x H					
	102451L	3240	45	1½	6.41
	102452L	1600	50	2	13.71
	102453L	480	15	3	29.32
	102454L	270	15	4	77.98
1/4 BEND (90°), LONG SWEEP - H x H					
	102275	2880	40	1¼	21.23
	102276	2400	50	1½	14.70
	102277	1200	25	2	25.64
	102278	480	10	3	57.56
	102279	216	12	4	105.49
1/4 BEND, Street (90°), LONG SWEEP - Spg x H					
	105276	2160	30	1½	13.40
	105277	1200	25	2	24.38
	105278	450	25	3	55.87
	105279	216	12	4	81.10
1/4 BEND, Street (90°) - Spg x H					
	102450	5400	75	1¼	12.83
	102451	4000	125	1½	5.40
	102452	2400	50	2	13.71
	102453	640	20	3	24.71
	102454	360	20	4	77.98
	102456	72	4	6	304.40

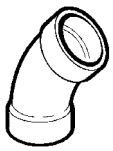
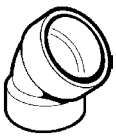
90˚ CLOSET ELBOWS

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
CLOSET BEND, Reducing - H x H					
	102223	360	20	4 x 3	64.32
CLOSET BEND, Reducing with Test Cap - Spg x H					
	103103	360	20	4 x 3	78.33

60˚ ELBOWS

1/6 BEND, (60°) - H x H					
	102601	2880	60	1½	11.88
	102602	2880	40	2	15.92
	102603	640	20	3	35.69
	102604	320	10	4	69.08
1/6 BEND (60°), LONG TURN - H x H					
	102602L	2160	30	2	18.27
	102603L	640	20	3	44.60

45˚ ELBOWS

1/8 BEND (45°), LONG TURN - H x H					
	102501	3600	100	1½	7.05
	102502	1800	50	2	13.20
	102503	640	20	3	29.06
	102504	320	10	4	54.08
1/8 BEND (45°), SHORT TURN - H x H					
	102520	7200	100	1¼	8.27
	102521	6000	125	1½	4.17
	102522	3600	50	2	7.06
	102523	800	25	3	18.59
	102524	450	25	4	36.35
	102506	144	8	6	236.75

45˚ ELBOWS Continued

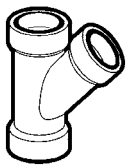
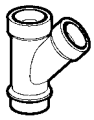
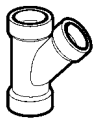
DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
1/8 BEND, Street (45°), LONG TURN - Spg x H					
	102400	5760	40	1¼	8.79
	102401	4800	100	1½	6.11
	102402	1800	50	2	12.07
	102403	640	20	3	29.03
	102404	320	10	4	65.88
1/8 BEND, Street (45°), SHORT TURN - Spg x H					
	102420	7200	100	1¼	8.27
	102421	6000	125	1½	4.23
	102422	3600	50	2	8.42
	102423	800	25	3	19.78
	102424	450	25	4	54.48
	102406	144	8	6	272.64

22-1/2˚ ELBOWS

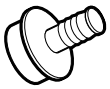
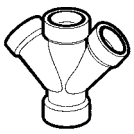
1/16 BEND (22½°) - H x H					
	102550	7200	100	1¼	10.29
	102551	5400	75	1½	6.41
	102552	2400	50	2	11.96
	102553	960	20	3	26.33
	102554	480	15	4	48.99
	102556	144	8	6	294.48
1/16 BEND, Street (22½°) - Spg x H					
	102561	6480	90	1½	7.10
	102562	3240	45	2	13.47
	102563	960	30	3	27.98
	102564	480	15	4	52.05

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

WYES

WYE - H x H x H					
	102300	2400	50	1¼	20.48
	102301	2240	70	1½	9.13
	102323	2160	30	1½x1½x1¼	13.02
	102302	1280	40	2	17.25
	102303	360	20	3	34.38
	102330	480	15	3 x 3 x 1¼	69.53
	102304	216	12	4	74.07
	102306	36	2	6	336.05
	102324	1200	25	2 x 1½ x 1½	20.11
	102325	1440	30	2 x 2 x 1½	16.26
	102331	640	20	3 x 3 x 1½	24.30
	102326	640	20	3 x 3 x 2	26.95
	102328	360	20	4 x 4 x 2	53.49
	102329	384	8	4 x 4 x 1½	53.49
	102327	270	15	4 x 4 x 3	67.14
	102343	72	4	6 x 6 x 3	221.52
	102344	72	4	6 x 6 x 4	258.08
WYE, Street - Spg x H x H					
	105303	360	20	3	78.33
WYE, Street - Spg x H x H					
	105331		20	3 x 3 x 1½	42.56
LONG TURN TEE WYE, Single - H x H x H					
	104301	1280	40	1½	25.32
	104302	800	25	2	41.28
	104303	240	10	3	61.23
	104304	90	5	4	97.67
	104317	1120	35	2 x 1½ x 1½	37.35
	104318	900	50	2 x 1½ x 2	41.42
	104320	960	20	2 x 2 x 1½	30.46
	104326	480	15	3 x 3 x 1½	66.23
	104327	384	12	3 x 3 x 2	40.77
	104337	270	15	4 x 4 x 2	90.51
	104338	144	8	4 x 4 x 3	220.56

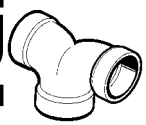
WYES Continued

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
APPLIANCE ADAPTER - Spg x Hose Barb					
	112320		80	1½ x ½	13.74
DOUBLE WYE - H x H x H x H					
	102351	960	30	1½	26.88
	102352	640	20	2	43.25
	102374	800	25	2 x 2 x 1½ x 1½	36.91
	102353	270	15	3	78.21
	102376	320	10	3 x 3 x 1½ x 1½	65.14
	102377	360	15	3 x 3 x 2 x 2	66.11
	102354	90	5	4	221.33
	102380	180	10	4 x 4 x 2 x 2	264.15
	102381	144	8	4 x 4 x 3 x 3	201.75
DOUBLE WYE, Street - Spg x H x H x H					
	105376	320	10	3 x 3 x 1½ x 1½	130.26

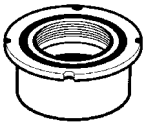
DOUBLE FIXTURE FITTINGS

DOUBLE FIXTURE FITTING - H x H x H x H					
	104149	960	20	2x1½x1½x1½	154.75
	104152	640	20	2 x 1½ x 2 x 2	60.70
	104152-3††	960	20	2 x 1½ x 1½ x 2	56.70
	104154	180	10	3 x 2 x 3 x 3	152.25
	104155	180	10	3	154.75

†† Fitting uses bushing

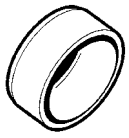
DOUBLE FIXTURE FITTING, Street - Spg x H x H x H					
	105357	180	10	3 x 2 x 3 x 3	169.18
DOUBLE 1/4 BEND - H x H x H					
	102261	2240	70	1½	46.49
	102263	320	10	3	106.53
	102262		30	2	73.94

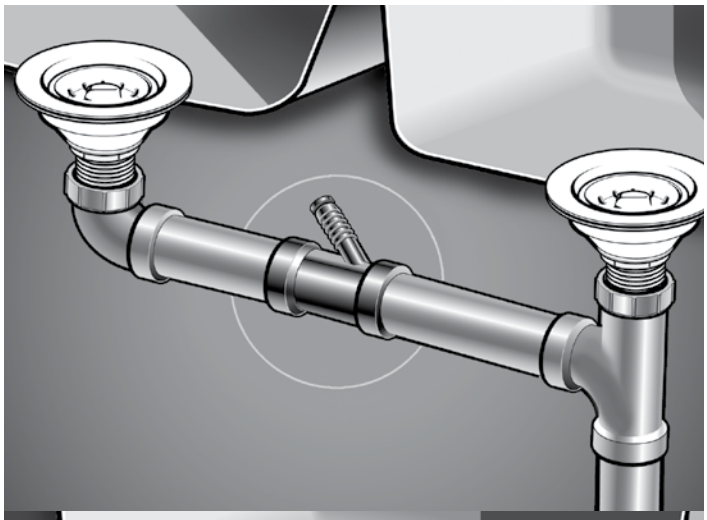
BUSHINGS

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
FLUSH BUSHING - Spg x H					
	102750	21600	150	1½ x 1¼	5.62
	102760	10800	150	2 x 1¼	8.57
	102752	10800	150	2 x 1½	3.74
	102762	2520	35	3 x 1½	18.13
	102754	2880	60	3 x 2	13.08
	102759	720	10	4 x 1½	29.13
	102758	1440	20	4 x 2	28.10
	102756	1680	35	4 x 3	25.00
	102766	432	24	6 x 3	123.63
	102767	384	8	6 x 4	140.53
FLUSH BUSHING - Spg x FPT					
	102747††	17280	120	1½ x ½	8.23
	102749††	14400	100	1½ x ¾	12.78
	102751	14400	100	1½ x 1¼	10.19
	102753	9000	125	2 x 1½	15.07
	102755	2880	40	3 x 2	24.73

†† Can be used for either dishwasher or condensate connections when combined with thread x barb nipple

ADAPTER BUSHINGS

ADAPTER BUSHING - (Adapts Sewer Hub to DWV Spigot) Sewer Spg x DWV Hub					
	102764	2160	30	4 x 3	40.31
ADAPTER BUSHING - (Adapts DWV Hub to Sewer & Drain Spigot) Spg x H					
	102841	3600	50	3	10.80
	102842	1600	50	4	12.15
	102846	450	25	6	63.28
	102840		80	2	9.19
	102768	432	24	6 x 3	123.63



Appliance / Dishwasher Wye

- *For roughing in or installing a dishwasher, water softener or any appliance with a 1/2˝ or 3/4˝ discharge hose.*

Features

- Injection molded in ABS (Black) and PVC (White).
- Top and bottom sockets are 1 1/2˝ DWV (Schedule 40) size.
- Branch arm is a 1/2˝ or 3/4˝ hose barb.
- Unit comes complete with molded on plug.
- Plug will hold test without solvent cementing.
- Saves time and money.

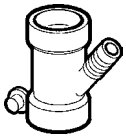
- CSA certified
- NSF, IAPMO listed

Installation

- For rough-in, insert plug into hose barb. When installing an appliance, simply remove plug and attach hose.
- Plug has oversized top to prevent installation of hose with plug still in place.
- Can be installed vertically or horizontally.

canplas® Exclusive!

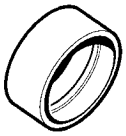
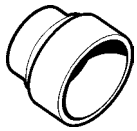
APPLIANCE WYE - H x H x Hose Barb
Snap-in Plug is Molded on Fitting for Use During "Rough-In"



112321	2880	40	1½ x 1½ x ½	15.92
112332	2880	40	1½ x 1½ x ¾	24.38
112333	2880	40	1½ x 1½ x 1	24.38

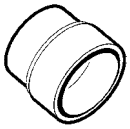
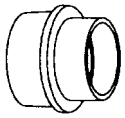
PRICE LIST C10-11-109 **JULY 1, 2011**

COUPLINGS

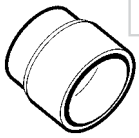
DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
COUPLING - H x H					
	103000	9000	125	1¼	6.73
	103001	9000	125	1½	2.96
	103002	4800	100	2	4.57
	103003	1440	45	3	10.62
	103004	800	25	4	19.23
	103006	216	12	6	122.37
REPAIR COUPLING (No Pipe Stop) - H x H					
	103001R††	8640	60	1½	3.12
	103002R††	5400	75	2	5.03
	103003R††	1440	45	3	11.25
	103004R††	810	45	4	19.87
REDUCER COUPLING - H x H					
	103020	9000	125	1¼ x 1½	9.45
	103021	6480	45	1¼ x 2	15.67
	103030	2520	35	1¼ x 3	20.37
	103022	5400	75	2 x 1½	8.16
	103023	2520	35	3 x 1½	19.61
	103024	2520	35	3 x 2	18.38
	103029	960	20	4 x 1½	29.74
	103025	960	20	4 x 2	29.74
	103026	960	30	4 x 3	25.85
	103027	480	15	3 x 5	67.98
	103037	360	20	6 x 4	47.24

†† Non CSA

ADAPTER COUPLINGS

ADAPTER COUPLING (Adapts Sewer & Drain to DWV) - H x H					
	103036	1200	25	4 x 3	35.17
	103035	360	20	6 x 4	92.48
ADAPTER COUPLING (Adapts Sewer & Drain to DWV) - Spg x H					
	103434BC	-	25	4 x 4	143.21

CAST IRON ADAPTERS

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
SPIGOT ADAPTER, Cast Iron (Adapts Cast Iron Spigot to DWV Spigot) - H x H					
	103304	480	15	4	74.33
HUB ADAPTER, Cast Iron (Adapts DWV Spigot to Cast Iron Hub)					
	103452	2160	30	2	22.55
	103453	960	30	3	35.59
	103454	480	15	4	66.88
	103464	480	10	3 x 4 CI	45.42
	103456	216	12	6	252.95
NO HUB ADAPTER, Cast Iron (Adapts No Hub Elastomer Coupling to DWV Spigot) - H x Spg					
	103420	7200	100	1½	18.87
	103422	3600	50	2	26.89
	103421	7920	110	2 x 1½	30.95
	103423	2160	30	3	30.56
	103424	1080	15	4	46.84
	103428	1080	15	4 x 3	46.84
	103426	256	8	6	223.82

EXPANSION JOINTS

Now approved for Horizontal Applications

canplas Exclusive!

EXPANSION JOINT - H x H					
	113811ABC	1728	12	1½	73.14
	113812ABC	1080	15	2	104.81
	113813ABC	480	15	3	135.70
TYPE I - 3" Travel					
	113814ABC	128	4	4	248.79
TYPE II - 8" Travel					

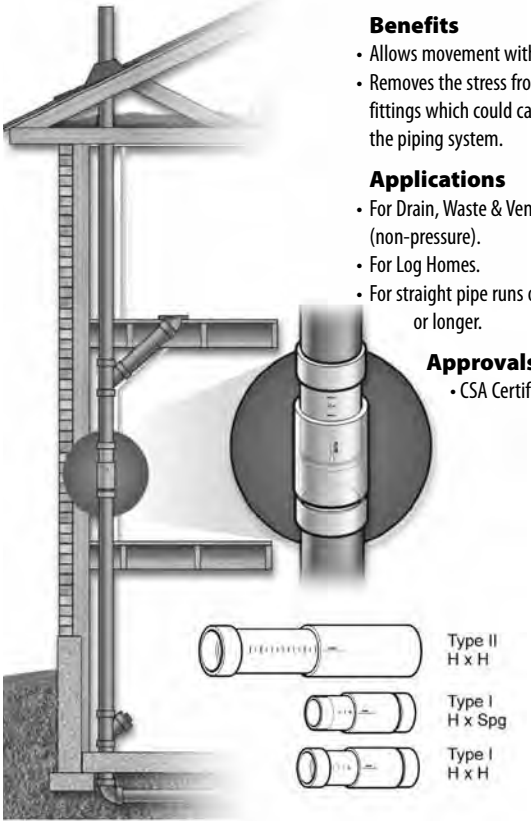
canplas Exclusive!

EXPANSION JOINT - H x Spg End Piston					
	113811BBC	1728	12	1½	70.19
	113812BBC	1080	15	2	101.32
	113813BBC	480	15	3	124.50
TYPE I - 3" Travel					

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

EXPANSION JOINTS

Allows for the expansion and contraction of pipe due to temperature change and the shrinkage of building materials that the pipe is connected to.



- Injected molded in ABS (Black) and PVC (Grey).
- Nitrile Buna-N O-ring.
- PQAA Grease #2 lubricant.

Features

- Allows for up to 3" (7.6 cm) of travel (Type I) or 8" (20.3 cm) of travel (Type II).
- Flow direction and proper degree of extention indicated on expansion joint.
- Approved for use in vertical and horizontal applications.

Benefits

- Allows movement without leakage.
- Removes the stress from both pipe and fittings which could cause failure of the piping system.

Applications

- For Drain, Waste & Vent applications (non-pressure).
- For Log Homes.
- For straight pipe runs of 30 ft. (9.1 m) or longer.

Approvals

- CSA Certified, IAPMO Listed

Installation Instructions

1. Locate unit (plunger side up). Perferably beneath lowest fixture.
2. Push plunger (inner section) until unit is fully closed.
3. Pull plunger back out specified distance according to temperature at time of installation.

Fahrenheit Degrees	Celsius Degrees	Distance
30	0	2.5" or 65mm
50	10	2.25" or 55mm
70	20	2" or 50 mm
85	30	1.75" or 45mm

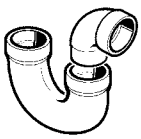
Based on 20 feet (6 meters) installation.

canplas® Exclusive!

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

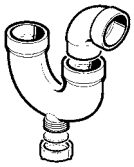
P TRAPS

P TRAP, with Solvent Weld Joint - H x H



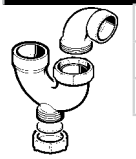
103200		20	1¼	47.51
103201	1280	40	1½	15.06
103202	640	20	2	35.78
103203	180	10	3	84.43
103204	108	6	4	165.85
103234	90	5	4 x 3	204.82

P TRAP, with Cleanout & Solvent Weld Joint - H x H



103200A		20	1¼	54.04
103201A	1120	35	1½	18.12
103202A	640	20	2	64.62

P TRAP, with Cleanout & Union Connection - H x H

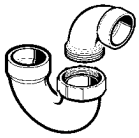


103210A		20	1¼	56.33
103211A	1120	35	1½	19.82
103212A		10	2	66.89

P TRAP U-Bend - H x H

103202-1	960	30	2	32.30
103203-1		15	3	82.06
103204-1	180	10	4	130.53
103206-1	48	2	6	942.08

P TRAP, with Union - H x H

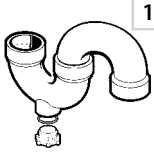


103210E		40	1¼	32.04
103211E	1280	40	1½	19.44
103212E	640	20	2	48.90

S TRAP, with Solvent Weld Joint - H x H

103251	960	20	1½	30.72

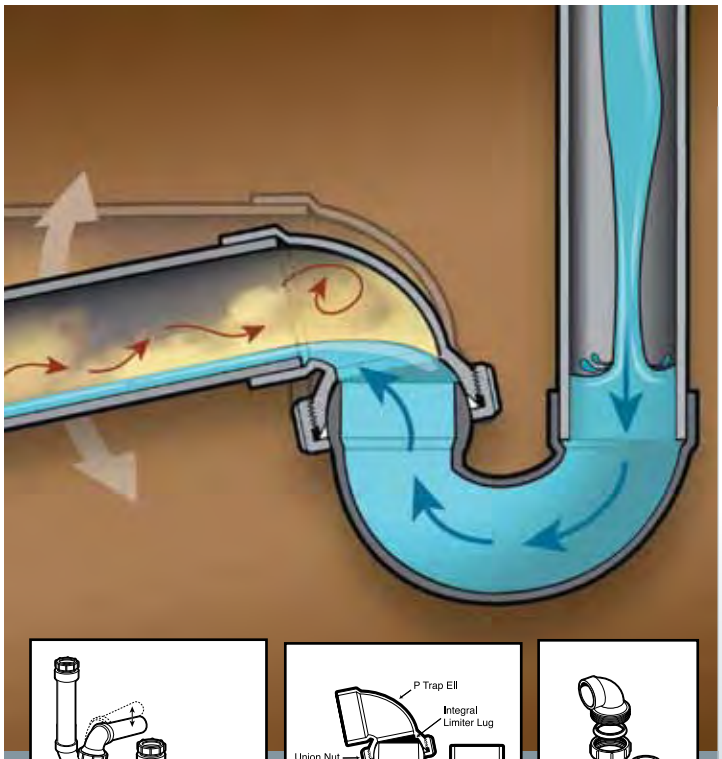
S TRAP, with Cleanout & Solvent Weld Joint - H x H

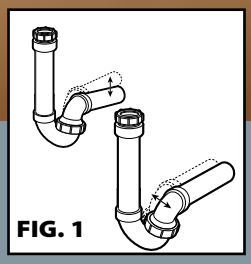


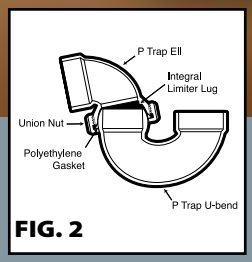
103251A	960	20	1½	32.92

P TRAP PRIMER PORT - Spg x Spg x FPT

112110-1	1440	20	3 x 3 x ½	52.13







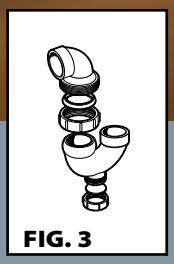


FIG. 1

The ball joint union connection allows the P Trap Ell to swivel up to 10° from vertical, in any direction, except directly backwards.

FIG. 2

An integral limiter lug prevents the P Trap Ell from pitching backwards providing the correct outlet slope for drainage. The polyethylene gasket ensures a leak proof connection in almost any installation situation.

FIG. 3

No need to tighten the union nut by mechanical means causing damage and possible leaks. The oversize union nut can be simply hand tightened for a positive seal.

Union nut can be easily undone and just as easily put back together numerous times without reducing the P Trap's sealing capability.

Installation

The Seller recommends against the use of oil based putty with an ABS fitting of it's manufacture. The union joint of the PermOseal® P Trap requires only hand tightening to affect a seal. Tightening by mechanical means may cause undue stress and possible failure of the fitting.

PermOseal® P Trap

(Patent # 6,859,956)

The Canplas PermOseal® P Trap is unlike any P Trap on the market today. It's unique design is the result of the innovative thinking you've come to expect from Canplas!

The unique design features a gasketed, ball joint, union connection that provides unequaled performance in even the most demanding installation conditions.

Features

The innovative ball joint style union allows the installer to overcome installation problems, such as pipe misalignment and offset fittings.

Gasket seal ensures a leak proof connection in almost any situation.

Oversize union nut can be easily hand tightened for a positive seal.

Material

Available in ABS (Black) with or without cleanout.

Testing

Our test results confirmed that when leak tested in misaligned installations, the new PermOseal® P Trap outperforms the top P Traps available in the North American market.

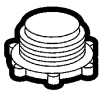
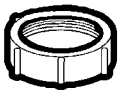
PERMOSEAL® P TRAP, with Union Connection - H x H

103231E	1120	35	1½	21.39

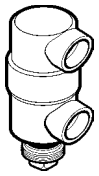
PERMOSEAL® P TRAP with Union Connection & Cleanout - H x H

103231A	1120	35	1½	21.80

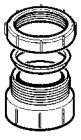
P TRAPS Continued

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
POLYETHYLENE GASKET for PermOseal® P Trap					
	103231-6	72000	500	-	2.10
THREADED PLUG FOR 1-1/2" S TRAP					
	103047		-	-	8.94
Used for 103251A					
P TRAP CLEANOUT CAP with Gasket					
	103046ABC	24000	500	1½ - 2	11.29
Used for 103201A & 103211A - 2008 and earlier and 103201AS, 103202A & 103231A - all years					
P TRAP CLEANOUT CAP self sealing (no gasket)					
	103044	43200	300	1½ - 2	11.29
Used for 103201A & 103211A - 2009 and newer					

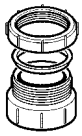
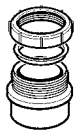
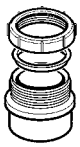
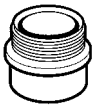
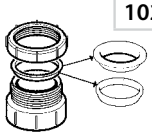
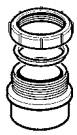
DRUM TRAPS

DRUM TRAP - H x H					
	103243A	288	4	1½	110.21

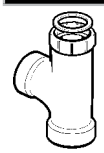
TRAP ADAPTERS

SANITARY TEE TRAP ADAPTER - H x H x Slip Joint					
	112171A	1600	50	1½	27.78
90° TRAP ADAPTER - H x Slip Joint, Ideal for Pedestal Sinks					
	112286A	3600	50	1½ x 1¼	20.11
	112281A	3600	50	1½ x 1½	20.11
TRAP ADAPTER, with Washer & Nut - H x Slip					
	102850A	9000	125	1¼	13.40
	102851A	7200	100	1½	8.27
	102860A	7200	100	1½ x 1¼	8.58
	102852A	4320	60	2	19.11

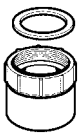
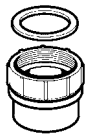
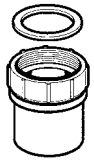
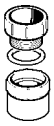
TRAP ADAPTERS Continued

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
TRAP ADAPTER, with One-piece Poly Nut - H x Slip					
	102854A	7200	100	1¼	12.85
	102853A	7200	100	1½	9.13
	102855A	7200	100	1¼ x 1½	9.61
FITTING TRAP ADAPTER, with Washer & Nut - Spg x Slip					
	102800		-	1¼	6.41
	102800A	7200	100	1¼	12.83
	102801A	7200	100	1½	9.15
	102802A	4320	60	2	21.44
	103211Y	7200	100	1½ x 1¼	9.62
FITTING TRAP ADAPTER, with One-piece Poly Nut - Spg x Slip					
	102805A	7200	100	1¼	13.40
	102804A	7200	100	1½	8.23
	102806A	7200	100	1¼ x 1½	8.58
FITTING TRAP ADAPTER, less Washer & Nut (Fitting Male Adapter) - Spg x MPT					
	102801		100	1½	4.62
	102802		60	2	17.50
2-IN-1 COMBINATION TRAP ADAPTER - H x Slip					
	102859A	7200	100	1½ x 1½ x 1¼	11.79
COPPER TO DWV PIPE ADAPTER - H x Slip					
	102862A††	7200	100	1¼	20.19
	102861A	5760	80	1½	15.29
	102864A††	5760	80	1½ x 1¼	18.70
	102865A	3600	50	2	31.41
	102866A	4320	60	2 x 1½	28.33

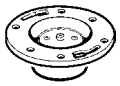
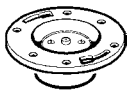
†† CSA certified for use in P Trap area only

SANITARY TEE SINK STRAINER ADAPTER H x H x Strainer Adapter (with Gasket)					
	112191A	1600	50	1½	28.07
90° SINK STRAINER ADAPTER H x Strainer Adapter (with Gasket)					
	112291A	3600	50	1½	24.92

TRAP ADAPTERS Continued

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
TRAY PLUG ADAPTER - Spg x FPT					
	103211-7		40	1½	14.23
TRAY PLUG ADAPTER - H x FPT					
	103211-9		40	1½	14.67
SWIVEL TRAY PLUG (STRAINER) ADAPTER, with Washer H x FPT					
	103217	7200	100	1½	17.43
	103218	5040	70	1¼ x 1½	17.53
SWIVEL TRAY PLUG (STRAINER) ADAPTER, with Washer Spg x FPT					
	103215	8640	60	1½	17.33
SWIVEL TRAY PLUG (STRAINER) ADAPTER, with Washer Ext. Spg x FPT					
	103216	5040	35	1½	18.78
	103214	7200	50	1¼ x 1½	16.90
UNION					
	102863A	3600	50	1½	23.93
SLIP JOINT NUT					
	103930	28000	200	1¼	3.75
	103931		-	1½	3.22
	103932	19200	600	2	10.20
SLIP JOINT WASHER					
	109210-003	144000	1000	1¼	1.91
	109210-004	115200	800	1½	1.96
	109210-005	7200	400	2	3.17

ONE PIECE CLOSET FLANGES

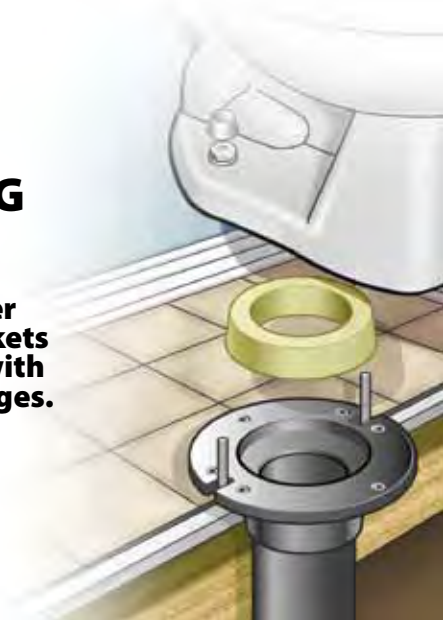
DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
CLOSET FLANGE, One Piece Plastic - Hub End with Gussets					
	103604	800	25	4	32.29
	103634	800	25	4 x 3	26.69
CLOSET FLANGE, One Piece Plastic - With Molded Test Plate					
	103634T	800	25	4 x 3	29.42
CLOSET FLANGE, One Piece Plastic - Hub					
	Hub				
	103633	800	25	4 x 3	21.48
CLOSET FLANGE, One Piece Plastic - Hub – Flush Fit					
	103631††	800	25	4 x 3	28.97
	Without Pipe Stop				
	103631X††	800	25	4 x 3	28.97
	103631SDRBC‡‡	800	25	4 x 3	28.97
	With molded test plate				
	103631T††	800	25	4 x 3	28.76

†† Fits over 3" or inside 4" Schedule 40 DWV pipe
‡‡ Fits over 3" DWV or inside 4" SDR 35 pipe

CLOSET FLANGE KIT FOR CONCRETE AND TILED FLOORS For Use in Slab on Grade Closet Flange Installations					
	With test plate				
	113650A	384	12	4 x 3	294.28
	Without test plate				
	113650B	384	12	4 x 3	153.80

WARNING

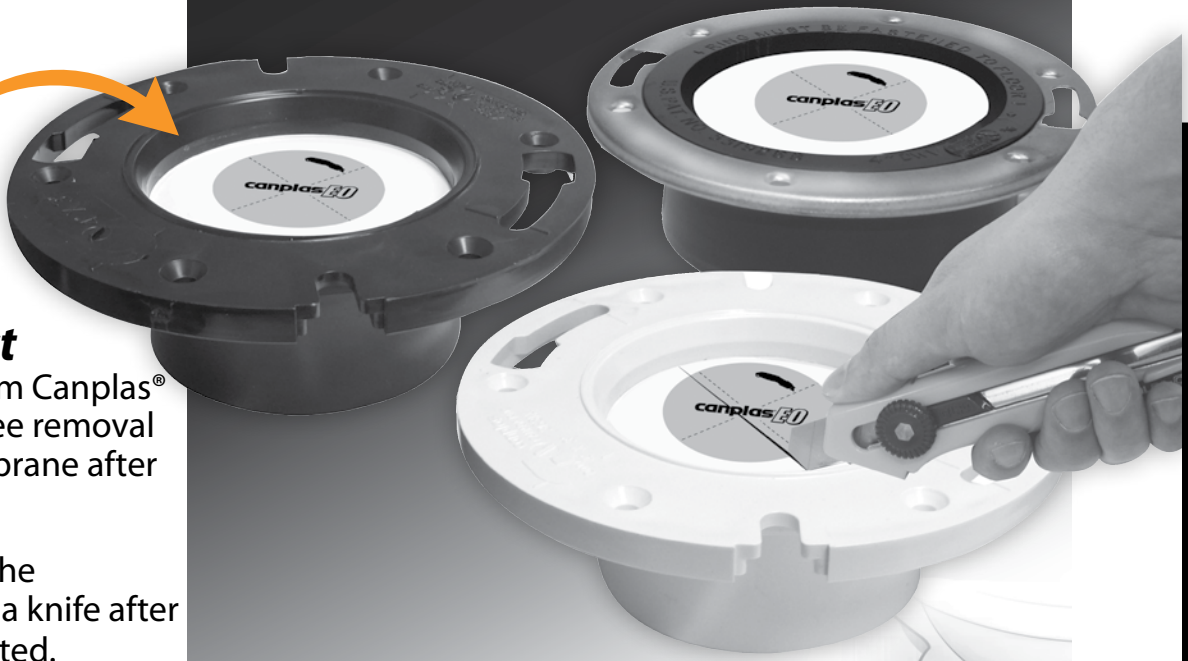
Canplas recommends sponge rubber and wax gaskets only for use with all closet flanges.



- **No more hammers**
- **No more damage!**

New! canplas® EO No Hammer-Easy Open

Test Cap Closet Flanges



New! Innovative test membrane from Canplas® enables mess-free removal of the test membrane after a water test.

Simply remove the membrane with a knife after the system is tested.

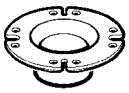
• Patent Pending

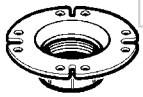
canplas® Exclusive!

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH
CanplasEO, No Hammer/Easy Open **TEST MEMBRANE CLOSET FLANGE**					
	Hub with Adjustable Ring (3" hub, or 4" inside pipe fit)				
	113614EO		25	4 x 3	57.47
	Hub with Adjustable Ring (3" Hub)				
	113624EO	800	25	4 x 3	52.70
	45° Discharge Closet Flange (3" Hub)				
	113628EO		20	4 x 3	84.28
	Hub Flush Fit, One Piece Plastic (3" Hub)				
	113631EO		25	4 x 3	29.82

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

REDUCING **CLOSET FLANGES**

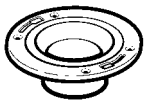
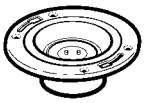
CLOSET FLANGE, Reducing - 2½" Overall (Spg)					
	103634-7	800	25	4 x 3	32.48

CLOSET FLANGE, Reducing - 1¾" Overall (FPT)					
	103634-5	1280	40	4 x 3 Close	46.84

CLOSET FLANGE, Reducing - 1¾" Overall (MPT)					
	103634-3	1200	25	4 x 3 Close	71.36

CLOSET FLANGE, Reducing - 2¼" Overall (MPT)					
	103634-4	1200	25	4 x 3 Long	71.36

ADJUSTABLE **CLOSET FLANGES**

CLOSET FLANGE, Adjustable					
	Hub End, Flush Fit with Adjustable Plastic Ring				
	103627	800	25	4 x 3	40.97
	Hub End, with Adjustable Plastic Ring				
	103624	800	25	4 x 3	42.18
	Spigot End, with Adjustable Plastic Ring				
	103626	800	25	4 x 3	50.07
	Hub End, with molded test plate				
	103627T	800	25	4 x 3	42.28
	Hub End, with molded test plate				
	103624T	800	25	4 x 3	43.53
	Spigot End, with molded test plate				
	103626T	800	25	4 x 3	50.07

ADJUSTABLE CLOSET FLANGE for 3" Pipe I.D. (Non CSA)					
	103630		25	4 x 3	50.73

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

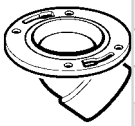
OFFSET **CLOSET FLANGES**

3" OR 4" OFFSET 2" CLOSET FLANGE					
	113645		20	3 x 4	53.98

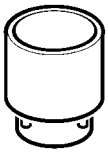
OFFSET CLOSET FLANGE - Hub (Offset 1½")					
	103644	480	15	4 x 3	89.62
	(with molded test plate)				
	103644T††	480	15	4 x 3	92.48

†† Non CSA

45° **CLOSET FLANGES**

45° DISCHARGE CLOSET FLANGE - Hub					
	(with adjustable plastic ring)				
	113628	640	20	4 x 3	67.42
	113635	384	12	4	87.15
	(with adjustable stainless steel ring)				
	113628SS	640	20	4 x 3	93.09

CLOSET FLANGE ACCESSORIES

ADAPTER Only for Closet Flange Kit for Concrete - H x Spg					
	113650-1	576	12	4 x 3	114.87

CLOSET FLANGE SPACER RING					
	119180-002	3600	25	4 x 3	15.82

CLOSET FLANGE SPACER RING					
	113609	3600	25	4 x 3	14.24

Fig. 1
Front flange detail

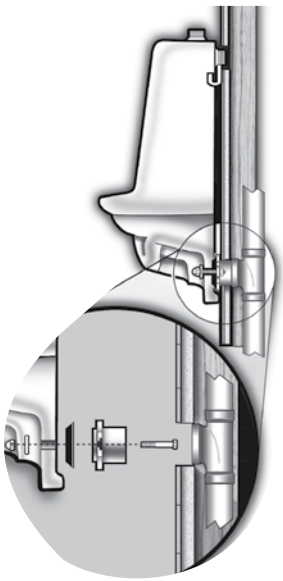


Fig. 2
Side exploded detail

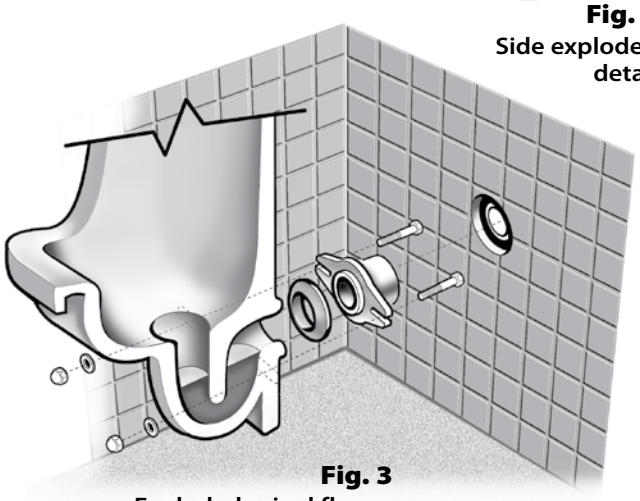


Fig. 3
Exploded urinal flange

canplas®
Urinal Flange Kit

- ***Used to provide a seal between 2" internally trapped urinals and drainage system.***

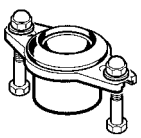
Features

- Flanges are made of corrosion resistant ABS and PVC plastic. They will not rot out like traditional urinal flanges providing longer life and fewer health concerns.
- 2" connections available in Hub, Spigot and Female Threaded versions making Canplas urinal flange kits adaptable to a variety of systems.
- Each Canplas urinal kit comes complete with all the necessary mounting hardware. This complete kit eliminates missing or back-ordered parts.
- The Canplas urinal flange has an adjustable 4" - 7" center which can be cut easily to accommodate the requirements of most applications.
- The flange is reinforced with a cross rib to prevent the fork from spreading.
- Ease of installation as illustrated in figures 1 through 3 (long ear cut to accommodate 4" center shown), lowers labor costs and increases job turnaround time.
- Thick foam gasket provides a positive seal, reducing the potential for leaks.
- Injection molded in ABS (Black) and PVC (White) function.

Kits come individually packaged with installation instructions on header card, plastic urinal flange, foam gasket, stainless steel bolts, washers and nuts.

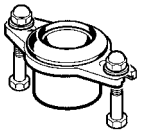
canplas® Exclusive!

URINAL FLANGE KIT - ABS – Spigot



113660††	1200	25	2	83.15
113661‡‡	1440	20	2	90.12

URINAL FLANGE KIT - ABS – Hub



113662††		25	2	102.00
113663‡‡		20	2	119.76

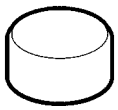
†† with 4" Center ‡‡ with Adjustable Center: 4" - 7"

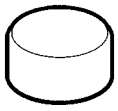
DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

GRATES

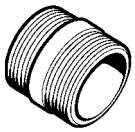
DRAIN GRATE - Spg					
	103863	3600	50	3	21.04
	103864	1800	25	4	25.60

CAPS

ABS CAP - Hub					
	103080	17280	120	1¼	9.98
	103081	12960	90	1½	9.24
	103082	7920	110	2	15.87
	103083	2160	30	3	27.58
	103084	1200	25	4	29.86
	103086	384	12	6	124.37

POLYETHYLENE CAP Slip-on Style - Orange					
	10TC314	18000	125	1¼	5.49
	10TC315	14400	200	1½	3.49
	10TC316	10800	150	2	6.47
	10TC318	2520	35	3	8.50
	10TC320	1920	40	4	11.89
	10TC322	480	10	6	30.13

NIPPLES

NIPPLE - MPT x MPT					
	103502	2240	70	3 x 2⅝	19.65
	103503	2240	70	3 x 3	26.52
	103510		10	3 x 10	70.66

TEST PLATES

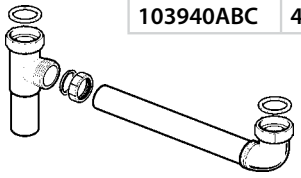
TEST PLATE - Spg					
	103761		100	1½	8.89
	103762		100	2	10.63
	103763		100	3	10.90
	103764	7200	100	4	14.24

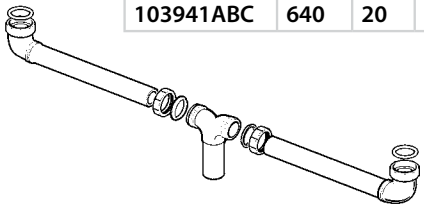
DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

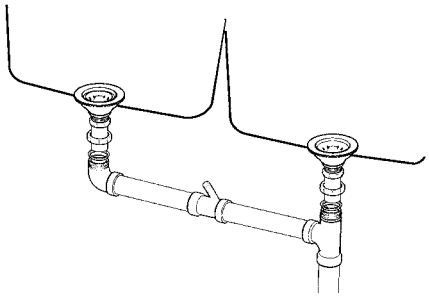
TERMINATION SCREENS

TERMINATION SCREEN - Polypropylene					
	Black Polypropylene				
	112002	17150	50	2	8.45
	112003	14400	100	3	15.92
	White Polypropylene				
	112002W	22050	50	2	8.53
	112003W	14400	100	3	15.92

CONTINUOUS WASTE

CONTINUOUS WASTE END OUTLET - TUBULAR 16" Long (Center to Center) - DIRECT CONNECT					
	103940ABC	480	20	1½	65.68

CONTINUOUS WASTE CENTER OUTLET - TUBULAR 16" Long - DIRECT CONNECT					
	103941ABC	640	20	1½	78.91

CONTINUOUS WASTE TRAP ADAPTER STYLE End Outlet (pipe not included) - SLIP JOINT					
	103950ABC	720	15	-	39.54

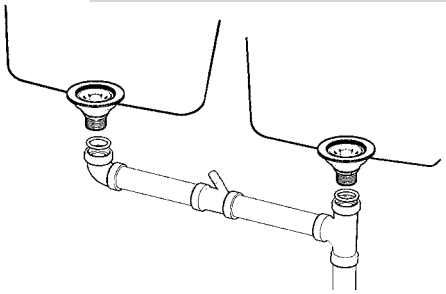
Consisting of:

(1) 112281A 1½" 90° Trap Adapter
(1) 112171A 1½" Sanitary Tee Trap Adapter
(1) 112321 1½" x 1½" x ½" Appliance Wye

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

CONTINUOUS WASTE
Continued

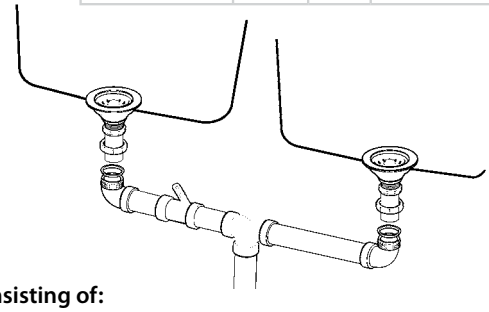
CONTINUOUS SINK STRAINER ADAPTER STYLE End Outlet (pipe not included) - DIRECT CONNECT					
	103951ABC	720	15	-	39.54



Consisting of:

(1) 112291A 1½" 90° Sink Strainer Adapter
(1) 112191A 1½" Sanitary Tee Sink Strainer Adapter
(1) 112321 1½" x 1½" x ½" Appliance Wye

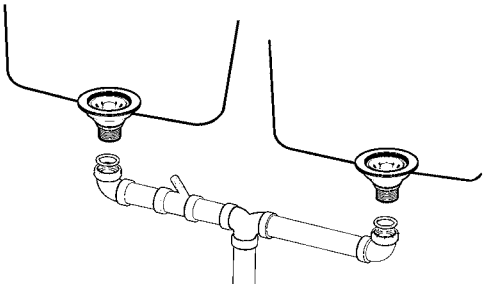
CONTINUOUS SINK TRAP ADAPTER STYLE Center Outlet(pipe not included) - SLIP JOINT					
	103952ABC	720	15	-	61.40



Consisting of:

(2) 112281A 1½" 90° Trap Adapters
(1) 102261 1½" Double ¼ Bend, H x H x H
(1) 112321 1½" x 1½" x ½" Appliance Wye

CONTINUOUS SINK STRAINER ADAPTER STYLE Center Outlet (pipe not included) - DIRECT CONNECT					
	103953ABC	720	15	-	61.40



Consisting of:

(2) 112291A 1½" 90° Sink Strainer Adapters
(1) 102261 1½" Double ¼ Bend, H x H x H
(1) 112321 1½" x 1½" x ½" Appliance Wye

DESC.	PART #	SKID QTY.	CTN. QTY.	SIZE	PRICE EACH

APPROVALS:
Unless otherwise noted, products are approved / listed by CSA International, NSF and IAPMO to standards that include:

CSA	**B79, B181.2**
NSF	**Standard 14**
IAPMO	**IS5, PS 146-99**
ASTM	**D2665, D1784, D3311**

PART#	Weight (Kgs.)	CARTON BARCODE	PG. #
102107A	0.727	10662671100013	4
102114A	0.098	10662671100037	4
102115A	0.107	10662671100044	4
102116A	0.440	10662671100051	4
102117A	0.780	10662671100068	4
102118A	2.012	10662671103526	4
102125	0.087	10662671100075	3
102126	0.114	10662671100082	3
102127	0.123	10662671100099	3
102128	0.109	10662671100105	3
102130	0.287	10662671100129	3
102131	0.293	10662671100136	3
102132	0.084	10662671100150	3
102133	0.127	10662671100167	3
102134	0.462	10662671100174	3
102135	0.307	10662671100181	3
102136	0.636	10662671100198	3
102137	0.089	10662671100204	3
102144	1.428	10662671107487	3
102147L	0.496	10662671100211	3
102147LR	0.541	10662671100228	3
102147R	0.509	10662671100235	3
102148L	0.511	10662671100242	3
102148LR	0.594	10662671107364	3
102148R	0.500	10662671100259	3
102150	0.072	10662671100266	3
102151	0.081	10662671100273	3
102152-2	0.171	10662671107845	3
102152	0.125	10662671100297	3
102153	0.458	10662671100310	3
102154	0.707	10662671100334	3
102156	2.025	10662671103564	3
102163L	0.665	10662671100358	4
102182-1	0.335	10662671107685	3
102184	0.604	10662671103373	4
102185	1.048	10662671100372	4
102186	0.224	10662671100389	4
102187	0.144	10662671100396	4
102188	0.170	10662671100402	4
102188-2	0.192	10662671109566	4
102189	0.287	10662671100419	4
102191	0.735	10662671107869	4
102221	0.099	10662671109511	6
102223	0.455	10662671100426	6
102250	0.053	10662671100433	6
102250L	0.059	10662671106947	6
102251	0.061	10662671100440	6
102251L	0.078	10662671100464	6
102252	0.083	10662671100471	6
102252L	0.122	10662671103366	6
102253	0.285	10662671100488	6
102253L	0.324	10662671100501	6
102254	0.535	10662671100518	6
102254L	0.608	10662671100532	6
102256	1.664	10662671100549	6
102261	0.103	10662671107890	8
102262	0.162	10662671107906	8
102263	0.507	10662671107913	8
102275	0.075	10662671107456	6
102276	0.094	10662671100556	6
102277	0.134	10662671100563	6
102278	0.403	10662671100570	6
102279	0.740	10662671107159	6
102300	0.087	10662671100600	7
102301	0.108	10662671100617	7
102302	0.150	10662671100631	7
102303	0.469	10662671100655	7
102304	0.884	10662671100679	7
102306	2.454	10662671100693	7
102323	0.095	10662671100709	7
102324	0.165	10662671100716	7
102325	0.116	10662671100723	7
102326	0.312	10662671100730	7
102327	0.676	10662671100747	7
102328	0.545	10662671100761	7
102329	0.458	10662671109382	7
102330	0.343	10662671100778	7
102331	0.277	10662671100785	7
102343	1.670	10662671109351	7
102344	1.695	10662671100808	7
102351	0.161	10662671100815	8
102352	0.231	10662671100822	8
102353	0.606	10662671100839	8
102354	1.270	10662671100846	8
102374	0.208	10662671100853	8
102376	0.407	10662671100860	8
102377	0.438	10662671100877	8
102380	0.667	10662671100884	8
102381	1.069	10662671100891	8
102400	0.049	10662671100907	7
102401	0.061	10662671100914	7
102402	0.102	10662671100921	7
102403	0.283	10662671100938	7
102404	0.489	10662671100945	7
102406	1.129	10662671100952	7
102420	0.032	10662671100969	7
102421	0.041	10662671100976	7
102422	0.057	10662671100983	7
102423	0.211	10662671100990	7
102424	0.337	10662671101003	7
102450	0.049	10662671101010	6
102451	0.059	10662671101027	6
102451L	0.075	10662671106923	6
102452	0.082	10662671101041	6
102452L	0.114	10662671106800	6
102453	0.271	10662671101058	6
102453L	0.319	10662671101072	6
102454	0.505	10662671101089	6
102454L	0.591	10662671101096	6
102456	1.640	10662671103380	6
102501	0.065	10662671101119	6
102502	0.108	10662671101126	6
102503	0.305	10662671101133	6
102504	0.519	10662671101140	6
102506	1.135	10662671101157	6
102520	0.035	10662671101164	6
102521	0.043	10662671101171	6
102522	0.059	10662671101201	6
102523	0.217	10662671101225	6
102524	0.364	10662671101232	6
102550	0.041	10662671101249	7
102551	0.046	10662671101256	7
102552	0.073	10662671101263	7
102553	0.211	10662671101270	7
102554	0.355	10662671101287	7
102556	0.992	10662671101294	7
102561	0.044	10662671106893	7
102562	0.069	10662671106909	7
102563	0.206	10662671107319	7
102564	0.347	10662671107944	7
102601	0.068	10662671101317	6
102602	0.064	10662671101324	6
102602L	0.100	10662671107265	6
102603	0.232	10662671101331	6
102603L	0.279	10662671106961	6
102604	0.473	10662671101348	6
102747†	0.024	10662671101355	8
102749†	0.025	10662671101379	8
102750	0.013	10662671101386	8
102751	0.016	10662671101409	8
102752	0.022	10662671101416	8
102753	0.034	10662671101430	8
102754	0.129	10662671101447	8
102755	0.121	10662671107180	8
102756	0.172	10662671101461	8
102758	0.196	10662671101485	8
102759	0.980	10662671101508	8
102760	0.031	10662671101515	8
102762	0.140	10662671101522	8
102764	0.145	10662671101546	8
102766	0.693	10662671108866	8
102767	0.648	10662671101560	8
102768	0.465	10662671108972	8
102800	0.024	10662671109764	13
102800A	0.033	10662671101577	13
102801	0.028	10662671108262	13
102801A	0.039	10662671101591	13
102802	0.038	10662671107968	13
102802A	0.054	10662671101607	13
102804A	0.043	10662671109726	13
102805A	0.037	10662671109719	13
102806A	0.039	10662671109733	13
102840	0.100	10662671109399	8
102841	0.038	10662671101621	8
102842	0.060	10662671101645	8
102846	0.240	10662671103410	8
102850A	0.033	10662671101652	13
102851A	0.039	10662671101669	13
102852A	0.052	10662671101676	13
102853A	0.043	10662671109696	13
102854A	0.037	10662671109689	13
102855A	0.043	10662671109702	13
102859A	0.043	10662671108934	13
102860	0.029	10662671108255	4
102860A	0.038	10662671101683	13
102861A	0.053	10662671101706	13
102862A	0.047	10662671101720	13
102863A	0.078	10662671101737	14
102864A	0.051	10662671101744	13
102865A	0.069	10662671101768	13
102866A	0.067	10662671109108	13
102870	0.025	10662671101775	4
102871	0.029	10662671101782	4
102872	0.037	10662671101805	4
102873	0.133	10662671101812	4
102874	0.208	10662671101836	4
102876	0.529	10662671109160	4
102890	0.034	10662671101843	4
102890A	0.080	10662671101850	4
102891	0.038	10662671101867	4
102891A	0.116	10662671101874	4
102892	0.050	10662671101881	4
102892A	0.121	10662671101898	4
102893	0.169	10662671101904	4
102893A	0.262	10662671101911	4
102894	0.257	10662671101928	4
102894A	0.399	10662671101935	4
102896	0.637	10662671101942	4
103000	0.025	10662671101959	10
103001	0.028	10662671101966	10
103001R†	0.028	10662671108354	10
103002	0.040	10662671101980	10
103002R†	0.037	10662671107814	10
103003	0.152	10662671102000	10

PART#	Weight (Kgs.)	CARTON BARCODE	PG. #
103003R†	0.149	10662671108347	10
103004	0.248	10662671102024	10
103004R†	0.254	10662671108361	10
103006	0.729	10662671102048	10
103020	0.035	10662671102055	10
103021	0.045	10662671102062	10
103022	0.046	10662671102079	10
103023	0.131	10662671102093	10
103024	0.125	10662671102109	10
103025	0.233	10662671102116	10
103026	0.231	10662671102123	10
103027	0.438	10662671102130	10
103029	0.243	10662671102147	10
103030	0.134	10662671102154	10
103035	0.600	10662671109320	10
103036	0.162	10662671102161	10
103037	0.664	10662671109337	10
103044	0.143	10662671109979	13
103046ABC	0.017	20662671109433	13
103047	0.008	90662671103409	13
103050	0.024	10662671102192	4
103051	0.048	10662671102215	4
103052	0.037	10662671102239	4
103053	0.097	10662671102253	4
103054	0.145	10662671102260	4
103057	0.670	10662671102277	4
103062	0.029	10662671107999	4
103063	0.049	10662671108002	4
103064	0.114	10662671108682	4
103066	0.342	10662671107395	4
103080	0.022	10662671102284	18
103081	0.028	10662671102291	18
103082	0.037	10662671102307	18
103083	0.115	10662671102314	18
103084	0.204	10662671102321	18
103086	0.541	10662671103496	18
103103	0.493	10662671102338	6
103200A	0.160	10662671102352	11
103201A	0.157	10662671102376	11
103200	0.140	10662671102345	11
103201	0.143	10662671102369	11
103202	0.285	10662671102383	11
103202-1	0.184	10662671107043	11
103202A	0.299	10662671102390	11
103203	0.836	10662671102406	11
103203-1	0.571	10662671102413	11
103204	1.589	10662671102420	11
103204-1	1.080	10662671103489	11
103206-1	2.555	10662671107753	11
103210A	0.654	10662671102444	11
103210E	0.164	10662671102451	11
103211-7	0.070	10662671107548	14
103211-9	0.068	10662671107111	14
103211A	0.176	10662671102468	11
103211E	0.167	10662671102482	11
103211Y	0.035	10662671102505	13
103212A	0.132	10662671103342	11
103212E	0.301	10662671102512	11
103214	0.028	10662671108415	14
103215	0.036	10662671102529	14
103216	0.040	10662671102536	14
103217	0.037	10662671102543	14
103218	0.032	10662671107647	14
103231-6	0.002	10662671109238	13
103231A	0.235	10662671109269	12
103231E	0.210	10662671109276	12
103234	1.572	10662671102567	11
103243A	0.539	10662671103458	13
103251	0.196	10662671102574	11
103251A	0.207	10662671102581	11
103304	0.374	10662671107173	10
103420	0.033	10662671108859	10
103421	0.042	10662671102598	10
103422	0.059	10662671102604	10
103423	0.137	10662671102611	10
103424	0.210	10662671102628	10
103426	0.491	10662671108989	10
103428	0.180	10662671103427	10
103434BC	0.441	10662671109412	10
103452	0.106	10662671102635	10
103453	0.253	10662671102642	10
103454	0.382	10662671102659	10
103456	0.677	10662671109009	10
103464	0.343	10662671102666	10
103502†	0.085	10662671108613	18
103503†	0.099	10662671107463	18
103510†	0.486	10662671108392	18
103604	0.224	10662671102680	14
103624	0.257	10662671102697	16
103624T	0.279	10662671102703	16
103626	0.249	10662671102710	16
103626T	0.350	10662671103328	16
103627	0.215	10662671108835	16
103627T	0.238	10662671108842	16
103630	0.275	10662671108798	16
103631	0.238	10662671102727	14
103631T	0.273	10662671102734	14
103631SDRBC	0.240	10662671109488	14
103631X	0.224	10662671109306	14
103633	0.258	10662671106671	14
103634	0.245	10662671102741	14
103634-3	0.188	10662671102758	16
103634-4	0.217	10662671102765	16
103634-5	0.212	10662671102772	16
103634-7	0.237	10662671102789	16
103634T	0.259	10662671102796	14
103644	0.339	10662671102802	16
103644T†	0.361	10662671109221	16
103700A	0.058	10662671102826	4
103700-1	0.035	10662671102819	4
103701A	0.057	10662671102840	4
103701-1	0.028	10662671102833	4
103702A	0.079	10662671102864	4
103702-1	0.042	10662671102857	4
103703A	0.223	10662671102888	4
103703-1	0.128	10662671102871	4
103704A	0.342	10662671102901	4
103704-1	0.203	10662671102895	4
103706A	0.857	10662671102925	4
103706-1	0.507	10662671102918	4
103750†	0.302	10662671108804	3
103761	0.004	10662671108422	18
103762	0.005	10662671102932	18
103763	0.011	10662671102949	18
103764	0.035	10662671102956	18
103863	0.109	10662671103038	18
103864	0.176	10662671103045	18
103930	0.008	10662671103052	14
103931	0.010	90662671103065	14
103932	0.014	10662671103076	14
103940ABC	0.225	20662671103080	18
103941ABC	0.253	20662671103110	18
103950ABC	0.271	20662671108870	18
103951ABC	0.259	20662671108887	19
103952ABC	0.324	20662671108894	19
103953ABC	0.309	20662671108900	19
104152	0.297	10662671107333	8
104152-3	0.318	10662671109542	8
104154	0.850	10662671108033	8
104155	0.891	10662671107128	8
104301	0.166	10662671107586	7
104302	0.245	10662671106855	7
104303	0.754	10662671108651	7
104304	1.414	10662671107616	7
104317	0.182	10662671108040	7
104318	0.244	10662671108057	7
104320	0.180	10662671108064	7
104326	0.349	10662671107135	7
104327	0.433	10662671107142	7
104337	0.618	10662671107340	7
104338	0.987	10662671107722	7
105130L	0.341	10662671107296	3
105131	0.288	10662671103151	3
105134	0.452	10662671103168	3
105144	1.426	10662671108910	3
105151	0.080	10662671103175	3
105153	0.460	10662671103182	3
105154	0.717	10662671103199	3
105156	1.982	10662671108996	3
105276	0.102	10662671108774	6
105277	0.170	10662671108781	6
105278	0.399	10662671108095	6
105279	0.753	10662671109344	6
105303	0.442	10662671103205	7
105331	0.360	10662671103212	7
105357	0.832	10662671109078	8
105376	0.394	10662671109085	8
109210-003	0.001	10662671108941	14
109210-004	0.001	10662671103236	14
109210-005	0.002	10662671103243	14
10TC314†	0.007	10662671103250	18
10TC315†	0.010	10662671103267	18
10TC316†	0.012	10662671103274	18
10TC318†	0.026	10662671103281	18
10TC320†	0.037	10662671103298	18
10TC322†	0.093	10662671109023	18
112002	0.007	10662671110173	18
112003	0.016	10662671110272	18
112002W	0.007	10662671117578	18
112003W	0.016	10662671117585	18
112107AT	0.728	10662671117127	5
112110-1†	0.170	10662671110012	11
112171A	0.122	10662671113501	13
112191A	0.116	10662671113556	13
112281A	0.070	10662671110586	13
112286A	0.064	10662671100594	13
112291A	0.063	10662671113549	13
112320†	0.230	10662671110234	8
112321	0.067	10662671103304	9
112332	0.073	10662671103465	9
112333†	0.076	10662671116700	9
113609	0.075	10662671117448	16
113614EO	0.248	10662671117486	15
113624EO	0.235	10662671117462	15
113628	0.299	10662671103311	16
113628EO	0.300	10662671117493	15
113628SS	0.401	10662671119152	16
113631EO	0.250	10662671057430	16
113635	0.382	10662671119053	16
113645†	0.298	10662671110470	16
113650A	0.588	10662671103359	14

PRICE LIST C10-11-109 **JULY 1, 2011**

PART#	Weight (Kgs.)	CARTON BARCODE	PG. #
113650B	0.554	10662671116618	14
113650-1	0.315	10662671119015	16
113660†	0.227	10662671118759	17
113661†	0.238	10662671118766	17
113662†	0.209	10662671110104	17
113663†	0.218	10662671119213	17
113811ABC	0.223	50662671102961	10
113811BBC	0.221	50662671102978	10
113812ABC	0.290	50662671102985	10
113812BBC	0.270	50662671102992	10
113813ABC	0.620	60662671103002	10
113813BBC	0.637	60662671103019	10
113814ABC	1.676	50662671103333	10
119180-002†	0.103	10662671113532	16

PART#	Weight (Kgs.)	CARTON BARCODE	PG. #

PART#	Weight (Kgs.)	CARTON BARCODE	PG. #

NOTES:

ABS DWV FITTINGS

PRICE LIST C10-11-109 **JULY 1, 2011**

canplas®

Head Office, Manufacturing Location and Customer Service Centre
500 VETERANS DRIVE, BOX 1800
BARRIE, ON L4M 4V3
CANADA
TELEPHONE: (705) 726-3361
FAX: (705) 726-2186
EMAIL: plumbing@canplas.com

Customer Service Centre and Sales Office
9489 - 200 STREET, UNIT 201
LANGLEY, B.C. V1M 3A7
CANADA
TELEPHONE: (604) 455-0432
FAX: (604) 455-0452

Customer Service Centre and Sales Office
11408-163rd STREET
EDMONTON, AB T5M 3T3
CANADA
TELEPHONE: (780) 451-3206
FAX: (780) 452-0536

www.canplasplumbing.com
1-800-461-5300

PRINTED IN CANADA
IMPRIMÉ AU CANADA

an Aliaxis company

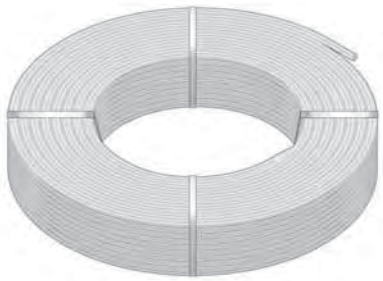
PureLink® Plus Blue Stripe PEX-a Tubing
20000 Series

High molecular crosslinked polyethylene (PEX) with minimum bending radius of 6× the diameter at 68˚F (20˚C). Maximum operating temperature 180˚F @ 100 psi (82˚C @ 7 bar). Blue printing on 2 sides for identification of cold water lines.

Meets or exceeds ASTM F876/F877/F2023, ASTM E84 (½" to 1-¼"), CSA B137.5, cNSFus-pw, NSF/ANSI-61, NSF/ANSI-14, Annex G, NSF U.P.Code, ICC-ES, ICC-PMG, ULC S102.2 (½" to 1-¼"), IAPMO UPC (½"), PPI TR-4. The PureLink® Plus PEX-a tubing may also be used with fittings that are compliant with ASTM F1807/F1960/F2080/F2098/F2159 standards.

Minimum bending radius @ 68˚F (20˚C) for:

½" = 3" (77 mm)
¾" = 4-½" (115 mm)
1" = 6" (153 mm)
1-¼" = 7-½" (191 mm)
1-½" = 9" (229 mm)



	Stk#	Description	Pkg Qty	Skid Qty	Unit	Disc.	List Price / Unit
	20105	½" 100ft Blue PureLink® Plus UV Stabilized PEX-a PexCube™	6	48	coil	PP	
	20305	½" 300ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	32	coil	PP	
	20505	½" 500ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	24	coil	PP	
	20905	½" 1000ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	14	coil	PP	
	20122	¾" 100ft Blue PureLink® Plus UV Stabilized PEX-a PexCube™	3	48	coil	PP	
	20322	¾" 300ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	14	coil	PP	
	20522	¾" 500ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	9	coil	PP	
	20922	¾" 1000ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	5	coil	PP	
	20128	1" 100ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	21	coil	PP	
	20328	1" 300ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	9	coil	PP	
	20135	1-¼" 100ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	14	coil	PP	
New!	20335	1-¼" 300ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	5	coil	PP	
New!*	20145	1-½" 100ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	TBD	coil	PP	
New!*	20345	1-½" 300ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	TBD	coil	PP	

	Stk#	Description	Pkg Qty	Master Bag	Unit	Disc.	List Price / Unit
	20205	½" 20×20ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
	20222	¾" 10×20ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
	20228	1" 5×20ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
	20235	1-¼" 5×20ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
New!*	20245	1-½" 5×20ft Blue PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	

* Check with your local representative for availability.

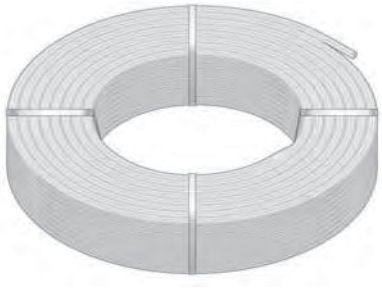
PureLink® Plus Red Stripe PEX-a Tubing
21000 Series

High molecular crosslinked polyethylene (PEX) with minimum bending radius of 6× the diameter at 68˚F (20˚C). Maximum operating temperature 180˚F @ 100 psi (82˚C @ 7 bar). Red printing on 2 sides for identification of hot water lines.

Meets or exceeds ASTM F876/F877/F2023, ASTM E84 (½" to 1-¼"), CSA B137.5, cNSFus-pw, NSF/ANSI-61, NSF/ANSI-14, Annex G, NSF U.P.Code, ICC-ES, ICC-PMG, ULC S102.2 (½" to 1-¼"), IAPMO UPC (½"), PPI TR-4. The PureLink® Plus PEX-a tubing may also be used with fittings that are compliant with ASTM F1807/F1960/F2080/F2098/F2159 standards.

Minimum bending radius @ 68˚F (20˚C) for:

½" = 3" (77 mm)
¾" = 4-½" (115 mm)
1" = 6" (153 mm)
1-¼" = 7-½" (191 mm)
1-½" = 9" (229 mm)



	Stk#	Description	Pkg Qty	Skid Qty	Unit	Disc.	List Price / Unit
	21105	½" 100ft Red PureLink® Plus UV Stabilized PEX-a PexCube	6	48	coil	PP	
	21305	½" 300ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	32	coil	PP	
	21505	½" 500ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	24	coil	PP	
	21905	½" 1000ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	14	coil	PP	
	21122	¾" 100ft Red PureLink® Plus UV Stabilized PEX-a PexCube	3	48	coil	PP	
	21322	¾" 300ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	14	coil	PP	
	21522	¾" 500ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	9	coil	PP	
	21922	¾" 1000ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	5	coil	PP	
	21128	1" 100ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	21	coil	PP	
	21328	1" 300ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	9	coil	PP	
	21135	1-¼" 100ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	14	coil	PP	
New!	21335	1-¼" 300ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	5	coil	PP	
New!*	21145	1-½" 100ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	TBD	coil	PP	
New!*	21345	1-½" 300ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	TBD	coil	PP	

	Stk#	Description	Pkg Qty	Master Bag	Unit	Disc.	List Price / Unit
	21205	½" 20×20ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
	21222	¾" 10×20ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
	21228	1" 5×20ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
	21235	1-¼" 5×20ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	
New!*	21245	1-½" 5×20ft Red PureLink® Plus UV Stabilized PEX-a Tubing	1	20	bundle	PP	

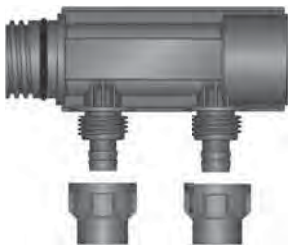
* Check with your local representative for availability.

Compression Stop Tee
Stk# 22001

The potable water module complete with shut-off. Order shut-off cap (#22180 & #22181) and PEX insert style, tubing to manifold connecters (#23000 series) separately.

There are 4 shrink-wrapped packages of 5 modules per box.

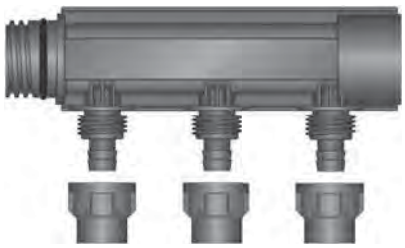
Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22001	Compression Stop Tee	1	20	ea.	P	



EasyFit™ 2-Port Tee
Stk# 22002

A 2-port tee with ½" EasyFit™ connections. Includes 2 nuts.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22002	EasyFit™ 2-Port Tee	1	50	ea.	P	



EasyFit™ 3-Port Tee
Stk# 22003

A 3-port tee with ½" EasyFit™ connections. Includes 3 nuts.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22003	EasyFit™ 3-Port Tee	1	50	ea.	P	

Mounting Bracket
Stk# 22121

Plastic mounting brackets which allow easy *snap-on* mounting of manifolds.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22121	EasyFit™ Single Mounting Bracket	1	10	ea.	P	

Red & Blue Shut-off Caps
Stk# 22180, 22181

Red (#22180) and blue (#22181) colored caps for use with Potable Module Tee with Compression Stop (#22001). No tools required.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22180	Red Shut-off Cap	1	250	ea.	P	
22181	Blue Shut-off Cap	1	250	ea.	P	

½" EasyFit™ Supply End Connection
Stk# 22193

O-ring sealing end piece with ½" EasyFit™ connection. Comes with o-ring.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22193	½" EasyFit™ Supply End Connection	1	–	ea.	P	

¾" FNPT Supply End Connection
Stk# 22191

O-ring sealing end piece with ¾" FNPT brass insert. Comes with o-ring.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22191	¾" FNPT Supply End Connection	1	–	ea.	P	

¾" EasyFit™ Supply End Connection
Stk# 22194

O-ring sealing end piece with ¾" EasyFit™ connection. Comes with o-ring.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22194	¾" EasyFit™ Supply End Connection	1	–	ea.	P	

1" MNPT Supply End Connection
Stk# 22196

O-ring sealing end piece with 1" MNPT brass insert. Comes with o-ring.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22196	1" MNPT Supply End Connection	1	–	ea.	P	

Closed End Cap
Stk# 22199

O-ring sealing end piece.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22199	EasyFit™ Manifold Closed End Cap	1	–	ea.	P	

¾" EasyFit™ Run End Connection
Stk# 22195

O-ring sealing end piece with ¾" EasyFit™ connection. Comes with o-ring.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
22195	¾" EasyFit™ Run End Connection	1	–	ea.	P	

EasyFit™ ½" Outlet Cap with o-ring
Stk# 23055

Plastic cap with o-ring to seal unused outlet of #22002 & #22003.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23055	½" EasyFit™ Outlet Cap with O-ring	10	–	ea.	P	

Tubing to Manifold Connecters
23000 Series

Plastic fitting is installed into the bottom of the manifold module and is held in place by the nut. The tubing is then pressed on to this fitting. SS press sleeves sold separately.

For use with Compression Stop Tee #22001.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23015	½" PEX Insert Manifold Connecter	5	–	ea.	P	
23032	¾" PEX Insert Manifold Connecter c/w Nut	5	–	ea.	P	

Heat Link® Stainless Steel Press Sleeve

Making a Lasting Impression

Press Sleeve

HeatLink Potable Water Systems now offers a start-to-finish system capped off with the unique PEX tubing watertight connection … the stainless steel Press Sleeve.

non-pressed

The Press Sleeve slides over the outer part of the PEX-a tubing, before inserting the fitting. When the fitting is in place, the press tool secures the connection in one single press, evidenced by a smooth visible depression ring on the sleeve's surface.

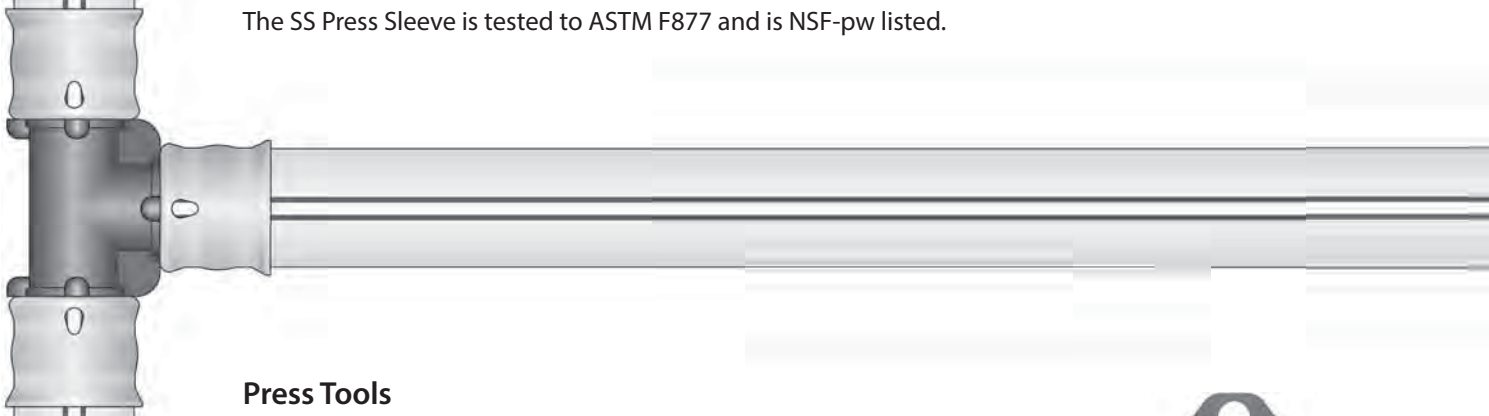
pressed

No crimp gauge is required with a Press Sleeve, thus eliminating a step in the whole installation procedure.

Once the pressing is complete, everything is set for the pressure test. The room for error is reduced, as the visible impression on the sleeve indicates readiness for the pressure test.

HeatLink's Press Sleeve—an impressive connection to have in any pressing situation.

The SS Press Sleeve is tested to ASTM F877 and is NSF-pw listed.



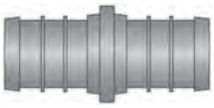
Press Tools

Designed to create a watertight seal, the Press Sleeve Tool has a toggle action handle and is available for all PEX sizes. Easy to load and simple to press, the pressed stainless steel sleeve provides a finished appearance on the transition from the end of the PEX to the insert fitting.

Stainless Steel Press Sleeves
24200 Series

Press sleeve with view hole.

	Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
	24205	½" SS Press Sleeve	100	1000	ea.	P	
	24222	¾" SS Press Sleeve	50	500	ea.	P	
	24228	1" SS Press Sleeve	50	250	ea.	P	
	24235	1-¼" SS Press Sleeve	10	150	ea.	P	
New!	24241	1-½" SS Press Sleeve	10	100	ea.	P	

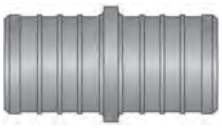


PEX Insert Couplings - *Brass*
29000 & 29200 Series

Solid brass PEX insert × PEX insert couplings. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
29005	½" × ½" PEX Brass Coupling	25	500	ea.	P	
29022	¾" × ¾" PEX Brass Coupling	25	250	ea.	P	
29225	¾" × ½" PEX Brass Coupling	25	500	ea.	P	
29028	1" × 1" PEX Brass Coupling	10	250	ea.	P	
29282	1" × ¾" PEX Brass Coupling	10	250	ea.	P	

No Lead



PEX Insert Couplings - *No Lead Brass*
29000NL & 29200NL Series

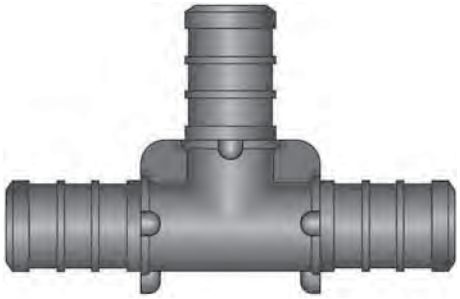
Solid no lead brass (C69300-ecobrass) PEX insert × PEX insert couplings. SS press sleeves sold separately.

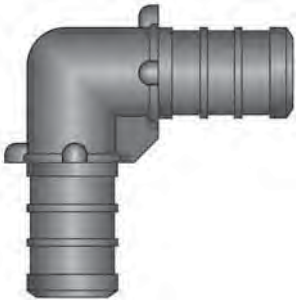
	Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
	29035NL	1-¼" × 1-¼" PEX No Lead Brass Coupling	5	180	ea.	P	
	29238NL	1-¼" × 1" PEX No Lead Brass Coupling	5	200	ea.	P	
New!	29041NL	1-½" × 1-½" PEX No Lead Brass Coupling	5	90	ea.	P	
New!	29248NL	1-½" × 1" PEX No Lead Brass Coupling	5	100	ea.	P	

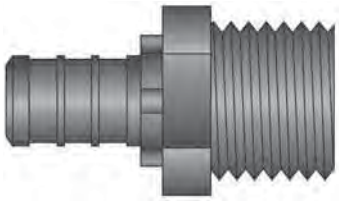
PEX Insert Couplings - *HPP*
19000 Series

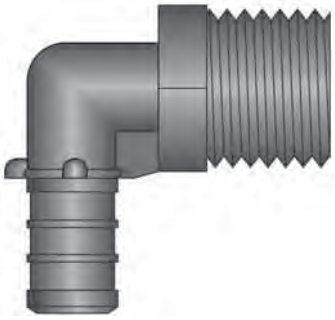
High Performance Polymer PEX insert couplings. SS press sleeves sold separately.

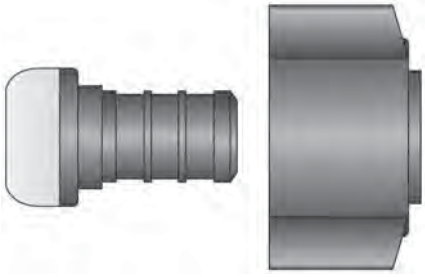
Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
19005	½" × ½" PEX HPP Coupling	25	1000	ea.	P	
19022	¾" × ¾" PEX HPP Coupling	25	500	ea.	P	
19225	¾" × ½" PEX HPP Coupling	25	600	ea.	P	
19028	1" × 1" PEX HPP Coupling	10	200	ea.	P	
19282	1" × ¾" PEX HPP Coupling	5	300	ea.	P	











Heat Link®

HPP Fitting System

The HeatLink High Performance Polymer (HPP) fitting system is produced from a specific blend of engineered high performance polyphenylsulfone (PPSU) resins. When combined, these resins offer outstanding long-term performance and chemical resistance. The sulfone family of resins began to replace brass in the plumbing industry over 20 years ago, and in the course of time have exceeded the stringent demands of the potable and heating industries.

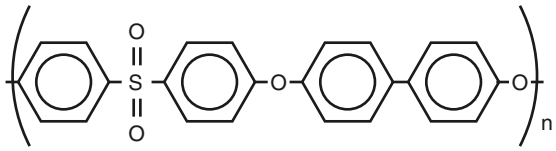
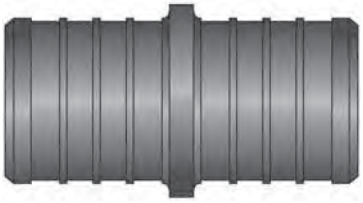
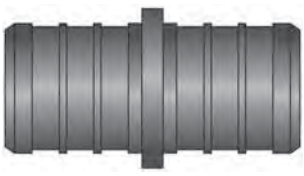


Figure #1 – General Chemical Structure of PPSU

The HeatLink HPP fittings standout in the market place due to a unique combination of characteristics designed to deliver superior performance.

- Outstanding resistance to hot chlorinated water
- Superior long-term hydrostatic strength
- Excellent thermal stability
- High resistance to mineral acids, alkali, and salt solutions
- Higher resistance to polar solvents and stress cracking than traditional polysulfone
- Robust toughness and impact strength
- Exceptional hydrolytic stability
- Improved notch resistance





PEX Insert Elbows - *Brass*
28000 & 28200 Series

Solid brass PEX insert × PEX insert elbows. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
28005	½" × ½" PEX Brass Elbow	25	250	ea.	P	
28022	¾" × ¾" PEX Brass Elbow	25	250	ea.	P	
28225	¾" × ½" PEX Brass Elbow	10	250	ea.	P	
28028	1" × 1" PEX Brass Elbow	10	100	ea.	P	

No Lead

PEX Insert Elbows - *No Lead Brass*
28000NL & 28200NL Series

Solid no lead brass (C69300-ecobrass) PEX insert × PEX insert elbows. SS press sleeves sold separately.

	Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
	28035NL	1-¼" × 1-¼" PEX No Lead Brass Elbow	5	120	ea.	P	
New!	28041NL	1-½" × 1-½" PEX No Lead Brass Elbow	5	50	ea.	P	

PEX Insert Elbows - *HPP*
18000 Series

High Performance Polymer PEX insert elbows. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
18005	½" × ½" PEX HPP Elbow	25	600	ea.	P	
18022	¾" × ¾" PEX HPP Elbow	25	300	ea.	P	
18225	¾" × ½" PEX HPP Elbow	10	400	ea.	P	
18028	1" × 1" PEX HPP Elbow	10	150	ea.	P	

PEX Insert × MNPT Elbows - *Brass*
28500 Series

Solid brass PEX insert elbows. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
28551	½" PEX × ⅜" MNPT Brass Dishwasher Elbow	25	–	ea.	P	

PEX Insert × MNPT Elbows - *No Lead Brass*
28500 Series

Solid no lead brass (C69300-ecobrass) PEX insert elbows. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
28583NL	1" PEX × 1-¼" MNPT No Lead Brass Elbow	5	60	ea.	P	
28535NL	1-¼" PEX × 1-¼" MNPT No Lead Brass Elbow	5	50	ea.	P	

PEX Insert × MNPT Elbows - *HPP*
18000 Series

High Performance Polymer PEX insert elbows. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
18551	½" PEX × ⅜" MNPT HPP Dishwasher Elbow	25	400	ea.	P	
18505	½" PEX × ½" MNPT HPP Elbow	25	375	ea.	P	

Drop Ear Elbows - *Brass*
28300 Series

Solid brass PEX insert × FNPT drop ear elbow. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
28312	½" PEX × ⅜" FNPT Drop Ear Brass Elbow	10	50	ea.	P	
28305	½" PEX × ½" FNPT Drop Ear Brass Elbow	10	50	ea.	P	

No Lead

Drop Ear Elbows - *No Lead Brass*
28300NL Series

Solid no lead brass (C69300-ecobrass) ½" PEX insert × ½" FNPT drop ear elbow. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
28312NL	½" PEX × ⅜" FNPT Drop Ear No Lead Brass Elbow	10	180	ea.	P	
28305NL	½" PEX × ½" FNPT Drop Ear No Lead Brass Elbow	10	160	ea.	P	

PEX Insert × FNPT Adapters - *Brass*
27600 Series

Solid brass PEX insert × FNPT adapters. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

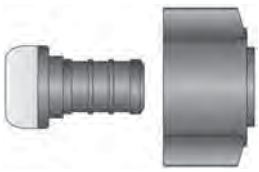
Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
27605	½" PEX × ½" FNPT Brass Adapter	25	250	ea.	P	
27622	¾" PEX × ¾" FNPT Brass Adapter	25	250	ea.	P	
27628	1" PEX × 1" FNPT Brass Adapter	25	250	ea.	P	

No Lead

PEX Insert × FNPT Adapters - *No Lead Brass*
27600NL Series

Solid no lead brass (C69300-ecobrass) PEX insert × FNPT adapters. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
27605NL	½" PEX × ½" FNPT No Lead Brass Adapter	25	400	ea.	P	
27622NL	¾" PEX × ¾" FNPT No Lead Brass Adapter	25	300	ea.	P	
27628NL	1" PEX × 1" FNPT No Lead Brass Adapter	25	150	ea.	P	
27635NL	1-¼" PEX × 1-¼" FNPT No Lead Brass Adapter	5	80	ea.	P	
New! 27641NL	1-½" PEX × 1-½" FNPT No Lead Brass Adapter	5	50	ea.	P	



PEX Insert × FNPT Swivel Adapters - *HPP*
17700 Series

High Performance Polymer PEX insert × FNPT swivel adapters. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
17755	½" PEX × ½" FNPT Swivel HPP Adapter	25	–	ea.	P	
17705	½" PEX × Ballcock/Closet FNPT Swivel HPP Adapter	25	400	ea.	P	
17722	¾" PEX × ¾" FNPT Swivel HPP Adapter	25	200	ea.	P	

PEX Insert × FNPT Swivel Elbow Adapter - *HPP*
Stk# 18605

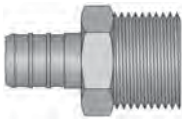
High Performance Polymer PEX insert × FNPT swivel elbow adapters. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
18605	½" PEX × ½" FNPT HPP Swivel Elbow	25	300	ea.	P	

½" PEX × ⅜" O.D. Comp. Straight Lav. Tube Adapter - *Brass*
Stk# 25751

Solid brass adapter for connecting faucets. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
25751	½" PEX × ⅜" O.D. Adapter	5	100	ea.	P	

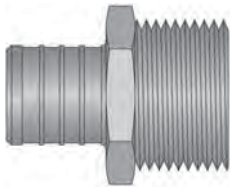


PEX Insert × MNPT Adapters - *Brass*
27500 Series

Solid brass PEX insert × MNPT adapters. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
27505	½" PEX × ½" MNPT Brass Adapter	25	250	ea.	P	
27552	½" PEX × ¾" MNPT Brass Adapter	10	250	ea.	P	
27522	¾" PEX × ¾" MNPT Brass Adapter	25	250	ea.	P	
27528	1" PEX × 1" MNPT Brass Adapter	10	250	ea.	P	
27582	1" PEX × ¾" MNPT Brass Adapter	5	250	ea.	P	

No Lead



PEX Insert × MNPT Adapters - *No Lead Brass*
27500NL Series

Solid brass no lead (C69300-ecobrass) PEX insert × MNPT adapters. SS press sleeves sold separately.

	Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
	27528NL	1" PEX × 1" MNPT No Lead Brass Adapter	10	150	ea.	P	
	27582NL	1" PEX × ¾" MNPT No Lead Brass Adapter	5	200	ea.	P	
	27535NL	1-¼" PEX × 1-¼" MNPT No Lead Brass Adapter	5	100	ea.	P	
	27538NL	1-¼" PEX × 1" MNPT No Lead Brass Adapter	5	100	ea.	P	
New!	27541NL	1-½" PEX × 1-½" MNPT No Lead Brass Adaptor	5	50	ea.	P	

PEX Insert × MNPT Adapters - *HPP*
17500 Series

High Performance Polymer PEX insert × MNPT adapters. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
17505	½" PEX × ½" MNPT HPP Adapter	25	500	ea.	P	
17552	½" PEX × ¾" MNPT HPP Adapter	25	350	ea.	P	
17522	¾" PEX × ¾" MNPT HPP Adapter	25	300	ea.	P	
17525	¾" PEX × ½" MNPT HPP Adapter	25	400	ea.	P	

PEX Insert × Sweat Adapters - *Brass*
27100 & 27200 Series

Solid brass PEX insert × sweat adapters. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

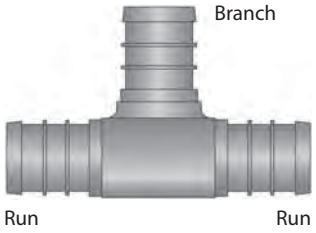
Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
27105	½" PEX × ½" M/Sweat Adapter	25	500	ea.	P	
27205	½" PEX × ½" F/Sweat Adapter	25	500	ea.	P	
27122	¾" PEX × ¾" M/Sweat Adapter	25	500	ea.	P	
27222	¾" PEX × ¾" F/Sweat Adapter	25	250	ea.	P	
27328	¾" PEX × 1" F/Sweat Adapter	10	100	ea.	P	
27128	1" PEX × 1" M/Sweat Adapter (¾" F/Sweat)	10	100	ea.	P	
27228	1"PEX × 1" F/Sweat Adapter	10	100	ea.	P	

No Lead

PEX Insert × Sweat Adapters - *No Lead Brass*
27100NL & 27200NL Series

Solid no lead brass (C69300-ecobrass) PEX insert × sweat adapters. SS press sleeves sold separately.

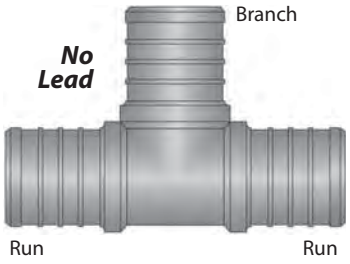
	Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
	27105NL	½" PEX × ½" M/Sweat No Lead Brass Adapter	25	700	ea.	P	
	27205NL	½" PEX × ½" F/Sweat No Lead Brass Adapter	25	700	ea.	P	
	27122NL	¾" PEX × ¾" M/Sweat No Lead Brass Adapter	25	400	ea.	P	
	27222NL	¾" PEX × ¾" F/Sweat No Lead Brass Adapter	25	400	ea.	P	
	27128NL	1" PEX × 1" M/Sweat No Lead Brass Adapter (¾" F/Sweat)	10	200	ea.	P	
	27228NL	1"PEX × 1" F/Sweat No Lead Brass Adapter	10	200	ea.	P	
	27135NL	1-¼" PEX × 1-¼" M/Sweat No Lead Brass Adapter	5	120	ea.	P	
	27235NL	1-¼" PEX × 1-¼" F/Sweat No Lead Brass Adapter	5	120	ea.	P	
New!	27141NL	1-½" × 1-½" M/Sweat No Lead Brass Adapter	5	80	ea.	P	



PEX Insert Tees - *Brass*
26000 Series

Solid brass PEX insert tees. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

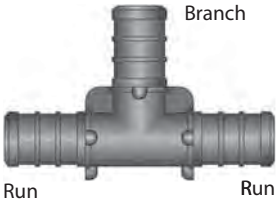
Stk#	Description (run × run × branch)	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
26555	½" × ½" × ½" PEX Brass Tee	25	250	ea.	P	
26552	½" × ½" × ¾" PEX Brass Tee	10	250	ea.	P	
26222	¾" × ¾" × ¾" PEX Brass Tee	25	250	ea.	P	
26225	¾" × ¾" × ½" PEX Brass Tee	25	250	ea.	P	
26252	¾" × ½" × ¾" PEX Brass Tee	25	250	ea.	P	
26255	¾" × ½" × ½" PEX Brass Tee	25	250	ea.	P	
26888	1" × 1" × 1" PEX Brass Tee	10	100	ea.	P	
26882	1" × 1" × ¾" PEX Brass Tee	5	100	ea.	P	
26822	1" × ¾" × ¾" PEX Brass Tee	5	100	ea.	P	
26885	1" × 1" × ½" PEX Brass Tee	10	100	ea.	P	



PEX Insert Tees - *No Lead Brass*
26000NL Series

Solid no lead brass (C69300-ecobrass) PEX insert tees. SS press sleeves sold separately.

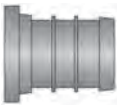
	Stk#	Description (run × run × branch)	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
	26333NL	1-¼" × 1-¼" × 1-¼" PEX No Lead Brass Tee	5	80	ea.	P	
	26338NL	1-¼" × 1-¼" × 1" PEX No Lead Brass Tee	5	80	ea.	P	
	26332NL	1-¼" × 1-¼" × ¾" PEX No Lead Brass Tee	5	80	ea.	P	
	26388NL	1-¼" × 1" × 1" PEX No Lead Brass Tee	5	100	ea.	P	
	26322NL	1-¼" × ¾" × ¾" PEX No Lead Brass Tee	5	100	ea.	P	
New!	26444NL	1-½" × 1-½" × 1-½" PEX No Lead Brass Tee	5	30	ea.	P	
New!	26443NL	1-½" × 1-½" × 1-¼" PEX No Lead Brass Tee	5	40	ea.	P	
New!	26448NL	1-½" × 1-½" × 1" PEX No Lead Brass Tee	5	40	ea.	P	
New!	26442NL	1-½" × 1-½" × ¾" PEX No Lead Brass Tee	5	50	ea.	P	
New!	26433NL	1-½" × 1-¼" × 1-¼" PEX No Lead Brass Tee	5	40	ea.	P	
New!	26438NL	1-½" × 1-¼" × 1" PEX No Lead Brass Tee	5	50	ea.	P	
New!	26432NL	1-½" × 1-¼" × ¾" PEX No Lead Brass Tee	5	50	ea.	P	
New!	26488NL	1-½" × 1" × 1" PEX No Lead Brass Tee	5	50	ea.	P	
New!	26422NL	1-½" × ¾" × ¾" PEX No Lead Brass Tee	5	60	ea.	P	



PEX Insert Tees - *HPP*
16000 Series

High Performance Polymer PEX insert tees. SS press sleeves sold separately.

Stk#	Description (run × run × branch)	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
16555	½" × ½" × ½" PEX HPP Tee	25	400	ea.	P	
16552	½" × ½" × ¾" PEX HPP Tee	25	300	ea.	P	
16222	¾" × ¾" × ¾" PEX HPP Tee	25	200	ea.	P	
16225	¾" × ¾" × ½" PEX HPP Tee	25	250	ea.	P	
16252	¾" × ½" × ¾" PEX HPP Tee	25	250	ea.	P	
16255	¾" × ½" × ½" PEX HPP Tee	25	300	ea.	P	
16888	1" × 1" × 1" PEX HPP Tee	10	100	ea.	P	
16882	1" × 1" × ¾" PEX HPP Tee	5	100	ea.	P	
16885	1" × 1" × ½" PEX HPP Tee	10	150	ea.	P	
16228	¾" × ¾" × 1" PEX HPP Tee	5	150	ea.	P	
16822	1" × ¾" × ¾" PEX HPP Tee	5	150	ea.	P	
16828	1" × ¾" × 1" PEX HPP Tee	5	100	ea.	P	



PEX Insert Plugs - *Brass*
25000 Series

Solid brass PEX insert plug. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
25005	½" PEX Brass Plug	25	1000	ea.	P	
25022	¾" PEX Brass Plug	25	500	ea.	P	
25028	1" PEX Brass Plug	5	500	ea.	P	

No Lead

PEX Insert Plugs - *No Lead Brass*
25000NL Series

Solid no lead brass (C69300-ecobrass) PEX insert plug. SS press sleeves sold separately.

	Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
	25035NL	1-¼" PEX No Lead Brass Plug	5	260	ea.	P	
New!	25041NL	1-½" PEX No Lead Brass Plug	5	110	ea.	P	

PEX Insert Plugs - *HPP*
15000 Series

High Performance Polymer PEX insert plugs. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
15005	½" PEX HPP Plug	25	2000	ea.	P	
15022	¾" PEX HPP Plug	25	1000	ea.	P	
15028	1" PEX HPP Plug	5	500	ea.	P	

Chrome Plated Straight Ball Valve - *Brass*
Stk #23505

½" PEX barb × ⅜" O.D. compression, plated straight ball valve. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

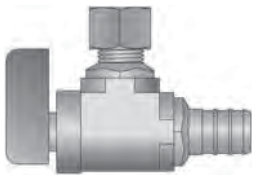
Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23505	½" PEX × ⅜" O.D. Plated Straight Ball Valve	24	144	ea.	P	

No Lead

Chrome Plated Straight Ball Valve - *No Lead Brass*
Stk #23505NL

No lead brass (C69300-ecobrass) ½" PEX barb × ⅜" O.D. compression, plated straight ball valve. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23505NL	½" PEX × ⅜" O.D. No Lead Brass Plated Straight Ball Valve	24	144	ea.	P	

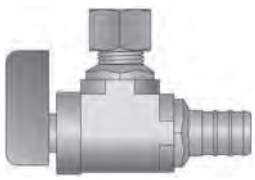


Chrome Plated Angle Ball Valve - *Brass*
Stk# 23605

½" PEX barb × ⅜" O.D. compression, plated angle ball valve. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23605	½" PEX × ⅜" O.D. Plated Angle Ball Valve	24	144	ea.	P	

No Lead



Chrome Plated Angle Ball Valve - *No Lead Brass*
Stk# 23605NL

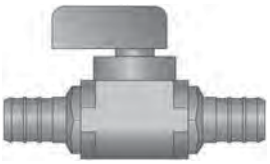
No lead brass (C69300-ecobrass) ½" PEX barb × ⅜" O.D. compression, plated angle ball valve. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23605NL	½" PEX × ⅜" O.D. No Lead Brass Plated Angle Ball Valve	24	144	ea.	P	

Straight Ball Valve - *Brass*
Stk# 23905

½" PEX barb × ¼" O.D. compression, straight ball valve. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23905	½" PEX × ¼" O.D. Straight Ball Valve	24	144	ea.	P	

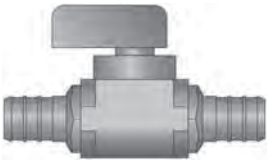


PEX Barb Straight Ball Valves - *Brass*
23700 Series

Brass valve. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23705	½" PEX Straight Ball Valve	24	144	ea.	P	
23722	¾" PEX Straight Ball Valve	24	144	ea.	P	

No Lead



PEX Barb Straight Ball Valves - *No Lead Brass*
23700NL Series

No lead brass (C69300-ecobrass) valve. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23705NL	½" PEX Straight No Lead Brass Ball Valve	24	144	ea.	P	
23722NL	¾" PEX Straight No Lead Brass Ball Valve	24	144	ea.	P	

Stop and Waste Valves - *Brass*
23770 Series

Brass stop and waste valve. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23775	½" PEX Stop and Waste Valve	24	144	ea.	P	
23772	¾" PEX Stop and Waste Valve	24	72	ea.	P	

½" PEX Barb × ½" M/Sweat Straight Ball Valve - *Brass*
Stk# 23405

Brass straight ball valve for ½" tubing. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23405	½" PEX × ½" M/Sweat Straight Ball Valve	24	144	ea.	P	

¾" PEX Barb × ¾" MNPT Straight Ball Valve - *Brass*
Stk# 23422

Brass straight ball valve for ¾" tubing. The HeatLink brass fittings comply with the NSF International dezincification resistant (DZR) requirements. SS press sleeves sold separately.

Stk#	Description	Pkg Qty	Carton Qty	Unit	Disc.	List Price / Unit
23422	¾" PEX × ¾" MNPT Straight Ball Valve	24	144	ea.	P	

Move mouse over image to zoom in

Simer 1/2-HP Cast Iron Shallow Well Jet Pump

by Simer

Be the first to write a review

Price **$224.00**

Check Store Pickup Availability

Lowe's Item
103823

Quantity
1

Store Pickup
Lowe's Truck Delivery

Add to Compare | Add to Wish List

Shipping Policy | Return Policy

Quick Links

Reviews | Q & A

Product Description

- Reliable performance to depths of water 25' or less
- Rugged cast iron construction maximizes pump life
- Heavy-duty dual-voltage motor preset to 115V
- Pre-wired pressure switch preset for 30/60 PSI operation
- Self priming after pump housing initially filled
- Check valve or foot valve required but sold separately
- Amps: 8.5
- Application: Pumps water from a shallow well
- Horsepower (HP): 0.5
- Impeller Material: Thermoplastic
- Inlet Connection: NPT
- Inlet Diameter: 1.25
- Outlet Connection: NPT
- Outlet Diameter: 1"
- Package Contents: Pump and owners manual
- Package Quantity: 1
- Submersible: No
- Sub Type: Shallow well jet pump
- Switch Type: Specialty
- Type: Well pumps
- Volts: 115 and 230
- Warranty: 1-year limited
- Water Flow (GPM): 8.5

Materials	Cast iron

Recommended For You


Simer 7-Gallon Horizo…
$114.40
Write a Review


Simer 5-Gallon Vertical
$89.98
Write a Review


Simer 19-Gallon Vertical
$143.10
Write a Review


Simer 2-Gallon Vertical
$54.98
Write a Review

Customer Reviews

This product has no customer reviews yet

Write an online review and be the first to share your thoughts with other customers

Questions & Answers

Type your question here... Ask

There are no questions from the community yet

Tag this product

A tag is a keyword assigned to a product which helps describe the item and allows it to be found by other customers

Add a new tag: Add Tag

Separate multiple tags with commas

What's this?

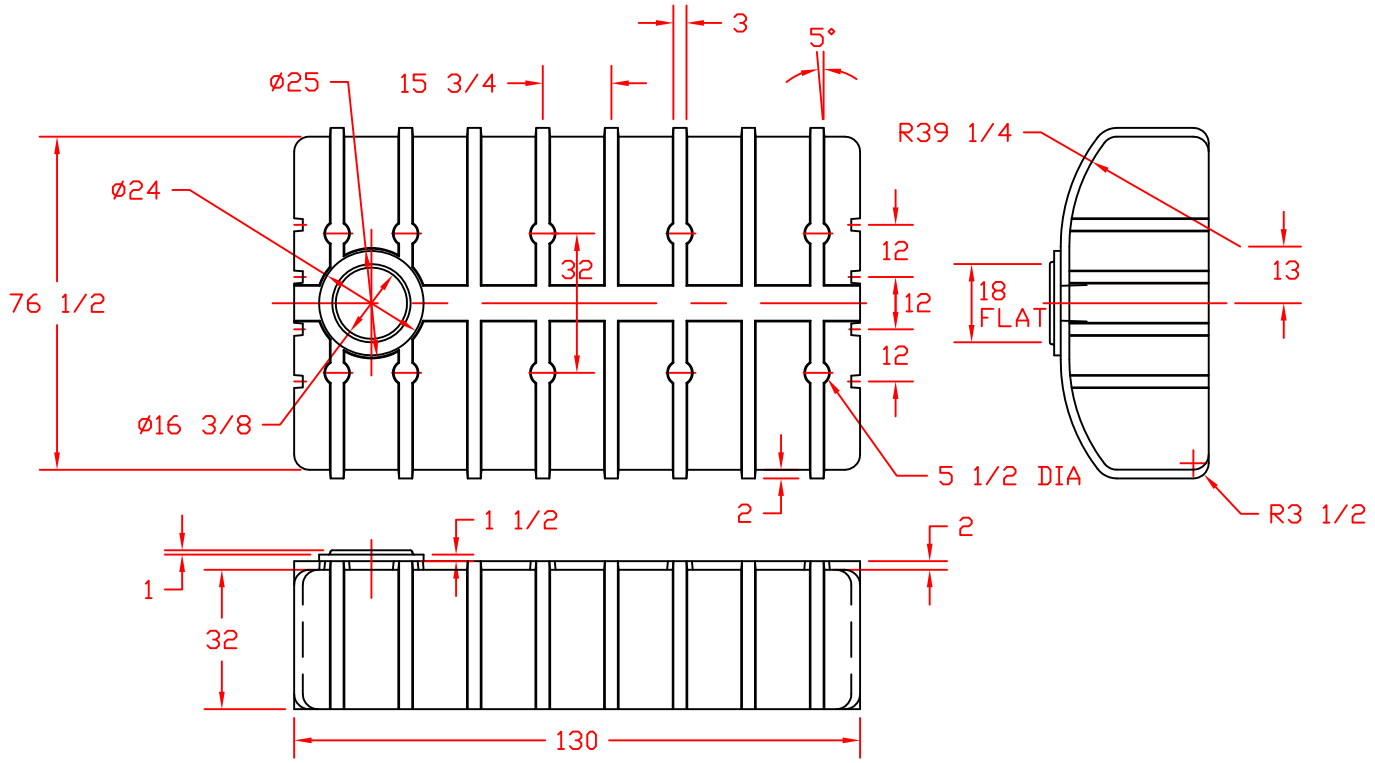
Additional Details

Mfr Part #	2205C
UPC #	022315361584
Group #	1437676
Category	Water Pumps - 2437
Style	- 0
Sales Rank	100000

Your Recently Viewed Items

Helllo world

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



NOTES:
1. END RIBS 3"W X 2" DEEP

FOB FAIRFIELD TX

NORWESCO
ST. BONIFACIUS, MN

1250 LOW PROFILE
WATER TANK

	SIZE	FSCM NO.	DWG NO.	REV
JTP 23FEB01	B			
	SCALE 1/32		SHEET	

Move mouse over image to zoom in

Simer 1/4-HP Thermoplastic Laundry Tray Pump

by Simer

Be the first to write a review

Price **$258.00**

Check Store Pickup Availability

Lowe's Item
188757

Quantity
1

Store Pickup
Lowe's Truck Delivery

Add to Compare | Add to Wish List

Shipping Policy | Return Policy

Dimensions & Weights

Cord Length	8 feet

Quick Links

Dimensions
Reviews
Q & A

Product Description

- Use for any above floor discharge of liquids such as under laundry tub, remodeling wet bar, humidifier or sink draining with overload protection
- Compact design includes 6 gal. structural foam drainage tank
- Easy installation
- Eliminates need for expensive plumbing renovation
- Amps: 8.5
- Application: Above floor discharge of liquids
- Horsepower (HP): 0.25
- Impeller Material: Thermoplastic
- Inlet Connection: N/A
- Inlet Diameter: 0
- Outlet Connection: NPT
- Outlet Diameter: 1.5"
- Package Contents: Pump and 6 gallon tank, owners manual
- Package Quantity: 1
- Submersible: Yes
- Sub Type: Laundry tray pump
- Switch Type: Vertical with piggyback
- Type: Sump pumps
- Volts: 115
- Warranty: 1-year limited
- Water Flow (GPM): 48

Materials	Thermoplastic

Customer Reviews

This product has no customer reviews yet

Write an online review and be the first to share your thoughts with other customers

Questions & Answers

Type your question here... Ask

There are no questions from the community yet

Tag this product

A tag is a keyword assigned to a product which helps describe the item and allows it to be found by other customers

Add a new tag: Add Tag

Separate multiple tags with commas

What's this?

Additional Details

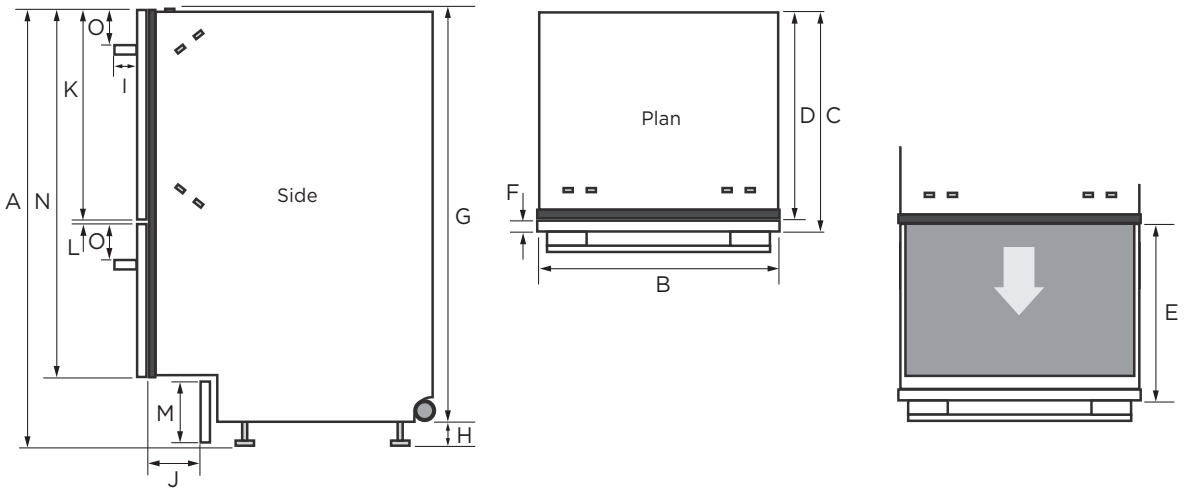
Mfr Part #	2925B
UPC #	017561515164
Group #	1437640
Category	Water Pumps - 2437
Style	- 0
Sales Rank	100000

Your Recently Viewed Items

Helllo world

DOUBLE DISHDRAWER™ DIMENSIONS

DD24DDFX7, DD24DI7, DD24DCX7, DD24DCB7, DD24DCW7



DIMENSIONS INCHES (MM)		DD24DDFX7		DD24DI7		DD24DCX7		DD24DCB7, DD24DCW7	
		Designer		Integrated Designer		Classic		Black Classic, White Classic	
A	overall height[1] of product	32 5/16 - 34 5/8"	(820-880)[2]	32 5/16 - 34 5/8"	(820-880)[2]	32 5/16 - 34 5/8"	(820-880)[2]	32 5/16 - 34 5/8"	(820-880)[2]
B	overall width of product	23 9/16"	(599)	23 9/16"	(599)	23 9/16"	(599)	23 9/16"	(599)
C	overall depth of product (excl. handle)	22 1/2"	(571)	22 1/2"	(571)[3]	22 15/16"	(582)	22 15/16"	(582)
D	depth of chassis (to back of front panel)	21 3/4"	(553)	21 3/4"	(553)	21 3/4"	(553)	21 3/4"	(553)
E	maximum extension of drawer (excl. handle)	21 7/16"	(545)	21 7/16"	(545)[3]	21 7/8"	(556)	21 7/8"	(556)
F	depth of front panel (excl. handle)	11/16"	(18)	5/8 - 13/16"	(16-20)	1 1/8"	(29)	1 1/8"	(29)
G	height[1] of chassis	31 15/16"	(811)	31 15/16"	(811)	31 15/16"	(811)	31 15/16"	(811)
H	height of levelling feet	3/8 - 2 11/16"	(9-69)[2]	3/8 - 2 11/16"	(9-69)[2]	3/8 - 2 11/16"	(9-69)[2]	3/8 - 2 11/16"	(9-69)[2]
I	depth of handle	1 5/8"	(41)	n/a	n/a	n/a	n/a	n/a	n/a
J	depth of toekick recess (to back of front panel)[4]	1 3/16 - 3 5/8"	(30-92)	1 3/16 - 3 5/16"	(30-84)[5]	1 3/16 - 3 5/8"	(30-92)	1 3/16 - 3 5/8"	(30-92)
K	height of upper front panel	15 11/16"	(398)	min. 15 11/16"	(398)	15 1/2 "	(394)	15 1/2 "	(394)
L	ventilation gap between front panels	5/16"	(8)	min. 5/16"	(8)	3/16"	(5)	3/16"	(5)
M	height of toekick panel (adjustable)	2 3/4 - 4 3/4"	(70-120)	2 3/4 - 4 3/4"	(70-120)	2 3/4 - 4 3/4"	(70-120)	2 3/4 - 4 3/4"	(70-120)
N	height of drawer fronts	30"	(762)	min. 28 1/4"	(717)	29 13/16"	(757)	29 13/16"	(757)
O	height from top of handle to top of front panel	2 1/2"	(64)	n/a	n/a	n/a	n/a	n/a	n/a

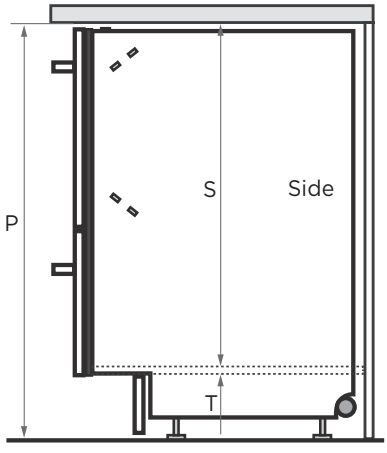
[1]includes 1/16" (2mm) high bracket slots [2]depending on adjustment of leveling feet [3]assuming front panel thickness of 11/16" (18mm) [4]adjustable to match toekick recess on adjoining cabinetry

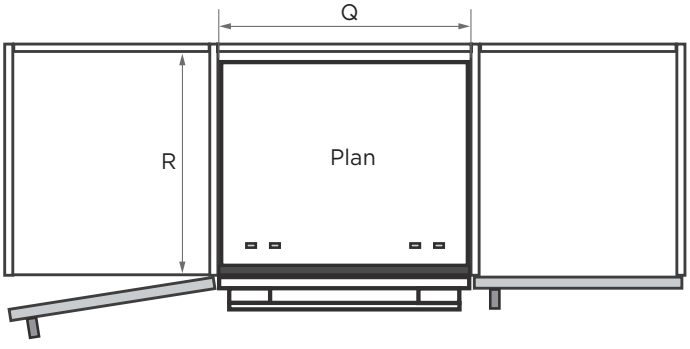
[5]assuming that toekick mounting bracket is used with a 11/16" (18mm) thick custom panel; if recess is between 1 15/16" - 3 5/16" (50 and 84 mm) deep, the panel will need to be cut out - see step 'Custom panel calculations'

Product dimensions and specifications are listed as a guide only. For complete installation instructions and specifications, refer to the product Use & Care Guide/Installation Instructions available at www.fisherpaykel.com

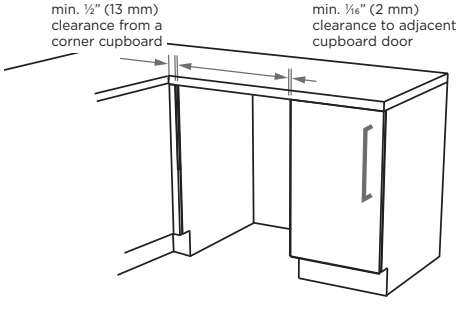
DOUBLE DISHDRAWER™ CABINETRY DIMENSIONS

DD24DDFX7, DD24DI7, DD24DCX7, DD24DCB7, DD24DCW7





Minimum clearances from adjacent cabinetry



DIMENSIONS INCHES (MM)		DD24DDFX7		DD24DI7		DD24DCX7		DD24DCB7, DD24DCW7	
		Designer		Integrated		Classic		Black Classic, White Classic	
P	inside height of cavity*	min. 32 5/16"	(820)	min. 32 5/16"	(820)	min. 32 5/16"	(820)	min. 32 5/16"	(820)
Q	inside width of cavity	23 5/8"	(600)	23 5/8"	(600)	23 5/8"	(600)	23 5/8"	(600)
R	inside depth of cavity	min. 22 1/16"	(560)	min. 22 1/16"	(560)	min. 22 1/16"	(560)	min. 22 1/16"	(560)
S	recommended height of adjacent cabinet space	30"	(762)	min. 28 3/8"	(720)	30"	(762)	30"	(762)
T	height of toekick space*	2 3/8 - 4 3/4"	(60-120)	3 15/16 - 6 5/16"	(100-160)	2 3/8 - 4 3/4"	(60-120)	2 3/8 - 4 3/4"	(60-120)

*depending on adjustment of leveling feet

Product dimensions and specifications are listed as a guide only. For complete installation instructions and specifications, refer to the product Use & Care Guide/Installation Instructions available at www.fisherpaykel.com

Fisher&Paykel

DD24DDFTX7

Double DishDrawer™ Tall

This model is designed for extra headroom in the top drawer. The increased drawer height fits 12" plates, making cleaning up after dinner parties a breeze. The DishDrawer™ Tall dishwasher can also easily accommodate oversized platters and extra-long stemmed glasses.

34 1/2 -36 3/8	23 19/32	22 15/32
H	W	D

DishDrawer™ Technology

What is DishDrawer™ Technology?

DishDrawer™ Technology

It combines compact technologies to provide a space efficient dishwasher in a drawer. The combination of the unique SmartDrive™ motor technology with intelligent electronics and simple mechanics means more space for dishes, greater reliability and better performance. The DishDrawer™ dishwasher's internal microprocessor controls how the wash mechanism operates based on the load and wash cycle. The spray arm rotates at different speeds depending on the wash cycle selected to deliver better dish care.

How DishDrawer™ Technology Helps.

Independent Drawers = Variety of Loads

An independent drawer-based dishwashing platform is part of what makes the DishDrawer™ dishwasher unique. In DishDrawer™ Double dishwashers, both drawers operate independently so different wash cycles can operate simultaneously to accomodate a variety of loads.

SmartDrive™ Wash Mechanism = Better Dish Care

The unique brushless DC motor acts as both a wash pump and a drain pump, which means fewer moving parts and greater reliability. The spray arm rotates at different speeds depending on the wash cycle selected, to deliver a superior clean and better dish care.

Nine Wash Options = Comprehensive Washing

The range of settings enables the dishwasher to wash everything from fine glass and crystal to heavily soiled pots and pans at the touch of a button.

SmartDrive™ Wash Function

The unique brushless DC motor acts as both a wash pump and a drain pump, which means less moving parts and greater reliability. The pump brings water into the spray arm, which rotates at different speeds depending on the wash cycle selected to deliver a superior clean and better dish care.

Nine Wash Options

All DishDrawer™ dishwashers feature nine wash programmes tailored to different washing requirements: Rinse, Fast Eco, Fast, Delicate Eco, Delicate, Normal Eco, Normal, Heavy Eco, Heavy. The range of settings enables DishDrawer™ to wash everything from fine glass and crystal to heavily soiled pots and pans at the touch of a button. Primary and secondary controls provide a simple interface for programme selection and operation while the delay start setting means the dishes can be done when it's most convenient.

Superior Filtration

One of the challenges in all dishwashers is a robust filter system that removes debris and avoids blocking. The kidney filter and overmoulded filter plate creates a firm seal to ensure that debris does not enter the wash mechanism and cause backflow. It is designed to be removable for easy and hygienic cleaning.

Adjustable Racking

DishDrawer™ includes a range of flexible and adjustable racking options for different wash requirements. The flexible cutlery basket can be customised for different utensils and incorporates a separate small item container for easy loading and unloading. Pitch adjustable folding tines allow greater flexibility to customise loads. Tines can be folded flat to accommodate a full load of pots and pans or fold up to hold delicate glassware and crystal. Pitch adjustable racks can accommodate normal plates or simply slide and the rack can conveniently stack deep bowls. Wine glass holders ensure delicate glasses are secure throughout the wash and all side racking is fully adjustable to accommodate short stem and long stem glasses. Added retainer clips are ideal for holding chopping boards and plastic containers in position during wash cycles.

Safe

DishDrawer™ dishwasher incorporates unique safety features such as Child Lock which both locks the drawer to prevent opening as well as disabling the buttons. In addition it includes three stage flood protection; the high strength hose withstands water pressure several times greater than normal, overfill detection cuts the water supply if limits are exceeded and the back-up switch activates the drain pump to remove any excess water.

Flow Through Detergent Dispenser

The DishDrawer™ detergent dispenser ensures that undissolved detergent does not drop into the tub, but instead is mixed as the machine fills with water. This not only cleans each load better but also reduces the possibility of damaging delicate items such as aluminum, cutlery or porcelain glazes.

Independent drawers

An independent drawer based dishwashing platform is part of what makes DishDrawer™ dishwasher unique. At bench height drawers glide open for easy access, visibility and better ergonomics. In Double DishDrawer™ dishwashers both drawers operate independently so different wash cycles can operate simultaneously to accommodate a variety of loads. Glasses, pots and pans can be washed in separate drawers at the same time.

Specs

Accessories

Cutlery basket	2
Kickstrip	1
Knife clip	4

Capacity and loading

Place settings per drawer	7
Flexible racking system	
Fold down and pitch adjustable tines	
Adjustable racks and cup racks	
Accommodates long stemmed wine glasses	
Accommodates plates up to	13 inches (top drawer)

Consumption Data

Test programme	Normal Eco
Energy Star™ approved	
Water usage (per drawer)	2 gallons
Energy rating (per drawer)	ENERGY STAR rated CEE tier 1
USA Energy guide label - DishDrawer™ Double	

Controls

- Key lock
- Child lock
- End of cycle beeps
- One button start
- Energy saving delay start option up to 12 hours
- Rinse aid indicator light and lens
- Electronic fault/Diagnostic indicator
- Concealed control panel with single touch programming

Dimensions

Overall height of product	34 1/2 -36 3/8
Overall width of product	23 19/32
Overall depth of product	22 15/32

Performance

- SmartDrive™ Technology
- Fan assisted drying
- Quiet operation
- Ergonomic design
- Flow through detergent dispenser
- Intelligent water level sensing for optimum performance

Power Requirements

Supply voltage	110-120V
Supply frequency	60Hz
AMP draw	10.6A

Safety

- Three stage flood protection

Warranty

Warranty	1 year

Wash Programmes

- 9 wash programmes
- Genuine half load wash option

Eco options
Permanent memory of the last cycle used
Heavy
Heavy Eco
Normal
Normal Eco
Fast
Fast Eco
Delicate
Delicate Eco
Rinse

Fisher&Paykel

RF175WDRX1

ActiveSmart™ Fridge - 17.5 cu. ft. Counter Depth Bottom Freezer

Introducing our new RF175 Active Smart™ refrigerators, offering new features that lead the market in innovation without sacrificing functionality. Features include Energy Star status, full extension freezer & produce drawers with individual bins and gallon door shelves.

69 7/8 - 70 5/8	32 5/8	28 1/2
H	W	D

ActiveSmart™ Technology

What is ActiveSmart™?

ActiveSmart™ consists of a microprocessor, interior temperature sensors, independently controlled variable speed fans and multiple air ducts. The microprocessor controls how the refrigerator operates based on changing patterns of use. The sensors continuously send information to the microprocessor, which analyses and adjusts the fan speed and compressor operations accordingly to deliver a consistent and stable temperature. Continuous feedback means that ActiveSmart™ adjusts to the way you live. Its ability to respond to daily use means that it only uses the energy needed to keep your food fresher for longer.

How ActiveSmart™ helps you.

Independent Control = Better Food Care

The Humidity Control System, together with the cool and consistent temperature delivered by ActiveSmart™ Technology, creates the perfect microclimate for your produce.

Greater Intelligence = Greater Efficiency

Sensors constantly record changes to fridge and freezer compartments, including when the doors are opened and when new items are introduced, ensuring temperature in each compartment is kept constant.

Rapid Chilling = Optimised Food Preservation

Independent variable-speed fans control airflow through multiple air ducts to all compartment as well as rapid chill and freezing to ensure food safety and maintain food quality.

Specs

Configuration	Consumption Data	Design	Dimensions

Cantilever glass shelves	2
Static glass shelves	1
Full extension freezer drawer	
Full extension runners	
Full-width gallon door shelves	1
Half- width door shelves	4
Covered door shelves	2
Humidity controlled half-width crisper bins	2
Counter depth	
Freezer bins	2
Ice cube trays	2
Front levelling feet	
Front rollers	
Adjustment screws	

Premium Energy Efficiency - Energy Star	
Energy usage (kWh/yr)	440

EZKleen stainless steel	
Bottom mount freezer	
Door opening	Available left and right
Silver prepaint cabinet	
Aluminium trims	

Depth - door closed not including handle	27 3/8"
Height - incl. feet and hinge cap	69 7/8 - 70 5/8"
Width	32 5/8"
Depth - including handle	28 1/2"
Minimum air clearance - on top	1/2"
Minimum air clearance - each side	3/16"
Minimum air clearance- at rear (incl. rear compartment cover)	1"
Refrigerator storage volume	12.4 cu.ft
Freezer storage volume	5.1 cu.ft
Total net volume	17.5 cu.ft

Performance Features

- ActiveSmart™ system
- Frost free
- Humidity Control System
- Halogen light
- Door alarm - refrigerator
- Door alarm - freezer

Warranty

- 1 year manufacturer's warranty
- Additional limited 4 year sealed refrigeration system

SteamClean Option

Model WOS92EC0AS

Rating: ★★★★★

Stainless Steel
MSRP$1,849.00

Black
MSRP$1,649.00

White Ice
MSRP$1,649.00

Whirlpool Gold® 5.0 cu. ft. Single Wall Oven with SteamClean Option

You won't have to worry about fitting this model into your existing cutout and cabinets. Thanks to the FIT system, now your 5.0 cu. ft. wall oven can fit seamlessly into your current cabinet cutout with minimal modification[1].* Its flexible installation system provides various options that are designed to effortlessly suit your decor. The AccuBake® temperature managemer system also helps you achieve delicious, consistent results every time. By surrounding food with even temperature, it ensures optimal heat and consistent baking, even on multiple racks. Clean up is even easier with the SteamClean option. It spot cleans everyday light spills using only heat and1-1/4 cups of water—no harsh chemicals or cleaners needed. *Available on 27" and 30" single and double wall ovens. See product specifications for minimum and maximum installation dimensions.

Model Number Variations

This model is similar to these older Whirlpool brand models:
GBS309PVS

why you'll love it...

Rated the #1 Wall Oven by a leading consumer magazine

AccuBake® Temperature Management System

With the AccuBake® temperature management system, you can now achieve delicious, consistent results every time. This system surrounds food with even temperatures and uses built-in sensors to monitor oven temperature. It even turns on the correct cooking elements to ensure optimal heat and deliver consistent baking, even on multiple racks.

TimeSavor™ Ultra true convection cooking system

Whirlpool brand's newest convection cooking system delivers exceptional results and faster baking on every rack. TimeSavor™ Ultra true convection uses a rear fan and a third 2,500-watt heating element to distribute heated air more efficiently, so the oven is filled with even heat, cutting roasting time and sealing in flavors and juices.

additional features...

Rapid Preheat

The Rapid Preheat option preheats the oven 25% faster and saves time and energy. Using all of the range elements and a fan, the oven heats up more quickly and creates the ideal temperature for single rack baking. Now cutting preheat time for your next batch of chocolate chip cookies or apple crisps is easy.

FIT System

With the FIT system, now your wall oven can fit seamlessly into your current cabinet cutout. Its flexible installation system provides various options that are designed to effortlessly suit your decor. Now replacingyour wall oven just got easier.

SteamClean option

Clean up after every day light spills using only heat and 1-1⁄4 cups of water—no harsh chemicals or cleaners needed. Usec periodically to clean light spills on the bottom of the oven, it keeps the oven clean and reduces the need for frequent self-clean cycles.

Largest capacity available

Cook multiple dishes for a large family meal or prepare treats for a bake sale with Whirlpool® wall ovens. Models with the largest capacity available offer enough room to handle even your largest cooking tasks.

Convection Conversion

Convection Conversion removes the guesswork from preparing your favorite dishes. Automatically converts standard times and temperatures to the convection equivalent.

New EasyView™ extra-large oven window

Monitor cooking progress without opening the door with the new EasyView™ extra-large oven window. The extra-large design adds a sleek, modern accent to the kitchen, saves energy and keeps oven temperatures steady and undisturbed.

Precise Clean® cleaning system

The Precise Clean® cleaning system tracks the time between self-clean cycles to determine the right cycle time. This makes sure the self-cleaning cycle only lasts as long as necessary for optimal cleaning and energy savings. No harsh chemicals or cleansers are required.

Hidden Bake Element

Simplifies cleanup with the bake element hidden beneath the oven floor, leaving a smooth interior surface that is easy to wipe clean.

Product Specifications

Oven Configuration :	Single Oven
Capacity :	5.0 cu. ft.
Fuel Type :	Electric

Oven Features

Number of Rack Guides :	6
Cleaning System :	Self-Cleaning
Hidden Bake Element :	Yes
Cooking System :	Convection
Broil Element Wattage @ 240 V :	3600
Number of Standard Racks :	3
Bake Element Wattage @ 240 V :	2800

Controls

Sabbath Mode :	Yes
Keep Warm Option :	Yes
Oven Control Type :	Membrane Switch
Convection Broil :	Yes

Convection Bake :	Yes
Clock :	Yes
Delayed Cooking Option :	Yes

Design

Number of Oven Lights :	2
Oven Light Switch :	Yes
Handle Color :	Color Coordinated
Oven Light Type :	Incandescent

Dimensions

Cutout Depth (in) :	24
Depth :	26 7/16
Height :	28 3/4
Width :	30
Depth With Door Open 90 Degree :	46 3/4
Cutout Height (in) :	28
Weight :	149
Cutout Width (in) :	28 1/2

MSRP is Manufacturer's Suggested Retail Price and may not necessarily be the price at which the product is sold in the consumer's area. Dealer alone determines actual price.

PHP900SM
GE Profile™ Series 30" Electric Induction Cooktop

Dimensions and Installation Information (in inches)

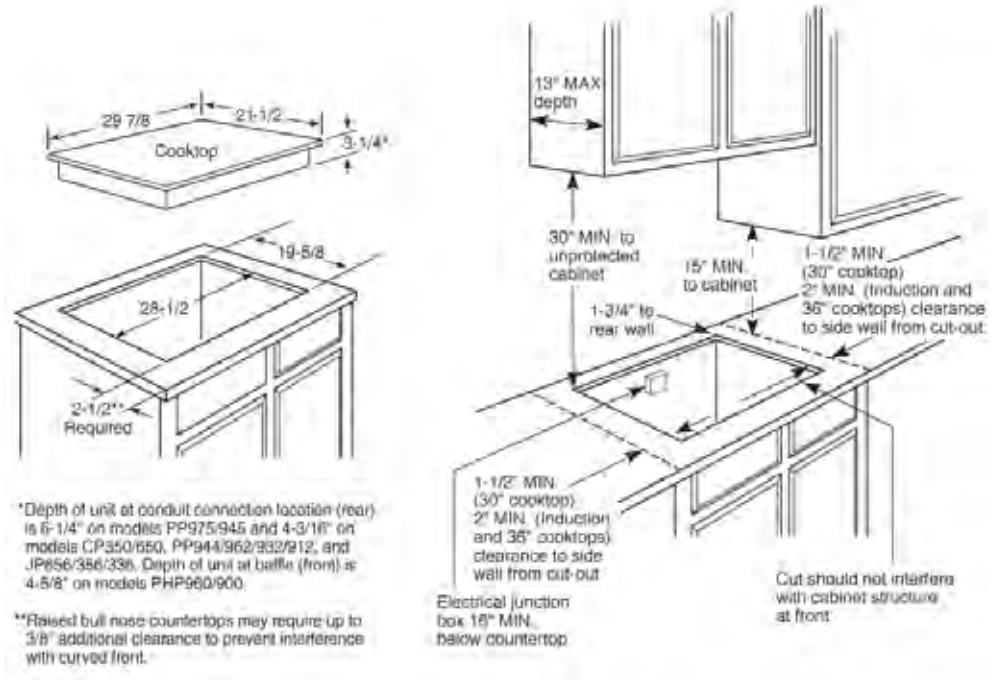
KW Rating	
240V	7.7
208V	5.8
Breaker Size	
240V	40 Amps†
208V	40 Amps†

†**Note:** Check local codes for required breaker size

Important: Allow 12" minimum vertical clearance between the cooktop bottom and any combustible surfaces. Free area not required when installing wall oven underneath cooktop. Refer to installation instructions. Requires a 15" minimum from cooktop to adjacent overhead cabinets. Units are furnished with a 36" flexible armored cable.

Note: 36" Ribbon cooktops are approved for use over GE 30" Single Wall Ovens and Warming Drawers only. Refer to cooktop and wall oven/warming drawer installation instructions packed with product for current dimensional data. If installed with a GE Profile™ Telescopic Downdraft System, consult both the cooktop and downdraft installation instructions packed with product before installing. Cooktop gas/electric supply may need to be re-routed to install downdraft. The countertop must be at least 26" deep with a flat surface area of 23-1/2" or more, front to back. In addition, other clearances to the front edge of the countertop must be considered, especially on raised bullnose countertops. Consult cabinet and countertop manufacturer's specs for flush mount installation prior to install.

Installation Information: Before installing, consult installation instructions packed with product for current dimensional data.



Above illustration intended for dimensional reference only. Refer to photograph for actual product appearance.

imagination at work

For answers to your Monogram® or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000.

Listed by Underwriters Laboratories

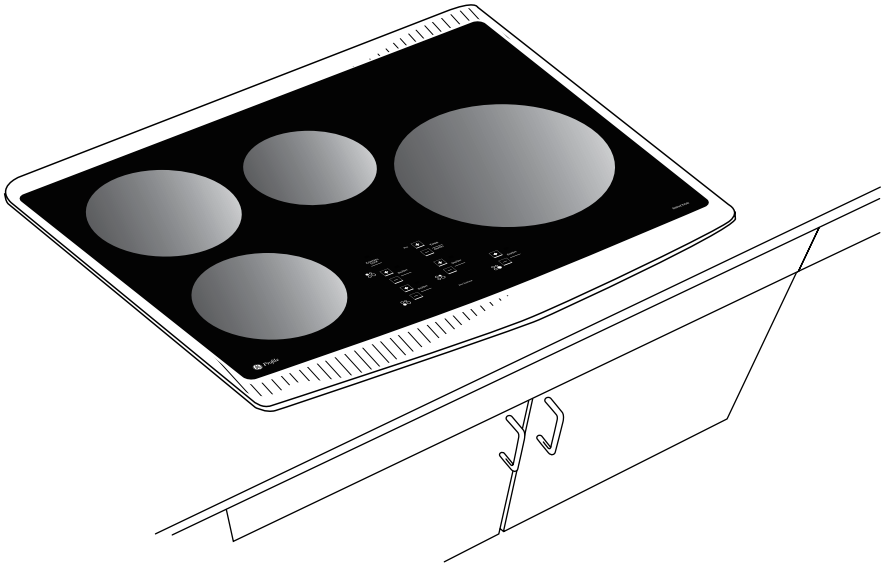
Specification Revised 3/13

220576

PHP900SM
GE Profile™ Series 30" Electric Induction Cooktop

Features and Benefits

- Induction Elements - Powerful yet precise induction elements generate heat directly to the cookware leaving the unused portion of the element unheated and easier to clean
- 11" Element - Offers a large 11" surface, wide enough to handle bigger pots and pans and accommodate family meals of any size
- 11" Element - At it's highest setting, the 11" element has 3700 watts of power, providing an incredibly fast time to boil water
- Electronic Touch Controls - Offer easy, point-and-cook convenience
- 19 Control Settings - Choose from 19 different power levels to select the temperature that is perfect for your meal
- Pan Presence Sensor - Detects when a burner element is left "on" and automatically shuts it off when not in use
- Control Lock Capability - Provides the ability to lock the cooktop's controls, helping protect from unintended activation
- Seamless Appearance - Installs nearly flush with countertop for a seamless appearance
- Electronic Kitchen Timer - Provides convenient notification to help coordinate meal preparation and cooking times
- Stainless Steel Frame - Brings an added touch of style to any decor and perfectly complements all other stainless steel appliances in the kitchen
- Frameless Design - A smooth and seamless cooktop surface makes cleaning quick and easy
- Model PHP900SMSS - Stainless steel



imagination at work

FRONT LOAD WASHERS

WM2240

Performance
- 4.3 cu.ft. Ultra Capacity with NeveRust™ Stainless Steel Drum (IEC)
- DirectDrive™ Motor for the Ultimate in Durability and Reliability
- 10° TilTub™ for Easy Reach into the Rear of the Drum
- 1200 RPM Powerful Spin for Efficient Water Extraction

Intelligent Fabric Care
- 6Motion™ Technology
- TrueBalance™ Anti-Vibration System
- SenseClean™ System for Intelligent Fabric Care
- SmartDiagnosis™
- 7 Washing Programs
- 5 Temperature Levels
- Delay Wash up to 19 hours for Washing Convenience

Style and Design
- Upfront Electronic Control Panel with LED Display and Dial-A-Cycle™
- Silver Door with Glass

Technology Benefits
- LoDecibel™ Quiet Operation
- Highly Energy and Water Efficient

White

Titanium

ENERGY STAR

LG front load washers exceed Energy Star classifications by a minimum of 39%.

Inverter DirectDrive

LG Life's Good

FRONT LOAD WASHERS

6Motion™

Get your clothes cleaner and help them last longer with revolutionary 6Motion™ technology. Each wash cycle combines up to 6 different wash motions to provide outstanding cleaning while being gentle on fabrics.

Smart Diagnosis™

It's unlikely you'll experience any problems with your LG washer, but if you ever do, this feature helps the service centre diagnose problems over the phone, helping you minimize costly, inconvenient service calls.

TrueBalance™ Anti-Vibration System

You shouldn't know your washer is on from the next room. The LG TrueBalance™ anti-vibration system is designed to reduce washer noise and vibration for smooth, quiet performance in any room of the house - even on the 2nd floor.

Direct Drive Motor 10 Year Warranty

When you buy a washer, you don't want to worry that it won't last. Because the Direct Drive Motor uses fewer moving parts and operates more efficiently, LG confidently backs the motor with a 10-year warranty.

TubFresh™ System

To get your clothes as clean as possible, you need the washer itself to stay clean and fresh. The TubFresh™ system includes an advanced tub-cleaning cycle and other innovations that help you easily maintain your washer's freshness by cleaning and drying the wash tub, door, and gaskets.

LoDecibel™ Quiet Operation

There's no need for laundry to be noisy. Thanks to LG's LoDecibel™ operation, chances are you'll never even notice it.

	WM2240
TYPE	
Front Loader	●
Design Look	Front Control
Intelligent Electronic Controls with Dial-A-Cycle™	●
Capacity*	IEC 4.3 cu.ft.
Dry Linen Capacity	>10.1kg
ENERGY	
Energy Star Compliant	●
WASH PROGRAMS	
7 Programs	Bulky/Large, Perm Press, Delicates, Cotton/Normal, Hand Wash/Wool, Speed Wash, Drain+Spin
5 Wash/Rinse Temperatures	Hot, Warm, EcoWarm, Cold, Tap Cold (All Cold Rinses)
Spin Speeds	Extra High (1200 max.), High, Medium, Low, No Spin
No. of Water Levels	Automatically adjusts to size of load
No. of Soil Levels	5
9 Options	Prewash, Rinse & Spin, Quick Cycle, Stain Cycle, Tub Clean, Delay Wash (up to 19 hours), Water Plus, Extra Rinse, Child Lock
FABRIC CARE FEATURES	
SenseClean™ System	●
CONVENIENCE FEATURES	
4 Tray Dispenser	Prewash, Main Wash (with liquid detergent cup), Bleach, Softener
End of Cycle Beeper	●
Child Lock	●
TrueBalance™ Anti-Vibration System	●
SmartDiagnosis™	●
Load Sense	●
Auto Suds Removal	●
Status Indicator(s)	●
Forced Drain System	●
Leveling Legs	4 Adjustable Legs
LoDecibel™ Quiet Operation	●
MOTOR AND AGITATOR	
Motor Type / Motor Speed / Axis	Direct Drive / Variable / Horizontal
MATERIALS AND FINISHES	
NeveRust™ Stainless Steel Drum	●
Easy Loading TilTub™	●
Cabinet	Painted Steel
Control Panel	Plastic
Top Plate	White, Titanium (Painted)
Transparent Door Glass	●
Door Rim	Silver
Available Colours	White (W), Titanium (S)
POWER SOURCE	
Ratings / Electrical Requirements / Type	UL Listed / 120V, 10 Amps / Electric
OPTIONS	
Pedestal	WDP4W, WDP4S
Pedestal (WxHxD)	27" x 13 3/5" x 28 2/5"
Stacking Kit	SSTK1
DIMENSIONS	
Product (WxHxD)	27" x 38 11/16" x 29 3/4" (51"D with door open)
Carton (WxHxD)	29 1/2" x 42 1/4" x 31 1/4"
Product Weight / Shipping Weight	192 / 210.5
UPC CODES	
WM2240CW	772454 056475
WDP4W	048231 011211
WM2240CS	772454 058271
WDP4S	772454 053412
SSTK1	048231 008587
WARRANTY	
	1 year (parts and labour) 3 years (controller) 5 years (liner and tub) 10 years (DirectDrive™ motor)

Design and specifications are subject to change without notice.
All trademarks are property of their respective owners.

LG ELECTRONICS CANADA INC.
550 Matheson Blvd. East, Mississauga, ON L4Z 4G3
Tel: 905.568.6800 | Fax: 905.507.9649 | LG.com
Customer Service & Parts
1-888-LG-CANADA | lgservice.com

Printed in March 2011

ELECTRIC DRYERS

DLE2240

Performance
- Extra Large Load Capacity Drum (7.1 cu.ft.)

Intelligent Fabric Care
- Sensor Dry System for Intelligent Fabric Care and Energy Efficiency
- SmartDiagnosis™
- 7 Drying Programs
- 5 Temperature Levels
- Wrinkle Care Option
- Custom Program

Style and Design
- Upfront Electronic Control Panel with LED Display and Dial-A-Cycle™
- Silver Door with Glass

Technology Benefits
- LoDecibel™ Quiet Operation

White

Titanium

LG
Life's Good

ELECTRIC DRYERS

Smart Diagnosis™

It's unlikely you'll experience any problems with your LG dryer, but if you ever do, this feature helps the service centre diagnose problems over the phone, helping you minimize costly, inconvenient service calls.

Intelligent Electronic Controls with Dual LED Display and Dial-A-Cycle™

Let us take the guesswork out of doing the laundry. The intuitive Intelligent Electronic Control Panel with Dual LED Display and Dial-A-Cycle™ makes it easy to find the right setting every time.

Sensor Dry System

What's worse than pulling clothes out of the dryer and finding they're still damp? Our Sensor Dry System measures the moisture levels during the cycle and automatically adjusts the drying time, assuring you get dry laundry every time.

Wrinkle Care Cycle

Pressed for time? Just pop your dry clothes in for a tumble on the Wrinkle Care Cycle to reduce creases.

	DLE2240
TYPE	
Front Loader	●
Design Look	Front Control
Intelligent Electronic Controls with Dual LED Display	●
Dial-A-Cycle™	●
Capacity	7.1 cu.ft.
Dry Linen Capacity	>10.1kg
DRYING PROGRAMS	
7 Programs	Sensor Dry: Cotton/Normal, Perm Press, Towels, Delicates Manual Dry: Speed Dry, Freshen Up, Air Dry
7 Options	More Time, Less Time, Signal (On/Off), Custom Program, Damp Dry Signal, Wrinkle Care, Child Lock
5 Temperature Levels	High, Medium High, Medium, Low, Ultra Low
5 Drying Levels	Very Dry, More Dry, Normal Dry, Less Dry, Damp Dry
Dry Times	60 min., 50 min., 40 min., 30 min., 20 min., More Time/Less Time
FABRIC CARE FEATURES	
Sensor Dry	●
CONVENIENCE FEATURES	
End of Cycle Signal	●
Child Lock	●
Venting Option	4 Way Venting
SmartDiagnosis™	●
Drum Light	●
Reversible Door	●
Remaining Time Display/Status Indicator(s)	●
Leveling Legs	4 Adjustable Legs
Wrinkle Care Option	●
LoDecibel™ Quiet Operation	●
MATERIALS AND FINISHES	
Aluminized Alloy Steel	●
Top Plate	White, Titanium (Painted)
Cabinet	Painted Steel
Control Panel	Plastic
Transparent Glass Door	●
Door Rim	Silver
Available Colours	White (W), Titanium (S)
POWER SOURCE	
Ratings	UL Listed
Electrical Requirements	240V, 30 Amps
Type	Electric
OPTIONS	
Pedestal	WDP4W, WDP4S
Pedestal (WxHxD)	27" x 13 3/5" x 28 2/5"
Stacking Kit	SSTK1
DIMENSIONS	
Product (WxHxD)	27" x 38 11/16" x 30" (51"D with door open)
Carton (WxHxD)	29 1/2" x 43" x 31 1/4"
Product Weight / Shipping Weight	126 lbs / 144 lbs
UPC CODES	
DLE2240W	772454 058288
WDP4W	048231 011211
DLE2240S	772454 056482
WDP4S	772454 053412
SSTK1	048231 008587
WARRANTY	
	1 year (parts and labour) 3 years (controller) 5 years (liner and tub)

Design and specifications are subject to change without notice.
All trademarks are property of their respective owners.

LG ELECTRONICS CANADA INC.
550 Matheson Blvd. East, Mississauga, ON L4Z 4G3
Tel: 905.568.6800 | Fax: 905.507.9649 | LG.com
Customer Service & Parts
1-888-LG-CANADA | lgservice.com

Printed in March 2011

WARNING

WARNING: AIR OR COMPRESSED GAS MUST NEVER BE USED FOR PRESSURE TESTING. VIOLATION OF THIS WARNING MAY CAUSE SYSTEM FAILURE AND/OR PRODUCT DAMAGE, AND MAY RESULT IN PROPERTY DAMAGE, SEVERE PERSONAL INJURY AND/OR DEATH.

Painting Pipe & Fittings

Water based acrylic latex paint is the preferred and recommended paint to use on BlazeMaster® pipe and fittings. Consult with local Authority Having Jurisdiction (AHJ) prior to covering any markings on Viking Plastics CPVC pipe.

WARNING

WARNING: THE UL AND C-UL LISTING DOES NOT COVER PAINTED CPVC FIRE SPRINKLER PIPING PRODUCTS. USE OF CERTAIN PAINTS, SUCH AS OIL-BASED, CAN DAMAGE CPVC FIRE SPRINKLER PIPING PRODUCTS.BEFORE PAINTING ANY CPVC FIRE SPRINKLER PIPING PRODUCTS, YOU MUST CONSULT WITH YOUR LOCAL AUTHORITY HAVING JURISDICTION FOR RESTRICTIONS, OR CONTACT VIKING PLASTICS FOR PAINTING RECOMMENDATIONS. VIOLATION OF THIS WARNING MAY CAUSE SYSTEM FAILURE AND/OR PRODUCT DAMAGE, AND MAY RESULT IN PROPERTY DAMAGE, SEVERE PERSONAL INJURY AND/OR DEATH.

Transitions to Other Materials

Specifically designed threaded adapters, grooved coupling adapters, and flanges are listed for connecting systems incorporating Viking Plastics Blazemaster® CPVC fire sprinkler products to other materials, valves, and accessories.

NOTICE

NOTICE: Use only compatible lubricants, thread pastes, and gasket materials. Incompatible products may result in product failure and property damage.

Engineering Data - Product Specifications

Viking Plastics Blazemaster® CPVC fire sprinkler products are produced in SDR 13.5 dimensions, as specified in ASTM F-442. These products are UL Listed, or C-UL, and FM Approved for a rated working pressure of 175 psi (1200 kPa) at 150°F (65°C) for sprinkler service. Engineering data on Material Properties and Expansion & Contraction for CPVC pipe in this manual are provided for Viking Plastics Blazemaster® CPVC Fire Sprinkler Pipe.

BlazeMaster® CPVC Fire Sprinkler Fittings are produced in Schedule 40 dimensions for sizes 3/4 inch (20 mm) through 1-1/4 inch (32 mm) in accordance with ASTM F-438 and Schedule 80 dimensions for sizes 1-1/2 inch (40 mm) through 3 inch (80 mm) in accordance with ASTM F-439. Consult fitting manufacturers for applicable variations.

BlazeMaster® Pipe Dimensions & Weights SDR 13.5 (ASTM F-442)				
Nominal Size Inches/ (mm)	**Average OD Inches/ (mm)**	**Average ID Inches/ (mm)**	**Empty lbs/ft (Kg/m)**	**H_20 Filled lbs/ft (Kg/m)**
3/4" (20.0 mm)	1.050" (26.7 mm)	0.874" (22.2 mm)	0.168 lbs (0.250 kg)	0.428 lbs (0.637 kg)
1" (25.0 mm)	1.315" (33.4 mm)	1.101" (28.0 mm)	0.262 lbs (0.390 kg)	0.675 lbs (1.005 kg)
1-1/4" (32.0 mm)	1.660" (42.2 mm)	1.394" (35.4 mm)	0.418 lbs (0.622 kg)	1.079 lbs (1.606 kg)
1-1/2" (40.0 mm)	1.900" (48.3 mm)	1.598" (40.6 mm)	0.548 lbs (0.816 kg)	1.417 lbs (2.109 kg)
2" (50.0 mm)	2.375" (60.3 mm)	2.003" (50.9 mm)	0.859 lbs (1.278 kg)	2.224 lbs (3.310 kg)
2-1/2" (65.0 mm)	2.875" (73.0 mm)	2.423" (61.5 mm)	1.257 lbs (1.871 kg)	3.255 lbs (4.844 kg)
3" (80.0 mm)	3.500" (88.9 mm)	2.950" (75.0 mm)	1.867 lbs (2.778 kg)	4.829 lbs (7.186 kg)

NOTE: The above average OD and average ID information is per ASTM F-442. Check with individual manufacturers for actual OD and ID information.

Hydraulic Design

Hydraulic calculations for the sizing of systems incorporating Viking Plastics Blazemaster® CPVC fire sprinkler products must be calculated using a Hazen-Williams C value of 150. Pipe friction loss calculations must be made according to NFPA Standard 13. The following table shows the allowance for friction loss for fittings, expressed as equivalent length of pipe. For additional information regarding friction loss, contact Viking Plastics.

Allowance for Friction Loss in Fittings (SDR 13.5 Equivalent Pipe)							
	3/4" (20 mm)	**1"** (25mm)	**1-1/4"** (32mm)	**1-1/2"** (40 mm)	**2"** (50 mm)	**2-1/2"** (65 mm)	**3"** (80 mm)
Tee Branch	**3'** (0.91 m)	**5'** (1.52 m)	**6'** (1.83 m)	**8'** (2.44 m)	**10'** (3.05 m)	**12'** (3.66 m)	**15'** (4.57 m)
Elbow 90	**7'** (2.13 m)	**7'** (2.13 m)	**8'** (2.44 m)	**9'** (2.74 m)	**11'** (3.35 m)	**12'** (3.66 m)	**13'** (3.96 m)
Elbow 45	**1'** (0.31 m)	**1'** (0.31 m)	**2'** (0.61 m)	**2'** (0.61 m)	**2'** (0.61 m)	**3'** (0.91 m)	**4'** (1.22 m)
Coupling	**1'** (0.31 m)	**1'** (0.31 m)	1' (0.31 m)	**1'** (0.31 m)	**1'** (0.31 m)	**2'** (0.61 m)	**2'** (0.61 m)
Tee Run	**1'** (0.31 m)	**1'** (0.31 m)	**1'** (0.31 m)	**1'** (0.31 m)	**1'** (0.31 m)	**2'** (0.61 m)	**2'** (0.61 m)

Hangers & Supports

Since CPVC fire sprinkler pipe is rigid, it requires fewer supports than flexible, plastic systems. NOTE: Listed hangars are required for all exposed installations. Viking Plastics recommends the use of hangers that are designed and listed for supporting the CPVC Fire Sprinkler pipe. However, some hangers designed for steel pipe may be used if their suitability is clearly established.

CAUTION

CAUTION: These hangers must have a minimum 1/2 inch (13 mm) load-bearing surface, and they must be selected to accommodate the specific pipe size. In addition, they cannot contain rough or sharp edges that contact the pipe, and they must not bind the pipe from axial movement. Vertical runs must be supported so that the weight of the run is not on a fitting or a joint.

Horizontal runs must be braced so that the stress loads (caused by bending or snaking pipe) will not be placed on a fitting or a joint. Support spacing is shown in the following table. See “Pipe Deflection” in this manual for information regarding bending or snaking CPVC Fire Sprinkler Pipe.

NFPA 13D permits “support methods comparable to those required by local plumbing codes.” These hanger support requirements must also be followed on NFPA 13D systems.

Table A - Standard Support Spacing

Nominal Size, Inches/(mm)	Max. Support Spacing, Feet/(Meters)
3/4" (20.0 mm)	**5-1/2'** (1.67 m)
1” (25.0 mm)	**6’** (1.82 m)
1-1/4” (32.0 mm)	**6-1/2’** (1.98 m)
1-1/2” (40.0 mm)	**7’** (2.13 m)
2” (50.0 mm)	**8’** (2.43 m)
2-1/2” (65.0 mm)	**9’** (2.74 m)
3” (80.0 mm)	**10’** (3.04 m)

CAUTION

CAUTION: DO NOT use hanger items such as plumber’s tape or “nail-on” devices. Pipe hanger must comply with NFPA 13, 13D and 13R.

CAUTION

CAUTION: When a sprinkler head activates, a significant reactive force can be exerted on the pipe. With a pendent head, this

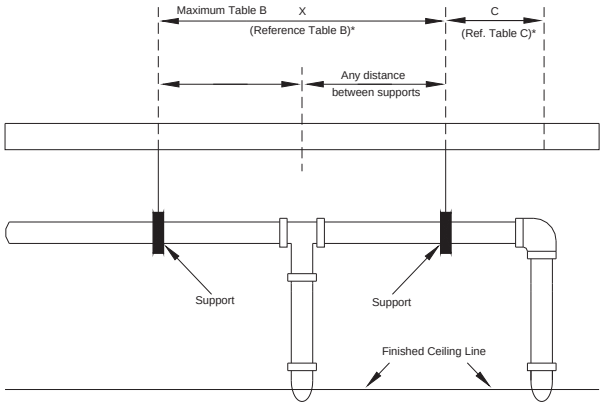
reactive force can cause the pipe to lift vertically if it is not secured properly, especially if the sprinkler drop is from small diameter pipe. The pipe must be braced against vertical lift-up with the closest hanger. Refer to the following illustration and Tables B & C.

Table B - Maximum Support Spacing Distance In Line Sprinkler Head Drop Tee

Nominal Pipe Size (inches/mm)	Less than 100 psi (690 kPa)	More than 100 psi (690 kPa)
3/4" (20 mm)	**4'** (1.22 m)	**3'** (0.91 m)
1" (25 mm)	**5'** (1.52 m)	**4'** (1.22 m)
1-1/4" (32 mm)	**6'** (1.83 m)	**5'** (1.52 m)
1-1/2" – 3" (40 - 80 mm)	**7'** (2.13 m)	**7'** (2.13 m)

Table C - Maximum Support Spacing Distance End Sprinkler Head Drop Elbow

Nominal Pipe Size (inches/mm)	Less than 100 psi (690 kPa)	More than 100 psi (690 kPa)
3/4" (20 mm)	**9"** (228.6 mm)	**6"** (152.4 mm)
1" (25 mm)	**12"** (304.8 mm)	**9"** (228.6 mm)
1-1/4" (32 mm)	**16"** (406.4 mm)	**12"** (304.8 mm)
1-1/2" – 3" (40 – 80 mm)	**24"** (609.6 mm)	**12"** (304.8 mm)



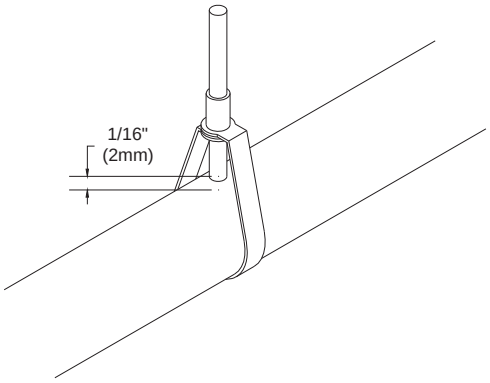
Support Spacing Drop Elbow and Drop Tee

Numerous common methods are used to brace fire sprinkler pipe. Acceptable methods include, but are not limited to, the following:

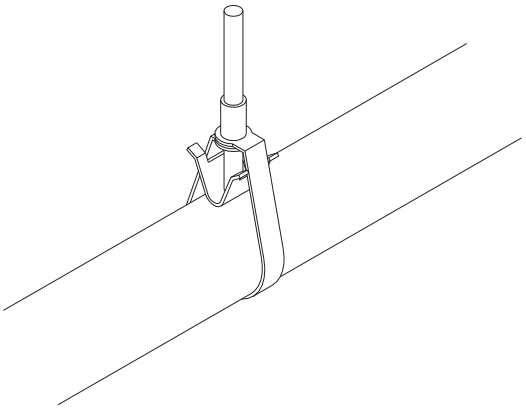
- Use of a standard band hanger by positioning the threaded support rod to 1/16 inch (2 mm) above the pipe (however, it is important that the rod does not contact the pipe).
- A wrap around U-hanger.
- A special escutcheon which prevents upward movement of the sprinkler through the ceiling or band hangers with surge restraints to provide surge protection for the system.

Pipe hangers are available that are tested and UL Listed for fire sprinkler service. These hangers comply with NFPA 13 requirements for use with CPVC fire sprinkler piping systems. The following descriptions are examples of these.

Band Hanger - designed to support CPVC piping systems when used in conjunction with a hanging steel threaded rod that is suspended from a ceiling or other flat, horizontal surface. The threaded rod must be leveled properly before installing the hanger and restraint.



Surge Restraint - when installed with the band hanger, as shown below, provides surge protection for the system.

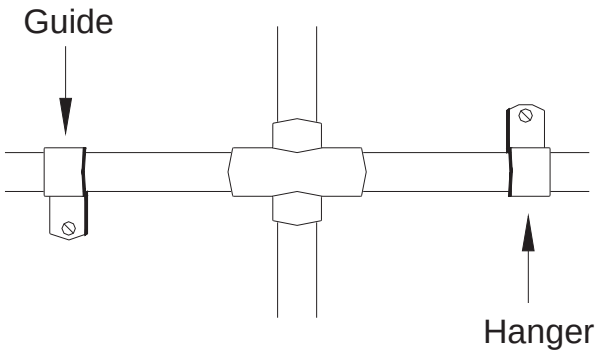


One Hole Wrap-Around Strap - designed to support CPVC piping systems only when the hanger tab is in the vertical

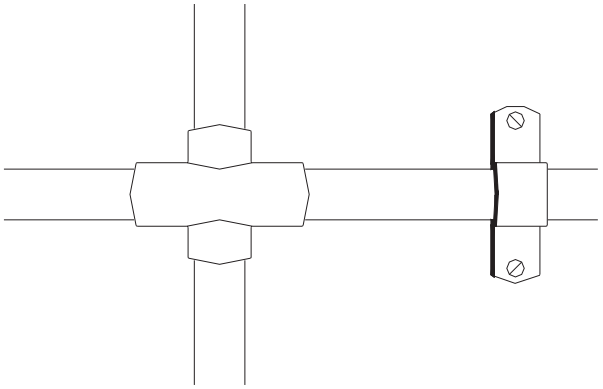
position, and the screw-type fastener is in the horizontal position. The one-hole strap can be used as a pipe restrainer when the hanger tab is in the downward position, but it cannot be used as a hanger to hold any weight of the system. In addition, the one-hole strap can be used as a piping system guide when the system lies on top of the beam, and the beam supports the system's weight.

CAUTION

CAUTION: The one-hole strap is not intended to support the CPVC piping system from under a ceiling or any other flat, horizontal surface. For this application, install a two-hole strap.

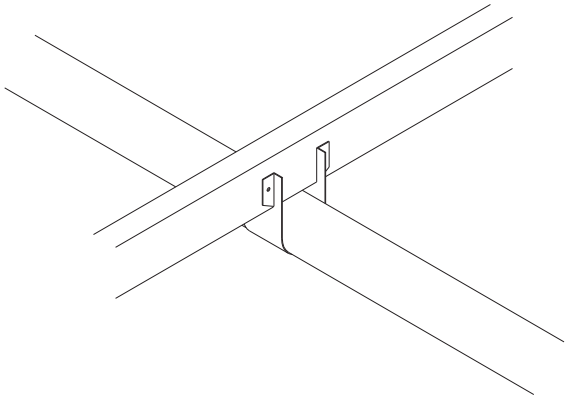


Two-Hole Strap - designed to support CPVC piping systems when attached to a flat, horizontal surface with the screw-type fasteners in the vertical position. In addition, the two-hole strap is designed to support CPVC piping systems when attached to a flat, vertical surface with one mounting tab in the vertical position and the screw-type fasteners in the horizontal position. The two-hole strap can be used as a piping system guide when the system lies on top of a beam, and the beam supports the system's weight.



Two-Hole 90°Side Mount Strap - designed to support CPVC piping systems when attached to a horizontal beam with the

screw-type fasteners in the horizontal position and the pipe hanging below the beam. The fastener's mounting edges are designed to allow the screws to be installed horizontally. This is a benefit when overhead clearance is limited. In addition, the 90° side mount strap can be used in a restrainer fashion when it is attached to the top of a beam, and the system lies on top of the beam.



Riser Supports

Risers must be supported by pipe clamps or by hangers located on the horizontal connection close to the riser. Only Listed hangers and clamps can be used. Vertical lines must be supported at intervals to avoid placing excessive load on a fitting at the lower end. This can be done by using riser clamps or double-bolt pipe clamps listed for this service.

CAUTION

CAUTION: Hangers and supports must not compress, distort, cut, or abrade the piping, and they must allow free movement of the pipe for thermal expansion and contraction. DO NOT use riser clamps that squeeze the pipe and depend on compression of the pipe to support the weight.

Maintain vertical piping in straight alignment with supports at each floor level or 10-foot (3.05 m) intervals, whichever is less. CPVC risers in vertical shafts or buildings with ceilings over 25 feet (7.62 m) must be aligned straight and supported at each floor level or 10-foot (3.05 m) intervals, whichever is less.

Clamps must not exert compressive stresses on the pipe. If possible, the clamps should be located directly below a coupling so that the shoulder of the coupling rests against the clamp. A coupling can be modified to achieve this by cutting a CPVC coupling just above the stop at the socket bottom. Then, cut this piece in half lengthwise to provide two halves that do not contain the stop. Follow the "Solvent Cement Welding Instructions" to cement the two halves to the pipe at the required location, and make sure that the shoulder of the modified coupling rests on the

clamp. Allow the assembly to cure before placing any stress on the joint.

WARNING

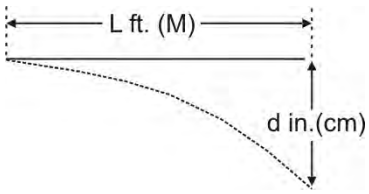
WARNING: CPVC PIPE AND/OR SYSTEM COMPONENTS MUST NOT BE USED TO PROVIDE STRUCTURAL SUPPORT FOR THE SYSTEM. CARE SHOULD BE USED WHEN INSTALLING, HANGING, OR BRACING TO PREVENT UNNECESSARY STRESS LOADS ON THE CPVC PIPING SYSTEM. FAILURE TO FOLLOW THIS WARNING CAN CAUSE PRODUCT FAILURE AND MAY RESULT IN PROPERTY DAMAGE, SEVERE PERSONAL INJURY AND/OR DEATH.

Earthquake Bracing

Since CPVC fire sprinkler plastic piping is more ductile than metallic sprinkler pipe, it has a greater capacity to withstand earthquake damage. In areas subject to earthquakes, CPVC fire sprinkler systems should be designed and braced in accordance with national, state and local codes including NFPA Standard 13.

Pipe Deflection

Viking Plastics Blazemaster® CPVC fire sprinkler piping is inherently ductile allowing it to be deflected, within permissible limits, around or away from objects during installation, which can reduce installation time. This ductility allows for greater freedom of design and lower installed cost. The maximum installed deflections for BlazeMaster® piping are as follows:



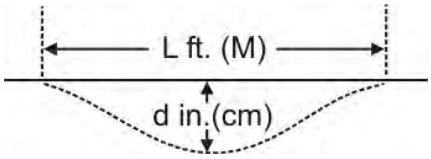
Maximum Installed Deflections
(One End Restrained)

Permissible Bending Deflections SDR 13.5 (73ºF) in Inches														
Pipe Size	Pipe Length in Feet													
	2	5	7	10	12	15	17	20	25	30	35	40	45	50
3/4"	1.3	7.8	15.4	31.3	45.1	70.5	90.6	125.4	195.9	282.1	383.9			
1"	1.0	6.3	12.3	25.0	36.0	56.3	72.3	100.1	156.4	225.2	306.6	400.4		
1-1/4"	0.8	5.0	9.7	19.8	28.5	44.6	57.3	79.3	123.9	178.4	242.8	317.2	401.4	
1-1/2"	0.7	4.3	8.5	17.3	24.9	39.0	50.1	69.3	108.2	155.9	212.2	277.1	350.7	433.0
2"	0.6	3.5	6.8	13.9	20.0	31.2	40.0	55.4	86.6	124.7	169.7	221.7	280.6	346.4
2-1/2"	0.5	2.9	5.6	11.4	16.5	25.8	33.1	45.8	71.5	103.0	140.2	183.1	231.8	286.2
3"	0.4	2.4	4.6	9.4	13.5	21.2	27.2	37.6	58.8	84.6	115.2	150.4	190.4	235.1

Note: Allowable Bending Deflections Based on BlazeMaster® 88738 Orange 734 CPVC compound.

Permissible Bending Deflections SDR 13.5 (23°C) in cm														
Pipe Size	Pipe Length in Meters													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
20 mm	8.6	34.3	77.1	137.1	214.2	308.4	419.8	548.3	694.0	856.7	1036.7			
25 mm	6.8	27.4	61.6	109.5	171.0	246.3	335.2	437.8	554.1	684.1	827.8	985.1		
32 mm	5.4	21.7	48.8	86.7	135.5	195.1	265.5	346.8	439.0	541.9	655.7	780.4	915.8	
40 mm	4.7	18.9	42.6	75.8	118.4	170.4	232.0	303.0	383.5	473.5	572.9	681.8	800.2	928.0
50 mm	3.8	15.2	34.1	60.6	94.7	136.4	185.6	242.4	306.8	378.8	458.3	545.4	640.1	742.4
65 mm	3.1	12.5	28.2	50.1	78.2	112.6	153.3	200.3	253.4	312.9	378.6	450.6	528.8	613.3
80 mm	2.6	10.3	23.1	41.1	64.3	92.5	125.9	164.5	208.2	257.0	311.0	370.1	434.4	503.8

Note: Allowable Bending Deflections Based on BlazeMaster® 88738 Orange 734 CPVC compound.



Maximum Installed Deflections (Both Ends Restrained)

Permissible Bending Deflections SDR 13.5 (73ºF) in Inches														
Pipe Size	Pipe Length in Feet													
	2	5	7	10	12	15	17	20	25	30	35	40	45	50
3/4"	0.3	2.0	3.8	7.8	11.3	17.6	22.6	31.1	49.0	70.5	96.0	125.4	158.7	195.9
1"	0.3	1.6	3.1	6.3	9.0	14.1	18.1	25.0	39.1	56.3	76.6	100.1	126.7	156.4
1-1/4"	0.2	1.2	2.4	5.0	7.1	11.2	14.3	19.8	31.0	44.6	60.7	79.3	100.4	123.9
1-1/2"	0.2	1.1	2.1	4.3	6.2	9.7	12.5	17.3	27.1	39.0	53.0	69.3	87.7	108.2
2"	0.1	0.9	1.7	3.5	5.0	7.8	10.0	13.9	21.6	31.2	42.4	55.4	70.1	86.6
2-1/2"	0.1	0.7	1.4	2.9	4.1	6.4	8.3	11.4	17.9	25.8	35.1	45.8	57.9	71.5
3"	0.1	0.6	1.2	2.4	3.4	5.3	6.8	9.4	14.7	21.2	28.8	37.6	47.6	58.8

Note: Allowable Bending Deflections Based on BlazeMaster® 88738 Orange 734 CPVC compound.

Permissible Bending Deflections SDR 13.5 (23°C) in cm														
Pipe Size	Pipe Length in Meters													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
20 mm	2.1	8.6	19.3	34.2	53.5	77.1	104.9	137.0	173.4	214.1	259.0	308.2	361.8	419.5
25 mm	1.7	6.8	15.4	27.4	42.8	61.6	83.8	109.5	138.6	171.1	207.1	246.4	289.2	335.4
32 mm	1.4	5.4	12.2	21.7	33.9	48.8	66.4	86.7	109.7	135.4	163.9	195.0	228.9	265.4
40 mm	1.2	4.7	10.6	18.9	29.6	42.6	58.0	75.7	95.8	118.3	143.2	170.4	200.0	231.9
50 mm	0.9	3.8	8.5	15.2	23.7	34.1	46.4	60.7	76.8	94.8	114.7	136.5	106.2	185.8
65 mm	0.8	3.1	7.0	12.5	19.6	28.2	38.4	50.1	63.4	78.3	94.7	112.7	132.3	153.5
80 mm	0.6	2.6	5.8	10.3	16.1	23.1	31.5	41.1	52.1	64.3	77.8	92.6	108.6	126.0

Note: Allowable Bending Deflections Based on BlazeMaster® 88738 Orange 734 CPVC compound.

Material Properties

Table I
Modulus of Elasticity & Stress vs. Temperature For BlazeMaster® CPVC Fire Sprinkler Pipe

Property	Temperature °F							
	73	80	90	100	110	120	140	150
Modulus of Elasticity "E" x 10^5 psi	4.23	4.14	3.99	3.85	3.70	3.55	3.23	3.08
Working Stress "S" psi	2,000	1,875	1,715	1,560	1,415	1,275	1,000	875

Note: Material properties based on BlazeMaster® 88738 Orange 734 CPVC compound.

Table II
Physical & Thermal Properties of BlazeMaster®

Property	CPVC	ASTM
Specific Gravity	1.53	D 792
IZOD Impact Strength (ft. lbs./inch, notched)	> 3.0	D 256A
Modulus of Elasticity, @ 73°F, psi	4.23×10^{5}	D 638
Ultimate Tensile Strength, psi	> 8,400	D 638
Hazen-Williams C Factor	150	-
Coefficient of Linear expansion in./in./°F	3.4×10^{-5}	D 696
Thermal Conductivity BTU/hr./ft.^{2}/°F/in.	0.95	C 177
Limiting Oxygen Index	60%	D 2863
Electrical Conductivity	Non Conductor	

NOTE: Material Properties based on BlazeMaster® 88738 CPVC compound.

Expansion and Contraction

BlazeMaster® CPVC fire sprinkler products, like all piping materials, expand and contract with changes in temperature. If the coefficient of linear expansion is 3.4×10^{-5} inch /inch-°F, a 25° F (4º C) change in temperature will cause an expansion of 1 inch (25 mm) for a 100-foot (30 m) straight length. For most operating and installation conditions, expansion and contraction can be accommodated at changes of direction.

Table III
Thermal Expansion

Temp Change ?T °F	Length of Run in Feet													
	5	10	15	20	25	30	35	40	45	50	70	90	120	160
	Thermal Expansion ?L (in.)													
20	0.04	0.08	0.12	0.16	0.20	0.24	0.29	0.33	0.37	0.41	0.57	0.73	0.98	1.31
30	0.06	0.12	0.18	0.24	0.31	0.37	0.43	0.49	0.55	0.61	0.86	1.10	1.47	1.96
40	0.08	0.16	0.24	0.33	0.41	0.49	0.57	0.65	0.73	0.82	1.14	1.47	1.96	2.61
50	0.10	0.20	0.31	0.41	0.51	0.61	0.71	0.82	0.92	1.02	1.43	1.84	2.45	3.26
60	0.12	0.24	0.37	0.49	0.61	0.73	0.86	0.98	1.10	1.22	1.71	2.20	2.94	3.92
70	0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14	1.29	1.43	2.00	2.57	3.43	4.57
80	0.16	0.33	0.49	0.65	0.82	0.98	1.14	1.31	1.47	1.63	2.28	2.94	3.92	5.22
90	0.18	0.37	0.55	0.73	0.92	1.10	1.29	1.47	1.65	1.84	2.57	3.30	4.41	5.88
100	0.20	0.41	0.61	0.82	1.02	1.22	1.43	1.63	1.84	2.04	2.86	3.67	4.90	6.53

Thermal Expansion based on BlazeMaster® 88738 Orange 734 CPVC compound.

Temp Change ?T °C	Length of Run in Meters													
	1	2	4	6	8	10	12	14	16	18	20	30	40	50
	Thermal Expansion ?L (cm)													
20	0.06	0.12	0.24	0.37	0.49	0.61	0.73	0.86	0.98	1.10	1.22	1.84	2.45	3.06
30	0.09	0.18	0.37	0.55	0.73	0.92	1.10	1.29	1.47	1.65	1.84	2.75	3.67	4.59
40	0.12	0.24	0.49	0.73	0.98	1.22	1.47	1.71	1.96	2.20	2.45	3.67	4.90	6.12
50	0.15	0.31	0.61	0.92	1.22	1.53	1.84	2.14	2.45	2.75	3.06	4.59	6.12	7.65
60	0.18	0.37	0.73	1.10	1.47	1.84	2.20	2.57	2.94	3.30	3.67	5.51	7.34	9.18
70	0.21	0.43	0.86	1.29	1.71	2.14	2.57	3.00	3.43	3.86	4.28	6.43	8.57	10.71
80	0.24	0.49	0.98	1.47	1.96	2.45	2.94	3.43	3.92	4.41	4.90	7.34	9.79	12.24
90	0.28	0.55	1.10	1.65	2.20	2.75	3.30	3.86	4.41	4.96	5.51	8.26	11.02	13.77
100	0.31	0.61	1.22	1.84	2.45	3.06	3.67	4.28	4.90	5.51	6.12	9.18	12.24	15.30

Thermal Expansion based on BlazeMaster® 88738 Orange 734 CPVC compound.

$\Delta L = 12eL(\Delta T)$

e = 3.4 x10^{-5} in./in. °F (Coefficient of Linear Expansion for BlazeMaster® CPVC Fire Sprinkler Pipe)

L = Length of Run in Feet

ΔT = Temperature Change in °F

Example:
How much will a 40 ft. run of 2" BlazeMaster® CPVC Fire Sprinkler Pipe expand if the expected ambient temperature will range from 45°F to 85°F?

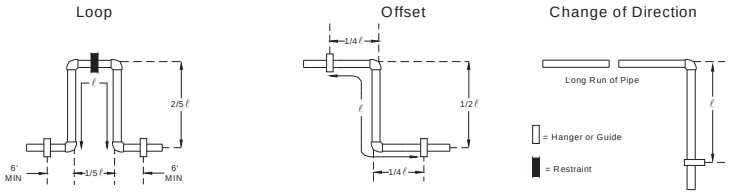
$\Delta L = 12eL(\Delta T)$

$\Delta L = 12\ (.000034) \times 40 \times 40$

$\Delta L = .65$”

Expansion Loop & Offset Configurations

Hangers or guides should only be placed in the loop, offset or change of direction as indicated below. Piping supports should restrict lateral movement and should direct axial movement into the expansion loop.



Expansion Loop and Offset Configuration

Table IV
Expansion Loop Length in Inches For BlazeMaster® CPVC Fire Sprinkler Pipe

Nominal Pipe Size	Avg. O.D.	Length of Run in Feet													
		5	10	15	20	25	30	35	40	45	50	70	90	120	160
		Length of Loop (in) Temperature = 100°F-30°F, ?T = 70°F													
3/4”	1.05	7	11	13	15	17	18	20	21	22	24	28	32	37	42
1”	1.315	8	12	14	17	19	20	22	24	25	26	31	35	41	47
1-1/4”	1.66	9	13	16	19	21	23	25	26	28	30	35	40	46	53
1-1/2”	1.9	10	14	18	22	22	25	27	28	30	32	38	43	49	57
2”	2.375	11	16	20	22	25	27	30	32	34	35	42	48	55	63
2-1/2”	2.875	12	18	21	25	27	30	33	35	37	39	46	52	60	70
3”	3.5	13	19	24	27	30	33	36	38	41	43	51	58	67	77

Note: Table IV is based on Stress & Elasticity at 100°F.

$\ell = \sqrt{\frac{3ED(L)}{2S}}$

ℓ = Length of Expansion Loop in Inches

E = Modulus of Elasticity at 100° F

D = Average O.D. of Pipe

ΔL = Change in Length of Pipe Due to Change in Temperature (Table III)
S = Working Stress at 100° F (Table I)

Example:
How much expansion can be expected in a 200 ft. run of 2" BlazeMaster® CPVC fire sprinkler pipe and how long should the expansion loop be to compensate for this expansion? (The expected temperature range will be from 40°F to 110°F).

First Find:
ΔT = (Change in Temperature)
$\Delta T = T2 - T1$
$\Delta T = 110°F - 40°F$
$\Delta T = 70°F$

To Find:
ΔL= (Amount of Expansion in inches from Table III)
ΔL = ΔL of 160 ft. with a ΔT of 70°F + ΔL of 40 ft. with a ΔL of 70°F
$\Delta L = 4.57" + 1.14"$
$\Delta L = 5.71"$

- OR -

$\Delta L = 12eL(\Delta T)$
$e = 3.4 \times 10^{-5}$ (from Table II)
L = Length of Run in Feet
ΔT = Change in Temperature in °F
$\Delta L = 12 \times .000034 \times 200 \times 70$
$\Delta L = 5.71"$

To find the length of the expansion loop or offset in inches:

$$\ell = \sqrt{\frac{3ED(L)}{2S}}$$

ℓ = Length of Expansion Loop in Inches
E = Modulus of Elasticity at 110° F (Table I)
D = Average O.D. of Pipe
ΔL = Change in Length of Pipe Due to Change in Temperature (Table III)
S = Working Stress at 110° F (Table I)

$$\ell = \sqrt{\frac{3ED(L)}{2S}}$$

$$\ell = \sqrt{\frac{3 \text{ X } 370000 \text{ X } 2.375 \text{ X } 5.71}{2 \text{ X } 1415}}$$

$$\ell = \sqrt{5319}$$

$\ell = 72.93"$

Review – Do's & Don'ts

NOTICE

Do's

- Installation should be made only by a qualified installer or contractor in accordance with all applicable codes and requirements.
- Read and follow the installation instructions.
- Follow recommended safe work practices.
- Make certain that thread sealants, gasket lubricants, or firestop materials are compatible with CPVC.
- Keep pipe and fittings in original packaging until needed.
- Cover pipe and fittings with an opaque tarp if stored outdoors.
- Follow proper handling procedures.
- Use tools specifically designed for use with plastic pipe and fittings.
- Use the proper solvent cement and follow application instructions.
- Use a drop cloth to protect interior finishes.
- Cut the pipe ends square.
- Deburr and bevel the pipe end with a chamfering tool.
- Rotate the pipe 1/4 turn when bottoming pipe in fitting socket.
- Make certain no solvent cement is on sprinkler head or adapter threads.
- Make certain that solvent cement does not run and plug the sprinkler head orifice.
- Follow the manufacturer's recommended cure times prior to pressure testing.
- Fill lines slowly and only at a proper pressure.
- Bleed the air from the system prior to pressure testing.
- Support sprinkler head properly to prevent lift up of the head through the ceiling when activated.
- Keep threaded rod within 1/16 inch of the pipe or use a surge arrestor.
- Install Viking Plastics Blazemaster® CPVC fire sprinkler products in wet systems only.
- Use only compatible insulation and/or manufacturer premixed glycerin solutions for freeze protection.
- Allow for movement due to expansion and contraction.
- Renew your Viking Plastics BlazeMaster® CPVC fire sprinkler products installation training every two years.

WARNING

Don'ts

- DO NOT use edible oils such as Crisco® as a gasket lubricant.
- DO NOT use petroleum or solvent-based sealants, lubricants, or firestop materials.
- DO NOT use any glycol-based solutions as an anti-freeze.
- DO NOT use anything other than manufactured premix glycerin solutions.
- DO NOT allow manufactured premixed glycerin solutions in contaminated containers.
- DO NOT use solvent cement that exceeds its shelf life or has become discolored or jellied.
- DO NOT allow solvent cement to plug the sprinkler head orifice.
- DO NOT connect rigid metal couplers to CPVC grooved adapters.
- DO NOT thread or groove CPVC pipe.
- DO NOT use solvent cement near sources of heat, open flame, or when smoking.
- DO NOT pressure test with air.
- DO NOT pressure test until recommended cure times are met.
- DO NOT exceed proper pressure for testing.
- DO NOT use ratchet cutters below 50°F.
- DO NOT use CPVC pipe that has been stored outdoors, unprotected and/or is faded in color.
- DO NOT allow threaded rod to come in contact with the pipe.
- DO NOT install BlazeMaster® CPVC Fire Sprinkler Products in cold weather without allowing for expansion.
- DO NOT install BlazeMaster® CPVC Fire Sprinkler Products in dry systems.
- DO NOT allow puddling of cement in fittings and pipe.
- DO NOT use dull or broken cutting tool blades when cutting pipe.

Reliable®

Model RFC30 (SIN RA0611)
Model RFC43 (SIN RA0612)
Model RFC49 (SIN RA0616)
Residential Flat Concealed Sprinklers

Bulletin 006 Rev. G

A Residential Flat Concealed Sprinkler engineered for a minimum design density of 0.05 gpm/ft² with low GPM requirements.

Features

1. Very low water flow requirements.
2. Cover plate attachment (Plain or Perforated) with ½" (13mm) Total adjustment.
3. Thread-On/Thread-Off or Push-On/Thread Off cover attachment option.
4. Smooth aesthetic ceiling profile.
5. Available in brass, chrome and black plated or painted finishes.

Listings & Approval

1. Listed by Underwriters Laboratories, and certified by UL for Canada (cULus)
2. NYC MEA 258-93-E

UL Listing Categories

Residential Automatic Sprinklers

UL Guide Number

VKKW

Product Description

Model RFC30, RFC43 and RFC49 Concealed Residential Sprinklers are fast response residential fusible solder link automatic sprinklers. Residential sprinklers differ from standard sprinklers primarily in their response time and water distribution patterns.

Model RFC30, RFC43 and RFC49 sprinklers discharge water in a hemispherical pattern below the sprinkler deflector. Residential distribution patterns are higher and generally contain a finer droplet size than standard sprinkler patterns.

The combination of speed of operation and high discharge pattern required for residential sprinklers has demonstrated, in fire testing, an ability for controlling residential fires, and thereby providing significant evacuation time for occupants.

The RFC30, RFC43 and RFC49 Sprinklers provide the best form of fire protection by combining an attractive appearance and ½" (13mm) of cover adjustment for ease of installation. The small diameter cover plate is easily and positively attached and blends into the ceiling, concealing the most dependable fire protection available, an automatic sprinkler system.

The RFC30, RFC43 and RFC49 are UL Listed Residential Sprinklers to be installed in the residential portions of any occupancy in accordance with NFPA 13, 13R, & 13D.

The RFC30, RFC43 and RFC49 can reduce the need for precise cutting of drop nipples. The threaded cover plate assembly can be adjusted without tools to fit accurately against the ceiling. The fire protection system need not be shut down to adjust or remove the cover plate assembly.

Application and Installation

The RFC30, RFC43 and RFC49, for residential installations, use a 165°F (74°C) fusible solder link in a tuning fork style sprinkler frame with a drop-down deflector. This assembly is recessed into the ceiling and concealed by a flat cover plate. The cover plate is attached to the skirt, using 135°F (57°C) ordinary temperature classification solder. When the ceiling temperature rises, the solder holding the cover plate releases the cover allowing the deflector to drop into position and exposing the sprinkler inside to

ceiling temperature. The subsequent operation of the solder link opens the waterway and causes the deflector to drop into position to distribute the discharging water in a hemispherical pattern below the sprinkler deflector. Any adjustment of thread engagement between the cover plate and cup will assure that the drop-down deflector is properly located below the ceiling. The residential distribution pattern contains a finer droplet size than a standard sprinkler, and the pattern produces significantly higher wall wetting.

After a $2^5/_8$ inch diameter hole is cut in the ceiling, the sprinkler is to be installed with the Model FC Wrench. When installing a sprinkler, the wrench is first positioned into the sprinkler/cup assembly and around the hexagonal body of the sprinkler frame. The Wrench must bottom out against the cup in order to ensure proper, safe installation. The sprinkler is then tightened into the pipe fitting. When inserting or removing the wrench from the sprinkler/cup assembly, care should be taken to prevent damage to the sprinkler. DO NOT WRENCH ON ANY OTHER PART OF THE SPRINKLER/CUP ASSEMBLY. MODEL RFC30, RFC43 AND RFC49 CONCEALED SPRINKLERS MUST BE INSTALLED ONLY WITH 135°F RATED COVERS.

Note: A leak tight ½" NPT (R1/2) sprinkler joint can be obtained with a torque of 8-18 ft-lbs (10,8 - 24,4 N-m). Do not tighten sprinklers over maximum recommended torque. It may cause leakage or impairment of the sprinklers.

Cover assemblies provide up to $^1/_2$" (13mm) of adjustment. Turn the cover clockwise until the flange is in contact with the ceiling. For the push-on/thread-off option, the cover assembly is pushed onto the cup and final adjustment is made by turning the cover clockwise until the skirt flange makes full contact with the ceiling. Cover removal requires turning in the counter-clockwise direction.

In ceilings that have a plenum space above the sprinkler, the plenum space may have neutral or negative pressurization but must not be positively pressurized. Inspect all sprinklers after installation to ensure that the gap between the cover plate and ceiling and the 4 slots in the cup are all open and free from any air flow impediment.

Temperature Rating

Sprinkler	Cover Plate	Max. Ambient Temp.
165°F/74°C	135°F/57°C	100°F/38°C

Installation Data: RFC30 (SIN RA0611)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½" (15mm)	3.0	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	9 (34.1)	9.0 (0.62)
½" (15mm)	3.0	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	10 (37.8)	11 (0.76)

Note: 1 bar = 100 Kpa

Installation Data: RFC43 (SIN RA0612)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½" (15mm)	4.3	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	12 (45)	7.8 (0.54)
½" (15mm)	4.3	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	13 (49)	9.1 (0.63)
½" (15mm)	4.3	16 x 16 (4.9x4.9)	8 (2.43)	8 (2.43)	13 (49)	9.1 (0.63)
½" (15mm)	4.3	18 x 18 (5.5x5.5)	9 (2.74)	8 (2.43)	18 (68)	17.5 (1.21)
½" (15mm)	4.3	20 x 20 (6.0x6.0)	10 (3.05)	8 (2.43)	21 (79)	23.8 (1.64)

Note: 1 bar = 100 Kpa

Installation Data: RFC49 (RA0616)

Thread Size inch (mm)	K Factor	Sprinkler Spacing ft. (m)	Maximum Distance to Wall ft. (m)	Minimum Distance between sprinklers ft. (m)	Minimum Required Sprinkler Discharge	
					Flow gpm (Lpm)	Press. psi (bar)
½" (15mm)	4.9	12 x 12 (3.6x3.6)	6 (1.83)	8 (2.43)	13 (49)	7.0 (0.48)
½" (15mm)	4.9	14 x 14 (4.3x4.3)	7 (2.13)	8 (2.43)	13 (49)	7.0 (0.48)
½" (15mm)	4.9	16 x 16 (4.9x4.9)	8 (2.43)	8 (2.43)	13 (49)	7.0 (0.48)
½" (15mm)	4.9	18 x 18 (5.5x5.5)	9 (2.74)	8 (2.43)	17 (64.3)	12.0 (0.83)
½" (15mm)	4.9	20 x 20 (6.0x6.0)	10 (3.05)	8 (2.43)	20 (75.7)	16.7 (1.14)

Note: 1 bar = 100 Kpa

FOR SLOPED CEILING APPLICATIONS SEE RASCO BULLETIN 035.

Maintenance

Model RFC30, RFC43 and RFC49 Concealed Sprinklers should be inspected quarterly and the sprinkler system maintained in accordance with NFPA 25. Do not clean sprinklers with soap and water, ammonia or any other cleaning fluids. Remove dust by using a soft brush or gentle vacuuming. Remove any sprinkler cover plate assembly which has been painted (other than factory applied) or damaged in any way. A stock of spare sprinklers should be maintained to allow quick replacement of damaged or operated sprinklers. Prior to installation, sprinklers should be maintained in the original cartons and packaging until used to minimize the potential for damage to sprinklers that would cause improper operation or non-operation.

Model RFC30, RFC43 and RFC49 Residential Concealed Sprinkler Specification

Sprinklers shall be cULus Listed low flow residential concealed sprinklers with drop-down deflector and adjustable flat cover plate engineered for a minimum design density of 0.05 gpm/ft^2. Sprinkler frame and deflector shall be of bronze frame construction having a ½" NPT thread. Thermal element shall consist of an approved black-painted beryllium-nickel fusible solder link with symmetric lever mechanism, maintaining a Teflon-coated Belleville spring washer and machined brass cap water seal assembly containing no plastic parts. Sprinkler K-factor shall be nominal 3.0 (44), 4.3 (62.4), and 4.91 (70) having a $^5/_{16}$", $^3/_8$" and $^7/_{16}$" orifice. Temperature rating shall be Ordinary 165°F (74°C); cover plate temperature rating to be 135°F (57°C). Cover plate assembly shall consist of a brass cover plate and copper alloy retainer flange allowing a ½" cover plate adjustment. Any secure engagement between the cover plate and the cup will assure that the drop-down deflector is properly located below the ceiling. A plastic protective cap shall be provided and factory installed inside the sprinkler cup to protect the drop-down sprinkler deflector from damage, which could occur during construction before the cover plate is installed. Standard cover finish: [Chrome] [White] [Specialty – specify]. Residential concealed sprinklers shall be Reliable Model RFC30, SIN RA0611 (Bulletin 006), Model RFC43, SIN RA0612 (Bulletin 006) or Model RFC49, SIN RA0616 (Bulletin 006).

Ordering Information

Specify:

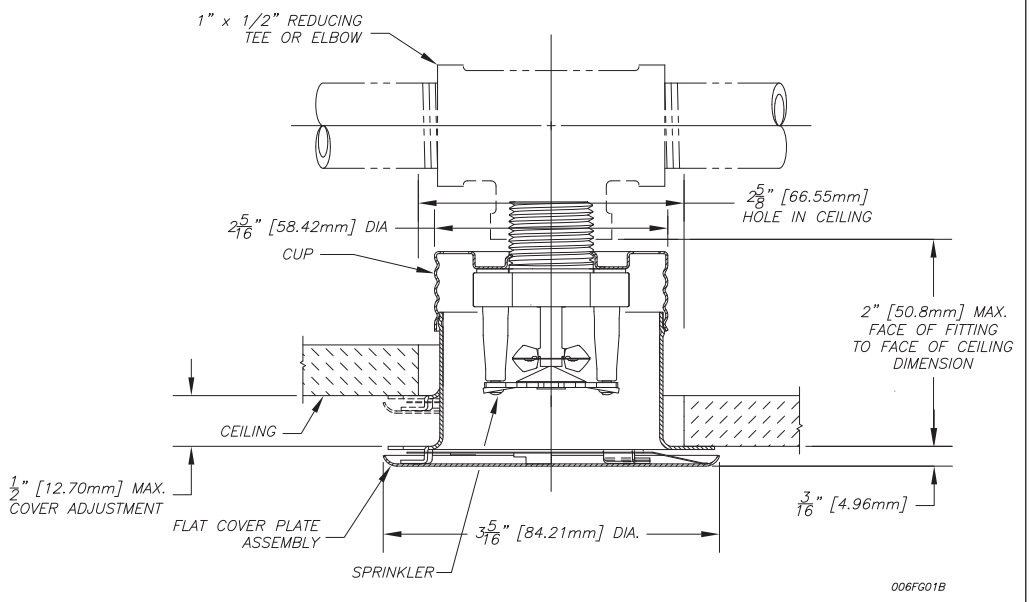
1. Sprinkler Model
2. Cover Plate Finish
3. Thread-On or Push-On Feature

Cover Plate Finishes[1]

Standard Finishes
Chrome
White Paint
Special Application Finishes[2]
Bright Brass
Finished Bronze
Black Plating
Black Paint
Off White
Satin Chrome

[1] Other finishes and colors are available on special order. Consult factory for details. Coverplate custom paint is semi-gloss, unless specified otherwise.

[2] For the perforated style coverplate, consult factory for availability on these and other custom finishes.



COVER PLATE: 1/2" [12.7mm] ADJUSTMENT

Reliable...For Complete Protection

Reliable offers a wide selection of sprinkler components. Following are some of the many precision-made Reliable products that guard life and property from fire around the clock.

- Automatic sprinklers
- Flush automatic sprinklers
- Recessed automatic sprinklers
- Concealed automatic sprinklers
- Adjustable automatic sprinklers
- Dry automatic sprinklers
- Intermediate level sprinklers
- Open sprinklers
- Spray nozzles
- Alarm valves
- Retarding chambers
- Dry pipe valves
- Accelerators for dry pipe valves
- Mechanical sprinkler alarms
- Electrical sprinkler alarm switches
- Water flow detectors
- Deluge valves
- Detector check valves
- Check valves
- Electrical system
- Sprinkler emergency cabinets
- Sprinkler wrenches
- Sprinkler escutcheons and guards
- Inspectors test connections
- Sight drains
- Ball drips and drum drips
- Control valve seals
- Air maintenance devices
- Air compressors
- Pressure gauges
- Identification signs
- Fire department connection

The equipment presented in this bulletin is to be installed in accordance with the latest published Standards of the National Fire Protection Association, Factory Mutual Research Corporation, or other similar organizations and also with the provisions of governmental codes or ordinances whenever applicable. Products manufactured and distributed by Reliable have been protecting life and property for over 90 years, and are installed and serviced by the most highly qualified and reputable sprinkler contractors located throughout the United States, Canada and foreign countries.

Manufactured by

Reliable®

The Reliable Automatic Sprinkler Co., Inc.
(800) 431-1588 Sales Offices
(800) 848-6051 Sales Fax
(914) 829-2042 Corporate Offices
www.reliablesprinkler.com Internet Address

Recycled Paper

Revision lines indicate updated or new data.

EG. Printed in U.S.A. 05/12 P/N 9999970261

Bulletin 135 Rev. H

Model F1 Residential Sprinklers for Design Density of .05 gpm/ft²

Model F1 Res Sprinklers engineered for the lowest flows to meet the minimum design density of .05 gpm/ft²

Types:

1. F1 Res 30 Pendent
2. F1 Res 30 Recessed Pendent/F2
3. F1 Res 30 Recessed Pendent/FP
4. F1 Res 49 Pendent
5. F1 Res 49 Recessed Pendent/F1
6. F1 Res 49 Recessed Pendent/FP
7. F1 Res 58 Pendent
8. F1 Res 58 Recessed Pendent/F1
9. F1 Res 58 Recessed Pendent/FP
10. F1 Res 76 Pendent
11. F1 Res 76 Recessed Pendent/F1
12. F1 Res 76 Recessed Pendent/FP
13. F1 Res 30 CCP Pendent
14. F1 Res 49 CCP Pendent
15. F1 Res 58 CCP Pendent
16. F1 Res 76 CCP Pendent
17. F1 Res 44 HSW
18. F1 Res 44 Recessed HSW/F2
19. F1 Res 58 HSW
20. F1 Res 58 HSW Recessed HSW/F2
21. F1 Res 44 SWC

Listings & Approvals

1. Listed by Underwriters Laboratories Inc. and UL Certified for Canada (cULus)
2. NYC MEA 258-93-E

Slope Ceiling Approvals: Refer to Bulletin 035

Sprinklers for .10 Density: Refer to Bulletin 176

UL Listing Category

Residential Automatic Sprinkler

UL Guide Number

VKKW

Patents

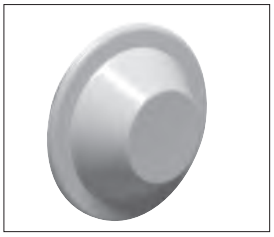
US Patent No. 6,516,893 applies to the Model F1 Res 49 & 58 Pendent Sprinklers

Product Description

Model F1 Res Pendent sprinklers (Figs. 1, 2, 3, & 4) are fast response sprinklers combining excellent durability, high sensitivity glass-bulb and low profile decorative design. The F1 Res Horizontal Sidewall sprinklers (Figs. 5, 6 & 7) are equally attractive when above ceiling piping cannot be used.

F1 Res 30, 49, 58 & 76 Recessed Pendent / F1

F1 Res 30, 49, 58 & 76 Recessed Pendent / FP



F1 Res 30, 49, 58 & 76 CCP Pendent

F1 Res 44 & 58 Recessed HSW/F2

F1 Res 44 SWC

The 3mm glass-bulb pendent sprinklers permit the efficient use of residential water supplies for sprinkler coverage in residential fire protection design.

The low flow F1 Res sprinklers are specially engineered for fast thermal response to meet the sensitive fire protection application needs of the latest residential market standards (UL 1626 Standard). Upon fire conditions, rising heat causes a sprinkler's heat-sensitive glass-bulb to shatter, releasing the waterway for water flow onto the deflector, evenly distributing the discharged water to control a fire.

Technical Data:

- Thermal Sensor: Nominal 3mm glass-bulb
- Sprinkler Frame : Brass Casting
- Sprinklers' Pressure Rating : 175 psi
  Factory Hydrostatically Tested to 500 psi
- Thread Size: ½" NPT (R½)
- K-Factor: 3.0 (Actual) - F1 Res 30 Pendent Sprinkler
  4.9 (Actual) - F1 Res 49 Pendent Sprinkler
  5.8 (Actual) - F1 Res 58 Pendent & HSW Sprinkler
  7.6 (Actual) - F1 Res 76 Pendent Sprinkler
  4.4 (Actual) - F1 Res 44 HSW Sprinkler
- Density: Minimum 0.05 gpm/ft²

Application

Model F1 Res Sprinklers are used for Residential Fire Protection according to UL 1626 Standard*. Be sure that orifice size, temperature rating, deflector style and sprinkler type are in accordance with the latest published standards of The National Fire Protection Association or the approving authority having jurisdiction.

Installation

Models F1 Res sprinklers are to be installed as shown. Model F1, F2 and FP Escutcheons, illustrated herewith, are the only recessed escutcheons to be used with Model F1 Res sprinklers. Use of any other recessed escutcheon will void all approvals and warranties. For installing Model F1 Res Pendent sprinklers use only the Model D sprinkler

- **Model F1 Res 30, 49, 58 & 76 Pendent**

- **Model F1 Res 30 Recessed Pendent / F2**
- **Model F1 Res 49, 58 & 76 Recessed Pendent / F1**

F1 escutcheon, $^{3}/_{4}$" (19mm) adjustment

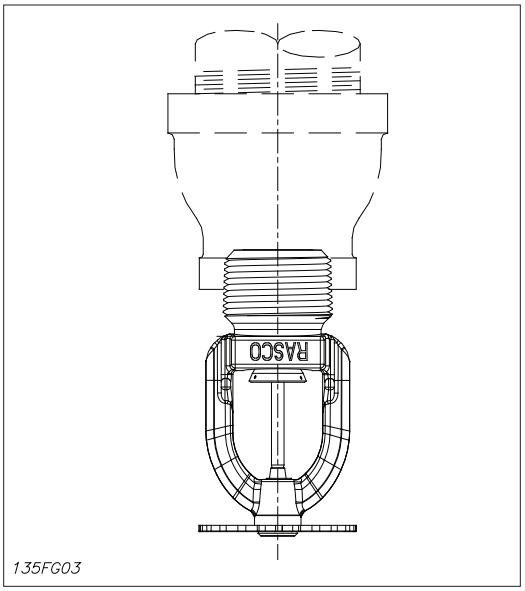


Fig. 1

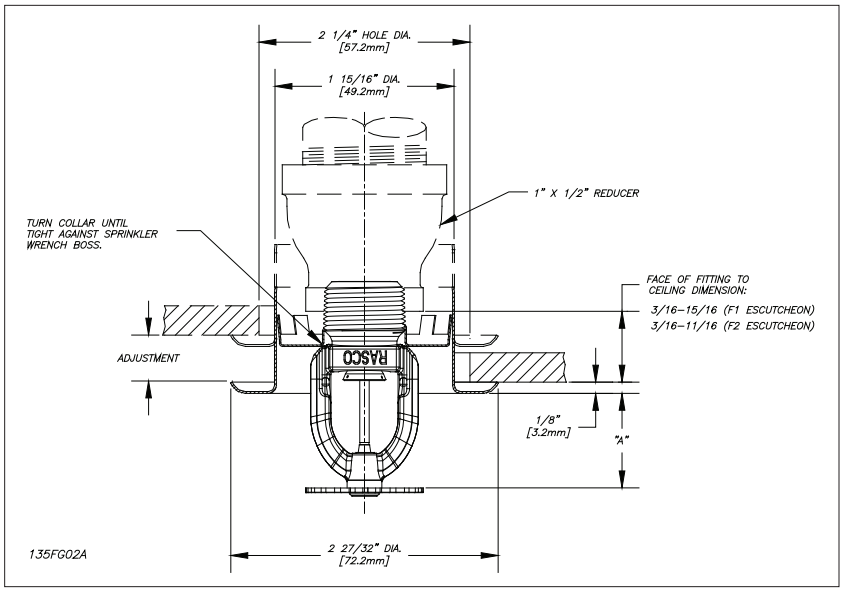


Fig. 2

Wrench; for installing Models F1 Res Recessed Pendent, CCP & SWC sprinklers use only the Model GFR2 sprinkler wrench; for installing Model F1 Res Recessed HSW sprinklers use only the Model GFR2 Sprinkler Wrench. Use of wrenches other than those specified may damage these sprinklers. Install F1 Res 44 with a ceiling to deflector distance of 4" - 12". Flow arrow on deflector must point away from near wall and "Top" marking must face ceiling.

Escutcheon*, F1 or F2, Data:

Type	Adjustment Inch (mm)	"A" Inch (mm)	Face of fitting to ceiling Inch (mm)
F1	3/4 (19.0)	Min.=$^{3}/_{4}$" (19.1) Max.=1$^{1}/_{2}$" (38.1)	$^{3}/_{16}$ - $^{15}/_{16}$ (4.7 - 24.0)
F2	1/2 (12.7)	Min.=$^{15}/_{16}$" (23.8) Max.=1$^{1}/_{2}$" (38.1)	$^{3}/_{16}$ - $^{11}/_{16}$ (4.7 - 17.4)

*** Note:** Escutcheons F1 or F2 may be used with Model F1 Res 49, 58 & 76 Recessed Pendent Sprinkler

Technical Data: F1Res 30 Pendent and Recessed Pendent

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		Actual K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	21/64" (8.2)	155 175	68 79	175 (12)	100	38	3.0	2.25 (57)

Deflector - to - ceiling
Maximum 1" (25mm) to 4" (100mm)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	8 (30.3)	7.0 (0,48)	R3511
14 x 14 (4,3 x 4,3)	10 (37.8)	11 (0,76)	

Technical Data: F1Res 49 Pendent and Recessed Pendent.

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		Actual K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	7/16" (11)	155 175	68 79	175 (12)	100 150	38 66	4.9	2.25 (57)

Deflector - to - ceiling
Maximum 1" (25mm) to 4" (100mm)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	13 (49)	7.0 (0,48)	R3516
14 x 14 (4,3 x 4,3)	13 (49)	7.0 (0,48)	
16 x 16 (4,9 x 4,9)	13 (49)	7.0 (0,48)	
18 x 18 (5,5 x 5,5)	17 (64.3)	12.0 (0,83)	
20 x 20 (6,1 x 6,1)	20 (75.7)	16.7 (1,14)	

Deflector - to - ceiling
Maximum 4" (100mm) to 8" (203mm)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	15 (57)	9.4 (0,65)	R3516
14 x 14 (4,3 x 4,3)	16 (60.5)	10.6 (0,73)	
16 x 16 (4,9 x 4,9)	17 (64.3)	12.0 (0,83)	
18 x 18 (5,5 x 5,5)	19 (72)	15.0 (1,0)	
20 x 20 (6,1 x 6,1)	22 (83.2)	20.2 (1,4)	

***Note:** The F1 Res 49 pendent and recessed pendent residential sprinklers can be installed per NFPA 13 in beamed ceilings meeting the following criteria:

1. Maximum beam depth = 7" (178mm)
2. Beam spacing at or greater than 7.5 ft. (2.3m) on center.

Technical Data: F1Res 58 Pendent and Recessed Pendent.

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		Actual K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	½" (13)	155 175	68 79	175 (12)	100 150	38 66	5.8	2.25 (57)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Ceiling -to- Deflector Inch (mm)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	16 (61)	7.6 (0,53)	1- 4 (25 - 100)	R3513
14 x 14 (4,3 x 4,3)	16 (61)	7.6 (0,53)		
16 x 16 (4,9 x 4,9)	16 (61)	7.6 (0,53)		
18 x 18 (5,5 x 5,5)	19 (72)	10.8 (0,75)		
20 x 20 (6,1 x 6,1)	22 (83.3)	14.4 (1,0)		

Technical Data: F1 Res 76 Pendent and Recessed Pendent

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating °F	Sprinkler Temp. Rating °C	Max. Pressure psi (bar)	Max. Ambient Temp. °F	Max. Ambient Temp. °C	K Factor	Sprinkler Length Inch (mm)
3/4" NPT (R½)	17/32" (13.5)	155 175	68 79	175 (12)	100 150	38 66	7.6	2.25 (57)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	21 (79.5)	7.6 (0,53)	R7618
14 x 14 (4,3 x 4,3)	21 (79.5)	7.6 (0,53)	
16 x 16 (4,9 x 4,9)	21 (79.5)	7.6 (0,53)	
18 x 18 (5,5 x 5,5)	21 (79.5)	7.6 (0,53)	
20 x 20 (6,1 x 6,1)	23 (87.1)	9.2 (0,63)	

- **Model F1 Res 30, 49, 58 & 76 CCP Pendent**

- **Model F1 Res 30, 49, 58 & 76 Recessed Pendent / FP**

FP push-on/thread-off escutcheon

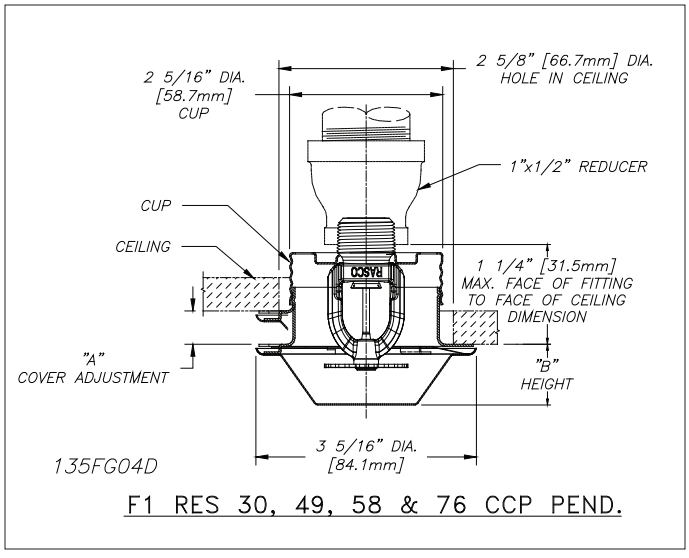


Fig. 3

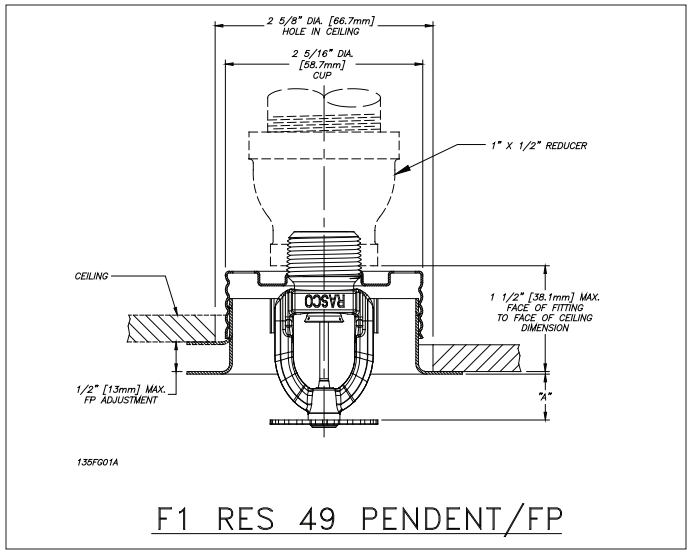


Fig. 4

Note: The F1 Res 76 will use a 1" x ¾" reducer.

Technical Data: F1Res 30 CCP Pendent and Recessed Pendent/FP

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating °F	Sprinkler Temp. Rating °C	CCP Assembly Temp. Rating °F	CCP Assembly Temp. Rating °C	Max. Pressure psi (bar)	Max. Ambient Temp. °F	Max. Ambient Temp. °C	K Factor	Sprinkler Length Inch (mm)
½" NPT (R½)	21/64" (8.2)	155	68	135	57	175 (12)	100	38	3.0	2.25 (57)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	8 (30.3)	7.0 (0,48)	R3511
14 x 14 (4,3 x 4,3)	11 (41.6)	13.4 (0,92)	

Technical Data: F1Res 49 CCP Pendent and Recessed Pendent/FP

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating °F	Sprinkler Temp. Rating °C	CCP Assembly Temp. Rating °F	CCP Assembly Temp. Rating °C	Max. Pressure psi (bar)	Max. Ambient Temp. °F	Max. Ambient Temp. °C	K Factor	Sprinkler Length Inch (mm)
½" NPT (R½)	7/16" (11)	155	68	135	57	175 (12)	100	38	4.9	2.25 (57)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	13 (49)	7.0 (0,48)	R3516
14 x 14 (4,3 x 4,3)	13 (49)	7.0 (0,48)	
16 x 16 (4,9 x 4,9)	14 (53)	8.2 (0,56)	
18 x 18 (5,5 x 5,5)	18 (68.1)	13.5 (0,93)	
20 x 20 (6,1 x 6,1)	20 (75.7)	16.7 (1,14)	

CCP Options Data:

"A" Cover Adjustment Inch (mm)	"B" CCP Height Inch (mm)
1/2 (12.7)	15/16 (24)
5/16 (7.9)	3/4 (19)

FP Data "A":

FP Position	"A" Inch (mm)
Max. Recessed	7/16 (11)
Min. Recessed	15/16 (24)

Note: Sprinklers shown in Fig. 3 and Fig. 4 are not suitable for installation in ceilings which have positive pressure in the space above.

Technical Data: F1Res 58 CCP Pendent and Recessed Pendent/FP

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating °F	Sprinkler Temp. Rating °C	CCP Assembly Temp. Rating °F	CCP Assembly Temp. Rating °C	Max. Pressure psi (bar)	Max. Ambient Temp. °F	Max. Ambient Temp. °C	K Factor	Sprinkler Length Inch (mm)
½" NPT (R½)	1/2" (13)	155	68	135	57	175 (12)	100	38	5.8	2.25 (57)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	16 (61)	7.6 (0,53)	R3513
14 x 14 (4,3 x 4,3)	16 (61)	7.6 (0,53)	
16 x 16 (4,9 x 4,9)	16 (61)	7.6 (0,53)	
18 x 18 (5,5 x 5,5)	19 (72)	10.8 (0,75)	
20 x 20 (6,1 x 6,1)	22 (83.3)	14.4 (1,0)	

Technical Data: F1Res 76 CCP Pendent and Recessed Pendent/FP

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating °F	Sprinkler Temp. Rating °C	CCP Assembly Temp. Rating °F	CCP Assembly Temp. Rating °C	Max. Pressure psi (bar)	Max. Ambient Temp. °F	Max. Ambient Temp. °C	K Factor	Sprinkler Length Inch (mm)
3/4" NPT (R3/4)	17/32" (13.5)	155 175	68 79	135	57	175 (12)	100 150	38 66	7.6	2.25 (57)

Max. Sprinkler Spacing ft (m)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	21 (79.5)	7.6 (0,53)	R7618
14 x 14 (4,3 x 4,3)	21 (79.5)	7.6 (0,53)	
16 x 16 (4,9 x 4,9)	21 (79.5)	7.6 (0,53)	
18 x 18 (5,5 x 5,5)	22 (83.3)	8.4 (0,58)	
20 x 20 (6,1 x 6,1)	25 (94.6)	10.8 (0,74)	

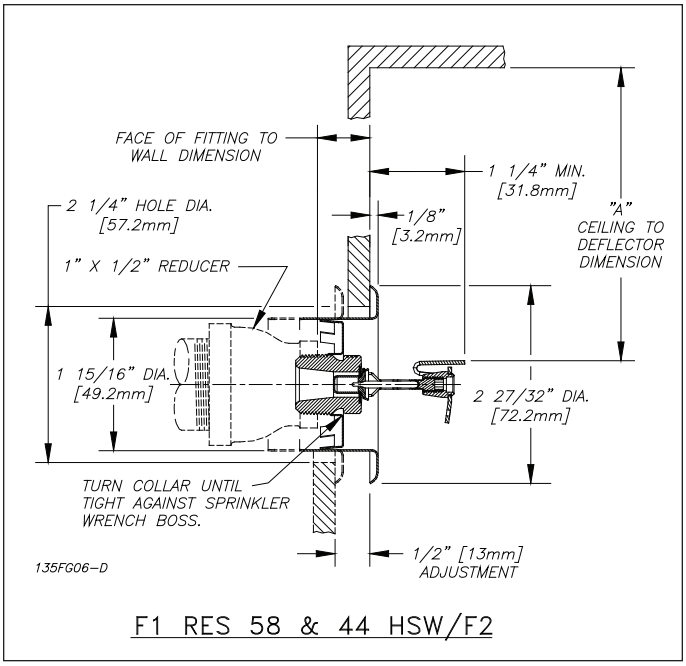
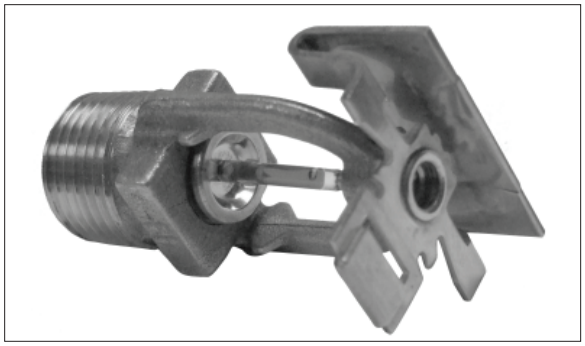
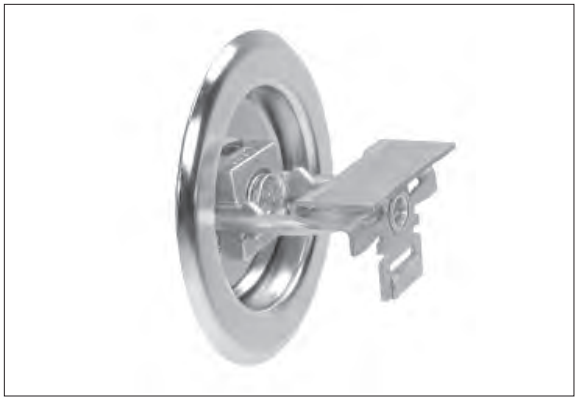


Fig. 5

- **Model F1 Res 44 & 58 HSW**



- **Model F1 Res 44 & 58 Recessed HSW/F2**



F2 escutcheon,
1/2" (13mm) adjustment

Technical Data: F1Res 44 HSW & HSW/F2

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	⅜" (10)	155 175	68 79	175 (12)	100 150	38 66	4.4	2.45 (62)

Escutcheon, F2, Data:

Type	Adjustment Inch (mm)	Face of Fitting to wall Inch (mm)
F2	½ (13)	3/16 - 11/16 (4.7 - 17.4)

Max. Sprinkler Spacing ft (m)	"A" Ceiling to Deflector Inch (mm)	Sprinkler Temp. Rating °F (°C)		Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	4 - 6 (101 - 152)	155 (68)	175 (79)	12 (45,4)	7.5 (0,52)	R3531
14 x 14 (4,3 x 4,3)		155 (68)	175 (79)	14 (53,0)	10.2 (0,71)	
16 x 16 (4,9 x 4,9)		155 (68)	175 (79)	16 (60,6)	13.3 (0,92)	
16 x 18 (4,9 x 5,5)		155 (68)	175 (79)	18 (68,1)	16.8 (1,16)	
18 x 18 (5,5 x 5,5)		155 (68)	175 (79)	19 (72,0)	18.7 (1,29)	
16 x 20 (4,9 x 6,1)		155 (68)	175 (79)	23 (87,1)	27.4 (1,89)	
12 x 12 (3,6 x 3,6)	6 - 12 (152 - 305)	155 (68)	175 (79)	14 (53,0)	10.2 (0,71)	
14 x 14 (4,3 x 4,3)		155 (68)	175 (79)	16 (60,6)	13.3 (0,92)	
16 x 16 (4,9 x 4,9)		155 (68)	175 (79)	17 (64,4)	15.0 (1,04)	
16 x 18 (4,9 x 5,5)		155 (68)	175 (79)	20 (75,7)	20.7 (1,43)	
16 x 20 (4,9 x 6,1)		155 (68)	175 (79)	23 (87,1)	27.4 (1,89)	

Technical Data: F1Res 58 HSW & HSW/F2

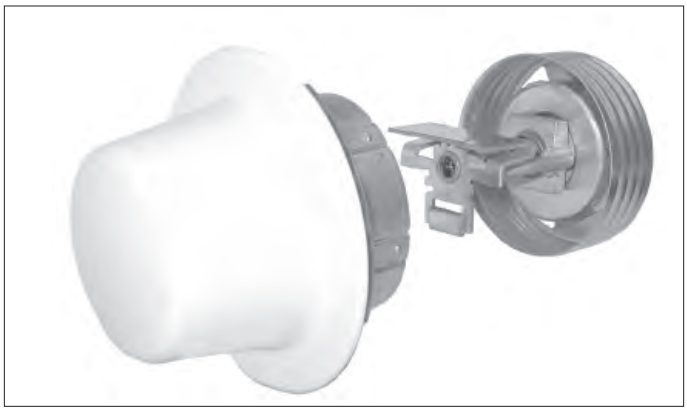
Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		K Factor	Sprinkler Length Inch (mm)
		°F	°C		°F	°C		
½" NPT (R½)	½" (13)	155 175	68 79	175 (12)	100 150	38 66	5.8	2.45 (62)

Escutcheon, F2, Data:

Type	Adjustment Inch (mm)	Face of Fitting to wall Inch (mm)
F2	½ (13)	3/16 - 11/16 (4.7 - 17.4)

Max. Sprinkler Spacing ft (m)	"A" Ceiling to Deflector Inch (mm)	Sprinkler Temp. Rating °F (°C)		Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	4 - 6 (101 - 152)	155 (68)	175 (79)	16 (60,6)	7.6 (0,53)	R3533
14 x 14 (4,3 x 4,3)		155 (68)	175 (79)	18 (68,2)	9.7 (0,67)	
16 x 16 (4,9 x 4,9)		155 (68)	175 (79)	21 (79,5)	13.2 (0,91)	
16 x 18 (4,9 x 5,5)		155 (68)	175 (79)	25 (94,7)	18.6 (1,28)	
16 x 20 (4,9 x 6,1)		155 (68)	175 (79)	29 (109,8)	25 (1,73)	
12 x 12 (3,6 x 3,6)	6 - 12 (152 - 305)	155 (68)	175 (79)	22 (83,3)	14.4 (1,0)	
14 x 14 (4,3 x 4,3)		155 (68)	175 (79)	22 (83,3)	14.4 (1,0)	
16 x 16 (4,9 x 4,9)		155 (68)	175 (79)	26 (98,4)	20.1 (1,39)	
16 x 18 (4,9 x 5,5)		155 (68)	175 (79)	31 (117,4)	28.6 (1,97)	

- **Model F1 Res 44 SWC**



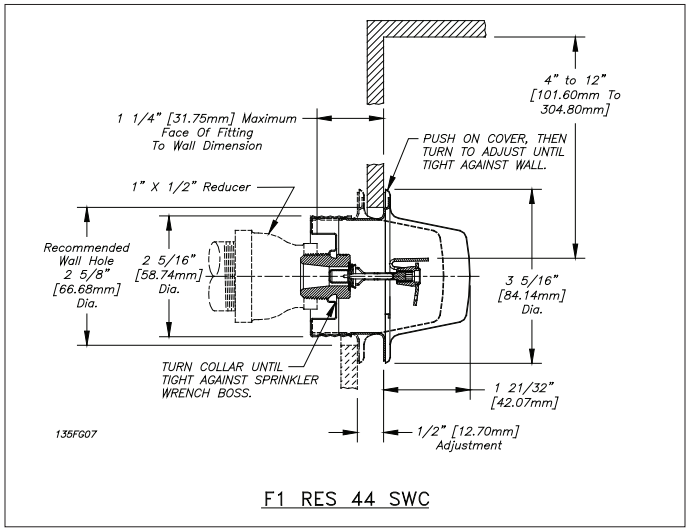


Fig. 6

Technical Data: F1Res 44 SWC

Thread Size	Nominal Orifice Inch (mm)	Sprinkler Temp. Rating		Cover Temp. Rating		Max. Pressure psi (bar)	Max. Ambient Temp.		K Factor	Sprinkler Length Inch (mm)
		°F	°C	°F	°C		°F	°C		
½" NPT (R½)	3/8" (10)	155	68	135	57	175 (12)	100	38	4.4	2.45 (62)

Max. Sprinkler Spacing ft (m)	"A" Ceiling to Deflector Inch (mm)	Flow gpm (Lpm)	Pressure psi (bar)	Sprinkler Identification Number (SIN)
12 x 12 (3,6 x 3,6)	4 - 6 (101 - 152)	13 (49,2)	8.7 (0,60)	R3531
14 x 14 (4,3 x 4,3)		14 (53,0)	10.2 (0,71)	
16 x 16 (4,9 x 4,9)		17 (64,3)	15.0 (1,1)	
16 x 18 (4,9 x 5,5)		19 (71,8)	18.7 (1,13)	
16 x 20 (4,9 x 6,1)		23 (87,1)	27.4 (1,89)	
12 x 12 (3,6 x 3,6)	6 - 12 (152 - 305)	14 (52,9)	10.2 (0,71)	
14 x 14 (4,3 x 4,3)		15 (56,7)	11.7 (0,81)	
16 x 16 (4,9 x 4,9)		18 (68,1)	16.8 (1,16)	
16 x 18 (4,9 x 5,5)		20 (75,6)	20.7 (1,43)	

Maintenance

Model F1 Res 30, 49, F1 Res 58, F1 Res 76 and F1 Res 44 Sprinklers should be inspected quarterly, and the sprinkler system maintained in accordance with NFPA 25, 13, 13D, and 13R. Do not clean sprinkler with soap and water, Ammonia or any other cleaning fluids. Remove dust by using a soft brush or gentle vacuuming. Remove any sprinkler which has been painted (other than factory applied) or damaged in any way. A stock of spare sprinklers should be maintained to allow quick replacement of damaged or operated sprinklers. Prior to installation, sprinklers should remain in the original cartons and packaging until used. This will minimize the potential for damage to sprinklers that could cause improper operation or non-operation.

Model F1 Res 30, 49 & 58 Pendent Sprinkler Specifications

Sprinklers shall be [cULus Listed] [New York City MEA Approved (258-93-E)] low flow residential pendent sprinklers engineered to provide a minimum design density of 0.05 gpm/ft^2 over the listed coverage area. Listed flows as specified by the manufacturer's technical data sheets are to be used. Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Where pendent residential sprinklers are installed under sloped ceilings having a pitch from [4/12] to [8/12], the sprinklers shall be listed for such use. Deflector-to-ceiling distance listing shall be 1" to 8" maximum. Sprinkler frame and deflector shall be of bronze frame construction having a ½" NPT thread. Water seal assembly shall consist of a Teflon-coated Belleville spring washer with top-loaded extruded or cold head cup with 3 mm glass bulb containing no plastic parts, and having a temperature rating of [155°F (68°C)] [175°F (79°C)]. Sprinklers shall have a nominal K-factor of 3.0, 4.9 and 5.8. Standard finish: [Bronze] [Chrome-plated] [White Polyester] [Special finish– specify]. Residential pendent sprinklers shall be Reliable Model F1 Res 30, 49 & 58, SIN R3511, R3516 & R3513 (Bulletin 135).

Model F1 Res 49 & 58 Recessed Pendent/F1, Model F1 Res 30, 49 & 58 Recessed Pendent/F2, Model F1 Res 30, 49 & 58 Recessed Pendent/FP

Sprinklers shall be [cULus Listed] [New York City MEA Approved (258-93-E)] low flow residential recessed pendent sprinklers engineered to provide a minimum design density of 0.05 gpm/ft^2 over the listed coverage area. Listed flows as specified by the manufacturer's technical data sheets are to be used. Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Where pendent residential sprinklers are installed under sloped ceilings having a pitch from [4/12] to [8/12], the sprinklers shall be listed for such use. Deflector-to-ceiling distance listing shall be 1" to 8" maximum. Sprinkler frame and deflector shall be of bronze frame construction having a ½" NPT thread. Water seal assembly shall consist of a Teflon-coated Belleville spring washer with top-loaded extruded or cold head cup with 3 mm glass bulb containing no plastic parts, and having a temperature rating of [155°F (68°C)] [175°F (79°C)]. Sprinklers shall have a nominal K-factor of 3.0, 4.9 & 5.8. Standard finish: [Bronze] [Chrome-plated] [White Polyester] [Special finish– specify]. Recessed escutcheon assembly shall be a steel, two-piece escutcheon [with ½" adjustment (Model F2)] [with ¾" adjustment (Model F1)] [of push-on and thread off design with ½" adjustment (Model FP)]. Standard finish shall be [brass][bright chrome] [white painted]. Residential recessed pendent sprinklers shall be Reliable [Model F1 Res 30, 49 & 58 Recessed Pendent/F1] [Model F1 Res 30, 49 & 58 Recessed Pendent/F2] [Model F1 Res 30, 49 & 58 Recessed Pendent/FP] SIN R3511, R3516 & R3513 (Bulletin 135).

Model F1 Res 30, 49 & 58 CCP Pendent (Concealed)

Sprinklers shall be [cULus Listed] [New York City MEA Approved (258-93-E)] low flow residential concealed sprinklers engineered to provide a minimum design density of 0.05 gpm/ft^2 over the listed coverage area. Listed flows as specified by the manufacturer's technical data sheets are to be used. Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Where pendent residential sprinklers are installed under sloped ceilings having a pitch from [4/12] to [8/12], the sprinklers shall be listed for such use. Sprinkler frame and deflector shall be of bronze frame construction having a ½" NPT thread. Water seal assembly shall consist of a Teflon-coated Belleville spring washer with top-loaded extruded or cold head cup with 3 mm glass bulb containing no plastic parts, and having a temperature rating of 155°F (68°C). Cover plate assembly shall consist of a brass cover plate and copper alloy retainer flange. Method of attaching the cover plate to the sprinkler cup shall be a push-on and thread-off design allowing a ½" cover plate adjustment. Cover plate temperature rating shall be 135°F (57°C). A plastic protective cap shall be provided and factory installed inside the sprinkler cup to protect the sprinkler from damage, which could occur during construction before the cover plate is installed. Standard cover plate finish: [White] [Custom Color– specify].]. Concealed pendent sprinklers shall be Reliable Model F1 Res 30, 49 & 58 CCP, SIN R3511, R3516 & R3513 (Bulletin 135).

Model F1 Res 44 Horizontal Sidewall Residential Sprinkler Specifications

Sprinklers shall be [cULus Listed] [New York City MEA Approved (258-93-E)] low flow residential horizontal sidewall sprinklers engineered to provide a minimum design density of 0.05 gpm/ft^2 over the listed coverage area. Listed flows as specified by the manufacturer's technical data sheets are to be used. Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Where horizontal sidewall residential sprinklers are installed under sloped ceilings having a pitch from [4/12] to [8/12], the sprinklers shall be listed for such use. Sprinkler frame and deflector shall be of bronze frame construction having a ½" NPT thread. Water seal assembly shall consist of a Teflon-coated Belleville spring washer with top-loaded extruded or cold head cup with 3 mm glass bulb containing no plastic parts, and having a temperature rating of [155°F (68°C)] [175°F (79°C)]. Sprinklers shall have a nominal K-factor of 4.4 (62.8). Standard finish: [Bronze] [Chrome-plated] [White Polyester] [Special finish– specify]. Residential horizontal sidewall sprinklers shall be Reliable Model F1 Res 44, SIN R3531 (Bulletin 135).

Model F1 Res 44 Recessed Horizontal Sidewall Sprinkler

Use description for the Model F1 Res 44 horizontal sidewall sprinkler with the following modifications: Replace "horizontal sidewall sprinkler" with "recessed horizontal sprinkler." Add: Recessed escutcheon assembly shall be a steel, two-piece escutcheon with ½" adjustment (Model F2). Standard finish shall be [brass][bright chrome] [white painted] [Special finish– specify]. Residential recessed horizontal sidewall sprinklers shall be Reliable Model F1 Res 44/F2, SIN R3531 (Bulletin 135).

Model F1 Res 76 Pendent

Sprinklers shall be [cULus Listed] low flow residential pendent sprinklers engineered to provide a minimum design density of 0.05 gpm/ft^2 over the listed coverage area. Listed flows as specified by the manufacturer's technical data sheets are to be used. Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Sprinkler frame and deflector shall be of bronze frame construction having a ¾" NPT thread. Water seal assembly shall consist of a Teflon-coated Belleville spring washer with machined or cold head cup with 3 mm glass bulb containing no plastic parts, and having a temperature rating of [155°F (68°C)] [175°F (79°C)]. Sprinklers shall have a nominal K-factor of 7.6. Standard finish: [Bronze] [Chrome-plated] [White Polyester] [Special finish– specify]. Residential pendent sprinklers shall be Reliable Model F1 Res 76, SIN R7618 (Bulletin 135).

Model F1 Res 76 Recessed Pendent/F1, Model F1 Res 76 Recessed Pendent/F2, Model F1 Res 76 Recessed Pendent/FP

Sprinklers shall be [cULus Listed] low flow residential recessed pendent sprinklers engineered to provide a minimum design density of 0.05 gpm/ft^2 over the listed coverage area. Listed flows as specified by the manufacturer's technical data sheets are to be used. Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Sprinkler frame and deflector shall be of bronze frame construction having a ¾" NPT thread. Water seal assembly shall consist of a Teflon-coated Belleville spring washer with machined or cold head cup with 3 mm glass bulb containing no plastic parts, and having a temperature rating of [155°F (68°C)] [175°F (79°C)]. Sprinklers shall have a nominal K-factor of 7.6. Standard finish: [Bronze] [Chrome-plated] [White Polyester] [Special finish– specify]. Recessed escutcheon assembly shall be a steel, two-piece escutcheon [with ½" adjustment (Model F2)] [with ¾" adjustment (Model F1)] [of push-on and thread off design with ½" adjustment (Model FP)]. Standard finish shall be [brass][bright chrome] [white painted]. Residential recessed pendent sprinklers shall be Reliable [Model F1 Res 76 Recessed Pendent/F1] [Model F1 Res 76 Recessed Pendent/F2] [Model F1 Res 76 Recessed Pendent/FP] SIN R7618 (Bulletin 135).

Model F1 Res 76 CCP Pendent (Concealed)

Sprinklers shall be [cULus Listed] low flow residential concealed sprinklers engineered to provide a minimum design density of 0.05 gpm/ft^2 over the listed coverage area. Listed flows as specified by the manufacturer's technical data sheets are to be used. Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Sprinkler frame and deflector shall be of bronze frame construction having a ¾" NPT thread. Water seal assembly shall consist of a Teflon-coated Belleville spring washer with machined or cold head cup with 3 mm glass bulb containing no plastic parts, and having a temperature rating of 155°F (68°C). Cover plate assembly shall consist of a brass cover plate and copper alloy retainer flange. Method of attaching the cover plate to the sprinkler cup shall be a push-on and thread-off design allowing a ½" cover plate adjustment. Cover plate temperature rating shall be 135°F (57°C). A plastic protective cap shall be provided and factory installed inside the sprinkler cup to protect the sprinkler from damage, which could occur during construction before the cover plate is installed. Standard cover plate finish: [White] [Custom Color– specify].]. Concealed pendent sprinklers shall be Reliable Model F1 Res 76 CCP, SIN R7618 (Bulletin 135).

Finishes [1]

Standard Finishes		
Sprinkler	**F1, F2, FP Escutcheons**	**Cover Plates**
Bronze Chrome Plated White and Black Polyester Coated	Brass Bright Chrome Plated White Painted	White Painted Chrome
Special Application Finishes		
Sprinkler	**F1, F2, Escutcheons**	**Cover Plates**
Bright Brass Black Plated Black Paint Off White Satin Chrome	Bright Brass Black Plated Black Paint Off White Satin Chrome	Bright Brass Black Plated Black Paint Off White Satin Chrome

[1] Other finishes and colors are available on special order. Consult factory for details.

Note: Paint or any other coating applied over the factory finish will void all approvals and warranties.

Ordering Information

Specify:

1. Sprinkler Model
2. Sprinkler Type
3. Temperature Rating
4. Sprinkler Finish
5. Escutcheon Finish
6. Cover Plate Finish

Reliable...For Complete Protection

Reliable offers a wide selection of sprinkler components. Following are some of the many precision-made Reliable products that guard life and property from fire around the clock.

- Automatic sprinklers
- Flush automatic sprinklers
- Recessed automatic sprinklers
- Concealed automatic sprinklers
- Adjustable automatic sprinklers
- Dry automatic sprinklers
- Intermediate level sprinklers
- Open sprinklers
- Spray nozzles
- Alarm valves
- Retarding chambers
- Dry pipe valves
- Accelerators for dry pipe valves
- Mechanical sprinkler alarms
- Electrical sprinkler alarm switches
- Water flow detectors
- Deluge valves
- Detector check valves
- Check valves
- Electrical system
- Sprinkler emergency cabinets
- Sprinkler wrenches
- Sprinkler escutcheons and guards
- Inspectors test connections
- Sight drains
- Ball drips and drum drips
- Control valve seals
- Air maintenance devices
- Air compressors
- Pressure gaugesIdentification signs
- Fire department connection

The equipment presented in this bulletin is to be installed in accordance with the latest published Standards of the National Fire Protection Association, Factory Mutual Research Corporation, or other similar organizations and also with the provisions of governmental codes or ordinances whenever applicable.

Productsmanufactured and distributed by Reliable have been protecting life and property for over 90 years, and are installed and serviced by the most highly qualified and reputable sprinkler contractors located throughout the United States, Canada and foreign countries.

Manufactured by

Reliable®

The Reliable Automatic Sprinkler Co., Inc.
(800) 431-1588 Sales Offices
(800) 848-6051 Sales Fax
(914) 829-2042 Corporate Offices
www.reliablesprinkler.com Internet Address

Recycled Paper

Revision lines indicate updated or new data.

EG. Printed in U.S.A 09/10 P/N 9999970235

Bulletin 204 Rev. V

Reliable®

- **Sprinkler Emergency Cabinets**
- **Sprinkler Escutcheons**

Sprinkler Emergency Cabinets

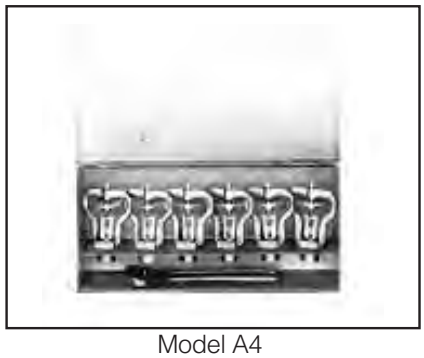
• Model A4

Designed to carry an emergency supply of sprinklers and a sprinkler wrench. Made of light weight steel with holes for mounting. These compact cabinets are finished in attractive red enamel and are furnished with knockouts to accommodate either ½" or ¾" sprinkler threads. The Model A4 Cabinets are available in the following sizes:

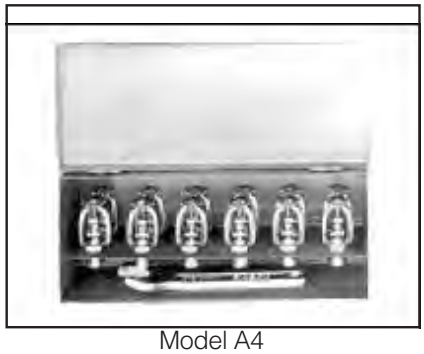
- 3 Capacity - For residential sprinklers in NFPA 13D and 13R systems
  5" high x 7 3/16" long x 2 3/8" deep.
  Locate wrench separately.
- 6 Capacity Standard - For ½" and ¾" NPT standard and large orifice sprinklers.
  5" high x 14" long x 2 3/8" deep.
- 6 Capacity Large - For ESFR, XLO and VELO Sprinklers.
  6 1/4" high x 14" long x 3 1/8" deep.
- 12 Capacity Standard - For ½" and ¾" NPT standard and large orifice sprinklers.
  5" high x 14" long x 4" deep.

Model A4
3 Capacity Residential

Model A4
6 Capacity Standard



Model A4
6 Capacity Large



Model A4
12 Capacity Standard

• Model A3

Model A3 Cabinets are designed to carry an emergency supply of decorative type sprinklers and an installation wrench. They are able to accommodate 12 Reliable Models G Recessed, G1, G4, G4FR, ZX or Model B Flush Sprinklers, and up to 6 sprinklers with a 1″ adjustable inlet.

Installation Data:

Size of Cabinet: 16 13/16" long x 14 1/4" high x 3 13/16" deep.
Size of Mounting Holes: ¼" diameter.
Spacing of Mounting Holes: 13½" length - 11" height.

Ordering Information

When ordering, specify Model (A4 or A3) and cabinet capacity size and type (Standard or Large). Sprinklers and sprinkler wrenches are to be ordered separately.

Sprinkler Escutcheons

These escutcheons enhance the appearance of installations by covering exposed fittings of automatic sprinkler systems that are visible beyond finished ceilings and walls. Furnished to accommodate NPT male pipe threads, escutcheons are held firmly in place by the sprinklers. The finishes provided are decorative and intended for indoor use.

Approvals

There are no UL Listings or FM Approvals associated with the Models A, B, and C one piece escutcheons or the Model HB two piece escutcheon. They may be used with any Reliable Sprinkler with the exception of recessed sprinklers which are listed together with their respective escutcheons. Refer to the appropriate technical bulletins for this information.

• Model B - One Piece

Available in steel with satin chrome, bright chrome and brass plated and white painted finishes. Inner fingers grip tightly to the sprinkler. Also available for 10mm sprinklers.

Diameter: 2⅞"; Depth: 1 1/16"; ½" NPT.

• Model C - One Piece

Available in steel with satin chrome, bright chrome and brass plated and white painted finishes. Inner fingers grip tightly to the sprinkler. Also available for 10mm sprinklers

Diameter: 2⅞"; Depth: ⅛"; ½" NPT.

• Model HB - Two Piece

Telescoping design permits up to 1" adjustment to compensate for variations in the distance that pipe couplings extend below ceilings. Made of steel and available in brass, chrome, satin nickel and off-white finishes.

Diameter: 3½"; Depth: 2" Min, 3" Max; ½" and ¾" NPT.

Manufactured by

Reliable®

The Reliable Automatic Sprinkler Co., Inc.

(800) 431–1588 Sales Offices
(800) 848–6051 Sales Fax
(914) 829–2042 Corporate Offices
www.reliablesprinkler.com Internet Address

Recycled Paper

Revision lines indicate updated or new data.
PG. Printed in U.S.A. 12/07 P/N 9999970035

RFP System

for

Residential Fire Protection

Specifically Designed for
NFPA 13D Applications

Quality & Service Since 1936

Specifically Designed for use in NFPA 13D Applications

General Air Products' **Residential Fire Protection Pump System** (RFP System) is the benchmark of quality for meeting current NFPA 13 D application requirements. Our RFP Systems deliver a wide variety of features & benefits that work together to meet the need of your application simply, efficiently and reliably.

RFP System Configurations

Contractors need a residential fire protection pump system that is easy to order, easy to install, and known for its reliability. Homeowners want a system that requires as little space and as little maintenance as possible while providing the safety and security they need.

General's RFP System addresses all of these needs and more. One of the ways we do this is by offering a variety of configurations - each utilizing an absolute minimum of space, easy to install, reliable and virtually maintenance free.

Open or Enclosed

Basic or Complete

Include Narrow Water Storage Tank

All RFP Systems are Completely Corrosion Resistant

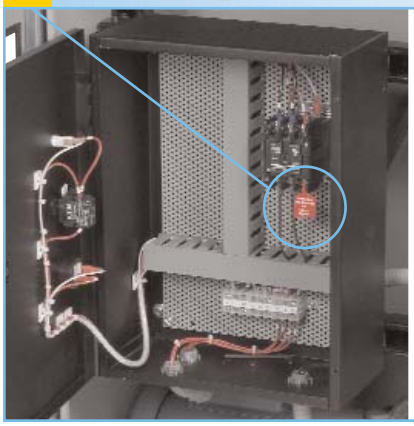
Basic Pump System

Unit Shown:
Enclosed Basic with 300 Gal. Tank

1. 29" Wide Narrow Water Tank
2. Stainless Steel Flex Hose (shipped loose)
3. Fill Valve (shipped loose)
4. Cut & Sealed Bulkhead Fittings
5. Stainless Steel TEFC Pump
6. NEMA Rated Control Box
7. "Power On" Indicator
8. Pump Test Button
9. Audible Alarm System
10. Alarm Signal Contact
11. Water Delivery Press. Gauge
12. DPDT Flow Switch
13. Non Ferrous Piping System
14. Adjustable Pressure Switch
15. Suction Line

Unit Shown:
Open Basic Stand-Alone

10 Alarm Signal Contact



The alarm signal contact allows contractors to wire the RFP System directly to an alarm bell or fire security system.

The alarm signal contact is one of many important, innovative features of the RFP System.

RFP System

Complete Pump System

Unit Shown:
Open Complete
with 300 Gal. Tank

1. 29" Wide Narrow Water Tank
2. Stainless Steel Flex Hoses (2)
3. Fill Valve (Built-in Float)*
4. Cut & Sealed Bulkhead Fittings
5. Stainless Steel TEFC Pump
6. Return Line for Testing
7. Tank Drain Valve
8. Pre-Piped for Instant Installation
9. Removable Inlet Connection
10. Alarm Signal Contact*
11. NEMA Rated Control Box
12. H-O-A Switch
13. "Power On" Indicator
14. "Pump On" Indicator
15. "Water Flow" Indicator
16. Motor Starter "Reset"
17. Audible Alarm System
18. Water Delivery Press. Gauge
19. DPDT Flow Switch
20. Non Ferrous Piping System
21. Adjustable Pressure Switch
22. Motor Overload Protection*
23. Fused Control Circuit*
24. System Drain Valve

** Features located internally*

5 Stainless Steel TEFC Pump

A standard feature on all of General's RFP Systems is a corrosion resistant Stainless Steel TEFC pump. The importance of non-ferrous components on a residential fire sprinkler system can not be overstated. Cast iron pumps and black iron fittings will corrode over time, and in the process potentially cause system failure.

All RFP Systems are Completely Corrosion Resistant.

- Stainless Steel TEFC Pump
- Non ferrous Piping
- Stainless Steel Hoses
- Many More Corrosion Resistant Components

Unit Shown:
Enclosed Complete
Stand-Alone

RFP System Accessories

Battery Backup *Power System*

General Air Products' Battery Back-up Power Systems are specifically designed to provide power to the RFP System in the event of a loss of power - ensuring that the fire protection system in the residence is fully functional at all times.

General's Battery Back-up Power System provides the maximum amount of system reliability making it the perfect solution for remote locations where reliable power supply is a problem.

- **Built-in charger and auto-switchover** guarantees your fire protection system will be ready during a power failure event.

- **Industrial duty stand** aids in the protection of the trickle charger and batteries.

- **Pre-formed cables** come standard to minimize field installation.

- **Standard units in 230v** but other voltages are available (consult factory).

RFP System Pump Selection

Use the chart below to select the correct pump horsepower for your system. For example, if your system has a flow of 30 gallons per minute (GPM) at 45 PSI the correct selection would be a 1 1/2 HP pump.

Gallons Per Minute								
		20	25	30	35	40	45	
Pressure	25	3/4	3/4	3/4	3/4	1	1 1/2	Pump HP
	30	3/4	3/4	3/4	1	1	1 1/2	
	35	3/4	1	1	1	1 1/2	2	
	40	1	1	1 1/2	1 1/2	1 1/2	2	
	45	1 1/2	1 1/2	1 1/2	2	2	2	
	50	1 1/2	1 1/2	2	2	2	5L	
	55	2	2	2	5L	5L	5L	
	60	3	3	5H	5H	5H	5H	
	65	5H	5H	5H	5H	5H	5H	
	70	5H	5H	5H	7 1/2	7 1/2	7 1/2	

All Information in this brochure is subject to change without notice. Consult factory for current information

Limited Warranty Statement

General Air Products, Inc. warrants its products to be free of defects in material and workmanship under normal use and service for 12 months from date of purchase. Our warranty applies only when such defective parts are returned to us, or our Authorized Service Depot, transportation prepaid, and subject to our inspection and approval.

Liability is limited to repair or replacement of material found defective, free of charge, F.O.B. our plant. Motors and pumps are covered by the original manufacturer's warranty only and should be returned by the customer to their authorized station for service. Unauthorized repairs or replacements will not be subject to factory warranty. This warranty is in lieu of all other warrants, expressed or implied.

Since 1936 General Air Products has offered our customers products of the highest quality. Through innovative engineering and without sacrifice of quality industrial components we continually deliver a five star level of excellence. We want you to expect nothing short of the best possible experience when you purchase any of our products.

Our sales staff is available to help you select the proper equipment to meet any unique application. Our production team and customer service representatives will ensure that your order is constructed to our five star standards and delivered on time. Once your unit is at the job site, our expert technical support staff is a phone call away and eager to assist you at each step of the installation process. After properly installed our quality assurance continues through the life of the product.

General Air Products, Inc. is proud of its role in providing quality equipment to the fire sprinkler contractor and its continued support of the fire protection industry.

General Air Products is the leading manufacturer of air compressors specifically designed for dry pipe and pre-action systems.

We offer a full line of compressors including oilless riser and tank mounted units, lubricated base and tank mounted units, air compressor accessories, and our FM Approved Dry Air Pac - designed for cold storage and freezer room applications.

SPEC CENTER

Attention Engineers and Designers

Be sure to visit the latest addition to our web site, General's Spec Center - specifically designed to make your job easier.

In the Spec Center you will find all the CAD (.DWG, .DXF), and Text (.DOC) files you need to add our complete line of air compressors to your specification booklet by simply cutting and pasting.

General Air Products, Inc.
118 Summit Drive
Exton, PA 19341

Phone: 610-524-8950
Fax: 610-524-8965

Call Toll Free 1-800-345-8207 or visit us on the web at www.GENERALAIRPRODUCTS.com

HPB-105
Effective 09/30/07
Revised 02/15/09

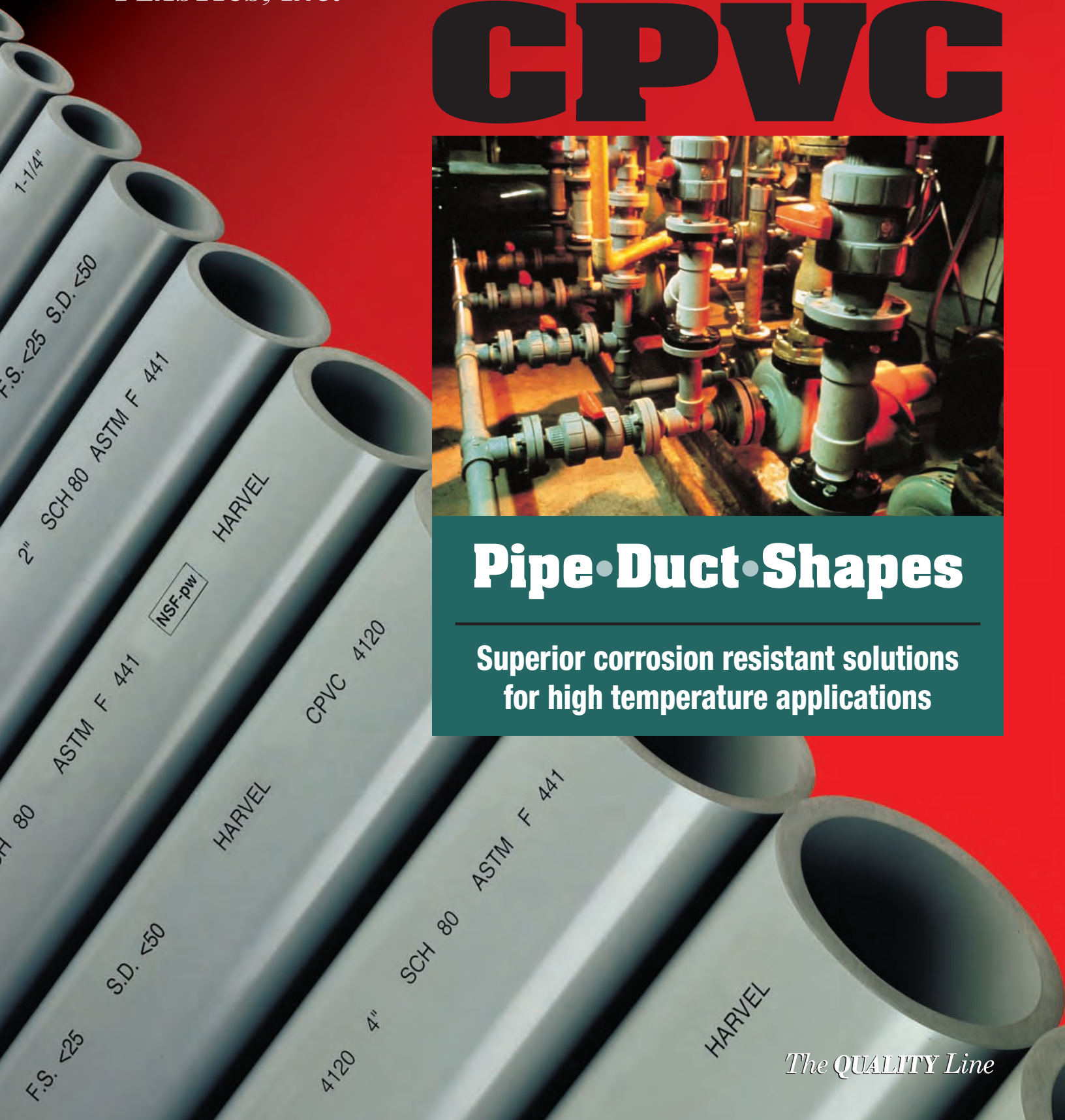
HARVEL®

PLASTICS, INC.

CPVC

Pipe•Duct•Shapes

Superior corrosion resistant solutions for high temperature applications



The QUALITY Line

PIPE

PROPERTIES OF CPVC

CPVC piping systems manufactured by Harvel can handle more than three-fourths of the temperature/pressure requirements of today's typical process plants. CPVC pressure pipe has an upper working temperature limit of 200°F (93°C), or approximately 60°F (15°C) above that of Type I Grade I PVC. As with all thermoplastic piping systems, CPVC's ability to withstand pressure varies with pipe diameter, wall thickness, and temperature. For pressure piping applications it is recommended for temperatures as high as 200°F (93°C) when appropriate temperature de-rating factors are applied. As the pipe diameter and temperature increases, the pressure rating of the product decreases. For example, 1/2" Schedule 80 CPVC pipe is engineered for continuous service of 850 psi @ 73°F (23°C). The same pipe in service @ 180°F (82°C) carries a maximum working pressure rating of 210 psi at this temperature. 6" Schedule 80 CPVC pipe is designed for 270 psi @ 73°F, and 54 psi @ 200°F.

Harvel CPVC pipe will withstand surprisingly high pressures for long periods, even at elevated temperature. CPVC has a tensile strength of more than 2000 psi at 212°F. It also shows a high modulus over a wide range of temperature, and heat deformation at 264 psi does not occur below 230°F. The low thermal conductivity of CPVC reduces moisture condensation on water lines, and its smooth interior walls provide a low friction factor (Hazen Williams C=150) assuring greater throughput and optimum pumping discharges.

CPVC is essentially immune to solvation or direct chemical attack by virtually all acids, bases, salts, aliphatic solutions, oxidants, and halogens. Like other thermoplastics, CPVC can handle mixtures

CPVC Pipe Dimensions

Schedule 40**

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Weight per ft.	Max. W.P. PSI*
1/4	.540	.344	.088	.096	780
3/8	.675	.473	.091	.128	620
1/2	.840	.602	.109	.190	600
3/4	1.050	.804	.113	.253	480
1	1.315	1.029	.133	.371	450
1-1/4	1.660	1.360	.140	.502	370
1-1/2	1.900	1.590	.145	.599	330
2	2.375	2.047	.154	.803	280
2-1/2	2.875	2.445	.203	1.267	300
†3	3.500	3.042	.216	1.660	260
3-1/2	4.000	3.521	.226	1.996	240
4	4.500	3.998	.237	2.363	220
5	5.563	5.016	.258	2.874	190
6	6.625	6.031	.280	4.164	180
8	8.625	7.942	.322	6.268	160
10	10.750	9.976	.365	8.886	140
12	12.750	11.889	.406	11.751	130
14	14.000	13.073	.437	13.916	130
16	16.000	14.940	.500	18.167	130
18	18.000	16.809	.562	22.965	130
20	20.000	18.743	.593	29.976	120
24	24.000	22.544	.687	37.539	120

Schedule 80

Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Weight per ft.	Max. W.P. PSI*
1/4	.540	.282	.119	.117	1130
3/8	.675	.403	.126	.162	920
1/2	.840	.526	.147	.238	850
3/4	1.050	.722	.154	.322	690
1	1.315	.936	.179	.473	630
1-1/4	1.660	1.255	.191	.654	520
1-1/2	1.900	1.476	.200	.793	470
2	2.375	1.913	.218	1.097	400
2-1/2	2.875	2.290	.276	1.674	420
†3	3.500	2.864	.300	2.242	370
3-1/2	4.000	3.326	.318	2.735	350
4	4.500	3.786	.337	3.277	320
5	5.563	4.768	.375	4.078	290
6	6.625	5.709	.432	6.258	280
8	8.625	7.565	.500	9.506	250
10	10.750	9.493	.593	14.095	230
12	12.750	11.294	.687	19.392	230
14	14.000	12.410	.750	23.261	220
16	16.000	14.213	.843	29.891	220
18	18.000	16.014	.937	35.419	220
20	20.000	17.814	1.031	45.879	220
24	24.000	21.418	1.218	64.959	210

CPVC Pipe Maximum Support Spacing (Feet)

Schedule 40

Pipe Size (in.)	Temperature °F					
	73	100	120	140	160	180
1/2	5	4-1/2	4-1/2	4	2-1/2	2-1/2
3/4	5	5	4-1/2	4	2-1/2	2-1/2
1	5-1/2	5-1/2	5	4-1/2	3	2-1/2
1-1/4	5-1/2	5-1/2	5-1/2	5	3	3
1-1/2	6	6	5-1/2	5	3-1/2	3
2	6	6	5-1/2	5	3-1/2	3
2-1/2	7	7	6-1/2	6	4	3-1/2
3	7	7	7	6	4	3-1/2
3-1/2	7-1/2	7-1/2	7	6-1/2	4	4
4	7-1/2	7-1/2	7	6-1/2	4-1/2	4
5	8	7-1/2	7	7	5	4-1/2
6	8-1/2	8	7-1/2	7	5	4-1/2
8	9-1/2	9	8-1/2	7-1/2	5-1/2	5
10	10-1/2	10	9-1/2	8	6	5-1/2
12	11-1/2	10-1/2	10	8-1/2	6-1/2	6
14	12	11	10	9	8	6-1/4
16	13	12	11	9-1/2	8-1/2	7
18	13	12-1/2	11	10	9	7-1/2
20	14	13	11-1/2	10-1/2	9	7-1/2
24	15	14	12-1/2	11	9-1/2	8

Schedule 80

Pipe Size (in.)	Temperature °F					
	73	100	120	140	160	180
1/2	5-1/2	5	4-1/2	4-1/2	3	2-1/2
3/4	5-1/2	5-1/2	5	4-1/2	3	2-1/2
1	6	6	5-1/2	5	3-1/2	3
1-1/4	6-1/2	6	6	5-1/2	3-1/2	3
1-1/2	7	6-1/2	6	5-1/2	3-1/2	3-1/2
2	6	7	6-1/2	6	4	3-1/2
2-1/2	8	7-1/2	7-1/2	6-1/2	4-1/2	4
3	8	8	7-1/2	7	4-1/2	4
3-1/2	8-1/2	8-1/2	8	7-1/2	5	4-1/2
4	8-1/2	9	8-1/2	7-1/2	5	4-1/2
5	9-1/2	9	8-1/2	8	5	4-1/2
6	10	9-1/2	9	8	5-1/2	5
8	11	10-1/2	10	9	6	5-1/2
10	11-1/2	11	10-1/2	9-1/2	6-1/2	6
12	12-1/2	12	11-1/2	10-1/2	7-1/2	6-1/2
14	15	13-1/2	12-1/2	11	9-1/2	8
16	16	15	13-1/2	12	10	8-1/2
18	16	15-1/2	14	12-1/2	10-1/2	9
20	17	16	14-1/2	13	11	9-1/2
24	17-1/2	16-1/2	15	13-1/2	11-1/2	10

Temperature De-Rating Factors

(To be applied to 73.4°F working pressures with water for Schedules 40 and 80 CPVC pipe.)

Working Temp. (°F)	De-Rating Factor
73	1.00
110	.72
120	.65
130	.57
140**	.50
150**	.42
160**	.35
170**	.29
180**	.25
200**	.20

† Consult factory for minimum run.
* For water at 73.4°F.
** Pipe should not be threaded. Use flanged joints or unions where disassembly is necessary.
ASTM Standards: D1784 for materials and F-441 for pipe. Standard D1784 classification equivalents: CPVC (Hi-Temp) = Type IV Grade I = 4120 = Cell Classification 23447.

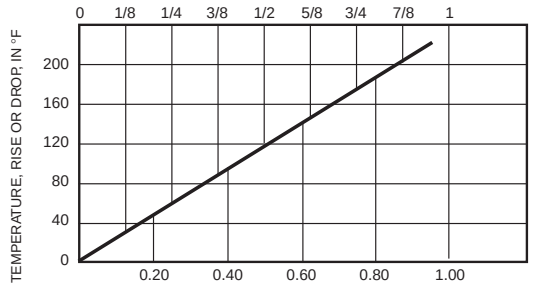
of corrosive solutions of varying concentrations. It is inert and will not initiate catalytic activity in the contained fluid. Detailed chemical resistance data is available and should be referenced for proper material selection.

In addition to chemical inertness and mechanical strength, Harvel CPVC products have excellent flammability properties when compared to other plastics and many common building materials. Harvel CPVC products will not support combustion, are rated as self-extinguishing, and have a flame spread of <25 and a smoke development rating of <50 per independent testing conducted by Underwriters Laboratories of Canada (ULC). Consequently, many codes throughout the country have approved Harvel CPVC products for piping and conduit work. Refer to Physical Properties table for additional information.

TYPICAL CPVC PIPE APPLICATIONS

The use of CPVC piping can be considered for any industrial application where inorganic chemicals or aggressive hot water piping systems are needed. CPVC pipe's corrosion resistance, mechanical properties, temperature capabilities, flow characteristics, light weight, and longevity offer significant cost-saving advantages over metallic systems (up to 25 percent less than carbon steel and much less than stainless steel or exotic alloys.) CPVC pipe has a distinct advantage in handling and installation due to its inherent light weight as compared to carbon steel pipe, which weighs nearly five times more than CPVC. This characteristic alone can result in considerable savings due to reduced installation labor, storage, and handling costs.

Applications for Harvel CPVC pipe can typically be found in the following industries: chemical processing, metal finishing, plating and treatment, pulp and paper, air pollution control, mining, aerospace, textiles, semi-conductor and electronics, waste water treatment, water processing, hot water distribution, and food and beverage processing. Harvel CPVC piping products are independently tested for chemical extraction to ensure the finished products remain pure, odorless, and tasteless. As a result, Harvel piping products are approved by the National Sanitation Foundation (NSF) for use with potable water.



Thermal expansion and contraction in length of CPVC pipe with temperature variation

CPVC Pipe and Duct Physical Properties

Property	Value	Test Method
GENERAL		
Cell Classification	23447	ASTM D1784
Maximum Service Temperature	200°F	
Color	Medium Gray	
Specific Gravity (g/cu.cm @ 73°F)	1.52 ± .02	ASTM D792
Water Absorption		
% increase 24hrs @ 25°C	0.03	ASTM D570
Hardness, Rockwell	117	ASTM D785
Poisson's ratio @ 73°F	0.386	
Hazen-Williams Factor	C=150	
MECHANICAL		
Tensile Strength, psi @ 73°F	7,600	ASTM D638
Tensile Modulus of Elasticity, psi @ 73°F	360,000	ASTM D638
Flexural Strength, psi @ 73°F	13,000	ASTM D790
Flexural Modulus, psi @ 73°F	360,000	ASTM D790
Compressive Strength, psi @ 73°F	10,000	ASTM D695
Compressive Modulus, psi @ 73°F	196,000	ASTM D695
Izod Impact, ft-lb/in @ 73°F	2.0	ASTM D256
THERMAL		
Coefficient of Linear Expansion (in/in/°F)	3.7×10^{-5}	ASTM D696
Coefficient of Thermal Conductivity		ASTM C177
(Cal.)(cm)/(cm^2)(Sec.)(°C)	3.27×10^{-4}	
BTU/in/hr/ft^2/°F	.95	
Watt/m/°K	0.137	
Heat Deflection Temperature Under Load (264psi, Annealed)	226°F	ASTM D648
ELECTRICAL		
Dielectric Strength, volts/mil	1,250	ASTM D149
Dielectric Constant, 60Hz, 30°F	3.70	ASTM D150
Volume Resistivity, ohm/cm @ 73°F	3.4×10^{15}	ASTM D257
Power Factor, 1000Hz	0.007%	ASTM D150
Harvel CPVC Pipe is non-electrolytic.		
FLAMMABILITY		
Flammability Rating	V-0, 5VB, 5VA	UL-94
Flame Spread Index	< 10	ASTM E162
Flame Spread	< 25	ASTM E-84
		UL 723
	< 25	ULC
Smoke Generation	≤ 50	ASTM E-84
		UL 723
	< 50	ULC
Flash Ignition Temperature	900°F	
Average Time of Burning (sec.)	< 5	ASTM D635
Average Extent of Burning (mm)	< 10	
Burning Rate, (in/min.)	Self Extinguishing	
Softening Starts, (approx.)	295°F	
Material Becomes Viscous	395°F	
Material Carbonizes	450°F	
Limited Oxygen Index (LOI)	60	ASTM D2863
Clean Room Materials Flammability Test	FPI = 1.20	FM 4910
	SDI = 0.09	

Note: The physical properties shown are considered general CPVC physical properties. Harvel utilizes several CPVC compounds for the production of different CPVC product lines. Different CPVC compounds may exhibit slight variations in actual physical properties as compared to those stated. Consult Harvel Tech Services for additional information if necessary.

DUCT

CPVC DUCT

Harvel CPVC duct is produced with physical properties desirable for duct applications (i.e., improved impact resistance and good fire resistance capabilities). Harvel's CPVC duct safely withstands temperatures up to 200°F making it ideal for hot corrosive fume and drain service. The product's light weight and ease of fabrication provide a long-lasting, cost-effective solution for many industrial fume and drain applications, such as: metal finishing and plating operations, anodizing, laboratory use, and waste water treatment facilities.

Harvel CPVC is listed for surface burning characteristics having a low flame-spread rating <25 and a low smoke development rating <50. This makes it an ideal choice for use in corrosive environments where fire performance is a concern.

Extruded to IPS dimensions, the CPVC duct is easily joined by solvent cementing or thermal welding joining techniques, easing fabrication. Harvel's CPVC duct is stocked in 10' and 20' lengths, inside under roof, to ensure door to door quality. Fabricated fittings of all configurations are readily available in sizes 6" through 24".

Refer to Harvel's CPVC DUCT Bulletin (HPB-106) for detailed information

Duct Maximum Hanger Support Spacing (Feet)

Nominal Pipe Size (in.)	Temperature °F						
	73	100	120	140	160	180	200
6	10	10	10	10	10	8	8
8	10	10	10	10	10	8	8
10	10	10	10	10	10	10	10
12	10	10	10	10	10	10	10
14	12	12	12	12	10	10	10
16	12	12	12	12	12	10	10
18	12	12	12	12	12	12	12
20	12	12	12	12	12	12	12
24	12	12	12	12	12	12	12

CPVC Seamless Extruded Duct for Drain & Fume Service

Size (in.)	Average O.D.	Average O.D. Tol.	O of R Tol.	Min. Wall	Average Wall	Max. Wall	Weight (lbs.) per ft.
6	6.625	± .020	± .050	.172	.187	.202	2.555
8	8.625	± .020	± .075	.172	.187	.202	3.349
10	10.750	± .025	± .075	.172	.187	.202	4.192
12	12.750	± .025	± .075	.172	.187	.202	4.986
14	14.000	± .030	± .075	.172	.187	.202	5.485
16	16.000	± .030	± .075	.172	.187	.202	6.273
18	18.000	± .040	± .080	.172	.187	.202	7.580
20	20.000	± .070	± .140	.199	.219	.239	9.145
24	24.000	± .090	± .180	.230	.250	.270	12.536

SHAPES

CPVC EXTRUDED SHAPES

A wide range of products can easily be machined from Harvel's line of CPVC solid round bar and hollow bar extruded shapes. Using conventional machining methods such as cutting, boring, drilling, and threading, an endless variety of finished parts and subcomponents can be readily produced. This provides a means to produce many custom assemblies and fixtures that are not available as extruded or molded items. Machined components and fixtures can then be incorporated into large assemblies or existing systems using standard solid cementing and hot air welding techniques, providing material consistency and integration for an entire system.

The heavy-wall hollow bar offered provides considerable material savings when custom bored parts are required. Some hollow bar sizes are available in IPS and can be used as bushing stock or very heavy wall pipe which is not commercially available.

Typical products produced from extruded bar and rod include: ball valves, check valves, foot valves, needle valves, bulkhead fittings, pump components, bushings, faucet parts, compression fittings, flanges, hangers, headers, hooks, adapters, spacers, caps, sleeves, plugs, stiffeners, hubs, and other mechanical components.

Solid Round CPVC Bar

Size (in.)	Weight per ft.
1/4	.032
3/8	.074
7/16	.105
1/2	.131
5/8	.204
3/4	.296
1	.526
1-1/4	.821
1-1/2	1.183
2	2.109
2-3/8	2.966
2-1/2	3.375
3	4.595
3-1/2	6.439
4	8.460
5	13.950
†6	19.203

Hollow CPVC Bar

Min. O.D. (in.)	Max. I.D. (in.)	Weight per ft.
1.625	.562	1.288
2.125	.750	2.243
2.250	1.125	2.260
2.375	1.000	2.671
2.625	1.500	2.802
2.750	1.000	3.682
2.875	1.500	3.525
3.000	1.250	4.207
3.563	1.500	5.853
4.000	2.500	5.751
4.250	1.750	8.316
4.750	3.000	7.889
5.000	3.000	9.170
†6.625	4.000	16.640
†6.625	2.875	20.121

CPVC centerless ground rod, hex, angle and other shapes are also available.

† Consult factory for minimum run.

CPVC Extruded Shapes Physical Properties

Property	Value	Test Method
GENERAL		
Cell Classification	23447	ASTM D1784
Specific Gravity, g/cc	1.55	ASTM D792
MECHANICAL		
Tensile Strength, psi @ 73°F	8,100	ASTM D638
Tensile Modulus, psi @ 73°F	370,000	ASTM D638
Izod Impact, ft-lb/in notched @ 73°F	3.2	ASTM D256
THERMAL		
Heat Deflection Under Load, °F	223	ASTM D648
OTHER		
NSF	Approved for Potable Water	

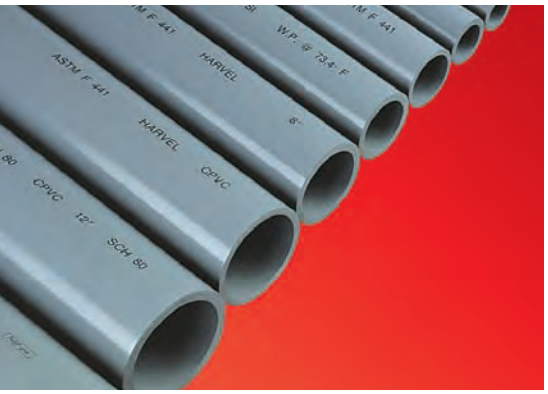
CPVC

HARVEL®
PLASTICS, INC.

Harvel CPVC pipe, duct and machining shapes offer superior corrosion resistance in high temperature applications

Recent developments in extrusion technology combined with advancements in engineered CPVC materials have led to a new generation of high temperature CPVC with distinct physical properties targeted to specific end product applications. The result is large diameter CPVC Schedules 40 and 80 pressure pipe, large diameter duct, and improved CPVC machining shapes.

Both PVC (polyvinyl chloride) and CPVC (chlorinated polyvinyl chloride) are hydrocarbon based polymers that can be compounded to have a wide range of physical properties and processing characteristics. The major distinction is that the CPVC molecule contains additional chlorine atoms which enable a higher heat distortion temperature compared to that of PVC. This provides a material with high temperature strength in addition to other beneficial properties, such as superior corrosion resistance, which are desirable for industrial piping products.

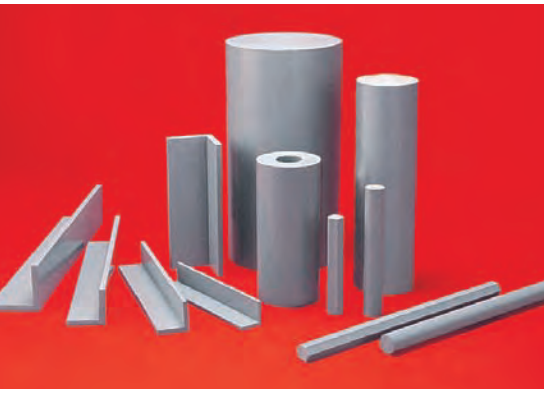


INDUSTRIAL PIPE — 1/4" to 24"

Harvel's line of CPVC pipe has grown to include standard and custom extrusions in Schedules 40 and 80, in sizes 1/4" to 24". Having superior high-temperature strength and chemical resistance, CPVC piping systems are used in a wide variety of applications. Harvel CPVC pipe is lightweight for easy, low-cost installation.

FUME EXHAUST AND DRAIN DUCT — 6" to 24"

Superior resistance to corrosion and chemical attack makes Harvel CPVC duct ideally suited for hot fume handling systems in applications as diverse as metal finishing or atomic energy. Safely withstanding temperatures of up to 200°F (93°C), Harvel CPVC seamless extruded duct is now available in sizes 6" to 24" with fabricated fittings of all configurations.



MACHINING SHAPES — 1/4" to 6"

Because of the excellent machining characteristics of Harvel's CPVC solid round and hollow bar, a seemingly endless variety of products can be easily manufactured. Extruded in sizes 1/4" to 6", Harvel CPVC shapes are lightweight, chemical resistant and can safely withstand temperatures of up to 200°F (93°C).

Typical Applications of Harvel CPVC Pipe, Duct and Machining Shapes

Schedule 80 CPVC piping transfers hot sulfuric acid dyes

Harvel CPVC duct exhausts chromic acid fumes from plating operation

Harvel CPVC piping can be integrated into hot corrosive drainage systems.

An endless variety of finished parts and subcomponents can be readily produced using Harvel CPVC machining shapes

NOTE: The data furnished herein is based on information provided by manufacturers of the raw material. This information may be considered as a basis for recommendation, but not as a guarantee. Materials should be tested under actual service conditions to determine suitability for a particular purpose. Harvel Plastics does not recommend the use of PVC or CPVC thermoplastic piping for the transport or storage of compressed air or gases, nor the testing of these systems with compressed air or gases.

NOTE: A detailed engineering and technical bulletin on rigid CPVC and PVC pipe is available from Harvel Plastics. Bulletin 112/401 contains more specific data, including charts and tables on physical properties, dimensions and weights, working pressures, support spacing, corrosion resistance, cementing instructions, valves, and pressure fittings.

Harvel Plastics, Inc.
Quality Systems Certificate Nos. 270/455
Assessed to ISO 9001

HARVEL® PLASTICS, INC.

ISO 9001 CERTIFIED

300 Kuebler Road, P.O. Box 757, Easton, PA 18044-0757
Phone: 610-252-7355 Fax: 610-253-4436
www.harvel.com • e-mail: harvel@harvel.com

Distributed by:

HPB-117
Effective 6/15/11

HARVEL®

FLOWGUARD GOLD®

High-Quality Hot & Cold Water CPVC Plumbing Pipe

A safe, cost-effective choice for long-term residential and commercial plumbing system service.

THE QUALITY LINE

***Harvel® FlowGuard Gold® CTS CPVC Plumbing Pipe** provides exceptional corrosion resistance for hot and cold water plumbing applications. Easily installed using reliable solvent-welded joining techniques, Harvel® FlowGuard Gold® CTS CPVC pipe is the quality, cost-effective choice for long-term system service.*

Product Ratings

Harvel® FlowGuard Gold® CTS CPVC hot and cold water plumbing pipe is manufactured in strict compliance with ASTM D2846. This standard defines requirements for materials, workmanship, dimensions, tolerances, pressure-bearing capability, and thermocycling resistance. Harvel® FlowGuard Gold® plumbing pipe is manufactured to SDR 11 specifications in accordance with this standard. With SDR series pipe, the outside-diameter-to-wall- thickness ratio is constant regardless of pipe diameter; therefore all sizes of pipe carry the same pressure rating.

Performance Testing

In addition to Harvel's rigorous in-house testing, Harvel® FlowGuard Gold® pipe is regularly tested by independent third parties to verify the product's quality and safety. Stringent testing is conducted by the National Sanitation Foundation (NSF) to ensure that Harvel pipe meets the requirements of NSF Standard 14 and NSF Standard 61 for quality and health effects. In addition to physical performance testing to ensure product quality, this testing ensures that Harvel® FlowGuard Gold® pipe does not contain nor contribute any harmful substances to the drinking water transported. As a result, Harvel® FlowGuard Gold® pipe contains the NSF stamp of approval for potable (drinking) water applications.

Based on large scale testing, Harvel® FlowGuard Gold® is also listed for surface burning characteristics by ULC having a low flame spread rating (<25) and a low smoke development rating (<50) validating the excellent fire performance properties of the piping. This listing can be used to validate that Harvel® FlowGuard Gold® can be installed within return air plenums based on its excellent fire performance properties. Harvel® FlowGuard Gold® also meets CSA B137.6 Chlorinated Polyvinyl Chloride (CPVC) pipe, tubing and fittings for hot and cold water distribution systems – this information, along with ULC flame and smoke information is printed on the pipe for easy identification in the field.

Code Approvals

Major building codes have approved the use of CPVC piping as an acceptable material for plumbing systems, provided that the piping conforms to applicable industry standards and has been listed by a third party for conformance to NSF Standard 14 and /or NSF Standard 61 requirements. Code bodies that accept the use of CPVC include BOCA National Plumbing Code, National Standard Plumbing Code, SBCCI Standard Plumbing Code, International Plumbing Code, and the Uniform Plumbing Code to name a few. The user should determine approval and installation requirements from the local code having jurisdiction prior to use.

Harvel® FlowGuard Gold® CTS CPVC Pipe
SDR 11 Dimensions and Tolerances (inches)

Nominal Pipe Size (in.)	Average O.D.	O.D. TOL	Average I.D.	Minimum Wall	Wall TOL	Pressure Rating @73°F	Pressure Rating @180°F
1/2	0.625	±.003	0.469	0.068	+0.020	400	100
3/4	0.875	±.003	0.695	0.080	+0.020	400	100
1	1.125	±.003	0.901	0.102	+0.020	400	100
1-1/4	1.375	±.003	1.105	0.125	+0.020	400	100
1-1/2	1.625	±.004	1.309	0.148	+0.020	400	100
2	2.125	±.004	1.716	0.193	+0.023	400	100

Installation

It is important to follow proper storage and handling, joining, assembly, and other installation techniques to ensure a quality system installation. A properly designed and installed Harvel® FlowGuard Gold® plumbing system will provide years of trouble-free service, lasting much longer than metallic systems due to the product's inherent corrosion resistance and other factors. The following information is provided as a general guide toward that end.

Solvent Cement Joining Techniques

Harvel® FlowGuard Gold® pipe is joined by the solvent cementing process; a reliable field-proven, joining technique for many years. When properly conducted, this method provides a strong, homogenous joining area in which the mating surfaces are chemically fused together, producing a strong, leak-tight seal when cured. Prior to solvent cementing, appropriate safety precautions should be taken:

- *Use only CPVC cement conforming to ASTM F493*
- *Follow the solvent cement manufacturer's instructions*
- *Avoid breathing vapors*
- *Use only with adequate ventilation*
- *Avoid frequent contact with skin*
- *Avoid contact with eyes*
- *Eliminate all ignition sources*
- *Store primer and solvent cement in the shade between 40°F and 110°F*
- *Close containers tight when not in use, and cover as much as possible during use*
- *Follow all manufacturer-recommended precautions when using power tools*
- *Flush the system for a minimum of 10 minutes after pressure testing to remove trace amounts of solvents or other system components*

Minimum Cure Time Prior to Testing at 150 psi with Cold Water (based on use of IPS one-step CPVC cement)

Pipe Size (in.)	Ambient Temperature During Cure Time		
	>60°F	40°F-60°F	<40°F
1/2	15 min.	20 min.	30 min.
3/4	15 min.	20 min.	30 min.
1	15 min.	20 min.	30 min.
1-1/4	15 min.	20 min.	30 min.
1-1/2	30 min.	45 min.	1 hour
2	30 min.	45 min.	1 hour

Exercise special care when assembling Harvel® FlowGuard Gold® pipe in extremely low temperatures (below 40°F) or extremely high temperatures (above 80°F). Extra set and handling times must be allowed in colder temperatures. Make certain cement has not "gelled" when cementing pipe and fittings in colder temperatures. Make certain both surfaces being joined are wet with cement during assembly when working in extremely hot temperatures.

Hangers and Supports

Proper support spacing is critical to ensure that deflection is kept to a minimum. Hangers used must have an adequate load bearing surface free of any rough or sharp edges that could damage the pipe during use. They must also not restrict linear movement of the system due to the effects of expansion and contraction; overtightening must be avoided.

Pipe Size (in.)	Max. Hanger Support Spacing (ft.)
1/2	3
3/4	3
1	3
1-1/4	4
1-1/2	4
2	4

Wall Penetration

Building codes require that a fire-rated wall or floor must be sealed back to its original integrity when penetrated. Several sealants and materials are suitable for use with Harvel® FlowGuard Gold® pipe to construct an appropriate UL Classified penetration system (fire-rated penetration system). When installed properly, these systems will provide a two-hour fire rating. Consult local building code requirements. CAUTION: Certain fire-stopping sealants and components contain stress cracking agents and other chemicals which may cause damage to CPVC piping; contact the appropriate manufacturer for compatibility with CPVC piping prior to use.

Note: When installing CPVC piping in areas where the system must be drained to protect it from freezing, the lines must be sloped to drain.

Threaded Connections

Harvel® FlowGuard Gold® pipe can be connected to copper, brass, valves, and other piping materials using transition unions, compression fittings, specially reinforced male and female adapters, and other readily available transition fittings. Follow the fitting manufacturer's installation instructions for the specific connection being used to ensure a proper leak-free joint. When using compression fittings utilizing brass ferrules, it is recommended that Teflon tape be wrapped around the ferrule prior to assembly to help compensate for differences in expansion rates between CPVC and metallics. Teflon tape is also the recommended thread sealant for threaded connections. Certain pipe joint pastes and sealant compounds contain substances which could be damaging to CPVC and result in system failure. If joint sealant other than Teflon tape is used, contact the sealant manufacturer for compatibility with CPVC. Caution must be exercised to prevent overtightening of threaded connections and compression fittings.

Where water temperatures are 150°F or higher, use transition fittings incorporating rubber seals or other approved specialty transition fittings at the plastic to metal changeover. Follow appropriate safety precautions and manufacturer's recommendations when working with or near open flame during soldering operations. Extreme care must be used when soldering to prevent flame contact with CPVC tubing.

Water Heater Connections

Care should be used to prevent contact of the Harvel® FlowGuard Gold® pipe with heat-producing sources. Gas water heaters require the use of a metallic nipple or appliance connector at least six inches long to be installed above the flue piping as a transition piece to prevent damage to the CPVC by excessive heat build-up from the flue. CPVC can be installed directly onto electric water heaters with special transition fittings. Some codes require metal connectors on electric water heaters; consult applicable code requirements prior to installation.

Testing

Once the system has been installed and allowed to cure properly the system shall be tested in accordance with applicable code requirements. When testing with water (hydrostatic testing), the system must be slowly filled with water and the air bled from the highest and furthest points in the system before test pressure is applied. Air must be removed from piping systems to prevent it from being locked in the system when pressure is applied. Failure to do so could be harmful to jobsite personnel should a failure occur. If a leak is found, the affected product must be cut out and discarded. A new section can be installed using couplings or other approved means.

⚠ WARNING — THE USE OF COMPRESSED AIR OR GASES FOR PRESSURE TESTING CAN RESULT IN SYSTEM DAMAGE, SERIOUS BODILY INJURY, OR EVEN DEATH.

Storage and Handling

Reasonable care should be exercised when handling and storing Harvel® FlowGuard Gold® CTS CPVC pipe to prevent damage caused by impact, improper storage, or other forms of abuse. Harvel® FlowGuard Gold® pipe should be kept in its original packaging to keep it free from dirt and debris, and to reduce the possibility of damage. Product containing fractures, splits, gouges, or other damaged sections must not be used. Damaged sections must be cut out and discarded. When stored outdoors, Harvel pipe should be covered with a non-transparent material. Brief exposure to sunlight may cause the product's color to fade, but it will not affect its physical properties.

Thermal Expansion

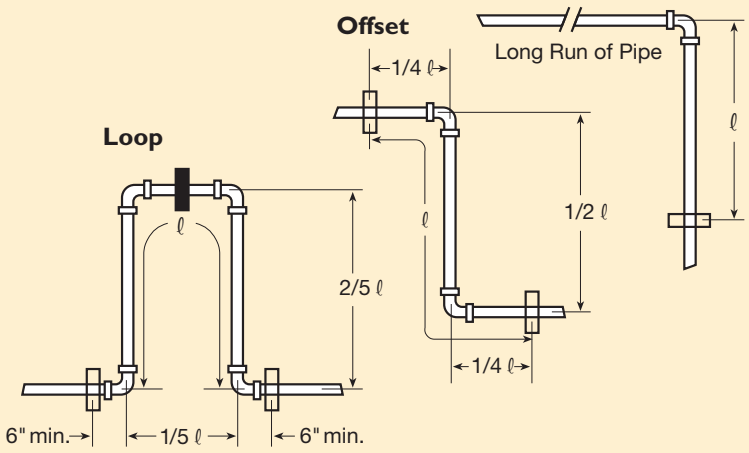
All piping systems expand and contract with changes in temperature. This issue must be addressed with appropriate system design to prevent damage to the system. Harvel® FlowGuard Gold® CTS CPVC plumbing pipe will expand or contract approximately 1 inch per 50 feet of pipe with every 50°F of temperature rise or fall. The effects of expansion/contraction are usually absorbed by the system at changes of direction in the piping. In other words, long, straight runs of piping are more susceptible to experiencing measurable movement with changes in temperature. As with other piping materials, the installation of an expansion loop or offset is required on long, straight runs, which will allow the piping system to absorb the forces generated by expansion/contraction without damage. The rate of expansion does not vary with pipe size. The effects of expansion/contraction are more pronounced on hot water lines. Generally the amount of temperature change experienced is no more than 100°F. The chart below can be used to determine the size of an expansion joint needed to compensate for movement when a temperature change of 80°F is experienced.

Length of Expansion Loop (ℓ) in Inches Required for 80°F Temperature Change

Pipe Size (in.)	Length of Run			
	40 ft.	60 ft.	80 ft.	100 ft.
1/2	22	27	31	34
3/4	26	32	36	41
1	29	36	41	46
1-1/4	32	40	46	51
1-1/2	35	43	50	56
2	40	49	57	64

Expansion Loop and Offset Configurations

Change of Direction



Hangers or guides should only be placed in the loop, offset, or change of direction as indicated above. Piping supports should restrict lateral movement and should direct axial movement into the expansion loop. Do not restrain "change in direction" configurations by butting up against joists, studs, walls, or other structures.

For temperature changes greater than 100°F the actual amount of movement to be expected must be calculated based on the temperature changes anticipated. The rate of expansion or contraction can be calculated as follows:

$\Delta L = 12\ y l\ (\Delta T)$
where: ΔL = expansion or contraction in inches
$y = 3.8 \times 10^{-5}$ (coefficient of linear expansion)
l = length of piping run in feet
ΔT = temperature change °F
(Maximum temperature - temperature @ installation)

Once the change in length (ΔL) has been determined, the length of an offset or expansion loop required to compensate for this change can be calculated as follows:

$$\ell = \sqrt{\frac{3ED(\Delta L)}{2S}}$$

ℓ = Length of expansion loop in inches
E = Modulus of elasticity
D = Average outside diameter of pipe
ΔL = Change in length of pipe due to temperature change
S = Working stress at max. temperature

CAUTIONS

CPVC products resist attack from a wide range of chemicals that are corrosive to metallic piping. CPVC products can however be damaged by contact with chemicals found in some construction and ancillary products such as thread sealants, anti-freeze solutions, fire stop materials, etc. It is important to verify the compatibility of materials that come in contact with the CPVC system prior to use to ensure long-term performance.

- *DO NOT stack, support, hang equipment, or hang flexible wire/cable (especially communications cable), or other material on the CPVC system.*
- *DO NOT expose CPVC products to incompatible substances such as cutting oils, non-water based paints, packing oils, traditional pipe thread paste and dope, fungicides, termiticides, insecticides, detergents, building caulks, adhesive tape, solder flux, flexible wire/cable (with special consideration for communications cabling), and non-approved spray foam insulation materials.*
- *DO NOT expose CPVC products to edible oils, solvents, or glycol-based anti-freeze fluids.*
- *DO NOT expose CPVC products to open flame, solder, and soldering flux.*
- *DO NOT drop, distort, or impact CPVC products or allow objects to be dropped on them.*

Failure to follow this notice may cause cracks or fractures to develop in CPVC products resulting in property damage and personal injury due to leaks or flooding.

For additional information contact Harvel Technical Services at 610-252-7355 or via email at harvel@harvel.com.

1. Cutting

Harvel® FlowGuard Gold® pipe must be cut square to obtain the proper insertion depth and to provide the maximum bonding area for solvent cementing. Harvel pipe can easily be cut with a wheel-type plastic tubing cutter, ratchet-style cutter, fine-toothed hand saw (hack saw), or power saw. A miter box should be used when working with saws to ensure a square cut. If ratchet-style cutters are used, their blades must be sharpened regularly. The use of ratchet cutters with dull blades, or their use in cold weather, will tend to compress the pipe prior to cutting which can result in hairline fracturing. The raised bead left on the pipe OD after cutting, must be removed prior to solvent cementing — see step number 2 regarding beveling. Any cuts, fractures, splits, or other damaged areas must be removed prior to joining. Cut off at least 2" beyond any visible fracture.

2. Beveling/Deburring

Burrs, filings, shavings etc. caused by the cutting process must be removed from the outside and inside of the pipe. Shavings and other debris will prevent proper contact of the joining surfaces and can lead to joint failure. Chamfering tools are available for this purpose, however pocket knives or files are also suitable. A slight bevel is required on the pipe end to help ease entry into the fitting socket, and to prevent solvent cement from being pushed ahead of the pipe during the assembly process. Many chamfering tools designed for use with plastic are readily available. These tools are specifically designed to remove burrs and provide a proper bevel simultaneously.

3. Fitting Preparation

Wipe dirt, debris, and moisture from the pipe end and fitting socket using a clean, dry rag. Moisture will slow the cure time and reduce joint strength. Inspect piping and components for damage or irregularities prior to assembly. Do not use components that appear irregular or that do not fit properly; contact the appropriate manufacturer of the product in question to determine usability. Check the dry fit of the pipe and fitting prior to assembly. The pipe should enter the fitting socket easily one-quarter to three-quarters of the way.

4. Solvent Cement Application

USE ONLY CPVC CEMENT that conforms to ASTM F493. The use of the wrong cement can result in failure. Harvel recommends the use of IPS 713 CPVC cement, P-68 primer, or IPS Low VOC one-step CPVC cement or equivalent. Two solvent cementing processes are available: the two-step solvent cement and primer process and the one-step process. The two-step process utilizes the application of primer to the outside of the pipe and the interior fitting socket prior to applying the solvent cement. When using primer, it must be applied to both the pipe and fittings using the appropriate size applicator. A dauber or paint brush approximately half the size of the pipe diameter is appropriate. A rag must not be used. Apply primer to the fitting socket, then to the outside of the pipe end, re-dipping the applicator as necessary to ensure the entire joining surfaces are wet; apply solvent cement immediately after primer application while primed surfaces are tacky. Cement application for one- or two-step process: Apply a heavy, even coat of cement to the outside pipe end. Apply a medium coat to the fitting socket. A second application of cement should be applied to the pipe end if there was little or no interference when the dry fit was checked. Do not allow excess cement to puddle in the pipe or fitting.

5. Assembly

Immediately insert the pipe into the fitting while rotating the pipe one-quarter turn to help distribute cement. Properly align the fitting for installation at this time. Pipe must bottom completely to the stop in the fitting. Hold the assembly for 10 to 15 seconds to ensure initial bonding. A continuous bead of cement should be evident around the pipe and fitting juncture. If the bead is not continuous, it may indicate that insufficient cement was applied. If insufficient cement is applied the fitting must be cut out, discarded, and begun again. Cement in excess of the bead should be wiped off with a rag.

6. Set and Cure Times

Assembled joints must be allowed to set and cure properly prior to testing the system. Set and cure times are a function of type of cement used, pipe size, temperature, humidity, and tightness of fit. Drying time is faster for drier environments, smaller sizes, higher temperatures, and tighter fits. The assembly must be allowed to set without any stress on the joint for one to five minutes depending on the pipe size and temperature. Following the initial set period, the assembly can be handled carefully. FOLLOW THE CEMENT MANUFACTURER'S RECOMMENDED CURE TIMES PRIOR TO PRESSURE TESTING — FAILURE TO DO SO WILL RESULT IN JOINT FAILURE.

SAMPLE SPECIFICATION

All CPVC SDR 11 Series hot and cold water plumbing pipe shall be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 24448 (CPVC4120) per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D2846, consistently meeting and/or exceeding the quality assurance test requirements of this standard with regard to pressure rating, material, workmanship, burst pressure, flattening resistance, and extrusion quality. The pipe shall be manufactured in the USA by an ISO 9001 certified manufacturer. All pipe shall be packaged on-line immediately after its manufacture and stored indoors after production at the manufacturing site until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications. The pipe shall have a flame spread rating <25 and a smoke development rating <50 when tested and listed for surface burning characteristics in accordance with ULC-S102.2 or equivalent; this information shall be printed on the pipe along with the mark of the listing agency. This pipe shall also meet the requirements of CSA B137.6 for CPVC hot and cold water distribution piping. All pipe shall be manufactured by Harvel Plastics, Inc., trade name Harvel® FlowGuard Gold® CTS CPVC – No Equal.

HARVEL® PLASTICS, INC.

610-252-7355 · HarvelFlowGuardGold.com
300 Kuebler Road, P.O. Box 757, Easton, PA 18044-0757
Fax: 610-253-4436 • harvel @harvel.com

PPFA

ASTM

NSF

ISO 9001 CERTIFIED

LPCB

UKAS QUALITY MANAGEMENT 007

Harvel Plastics, Inc.
Quality Systems Certificate Nos. 270/455
Assessed to ISO 9001

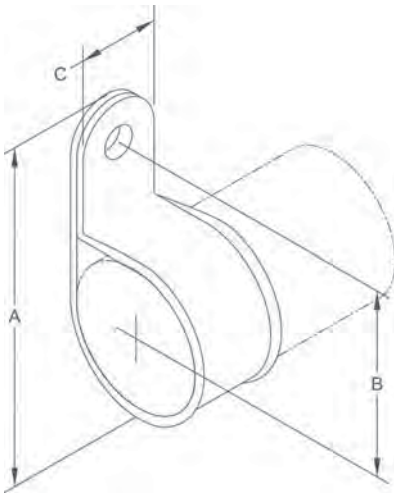
member iapd international association of plastics distribution

Distributed by:

6/15/11(?M); 6/26/09(5M); 4/3/07(10M)

Fig. 22 - Hanger for CPVC Plastic Pipe Single Fastener Strap Type

c UL US LISTED



Size Range — 3/4" thru 2" CPVC pipe

Material — Pre-Galvanized Steel

Function — Intended to perform as a hanger to support CPVC piping used in automatic fire sprinkler systems. The product acts as a hanger when tab is upward and the fastener screw is in the horizontal position. Figure 22 can be installed on the top of a beam, but in this situation acts as a guide to the piping which is supported by the beam itself. It is not intended to support CPVC pipe from under a flat horizontal surface, such as a ceiling. For this type of installation, use the TOLCO® Fig. 23, Double Fastener Strap for CPVC Piping. Fig. 22, when inverted, with the hanger tab downward, can function as a restrainer to prevent the upward movement of the sprinkler head during activation.

Approvals — Underwriters' Laboratories Listed in the USA **(UL)** and Canada **(cUL)** to support fire sprinkler piping. May be installed in wood using fasteners supplied with product, or into minimum 20 gauge steel using (1) 1/4" x 1" tek type screw. Meets and exceeds the requirements of NFPA 13, 13R and 13D.

Features — Fig. 22 incorporates features which protect the pipe and ease installation. The flared edge design protects CPVC pipe from any rough surface. It is easily attached to the building structure using the special UL Listed hex head self threading screw* furnished with the product. It is recommended that rechargeable electric drills fitted with a hex socket attachment to be used as installation tools. No impact tools (such as a hammer) are allowed. Damage has been known to result from installations using impact type tools. No pre-drilling of a pilot hole in wood is required.

Finish — Pre-Galvanized

Order By — Figure number and CPVC pipe size.

*** Hardened hex head self threading screw is furnished with the product and is the minimum fastener size acceptable.**

Dimensions • Weights

CPVC Pipe Size	A	B	C	Max. Hanger Spacing (Ft.)	Fastener Hex Head Size	Approx. Wt./100
3/4	2 7/16	1 5/16	1 3/16	5½	5/16	9
1	2 11/16	1 7/16	1 3/16	6	5/16	9
1¼	3 1/16	1 5/8	1 3/16	6½	5/16	11
1½	3 5/16	1¾	1 3/16	7	5/16	12
2	3¾	2 1/8	1 3/16	8	5/16	15

Data sheet

UN2
Universal controller

Overview
Networking
• Ethernet connector for BACnet Ethernet/IP connectivity
• 802.15.4 wireless mesh (25 nodes per coordinator)
• Wired serial bus for daisy chain (CANbus)
Third party interoperability
• BACnet
• oBIX
• EnOcean (wireless)
• Zigbee (wireless)
• Modbus
• CANbus
Inputs/Outputs
• Inputs: 6 universal
• Outputs: 2 relay, 4 analog
• EnOcean (wireless): 128 points
• ZigBee (wireless): 10 peripherals
Other
• Real-time clock
• 400MHz processor
• 64MB of RAM
• 2GB of Flash
• Embedded web server hosting the Web BEMS

Introduction

A flexible line of controllers that allows facility managers, contractors and OEM manufacturers to deploy integrated solutions for HVAC, lighting, and more, quickly and efficiently linking multiple devices based on many standard protocols. They are all interoperable with any BACnet compliant building management system.

Control features

- Control of wired end-devices (6 inputs and 6 outputs).
- Wireless control of EnOcean end-devices (128 points per UN2).
- Wireless control of ZigBee end-devices (10 peripherals per UN2).
- Modbus (optional).
- Programmable via the CAN2GO Web BEMS or a BACnet IP system.
- Real-time response to scripting/graphical programming.

Applications

Supports HVAC, lighting and metering application including:

- HVAC and lighting room and zone control.
- Unitary equipment such as rooftop HVAC units, air handling units, heat pumps and dehumidification units.
- Mechanical rooms and equipment closets.
- Metering: the UN2 Modbus connectors enable management of a wide variety of power meters and other metering devices.

Networking between units

- Wireless - ZigBee wireless mesh network (self-forming/healing).
- Wired - Daisy chain.
- IP/Ethernet - Ethernet port.

Embedded gateway

- EnOcean (wireless) to BACnet IP.
- ZigBee (wireless) to BACnet IP.
- Modbus to BACnet IP.

CAN2GO Web Building Energy Management System

The UN2 has an embedded web server hosting the CAN2GO Web BEMS. The BEMS offers management and monitoring of building systmes (HVAC, Lighting, Metering, etc.) through dashboards, maps, graphical programming and scripting. Visit our website for more information.
http://www.can2go.com/en/products/webbms.htm

Data sheet
UN2 Universal Controller

Specifications - UN2 Universal Controller

POWER	
Voltage	- 24VAC; ± 15%; 50/60HZ; Class 2. - 24VDC ± 10%
Typical Consumption	- 3 VA + Output (VAC) - 1.2W + Output (VDC)

GENERAL	
Processor	ARM9 32-bit, 400MHz
Memory	64MB RAM
Storage	2GB Flash
Real-time clock	Battery backed (10,000 hours)
Communication	- Zigbee Pro, EnOcean, BACnet - CANbus (125-500 Kbps) - Ethernet (10/100 Mbps)

ENCLOSURE	
Material	Rigid ABS
Dimensions	132mm (5.20 in) X 126mm (4.96 in)
Rating	UL940-5VA
Mounting	Din-rail, wall or ceiling mount

ENVIRONMENTAL	
Operating Temperature	0°C (32°F) to 60°C (140°F)
Storage Temperature	-20°C (-4°F) to 60°C (140°F)
Relative Humidity	0 to 90% non-condensing

AGENCY APPROVALS
Energy Management Equipment, UL 916, Fourth Edition, December 23, 1998, rev. December 17, 2007
CSA Standard for Signal Equipment C22.2 No. 205-M1983 (R2004)
CFR47 FCC Part15, Subpart B:2009
ICES-003: Issue 4 (2004)
CE
Japanese Radio Law

INPUTS	
Quantity	6
Voltage	0-10 volt
Current	4-20mA with 249 Ω external resistor
Resistance	1 kΩ to 100 kΩ
Resolution	14-bit

OUTPUTS	
Analog (x4)	0-12V, nominal 50 mA max each, 12-bit resolution
Relay (x2)	24V, 1.1 Amp per relay

SOFTWARE	
Type	Embedded web interface
Local installation	None necessary
PDA/Smartphone compatible	Yes
Browser compatibility	Firefox ESR

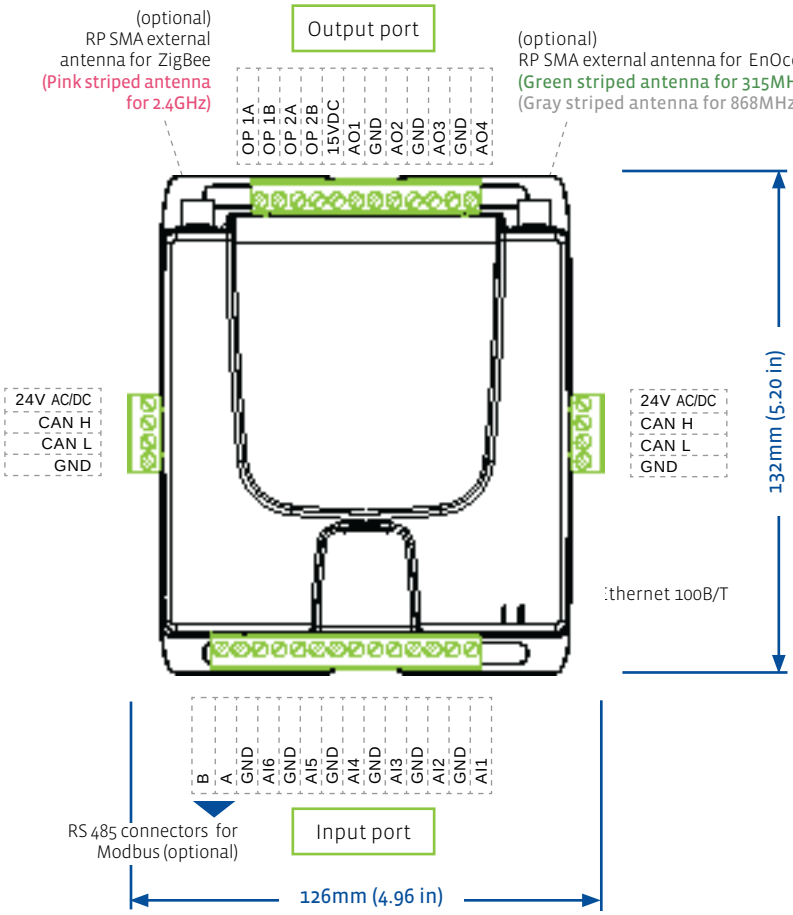
RS 485 (OPTIONAL)	
Supported protocols	Modbus

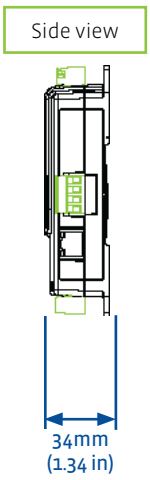
ENOCEAN TRANSCEIVER (OPTIONAL)	
Frequency	315.0 MHz or 868.3 MHz
Receiver Sensitivity	–95dBm
Conducted Output Power 5dBm	
Range	Up to 100m/300ft. open air / Up to 30m/100ft. in building
Antenna	- 15 cm wire - (Optional) External whip, RP SMA 0dBi

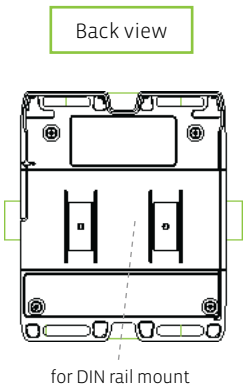
ZIGBEE TRANSCEIVER (OPTIONAL)	
Frequency	2400 – 2483.5 MHz, 16 RF channels
Data rate / Mod. type	250 Kbps
Receiver Sensitivity	-101dBm / -105dBm (amplified)
Nominal Output Power	8dBm / 18dBm (amplified)
Range	Up to 300m/1000ft. open air / Up to 100m/300ft. in building
Antenna	- Internal - (Optional) External whip, RP SMA 2.5dbi

4001432

Dimensions & Wiring - UN2 Universal Controller







Ordering information - UN2 - Universal Controller

Code all blocks in table.

U N 2 —				—		
Model	EnOcean radio	ZigBee radio	Communication	Pressure sensor	Actuator

Model
UN2

EnOcean radio
A = 315MHz wire antenna
B = 868MHz wire antenna
C = 315MHz external whip antenna
D = 868MHz external whip antenna
0 = No radio

ZigBee radio
N = Nominal (8dBm)
M = Nominal + external antenna
I = High + external antenna
0 = No radio

Communication
4 = RS-485 (Modbus)
0 = None

Pressure sensor
S = Equipped
0 = Not equipped

Actuator
0 = Not equipped

Models available

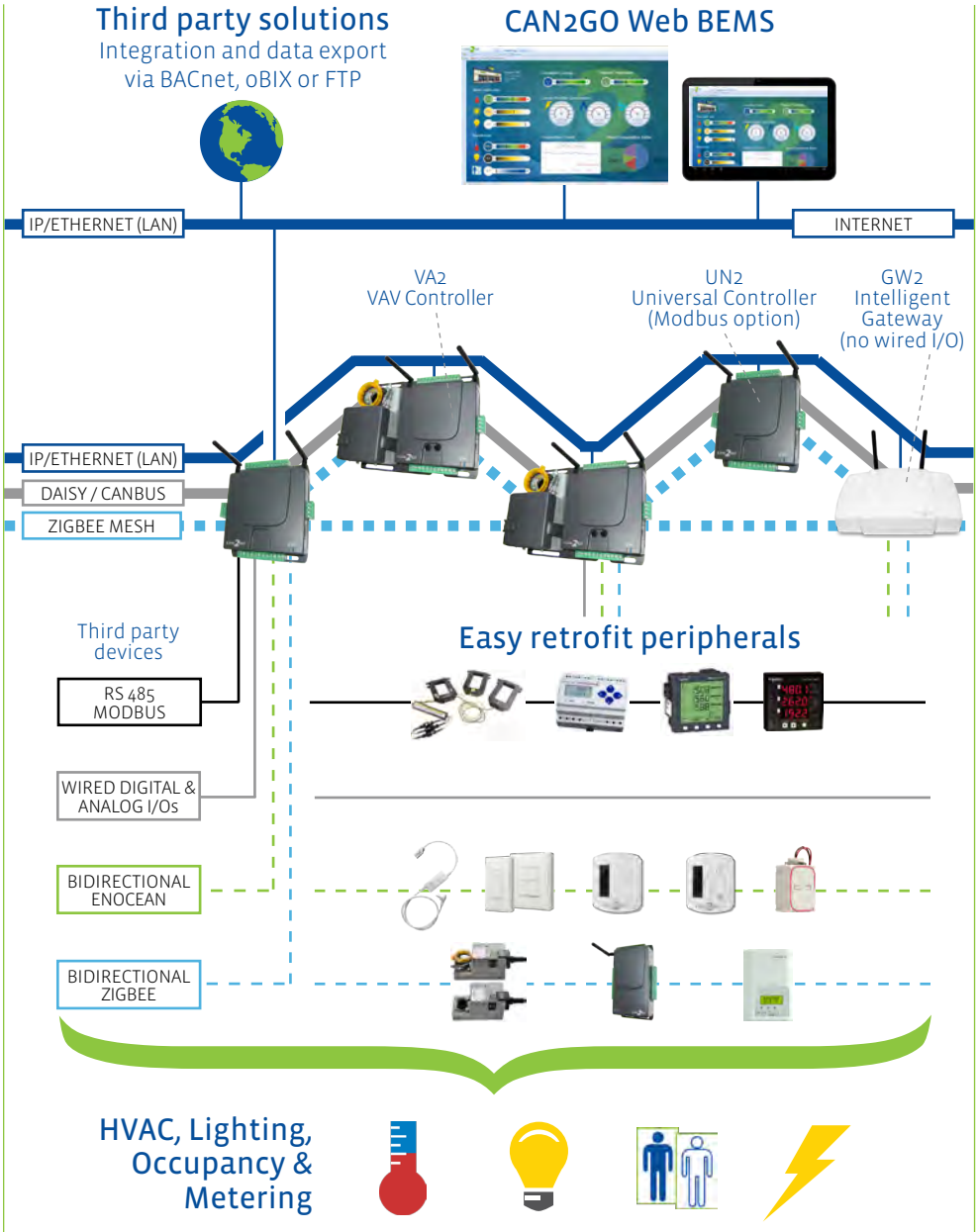
UN2 - AN0 - 00
UN2 - CI0 - 00
UN2 - CI4 - 00
UN2 - DM4 - 00
UN2 - AN4 - 00
UN2 - C00 - 00
UN2 - 0M0 - 00
UN2 - 000 - 00
UN2 - AN4 - S0
UN2 - BN0 - 00
UN2 - D00 - 00

www.can2go.com
sales@can2go.com

5800 Saint-Denis, suite 222
Montreal, QC, Canada, H2S 3L5
T:1-514-313-8885 F:1-514-313-8894

Open and Interoperable System Architecture

CAN2GO can be used as a stand-alone solution, complete with programmable controllers and an embedded web building energy management system. It can also be integrated with BACnet, oBIX and IP/Ethernet building automation systems.



Management

CAN2GO Web BEMS

The CAN2GO Web BEMS is a building energy management system hosted directly by the CAN2GO controllers (no license fee). The Web BEMS can also export data and be integrated to third party solutions (BAS, cloud or software) using BACnet, oBIX or FTP.

Controllers

UN2 / VA2 / GW2

Fully programmable with **400MHz** processors, **64MB** of RAM and **2GB** of Flash. The controllers can network via wireless mesh, daisy-chain or IP/Ethernet. The controllers have embedded gateways and web servers. Protocol conversion is made in-node.

Easy retrofit peripherals

Addressing the needs of building owners and facility managers, CAN2GO offers a unique Easy Retrofit Solution enabling quick and easy retrofits of the most commonly found HVAC systems in commercial buildings.

The solution combines CAN2GO's controllers and Web BEMS with application specific peripherals (from multiple vendors) designed to handle popular HVAC equipment. The Web BEMS already has pre-configured objects matching those peripherals for easy integration and population of inputs and outputs. This combination greatly reduces commissioning time, while the wireless capabilities of devices reduces deployment time and inconvenience.

Third party devices

CAN2GO controllers can manage devices using multiple wired and wireless communication protocols including: EnOcean, ZigBee, Modbus and wired universal, analog and digital inputs and outputs.

Decorator Switches

echoflex

Echoflex Solutions Inc manufacture's the decorator style switch for wireless, self powered control – no batteries, no maintenance. The push of the button is enough to transmit a unique 32 bit RF telegram up to 30 m within a building (through the walls) and 300 m outdoors. Easily mounted into an existing wall box or by using the flush mounting plate (single, double or triple gang) affix the switches to walls (concrete, glass, timberframe, log) and even furniture. Available in two frequencies at 868Mhz or 315Mhz, Echoflex has the solutions for your control needs. Also available the Dual Decorator Style Switch. The Dual Rocker Decorator switch allows multiple controls from a single switch. Lower your cost and double your control.

PTM265

PTM265D

Wireless

Battery Free

RCM255

Power

Load

www.echoflexsolutions.com

Solutions: Shawn Pedersen
shawn_p@echoflexsolutions.com
Unit #1
38924 Queens Way
Squamish B.C.
V8B 0K8 Canada

Integration: Brian Aikens
brian_a@shaw.ca
Phone 1(888)ECHOFLX
1(888)324-6359
Local (604)815-0091
Fax (604)815-0078

The power of unused energy
enocean®

Decorator Switches

echoflex

Features and Technical Overview

Operating modes: ..... on-off, toggle, scene control
Power supply: ..... powered by finger press (Electrodynamic Energy Harvester)
Antenna: ..... Integrated 9cm whip antenna
Frequency:/Transmission power: ..... 315 or 868.3 MHZ / max. 10MW EIRP
Transmission range: ..... 300m LOS, 30m indoor typical
Energy bowtravel / Operating force::..... > 50,000 actuations tested to EN 60669 / VDE 0632
Operating temperature: ..... -25° to +65°C

Model	Description
Echoflex PTM265	Decorator Style Wall Switch
Echoflex PTM265D	Dual Rocker Decorator Wall Switch
Associated Products pictured above	
RCM255	for residential/office use of under 200W
also available	
ER1C-B	for full circuit loads up to 20A

Distribution by:

www.echoflexsolutions.com

Solutions: Shawn Pedersen
shawn_p@echoflexsolutions.com
Unit #1
38924 Queens Way
Squamish B.C.
V8B 0K8 Canada

Integration: Brian Aikens
brian_a@shaw.ca
Phone 1(888)ECHOFLX
1(888)324-6359
Local (604)815-0091
Fax (604)815-0078

The power of unused energy
enocean®

GreenEye Monitor™ Specifications

Power Metering

Number of Channels	32 (expansion available in the future)
Measurement	POWER: • True (or Real) Power using high speed volt and current sampling VOLTAGE: • True RMS
Accuracy	Power/Energy Measurements: • Typically +/- 1% plus CT accuracy Voltage Measurement: • Better than 1% with PT-Type value trimmed to a reference.
Sampling Frequency	Voltage sampled @ 20.8 kHz Current sampled @ 10.4 kHz
Maximum Input Current	Dependent on current transformer. Currents greater than 1,000A may be monitored.
Current Transformer Input	Type A CT with AC mV output: • 700 mV max for single CT • 350 mV max for each of two connected CT on a given channel Type B CT with AC mA output: • 103 mA max for single CT • 51.5 mA max for each of two connected CT on a given channel **NOTE:** • Exceeding the specified input values will affect channel accuracy. • Connecting a Type B CT to terminals designated for TYPE A CTs may cause a channel overload to the point that all channels display unpredictable power values
Input Impedance:	• 1,000 ohms for Type A CT connection. Terminals 1&2 and 3&4 • 6.8 ohm (burden resistor) for Type B CT connection. Terminals 2&3
Potential Transformer Input	3.5mm Jack PT Input: • Mono plug PT signal 8VAC to 18VAC. Voltages greater than 14VAC require a PT shorting jumper to attenuate PT signal. • Stereo plug: “sleeve” and “ring” connection, “tip” not connected. 333 mVAC without PT shorting jumper or 666mVAC with shorting jumper. Mini USB Jack Input: • PT signal to pins 3 and 4 of mini USB • 333 mVAC without PT shorting jumper or 666mVAC with shorting jumper

Potential Transformer (PT)	GEM supplied with UL/c wall transformer with < 2 degree phase error. Optional PT (part number PT01) may be ordered: • 1% accuracy • Input voltages between 120V to 480V. • 600V rated leads
Load/System Types	Single and Polyphase systems.
System Frequency	50Hz or 60Hz. Default is 60Hz. May be configured for 50Hz via setup software.
Resolution	Power: 1 Watt Energy: 1 Watt-Second (.000000277 kilowatt-hour) Voltage: 0.1 Volt
NET Metering	All channels are capable of NET metering. Two sets of watt-second counters are used for energy flow direction.
Watt-Second Counters	Each channel has two 5-byte incrementing watt-second counters, one absolute and one polarized. Counter "wrap around" occurs after 2^{40} watt-seconds or 305,419 kilowatt-hours.

Pulse Counting

Pulse Counting Channels	Four Individual pulse counters • Two dry contact inputs • Two DC pulse inputs
Counter Input	Counter #1 and #2: • Requires DC pulses • Galvanic isolated from GEM system via opto-isolator • Requires DC pulses between 3.5 and 24VDC. (5VDC ideal) Counter #3 and #4: • Requires "dry" contact closure from reed switch, relay, etc. • Input is not isolated from the GEM power supply therefore connection to this input must be isolated from the pulse source's power supply. This is typical when using reed switches.
Pulse Frequency	Less than 1pps (pulse/second) *Subject to change
Pulse Width (Duration)	Minimum pulse duration 550ms. *Subject to change
Counter Registers	Each counter has a 3-byte up-counter Counter wraps around when full 2^{24} pulses.
Counter Volatility	Counter values are stored in RAM and preserved by battery power when a power interruption occurs.

Temperature Sensing

Temperature Sensor Channels	8 Channels
Sensor Type	Uses 1-Wire Bus system Compatible with the following 1-Wire sensor types: • DS18B80 • DS18S80
1-Wire Bus	Uses three push terminals: • GND • DATA • +5 VDC "1-Wire" devices are connected in parallel For more info visit: http://www.1wire.org/
Conversion Interval	All temperature sensors perform a temperature conversion every 16 seconds
Sensor Read Interval	Each enabled temperature sensor is read once every 64 seconds One of eight temperature sensors is read every 8 seconds, hence 8 X 8 = 64 sec
Temperature Units	The GEM may be configured for Celsius or Fahrenheit degrees
Temperature Resolution	0.5^{o} C resolution. Fahrenheit degree values are derived from the C value and converted to 1 decimal point accuracy.

Communication

Standard Communication Ports	• RS-232 via COM1 and RS-232 via COM2 • 19,200 baud 8-bits, no parity, one stop bit (8N1) • GND, TX, RX no hardware flow control • Connection via "push terminals"
Optional Board SMT Soldered WiFi Module	Uses Roving Networks RN-171 WiFly Module • Receive Sensitivity: -83dB typical • Output Power: 12 dBm • Serial Communication 19,200 baud • On board wire whip antenna
Ethernet Module	Uses third party Ethernet Module • Supports: TCP, UDP, ICMP, IPv4 ARP, IGMP, PPPoE, Ethernet • Client, Server and Mixed modes. Default is "Client" mode • 10BaseT/100BaseTX Ethernet PHY • Configured via UDP using simple setup application

WiFi+Ethernet Module

Provides Both Wifi and Ethernet Options simultaneously

- Support 802.11b/g/n wireless standards
- Output Power:
  - 802.11b: +20dBm
  - 802.11b: +18dBm
  - 802.11b: +15dBm
- Web Configuration Page
- Supports WEP/WPA-PSK/WPA2-PSK/WAPI
- Encryption: WEP64/WEP128/TKIP/AES
- RP-SMA 2dBi external antenna

XBee® (ZigBee®) Module

- Socketed for Digi International XBee® ZB modules
- Accepts any of the three ZB-24 module antenna options
- Communicates at 19,200 baud
- Hardware flow control may be enabled
- GEM setup option provides the option of chunking data to XBee® modules in order to limit data flow restrictions inherent with ZigBee® protocol

Data Communication:

Real-Time Data:

- May be configured to "push" energy usage data at a user defined interval or "pull" data via API
- Various data packet formats available
- May be configured to post data using "POST" or "GET" methods
- Efficient binary packet options available
- Packet formats available for custom software development
- Custom packet formats may be available based on the project size

Setup and Setting Commands

- Documentation available listing the commands used to read or write GEM setup parameters

GEM Firmware Upgrades

Firmware upgrades may be accomplished using any of the communication options above including USB if a "serial to USB" adaptor is available.

Alternate Communication Options

Custom communication solutions are available via a 10-pin header or XBee® socket header providing access to UART TTL COM1 or COM2 ports.

NOTE: Contact Brultech support before attempting to use these headers! Improper use may damage the GEM and void warranty

GEM System

Power Supply

Volt and Current:

- 5VDC +/- 5% UL/CSA approved
- 1.5A AC Adaptor (typically uses less than 200mA depending on communication module used)

Consumption:

- Typically less than 1 watt

Power Connection:

- 2.1mm X 5.5mm barrel jack, center positive (standard)
- Optional power connection via mini USB jack instead of barrel jack

Isolation	• The GEM must not be installed in the electrical breaker panel! • All connection to the GEM must have galvanic isolation to the power-line • Signals to the GEM must be Class2 low voltage • Current transformers (CT) and the Potential Transformer (PT) connected to the monitored electrical panel must be UL/c listed and suitably rated above the maximum voltage and current to be encountered
LED Indicators	Tri-color system LED (left side) • Displays system status, packet transfer, etc. Two color communication device status (right side) • Displays status of the communication module. Color sequence depends on the module installed • When no communication modules are installed only the green LED will come on when 5VDC power is present. This is due to the jumper connection between pins 2 and 7 of the header (#9)
Battery	• CR-2032 battery used for memory backup when 5VDC power is lost • Typically drains less than 2 uA when GEM is powered down • Life: approximately same as battery shelf life • Battery replacement should be done while GEM is powered up if accumulated watt-second, counter and time values are to be preserved
Memory Backup	• Uses EEPROM to store GEM user settings • Battery backup holds CPU ram content during power outages. This includes all watt-second, counter and time registers
Operating Temperature	Better than: 0 - 40C (TBD)
Humidity	5% to 95% non-condensing
Enclosure Material	UL94-V0 ABS Plastic
Dimensions	9 1/8” X 7 1/8” X 2”
Weight (GEM Device)	Between 1.2 and 1.4 pounds depending on installed modules
FCC Certification	The GEM complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Depending of the GEM options, the following wireless modules may be installed in the GEM: • Roving Networks WiFly Module FCC ID: T9J-RN171 • Digi International XBee® Module FCC ID: OUR-XBEE2 • WiFi Module FCC ID: AZYHF-A111

SPLIT-200 Current Transformer

FEATURES

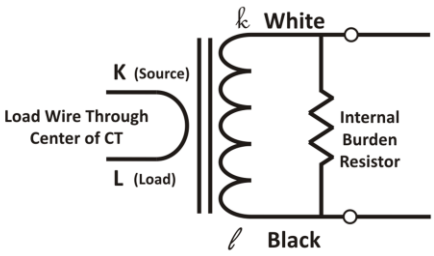
- **Very Accurate**
- **Easy installation**
- **"Split –core" style eliminates the need to disconnect the load wire**

c UL us
E325090

The SPLIT-200 CT is commonly used for monitoring the main panel feed of 200A service panels. This is a high quality current transformer constructed with a special nickel-iron alloy providing excellent linearity and accuracy. The meshed lamination design reduces the possibility of measurement error caused by debris in the core mating area.

Specifications

Current	1 - 250A (360A Max)
Rated Output	333mV @ 200A
Frequency Range	50Hz – 60Hz
Accuracy	+/- 1%
Linearity	0.5%
Phase Angle Error @ Rated Current	< 1°
Max Diameter of Sensed Conductor	0.98" diameter
Lead Length	3 m (9'10")
Lead Rating	UL-2468 24AWG 300V
Certification	UL/c Recognized (USA and Canada)
Dielectric Withstanding Voltage	2.5kV/1mA/1min
Insulation Resistance	DC500V/100MΩ min
Impulse Withstanding Voltage	5kV Peak
Operating Temperature Range	-45 ~ 80 ℃



Brultech Research Inc
www.brultech.com

Micro-50 Current Transformer

FEATURES

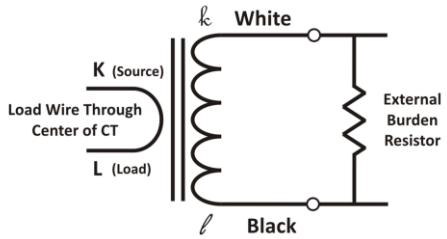
- Small Size
- High Accuracy
- Low Cost

c UL us
E325090

The Micro-50 is miniature donut style current transformer. It's high accuracy and low cost makes it ideal for branch circuit monitoring of electrical panels where accuracy is important.

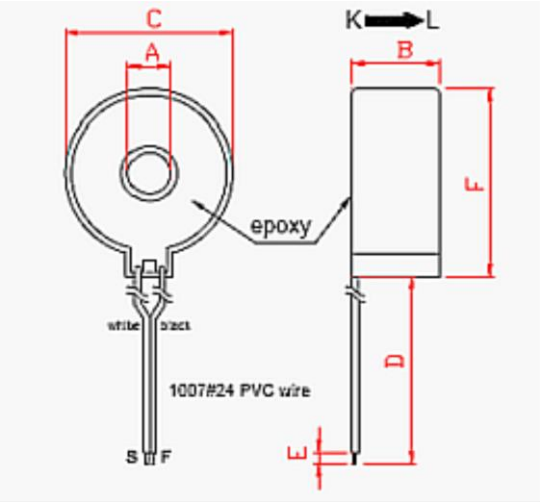
Specifications

Current	0.2A – 40A
Rated Output	6.66mA @ 10A
Frequency Range	50Hz – 60Hz
Accuracy	+/- 1%
Max Diameter of Sensed Conductor	0.35" diameter
Lead Length	1.5 m
Lead Rating	UL-1007 24AWG 300V
Certification	UL/c Recognized (USA and Canada)
Dielectric Withstanding Voltage	2.5kV/1mA/1min
Impulse Withstand Voltage	5 kV Peak
Insulation Resistance	DC500V/100MΩ min
Operating Temperature Range	-40 ~ 85 °C



NOTE: The Micro-50 CT has no internal burden resistor

A	9mm (0.35")
B	8.2mm (0.32")
C	22mm (0.87")
D	1500mm (59")
E	10mm (0.39")
F	25mm (0.984")



Brultech Research Inc
www.brultech.com

Item Code: RTGS002085 **Part Number:** NANO 1000

Nano 1000 - Intel Core i3 3217U - 8GB DDR3, 120GB SSD, HD 4000 Graphics - Dual HDMI, 802.11n, Wifi, Giga LAN, USB 2.0

Product may not be as shown

Avg. Rating: No reviews yet
» Write a Review
» Add to Wishlist
» Email to a friend

Our Price **$549.00**

Up to $27.45 additional bundle discount available.

Save additional $27.45 for online ship out order!

Promotion ends 2013-09-30.
(Terms & Conditions)

CANADA COMPUTERS WARRANTY

- None, I do not want canada computers warranty
- 2 Year Enhanced Extended Depot Warranty $71.37
- 3 Year Enhanced Extended Depot Warranty $82.35

Quantity: 1 + Add to Cart

Special Notes:

4" x 4" Foot print
Lighting speed for everyday computing
Full HD Blu-Ray support
Super energy efficient
WiDi Ready
Gigab LAN & USB 2.0

Bundle Options - Click More, Save More!


Microsoft Office Bundle Discount


Microsoft Office Bundle Discount


Microsoft Office Bundle Discount

Microsoft Windows Bundle


Microsoft Windows Bundle

Stock Level	Overview	Specifications	Warranty	Reviews

Brand	Canada Computers
Model	Nano 1000
Type	Mini PC
Operating System	No OS
Form Factor	Mini PC
Processor Model	Intel Core i3 3217U
Processor Speed	1.8 GHz
Graphics	Integrated

My Shopping Cart

Subtotal **$0.00**

Checkout

Subtotal is the calculation before taxes and fees.

No Optical Drive (19/19)

Form Factor All
- MID Tower (81/81)
- Small Form Factor (29/29)
- Ultra Small Form Factor (8/8)
- Mini PC (47/47)

Operating System All
- Windows 8 (50/50)
- Windows 7 Home Premium (9/9)
- Windows 7 Professional (50/50)
- Linux (1/1)
- Dos (2/2)
- NO OS (54/54)

Keywords:

Manufacturer: All

Search

Price Range
- $0.00-$199.99 (4)
- $200.00-$299.99 (19)
- $300.00-$399.99 (23)
- $400.00-$499.99 (29)
- $500.00-$599.99 (40)
- $600.00-$699.99 (29)
- $700.00-$799.99 (45)
- $800.00-$999.99 (53)
- $1,000.00-$1,499.99 (24)
- $1,500.00-$4,400.00 (13)

Standard Memory	8 GB
Hard Drive Capacity	Non HDD
SSD Capacity	120GB
Optical Drive	No Optical Drive
Operating System	No OS

Partners / Shop By Brand

AMD Fusion Partner Elite

Intel Channel Partner Premier 2010

acer Antec ASUS AVerMedia belkin brother Canon Cooler Master
CORSAIR CREATIVE CyberPower D-Link GIGABYTE Kingston lenovo
LG LINKSYS Logitech Mediasonic Microsoft msi mushkin
NVIDIA Nikon OCZ PATRIOT QNAP SAMSUNG SAPPHIRE
Seagate SONY TP-LINK wacom WD VONNIC
Pioneer RAZER SHARP SIERRA TIGER TRIPP-LITE xerox ZOTAC

Community
- CC Hotspot Blog
- Facebook
- Twitter
- Youtube
- Forums
- Pinterest
- Instagram
- Weibo

Resources
- Newsletter
- RSS Feed
- Daily Deals
- Weekly Specials
- Bundle Deals

My Account
- Login
- My Account
- Online Shopping
- View Cart
- View Wish List
- Order History

Customer Services
- Frequently Asked Questions (FAQ)
- Service Centre
- Mail-in-Rebate Centre
- Contact Us
- Customer Feedback
- Warranty Plans
- Product Request

About Us
- About us
- Contact us
- Career
- Store Locations & Hours
- Corporate Sales
- Wholesales
- Vonnic Installer Club

Policies
- Recycling Fee
- Privacy Policies
- Online Policies
- Shipping Policies
- Returns & Warranty
- Terms & Conditions
- AODA policy

$ PRICE $ MATCH IT!

Galaxy TAB 2™ 10.1''

GT-P5113 79 REVIEWS

SAR Information

Table view

Platform

Operation System	Android 4.0 (Ice Cream Sandwich) Operating System
Browser	Android 4.0 (Ice Cream Sandwich) Operating System

Physical Specifications

Dimension(HxWxD)	175.26 x 256.54 x 9.65 mm
Weight	581 grams

Display

Internal	**Technology**	TFT
	Resolution	1280 x 800 screen resolution
	Size	10.1" display size

Camera

Camera Resolution	3.0 MP Camera
Digital/Optical Zoom	Digital Zoom
Shot mode	3 shot modes available
Photo Effects	3 photo effects available

Video

Video player	mp4, wmv, avi / divx, mkv, flv, webm format support.
Video recording	Video recording available

Music & Sound

Music Player	y, mp3, aac / aac + / eaac + , wma, ogg, flac, ac-3 music player format support

Poly Ringtones	Polyphonic Ringtones Available
MP3 Ringtone	MP3 Ringtone Available
DRM	DRM Available (OMA v 1.0 FL)
Music Library	Music Library Available

Fun&Entertainment

Embedded Wallpaper	10 wallpapers available

Messaging

SMS/EMS/MMS	SMS, MMS, Video messaging supported
Predictive Text Input T9	Predictive Text Input T9 Available
Email	Email Available
Instant Messaging	Instant Messaging

Connectivity

Bluetooth	Bluetooth™ version 3.0
USB	USB available
Internet HTML Browser	Internet HTML Browser Supported

Memory

User Memory	16 GB Internal memory
External Memory	up to 32 GB MicroSD

Personal Information Management

Calendar	Calendar Available
Scheduler	Scheduler Available
To do list	To do list available
Clock	Clock Available
Worldtime	World Time available
Alarm	Alarm Available
Currency converter	Currency Converter available
Converter	Converter Available
Calculator	Calculator Available
Memo book	Memo book available
Stop Watch	Stop watch
Countdown Timer	count down available

Call Function

Speaker Phone	Speakerphone Available

About Samsung
Careers
News
Affiliated Companies
Investor Relations
Samsung Recycling Direct™
Hope for Children
Sign up for our newsletter
The Samsung Store

Mobile
Mobile Phones
Galaxy Note
ATIV
Tablets
Galaxy Camera

TV & Video
TV
Blu-ray Players
Home Entertainment
Wireless Audio

Camera & Camcorder
SMART Cameras
Galaxy Camera
SMART Camcorders

Computing
ATIV
Chrome Devices
Monitors
Printer & Multifunction

Home Appliances
Refrigerators
Washers & Dryers
Microwaves
Dishwashers
Ranges
Vacuums
LED Lighting

Accessories
Mobile Accessories
Tablet Accessories
TV Accessories
SMART Camera NX Lenses
SMART Camera NX Accessories
SMART Camera Accessories
Supplies & Accessories
More Accessories

Find product support
Get downloads
How-to Guides
Articles
Contact us
Accessibility Help

Search

Canada / English
Low bandwidth version
FEEDBACK

Business Privacy Legal Contact Us Careers Sitemap

Your very own digital canvas.

Whether you're creating movies and music or enjoying them, XPS 15 delivers the power of 3rd Gen Intel® Core™ processors in a thin package that's crafted from the finest materials.

Featured at $1,299.99[1]

Processor

3rd Generation Intel® Core™ i5-3230M processor (3M Cache, up to 3.2 GHz)

Operating System

Windows® 7 Home Premium, 64bit, English
Windows® 7 Professional, 64bit, English
Windows® 7 Ultimate, 64bit, English
Windows 8 Pro, 64-bit, English
Windows 8, 64-bit, English
Windows 8 Pro, 64-bit, MUI French/English

Memory[9]

6GB DDR3 1600MHz Memory
8GB DDR3 1600MHz Memory
12GB DDR3 1600MHz Memory
16GB DDR3 1600MHz Memory

Chipset

Intel® HM77

Video Card

NVIDIA® GeForce® GT 630M with 1GB GDDR5 VRAM
NVIDIA® GeForce® GT 640M with 2GB GDDR5 VRAM

Display

Silver Anodized Aluminum and 15.6" FHD 1080p Truelife WLED Display and Skype-Certified HD Webcam

Audio and Speakers

High Definition Audio + Waves MaxxAudio® 4
2W x2 = 4W total

Productivity & Entertainment Software

Adobe® Reader X, WebCam Central, Skype™ with H.264 enablement, Internet Explorer, Windows Live™ Essentials Wave 4, McAfee SecurityCenter trial, Dell DataSafe

Hard Drive

Up to 1000GB[10] SATA hard drive (5400RPM)
Up to 750GB[10] SATA hard drive (7200RPM)

Optical Drive

Integrated slot load DVD-RW or Blu-ray Disc drive

Glass integrated button touchpad with gesture support

Construction

Machined aluminum in silver
Aluminum display back
Silicone base with machined aluminum casing
Magnesium palmrest with soft touch paint

Power

65WHr battery; 9-Cell Li-Polymer (built-in)*

* *Battery is built-in to the laptop and is not replaceable by the customer.*

AC Adapter

90W AC adaptor

Camera

1.3MP webcam with dual array digital microphones

Wireless

Killer™ Wireless-N, 1202 for Video 7 Voice + BT 4.0

Ports, Slots & Chassis

USB 3.0 (3, 1 w/Powershare), mini DisplayPort (1), HDMI (1), RJ-45 (1), 3-in-1 media card reader, headphone jack (1), headset jack (1), Kensington lock

Dimensions(HxWxD)

Height: 0.91" (23.2mm) / Width: 14.6" (371mm) / Depth 9.8" (249mm)

Starting at Weight[11]

Starting at 5.79lbs (2.6kg)

Regulatory

Product Safety, EMC and Environmental Datasheets
Dell Regulatory Compliance Home Page
Dell and the Environment

Table 1. Product Specifications

Feature	**Description**
Performance	
Switching capacity Forwarding capacity	3.2 Gbps Forwarding rate in million packets per second (mpps) (based on 64-byte packets): 1.4 mpps
Layer 2 Switching	
Head-of-line (HOL) blocking	HOL blocking prevention
Jumbo Frame	9216 bytes
Quality of Service (QoS)	
Priority levels	4 hardware queues
Scheduling	Priority queuing and weighted round-robin (WRR)
Class of service	802.1p priority based
Product Specifications	
Ports PoE	16 RJ-45 connectors for 10BASE-T/100BASE-TX 8 PoE ports with 64W dedicated power budget
Cabling type	Unshielded twisted pair (UTP) Category 5 or better for 10BASE-T/100BASE-TX; 1000BASE-T recommended
LEDs	System/PWR, Link/Activity, 100M,* PoE, Max PoE, Gigabit,* mini-GBIC* **if present*
Standards	802.3 10BASE-T Ethernet 802.3u 100BASE-TX Fast Ethernet 802.3ab 1000BASE-T Gigabit Ethernet

	802.3z Gigabit Ethernet 802.3x flow control 802.1p priority IEEE 802.3az, Energy Efficient Ethernet 802.3af , Power Over Ethernet
Environmental	
Dimensions W x H x D Unit weight Power Certifications	6.29 x 3.54 x 1.69 inches (160 x 90 x 43 mm) 0.99 lb. (0.45 kg) 100-240VAC, 50-60 Hz, internal, universal UL (UL 60950), CSA (CSA 22.2), CE mark, FCC Part 15 (CFR 47) Class A
Operating temperature	32° to 104°F (0° to 40°C)
Storage temperature	-4° to 158°F (-20° to 70°C)
Operating humidity	10% to 90%, relative, non-condensing
Storage humidity	10% to 90%, relative, non-condensing
Package Contents	
• Cisco 100 Series Switch • Power cord/power adapter • Mounting hardware • Quick-start guide	
Minimum Requirements	
• Category 5 Ethernet network cable • TCP/IP, network adapter, and network operating system (such as Microsoft Windows, Linux, or Mac OS X) installed on each computer in the network	

RT-N16

Network Standard

IEEE 802.11b, IEEE 802.11g, IEEE 802.11n

Product Segment

N300 complete networking; 300Mbps

Data Rate

802.11b : 1, 2, 5.5, 11Mbps
802.11g : 6,9,12,18,24,36,48,54Mbps
802.11n : up to 300Mbps

Antenna

External antenna x 3

Operating Frequency

2.4GHz

Encryption

64-bit WEP, 128-bit WEP, WPA2-PSK, WPA-PSK, Radius with 802.1x

Firewall & Access Control

Firewall: NAT and SPI (Stateful Packet Inspection), intrusion detection including logging
Logging: Dropped packet, security event, Syslog
Filtering: Port, IP packet, URL keyword, MAC address

WAN Connection Type

Internet connection type : Automatic IP, Static IP, PPPoE(MPPE supported), PPTP, L2TP

Ports

1 x RJ45 for 10/100/1000 BaseT for WAN, 4 x RJ45 for 10/100/1000 BaseT for LAN, Support Ethernet and 802.3 with max. bit rate 10/100/1000 Mbps and auto cross-over function(MDI-X)
USB 2.0 x 2

OS Support

Windows® 8 , 32bit/64bit
Windows® 7 , 32bit/64bit
Windows® Vista , 32bit/64bit
Windows® XP , 32bit/64bit
Mac OS X
Linux

Dimensions

216 x 161.9 x 40.5 mm (WxDxH)

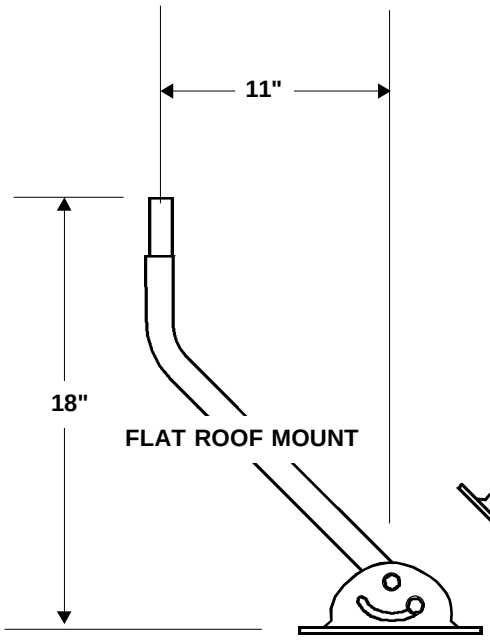
Weight

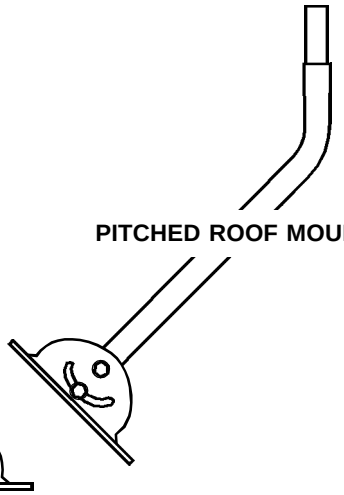
470 g

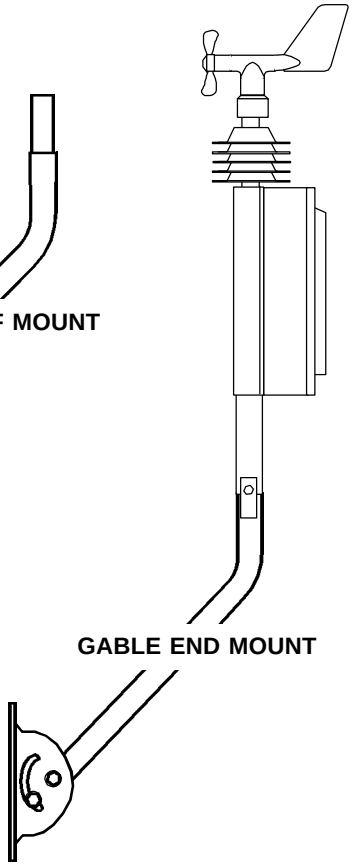
Router Special Features

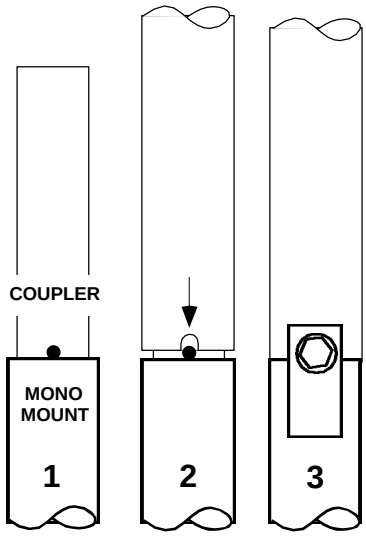
3G/4G data sharing AiCloud Printer server Download Master AiDisK Multiple SSIDs Parental Control

MKIII MONO MOUNT



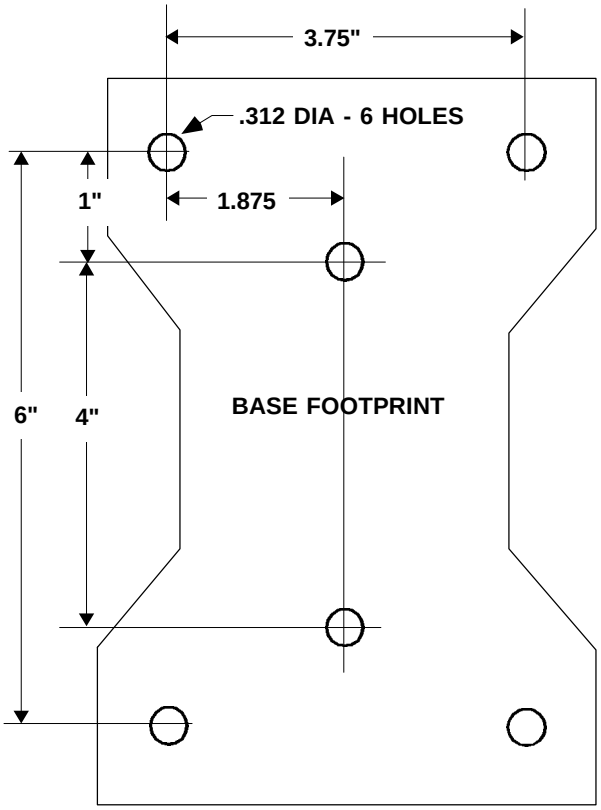


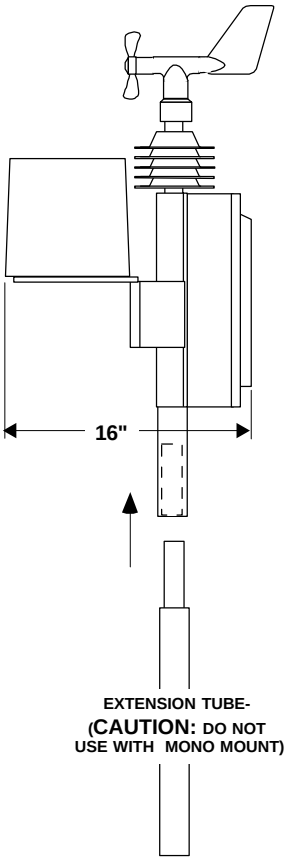




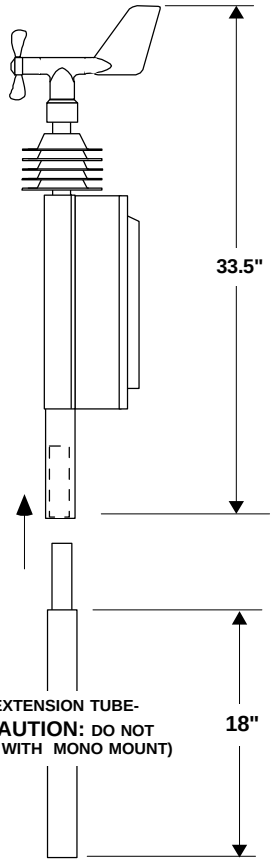
INSTRUCTIONS FOR SECURING THE MKIII TO THE MONO MOUNT

1. Place the coupler into the mount tube Rotate the coupler until the hole is facing you.
2. Lower the MKIII onto the coupler, aligning the slot with the hole.
3. Fasten the clamp loosely in place with the screw provided. Rotate the station until the solar panel is facing TRUE SOUTH. Tighten the clamp screw to prevent rotation of the MKIII.





MKIII WITH INTEGRAL RAIN GAUGE



MKIII

RainWise® Inc.
P.O. Box 443 • BAR HARBOR, MAINE 04609-0443 • 800-762-5723
VISIT OUR WEBSITE AT www.rainwise.com

NOTE: This equipment generates and uses radio frequency energy, and if not installed properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

* Reorient the receiving antenna.
* Increase the separation between the equipment and the receiver.
* Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
* Consult the dealer or an experienced radio/television technician for help.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

GUARANTEE

RainWise, Inc. warrants this new ***MK III*** weather station against defects in materials and workmanship for a period of two years from the date of purchase, and agrees to repair or replace any defective product without charge. Additionally, the solar panel is guaranteed for five years from the date of purchase.

This warranty does not cover damage resulting from accident, misuse or abuse, lack of reasonable care, the fixing of any attachment not provided with the product or damage due to a lightning strike. RainWise will not reimburse for take down or reinstallation charges. RainWise will not pay for any warranty service performed by a non-authorized repair service and will not reimburse the consumer for damage resulting from warranty service performed by a non-authorized repair service. No responsibility is assumed for any special, incidental or consequential damages. No other warranty, written or oral is authorized by RainWise, Inc. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state. Some states do not allow the exclusion , incidental or consequential damages, so the above exclusions and limitations may not apply to you.

To return a unit under warranty call **1-800-762-5723** . For a period of 90 days after date of purchase, RainWise will issue a UPS call tag for pickup of the equipment at your address. RainWise will also pay for return UPS charges. If expedited shipping is requested, the excess cost must be paid by the customer. After 90 days from the date of purchase, the customer is responsible for all shipping charges. **Make sure that the equipment is properly packed. . . preferably in the original box, because damage incurred in shipping is not covered by this warranty.**

If you are having a problem . . . before you call:

Check the cable connections to the receiver box and the display. Make sure that the cable is plugged in correctly. It should snap and lock into position on both ends.

Please have the the serial number of your ***MK III*** available if you call. It will also save time if you have your display near the phone.

FOR SERVICE, CALL: 1-800-762-5723

RainWise Inc.
P.O. BOX 443 - BAR HARBOR, MAINE 04609 - 800.762.5723

Instructions

for the RainWise
MK-III RTI-LR
Weather Transmitter

Equipped With an Integral - mounted Rain Gauge

LONG RANGE VERSION

Rev: 1.1 - 07-18-06

Congratulations. . . You are unpacking the ultimate in weather watching. This ***MKIII*** is the result of 29 years of experience in the design and manufacture of fine weather instrumentation.

A word about location and instrumentation:

In order to obtain accurate measurements from the MK-III-RTI-LR it must be correctly located. For accurate wind readings the MK-III RTI-LR should be mounted so that it is not obstructed by an structures or trees. If the unit is to be mounted on a roof, it should be at least 2 1/2 feet above the roof line. The station should also be mounted in a location where it will receive the maximum amount of sun exposure. Avoid locating the station near any heat sources such as chimneys or vents. If possible avoid mounting the station above large dark surfaces that may heat up in the sun. If you are mounting the station on a roof, try locate it as close to the edge as possible.

Regardless of how you mount the system, the bottom of the electronic enclosure should not extend more than 12" or less than 7" above the support of the mounting tube.

The MK-III-LR has a range in excess of a mile. This range is based on an unobstructed true line of site installation. Actual range will vary depending on the installation. Trees, structures, walls (including glass) will reduce this distance. The closer you can keep the transmitter to the receiving devices the better. Always test the range before making the final installation. In most cases a range of 400 to 500 feet does not present any issues.

We also suggest that you operate your system at ground level and make sure that it operates properly prior to installation. Consult the instructions for your display and/or computer interface.

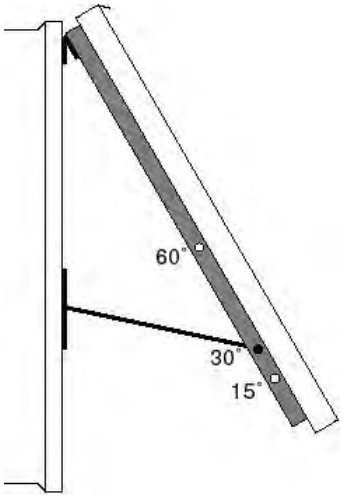
1. Mount the support tube as indicated above. Insert the necked down end into the ***MKIII*** sensor assembly, until it bottoms with the retaining screw in the slot. Tighten the screw.

2. Rotate the assembly until the solar panel faces TRUE SOUTH, TRUE NORTH if you are in the southern hemisphere. Secure the support tube to the assembly from rotating.

3. Adjust the solar panel angle for optimum performance. Use the table below to determine your optimum angle.

Latitude	Panel Angle (from vertical)
0° - 22.5°	60°
22.5° - 55°	30°
55° - 90°	15°

4. The top of the solar panel is hinged. Lift the bottom of the solar panel up and insert the two support bars into the appropriate mounting holes in the solar panel.



5. Turn the system on by pulling switch forwards towards the front of the unit. The switch will click into position. The system is now transmitting.

This completes the assembly!

MKIII C8051 Specifications

MKIII MSP430 Sensor Assembly

Power Specification:

Power Requirements:	6V 5AH AGM Sealed Lead Acid, 0.6W Solar Panel

Operating Environment:

Temperature:	-40 ~ 70°C
Humidity:	0 ~ 100% Condensing

Ambient Air Temperature Sensor:

Range:	-54°C ~ 74°C
Accuracy:	±0.5°C

Relative Humidity:

Range:	0 ~ 100%
Accuracy:	±2% at 25°C

Barometric Pressure:

Range:	551 ~ 1084 mbar
Accuracy:	± 1.69 mbar mbar at 25°C

Liquid Precipitation:

Range:	0 ~ 762 mm/hr
Accuracy:	±2% at 25.4 mm./hr
Resolution:	0.254 mm.

Wind Direction:

Range:	0 ~ 360°
Accuracy:	±11.25°
Resolution:	22.5°, No Deadband

Wind Speed:

Range:	0 ~ 67 m/s
Accuracy:	±2% of full scale
Resolution:	1.0 unit

Radio Transmitter

2.4GHz

Operational Temperature:	-40 ~ 85°C
Outdoor Line-of-Sight Range:	Up to 1600 m, up to 750 m EU Variant
Transmit Power Output:	18dBm, 10 dBm for EU Variant
Operating Frequency:	ISM 2.4GHz

418/433MHz

Operational Temperature:	-30 ~ 70°C
Outdoor Line-of-Sight Range:	Up to 122 m
Transmit Power Output:	0dBm
Operating Frequency:	418MHz, 433MHz

MKIII C8051 Optional Sensors

Pyranometer Sensor:

Operational Temperature:	-25 ~ 55°C
Range:	0 ~ 1750 W/m^2
Accuracy:	±5%
Cosine Response 45°:	±1%
Cosine Response 75°:	±5%
Resolution:	1 W/m^2

Leaf Wetness:

Operational Temperature:	0 ~ 70°C
Senses:	Dew and Precipitation
Resolution:	Wet or Dry

UV Sensor:

Range:	0 ~ 15 UVI
Spectral Response:	290 ~ 400 nm
Accuracy:	±10%
Resolution:	0.1 UVI

C ADMINISTRATIVE MODIFICATION

APPROVED
By Joe Simon at 1:40 pm, Jul 23, 2012

Request for mounting a weather station

Extruding the Solar Envelop

Team Ontario would like to request permission to install a RainWise MK-III LR weather station on the roof of the *echo* home.

The station would not have significant impact, if any, on shading the other competitors. The station would be located on the south-west corner of the roof and mounted on the edge of the proposed exo-structure. The location of the *echo* home is on a corner lot such that the west and north sides are directly exposed to the public. Hence, with the station reaching a total height of 4'- 3.5" (see figure 1) on the exo-structure currently designed at maximum height of 18', this will not restrict sunlight on any of the adjacent neighbours.

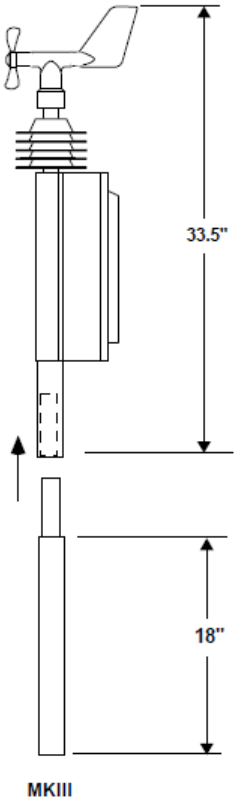


Figure 1: A diagram showing the height of the weather station.

The compact weather station would allow Team Ontario to collect an array of data, including pressure, temperature, wind speed/direction, humidity, and more. This data would then interface with the various automation systems in the home, allowing the weather station to not only inform the occupants about outside conditions, but to also help the home make smarter and more energy saving decisions.

Thank you for your consideration.

Sincerely,

Team Ontario, Solar Decathlon 2013.

APPROVED
By Thomas Meyers CBO at 5:11 pm, Feb 04, 2013

Tom Meyers
Building Official
U.S. Department of Energy Solar Decathlon

Re: Request for Administrative Modification

Team Ontario is requesting an administrative modification under the IRC Section R104.10 to have a use a window within our second bedroom which does not meet the minimum size requirement of an egress window for a bedroom under the IRC. We request this modification based on the following conditions:

- Our window supplier was unable to manufacture a single casement window to our specifications due to their hinges not be able to support the weight of our triple pane window design.
- Within the Ontario Building Code, based on section 9.7.1.1.(1) which states "Except where a door on the same floor level as the bedroom provides direct access to the exterior, every floor level containing a bedroom in a *suite* shall be provided with at least 1 outside window that…" (see attached document), in Ontario, Canada, which will be the final resting place of Team Ontario's house, it is not required to provide an egress window in every bedroom on the ground floor. In our case, since our house is a bungalow and has 3 doors leading directly outside on the same level, we would not be required to provide an egress window in this bedroom.
- During the competition, the only time the house will be assembled outside the province of Ontario, the room will not be occupied for sleeping, so this will not be used as a bedroom during this period.
- Our house will have an installed a fire suppression sprinkler system and the dispensation afforded in Section 1029 of the International Building Code should be applicable in this circumstance. This will allow for a delay in fire growth, allowing additional egress time for the occupant.

Based on these conditions, we hope an administrative modification will be issued allowing us to use a window that does not meet the IRC's minimum egress requirements for a bedroom window, but that meets all of the requirements of the Ontario Building Code, which have jurisdiction in the final resting place of Team Ontario's house

Regards,

Karl Kadwell

Project Manager
Team Ontario
U.S. Department of Energy Solar Decathlon 2013
E: karl.kadwell@ontariosd.ca
P: 613-533-6682

Section 9.7. Windows and Skylights

9.7.1. General

9.7.1.1. Application

(1) Windows and skylights shall conform to the requirements of this Section.

9.7.1.2. Minimum Window Areas

(1) Except as required in Article 9.7.1.3. and Sentence (3), the minimum window glass area for rooms in *buildings* of *residential occupancy* or that are used for sleeping shall conform to Table 9.7.1.2.

(2) The unobstructed glass area of a door or skylight is considered equivalent to that of a window.

(3) Work areas in *live/work units* shall conform to Clause 3.7.2.1.(2)(a).

(4) Where rooms with different requirements for window glass area are combined as described in Sentence 9.5.1.4.(1), the more restrictive requirement shall govern.

Table 9.7.1.2.
Glass Areas for Rooms of Residential Occupancy
Forming Part of Sentence 9.7.1.2.(1)

Location	Minimum Unobstructed Glass Area	
	With No Electric Lighting	With Electric Lighting
Laundry, *basement* recreation room, unfinished *basement*	4% of area served	Windows not required
Water-closet room	0.37 m^2 (4 ft^2)	Windows not required
Kitchen, kitchen space, kitchen alcove	10% of area served	Windows not required
Living rooms and dining rooms	10% of area served	10% of area served
Bedrooms and other finished rooms not mentioned above	5% of area served(1)	5% of area served(1)
Column 1	2	3

Notes to Table 9.7.1.2.:
(1) See Article 9.7.1.3.

9.7.1.3. Bedroom Windows

(1) Except where a door on the same floor level as the bedroom provides direct access to the exterior, every floor level containing a bedroom in a *suite* shall be provided with at least 1 outside window that,
(a) is openable from the inside without the use of tools,
(b) provides an individual, unobstructed open portion having a minimum area of 0.35 m^2 (3.8 ft^2) with no dimension less than 380 mm (15 in), and
(c) maintains the required opening described in Clause (b) without the need for additional support.
(See Appendix A.)

(2) Except for *basement* areas, the window described in Sentence (1) shall have a maximum sill height of 1 000 mm (3 ft 3 in) above the floor. (See Appendix A.)

U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

Joseph Simon
Solar Decathlon Competition Manager
National Renewable Energy Laboratory
303-886-8213 | joseph.simon@nrel.gov

Team Ontario,

This letter is to confirm that the Organizers have discussed and approved Team Ontario's plan to use water instead of glycol in their mechanical system while in Irvine, CA. The set point for the maximum temperature of the cold water tank shall be set to 11°C during the competition.

It is the understanding of competition management that the only benefit you are receiving from this approach relates to your operational aspects (not having to plan for the disposal or spill of the glycol) and not any competition aspects.

You have permission to use water only for your system yet talk about a glycol-based system for your target market.

The provided energy analysis has been reviewed and the approach has been confirmed by Tom Meyers.

Joe Simon