TECHNICAL SPECIFICATIONS FOR:

PROJECT	:	THE CELL HOUSE PROPOSAL FOR THE SOLAR DECATHLON 2007 UNIVERSITY OF PUERTO RICO
TEAMS	:	ARCHITECTURE CIVIL ENGINEERING MECHANICAL ENGINEERING ELECTRICAL ENGINEERING AGRICULTURAL SCIENCES BUSINESS ADMINISTRATION
DATE	:	MARCH 6, 2007

SECTION 01045 - CUTTING AND PATCHING

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A. Cutting and patching includes cutting into executed construction work to provide for the performance of other work and subsequent fixing and patching required to restore surfaces to their original condition.

B. Cutting and patching is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.

1.02 QUALITY ASSURANCE:

A. Requirements for Structural Work:

Do not cut and patch structural work in a manner that would result in a reduction of load-carrying capacity or of load-deflection ratio.

B. Before cutting and patching the following categories of work, obtain the Architect/Engineer's approval to proceed with cutting and patching:

1. Structural elements.
2. Foundation construction.
3. Bearing and retaining walls.

C. Operational and Safety Limitations:

Do not cut and patch operational elements or safety related components in a manner that would result in a reduction of their capacity to perform in the manner intended, including energy performance, or that would result in increased maintenance, or decreased operational life or decreased safety.

D. Visual Requirements:

Do not cut and patch work on the building's exterior or in it's occupied spaces, in a manner that would, in the Architect's opinion, result in lessening the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patch work. Remove and replace work judged by the Architect to be cut and patched in a visually unsatisfactory manner.

1.03 SUBMITTALS:

Where prior approval of cutting and patching is required, submit proposed procedures for the work. Include the following information in the submittal:

A. Describe the work and how it is to be performed, indicating why cutting and patching cannot be avoided.

B. List utilities that will be disrupted by work, including those that will be relocated and those that will be out-of-service temporarily.

C. Where cutting and patching of structural work involves the addition of reinforcement, submit details and engineering calculations prepared by and Engineer for the approval of the Structural Engineer.

D. Approval by the Architect/Engineer to proceed with cutting and patching work does not waive the Architect/Engineer's right to require complete removal and replacement of work found to be unsatisfactory.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Except as otherwise indicated, directed or approved by the Architect/Engineer, use materials for cutting and patching that are identical to existing materials. Refer to the section of the Specifications of said material for additional information.

B. If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Consult with Architect before proceeding with Work.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Before cutting, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.

B. Before the start of cutting work, meet at the work site with all parties involved, including mechanical and electrical trades. Review areas of potential interference and conflict between the various trades. Coordinate layout of the work and resolve potential conflicts before proceeding with the work.

3.02 PREPARATION:

A. To prevent failure provide temporary support of work to be cut.

B. Protect other work during cutting and patching to prevent damage.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take precautions not to cut existing pipe, conduit or duct serving the building but scheduled to be relocated until provisions have been made to bypass them.

3.03 PERFORMANCE:

A. General:

Employ skilled workmen to perform cutting and patching work. Except as otherwise indicated, proceed with cutting and patching at the earliest feasible time and complete work without delay.

B. Cutting:

1. Cut the work using methods that are least likely to damage work to be retained or adjoining work.

2. Use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as a carborundum saw or core drill to insure a neat hole. Cut holes and slots neatly to size required with minimum disturbance of adjacent work.

3. By-pass utility services such as pipe and conduit, before cutting, where such utility services are shown or required to be removed, relocated or abandoned. Cut-off conduit and pipe in walls or partitions to be removed. After by-pass and cutting, cap, valve or plug and seal tight remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter.

4. Comply with requirements of applicable sections of Division 2 where cutting and patching requires excavating and backfilling.

C. Restoration of Surface (Patching):

A. Restore exposed finishes of patched areas, and where necessary, extend finish restoration into retained adjoining work in a manner which will eliminate evidence of patching and refinishing.

B. Comply with the requirements of the Section of the Specifications of the material that will be used to patch.

D. Cleaning:

Thoroughly clean areas and spaces where work is performed or used as access to work. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied.

END OF SECTION 01045

SECTION 01050 – FASTENING DEVICES

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A. Work includes the fastening of all items which are located on the roof and exterior walls. These include, but are not limited to: air conditioning and ventilation equipment; ducts; electric facilities; windows; decorative panels; and exterior signage.

B. It is the intention of this Section to require the Contractor to properly fasten items which are located on the roof and exterior walls to provide the necessary fasteners so that items are properly fastened to comply with code requirements, but not less than wind loads of 90 mph with a gust factor of 1.25.

C. In the event that the fastening of a particular item is indicated elsewhere in the Contract Documents, the Contractor shall provide the manufacturer's recommendation to comply with wind load requirements, and the more stringents requirements shall apply.

1.02 QUALITY ASSURANCE:

Provide the recommendation of the manufacturer of the item being fasten or that of a Structural Engineer for compliance with wind load requirements stated above or otherwise required in the Contract Documents.

1.03 SUBMITTALS:

With the product data and/ or shop-drawings of each item located on the roof or exterior walls, provide manufacturer's recommended fastening for compliance with wind load requirements indicated herein.

PART 2 - PRODUCTS

2.01 FASTENING MATERIALS:

A. Unless otherwise approved, all anchorage items- including but not limited to screws, bolts, expansions, straps and cables- shall be of stainless steel.

B. Tapcom type screws are permitted.

C. Cables shall have a protective cover.

PART 3 - EXECUTION

3.01 GENERAL:

Fasten all items in accordance with approved recommendations and/ or as per approved shop-drawings.

END OF SECTION 01050

SECTION 01200 - PROJECT MEETINGS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A.Project meeting consist of progress meeting and specially called meeting.

B.The Owner (or the person appointed by the Owner) shall schedule and administer project meetings throughout the progress of the work. For said meetings the Owner shall:

1.Prepare agenda for meetings.
2.Give notice of each meeting in advance.
3.Make physical arrangements for meetings.
4.Preside at meetings.
5.Record the minutes; include all significant proceedings and decisions.
6.Reproduce and distribute copies of minutes to all participants in the meeting and/or all parties affected by decisions made at the meeting.

C.The Contractor and his Sub-Contractors and Suppliers (as required by the agenda) shall attend the project meetings. Representatives attending shall be qualified and authorized to act on behalf of the entity each represents.

D.Architect/Engineer shall attend meetings as required by Contract, and to ascertain that work expedited is consistent with Contract Documents.

1.02 PROGRESS MEETINGS:

A.Project meetings shall be held weekly, or as otherwise required elsewhere in the Contract Documents, or as required by the progress of Work.

B.The purpose of the progress meetings is to evaluate problems that may arise related to the execution of the construction work; interpreted and/or provide clarifications to the Contract Documents and observe the quality of the work being executed.

C.Unless otherwise required, progress meetings shall be held at project field office of the Contractor.

D.Suggested Agenda of progress meeting shall include:

1.Reviewal and approval of minutes of previous meeting, which shall be signed by all parties and become a part of the project documents.
2.Field observations, problems, and conflicts.
3.Problems which affect Construction Schedule.
4.Evaluation of submittal schedule.

5.Evaluation of work executed.
6.Status of change orders.
7.All other Business that is related to the execution of the Construction.

1.03 SPECIALLY CALLED MEETINGS:

Specially called meetings may be requested by the Owner, Contractor or Architect, and shall be held as required.

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A. Make all submittals required by the Contract Documents, and revise and resubmit as necessary to establish compliance with the specified requirements. Individual requirements for submittals are described in the respective sections of these Specifications and/or as required herein.

B. **In the event that the product and/or material is a substitution to the product and/or material specified in the Contract Documents, the Contractor shall also comply with Section 01630 - Substitution and Product Options of the Specifications. Failure to identify that a product and/or material is different than specified, and comply with the requirements established in the above referred to Section shall void the approval of the submittal.**

1.02 QUALITY ASSURANCE:

Prior to submitting each submittal, the Contractor shall carefully **review and coordinate** all aspects of each item being submitted and verify that the submittal **conforms** in all respects with the requirements of the Contract Documents. By affixing his signature to each submittal, the Contractor certifies that this coordination has been performed.

1.03 LIST OF MATERIAL AND/OR PRODUCT SUBMITTALS:

The Contractor shall provide a list of all the submittals. The list shall be prepared in the order that the products submittals are to be submitted and shall be revised as required.

1.04 LIST OF SUB-CONTRACTORS AND SUPPLIERS:

The Contractor shall provide a list of all subcontractors. The list shall include the firm's name, address and key personnel.

1.05 PRODUCT AND/OR MATERIAL SUBMITTALS:

A. All product and/or material submittals shall be submitted **so as not to delay the construction of the project, by not more than one-hundred (100) calendar days** after the Order to Proceed with construction, unless otherwise indicated.

B. Submit product and/or material submittals for all products and/or materials specified except for bulk materials (unless otherwise indicated in the respective section of the Specifications and/or Drawings).

C. Submit the number of copies which are required to be returned plus one (1) copy for the Architect and one (1) copy for the Consultant (when submittal must be reviewed by a Consultant).

D.Submittals shall include, but not be limited to: project name; general contractor; subcontractor; manufacturer's name, address, phone and fax number; product model number, technical specifications and options being included; and section of this specification where product was specified.

1.06 SHOP-DRAWING SUBMITTALS:

A.All shop-drawing submittals shall be submitted **so as not to delay the construction of the project, by not more than one-hundred (100) calendar days** after the Order to Proceed with construction, unless otherwise indicated.

B.Submit shop-drawings for all fabricated work and for roughing-in and/or coordination with other trades.

C.Submit all shop-drawings in the form of one (1) paper transparency of each sheet, plus one (1) blueprint copies of each sheet for the Architect and one (1) copy for the Consultant (when submittal must be reviewed by a Consultant). The Contractor shall make all the copies he needs from the returned marked-up transparency.

D.Submittals shall include, but not be limited to: project name; general contractor; subcontractor; manufacturer's name, address phone and fax number; product model number, technical specifications and options being included; and section of this specification where product was specified.

1.07 MANUFACTURER'S LITERATURE:

A.Where contents of submitted literature from manufacturers include data not pertinent to the submittal, clearly indicate, which portion of the contents is being submitted for review.

B.Submit the number of copies which are required to be returned plus one (1) copy for the Architect and one (1) copy for the Consultant (when submittal must be reviewed by a Consultant).

1.08 SAMPLES:

A.Samples shall be of the precise article proposed or specified.

B.Samples of colors, textures or patterns will be selected from standard patterns, textures and color chips of Contractors' intended manufacturer, unless otherwise indicated in the section of the product specified.

C.No product and/or material requiring submission of samples and/or colors shall be installed without first receiving the approval of the color by the Architect.

1.09 TEST REPORTS:

Submit the number of copies which are required to be returned plus one (1) copy for the Architect and one (1) copy for the Consultant (when submittal must be reviewed by a Consultant).

1.10 CERTIFICATES OF COMPLIANCE:

Where compliance with product standards or testing standards are required by the Contract Documents, submit a minimum of three (3) copies of test data by a recognized independent testing laboratory certifying compliance with the referenced standard or test.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 IDENTIFICATION OF SUBMITTALS:

Consecutively number all submittals. Accompany each submittal with a letter of transmittal containing all pertinent information required for identification and checking of submittals. When re-submittal is required, transmit under a new letter of transmittal and with the same submittal number plus the letter "R" and the digit indicating the number of resubmittal (ie R1, R2, etc.).

3.02 COORDINATION OF SUBMITTALS:

A.Coordinate all submitted materials including, but not limited to the following:

1.Verify all interface conditions, catalog numbers.
2.Coordinate with other trades as required.
3.Indicate deviations from the specified requirements.

B.All submitted materials related to each of the following work shall be submitted complete and at one time:

1.Electrical system.
2.Air-conditioning and ventilation system.
3.Plumbing system.
4.Door, door frames and finished hardware.

3.03 TIMING OF SUBMITTALS:

A.Allow at least fifteen (15) calendar days for review by the Architect following his receipt of the submittal.

B.Delays because of tardiness in submitting submittals will not be a basis for an extension of contract time.

C.Unless otherwise agreed, partial submittals will be rejected and the Contractor shall be liable for all delays as described above.

3.04 ARCHITECTS REVIEW:

A.The review of submittals shall not be construed as relieving the Contractor of the responsibility for any error in detail, dimensions or otherwise that may exist, or approving departure from additional details of instructions previously furnished by the Architect/Engineer.

B.Submittals marked as "Revise and Resubmit" shall be promptly resubmitted. No work identified in the shop drawings shall commence prior to the Contractor having received the shop drawings marked "Approved", "Approved as Corrected", "Reviewed, No Exceptions Taken" or equivalent language.

END OF SECTION 01300

SECTION 01310 - CONSTRUCTION SCHEDULE

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

Preparation and submittal of an initial construction schedule and revised progress schedules, as required herein.

1.02 SUBMITTALS:

The Contractor shall submit documents for reviewal and comments.

A.An initial construction schedule within fifteen (15) days after the awarding of the Contract.

B.Revised progress schedules with each application for payment, copy of which shall be affixed to the original of each application for payment.

1.03 FORM OF CONSTRUCTION SCHEDULES:

The construction schedule shall be a horizontal bar chart, as follows:

A.Format and identification of listings shall be in accordance with approved Breakdown for Payment.

B.Provide separate horizontal bar for each trade or operation.

C.Horizontal time scale shall identify the first work day of each week.

D.Scale and spacing to allow space for notations and future revisions.

E.Minimum sheet size shall be 11" by 17".

1.04 CONTENT OF CONSTRUCTION SCHEDULES:

The Construction Progress Schedule shall:

A.Show the dates for the beginning and completion of each major element of construction.

B.Show the complete sequence of construction by activity so that operation of existing facilities remain unaltered.

C.Show projected percentage of completion for each item, as of the first day of each month.

D.Identify critical portions of prime schedules.

1.05 PROGRESS REVISIONS:

Revised progress schedules shall:

A.Indicate progress of each activity from date of original submission.

B.Show changes occurring since previous schedule submitted, including:

1.Major changes in scope.

2.Activities modified since previous submission.

3.Revised projections of progress and completion.

4.Other identifiable changes.

C.Provide a narrative report as needed to define:

1.Problem areas, anticipated delays, changes and other impacts on the schedule.

2.Corrective action recommended, and its effect.

END OF SECTION 01310

SECTION 01380 - CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

The Contractor shall take photographs of the construction as required herein.

1.02 MONTHLY PROGRESS PHOTOGRAPHS:

The Contractor shall take five (5) photographs of the construction at monthly intervals, coinciding with the work cutoff date associated with each monthly payment request. Photographs shall provide a visual record of the construction progress at regularly scheduled intervals; therefore, the Contractor shall select the vantage point for each shot so as to best show the status of construction and the progress of the work since the last photographs were taken.

1.03 ADDITIONAL PHOTOGRAPH:

The Contractor shall take photographs of any significant accident or other loss at project site.

1.04 SUBMITTALS:

A.Monthly Progress Photographs:

The Contractor shall submit two (2) set of the photographs with each application for payment,

B.Additional Photographs:

The Contractor shall submit two (2) sets of the photographs within five (5) days of any occurrence.

PART 2 - PRODUCT

2.01 PHOTOGRAPHS:

A.Provide 8" by 10" smooth surface glossy color prints on commercial-grade stock or 8-1/2" x 11" digital photographs on photographic quality paper.

B.Identification:

Clearly label each photograph on the back side with either an applied label or a rubber stamped impression; provide

the following information:

1.Name of the project.
2.Name of the Architect.
3.Name of the Contractor.
4.Date the photograph was taken.
5.Description of the vantage point, in terms of location and direction.

PART 3 - EXECUTION

Not Applicable

END OF SECTION 01380

SECTION 01410 - TESTING LABORATORY SERVICES

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A.Work Includes:

1.Providing testing and inspecting as specified in this Section and/or elsewhere in the Contract Documents.

2.Cooperating with the selected testing laboratory and all others responsible for testing and inspecting the Work.

3.Where no testing requirements are described, but the Owner decides that testing is required, the Owner may direct that such testing be performed under current standards for test and/or as described herein.

B.Extent of Work:

Any material and/or equipment may be subject to testing to determine that the materials and/or equipment provided for the Work meet the specified requirements.

C.Related Work Described Elsewhere:

Requirements for testing may be described in other Sections of these Specifications and/or on the Drawings. Testing specified elsewhere shall also comply with the requirements specified herein.

1.02 QUALITY ASSURANCE:

A.Qualifications of Testing Laboratory:

The testing laboratory will be qualified in accordance with ASTM requirements for the testing required, and shall be submitted for approval.

B.Codes and Standards:

Testing will be in accordance with pertinent codes and regulations and with selected standards of the American Society for Testing and Materials.

1.03 PAYMENT FOR TESTING REQUIRED BY CONTRACT DOCUMENTS:

The Contractor shall pay for all testing required in the Construction Documents.

1.04 PAYMENT FOR TESTING OF MATERIALS AND/OR PRODUCTS FOR COMPLIANCE WITH CONTRACT DOCUMENTS:

In the case that the Contractor submits a product and/or material that is different than the product and/or material specified, and in the opinion of the Architect or his Consultants more testing information is necessary to determine that the product and/or material being substituted complies with the Contract Documents, the Contractor shall pay for all testing.

1.05 PAYMENT FOR TESTING NOT REQUIRED BY CONTRACT DOCUMENTS:

In the case that the Owner requires additional testing that is not in the Contract Documents and/or is not to determine if the product and/or material being substituted complies with the Contract Documents, payment for said testing shall be as follows:

A.Initial Services:

1.The Owner will pay for initial testing services requested.

2.When initial tests indicate non-compliance with the Contract Documents, the costs of initial tests associated with that non-compliance will be deducted by the Owner from the Contract Sum.

B.Retesting:

When initial tests indicate non-compliance with the Contract Documents, all subsequent retesting occasioned by the non-compliance shall be performed by the same testing agency and the costs thereof will be deducted by the Owner from the Contract Sum.

1.06 CODE COMPLIANCE TESTING:

Inspections and tests required by codes or ordinances, or by a Government Agency having jurisdiction, shall be the responsibility of and paid by the Contractor, unless otherwise provided in the Contract Documents.

1.07 CONTRACTOR'S CONVENIENCE TESTING:

Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of and paid by the Contractor.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 COOPERATION WITH TESTING LABORATORY:

Representative of the testing laboratory shall have access to the Work at all times. Provide facilities for such access in order that the laboratory may properly perform its function.

3.02 TAKING SPECIMENS:

Specimens and samples for testing, unless otherwise provided in the Contract Documents, will be taken by the testing personnel. Sampling equipment and personnel will be provided by the testing laboratory. Deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

END OF SECTION 01410

SECTION 01500 - TEMPORARY UTILITIES & FACILITIES

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

Work includes, but is not limited to:

A.Temporary utility and services required for use at the project site include, but are not limited to, the following:

1.Water service and distribution.
2.Temporary electric power and light.

It is the Contractor's responsibility to determine and provide adequate capacity for each utility needed at each stage of construction; and to obtain and pay for all and any temporary easements required to bring temporary utilities to the project site, where the Owner's permanent easement cannot be utilized for that purpose.

B.The construction of temporary offices and support facilities as required in the Contract Documents and as required for the proper execution of the project, include, but are not limited to the following:

1.Field offices and storage sheds.
2.Sanitary facilities, including drinking water.
3.Temporary enclosures.
4.Barricades and warning signs.
5.Bulletin boards and signs.
6.Waste disposal facilities and services.

C.Provide the security and protection facilities and services required in the Contract Documents and as required for the project.

1.02 QUALITY ASSURANCE:

Comply with requirements of local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary services and facilities, including but not limited to the following:

A.Building Codes, including permits and inspection.
B.Health and safety regulations.
C.Utility company regulations and recommendations governing temporary utility services.
D.Fire Department rules and recommendations.
E.Environmental protection regulations governing use of water and energy, and the control of dust, noise and other nuisances.

1.03 JOB CONDITIONS:

A.The Contractor shall make all required connections to existing utility systems with minimum disruption to services in the existing utility systems. When disruption of the existing service is required, provide alternate temporary service.

B.Provide each temporary service and facility ready for use at each location. Maintain and expand as required, and modify temporary services and facilities as needed throughout the progress of the Work. Remove all temporary services and facilities at the completion of the project.

C.Conditions of Use:

Operate temporary services and facilities in a safe and efficient manner. Do not overload temporary services or facilities, and do not permit them to interfere with the progress of the work. Do not allow unsanitary conditions, public nuisances or hazardous conditions to develop or persist on the site.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

Provide new materials and equipment for temporary services and facilities or used materials and equipment that are undamaged and in serviceable condition may be used. Provide only materials and equipment that are recognized as being suitable for the intended use, by compliance with appropriate standards.

2.02 TEMPORARY UTILITIES:

A.General:

Comply with all codes and utility company regulations.

B.Water:

The Contractor shall connect himself to the water system, and shall furnish and install all necessary temporary water lines and drainage pipes, and upon completion of the work and shall remove all such temporary facilities.

B.Electricity:

The Contractor shall connect himself to the electrical system, and shall furnish and install temporary wiring, lighting, and, upon completion of the work and shall remove all such temporary facilities.

C.VAC:

The Contractor shall provide and maintain all temporary ventilation/climate control facilities and, upon completion of the work, shall remove all such temporary facilities.

2.03 FIELD OFFICE AND STORAGE TRAILER:

A.The Contractor will be provided an area within the project site to locate his field office. Within the field office, the Contractor shall provide the required tables, chairs and utilities.

B.The Contractor shall provide a storage trailer(s) adequate in size to accommodate all supply and storage necessary for the project. It is permitted to the Contractor to locate the storage trailer(s) in the parking area for the duration of the project. The Owner will not be responsible for the storage trailer nor its contents.

2.04 SANITARY FACILITIES:

Provide temporary sanitary facilities required including temporary toilets, wash facilities and drinking water fixtures for use of all personnel. Provide in compliance with governing regulations including safety and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Maintain sanitary conditions at all times.

2.05 BARRICADES AND WARNING SIGNS:

Furnish, install and maintain for the duration of construction all required scaffolds, tarpaulins, canopies, warning signs, steps, bridges, platforms, and other temporary construction necessary for proper completion of the work in compliance with all safety and other regulations.

2.06 WASTE DISPOSAL SERVICES:

Provide waste bins for the dispose of all construction debris and garbage. Waste bins shall be equal to the 20 cubic yards capacity metal waste bins rented by Browning-Ferris Industries or other waste company.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

A.General:

1.Locate temporary services and facilities where they will serve the entire project adequately and result in minimum interference with the performance of the Work.

2.Relocate, modify and extend services and facilities as required during the course of work so as to accommodate the entire work of the project.

3.Maintain all temporary facilities as long as needed for the safe and proper completion of the work.

B.Electricity:

Comply with applicable NEMA, NECA and UL standards and governing regulations for materials and layout of temporary electric service.

C.Collection and Disposal of Wastes:

1.Establish a system for collection and disposal of waste materials from construction areas and elsewhere on

the site. Handle waste materials that are hazardous, dangerous, or unsanitary separately from other inert waste by containerizing appropriately. Dispose of waste material in a lawful manner.

2. Burying or burning of waste materials on the site will not be permitted.

3. Washing waste materials down sewers or into waterways will not be permitted.

D. Barricades, Warning Signs and Lights:

Comply with recognized standards and code requirements for the erection of substantial, structurally adequate barricades where needed to prevent accidents and losses. Paint with appropriate colors, graphics and warning signs to inform personnel at the site and the public, of the hazard being protected against. Provide lighting where appropriate and needed, including flashing red lights where appropriate.

3.02 TERMINATION AND REMOVAL:

A. Remove all temporary utilities, service, facility, etc. promptly after a substantial portion of the work has been completed, or no later than substantial completion. Complete, or, if necessary, restore permanent work which may have been delayed because of interference with the temporary service or facility. Repair damaged work, clean exposed surfaces and replace work which cannot be satisfactorily repaired.

B. Materials and facilities that constitute temporary services and facilities are and remain the property of the Contractor. The Owner reserves the right to take possession of the project identification signs.

END OF SECTION 01500

SECTION 01630 - PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF REQUIREMENTS:

A.The Contractor's requests for changes in the products, materials, equipment and methods of construction required by the Contract Documents are considered "Requests for Substitutions" and are subject to the requirements specified herein.

B.Products, materials and/or construction methods indicated in the Contract Documents are not subject to the requirements for substitutions as herein specified.

1.02 CONTRACTOR'S PRODUCT OPTIONS:

A.For products specified by reference standard, the Contractor shall select product meeting that standard by any manufacturer.

B.For products specified by naming several products and/or manufacturers, the Contractor shall select any one of products and manufacturers named.

C.For products specified by naming one product and manufacturer, and stating "equal products of other manufacturers may be submitted", the Contractor shall submit a Request for Substitution for product or manufacturer which is not specifically named with documentary and test evidence of its equality for the Architects approval.

D.For products specified by naming one product and manufacturer, and **not stating** "equal products of other manufacturers may be submitted", the Contractor shall submit the specified product.

1.03 PRODUCT SUBSTITUTION (REQUEST FOR SUBSTITUTION):

A.The Contractor shall submit a separate Request for Substitution for each product substitution. Unless otherwise accepted by the Architect, each request shall be supported with **complete data substantiating compliance** of proposed substitution with requirements stated in the Contract Documents and stated below:

1.Product identification, including manufacturer's name and address.

2.Manufacturer's literature, including:

a.Product description.
b.Reference standards.
c.Performance and test data.

3.Samples, as applicable.

4.List of how the proposed product compares to the specified product.

5.List of changes required in other work or products.

6.Accurate cost data comparing proposed substitution with product specified.

7.Designation of availability of maintenance services, sources of replacement materials.

B.The Request for Substitution shall list in a clear and precise manner how the proposed product compares to the specified product. It will be assumed that any aspects of the proposed product not listed in the Request for Substitution means that proposed product complies with the specified product. If, even after installed, it is found that the proposed product does not comply with the specified product, the Owner may request the Contractor to replace the product with one that complies or may request a credit for the value of the product.

C.Substitutions will not be considered when:

1.They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.

2.Acceptance will require substantial revision of Contract Documents.

3.Its equality with the specified products is not clearly demonstrated.

D.Substitute products shall not be ordered or installed without written acceptance of Owner.

E.Owner will determine acceptability of proposed substitutions.

1.04 CONTRACTOR'S REPRESENTATION:

A.In making a formal Request for Substitution, the Contractor represents that:

1.He has investigated the proposed product and has determined that it is equal to or superior in all respect to the product specified.

2.He will provide same warranties or bonds for substitution as for products specified.

3.He will coordinate installation of accepted substitution into the work, and will make such changes as may be required for the work to be complete in all respects.

4.He waives claims for additional cost caused by substitution, which may subsequently become apparent.

1.05 OWNER'S DUTIES:

A.Review Contractor's requests for substitutions with reasonable promptness.

B.Notify Contractor, in writing, of decision to accept or reject request substitution.

END OF SECTION 01630

SECTION 01710 - PROGRESS AND FINAL CLEANING

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A.Work Includes:

Throughout the construction period maintain the structures, site and areas around the site clean of all construction debris as required in this Section.

B.Related Work Described Elsewhere:

In addition to standards described in this Section, comply with all requirements for cleaning as described in other Sections of these Specifications.

1.02 QUALITY ASSURANCE:

A.Inspection:

Conduct inspections of the site and the area immediately around the site to verify that requirements of cleanliness are being met.

B.Codes and Standards:

In addition to the standards described in this Section, comply with all pertinent requirements of governmental agencies having jurisdiction.

C.Waste Dumping:

Submit written evidence that the site for dumping waste from the project has been duly permitted by the Environmental Quality Board. At no time shall the site or area around the site be used as a dump on a temporary or permanent basis.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT:

Provide all required personnel, equipment and materials needed to maintain the specified or required standard of cleanliness.

2.02 COMPATIBILITY:

Use only cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material.

PART 3 - EXECUTION

3.01 PROGRESS CLEANING:

A.Maintain all stored items in an orderly arrangement and properly protected.

B.Do not allow the accumulation of scrap, debris, waste material and other items not required for the construction of this Work.

3.02 FINAL CLEANING:

A.Definition:

For the purpose of the final cleaning "clean" shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.

B.General:

Prior to completion of the Work, remove from the job site all tools, surplus materials, equipment, scrap, debris and waste. Conduct final progress cleaning as described herein and in other Sections of these Specifications.

C.Site:

Unless otherwise specifically directed, broom clean all paved areas on the site and all public paved areas directly adjacent to the site. Completely, remove all resultant debris.

D.Interior and Exterior of Structures:

1.Inspect all exterior surfaces and remove all traces of soil, waste material, smudges and other foreign matter. Remove all traces of splashed materials from adjacent surfaces. Remove all paint droppings, spots, stains and dirt from finished surfaces.

2.Broom and mop all interior areas, as applicable.

3.Vacuum all carpet, as applicable.

4.Clean all glass and aluminum windows and storefronts, removing all markings.

5.Clean all plumbing fixtures and bathroom accessories.

6.Clean all lighting and A/C ventilation fixtures.

7.Clean all surfaces of millwork, casework, etc.

8.Comply with the requirements for cleaning as described in other Sections of these Specifications.

END OF SECTION 01710

SECTION 01720 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A.Throughout progress of the work of this Contract, maintain an accurate record of all changes to the Construction Drawings (i.e. As-Built), as described in this Section.

B.The intent of the Record Documents is to provide factual information regarding all aspects of the construction work, both concealed and visible.

1.02 QUALITY ASSURANCE:

A.Coordinate all changes to the Project Record Documents, making adequate and proper entries on each sheet of drawings and other documents where such entry is required to properly show the change. **All entries shall be dated and initialed by the person making the entry.**

B.Accuracy of records shall be such that future search for items shown in the Contract Documents may rely on information obtained from the approved Record Documents.

1.03 SUBMITTALS:

A.Prior to the submittal of each progress payment, the Contractor shall show the Architect that the Record Documents are being kept current with the construction work executed.

B.Prior to submitting the request for final payment, submit the final Record Documents to the Architect and secure his approval.

1.04 PRODUCT HANDLING:

A.Use all means necessary to maintain the Record Documents completely protected from deterioration and from loss and damage until completion of the Work.

B.In the event of loss of recorded data, use all means necessary to secure the data to the Architect's approval.

PART 2 - PRODUCTS

2.01 RECORD DOCUMENTS:

Promptly following the award of the Contract, prepare one (1) complete set of the Contract Documents to serve as the Record Documents.

PART 3 - EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS - AS-BUILT:

A.Immediately upon receipt of the job set described above, identify each of the Documents with the title "RECORD DOCUMENTS - AS BUILT".

B.Do not use the Record Documents for any purpose except entry of changes to the Contract Documents.

3.02 ENTRIES ON THE RECORD DOCUMENTS - AS-BUILT:

Using a red pen, clearly describe the change by note and by graphic line, as required. Date all entries. Call attention to the entry by a "cloud" around the areas affected. In the event of overlapping changes, different colors may be used for each of the changes.

3.03 CONVERSION OF DIAGRAMMATIC LAYOUTS:

In most cases on the drawings, arrangement of conduits and circuits, piping, ducts, and other similar items, is shown diagrammatically and is not intended to portray precise physical layout. Final physical arrangement is as determined by the Contractor, subject to the Architect's approval. Since design of future modifications of the facility may require accurate information as to the final physical arrangement of items, show on the As-Built the centerline of each run of items such as those described above and show by symbol or note, the vertical location of the item ("under slab", "in ceiling plenum", "exposed", etc.").

3.04 ACCURACY OF ENTRIES:

Use all means necessary, including the proper tools for measurement, to determine actual locations of the installed items.

END OF SECTION 01720

SECTION 01730 - CONTRACT CLOSEOUT

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

Work Includes:

A.Upon completion of the Work, remove all temporary facilities, fences, scaffolding, surplus materials and rubbish of any kind from the site of the work.

B.Comply with the requirements of Section 01710 - Cleaning of the Specifications.

C.Comply with the requirements of Section 01720 - Project Record Documents of the Specifications.

D.Submittal of all required documentation.

E.Obtainment of all required endorsements/permits.

F.Obtainment of the Certificate of Occupancy.

1.02 DOCUMENTS REQUIRED PRIOR TO FINAL PAYMENT:

Prior to final payment and before the issuance of the final Certificate for Payment, the Contractor shall submit the following documents:

A.Manuals:

One (1) complete set of the manuals of all equipment and systems furnished under the Contract and any additional data required in the Contract Documents. Manuals shall be arranged in proper order, indexed and suitably bound.

B.Guarantees:

One (1) complete set of the guarantees (warranties) required in the General, Special and Supplementary Conditions and any other guarantees stated in the technical sections of the Specifications. Guarantees shall be arranged in proper order, indexed and suitably bound.

C.Project Record Documents:

One (1) complete set of project record documents as required in Section 01720 - Project Record Documents of the Specifications.

D.Consent of Surety:

One (1) copy of the consent of surety to release of withholding or final payment as may be required by the General Conditions.

E.Liquidation Requirements:

All other documents required in the Contract Documents.

1.04 ENDORSEMENTS:

Obtain and pay any fees related to obtaining the necessary endorsements required for the Certificate of Occupancy, and provide copy to Owner.

1.05 CERTIFICATE OF OCCUPANCY:

Obtain and pay any fees related to the Certificate of Occupancy ("Permiso de Uso") and deliver to the Owner.

END OF SECTION 01730

SECTION 02900 - LANDSCAPING

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK

A combination of different GreenGrid® modules will be used in our landscaping design to prevent site disturbance. This system is typically used on green roof applications, but its characteristics make it an ideal option for the achievement of creating a temporary landscape with an appropriate modularity that eases the installation and removal with minimum disturbance of the existing conditions.

PART 2 - PRODUCTS

2.01 PRODUCT DESCRIPTION

A. **Modules –** Patented GreenGrid® modules are composed of 60% post-industrial, recycled, high molecular weight polyethylene. The modules come in a variety of sizes and are available in three depths. The Ultra Extensive (2.5-inch depth) modules – supporting only sedum species – weigh only 10 pounds per square foot (wet). The Extensive (4-inch depth) modules – supporting shallow rooting grass, sedum, and wildflower species – weigh approximately 15 pounds per square foot (wet). The Intensive (8-inch depth) modules – supporting a large variety of ornamental perennials and shrubs – weigh approximately 28 pounds per square foot (wet).

B. **Growing Media –** GreenGrid® is a proprietary mixture of organic and inorganic material, formulated on the basis of years of research and field testing by soil scientists and horticulture experts.

C. **Preplanted Vegetation –**Plants will be selected and specified by our Horticulture student's team.

D. **Edge Treatments –** Wood, recycled composite wood, metal, or other specialty materials (in various colors and designs) could be included as part of the GreenGrid® system design.

E. **Optional Features –** Pavers made from 100% post-industrial recycled rubber, walkways, and planter boxes can be incorporated into the GreenGrid® system.

2.2 SYSTEM SPECIFICATIONS

ELEMENT	DESCRIPTION
Module size	Standard – 2 ft. x 4 ft. 2 ft. x 2 ft. x 2.5 in. 2 ft. x 2 ft. x 4 in.
Depth of modules (three depths)	2.5 in., 4 in., and 8 in. (nominal)
Weight of planted modules (fully saturated)	2 in. depth – Approx. 10 lb. per sq. ft. 4 in. depth – Approx. 15 lb. per sq. ft. 8 in. depth – Approx. 28 lb. per sq. ft.
Module material	60% post-industrial recycled HDPE – 150 mil. 2.5 and 4 in. – 175 mil. 8 in.
Color of modules	Black
Paver size	Length – 2 ft., width – 2 ft., depth – 1.75 in.
Paver material	100% recycled rubber
Paver colors	Forest green, charcoal, brick red
Paver weight	7.5 lbs./sq. ft.
Drainage/root resistance medium	Spunbonded polypropylene geotextile
Growth media	Proprietary mixture consisting of organic and inorganic material.
Edge treatments	Wood, recycled composite wood, metal, or other specialty materials (in various colors and designs)
Plants	Perennials, grasses, or shrubs specifically selected for climate, hardiness zone, color, and size.

PART 3 - EXECUTION

GreenGrid® modules arrive at the jobsite preplanted and ready for installation.

END OF SECTION 05500

SECTION 05500 - METAL FABRICATION

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this section.

1.01 DESCRIPTION OF WORK:

A. Extent of metal fabrication is indicated on the Drawings, and as specified herein.

B.Types of work in this section include, but are not limited to, metal fabrications for:

1. Stainless steel railings and handrails.
2. Miscellaneous steel fabrication.
3. Metal fastenings.

1.02 QUALITY ASSURANCE:

A.Use skilled workmen who are thoroughly trained and experienced and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B.Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Mark units for reassembly and coordinated installation.

C.Perform all shop and field welding required in this Section, adhering strictly to the current pertinent recommendations of the American Welding Society.

1.03 SYSTEM PERFORMANCES:

Metal assemblies shall comply with the Uniform Building Code and the following minimum requirements for structural performance:

A. Handrails and Toprails:

Design, engineer, fabricate, and install handrails and railing systems to withstand the following loads applied as indicated when tested per ASTM E 935.

1. Concentrated loads of 300 lbf. Applied at any point in any direction.
2. Uniform load af 75 lbf. per linear ft. applied simultaneously in both vertical and horizontal directions.

1.04 SUBMITTALS:

A.Product Data:

Submit manufacturer's specifications, anchor details and installation instructions for products used in miscellaneous

metal fabrications, including paint products and grout.

B.Shop Drawings:

Submit shop drawings for fabrication and erection of all metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.01 MATERIALS AND COMPONENTS:

A.General:

For fabrication of the work of this Section use only those materials which are smooth and free from surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.

B.Unless otherwise indicated, materials shall comply with:

1.Steel plates, shapes, and bars: ASTM A36.

2.Steel plates to be bent or cold formed: ASTM A283, Grade C.

3.Steel Bar Grating: ASTM A 569 or ASTM A 36.

4.Steel Tubing: Hot-rolled, ASTM A 501, seamless.

5.Steel Pipe: ASTM A 53; type and grade as selected by fabricator and as required for design loading; galvanized finish; standard weight (schedule 40), unless otherwise indicated.

6.Structural Steel Sheet: Hot-rolled, ASTM A 570; or cold-rolled ASTM A 611, Class 1; of grade required for design loading.

7.Galvanized Structural Steel Sheet: ASTM A 446, of grade required for design loading. Coating designation as indicated, or if not indicated, G90.

8.Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

9.Galvanizing: Minimum 1.5 ounces per square foot zinc coating in accordance with ASTM A386.

10. Non-shrink nonferrous grout: CE CRD C588.

C.Fasteners:

1.General:

Provide zinc-coated fasteners for exterior use and where built into exterior walls. Select fasteners for the type, grade and class required for proper fabrication and installation.

2.Unless otherwise indicated, all fasteners shall comply with:

1.Bolts and nuts:

Regular hexagon-head type, ASTM A307, Grade A.

2.Lag bolts:

Square-head type, Fed. Spec. FF-B-561.

3.Machine screws:

Cadmium plated steel, Fed. Spec. FF-S-92.

4.Wood screws:

Flat-head carbon steel, Fed. Spec. FF-S-111.

5.Plain washers:

Round, carbon steel, Fed. Spec. FF-W-92.

6.Lock washers:

Helical spring type carbon steel, Fed. Spec. FF-W-84.

D.Paint:

In addition to any requirements set forth in this Section, comply with Section 09900 - Painting of the Specifications.

2.02 METAL FABRICATION - GENERAL:

A.Use materials of size and thickness indicated on drawings, as required for proper fabrication and installation, and to comply requirements established in Paragraph 1.03 - System Performances of this Section. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of work.

B.Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

C.Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

D.Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts.

E.Provide for anchorage of type indicated, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

F.Cut, reinforce, drill and tap miscellaneous metal work as required to receive finish hardware and similar items.

G. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

H. Galvanizing:

Provide a zinc coating for those items indicated or specified to be galvanized, as follows:

1. ASTM A 153 for galvanizing iron and steel hardware.

2. ASTM A 123 for galvanized rolled, pressed and forged steel shapes, plates, bars and strip 1/8" thick and heavier.

3. ASTM A 386 for galvanizing assembled steel products.

I. Apply shop primer to surfaces of metal fabrications except those which are galvanized or as indicated to be embedded in concrete or masonry, unless otherwise indicated, and in compliance with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.

2.03 STAINLESS STEEL RAILINGS AND HANDRAILS:

A. Fabricate stainless steel railings and handrails to design, dimensions, and details indicated. Provide railings and handrails members formed of pipe of sizes and wall thickness indicated, but not less than that required to support design loading requirement established in Paragraph 1.03 – System Performances of this Section.

B. Except as otherwise indicated, interconnect railing and handrail members by butt-welding with internal connectors.

C. At tee and cross intersections provide coped joints.

D. At bends interconnect pipe by means of prefabricated elbow fittings or flush radius bends, as applicable, of radiuses indicated.

E. Form bends by use of prefabricated elbow fittings and radius bends or by bending pipe, at fabricator's option.

F. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of pipe.

G. Provide wall returns at ends of wall-mounted handrails, except where otherwise indicated.

H. Close exposed ends of pipe by welding 3/16" thick steel plate in place or by use of prefabricated fittings.

I. Where indicated, provide toeboards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated, if not indicated, use a 4" high x 1/8" plate welded to, and centered between, each railing post.

J. Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings and handrails to other work.

K. Galvanize steel railings, including pipe, fittings, brackets, fasteners and other ferrous metal components.

2.04 MISCELLANEOUS STEEL TRIM:

Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.

PART 3 - EXECUTION

3.01 FIELD MEASUREMENTS:

Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

3.02 GENERAL INSTALLATION:

A.Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction, including: threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

B.Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plus, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.

C.Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D.Field Welding:

Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

E.Expansion Joints:

Provide expansion joints at locations indicated, or if not indicated, at intervals not to exceed 40 feet. Provide slip joint with internal sleeve extending 2" beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6" of posts.

3.04 TOUCH-UP PAINTING AND CLEAN:

A.Touch-Up Painting:

Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film

thickness of 2.0 mils.

B.Galvanize surfaces:

Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05500

SECTION 06065- PLASTIC MATERIALS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A. Extent of plastic materials is indicated on schedules, drawings, and/ or as specified herein.

B. Related work described elsewhere:

1. Section 08120- Aluminum Doors & Frames
2. Section 08350- Folding Doors & Grilles
3. Section 06400- Architectural Millwork

1.02 QUALITY ASSURANCE:

A. The material covered by these specifications shall be furnished by a certified manufacturer of proven ability who has regularly engaged in the manufacture and installation of the product.

B. Substitution of any component or modification of system shall be made only when approved by the Architect or Engineer.

C. Manufacturer's qualifications: Experienced in successfully producing fabrications similar to that indicated for this project.

D. In addition to requirements of these specifications, comply with the manufacturer's instructions and recommendations for work.

1.03 SUBMITTALS:

A. Shop Drawings: Submit fabrication and installation shop drawings for each product and process specified as work of this section. Indicate materials, construction, dimensions, locations, tolerances, connections and installation details.

B. Product data: Submit manufacturer's product data for each product and process specified as work of this section. Indicate materials, construction, dimensions, locations, tolerances, physical properties, connections and installation details.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S CONTACT:
IGMAN INTERNATIONAL

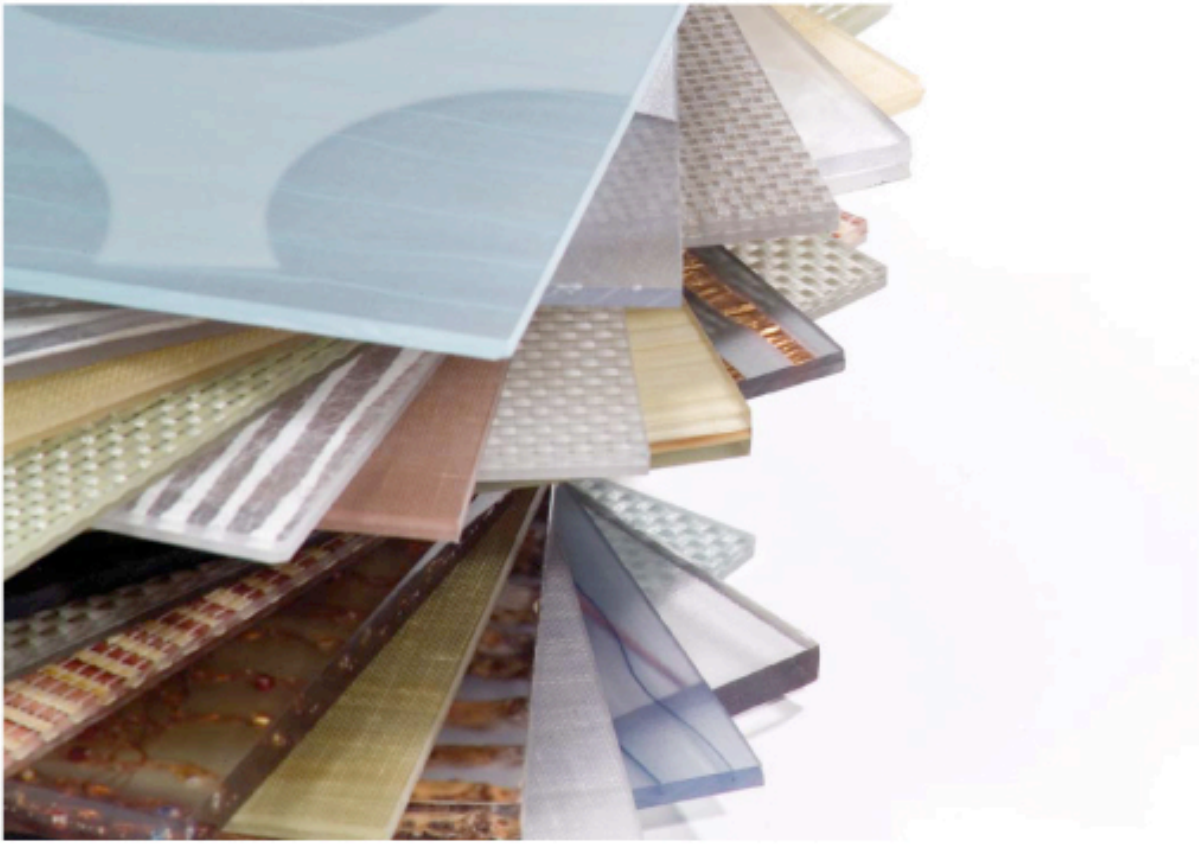
San Juan, Puerto Rico 00913 tel 787 765 3574, 787 758 3976

Email: dzeligman@3-form.com

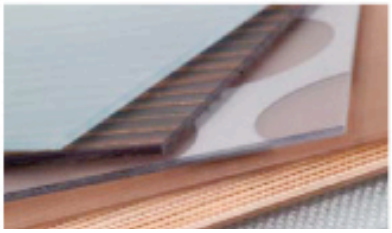
2.02 MATERIALS:

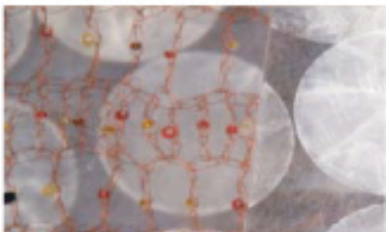
Shall be 3 FORM Varia, orange tan super matte as manufactured by 3 FORM, Inc. Panel shall be 1/8" thick and of style and height indicated on drawings.

3form® ecoresin™



3form® ecoresin™ is a dynamic panel system. The choices of ecoresin panels are as diverse as your imagination. By allowing you to custom-select the color, pattern, texture, interlayer and finish of your material, ecoresin transforms into the perfect medium for your architectural application.





PRODUCT DESCRIPTION

Ecoresin is a dynamic panel system. Options offered by *ecoresin* panels are as diverse as your imagination. By allowing you to custom-select the color, pattern, texture, interlayer and finish of your material, *ecoresin* transforms into the perfect medium for your architectural application.

An award-winning 3form product line, *ecoresin* has the added benefits of being made from a specially-formulated co-polyester resin which is both environmentally responsible and high-performing. *ecoresin* has been engineered to incorporate 40% post-industrial re-grind content, without compromising its overall physical properties. From a recycle stand-point, *ecoresin* is also compatible with one of the largest post-consumer recycle streams, and is GREENGUARD Indoor Air Quality Certified®.

FEATURES AND BENEFITS

Produced on a individual order basis, allowing for creative design and product selection (minimum order quantity – ONE sheet!)
Post-formable into virtually any shape or size for eye-catching installations
Enables qualification for LEED credits for building sustainability
Very tough, allowing for easy fabrication and maximum installed durability
Extremely versatile which enables designers to achieve full design potential
Lightweight, half the density of glass, which makes for easier installation and reduces structural support requirements
Excellent chemical resistance which reduces potential harm incurred by cleaning agents
ecoresin is GREENGUARD Indoor Air Quality Certified®

AVAILABLE COLORS

Available in a variety of standard colors
Custom colors also available

TEXTURES/PATTERNS/FINISHES

The *ecoresin* collection includes a wide range of textures and patterns from our Organics, Moderna, Play, Texture, Color, and Graphic sub-collections.

Each item in the *ecoresin* collection comes standard with both a front and back finish. Additionally, 3form provides the option of substituting between 8 standard finishes. In most cases, you can even pick different front and back finishes. Finishes include:

Liquid Silver - Smooth, silver, mirror-like finish on the backing of a panel
Markerboard Plus - Shiny, patent leather look which allows the *ecoresin* surface to be used as a Dry Erase Board
Patent - Shiny, high gloss finish
Patina - Non-glare, slightly frosted, worn-look finish

Pixel - Micro-grid look, creates moiré when applied to both sides, cannot be used in pieces > 1/2"
Sandstone - Grainy texture, slightly frosted look
Stucco - Pebble-like finish
Supermatte - MicroGrain texture, frosted look
Topo - Larger pebble-like finish
Opaque White Backer
Vision Plus

PANEL SIZES AND TOLERANCES

3form ecoresin panels are offered in 4' x 8' (1.2 m x 2.4 m) and 4' x 10' (1.2 m x 3 m). All dimensions and squareness (standard with custom) are subject to a 1/16" (1.5 mm) tolerance. 5' x 10' (1.5 m x 1.3 m) is also available though some restrictions apply.

Ecoresin is available in gauges from 1/16 inch to 1 inch.

All 'Solo' Sheets

NOMINAL GAUGE	MINIMUM ALLOWANCE GAUGE	MAXIMUM ALLOWANCE GAUGE
1/16" (0.0625")	0.050	0.070
1/8" (0.125")	0.104	0.132
3/16" (0.1875")	0.168	0.192
1/4" (0.250")	0.212	0.260
3/8" (0.375")	0.324	0.384
1/2" (0.500")	0.436	0.508
3/4" (0.750")	0.648	0.768
1" (1.000")	0.850	1.060

Non 'Solo' product sheets

NOMINAL THICKNESS	MINIMUM ALLOWANCE GAUGE	MAXIMUM ALLOWANCE GAUGE
1/8" (0.125")	0.098	0.138
3/16" (0.1875")	0.155	0.205
1/4" (0.250")	0.196	0.306
3/8" (0.375")	0.304	0.434
1/2" (0.500")	0.412	0.562
3/4" (0.750")	0.618	0.798
1" (1.000")	0.850	1.090

Sheet tolerance readings are based on an average of several on measurements along both long edges of each panel. These measurements are taken 2-3 inches (50-75 mm) from the edges of the panel.

SPECIFICATIONS

FLAMMABILITY & SMOKE TEST RESULTS – BUILDING CODE APPROVALS

*eco*resin panels (a polyester-based material), have been independently tested and meet the criteria for approved interior finishes and "light transmitting" resin materials as described in the 2003 International Building Code®.

TEST	3FORM *ECORESIN*	RESULT
ASTM D 2843 Smoke Density	71.6%	PASS Less than 75
ASTM D 635 Flame Spread	Self extinguishing	PASS CC1
ASTM D 1929 Self-ignition Temperature	716°F	PASS Greater than 650°F
ASTM E84-03		
Flame Spread, 1/4" to 1" thickness	65	Class B: 26-75
Smoke generated	425	<450
ASTM E84-03		
Flame Spread, 1" thickness	20	Class A: 0-25
Smoke generated	250	<450
NFPA 286, 1/4" thickness	Pass	Class A

PANEL WEIGHT

THICKNESS (INCHES)	WEIGHT FLUX (LB/FT²)
1/16" (1.5 mm)	0.4 lb/ft² (2.0 kg/m²)
1/8" (3 mm)	0.8 lb/ft² (4.0 kg/m²)
3/16" (4.5 mm)	1.2 lb/ft² (6.1 kg/m²)
1/4" (6 mm)	1.7 lb/ft² (8.1 kg/m²)
3/8" (9.5 mm)	2.5 lb/ft² (12.2 kg/m²)
1/2" (12.5 mm)	3.3 lb/ft² (16.1 kg/m²)
3/4" (19 mm)	5.0 lb/ft² (24.4 kg/m²)
1.0" (25 mm)	6.6 lb/ft² (32.2 kg/m²)

EXPANSION/CONTRACTION ALLOWANCES

Like all resin products, 3form *eco*resin will expand and contract nominally with fluctuations in temperature. The following formula provides allowances that should be made in framed or fitted applications:

Longest length of panel (inches) x temperature change of the sheet (°F) x 0.00004 =
Amount of Linear Expansion/Contraction (inches)

Example:

A 48" x 96" panel that experiences a 50°F temperature change will expand/contract:
96 inches x 50 degrees x 0.00004 in/in °F = 0.192 inches (expansion)

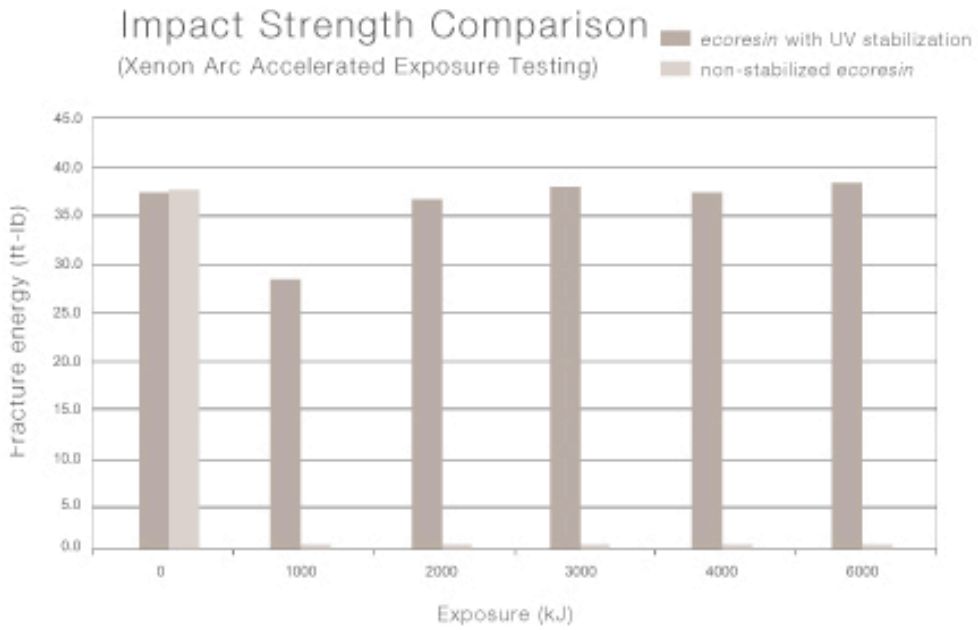
Installers should take extra precautions if installation is occurring before the HVAC systems are operational. Allowances should also be made in the following situations:

Fastening points
Holes for standoffs and other hardware
Meeting points for multiple sheets of 3form *ecoresin*

ULTRAVIOLET EXPOSURE PERFORMANCE

UV stabilizers, when incorporated with 3form *ecoresin* panels, have proven to be very effective in maintaining the integrity of the panels with extended exposure to UV radiation. The following charts provide an overview of the effectiveness of UV stabilizers that are incorporated with 3form *ecoresin* panels. Following 6,000 kJ of exposure (representing approximately 10-years outdoor Florida exposure) it is shown that the 3form *ecoresin* with UV stabilization exhibits excellent performance. The following chart demonstrates that the b* shift remains below the 5 b* visual threshold (and shows a leveling change over time).

Additionally, as demonstrated in the following chart, *ecoresin* panels maintain tremendous physical integrity when produced with UV stabilization technology.



DEFLECTION

3form *ecoresin* will exhibit different amounts of deflection given a variety of factors: fastening techniques, loads, gauges and panel dimensions to list a few. Your 3form Representative can assist you with general deflection guidelines for your application. If your application has specific engineering requirements, please contact the 3form Product Technology team for additional direction.

HEAT FORMING/COLD BENDING

ecoresin can be cold bent for simple bends and curved areas. As a rule, a minimum radius of 100 times thickness is acceptable for *ecoresin* (will depend on innerlayer material).

ECORESIN THICKNESS	MINIMUM COLD BEND RADII
1/16" (1.5 mm)	7" (178 mm)
1/8" (3 mm)	12" (305 mm)
3/16" (4.5 mm)	19" (483 mm)
1/4" (6 mm)	25" (635 mm)

3/8" (9.5 mm)	37" (940 mm)
1/2" (12.5 mm)	50" (1270 mm)
3/4" (19 mm)	75" (1905 mm)
1" (25 mm)	100" (2540 mm)

Because of its low thermoforming temperature, *eco*resin is easy to strip heat and line bend. Remove protective masking from area to be bent. Using a line heat device, regulate the heat to a temperature that allows *eco*resin to reach 250°F-300°F (138°C -160°C). Thicker gauge requires a longer period of time to allow heat penetration. Place sheet over heat source at bend area. Allow heat to soften material; time depends on gauge, 1/8" (3 mm) typically requires 2 minutes. Remove from heat and make desired bend, and place in wood or fabric-covered aluminum fixture to cool.

- Always strip heat a sample piece first
- Avoid drafty rooms which can cause uneven heating and cooling
- Be sure to cover forming fixtures with soft fabric to avoid scratching *eco*resin
- Bending *eco*resin when it is too cold results in a highly-stressed, weakened material
- Thicker gauges (over 1/8") may require heating on both sides by turning the sheet over periodically
- Always bend the sheet with the heated side forming the outside radius

EDGE FINISHING

Edges of 3form *eco*resin panels are able to be machined or routed into a variety of different forms. In addition to a straight edge, edges may accept beveling, rounding, etc. Additional finishing, such as sanding or polishing, can also be provided to some edges.

REFINISHING

*eco*resin finishes such as patent can have blemishes polished out; however, the majority of 3form products have a surface finish that would be ruined by buffing. "Stucco" is our most durable finish. This finish is recommended for any high-traffic areas.

Selected Mechanical and Physical Properties for 3form *eco*resin

					TYPICAL VALUE					
			UNITS		0.080" (2 MM)		0.118" (3 MM)		0.236" (6 MM)	
PROPERTY*	CONDITIONS	ASTM METHOD	SI	U.S. CUSTOMARY	SI	U.S. CUSTOMARY	SI	U.S. CUSTOMARY	SI	U.S. CUSTOMARY
GENERAL										
Density	23° C (73° F)	D 1505	kg/m^3	g/cm^3	1,270	1.27	1,270	1.27	1,270	1.27
Water Absorption	23° C (73° F), 24h immersion	D 570	%	%	0.3	0.3	0.2	0.2	0.1	0.1
Heat Deflection Temperature	@66psi	D648	°C	°F	—	—	73.3	164	—	—

					TYPICAL VALUE					
			UNITS		0.060" (2 MM)		0.118" (3 MM)		0.236" (6 MM)	
PROPERTY*	CONDITIONS	ASTM METHOD	SI	U.S. CUSTOMARY	SI	U.S. CUSTOMARY	SI	U.S. CUSTOMARY	SI	U.S. CUSTOMARY
MECHANICAL										
Tensile Stress @ Yield	50 mm/min (2 in./min)	D 638	MPa	psi	53	7,700	53	7,700	53	7,700
Tensile Stress @ Break	50 mm/min (2 in./min)	D 638	MPa	psi	31	4,500	26	3,800	26	3,800
Elongation @ Yield	50 mm/min (2 in./min)	D 638	%	%	4.7	4.7	4.8	4.8	5.0	5.0
Elongation @ Break	50 mm/min (2 in./min)	D 638	%	%	210	210	50	50	40	40
Tensile Modulus	5.0 mm/min (0.2 in./min)	D 638	MPa	psi	—	—	2,200	320,000	—	—
Flexural Modulus	1.27 mm/min (0.05 in./min)	D 790	MPa	psi	2,200	320,000	2,100	310,000	2,000	290,000
Flexural Strength	1.27 mm/min (0.05 in./min)	D 790	MPa	psi	71	10,300	77	11,200	83	12,000
Rockwell Hardness	—	D 785	R Scale	R Scale	104	104	115	115	117	117
Safety Glazing	75°F 23.8°C	ANSI 97.1	does not break		—	—	PASS		—	—
Izod Impact Strength, Notched	23°C (73°F)	D 256	J/m	ft·lbf/in.	—	—	88	1.7	62	1.2
	0°C (32°F)	D 256	J/m	ft·lbf/in.	—	—	66	1.2	—	—
	−30°C (−22°F)	D 256	J/m	ft·lbf/in.	—	—	39	0.7	—	—
Impact Strength, Unnotched	23°C (73°F)	D 4812	J/m	ft·lbf/in.	—	—	NB**	NB**	NB**	NB**
	0°C (32°F)	D 4812	J/m	ft·lbf/in.	—	—	NBB	NBB	—	—
	−30°C (−22°F)	D 4812	J/m	ft·lbf/in.	—	—	NBB	NBB	—	—
Impact Resistance—Puncture, Energy @ Max. Load	23°C (73°F)	D 3763	J	ft·lbf	21	15	33	24	71	53
	0°C (32°F)	D 3763	J	ft·lbf	25	18	40	30	93	69
	−10°C (14°F)	D 3763	J	ft·lbf	26	19	42	31	96	71
	−20°C (−4°F)	D 3763	J	ft·lbf	28	21	43	32	>100	>74
	−30°C (−22°F)	D 3763	J	ft·lbf	25	18	47	34	>100	>74

* Unless noted otherwise, all tests are run @ 23°C (73°F) and 50% relative humidity, using specimens machined from extruded sheeting with a thickness as indicated.

**Nonbreak as defined in ASTM D 4812 using specimens having a thickness as indicated. Properties reported here are typical of average lots. Sloan makes no representation that the material in any particular shipment will conform exactly to the values given.

SOUND TRANSMISSION CLASS (STC) VALUES FOR VARIOUS GAUGES OF *ECORESIN*

Measurement protocol: ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

ECORESIN THICKNESS	STC VALUES
1/8" (0.118")	25
3/16" (0.177")	29
1/4" (0.236")	31
3/8" (0.354")	34
1/2" (0.500")	34
1" (1.00")	39

CHEMICAL RESISTANCE OF 3FORM *ECO*RESIN TO SELECT COMPOUNDS

The following table provides indicative performance of the chemical resistance characteristics of *eco*resin tensile bars, the material from which *eco*resin panels are produced.

Polymer materials are affected by chemicals in different ways. Factors that initiate a change in performance or appearance when exposed to chemicals can be attributed to fabrication methods, exposure conditions, concentration of chemical substances or exposure duration of certain substances. Such factors can even influence the final affect on substances that 3form *eco*resin is considered "Resistant" to by this method. Further details are explained below:

Fabrication: Stresses generated from sanding, grinding, drilling, polishing, machining, sawing and/or forming (hot or cold).

Exposure: Exposure duration, stresses imparted during the application life-cycle due to loads, temperature changes, heat, environments, etc.

Application of chemicals: Application from contact, rubbing, wiping, spraying, soaking, etc. Also having an affect is the relative concentration of the chemical in question.

The following data is based on complete immersion of *eco*resin tensile bars in the chemical or reagent shown. Samples remained immersed and were stored at 23°C (73°F) for a period of one year. Following the test period the samples were removed from immersion, weighed and measured. This table represents the changes in weight, thickness and appearance of the immersed samples over the testing period.

REAGENT	% CHANGE		
	WEIGHT	THICKNESS	APPEARANCE AFTER EXPOSURE
Acetic Acid, 5%	<1	<1	Very slight yellowing
Acetic Acid, conc.	19	18	Discolored, swollen
Acetone	16	23	Discolored (brown), swollen, rubber-like
Ammonium Hydroxide, conc.	-29	-20	Turned white, outside crumbling off
Ammonium Hydroxide, 10%	4	4	Discolored (pink), surface has blisters

REAGENT	% CHANGE		
	WEIGHT	THICKNESS	APPEARANCE AFTER EXPOSURE
Antifreeze, Automotive Ethylene Glycol Type	<1	<1	No change
Benzene	34	43	Discolored, rubber-like
Brake Fluid, DOT3	2	2	No change
Brake Fluid	6	6	Turned yellow, surface attacked, flaking off
Carbon Tetrachloride	27	18	Discolored, swollen
Chromic Acid, 40%	<1	<1	Slightly discolored
Citric Acid, 10%	<1	<1	Slight yellowing
Cottonseed Oil	<1	<1	Very slight yellowing
Deionized Water	<1	<1	Slight yellowing
Detergent, Alconox (0.25%)	<1	<1	Slight yellowing
Di (2-Ethylhexyl) Phthalate	<1	<1	Very slight yellowing
Dibutyl Sebacate	<1	1	Slight yellowing
Diesel Fuel	<1	2	Discolored
Dimethyl Formamide	22	39	Badly discolored and distorted
Ethanol, 50%	<1	<1	Slight yellowing
Ethanol, 100%	<1	<1	Very slight yellowing
Ethyl Acetate	20	24	Badly discolored and swollen, softened
Ethylene Dichloride	—	—	Completely deteriorated after 1 week
Gasohol, 10% Ethanol	9	8	Cloudy, slight yellowing
Gasohol, 10% Methanol	11	10	Cloudy, yellowed
Gasoline, Base for Gasohol	6	6	Slight yellowing
Gasoline, Premium Unleaded	2	3	Discolored
Gasoline, Regular	<1	<1	Slight yellowing
Gasoline, Regular Unleaded	2	2	Discolored
Grease, Automotive	<1	<1	No change
Hand Cleaner, Waterless Jergens SBS30	<1	2	No change
Hexane	<1	<1	Slight yellowing
Hydrochloric Acid, conc.	1	<1	Badly discolored, blisters under surface
Hydrochloric Acid, 10%	<1	<1	Slight yellowing
Hydrogen Peroxide, 3%	<1	<1	Slight yellowing
Hydrogen Peroxide, 28%	<1	<1	Slight yellowing
Isooctane	<1	<1	Very slight yellowing

REAGENT	% CHANGE		
	WEIGHT	THICKNESS	APPEARANCE AFTER EXPOSURE
Kerosene	<1	<1	Very slight yellowing
Lacquer Thinner	7	6	Cloudy, white
Methyl Alcohol	<1	<1	Very slight yellowing, crazing
Mineral Oil	<1	<1	Very slight yellowing
Motor Oil	<1	<1	No change
Nitric Acid, conc.	—	—	Completely deteriorated after 1 wk.
Nitric Acid, 10%	<1	<1	Slight yellowing
Nitric Acid, 40%	1	<1	Turned white
Oleic Acid, 83%	<1	<1	Very slight yellowing
Olive Oil	<1	<1	Very slight yellowing
Penetrating Oil, Liquid Wrench #1	10	11	Discolored
Phenol, 5%	13	14	Turned black
Silicone Spray Lubricant	67	34	White, swollen
Soap Solution, 1%	<1	<1	Slight yellowing
Sodium Carbonate, 2%	<1	<1	Slight yellowing
Sodium Carbonate, 20%	<1	<1	Slight yellowing
Sodium Chloride, 10%	<1	<1	Slight yellowing
Sodium Hydroxide, 1%	<1	<1	Slight yellowing
Sodium Hydroxide, 10%	8	6	Slight yellowing
Sodium Hypochlorite, 3.5%	<1	<1	Slight yellowing
Sulfuric Acid, conc.	—	—	Completely deteriorated after 1 wk.
Sulfuric Acid, 3%	<1	<1	Slight yellowing
Sulfuric Acid, 30%	<1	<1	Slight yellowing
Tapping Oil	<1	1	No change
Toluene	26	31	Turned white, softened
Transformer Oil	<1	<1	Very slight yellowing
Transmission Fluid, Auto	<1	<1	No change
Turpentine	<1	<1	Slight yellowing

CLEANING INSTRUCTIONS

3form *ecoresin*, like all thermoplastic resin materials, should be cleaned periodically. A regular, seasonal cleaning program will dramatically help prevent noticeable weathering and dirt build-up.

Rinse the sheets with lukewarm water. Remove dust and dirt from *ecoresin* with a soft cloth or sponge and a solution of mild soap and/or liquid detergent in water. A 50:50 solution of isopropyl alcohol and water also works well. Rinse thoroughly with lukewarm water.

Always use a soft, damp cloth to blot dry. Rubbing with a dry cloth can scratch the material and create a static charge. Never use scrapers or squeegees on *ecoresin*. Also avoid scouring compounds, gasoline, benzene, acetone, carbon tetrachloride, certain deicing fluids, gasoline, lacquer thinner or other strong solvents.

Do not:

- Use a squeegee
- Strong solvents, highly alkaline or abrasive cleaning agents
- Clean in hot sun or elevated temperatures
- Rub with a dry cloth

PRESSURE WASHING

Pressure washing can also be an effective way to remove miscellaneous debris from surfaces of 3form *ecoresin* installations that are in exterior or hard-to-reach places.

Pre-soak panels with a light water spray to loosen and remove incidental surface debris.

It is recommended that the water pressure for cleaning *ecoresin* panels be 1,500 psi or less. 3form *ecoresin* is a tough material but can be damaged if high pressure is concentrated in a single position too long. Use a gradual sweeping motion over the application. Never concentrate water spray in a single position. Pressure nozzle should never be positioned closer than 8" (203 mm) from the panel surface.

Test a portion of the sheet first before spraying. If test piece shows any sign of material fatigue, abrasion or delamination – discontinue pressure washing and proceed with manual cleaning instructions as described above.

Coated or painted parts are not suitable for pressure washing as finish may be stripped off. Pressure washing is not suitable for *ecoresin* panels that have been edge sealed. If using detergent, use mild detergents only. Rinse sheet with light water spray after washing.

Do not:

- Concentrate spray in single position
- Use more than 1,500 psi pressure
- Position pressure nozzle closer than 8" (203 mm) from panel
- Proceed with pressure washing if test piece shows detrimental effects to panel
- Pressure wash ecoresin panels that have been painted or coated to maintain coating integrity
- Pressure wash ecoresin panels with sealed edges to ensure edge seals remain in tact

If debris or dirt is not removed by pressure washing attempt to clean with manual procedures described in preceding section.

Important: If a cleaning material is found to be incompatible in a short-term test, it will usually be found to be incompatible in the field. The converse, however, is not always true. Favorable performance is no guarantee that actual end-use conditions have been duplicated. Therefore, these results should be used as a guide only and it is recommended that the user test the products under actual end-use conditions.

For additional information about 3form ecoresin please contact 3form @ 801.649.2500

PART 3 - EXECUTION

3.01 INSPECTION:

A. Before cutting, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.

B. Before the start of cutting work, meet at the work site with all parties involved, including mechanical and electrical trades. Review areas of potential interference and conflict between the various trades. Coordinate layout of the work and resolve potential conflicts before proceeding with the work.

3.02 PREPARATION:

A. To prevent failure provide temporary support of work to be cut.

B. Protect other work during cutting and patching to prevent damage.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take precautions not to cut existing pipe, conduit or duct serving the building but scheduled to be relocated until provisions have been made to bypass them.

3.03 PERFORMANCE:

A. General:

Employ skilled workmen to perform cutting and patching work. Except as otherwise indicated, proceed with cutting and patching at the earliest feasible time and complete work without delay.

B. Cutting:

1. Cut the work using methods that are least likely to damage work to be retained or adjoining work.

2. Use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as a carborundum saw or core drill to insure a neat hole. Cut holes and slots neatly to size required with minimum disturbance of adjacent work.

3. By-pass utility services such as pipe and conduit, before cutting, where such utility services are shown or required to be removed, relocated or abandoned. Cut-off conduit and pipe in walls or partitions to be removed. After by-pass and cutting, cap, valve or plug and seal tight remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter.

4. Comply with requirements of applicable sections of Division 2 where cutting and patching requires excavating and backfilling.

C. Restoration of Surface (Patching):

A. Restore exposed finishes of patched areas, and where necessary, extend finish restoration into retained adjoining work in a manner which will eliminate evidence of patching and refinishing.

B. Comply with the requirements of the Section of the Specifications of the material that will be used to patch.

D. Cleaning:

Thoroughly clean areas and spaces where work is performed or used as access to work. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied.

END OF SECTION 06065

SECTION 06125 – WOOD DECKING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cedar Decking.

B. Cedar Seating.

1.02 RELATED SECTIONS

A. Section 05500 – Metal Fabrication.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Selection Samples: For each finished product specified two complete sets of color chips representing manufacturer's full range of available materials and finished appearance.

D. Verification Samples: For each finish product specified, two samples, nominal size 5 1/2 inches (140 mm) square representing actual product with finished color and texture.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Experience in successfully producing fabrications to those indicated in this project.

B. Substitutions of any component or modification of system shall be made only if approved by the Architect or Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inspect the materials upon delivery to assure that specified products have been received.

B. Store materials in safe area, away from construction traffic; store under cover and off ground, protected from moisture.

C. Keep materials clearly separated and identified with grade marks legible. Keep damaged material identified as damaged and stored separately.

1.06 PROJECT CONDITIONS

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

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

1.07 SUPPLEMENTAL MATERIALS

A. Fasteners, supports, and hangers shall be provided by manufacturers other than member organizations of the WRCLA, and conform to the requirements set forth by this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Western Red Cedar Lumber Association, which is located at: 1501 - 700 W. Pender St. Pender Place 1, Business Bldg. ; Vancouver, BC, Canada V6C 1G8; Toll Free Tel: 866-778-9096; Tel: 604-684-0266; Fax: 604-687-4930; Email: wrcla@wrcla.org; Web: www.wrcla.org

B. Requests for substitutions will be considered in accordance with provisions of Section 01630.

2.02 DECKING MATERIAL

A. Western Red Cedar Decking: Western Red Cedar Lumber Association decking grades.
1. Grade: Architect Clear.

2.03 FASTENERS

A. Nails:
1. Material: No. 304 stainless steel.
2. Material: No. 316 stainless steel.
3. Material: Hot-dipped galvanized.
4. Material: Aluminum.
5. Shank: Plain.
6. Shank: Spiral.
7. Shank: Ringed.
8. Length: 8d - 2 1/2 inches (64mm) for decking with 1 1/4 inch (32mm) nominal thickness.
9. Length: 10d - 3 inches (76mm) for decking with 2 inch (51mm) nominal thickness.

B. Screws:
1. Material: No. 304 stainless steel.
2. Material: No. 316 stainless steel.
3. Material: Double Hot-Dipped Galvanized.
4. Length: 2 1/2 inches (64mm) for decking with 1 1/4 inch (32mm) nominal thickness
5. Length: 3 inches (76mm) for decking with 2 inch (51mm) nominal thickness.

2.04 PROTECTING FINISH

A. Water repellant, fungus and mildew resistant penetrating stain that is resistant to Ultra Violet (UV) light.
1. Color: Translucent.

B. Follow guidelines of the Western Red Cedar Lumber Association.

C. Adhere to coating manufacturer's instructions.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate work with related trades; scribe and cope decking for accurate fit. Allow installation of related work to avoid cutting and patching.

B. Select decking boards of longest possible lengths. Discard boards that are warped, twisted, bowed, crooked or otherwise defective.

3.02 INSTALLATION

A. Install decking square, plumb, and level, evenly fitted and securely fastened.

B. Space decking planks 1/8 inch (3mm) apart to allow for adequate drainage and expansion.

C. Fasten decking using appropriate length nails for the application.
1. Use 3 inch (10d) nails to fasten decking with nominal thickness of 2 inches. Use 2-1/2 inch (8d) nails to fasten decking with nominal thickness of 1-1/4 inches (31.7 mm). Length may be reduced by 1/4 inch (6.3 mm) if ring or spiral shank nails are used.
2. Use thin shanked nails with blunt points to prevent splitting.
3. Provide one nail per joist for deck boards 2 inches (50 mm) wide, two nails per joist for deck boards 4 inches (100 mm) and wider.

D. Fasten deck with screws long enough to penetrate 1 inch (25 mm) into support members. Provide 1-1/2 inches (38 mm) penetration for structural components.

E. Secure decking with blind fastening system following blind fastener manufacturer's instructions.

F. Follow installation instructions specified in the Western Red Cedar Lumber Association's Installing Cedar Siding publication and DVD.

G. Installation must comply with local building codes and regulations.

H. Finish materials on all sides and ends. Apply touch up coating on new cuts. Factory finishing is preferred.

3.03 ADJUSTING AND CLEANING

A. As work proceeds, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris related to this work.

3.04 MAINTENANCE

A. Explain proper maintenance procedures to owner or owner's representative at project closeout.

B. Move planters, benches and other deck accessories periodically to allow the deck beneath to thoroughly dry.

C. Inspect decking annually for loose fasteners and finish condition. Re-apply coating as necessary.

D. The use of pressure washers is not recommended.

END OF SECTION 06125

SECTION 06400 - ARCHITECTURAL MILLWORK

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A.Extent of architectural millwork (woodwork) is indicated on drawings, in schedules and as herein specified.

B.Types of architectural woodwork include, but are not necessarily limited to, the following:

1.Wall and base cabinets.
2.Wood veneered finish wall panels and floors.
3. Wood sub-floors.
4. Wood floors.

1.02 QUALITY ASSURANCE:

A.AWI Quality Standards:

The latest edition of the "Quality Standards and Guide Specifications" of the Architectural Woodwork Institute (AWI) shall apply to the work in this Section, and is hereby made a part of this Section of the Specifications.

B.Manufacturer Qualifications:

Architectural woodwork manufacturer (fabricator) must have at least five (5) years of successful experience in comparable work and scope, must be knowledgeable with the AWI standards herein referred to, and must be acceptable by the Architect.

C.Installation Requirements:

Architectural woodwork items shall be installed by the manufacturer which fabricated them.

1.03 SUBMITTALS:

A.Product Data:

Submit manufacturer's product data for each product and process specified as work of this section and incorporated into items of architectural woodwork during fabrication, finishing and installation.

B.Samples:

Submit the following samples:

1. For each species and cut of lumber, provide a 6" x 12" x 3/4" sample finished on one side and one edge.

2. Plywood for concealed or exposed finish, provide a 6" x 12" sample of each type.

3. For wall panels, provide a 24" x 24" sample showing surface treatment (veneer), joint work and curved surface fabrication.

4. For veneers provide 12" x 12" for each type and surface finish.

5. For plastic laminate, provide 6" x 12" for each type, color, pattern and surface finish.

6. Exposed cabinet hardware, provide one (1) unit of each type and finish.

C. Shop Drawings:

Submit fabrication and installation shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices, hardware and other components.

1.04 PRODUCT HANDLING:

A. Protect architectural woodwork during transit, delivery, storage and installation to prevent damage and deterioration.

B. Do not deliver and/or install architectural woodwork until the installation area has been painted, all work that could damage or deteriorate woodwork has been completed and the area is dry so that the woodwork will not be damaged.

PART 2 - PRODUCTS

2.01 WOOD:

A. All wood shall be best of its respective kind, suitable for the particular purpose intended, well-seasoned, kiln dried to a maximum moisture content of 12%, free from shakes, large or loose knots and all imperfections, which might impair its strength, durability and appearance.

B. All rough lumber shall be treated No. 2 dimension spruce or douglas fir, free from knots, shales, rot or other defects, straight, square edged and straight grade.

C. Softwood shall be treated and conform to the Commercial Association grades and sizes based upon American Lumber Standards as specified in Simplified Practice Recommendation, R-16, Federal Bureau of Standards, Department of Commerce.

D. Veneer:

Unless otherwise indicated, veneer shall be Select White Birch and shall conform to the requirements of the AWI standards.

E.Plywood:

1.Concealed plywood shall be Type B-B, 3/4" treated.

2.Plywood for curged wall panels shall be Type A-B, of thickness required by manufacturer.

2.02 HARDWARE AND ACCESSORY MATERIALS:

A.General:

Provide all hardware and accessory materials specified and/or required for the proper fabrication of the types of architectural woodwork required.

B.Hardware:

Hardware shall be as follows:

1. Wood Door Hinges: Hafele flap hinges.
2. Drawer Guides/Runners: Hafele Drawer Slides Series.
3. Shelf Support: Hafele 7 mm diameter shelf series.
4. Folding bed: Hafele bed lift foldaway fitting

Hardware not specified, but required for the proper function of the cabinets shall comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.

C. All hardware shall be installed at mill.

D.Finish:

Exposed hardware shall be satin stainless steel, concealed hardware shall be manufacturer's standard finish which complies with product class requirements.

2.03 FASTENERS AND ANCHORS:

A.All materials shall be new and unused, and shall be of the required sizes and types.

B.Screws:

Select material, type, size and finish required for each use. Comply with FS FF-S-111 for applicable requirements.

C.Nails:

Select material, type, size and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

D.Anchors:

Select material, type, size and finish required by each substrate for secure anchorage.

2.04 FABRICATION, GENERAL:

A.Grade:

Fabricate all architectural woodwork to the **custom grade** standards of the Architectural Woodwork Institute.

B.Comply with requirements of referenced quality standard for moisture content of wood at time of fabrication and for relative humidity conditions in the installation areas.

C.Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises precut, where possible, to receive hardware and other items and work.

D.Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E.Fabricate architectural woodwork with pre-cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water-resistant coating.

F.Measurements:

Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

2.05 WALL AND BASE CABINETS:

Wall and base shall comply with:

A.Quality Standard:

Comply with AWI Section 400 and its Division 400B.

B.Laminate Cladding (Plastic Laminate):

Shall comply as manufactured by Pionite; color white or as selected by the Architect.

C.Provide dust panels of 1/2" plywood above compartments and drawers except where located directly under tops.

2.06 LAMINATED COUNTERS:

Counters shall comply with:

A.Quality Standard:

Comply with AWI Section 400 and its Division 400C.

B.Laminate Cladding (Plastic Laminate):

Shall comply as manufactured by Pionite; color white or as selected by the Architect.

C.Edge Treatment:

Unless otherwise indicated on drawings, edge treatment shall be preformed laminate cladding.

D.Countertop: GRC sculpted countertop

2.07 WOOD VENEER FINISHED WALLS AND FLOORS:

Wood veneer finished walls shall be manufactured by Plexwood, Inc. and shall comply with the AWI Section 500, custom grade, and as specified herein:

A.Species and Cut:

Select beech wood.

B.Veneer Matching:

Book and balanced matched.

C.Panel Matching:

Sequenced and numbered pre-manufactured sets of strips composed of grain wood and wood with the grain, cross-glued.

D. Floors:

Plank composed of grain wood and wood with the grain glued onto one side of a bearer with tongue and groove, easylox and rim. Color: beech

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PART 3 - EXECUTION

3.01 PREPARATION:

Condition woodwork to average prevailing humidity conditions in installation areas prior to installing. Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.02 FABRICATION:

Fabrication in compliance with referenced AWI standards and approved shop drawings.

3.03 INSTALLATION:

A.Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.

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

C.Handle, store, and install pressure treated wood in compliance with recommendations of chemical treatment manufacturer including those for adhesives, where required for installation.

D.Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

E.Wall and Base Cabinets:

Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of cabinets with transparent finish.

F.Counters and Countertops:

Anchor securely to base units and other support systems as indicated.

3.04 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION:

A.Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair replace woodwork.

B.Adjust joinery for uniform appearance.

C.Touch-up shop-applied finishes to restore damaged or soiled areas.

D.Clean, lubricate and adjust hardware.

E.Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures architectural woodwork being without damage or deterioration at time of substantial completion.

END OF SECTION 06400

SECTION 06414 – CABINET/DOOR HINGES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cabinet hinges.

1.2 RELATED SECTIONS

A. Section 06400 – Architectural millwork

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

A. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.5 DELIVERY, STORAGE, AND HANDLING

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

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Hafele America Co., which is located at: 3901 Cheyenne Dr. P.O. Box 4000 ;

Archdale, NC 27263; Toll Free Tel: 800-423-3531; Tel: 336 434-2322; Fax: 336-431-3831; Email: www.hafele.com/us/4255.asp; Web: www.hafele.com/us

B. Substitutions: Not permitted.

2.2 HINGES

A. Hinge: Zinc, die cast - nickel plated.
1. Hinge Type:
   a. Flap hinges, item no. 342.66.709
2. Mounting:
   a. Screw mount.
3. Action:
   a. 90 degree self-closing.
4. Door thickness

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 06411

SECTION 06414 – DRAWER SLIDE HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Drawer slides.

1.2 RELATED SECTIONS

A. Section 06400 - Architectural Millwork.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Submit schedule showing hardware, hardware location and finishes.

D. Verification Samples: Two of each different item of hardware for approval by Architect. One of each pair of approved items will be returned and may be used on the project.

1.4 SEQUENCING

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

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Hafele America Co., which is located at: 3901 Cheyenne Dr. P.O. Box 4000 ; Archdale, NC 27263; Toll Free Tel: 800-423-3531; Tel: 336 434-2322; Fax: 336-431-3831; Email: www.hafele.com/us/4255.asp; Web: www.hafele.com/us

B. Substitutions: Not permitted.

2.2 DRAWER SLIDES

A. Drawer Slides - Medium Duty:

1. Bottom Mounted, Epoxy Coated Slide: Cat. No. 423.37.755, nylon rollers, 3/4 extension bottom mounted standard slides, self closing with a 100 lb (45 kg) load rating.
   a. Finish: Powder coated white.
   b. Size: 22” (550 mm)

B. Accessories:
1. Varianta screws.
2. Flat head screws.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until cabinets have been properly prepared and finishes have dried.

B. If cabinet preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare substrates carefully, using templates provided by manufacturer.

C. Prepare hardware for installation using the methods recommended by the manufacturer.

3.3 INSTALLATION

A. Install cabinet hardware in strict accordance with manufacturer's instructions, using tools and hardware provided by or approved by manufacturer.

3.4 ADJUSTMENT

A. After cabinets have been installed in final location, make final adjustments in cabinet hardware to assure proper alignment and smooth operation.

B. Repair or replace cabinet hardware items damaged during installation.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Properly mask or otherwise protect installed slides before finishing furniture and cabinetry

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 06414

SECTION 06500- STRUCTURAL PLASTICS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.02 SUMMARY:

A. This section includes the following FRP Products & Fabrications:
1. FRP Pultruded Gratings and Treads
2. FRP Structural Shapes and Plate
3. FRP Standard Railing
4. FRP Ladders and Cages
5. FRP Foam Core Building Panels
6. FRP Building Panel System
7. FRP Planks
8. Molded Gratings and Treads

1.03 SCOPE OF WORK:

A. Furnish all labor, materials, equipment and incidentals necessary to install the fiberglass reinforced polymer (FRP) products as specified herein.

1.04 QUALITY ASSURANCE:

A. The material covered by these specifications shall be furnished by an ISO-9001:2000 certified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.

B. Substitution of any component or modification of system shall be made only when approved by the Architect or Engineer.

C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.05 DESIGN CRITERIA:

A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.

B. Design live loads of FRP gratings and floor panels shall not be less than 100 pounds per sq. ft. uniformly distributed unless specifically stated otherwise in drawings and/or supplementary conditions. Grating and floor panel deflection at the center of a simple span not to exceed .25 inches.

C. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members. Connections shall be designed to transfer the loads.

1.06 SUBMITTALS:

A. Shop drawings of all fabricated pultruded gratings and treads, structural shapes and plate, standard railings, ladders and cages, foam core building panels, building panel systems, planks, molded gratings and treads and appurtenances shall be submitted to the Engineer for approval in accordance with the requirements of Section 01340. Fabrication shall not start until receipt of Engineer's approval marked "Approved As Submitted" or "Approved As Noted".

B. Manufacturer's catalog data showing:
   1. Dimensions, spacings, and construction of products
   2. Materials of construction

C. Detail shop drawings showing:
   1. Dimensions
   2. Sectional assembly
   3. Location and identification mark
   4. Size and type of supporting frames required

D. Samples of each type of product shall be submitted for approval prior to placement of purchase orders.

1.07 SHIPPING AND STORAGE INSTRUCTIONS:

A. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.

B. All materials and equipment necessary for the fabrication and installation of pultruded gratings and treads, structural shapes and plate, standard railings, ladders and cages, foam core building panels, building panel systems, planks, molded gratings and treads and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.

C. Identify and match-mark all materials, items and fabrications for installation and field assembly.

PART 2 – PRODUCTS

2.01 GENERAL:

A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification.

B. All materials shall be of the kind and quality specified.

C. With the exception of molded gratings and treads, all FRP products noted in 1.02 shall be manufactured using a pultruded process utilizing polyester resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil shall achieve a flame spread of 25 or less in accordance with ASTM test method E-84.

D. After fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating.

E. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum U. V. coating can be applied.

F. All exposed surfaces shall be smooth and true to form.

G. Manufacturers:

1. Strongwell
2. Or approved alternative manufacturer

PART 3- STRUCTURAL SHAPES AND PLATES

A. Material

1. Structural shapes and plate shall be made from isophthalic polyester resin with fire retardant additives to meet a flame rating of less than 25 per ASTM E-84 and meet the self- extinguishing requirements of ASTM D- 635. All structural shapes shall contain a UV inhibitor.

B. Process

1. Manufactured by the pultrusion process.

2. Structural FRP members composition shall consist of a glass fiber reinforced polyester or vinyl ester resin matrix, approximately 50% glass by weight. A synthetic surface veil shall be the outermost layer covering the exterior surfaces. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats or stitched reinforcements shall be used internally for transverse strength.

3. Mechanical properties shall meet or exceed the values listed in Table I.

Table 1 – Fiberglass Pultruded Material Properties
Minimum Ultimate Coupon Properties (UN)

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 625 SHAPES	SERIES 500/525 PLATE⑤ 1/8" 3.175 mm	SERIES 500/525 PLATE⑤ 3/16" -1/4" 4.76-6.35 mm	SERIES 500/525 PLATE⑤ 3/8"-1" 9.5-25.4 mm	SERIES 625 PLATE⑤ 1/8" 3.175 mm	SERIES 625 PLATE⑤ 3/16"-1/4" 4.76-6.35 mm	SERIES 625 PLATE⑤ 3/8"-1" 9.5-25.4 mm
MECHANICAL										
Tensile Stress, LW	D638	psi	30,000	30,000	20,000	20,000	20,000	20,000	20,000	20,000
		N/mm²	207	207	138	138	138	138	138	138
Tensile Stress, CW	D638	psi	7,000	7,000	7,500	10,000	10,000	7,500	10,000	10,000
		N/mm²	48.3	48.3	51.7	68.9	68.9	51.7	68.9	68.9
Tensile Modulus, LW	D638	10^6 psi	2.5	2.6	1.8	1.8	1.8	1.8	1.8	1.8
		10^3N/mm²	17.2	17.9	12.4	12.4	12.4	12.4	12.4	12.4
Tensile Modulus, CW	D638	10^6 psi	.8	.8	.7	.9	1.4	1	1	1.4
		10^3N/mm²	5.52	5.52	4.83	6.21	9.65	6.89	6.89	9.65
Compressive Stress, LW	D695	psi	30,000	30,000	24,000	24,000	24,000	24,000	24,000	24,000
		N/mm²	207	207	165	165	165	165	165	165
Compressive Stress, CW	D695	psi	15,000	16,000	15,500	16,500	20,000	16,500	17,500	17,500
		N/mm²	103	110	107	114	138	114	121	121
Compressive Modulus, LW	D695	10^6 psi	2.5	2.6	1.8	1.8	1.8	1.8	1.8	1.8
		10^3N/mm²	17.2	17.9	12.4	12.4	12.4	12.4	12.4	12.4
Compressive Modulus, CW	D695	10^6 psi	1	1	1	1	1	1	1	1
		10^3N/mm²	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
Flexural Stress, LW	D790	psi	30,000	30,000	35,000	35,000	30,000	35,000	35,000	30,000
		N/mm²	207	207	241	241	207	241	241	207
Flexural Stress, CW	D790	psi	10,000	10,000	13,000	15,000	18,000	13,000	15,000	18,000
		N/mm²	68.9	68.9	89.6	103	124	89.6	103	124
Flexural Modulus, LW	D790	10^6 psi	1.6	1.6	1.8	2	2	1.8	2	2
		10^3N/mm²	11.0	11.0	12.4	13.8	13.8	12.4	13.8	13.8
Flexural Modulus, CW	D790	10^6 psi	0.8	0.8	0.9	1.1	1.4	1	1.1	1.4
		10^3N/mm²	5.52	5.52	6.21	7.58	9.65	6.89	7.58	9.65
Modulus of Elasticity①	full	10^6 psi	2.6	2.8						
	section	10^3N/mm²	17.9	19.3						
Modulus of Elasticity >4" >102 mm	full	10^6 psi	2.5	2.5						
	section	10^3N/mm²	17.2	17.2						
Parallel Compressive Shear Stress, LW②⑨	D3846	psi	3,000	3,000						
		N/mm²	20.7	20.7						
Shear Modulus, LW③	—	10^6 psi	.425	.425						
		10^3N/mm²	2.93	2.93						
Short Beam Shear, LW⑧⑨	D2344	psi	4,500	4,500						
		N/mm²	31.0	31.0						
Bearing Stress, LW	D953	psi	30,000	30,000	32,000	32,000	32,000	32,000	32,000	32,000
		N/mm²	207	207	220.6	221	221	221	221	221
Poisson's Ratio, LW⑨	D3039	in/in	.33	.33	.31	.31	.31	.32	.32	.32
		mm/mm	.330	.330	.310	.310	.310	.320	.320	.320
Notched Izod Impact, LW	D256	ft-lbs/in	25	25	15	10	10	15	10	10
		J/mm	1.33	1.33	.988	1.07	1.07	.988	1.07	1.07
Notched Izod Impact, CW	D256	ft-lbs/in	4	4	5	5	5	5	5	5
		J/mm	.214	.214	.267	.267	.267	.267	.267	.267

Table 1 — Fiberglass Pultruded Material Properties
Minimum Ultimate Coupon Properties (UN) – cont'd

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 625 SHAPES	SERIES 500/525 PLATE⑤ 1/8" 3.175mm	SERIES 500/525 PLATE⑤ 3/16" -1/4" 4.76-6.35mm	SERIES 500/525 PLATE⑤ 3/8"-1" 9.5-25.4mm	SERIES 625 PLATE⑤ 1/8" 3.175mm	SERIES 625 PLATE⑤ 3/16"-1/4" 4.76-6.35mm	SERIES 625 PLATE⑤ 3/8"-1" 9.5-25.4mm
PHYSICAL										
Barcol Hardness	D2583	—	45④	45④	40	40	40	40	40	40
24 HR Water Absorption⑦	D570	% Max by wt	.6	.6	.6	.6	.6	.6	.6	.6
Density	D792	lbs/in³ 10^{-3}g/mm³	.062-.070 1.72-1.94	.062-.070 1.72-1.94	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88
Coefficient of Thermal Expansion, LW⑨	D696	10^{-6}in/in/°F 10^{-6}in/in/°C	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0
Thermal Conductivity⑨	C177	BTU-in/ ft²/hr/°F W (m * °K)	4 .58	4 .58						
ELECTRICAL										
Arc Resistance, LW⑨	D495	seconds	120	120						
Dielectric Strength, LW⑨	D149	KV/in KV/mm	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38
Dielectric Strength, PF⑨	D149	volts/mil	200	200	200	N.T.	N.T.	250	N.T.	N.T.
FLAMMABILITY⑥										
Flammability Classification (1/16")	UL94	VO								
Tunnel Test	E-84	25 Max								
NBS Smoke Chamber	E-662	650-700 (typical)								
Flammability	D635	Self Extinguishing								
UL Thermal Index	Generic	130° C								
British Fire Test	BS 476-7	Class 1								

All values are minimum ultimate properties from coupon tests except as noted.

① This value is determined from full section simple beam bending of EXTREN® structural shapes.

② The shear stress test results will change radically if the notched orientation is altered. The value in this chart represents the test configuration where the notches are machined parallel to the reinforcing mat. For notches machined perpendicular to the reinforcing mat, this value would be two to three times larger.

③ The Shear Modulus value has been determined from tests with full sections of EXTREN® structural shapes. (See the Strongwell *Design Manual* for further information.)

④ Value would be 50 if the surfacing veil were not there.

⑤ Plate compressive stress/modulus measured edgewise and flexural stress/modulus measured flatwise.

⑥ Values apply to Series 525 and 625.

⑦ Measured as a percentage maximum by weight.

⑧ Span to depth ratio of 3:1; EXTREN® angles will have a minimum value of 4,000 psi and the I/W shapes are tested in the web.

⑨ Typical values because these are shape and composite dependent tests.

LW = Lengthwise PF = Perpendicular to laminate face

CW = Crosswise N.T. = Not Tested

PART 3 – EXECUTION

3.01 PREPARATION:

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from infiltration of water and debris.

3.02 INSPECTION AND TESTING:

A. The Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.

B. All labor, power, materials, equipment and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

3.03 INSTALLATION, GENERAL:

A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as determined by the Engineer.

B. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.

C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

3.04 ALL FRP INSTALLATION:

A. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

B. Install items specified as indicated and in accordance with manufacturer's instructions.

GENERAL FABRICATION CONSIDERATIONS

Fabrication with **EXTREN®** structural shapes is similar to working with wood, aluminum and other comparable materials. Strongwell has available an extensive *Fabrication and Repair Manual* that can be provided upon request to fabricators and contractors unfamiliar with fiberglass fabrication. Some of the more common questions concerning fabrication with **EXTREN®** are:

Q. Do I need special tools?

A. The tools and methods are the same, but since fiberglass is very abrasive, standard bits and blades wear quickly and will need frequent resharpening or replacing.

Q. What types of blades and bits work best?

A. Carbide tip blades and bits are preferred. Diamond tipped or coated blades are best, allowing faster speeds and longer tool life.

Q. Can **EXTREN®** be punched and sheared?

A. Yes, but material thickness should be limited to 3/16" for punching and 1/4" maximum for shearing. Punches and shears work best if the blade is tapered to permit the cutting edge to penetrate a small amount of the material at any one time.

Q. Can **EXTREN®** products be formed or bent?

A. No, **EXTREN®** cannot be bent, rolled or pressed as can steel shapes and plates.

Q. Fabrication can be very dusty. Is the dust harmful?

A. Although the dust is non-toxic and presents no serious health hazard, it can cause skin irritation. The amount of irritation will vary from person to person and can be reduced or eliminated by use of a protective cream. A coverall or shop coat and gloves will add to the operator's comfort.

Q. What other general fabrication practices should be observed?

A. Machine ways and other friction producing areas should be kept clean. Fiberglass chips are damaging abrasives.

Avoid excessive pressure when sawing, drilling, routing, etc. Too much force will rapidly dull tools and create excessive heat that can scorch the fiberglass.

Do not generate excessive heat in any machining operation. Excessive heat softens the bonding resin in the fiberglass resulting in a ragged rather than clean cut edge.

Support the fiberglass material rigidly during cutting operations. Shifting may cause chipping at the cut edges. Proper support will also prevent warping.

Always seal any cut surfaces or edges of the fiberglass shape with a compatible resin before reporting the job complete.

Fastenings and connections are an important part of both the fabrication and design process. See **CONNECTIONS** later in this section.

CONNECTIONS

INTRODUCTION

Connections of **EXTREN®** shapes and plates may be structural or non-structural. Structural joints — beams to beams, beams to columns, columns to floor, plate on grating (for composite action), etc. — must transmit design loads. Examples of non-structural joints might be coverplates of a foam cored insulating panel or a coverplate epoxied to fiberglass grating (for a walking surface).

Structural connections usually employ mechanical fasteners, adhesive bonding or a combination connection utilizing both. The strongest joint between pieces of **EXTREN®** shapes is obtained by using a combination of mechanical fasteners with adhesive applied to the mating surfaces.

Selection of the connection method is usually determined by:

- The required capacity of the joint
- Joint reliability
- The available space for the joint
- The types of members to be joined
- Suitability of joint for fabrication, especially high volume production work
- Service environment
- Need for disassembly
- Aesthetics desired

COMBINATION MECHANICAL AND ADHESIVE JOINTS

As was stated earlier, the best joints for most structural applications are combination joints. These joints offer the advantages of both types of connection. Adhesive bonding affords the joint good distribution of stresses, reduced effects of stress concentrations (at the holes) and increased joint stiffness while the mechanical fastening provides reliability, reduces the effect of peel and tension in eccentric joints and also provides the necessary clamping force to allow the curing of the epoxy. The table of allowable loads for clip angle at beam ends was developed using combination joints.

MECHANICAL CONNECTIONS

Mechanical connections utilize some type of mechanical fastener to join parts of fiberglass assemblies. Some of the more common types of mechanical fasteners are:

- Bolts with washer and nut (steel, stainless, monel, etc.)
- Threaded rod and nuts (steel and fiberglass **FIBREBOLT®**)
- Screws (self-tapping, and thread cutting)
- Rivets (blind rivets, drive rivets, solid rivets — available in many materials including steel, stainless, aluminum, nylon, etc.)
- Spring clips
- Nails
- Staples
- Threaded inserts with bolts
- Threaded holes with bolts

NOTE: Strongwell recommends the use of stainless steel fasteners to eliminate the corrosion problem associated with regular steel fasteners.

Although mechanical joints provide many advantages (such as conventional fabrication and assembly methods, ease of inspection, option of disassembly, etc.) the designer should be cautioned that improper spacing and edge distances of the bolts could cause a catastrophic failure by tear-out or shear-through. The American Society of Civil Engineers *Structural Plastics Design Manual* — Reference 2 recommends the edge distances (centerline of fastener to edge of material) and minimum pitch dimensions (center to center of fasteners in a line) – see table "Recommended Minimum

Fastener Edge Distances And Pitch Ratio Of Distance To Fastener Diameter" shown in this section.

ADHESIVE BONDED CONNECTIONS

A structural adhesive holds fiberglass parts together by surface attachment and can sustain a continuously applied load without excessive deformations or failure. In addition to sealing joints and surfaces, adhesives distribute the joint stresses more evenly.

Adhesive bonded joints work best when the adhesive layer is primarily stressed in shear or compression. Direct tensile or peel forces on adhesive joints should be avoided or evaluated with great care.

Successfully bonded adhesive joints of **EXTREN®** materials require careful fabrication procedures including:

1) Proper selection of the adhesive.

   The two types of adhesives recommended for use with **EXTREN®** fiberglass reinforced materials are polyesters and epoxies. Either adhesive will produce a satisfactory joint. However, polyester adhesives are somewhat less convenient to use because of the difficulty of measuring the small amount of catalyst required.

   The epoxy adhesives recommended for structural connections are either Shell 828 Epoxy Resin or Dow D.E.R. 331 Epoxy Resin or Strongwell Epoxy Adhesive. In general, epoxy adhesives provide stronger joints than polyester adhesives.

2) Proper preparation of the surfaces to be joined.

   The polyester surfacing veil must be removed to allow bonding of substrates.

   Contaminated surfaces must be thoroughly cleansed by wiping with a clean rag dampened with a solvent such as acetone, toluol or methyl alcohol. Wipe dry with a clean cloth. **Do not immerse or soak EXTREN® shapes in these solvents**.

3) Properly cure the adhesive joint.

   Freshly bonded joints should be held in position with clamps or weights until the adhesive cures. Joints bonded with epoxy adhesives generally can be handled with reasonable care after 8 hours of curing. It is desirable to leave the clamps or bonding pressure on the joints overnight for a total of 20 to 24 hours. If an oven is available, the curing time can be lessened considerably by heating moderately. The joint should not be expected to carry its design load until the adhesive joints have cured a minimum of 48 hours at 70°F. Lower temperatures require longer cure times.

   On the following page is a procedure for making structural epoxy joints. It provides additional information on surface preparation, mixing of epoxy and application.

PROCEDURE FOR MAKING STRUCTURAL EPOXY JOINTS

Materials Used

Strongwell epoxy adhesive base
Strongwell epoxy adhesive hardener
Small wax coated paper cup for mixing
Clean wooden or FRP stick for mixing
120 grit sandpaper
Clamps for holding epoxy joints during cure
Clean cloth

Surface Preparation

1) Sand mating surfaces with 120 grit sandpaper until the surface gloss has been removed. The surfacing veil must be ground off to expose the glass reinforcement. Sand blasting equipment can also be used.
2) Remove all dust with a clean cloth; air blasting equipment may also be used. Avoid recontamination of the surface from handling.

Mixing of Epoxy

Mix equal volume portions of the base and hardener in a small wax coated paper cup with a clean stick until a uniform gray color is attained and all marbled appearance is gone.

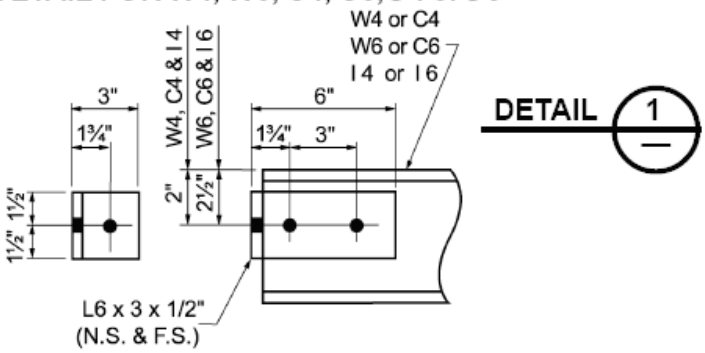
> **NOTE:** Other adhesive systems compatible with fiberglass can be utilized and the manufacturer's mixing instructions for these systems should be followed.

Application and Cure

1) Apply the mixed epoxy uniformly to all surfaces to be joined. A thin application is often more beneficial than a thick application.
2) Avoid introducing moisture into the joint.
3) Join the surfaces to be bonded. The pot life at 77°F for a 3 oz. mixture of equal volumes of base and hardener is 2.5 hours.
4) Secure the joint with clamps (or rivets or bolts) and allow 24 hours for a full cure. The assembly can often be handled with reasonable care in less than 8 hours. The structure should not be required to support its design load until at least 48 hours (at 70°F) after bonding. Lower temperatures require a longer cure.
5) After securing the joint, wipe away excess epoxy.

BEAM SHEAR CONNECTIONS

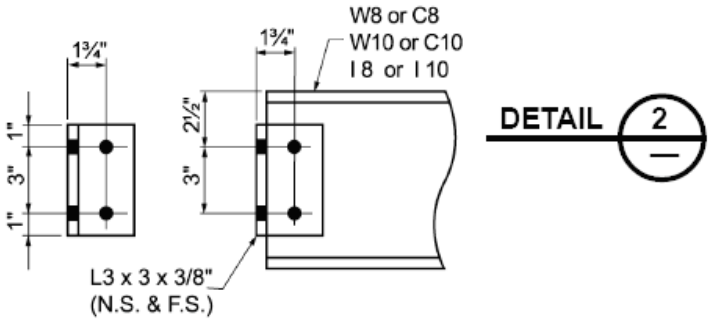
DETAIL FOR W4, W6, C4, C6, I 4 or I 6



BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 3375#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 1/4" Web = 1400#	3/8" Bolt & 3/8" Web = 2110#
1/2" Bolt & 1/4" Web = 1875#	1/2" Bolt & 3/8" Web = 2810#
5/8" Bolt & 1/4" Web = 2340#	5/8" Bolt & 3/8" Web = 3375#

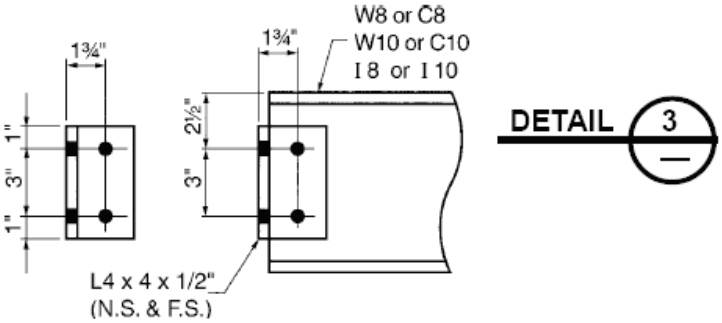
DETAIL FOR W8, W10, C8, C10, I 8 or I 10



BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 4200#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 2110#	3/8" Bolt & 1/2" Web = 2810#
1/2" Bolt & 3/8" Web = 2810#	1/2" Bolt & 1/2" Web = 3750#
5/8" Bolt & 3/8" Web = 3515#	5/8" Bolt & 1/2" Web = 4200#

DETAIL FOR W8, W10, C8, C10, I 8 or I 10

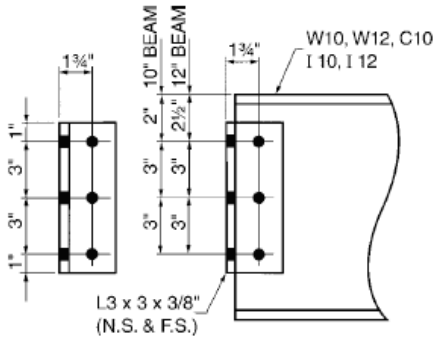


BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 5600#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 2110#	3/8" Bolt & 1/2" Web = 2810#
1/2" Bolt & 3/8" Web = 2810#	1/2" Bolt & 1/2" Web = 3750#
5/8" Bolt & 3/8" Web = 3515#	5/8" Bolt & 1/2" Web = 4680#

DETAIL FOR W10, W12, C10, C12, I 10 or I 12

DETAIL 4

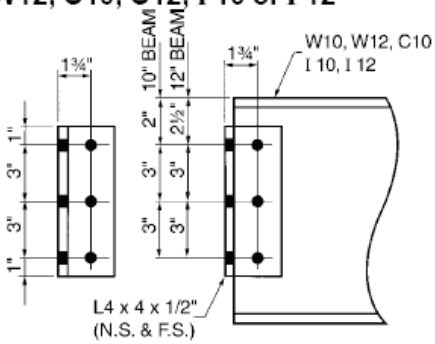


BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 6700#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 3160#	3/8" Bolt & 1/2" Web = 4220#
1/2" Bolt & 3/8" Web = 4220#	1/2" Bolt & 1/2" Web = 5620#
5/8" Bolt & 3/8" Web = 5270#	5/8" Bolt & 1/2" Web = 6700#

DETAIL FOR W10, W12, C10, C12, I 10 or I 12

DETAIL 5

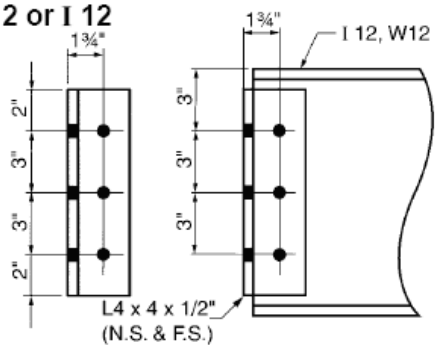


BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 9000#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 3160#	3/8" Bolt & 1/2" Web = 4220#
1/2" Bolt & 3/8" Web = 4220#	1/2" Bolt & 1/2" Web = 5620#
5/8" Bolt & 3/8" Web = 5270#	5/8" Bolt & 1/2" Web =7030#

DETAIL FOR W12 or I 12

DETAIL 6



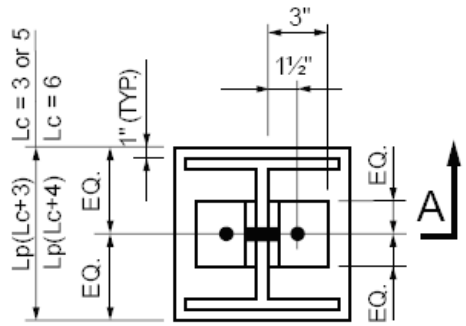
BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 11250#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 1/2" Web = 4220#
1/2" Bolt & 1/2" Web = 5620#
5/8" Bolt & 1/2" Web = 7030#

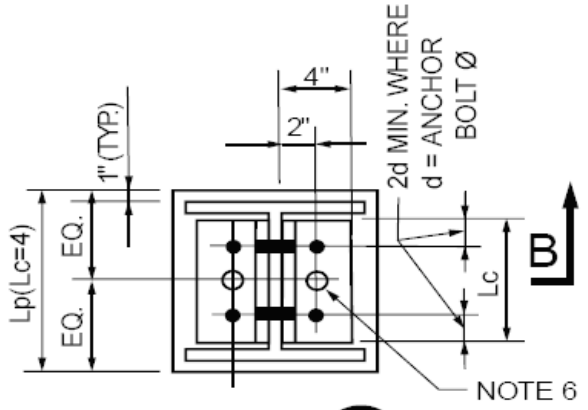
NOTES:

1. Capacities shown controlled by shear thru heel of angle (F_v=4500 psi / 4 = 1125 psi)
2. Capacities shown controlled by bearing around fastener or shear of stainless steel fasteners.
3. The beam capacity must be verified as being adequate.
4. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION** in the Strongwell *Design Manual*.
5. Details 1, 2 and 4 are standard Strongwell fabrication connections. Details 3, 5 and 6 are alternate fabrication connections.
6. Recommended hole diameters: Fastener +1/16".
7. 1/4" stainless steel angles can be substituted for the **EXTREN**® angles shown in the details.

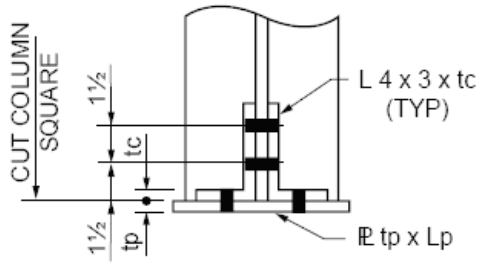
COLUMN BASE PLATES



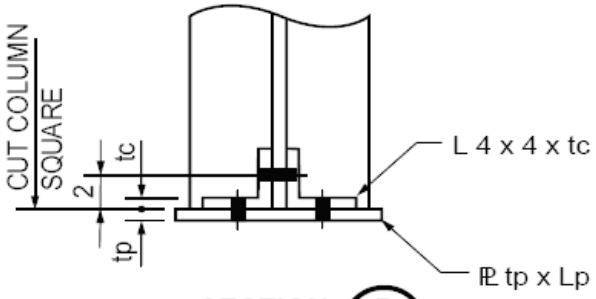
DETAIL 1 (PLAN)



DETAIL 2 (PLAN)



SECTION A



SECTION B

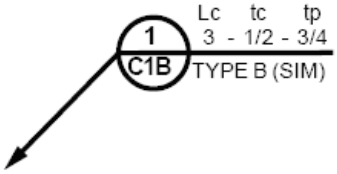
CAPACITIES -LBS				
CLIP		PLATE - tp		
Lc	tc	3/8	1/2	3/4
3	3/8	1325*	1850*	2550
	1/2	1800*	2350*	3375
5	3/8	2100*	2900*	4225
	1/2	2850*	3725*	5625
6	3/8	2550*	3500*	5075
	1/2	3450*	4525*	6750

* BENDING CONTROLS

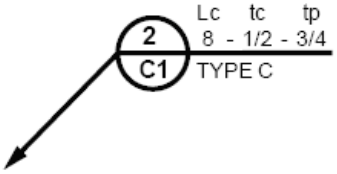
CAPACITIES -LBS				
CLIP		PLATE - tp		
Lc	tc	1/2	3/4	1
6	1/2	2825	4500	6650
	3/4	4400	6650	8750
8	1/2	3675	5800	8525
	3/4	5750	8275	11,350
10	1/2	4525	7125	10,425
	3/4	7075	10,175	13,900

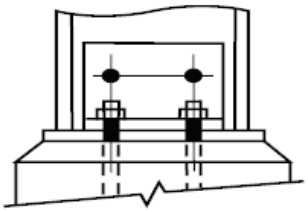
* BENDING CONTROLS

TYPICAL CALLOUT
ON DESIGN DWG.

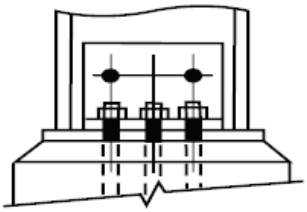


TYPICAL CALLOUT
ON DESIGN DWG.

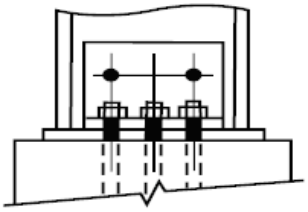




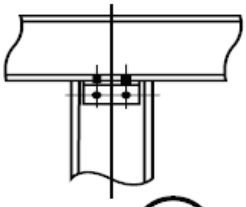
TYPE A
TYPICAL BOLTING



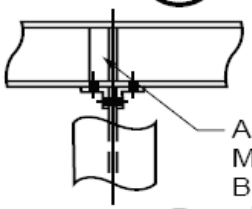
TYPE B
COLUMN ON GROUT
W/ CENTER ANCHOR BOLTS



TYPE C
COLUMN ON FLAT
W/ CENTER ANCHOR BOLTS



DETAIL 3



ANGLE (N.S. & F.S.)
MAY BE REQUIRED TO PREVENT
BEAM WEB BUCKLING
- REF. DESIGN GUIDE - BEAMS

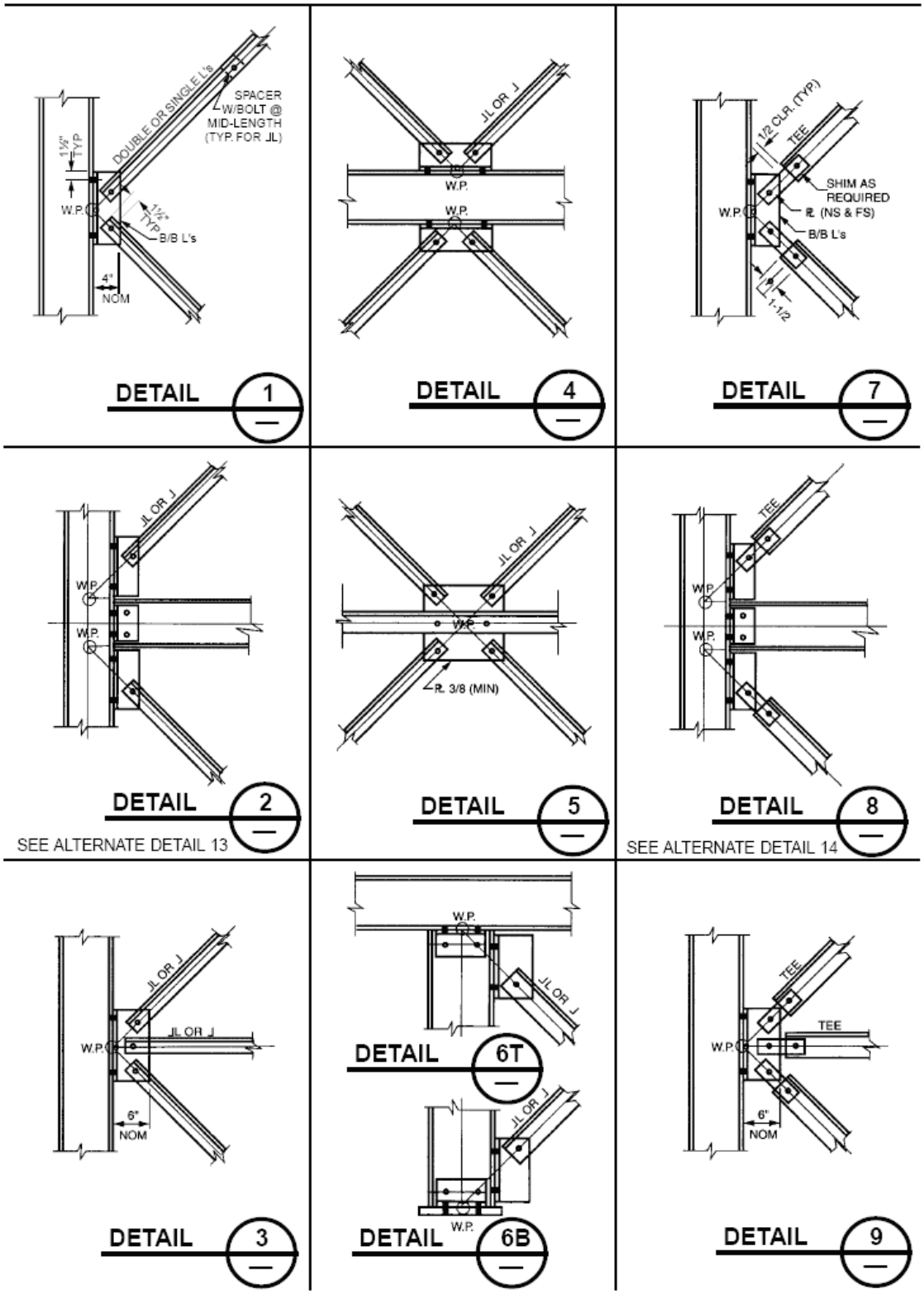
DETAIL 4

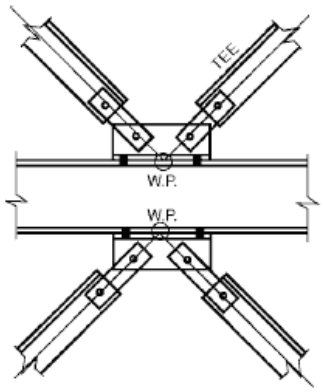
NOTES:

(DEVELOPED WITH TENSION LOADS)

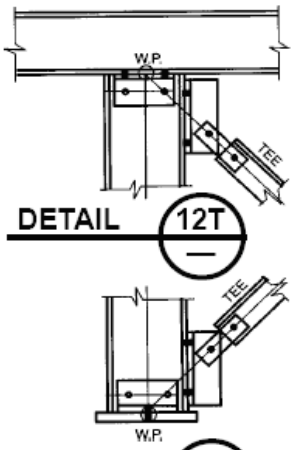
1. Values shown here are based on epoxy and bolted connections. For bolted only connections see Bearing and Shear values shown later in this section.
2. Capacities shown were controlled by shear through heel of angle (F_v=1125 psi) or bending of plate and angle with F_B=10000 psi/4=2500 psi.
3. For columns with combined tension and shear, both of which put shear into the heel of the angle, the total of the tension load + shear load must be less than the capacity listed.
4. 3/4" thick angles are special hand-layed-up angles and are not **EXTREN®** sections.
5. Plates shown square Lp required for capacity, but width can vary (i.e. for I-beam columns.)
6. Detail 2 can utilize anchor bolts separate from base plate assembly bolts. Two required, 1/2" dia. minimum.
7. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION**.
8. 1/4" stainless steel angles can be substituted for the **EXTREN®** angles shown in the details.

SINGLE/DOUBLE ANGLE & TEE BRACING DETAILS



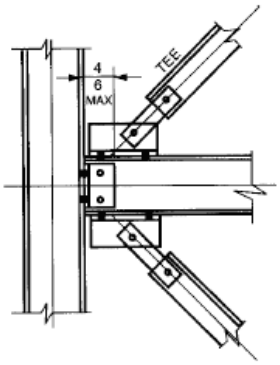


DETAIL 10

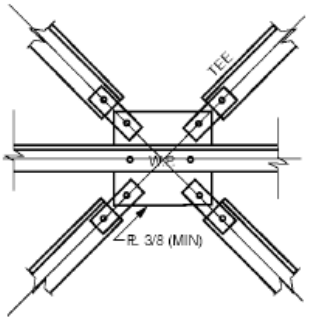


DETAIL 12T

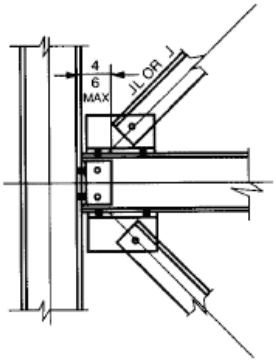
DETAIL 12B



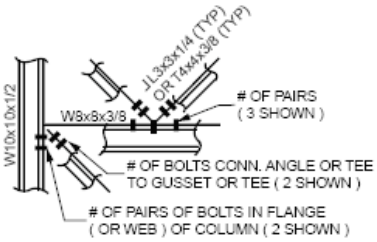
DETAIL 14



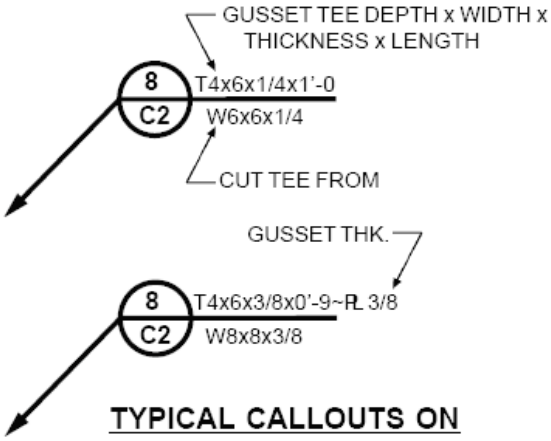
DETAIL 11



DETAIL 13



BOLT CALLOUT FOR ANGLES & TEES

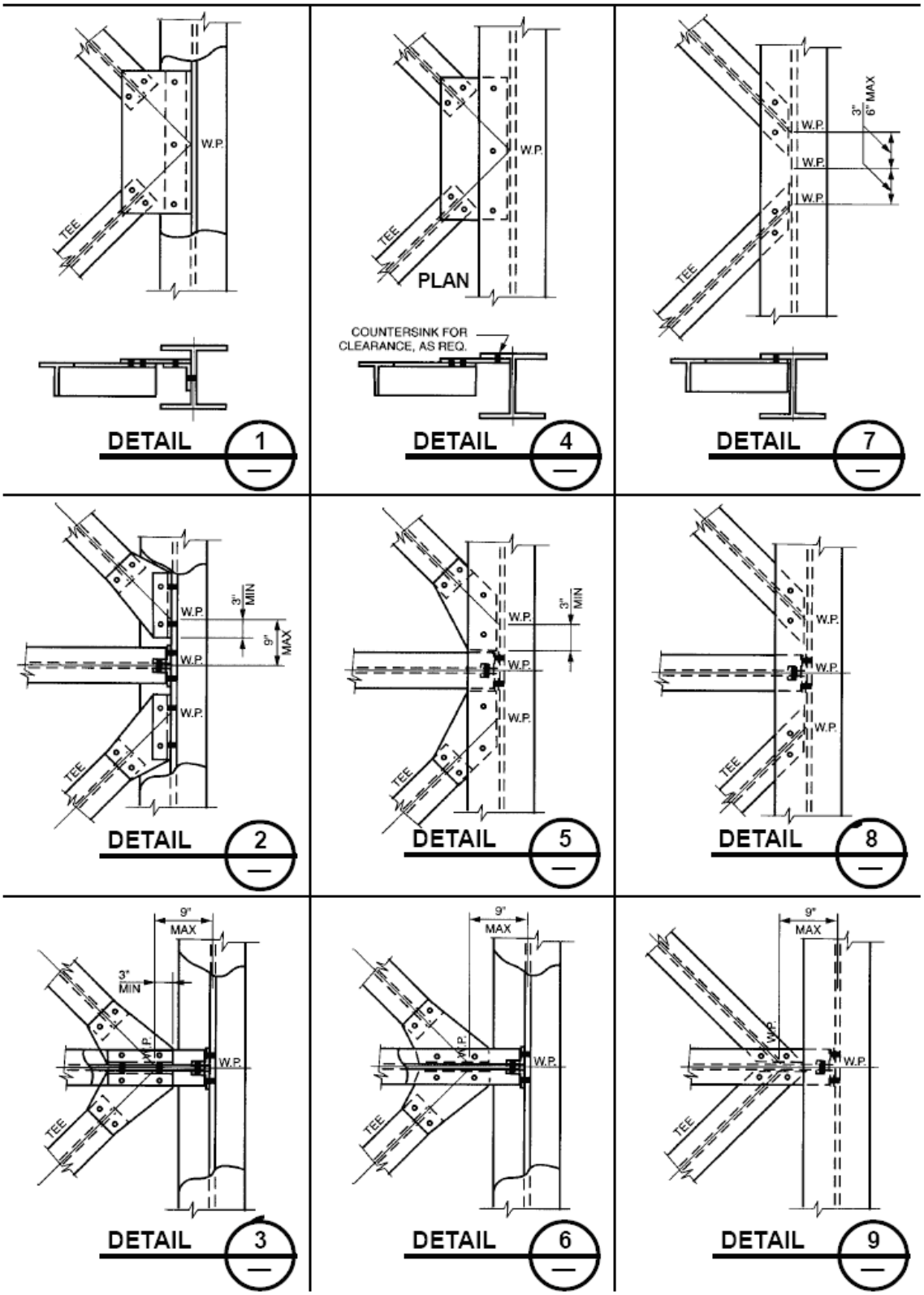


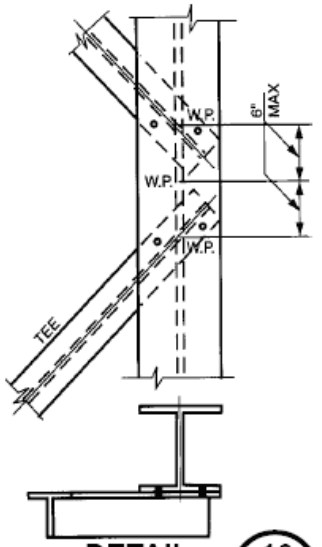
TYPICAL CALLOUTS ON DESIGN DRAWINGS

NOTES:

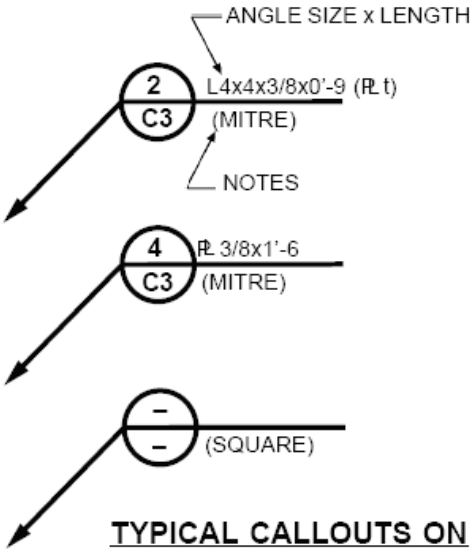
1. These connections are to be used with epoxy. 3/8" dia. bolts only provide clamp until epoxy cures. Ultimate capacity of joint = 1000 psi. For bolted only connections see Bearing and Shear values later in this section.
2. Designer is cautioned to check required area for epoxy with F_{ALL} = 1000/4 = 250 psi and tee thickness with Fv = 4500/4 =1125 psi.
3. Gussets should be symmetrical about WP whenever possible.
4. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION**.

HORIZONTAL BRACING — TEE & ANGLE DETAILS

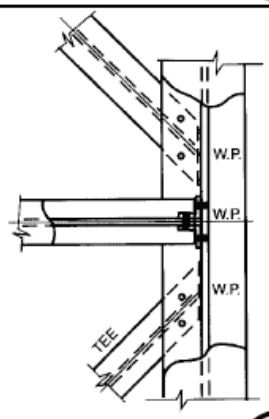




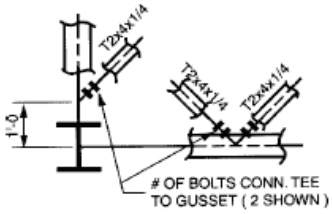
DETAIL 10



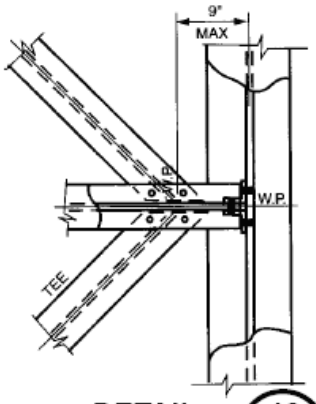
TYPICAL CALLOUTS ON DESIGN DRAWINGS



DETAIL 11



BOLT CALLOUT ON DESIGN DRAWINGS



DETAIL 12

NOTES:

1. These connections are to be used with epoxy. 3/8" dia. bolts only provide clamp until epoxy cures. Ultimate capacity of joint = 1000 psi. For bolted only connections see Bearing and Shear values later in this section.
2. Designer is cautioned to check required area for epoxy with F_{ALL} = 1000/4 = 250 psi and gusset/tee thickness with Fv = 4500/4 =1125 psi.
3. Gussets should be symmetrical about WP whenever possible.
4. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION**.

THREADED FASTENERS

BEARING

ALLOWABLE LOADS IN POUNDS

FIBERGLASS THICKNESS	BOLT DIAMETER 1/4"	3/8"	1/2"	5/8"	3/4"	1"
1/8"	234	352	469	586	703	938
1/4"	469	703	938	1172	1406	1875
3/8"	703	1055	1406	1758	2109	2812
1/2"	938	1406	1875	2344	2812	3750
3/4"	1406	2109	2812	3516	4219	5625

Allowable load = Allowable bearing stress x bearing area.

EXAMPLE

1/4" thickness with 1/2" dia. bolt

$$\text{Allowable load} = \frac{30{,}000\ \text{psi}}{4} \times .25'' \times .50'' = 938\ \text{lbs.}$$

NOTE: The above table assumes the bearing stress on fiberglass controls. The designer should verify that no other element of the connection controls.

SHEAR

ALLOWABLE LOADS IN POUNDS

BOLT TYPE	BOLT DIAMETER 1/4"	3/8"	1/2"	5/8"	3/4"	1"
S.S. Single Shear	1473	3312	5889	9204	13254	23562
S. S. Double Shear	2964	6624	11778	18408	26508	47124
FIBREBOLT®, Single Shear	—	400	650	950	1550	3750
FIBREBOLT®, Double Shear	—	750	1250	1875	3000	5000

NOTE: The above table assumes the shear capacity of the fastener controls. The designer should verify that no other element of the connection controls.

RECOMMENDED MINIMUM FASTENER EDGE DISTANCES AND PITCH RATIO OF DISTANCE TO FASTENER DIAMETER

	RANGE	COMMON
Edge Distance - end	2.0 to 4.5	3.0
Edge Distance - side	1.5 to 3.5	2.0
Pitch	4.0 to 5.0	5.0

FIBREBOLT® STUDS AND NUTS

STANDARD COLOR–BROWN

SHAPE–HEX

For structural applications where mechanical fasteners must not only be strong, but also non-corrosive and/or non-conductive, **FIBREBOLT®** fiberglass studs and nuts can be used in place of steel or other metal fasteners.

FIBREBOLT® is being utilized in chemical process equipment, air and water pollution control equipment, marine applications electrical equipment and in general industry.

FIBREBOLT® is available in diameters of 3/8", 1/2", 5/8", 3/4" and 1" with nuts for immediate delivery. Four foot lengths are standard. Other lengths are available on request. Custom partial length threading is also available on request.

Properties

	3/8 16 UNC	1/2 13 UNC	5/8 11 UNC	3/4 10 UNC	1 8 UNC
Ultimate thread shear using Strongwell fiberglass nut (lb.)①②	1,350	2,400	3,790	5,150	9600
Max ultimate tensile load using Strongwell fiberglass nut (lb.)②	1,050	2,000	3,100	4,500	6,500
Max ultimate tensile load using two (2) Strongwell fiberglass nuts (lb.)②	1,470	2,800	4,340	6,300	9,700
Transverse shear on threaded rod — double shear ASTM B-565 (min. load lb.)③	3,000	5,000	7,500	12,000	22,000
Transverse shear on threaded rod — single shear (min. load lb.)③	1,600	2,600	3,800	6,200	15,000
Compressive strength — longitudinal ASTM-D-695 (min. psi)③	60,000	60,000	60,000	60,000	60,000
Flexural strength ASTM-D-790 (min. psi)③	50,000	50,000	50,000	50,000	50,000
Flexural modulus ASTM-D-790 (min. psi x 10^6)③	2.0	2.0	2.0	2.50	2.75
Recommended maximum installation torque strength using Strongwell fiberglass nut lubricated with SAE 10W30 motor oil (ft./lbs.)②	4	8	16	24	50
Dielectric strength ASTM-D-149 (kv/in.)	35	35	35	35	35
Water absorption 24 hr. immersion—threaded ASTM-D-570 (%)	1	1	1	1	1
Coefficient of thermal expansion—longitudinal (in/in/°F)	$5x10^{-6}$	$5x10^{-6}$	$5x10^{-6}$	$5x10^{-6}$	$5x10^{-6}$
Max recommended operation temp —based on 50% retention of ultimate thread shear strength °C (°F)	95°C (203°F)	95°C (203°F)	95°C (203°F)	95°C (203°F)	95°C (203°F)
Stud weight (lb./ft.)	0.07	0.12	0.18	0.28	0.50
Thickness of nut & washer	3/4"	7/8"	1-1/8"	1-1/4"	1-5/8"
Flammability — ASTM – D635	Self-Extinguishing on All				

NOTE:

- All test results are for bolts with single nuts only. Proper safety factors should be applied to assembly.
- Properties above do not apply when fiberglass stud is used with metal nut.
- Appropriate safety factors must be applied.

① Ultimate strength values are averages obtained in design testing.
② New property categories added to better clarify stud thread shear properties.
③ Strength values are minimums derived from multiple production sample testing.

FIBREBOLT® STUDS AND NUTS USER'S GUIDE

FIBREBOLT® studs are pultruded, fiberglass reinforced vinyl ester threaded rods and thermoplastic hex-shaped nuts. The properties and characteristics of **FIBREBOLT®** differ from steel. Failure to follow the procedure below can result in damage and/or premature failure to the stud/nut assembly.

PROCEDURE

1) Verify that the nuts and studs are well lubricated. If the nuts are to be removed during the application, lubrication is a necessity. A light oil, dry lubricants, and silicone sprays are all satisfactory. Lubricants should be used in small quantities.
2) Bearing surfaces of the nuts must be parallel to the surfaces being fastened.
3) A torque wrench must be used.

The table below gives the ultimate and recommended maximum installation torque.

INSTALLATION TORQUE TABLE

Size	Ultimate Torque Strength	Recommended Maximum Installation Torque
3/8-16 UNC	8 ft-lbs.	4 ft-lbs.
1/2-13 UNC	18 ft-lbs.	8 ft-lbs.
5/8-11 UNC	35 ft-lbs.	16 ft-lbs.
3/4-10 UNC	50 ft-lbs.	24 ft-lbs.
1-8 UNC	110 ft-lbs.	50 ft-lbs.

4) Wrenches must make full contact with all nut edges. Partial contact will cause the corners to fracture, affecting the performance of the stud/nut assembly. A standard six point socket is recommended.
5) Whenever possible, the stud/nut assembly should be bonded to insure that the nuts do not loosen. The recommended bonding technique is to secure the nut to the proper torque value, then coat the entire nut and exposed stud assembly with a thick layer of adhesive or resin (this step is for assemblies in which the nut will not be subsequently removed).
6) Values reported in the **FIBREBOLT®** properties data sheet on the previous page were obtained for static conditions. Vibration should be eliminated or minimized in applications utilizing **FIBREBOLT®**.

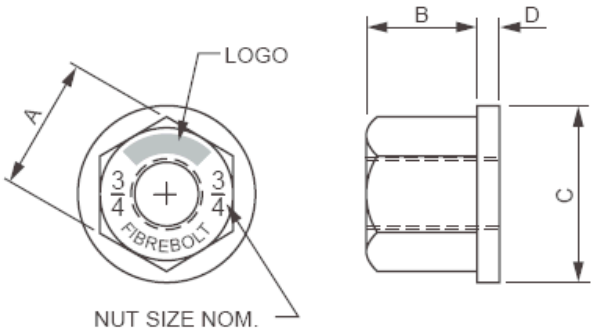
CAUTION

1) **All data regarding the FIBREBOLT® stud and nut assembly has been generated from tests involving only fiberglass nuts. No data has been generated for metal nuts. If metal nuts are used, strengths will be reduced because of less thread engagement. If metal nuts are used, extreme care should be taken to assure that the threads match and that a snug fit is achieved.**
2) **The FIBREBOLT® stud has cut, not molded threads. Threads that will be exposed to environments that might attack the glass reinforcements should be sealed after installation. If removal of the nut is anticipated, a very thin (1 mil) sprayed-on coat of polyurethane will normally be effective. Heavier coats of polyurethane, resin, or adhesive are recommended where possible.**

FIBREBOLT® NUTS

The hex shaped thermoplastic nut in Strongwell's **FIBREBOLT®** fastener system is manufactured from fiberglass reinforced PPS resin. The standard color is brown.

NOTE: FIBREBOLT® studs and nuts should be used together as a system to assure proper fit and properties. Interchange with other manufacturer's bolt or nut is not intended or assured.



FIBREBOLT® NUT

HEX NUT DIMENSIONS

NUT SIZE NOM.	WIDTH ACROSS FLATS "A"	NOM. WIDTH ACROSS FLATS	THICKNESS "B"	WASHER DIA. "C"	WASHER THICKNESS "D"
3/8 – 16 UNC	.745	3/4"	5/8"	1"	1/8"
1/2 – 13 UNC	.870	7/8"	3/4"	1-1/8"	1/8"
5/8 – 11 UNC	1.057	1-1/16"	15/16"	1-5/16"	3/16"
3/4 – 10 UNC	1.245	1-1/4"	1-1/16"	1-1/2"	3/16"
1 – 8 UNC	1.620	1-5/8"	1-3/8"	2"	1/4"

SECTION 06500- STRUCTURAL PLASTICS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.02 SUMMARY:

A. This section includes the following FRP Products & Fabrications:
1. FRP Pultruded Gratings and Treads
2. FRP Structural Shapes and Plate
3. FRP Standard Railing
4. FRP Ladders and Cages
5. FRP Foam Core Building Panels
6. FRP Building Panel System
7. FRP Planks
8. Molded Gratings and Treads

1.03 SCOPE OF WORK:

A. Furnish all labor, materials, equipment and incidentals necessary to install the fiberglass reinforced polymer (FRP) products as specified herein.

1.04 QUALITY ASSURANCE:

A. The material covered by these specifications shall be furnished by an ISO-9001:2000 certified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.

B. Substitution of any component or modification of system shall be made only when approved by the Architect or Engineer.

C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.05 DESIGN CRITERIA:

A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.

B. Design live loads of FRP gratings and floor panels shall not be less than 100 pounds per sq. ft. uniformly distributed unless specifically stated otherwise in drawings and/or supplementary conditions. Grating and floor panel deflection at the center of a simple span not to exceed .25 inches.

C. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members. Connections shall be designed to transfer the loads.

1.06 SUBMITTALS:

A. Shop drawings of all fabricated pultruded gratings and treads, structural shapes and plate, standard railings, ladders and cages, foam core building panels, building panel systems, planks, molded gratings and treads and appurtenances shall be submitted to the Engineer for approval in accordance with the requirements of Section 01340. Fabrication shall not start until receipt of Engineer's approval marked "Approved As Submitted" or "Approved As Noted".

B. Manufacturer's catalog data showing:
   1. Dimensions, spacings, and construction of products
   2. Materials of construction

C. Detail shop drawings showing:
   1. Dimensions
   2. Sectional assembly
   3. Location and identification mark
   4. Size and type of supporting frames required

D. Samples of each type of product shall be submitted for approval prior to placement of purchase orders.

1.07 SHIPPING AND STORAGE INSTRUCTIONS:

A. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.

B. All materials and equipment necessary for the fabrication and installation of pultruded gratings and treads, structural shapes and plate, standard railings, ladders and cages, foam core building panels, building panel systems, planks, molded gratings and treads and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.

C. Identify and match-mark all materials, items and fabrications for installation and field assembly.

PART 2 – PRODUCTS

2.01 GENERAL:

A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification.

B. All materials shall be of the kind and quality specified.

C. With the exception of molded gratings and treads, all FRP products noted in 1.02 shall be manufactured using a pultruded process utilizing polyester resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil shall achieve a flame spread of 25 or less in accordance with ASTM test method E-84.

D. After fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating.

E. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum U. V. coating can be applied.

F. All exposed surfaces shall be smooth and true to form.

G. Manufacturers:

1. Strongwell
2. Or approved alternative manufacturer

PART 3- STRUCTURAL SHAPES AND PLATES

A. Material

1. Structural shapes and plate shall be made from isophthalic polyester resin with fire retardant additives to meet a flame rating of less than 25 per ASTM E-84 and meet the self- extinguishing requirements of ASTM D- 635. All structural shapes shall contain a UV inhibitor.

B. Process

1. Manufactured by the pultrusion process.

2. Structural FRP members composition shall consist of a glass fiber reinforced polyester or vinyl ester resin matrix, approximately 50% glass by weight. A synthetic surface veil shall be the outermost layer covering the exterior surfaces. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats or stitched reinforcements shall be used internally for transverse strength.

3. Mechanical properties shall meet or exceed the values listed in Table I.

Table 1 – Fiberglass Pultruded Material Properties
Minimum Ultimate Coupon Properties (UN)

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 625 SHAPES	SERIES 500/525 PLATE⑤ 1/8" 3.175 mm	SERIES 500/525 PLATE⑤ 3/16" -1/4" 4.76-6.35 mm	SERIES 500/525 PLATE⑤ 3/8"-1" 9.5-25.4 mm	SERIES 625 PLATE⑤ 1/8" 3.175 mm	SERIES 625 PLATE⑤ 3/16"-1/4" 4.76-6.35 mm	SERIES 625 PLATE⑤ 3/8"-1" 9.5-25.4 mm
MECHANICAL										
Tensile Stress, LW	D638	psi	30,000	30,000	20,000	20,000	20,000	20,000	20,000	20,000
		N/mm²	207	207	138	138	138	138	138	138
Tensile Stress, CW	D638	psi	7,000	7,000	7,500	10,000	10,000	7,500	10,000	10,000
		N/mm²	48.3	48.3	51.7	68.9	68.9	51.7	68.9	68.9
Tensile Modulus, LW	D638	10^6 psi	2.5	2.6	1.8	1.8	1.8	1.8	1.8	1.8
		10^3N/mm²	17.2	17.9	12.4	12.4	12.4	12.4	12.4	12.4
Tensile Modulus, CW	D638	10^6 psi	.8	.8	.7	.9	1.4	1	1	1.4
		10^3N/mm²	5.52	5.52	4.83	6.21	9.65	6.89	6.89	9.65
Compressive Stress, LW	D695	psi	30,000	30,000	24,000	24,000	24,000	24,000	24,000	24,000
		N/mm²	207	207	165	165	165	165	165	165
Compressive Stress, CW	D695	psi	15,000	16,000	15,500	16,500	20,000	16,500	17,500	17,500
		N/mm²	103	110	107	114	138	114	121	121
Compressive Modulus, LW	D695	10^6 psi	2.5	2.6	1.8	1.8	1.8	1.8	1.8	1.8
		10^3N/mm²	17.2	17.9	12.4	12.4	12.4	12.4	12.4	12.4
Compressive Modulus, CW	D695	10^6 psi	1	1	1	1	1	1	1	1
		10^3N/mm²	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
Flexural Stress, LW	D790	psi	30,000	30,000	35,000	35,000	30,000	35,000	35,000	30,000
		N/mm²	207	207	241	241	207	241	241	207
Flexural Stress, CW	D790	psi	10,000	10,000	13,000	15,000	18,000	13,000	15,000	18,000
		N/mm²	68.9	68.9	89.6	103	124	89.6	103	124
Flexural Modulus, LW	D790	10^6 psi	1.6	1.6	1.8	2	2	1.8	2	2
		10^3N/mm²	11.0	11.0	12.4	13.8	13.8	12.4	13.8	13.8
Flexural Modulus, CW	D790	10^6 psi	0.8	0.8	0.9	1.1	1.4	1	1.1	1.4
		10^3N/mm²	5.52	5.52	6.21	7.58	9.65	6.89	7.58	9.65
Modulus of Elasticity①	full	10^6 psi	2.6	2.8						
	section	10^3N/mm²	17.9	19.3						
Modulus of Elasticity >4" >102 mm	full	10^6 psi	2.5	2.5						
	section	10^3N/mm²	17.2	17.2						
Parallel Compressive Shear Stress, LW②⑨	D3846	psi	3,000	3,000						
		N/mm²	20.7	20.7						
Shear Modulus, LW③	—	10^6 psi	.425	.425						
		10^3N/mm²	2.93	2.93						
Short Beam Shear, LW⑧⑨	D2344	psi	4,500	4,500						
		N/mm²	31.0	31.0						
Bearing Stress, LW	D953	psi	30,000	30,000	32,000	32,000	32,000	32,000	32,000	32,000
		N/mm²	207	207	220.6	221	221	221	221	221
Poisson's Ratio, LW⑨	D3039	in/in	.33	.33	.31	.31	.31	.32	.32	.32
		mm/mm	.330	.330	.310	.310	.310	.320	.320	.320
Notched Izod Impact, LW	D256	ft-lbs/in	25	25	15	10	10	15	10	10
		J/mm	1.33	1.33	.988	1.07	1.07	.988	1.07	1.07
Notched Izod Impact, CW	D256	ft-lbs/in	4	4	5	5	5	5	5	5
		J/mm	.214	.214	.267	.267	.267	.267	.267	.267

Table 1 — Fiberglass Pultruded Material Properties
Minimum Ultimate Coupon Properties (UN) – cont'd

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 500/525 SHAPES	SERIES 625 SHAPES	SERIES 500/525 PLATE⑤ 1/8" 3.175mm	SERIES 500/525 PLATE⑤ 3/16" -1/4" 4.76-6.35mm	SERIES 500/525 PLATE⑤ 3/8"-1" 9.5-25.4mm	SERIES 625 PLATE⑤ 1/8" 3.175mm	SERIES 625 PLATE⑤ 3/16"-1/4" 4.76-6.35mm	SERIES 625 PLATE⑤ 3/8"-1" 9.5-25.4mm
PHYSICAL										
Barcol Hardness	D2583	—	45④	45④	40	40	40	40	40	40
24 HR Water Absorption⑦	D570	% Max by wt	.6	.6	.6	.6	.6	.6	.6	.6
Density	D792	lbs/in³ 10^{-3}g/mm³	.062-.070 1.72-1.94	.062-.070 1.72-1.94	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88	.060-.068 1.66-1.88
Coefficient of Thermal Expansion, LW⑨	D696	10^{-6}in/in/°F 10^{-6}in/in/°C	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0	4.4 8.0
Thermal Conductivity⑨	C177	BTU-in/ ft²/hr/°F W (m * °K)	4 .58	4 .58						
ELECTRICAL										
Arc Resistance, LW⑨	D495	seconds	120	120						
Dielectric Strength, LW⑨	D149	KV/in KV/mm	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38	35 1.38
Dielectric Strength, PF⑨	D149	volts/mil	200	200	200	N.T.	N.T.	250	N.T.	N.T.
FLAMMABILITY⑥										
Flammability Classification (1/16")	UL94	VO								
Tunnel Test	E-84	25 Max								
NBS Smoke Chamber	E-662	650-700 (typical)								
Flammability	D635	Self Extinguishing								
UL Thermal Index	Generic	130° C								
British Fire Test	BS 476-7	Class 1								

All values are minimum ultimate properties from coupon tests except as noted.

① This value is determined from full section simple beam bending of EXTREN® structural shapes.

② The shear stress test results will change radically if the notched orientation is altered. The value in this chart represents the test configuration where the notches are machined parallel to the reinforcing mat. For notches machined perpendicular to the reinforcing mat, this value would be two to three times larger.

③ The Shear Modulus value has been determined from tests with full sections of EXTREN® structural shapes. (See the Strongwell *Design Manual* for further information.)

④ Value would be 50 if the surfacing veil were not there.

⑤ Plate compressive stress/modulus measured edgewise and flexural stress/modulus measured flatwise.

⑥ Values apply to Series 525 and 625.

⑦ Measured as a percentage maximum by weight.

⑧ Span to depth ratio of 3:1; EXTREN® angles will have a minimum value of 4,000 psi and the I/W shapes are tested in the web.

⑨ Typical values because these are shape and composite dependent tests.

LW = Lengthwise PF = Perpendicular to laminate face

CW = Crosswise N.T. = Not Tested

PART 3 – EXECUTION

3.01 PREPARATION:

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from infiltration of water and debris.

3.02 INSPECTION AND TESTING:

A. The Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.

B. All labor, power, materials, equipment and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

3.03 INSTALLATION, GENERAL:

A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as determined by the Engineer.

B. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.

C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

3.04 ALL FRP INSTALLATION:

A. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

B. Install items specified as indicated and in accordance with manufacturer's instructions.

GENERAL FABRICATION CONSIDERATIONS

Fabrication with **EXTREN®** structural shapes is similar to working with wood, aluminum and other comparable materials. Strongwell has available an extensive *Fabrication and Repair Manual* that can be provided upon request to fabricators and contractors unfamiliar with fiberglass fabrication. Some of the more common questions concerning fabrication with **EXTREN®** are:

Q. Do I need special tools?

A. The tools and methods are the same, but since fiberglass is very abrasive, standard bits and blades wear quickly and will need frequent resharpening or replacing.

Q. What types of blades and bits work best?

A. Carbide tip blades and bits are preferred. Diamond tipped or coated blades are best, allowing faster speeds and longer tool life.

Q. Can **EXTREN®** be punched and sheared?

A. Yes, but material thickness should be limited to 3/16" for punching and 1/4" maximum for shearing. Punches and shears work best if the blade is tapered to permit the cutting edge to penetrate a small amount of the material at any one time.

Q. Can **EXTREN®** products be formed or bent?

A. No, **EXTREN®** cannot be bent, rolled or pressed as can steel shapes and plates.

Q. Fabrication can be very dusty. Is the dust harmful?

A. Although the dust is non-toxic and presents no serious health hazard, it can cause skin irritation. The amount of irritation will vary from person to person and can be reduced or eliminated by use of a protective cream. A coverall or shop coat and gloves will add to the operator's comfort.

Q. What other general fabrication practices should be observed?

A. Machine ways and other friction producing areas should be kept clean. Fiberglass chips are damaging abrasives.

Avoid excessive pressure when sawing, drilling, routing, etc. Too much force will rapidly dull tools and create excessive heat that can scorch the fiberglass.

Do not generate excessive heat in any machining operation. Excessive heat softens the bonding resin in the fiberglass resulting in a ragged rather than clean cut edge.

Support the fiberglass material rigidly during cutting operations. Shifting may cause chipping at the cut edges. Proper support will also prevent warping.

Always seal any cut surfaces or edges of the fiberglass shape with a compatible resin before reporting the job complete.

Fastenings and connections are an important part of both the fabrication and design process. See **CONNECTIONS** later in this section.

CONNECTIONS

INTRODUCTION

Connections of **EXTREN®** shapes and plates may be structural or non-structural. Structural joints — beams to beams, beams to columns, columns to floor, plate on grating (for composite action), etc. — must transmit design loads. Examples of non-structural joints might be coverplates of a foam cored insulating panel or a coverplate epoxied to fiberglass grating (for a walking surface).

Structural connections usually employ mechanical fasteners, adhesive bonding or a combination connection utilizing both. The strongest joint between pieces of **EXTREN®** shapes is obtained by using a combination of mechanical fasteners with adhesive applied to the mating surfaces.

Selection of the connection method is usually determined by:

- The required capacity of the joint
- Joint reliability
- The available space for the joint
- The types of members to be joined
- Suitability of joint for fabrication, especially high volume production work
- Service environment
- Need for disassembly
- Aesthetics desired

COMBINATION MECHANICAL AND ADHESIVE JOINTS

As was stated earlier, the best joints for most structural applications are combination joints. These joints offer the advantages of both types of connection. Adhesive bonding affords the joint good distribution of stresses, reduced effects of stress concentrations (at the holes) and increased joint stiffness while the mechanical fastening provides reliability, reduces the effect of peel and tension in eccentric joints and also provides the necessary clamping force to allow the curing of the epoxy. The table of allowable loads for clip angle at beam ends was developed using combination joints.

MECHANICAL CONNECTIONS

Mechanical connections utilize some type of mechanical fastener to join parts of fiberglass assemblies. Some of the more common types of mechanical fasteners are:

- Bolts with washer and nut (steel, stainless, monel, etc.)
- Threaded rod and nuts (steel and fiberglass **FIBREBOLT®**)
- Screws (self-tapping, and thread cutting)
- Rivets (blind rivets, drive rivets, solid rivets — available in many materials including steel, stainless, aluminum, nylon, etc.)
- Spring clips
- Nails
- Staples
- Threaded inserts with bolts
- Threaded holes with bolts

NOTE: Strongwell recommends the use of stainless steel fasteners to eliminate the corrosion problem associated with regular steel fasteners.

Although mechanical joints provide many advantages (such as conventional fabrication and assembly methods, ease of inspection, option of disassembly, etc.) the designer should be cautioned that improper spacing and edge distances of the bolts could cause a catastrophic failure by tear-out or shear-through. The American Society of Civil Engineers *Structural Plastics Design Manual* — Reference 2 recommends the edge distances (centerline of fastener to edge of material) and minimum pitch dimensions (center to center of fasteners in a line) – see table "Recommended Minimum

Fastener Edge Distances And Pitch Ratio Of Distance To Fastener Diameter" shown in this section.

ADHESIVE BONDED CONNECTIONS

A structural adhesive holds fiberglass parts together by surface attachment and can sustain a continuously applied load without excessive deformations or failure. In addition to sealing joints and surfaces, adhesives distribute the joint stresses more evenly.

Adhesive bonded joints work best when the adhesive layer is primarily stressed in shear or compression. Direct tensile or peel forces on adhesive joints should be avoided or evaluated with great care.

Successfully bonded adhesive joints of **EXTREN®** materials require careful fabrication procedures including:

1) Proper selection of the adhesive.

   The two types of adhesives recommended for use with **EXTREN®** fiberglass reinforced materials are polyesters and epoxies. Either adhesive will produce a satisfactory joint. However, polyester adhesives are somewhat less convenient to use because of the difficulty of measuring the small amount of catalyst required.

   The epoxy adhesives recommended for structural connections are either Shell 828 Epoxy Resin or Dow D.E.R. 331 Epoxy Resin or Strongwell Epoxy Adhesive. In general, epoxy adhesives provide stronger joints than polyester adhesives.

2) Proper preparation of the surfaces to be joined.

   The polyester surfacing veil must be removed to allow bonding of substrates.

   Contaminated surfaces must be thoroughly cleansed by wiping with a clean rag dampened with a solvent such as acetone, toluol or methyl alcohol. Wipe dry with a clean cloth. **Do not immerse or soak EXTREN® shapes in these solvents**.

3) Properly cure the adhesive joint.

   Freshly bonded joints should be held in position with clamps or weights until the adhesive cures. Joints bonded with epoxy adhesives generally can be handled with reasonable care after 8 hours of curing. It is desirable to leave the clamps or bonding pressure on the joints overnight for a total of 20 to 24 hours. If an oven is available, the curing time can be lessened considerably by heating moderately. The joint should not be expected to carry its design load until the adhesive joints have cured a minimum of 48 hours at 70°F. Lower temperatures require longer cure times.

   On the following page is a procedure for making structural epoxy joints. It provides additional information on surface preparation, mixing of epoxy and application.

PROCEDURE FOR MAKING STRUCTURAL EPOXY JOINTS

Materials Used

Strongwell epoxy adhesive base
Strongwell epoxy adhesive hardener
Small wax coated paper cup for mixing
Clean wooden or FRP stick for mixing
120 grit sandpaper
Clamps for holding epoxy joints during cure
Clean cloth

Surface Preparation

1) Sand mating surfaces with 120 grit sandpaper until the surface gloss has been removed. The surfacing veil must be ground off to expose the glass reinforcement. Sand blasting equipment can also be used.
2) Remove all dust with a clean cloth; air blasting equipment may also be used. Avoid recontamination of the surface from handling.

Mixing of Epoxy

Mix equal volume portions of the base and hardener in a small wax coated paper cup with a clean stick until a uniform gray color is attained and all marbled appearance is gone.

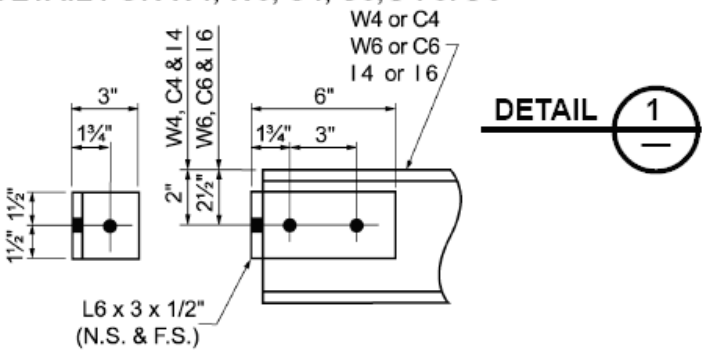
> **NOTE:** Other adhesive systems compatible with fiberglass can be utilized and the manufacturer's mixing instructions for these systems should be followed.

Application and Cure

1) Apply the mixed epoxy uniformly to all surfaces to be joined. A thin application is often more beneficial than a thick application.
2) Avoid introducing moisture into the joint.
3) Join the surfaces to be bonded. The pot life at 77°F for a 3 oz. mixture of equal volumes of base and hardener is 2.5 hours.
4) Secure the joint with clamps (or rivets or bolts) and allow 24 hours for a full cure. The assembly can often be handled with reasonable care in less than 8 hours. The structure should not be required to support its design load until at least 48 hours (at 70°F) after bonding. Lower temperatures require a longer cure.
5) After securing the joint, wipe away excess epoxy.

BEAM SHEAR CONNECTIONS

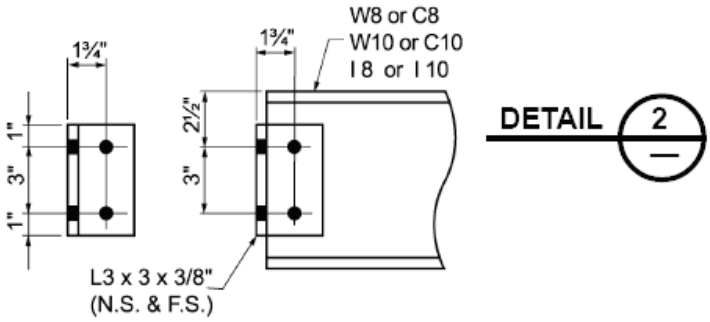
DETAIL FOR W4, W6, C4, C6, I 4 or I 6



BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 3375#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 1/4" Web = 1400#	3/8" Bolt & 3/8" Web = 2110#
1/2" Bolt & 1/4" Web = 1875#	1/2" Bolt & 3/8" Web = 2810#
5/8" Bolt & 1/4" Web = 2340#	5/8" Bolt & 3/8" Web = 3375#

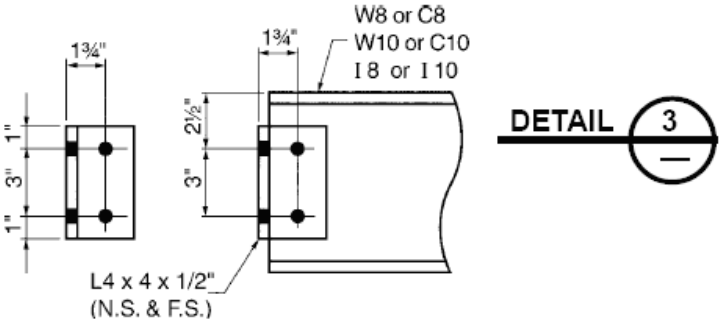
DETAIL FOR W8, W10, C8, C10, I 8 or I 10



BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 4200#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 2110#	3/8" Bolt & 1/2" Web = 2810#
1/2" Bolt & 3/8" Web = 2810#	1/2" Bolt & 1/2" Web = 3750#
5/8" Bolt & 3/8" Web = 3515#	5/8" Bolt & 1/2" Web = 4200#

DETAIL FOR W8, W10, C8, C10, I 8 or I 10

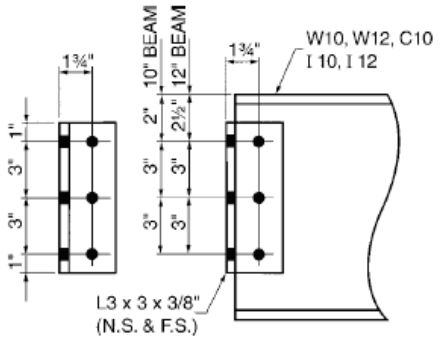


BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 5600#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 2110#	3/8" Bolt & 1/2" Web = 2810#
1/2" Bolt & 3/8" Web = 2810#	1/2" Bolt & 1/2" Web = 3750#
5/8" Bolt & 3/8" Web = 3515#	5/8" Bolt & 1/2" Web = 4680#

DETAIL FOR W10, W12, C10, C12, I 10 or I 12

DETAIL 4

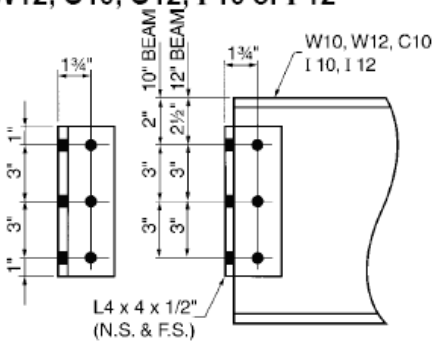


BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 6700#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 3160#	3/8" Bolt & 1/2" Web = 4220#
1/2" Bolt & 3/8" Web = 4220#	1/2" Bolt & 1/2" Web = 5620#
5/8" Bolt & 3/8" Web = 5270#	5/8" Bolt & 1/2" Web = 6700#

DETAIL FOR W10, W12, C10, C12, I 10 or I 12

DETAIL 5

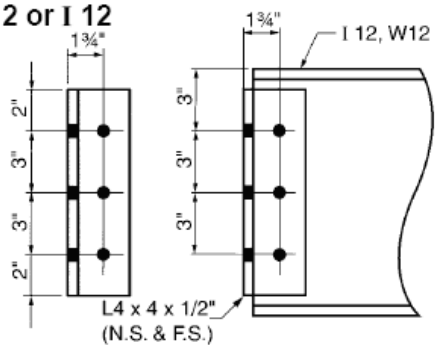


BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 9000#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 3/8" Web = 3160#	3/8" Bolt & 1/2" Web = 4220#
1/2" Bolt & 3/8" Web = 4220#	1/2" Bolt & 1/2" Web = 5620#
5/8" Bolt & 3/8" Web = 5270#	5/8" Bolt & 1/2" Web =7030#

DETAIL FOR W12 or I 12

DETAIL 6



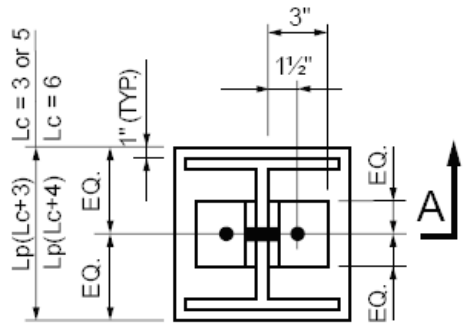
BOLTED AND EPOXIED CAPACITY (SEE NOTE #1) - 11250#
BOLTED ONLY CAPACITY (SEE NOTE #2)

3/8" Bolt & 1/2" Web = 4220#
1/2" Bolt & 1/2" Web = 5620#
5/8" Bolt & 1/2" Web = 7030#

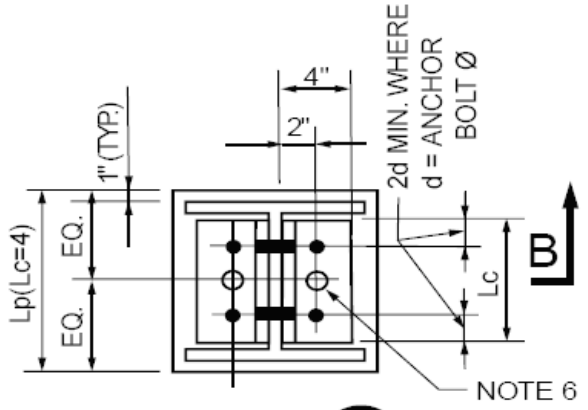
NOTES:

1. Capacities shown controlled by shear thru heel of angle (F_v=4500 psi / 4 = 1125 psi)
2. Capacities shown controlled by bearing around fastener or shear of stainless steel fasteners.
3. The beam capacity must be verified as being adequate.
4. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION** in the Strongwell *Design Manual*.
5. Details 1, 2 and 4 are standard Strongwell fabrication connections. Details 3, 5 and 6 are alternate fabrication connections.
6. Recommended hole diameters: Fastener +1/16".
7. 1/4" stainless steel angles can be substituted for the **EXTREN**® angles shown in the details.

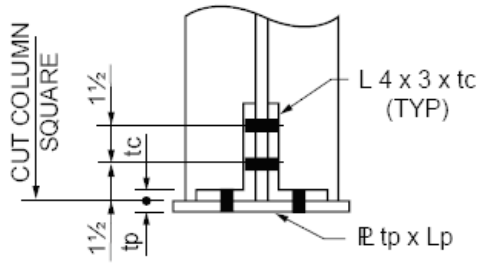
COLUMN BASE PLATES



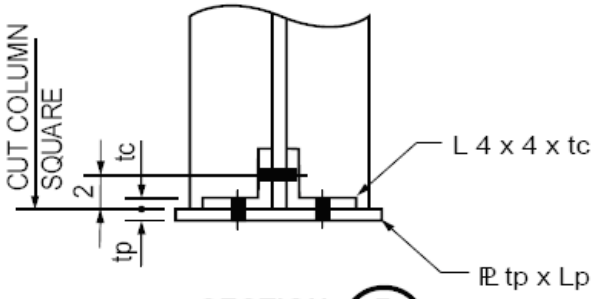
DETAIL 1 (PLAN)



DETAIL 2 (PLAN)



SECTION A



SECTION B

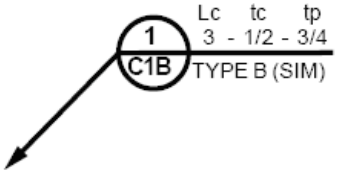
CAPACITIES -LBS				
CLIP		PLATE - tp		
Lc	tc	3/8	1/2	3/4
3	3/8	1325*	1850*	2550
	1/2	1800*	2350*	3375
5	3/8	2100*	2900*	4225
	1/2	2850*	3725*	5625
6	3/8	2550*	3500*	5075
	1/2	3450*	4525*	6750

* BENDING CONTROLS

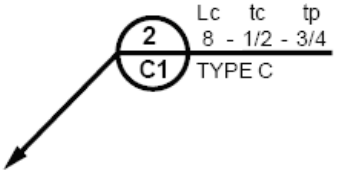
CAPACITIES -LBS				
CLIP		PLATE - tp		
Lc	tc	1/2	3/4	1
6	1/2	2825	4500	6650
	3/4	4400	6650	8750
8	1/2	3675	5800	8525
	3/4	5750	8275	11,350
10	1/2	4525	7125	10,425
	3/4	7075	10,175	13,900

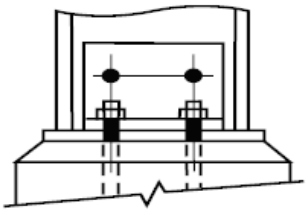
* BENDING CONTROLS

TYPICAL CALLOUT
ON DESIGN DWG.

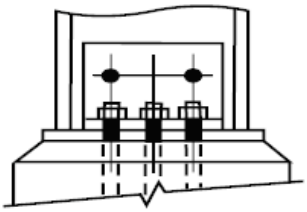


TYPICAL CALLOUT
ON DESIGN DWG.

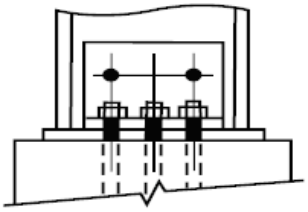




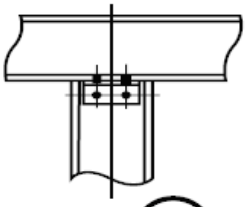
TYPE A
TYPICAL BOLTING



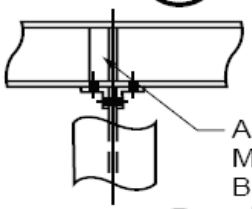
TYPE B
COLUMN ON GROUT
W/ CENTER ANCHOR BOLTS



TYPE C
COLUMN ON FLAT
W/ CENTER ANCHOR BOLTS



DETAIL 3



ANGLE (N.S. & F.S.)
MAY BE REQUIRED TO PREVENT
BEAM WEB BUCKLING
- REF. DESIGN GUIDE - BEAMS

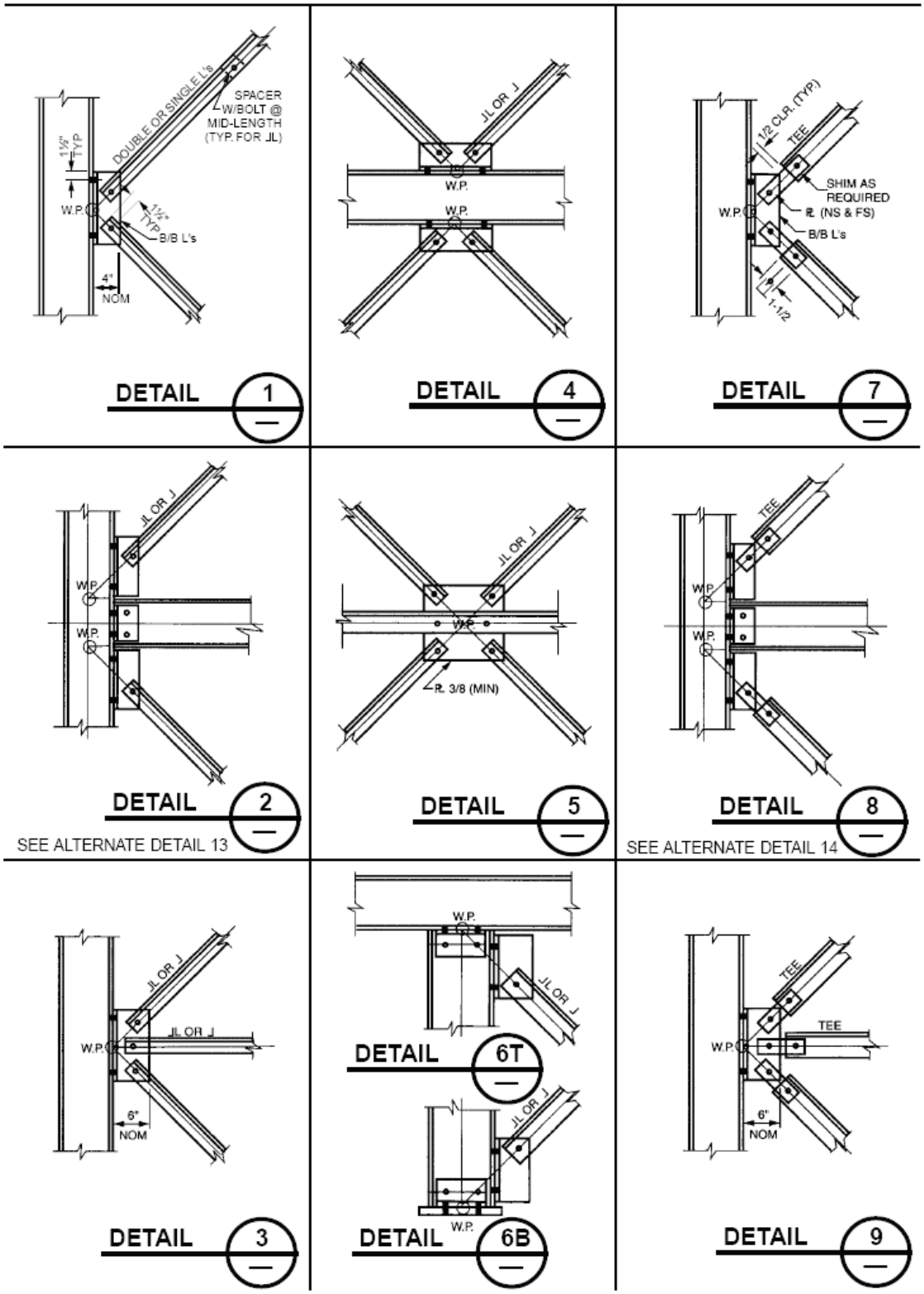
DETAIL 4

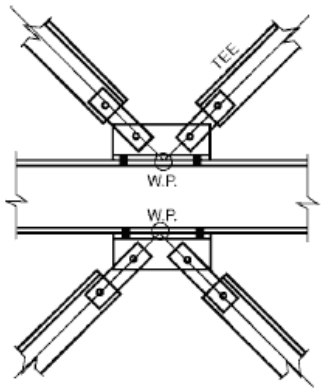
NOTES:

(DEVELOPED WITH TENSION LOADS)

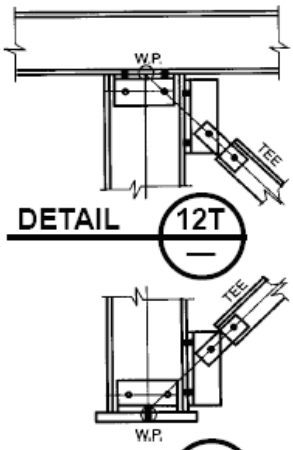
1. Values shown here are based on epoxy and bolted connections. For bolted only connections see Bearing and Shear values shown later in this section.
2. Capacities shown were controlled by shear through heel of angle (F_v=1125 psi) or bending of plate and angle with F_B=10000 psi/4=2500 psi.
3. For columns with combined tension and shear, both of which put shear into the heel of the angle, the total of the tension load + shear load must be less than the capacity listed.
4. 3/4" thick angles are special hand-layed-up angles and are not **EXTREN®** sections.
5. Plates shown square Lp required for capacity, but width can vary (i.e. for I-beam columns.)
6. Detail 2 can utilize anchor bolts separate from base plate assembly bolts. Two required, 1/2" dia. minimum.
7. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION**.
8. 1/4" stainless steel angles can be substituted for the **EXTREN®** angles shown in the details.

SINGLE/DOUBLE ANGLE & TEE BRACING DETAILS



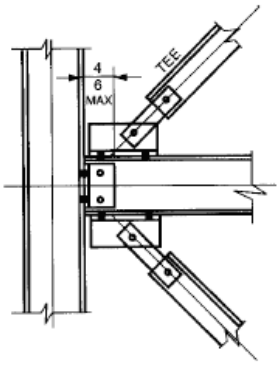


DETAIL 10

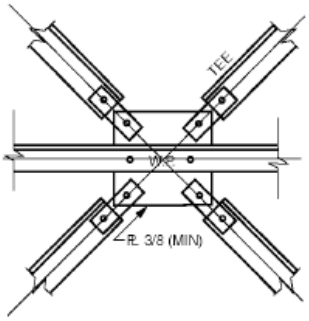


DETAIL 12T

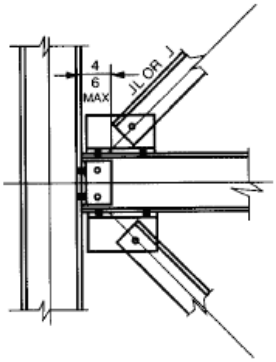
DETAIL 12B



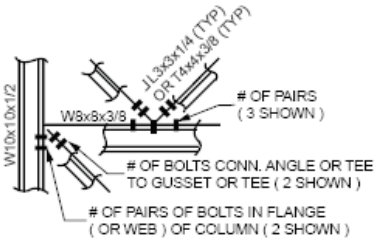
DETAIL 14



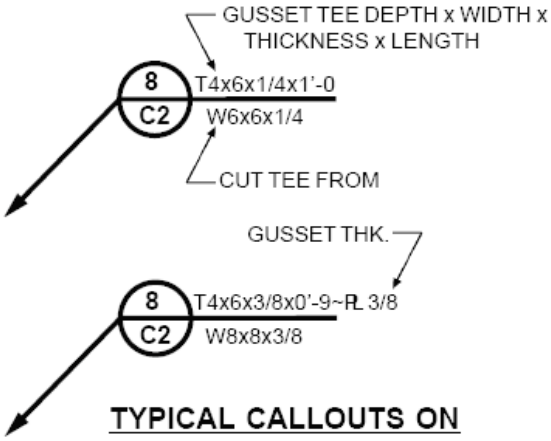
DETAIL 11



DETAIL 13



BOLT CALLOUT FOR ANGLES & TEES

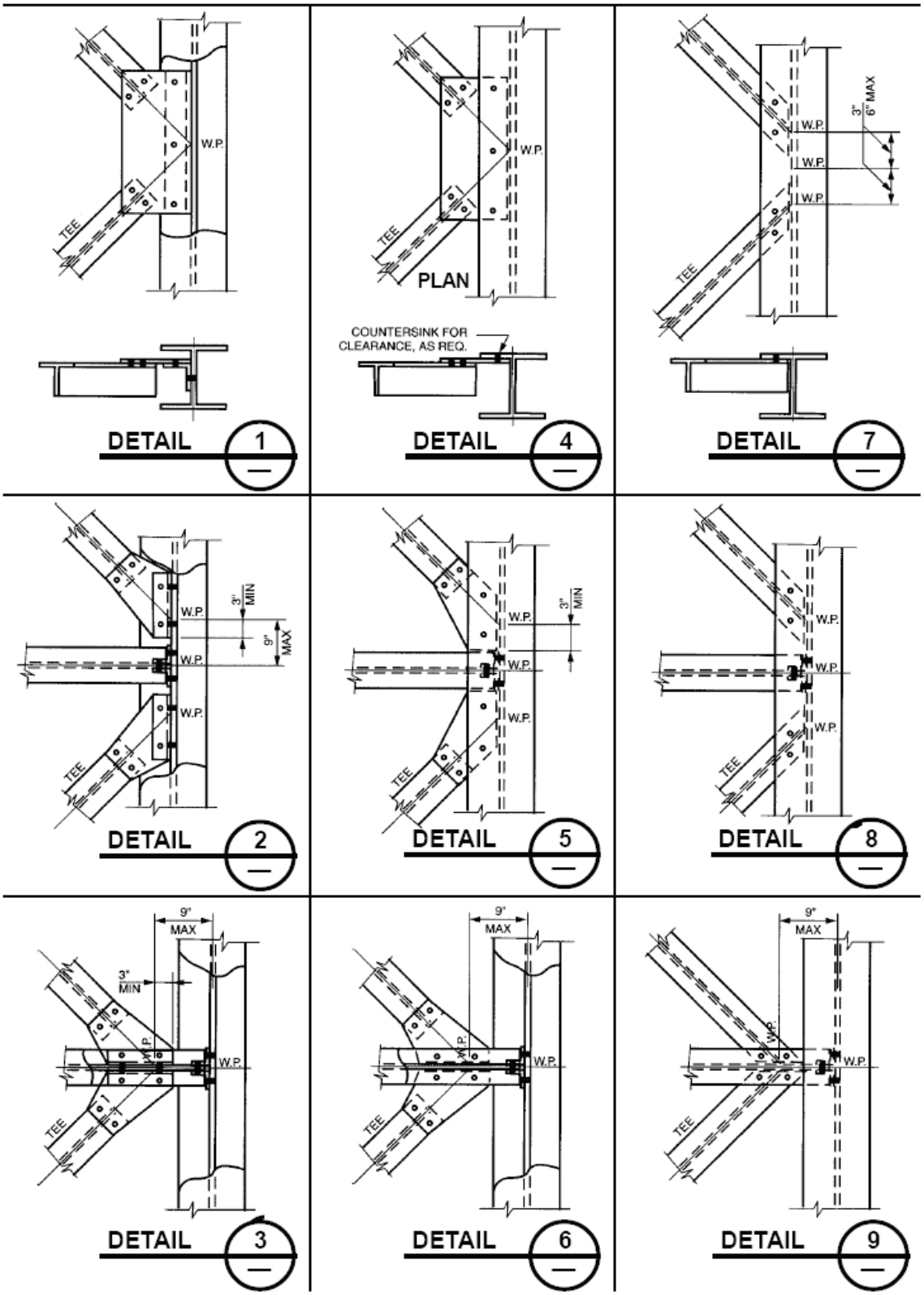


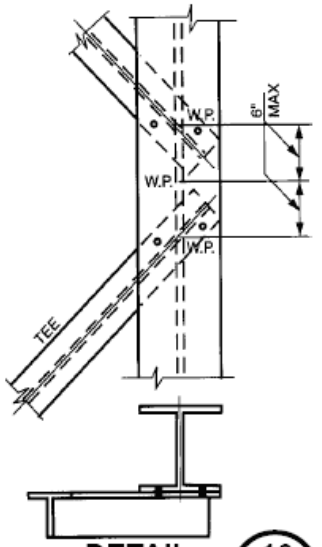
TYPICAL CALLOUTS ON DESIGN DRAWINGS

NOTES:

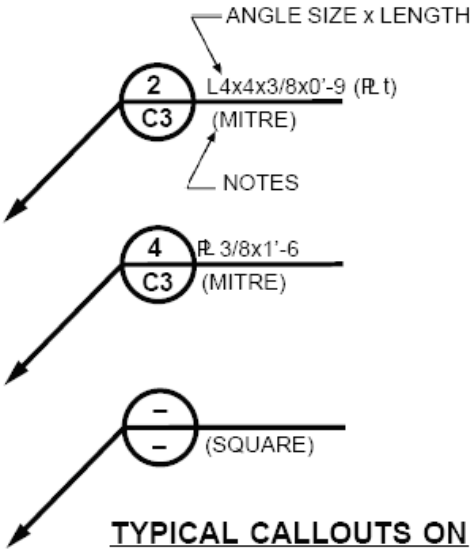
1. These connections are to be used with epoxy. 3/8" dia. bolts only provide clamp until epoxy cures. Ultimate capacity of joint = 1000 psi. For bolted only connections see Bearing and Shear values later in this section.
2. Designer is cautioned to check required area for epoxy with F_{ALL} = 1000/4 = 250 psi and tee thickness with Fv = 4500/4 =1125 psi.
3. Gussets should be symmetrical about WP whenever possible.
4. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION**.

HORIZONTAL BRACING — TEE & ANGLE DETAILS

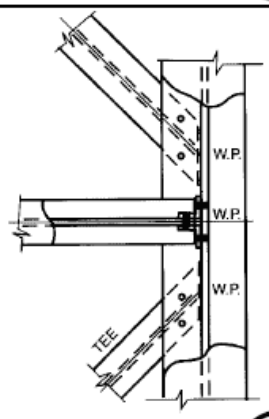




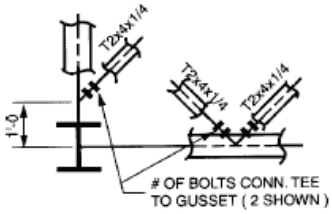
DETAIL 10



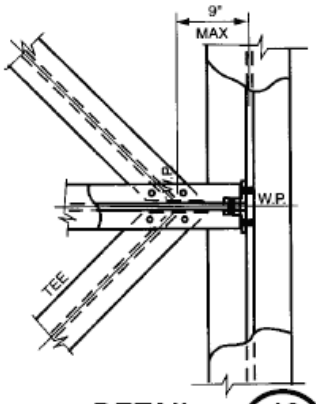
TYPICAL CALLOUTS ON DESIGN DRAWINGS



DETAIL 11



BOLT CALLOUT ON DESIGN DRAWINGS



DETAIL 12

NOTES:

1. These connections are to be used with epoxy. 3/8" dia. bolts only provide clamp until epoxy cures. Ultimate capacity of joint = 1000 psi. For bolted only connections see Bearing and Shear values later in this section.
2. Designer is cautioned to check required area for epoxy with F_{ALL} = 1000/4 = 250 psi and gusset/tee thickness with Fv = 4500/4 =1125 psi.
3. Gussets should be symmetrical about WP whenever possible.
4. Epoxy and joint preparation in accordance with Section 19 — **FABRICATION**.

THREADED FASTENERS

BEARING

ALLOWABLE LOADS IN POUNDS

FIBERGLASS THICKNESS	BOLT DIAMETER 1/4"	3/8"	1/2"	5/8"	3/4"	1"
1/8"	234	352	469	586	703	938
1/4"	469	703	938	1172	1406	1875
3/8"	703	1055	1406	1758	2109	2812
1/2"	938	1406	1875	2344	2812	3750
3/4"	1406	2109	2812	3516	4219	5625

Allowable load = Allowable bearing stress x bearing area.

EXAMPLE

1/4" thickness with 1/2" dia. bolt

$$\text{Allowable load} = \frac{30{,}000\ \text{psi}}{4} \times .25'' \times .50'' = 938\ \text{lbs.}$$

NOTE: The above table assumes the bearing stress on fiberglass controls. The designer should verify that no other element of the connection controls.

SHEAR

ALLOWABLE LOADS IN POUNDS

BOLT TYPE	BOLT DIAMETER 1/4"	3/8"	1/2"	5/8"	3/4"	1"
S.S. Single Shear	1473	3312	5889	9204	13254	23562
S. S. Double Shear	2964	6624	11778	18408	26508	47124
FIBREBOLT®, Single Shear	—	400	650	950	1550	3750
FIBREBOLT®, Double Shear	—	750	1250	1875	3000	5000

NOTE: The above table assumes the shear capacity of the fastener controls. The designer should verify that no other element of the connection controls.

RECOMMENDED MINIMUM FASTENER EDGE DISTANCES AND PITCH RATIO OF DISTANCE TO FASTENER DIAMETER

	RANGE	COMMON
Edge Distance - end	2.0 to 4.5	3.0
Edge Distance - side	1.5 to 3.5	2.0
Pitch	4.0 to 5.0	5.0

FIBREBOLT® STUDS AND NUTS

STANDARD COLOR–BROWN

SHAPE–HEX

For structural applications where mechanical fasteners must not only be strong, but also non-corrosive and/or non-conductive, **FIBREBOLT®** fiberglass studs and nuts can be used in place of steel or other metal fasteners.

FIBREBOLT® is being utilized in chemical process equipment, air and water pollution control equipment, marine applications electrical equipment and in general industry.

FIBREBOLT® is available in diameters of 3/8", 1/2", 5/8", 3/4" and 1" with nuts for immediate delivery. Four foot lengths are standard. Other lengths are available on request. Custom partial length threading is also available on request.

Properties

	3/8 16 UNC	1/2 13 UNC	5/8 11 UNC	3/4 10 UNC	1 8 UNC
Ultimate thread shear using Strongwell fiberglass nut (lb.)①②	1,350	2,400	3,790	5,150	9600
Max ultimate tensile load using Strongwell fiberglass nut (lb.)②	1,050	2,000	3,100	4,500	6,500
Max ultimate tensile load using two (2) Strongwell fiberglass nuts (lb.)②	1,470	2,800	4,340	6,300	9,700
Transverse shear on threaded rod — double shear ASTM B-565 (min. load lb.)③	3,000	5,000	7,500	12,000	22,000
Transverse shear on threaded rod — single shear (min. load lb.)③	1,600	2,600	3,800	6,200	15,000
Compressive strength — longitudinal ASTM-D-695 (min. psi)③	60,000	60,000	60,000	60,000	60,000
Flexural strength ASTM-D-790 (min. psi)③	50,000	50,000	50,000	50,000	50,000
Flexural modulus ASTM-D-790 (min. psi x 10^6)③	2.0	2.0	2.0	2.50	2.75
Recommended maximum installation torque strength using Strongwell fiberglass nut lubricated with SAE 10W30 motor oil (ft./lbs.)②	4	8	16	24	50
Dielectric strength ASTM-D-149 (kv/in.)	35	35	35	35	35
Water absorption 24 hr. immersion—threaded ASTM-D-570 (%)	1	1	1	1	1
Coefficient of thermal expansion—longitudinal (in/in/°F)	$5x10^{-6}$	$5x10^{-6}$	$5x10^{-6}$	$5x10^{-6}$	$5x10^{-6}$
Max recommended operation temp —based on 50% retention of ultimate thread shear strength °C (°F)	95°C (203°F)	95°C (203°F)	95°C (203°F)	95°C (203°F)	95°C (203°F)
Stud weight (lb./ft.)	0.07	0.12	0.18	0.28	0.50
Thickness of nut & washer	3/4"	7/8"	1-1/8"	1-1/4"	1-5/8"
Flammability — ASTM – D635	Self-Extinguishing on All				

NOTE:

- All test results are for bolts with single nuts only. Proper safety factors should be applied to assembly.
- Properties above do not apply when fiberglass stud is used with metal nut.
- Appropriate safety factors must be applied.

① Ultimate strength values are averages obtained in design testing.
② New property categories added to better clarify stud thread shear properties.
③ Strength values are minimums derived from multiple production sample testing.

FIBREBOLT® STUDS AND NUTS USER'S GUIDE

FIBREBOLT® studs are pultruded, fiberglass reinforced vinyl ester threaded rods and thermoplastic hex-shaped nuts. The properties and characteristics of **FIBREBOLT®** differ from steel. Failure to follow the procedure below can result in damage and/or premature failure to the stud/nut assembly.

PROCEDURE

1) Verify that the nuts and studs are well lubricated. If the nuts are to be removed during the application, lubrication is a necessity. A light oil, dry lubricants, and silicone sprays are all satisfactory. Lubricants should be used in small quantities.
2) Bearing surfaces of the nuts must be parallel to the surfaces being fastened.
3) A torque wrench must be used.

The table below gives the ultimate and recommended maximum installation torque.

INSTALLATION TORQUE TABLE

Size	Ultimate Torque Strength	Recommended Maximum Installation Torque
3/8-16 UNC	8 ft-lbs.	4 ft-lbs.
1/2-13 UNC	18 ft-lbs.	8 ft-lbs.
5/8-11 UNC	35 ft-lbs.	16 ft-lbs.
3/4-10 UNC	50 ft-lbs.	24 ft-lbs.
1-8 UNC	110 ft-lbs.	50 ft-lbs.

4) Wrenches must make full contact with all nut edges. Partial contact will cause the corners to fracture, affecting the performance of the stud/nut assembly. A standard six point socket is recommended.
5) Whenever possible, the stud/nut assembly should be bonded to insure that the nuts do not loosen. The recommended bonding technique is to secure the nut to the proper torque value, then coat the entire nut and exposed stud assembly with a thick layer of adhesive or resin (this step is for assemblies in which the nut will not be subsequently removed).
6) Values reported in the **FIBREBOLT®** properties data sheet on the previous page were obtained for static conditions. Vibration should be eliminated or minimized in applications utilizing **FIBREBOLT®**.

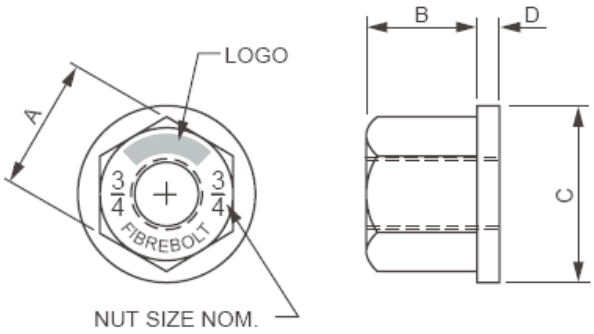
CAUTION

1) **All data regarding the FIBREBOLT® stud and nut assembly has been generated from tests involving only fiberglass nuts. No data has been generated for metal nuts. If metal nuts are used, strengths will be reduced because of less thread engagement. If metal nuts are used, extreme care should be taken to assure that the threads match and that a snug fit is achieved.**
2) **The FIBREBOLT® stud has cut, not molded threads. Threads that will be exposed to environments that might attack the glass reinforcements should be sealed after installation. If removal of the nut is anticipated, a very thin (1 mil) sprayed-on coat of polyurethane will normally be effective. Heavier coats of polyurethane, resin, or adhesive are recommended where possible.**

FIBREBOLT® NUTS

The hex shaped thermoplastic nut in Strongwell's **FIBREBOLT®** fastener system is manufactured from fiberglass reinforced PPS resin. The standard color is brown.

NOTE: FIBREBOLT® studs and nuts should be used together as a system to assure proper fit and properties. Interchange with other manufacturer's bolt or nut is not intended or assured.



FIBREBOLT® NUT

HEX NUT DIMENSIONS

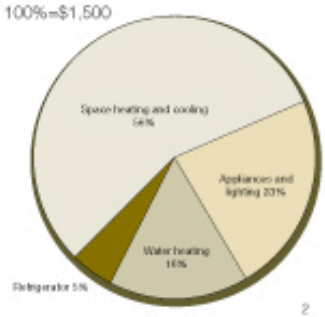
NUT SIZE NOM.	WIDTH ACROSS FLATS "A"	NOM. WIDTH ACROSS FLATS	THICKNESS "B"	WASHER DIA. "C"	WASHER THICKNESS "D"
3/8 – 16 UNC	.745	3/4"	5/8"	1"	1/8"
1/2 – 13 UNC	.870	7/8"	3/4"	1-1/8"	1/8"
5/8 – 11 UNC	1.057	1-1/16"	15/16"	1-5/16"	3/16"
3/4 – 10 UNC	1.245	1-1/4"	1-1/16"	1-1/2"	3/16"
1 – 8 UNC	1.620	1-5/8"	1-3/8"	2"	1/4"

SECTION 07200- INSULATION
HONEYWELL RESIDENTIAL CLOSED-UP CELL SPRAY INSULATION FOAM

PART 1 - GENERAL

RELATED DOCUMENTS:

Insulation helps create a living space that is comfortable, healthy and energy efficient



2

Air Flow
- Keep unconditioned air from leaking in
- Keep conditioned air from leaking out
- Prevent drafts within the structure

"Today, it is estimated that in residential and small commercial buildings, over 50% of the energy loss is associated with heat transfer and air leakage through building envelope components."
ORNL [1]

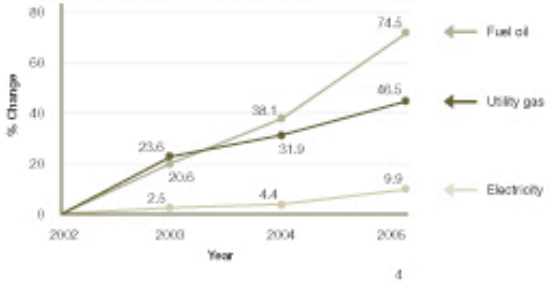
Heat Flow
- Keep heat in during winter
- Keep heat out during summer
- Maintain uniform temperature

"Heating and cooling (space conditioning) account for 50 – 70% of the energy used in the average American home."
DOE

Water Flow
- Bulk
- Air
- Vapor

"Of all environmental conditions, moisture poses the biggest threat to structural integrity and durability, accounting for up to 89% of damage in building envelopes."
M.T. Bomberg [3]

Consumer Price Index - % Change from 2002



4

1. Oak Ridge National Labs www.eere.energy.gov/consumer/tips/air_leaks.html
2. Department of Energy www.energystar.gov
3. Building Envelope and Environmental Control: Part 1- Heat, Air and Moisture Interactions by M.T. Bomberg and W.C. Brown. Originally published in "Construction Canada" 35(1) 1993, p. 15-18
4. Source: U.S. Department of Labor, Bureau of Labor Statistics, Average Price Data www.bls.gov

2

THE BUILDING ENVELOPE

- Insulation, working together with the roof, wall and foundation assemblies (as well as the related sub-elements of each assembly), forms the building envelope

- Among other functions, the building envelope must:
  - Keep wind and unconditioned air out
  - Keep the conditioned air in
  - Prevent drafts

- Air movement (into and out of the house) has many detrimental effects:
  - Moisture within air impacts the long-term performance and structural integrity of the building
  - Introduction and distribution of pollutants and microbes
  - Thermal heat transfer [1]

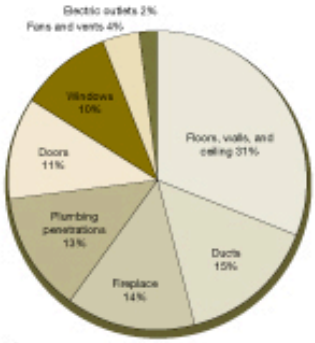
- To address these concerns, many building scientists have concluded that houses should be as tight and seamless as possible [2]

- The American Lung Association also recommends that homes need to be as tight as practical [3]

- Random natural infiltration should be minimized and controlled mechanical ventilation should be employed [4]

1. Joseph Lstiburek, Ph.D. , P. Eng. , Building Science Corporation
2. Arnie Katz, Director, Affordable Housing, Senior Building Science Consultant www.advancedenergy.org/buildings/about/specialists/arnie_katz.html
3. American Lung Association www.healthhouse.org/build/TopTenQuestionsbooklet.pdf
4. www.buildingscience.com

INSULATION & AIR CONTROL



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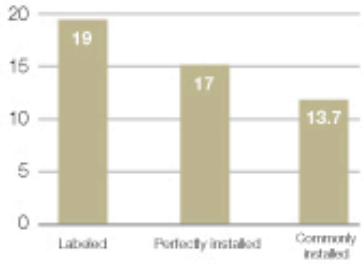


2 28% loss of R-value found in "commonly installed" insulation

How Does the Air Escape?

- Air moves in and out of your home through every hole, crack and seam
- About one third of this air infiltrates through openings in your ceilings, walls and floors

Traditional Fiberglass Insulation

- Even small voids in irregular framing or at the end of the batt of 1-2% of the insulation area can result in a 25-40% loss of R-value* [3]

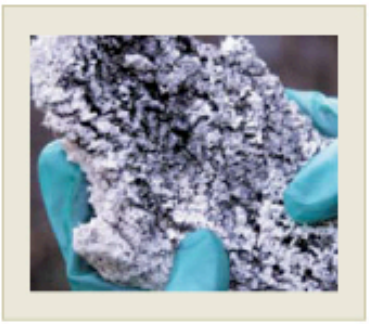
Traditional Air Control

- A typical 2,500 sq. ft. home has more than ½ mile of cracks and crevices [4]
- These usually occur in:
  - Poorly fitted and flashed doors and windows
  - Plumbing/electrical outlets
  - Gaps in drywall and wall plates
  - Rim/framing joists
- With an average 8 mph wind, your home could lose up to 30% installed R-value [5]
- Most insulation materials do not block air and require an air barrier (an incremental cost when comparing installation costs) [6]

1. Department of Energy www.eere.energy.gov/consumer/tips/air_leaks.html
2. Oak Ridge National Laboratory; Fiberglass Batts-Labeled vs. Installed Performance; Consumer Update: Insulation Effectiveness Bulletin
3. Kansas State University, Engineering Extension, Residential Insulation
4. Air Barrier Association of America, 9 Frequently Asked Questions, May 2005
5. E. I. du Pont de Nemours and Company, Tyvek, www.construction.tyvek.com/en/constrSystems/homeOwners/index.shtml
6. Joseph Lstiburek, Ph.D. , P. Eng. , Building Science Corporation

4

MOISTURE CONTROL



"Controlling moisture is key to preventing mold growth...When present in large quantities, mold can cause health problems, including allergic reactions, asthma episodes and respiratory problems." [1]

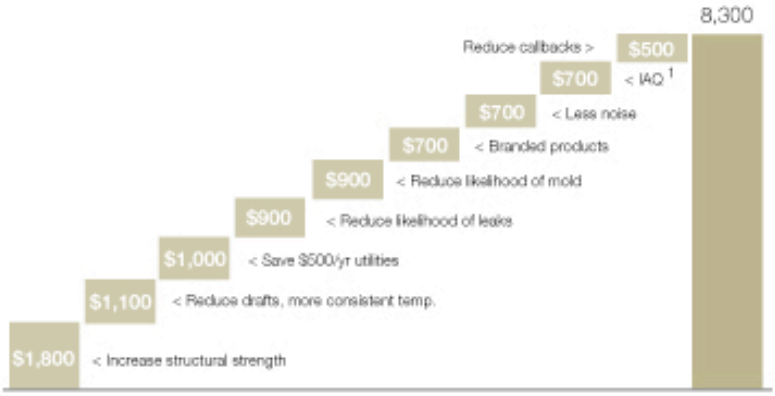
"Controlling rain and ground water are the most important factors in the design and construction of durable buildings and for the control of mold." [2]

FEMA Technical Bulletin 2-93 [3]

- Closed-cell foam is the only type of insulation classified as an "acceptable flood-resistant material" by FEMA.
- "Flood-resistant material" is defined as any building material capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage.
- Batt or blanket insulation types and all other insulation types are classified as "unacceptable".

1. American Lung Association www.epa.gov/mold/cleanupguidelines.html
2. www.buildingscience.com
3. Fema Technical Bulletin 2-93 "Flood-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program.

How much would you be willing to pay to:



About the Research

- 1,000 new home buyer respondents of 12,000 surveys sent
- Representative profile of U.S. new home buyers
- Strong demographics correlation with NAHB (e.g. age, income, purchase price, geography) and U.S. census data

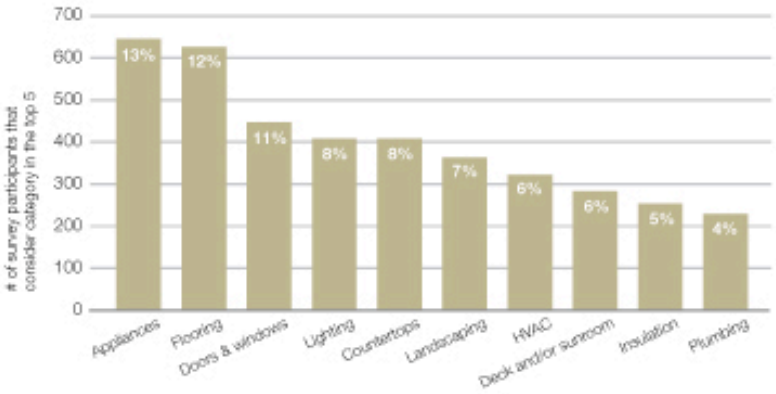
> ***"I wish the temperatures in my home were more consistent."***
>
> **-Survey Respondent**

1. Indoor Air Quality
   Source: Honeywell 2005 Residential Home Buyer Survey

6

Top categories for upgrade dollars

Appliances, flooring, doors & windows, lighting and countertops were the most common categories for upgrade dollars. Insulation was listed as the ninth most likely category for upgrade dollars.

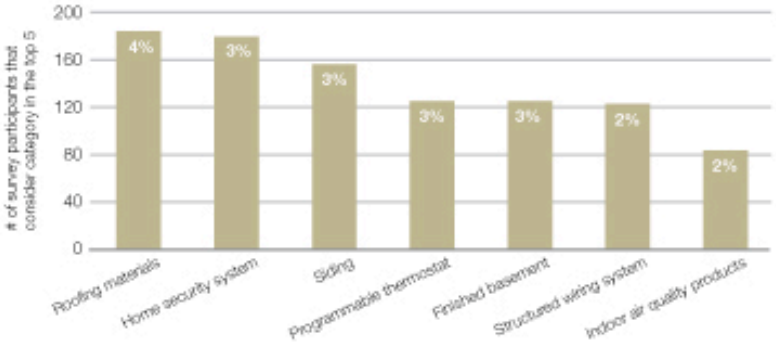


Insulation upgrades make the "top-ten" list for options spending

> 50% of the participants were highly satisfied with the upgrade options that they purchased

Homes > $500,000: top upgrade dollar spending was for countertops, flooring and doors & windows.

Categories with lower spending upgrade dollars

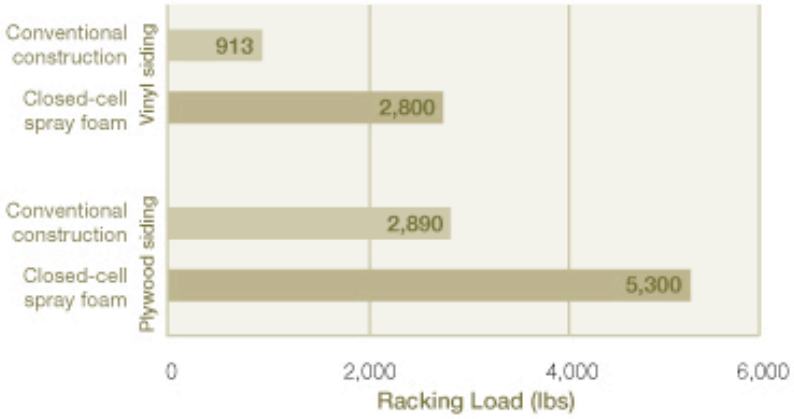


Source: Honeywell 2005 Residential Home Buyer Survey

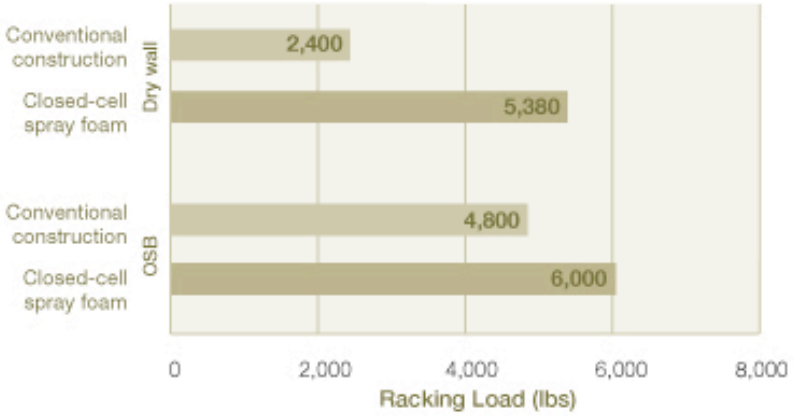
7

"During a design racking event like a hurricane, there would be less permanent deformation of wall elements and possibly less damage to a structure that was braced with SPF [spray polyurethane foam] filled walls." [1]

Average Maximum Racking Load (structural resistance to wind) Supported by 16" On-Center Spruce-Pine-Fir 2x4 Stud Framing [1]



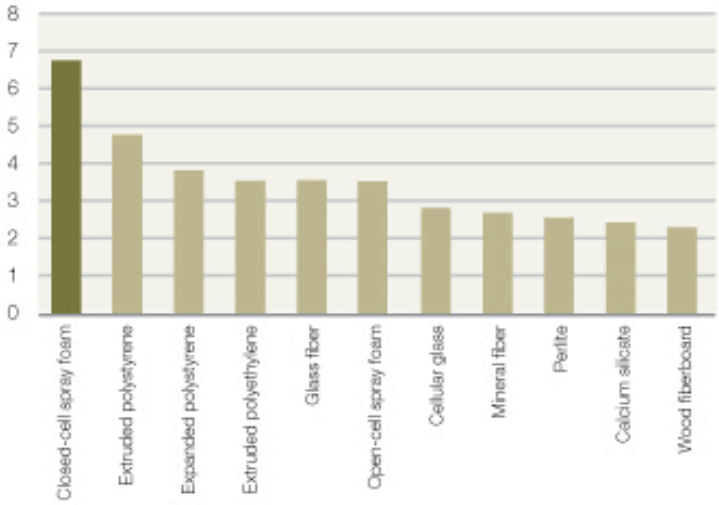
Maximum Racking Load (structural resistance to wind) for SPF vs Conventional R-19 Batts Supported by 24" On-Center 20-Gauge Light Structural Steel Framing [2]



1. National Association of Home Builders, Testing and Adoption of Spray Polyurethane Insulation for Wood Frame Building Construction, May 25, 1992
2. Test results are reported in a letter from Bob Dewey, Mechanical Engineer, NAHB Research Center to Mason Knowles, The Society of the Plastics Industry, Inc. Spray Polyurethane Foam Division, November 18,1996

8

Typical R-values of Insulation Materials [1]



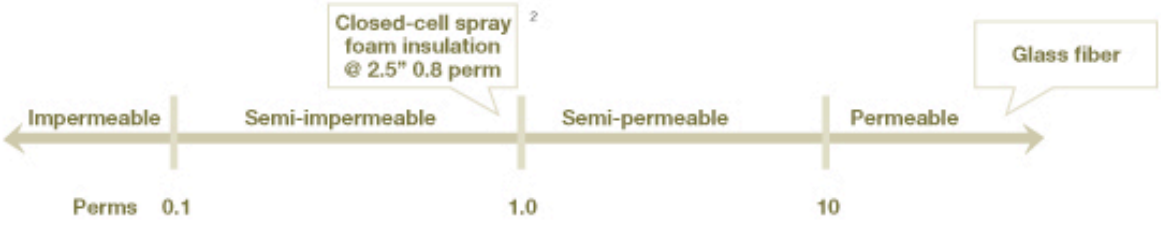
- Closed-cell spray foam provides the highest R-value of available insulation materials
- Closed-cell spray foam also provides the best defense against all six mechanisms of heat transfer
- Unlike other insulation materials, closed-cell spray foam seamlessly fills regular and irregular spaces [2]

1. Honeywell Analysis
2. Reference available upon request.

MOISTURE CONTROL

	1. Rain & ground water	2. Air infiltration	3. Vapor diffusion
How do you control	- Properly designed and constructed drainage planes - Use of repellent materials (building paper, house wrap, foam insulation) in the construction	- Seamless, continuous air barrier	- Vapor retardant materials - Optimal placement can change (from outside to inside or vice versa) depending on climate and weather differences
Closed-cell spray foam advantage	"SPF [spray polyurethane foam] can be applied within a building envelope to control heat, air and moisture transport by providing continuous and effective air barriers, rain screens, weather barriers, and thermal insulation... SPF also limits water movement within the building envelope since the water cannot flow within the SPF's closed cells, even if a hole is made in the SPF." (Mason Knowles, SPFA)	"SPF is an effective air barrier and weather barrier because of its ability to seamlessly fill irregular spaces and provide water resistance" Mark Bomberg, Ph.D, PE National Research Center of Canada, Construction Practice: Building Envelope and environmental Control	- Semi-impermeable, allows for controlled breathing and drying - Uniformity and consistency enables it to resist passage of vapor equally well in all directions (from David Frane, Journal of Light Construction) - Minimizes dew point problems and condensation (Mason Knowles, SPFA)

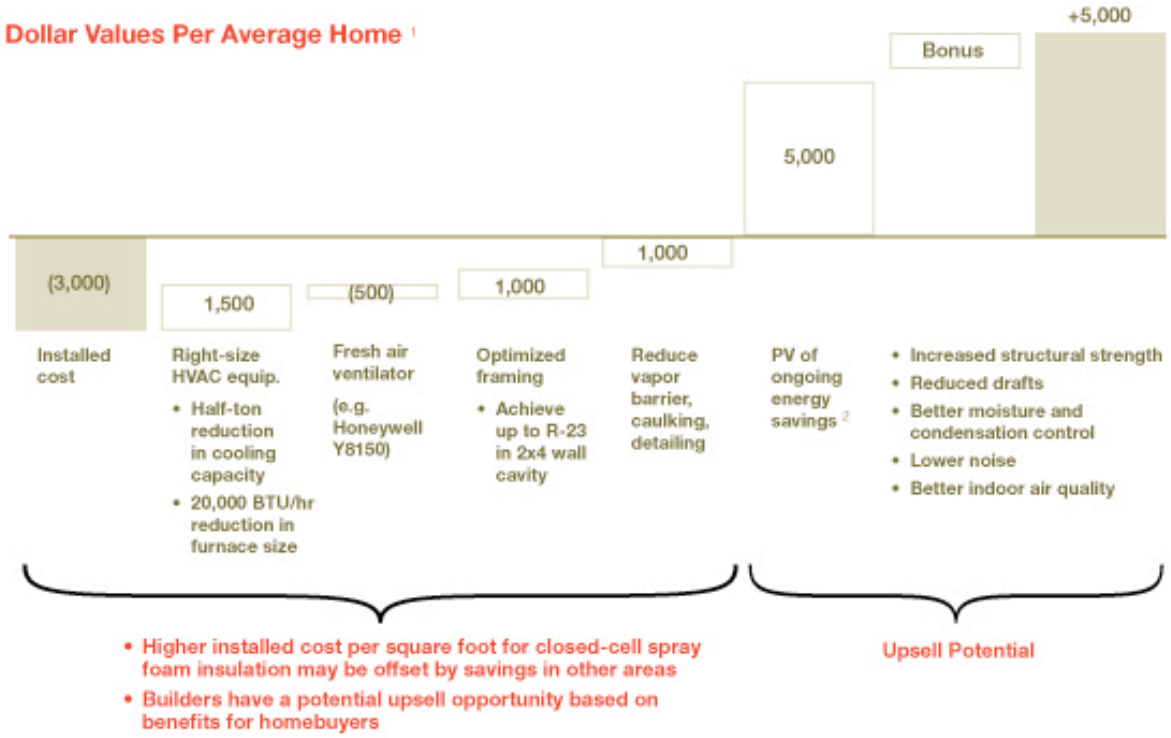
Classes of Materials Based on Permeance [1]



1. Joseph Lstiburek, Ph.D., P. Eng.
2. Reference available upon request.

10

CLOSED CELL SPRAY FOAM BENEFITS



LEED® Credits Opportunity 3

Credit	Points
Wall, floor, ceiling, crawl space insulation	1-2
Air infiltration	1-2
Local sources	3
Overall home Energy Star performance	16

LEED® Performance Levels

Certified	30 Points
Silver	50 Points
Gold	70 Points
Platinum	90 Points

Closed-Cell Spray Foam Features	Closed-Cell Spray Foam Benefits
• Structural strength	• Energy savings
• Air infiltration control	• Improved indoor air quality
• Moisture/condensation control	• Improved comfort (draft reduction)
• Thermal insulation (R-value)	• Problem solving tool
	- Ice dam
	- Rim joist
	- Pipe freeze
	- Tub enclosures
	- Unvented attics
	- Unvented crawl space
	- Leaky windows
	- Foundations
	- R-23 using 2x4 framing

1. Honeywell Estimates - Figures may vary depending on markets and building practices
2. Present Value (PV) assumes average utility bill reduction of $30/month ($360/year) at 7% interest rate
3. Leadership in Energy & Design, www.USGBC.org

11

ENERGY COMPARISONS

Case study #1	Sacramento, CA Comparable single story 2,400 square foot homes Several addresses apart on same side of street Gas and electric bills Feb to Dec, 2003	
Traditionally insulated home: • Utility bills -$2,239 electric -$477 gas -$2,716 total • Monthly average utilities -$247 • Average utility prices -Gas $0.95 per therm -Electric $0.17 per kWH	Closed-cell spray foam insulated: • Total gas and electric -$1,107 electric -$306 gas -$1,413 total • Monthly average utilities -$128 • Average utility prices -Gas $0.93 per therm -Electric $0.13 per kWH	Closed-cell spray foam energy savings: • 48% reduction in utility bills -$118 per month average savings -$1,422 per year; $42,645 over 30 years • How much extra financing could you afford on a 30 year mortgage with an extra $118 per month? -$19,758 at 6% -$17,805 at 8%

Case study #2	Roanoke, VA 2,240 square foot ranch Liquid propane gas heat Low fuel consumption got supplier's attention Monitored propane usage Aug '00 to Jul '01	
Ten similar homes with traditional insulation: • Total propane consumption -Average was 769 gallons	Closed-cell spray foam insulated: • Total propane consumption -321 gallons	Closed-cell spray foam energy savings: • 58% reduction in propane usage vs. average of ten comparable homes -30% savings vs. next best home -74% savings vs. worst home • Estimated savings -$896/yr with propane at $2 per gal -Mortgage value of $12,444 at 6%

Case study #3	Atlanta, GA Comparable residences 1,800 sq. ft. Less than two miles apart Similar occupancy	
Traditionally insulated home: • Monthly average utilities $143.76 • Cost of insulation $2,350	Closed-cell spray foam insulated: • Monthly average utilities $89.64 • Cost of insulation $5,200	Closed-cell spray foam energy savings: • 38% reduction in utilities -$54.12 per month average saving • Added mortgage cost $2,850 -$17.10 per month added mortgage payment at 6% interest • Extra cash in homeowner's pocket $37.02 per month

Source: Available upon request.

12

SECTION 07412 – METAL WALL PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Foamed insulation core horizontal metal wall panel assembly with integral reveals and profiled panels.

B. Related metal trim and accessories.

C. Secondary metal framing support system.

1.02 RELATED SECTIONS

A. Division 07 Section "Flashing and Sheet Metal" for sheet metal copings, flashings and roof drainage items.

B. Division 08 Section "Glazing" for glazing of window units.

1.03 REFERENCES

A. American Architectural Manufacturer's Association (AAMA):
1. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
2. AAMA 508-05 - Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.
3. AAMA 605.2 - Voluntary Specification for High Performance Organic Coatings.
4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. American Society of Civil Engineers (ASCE):
1. ASCE 7- Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM):
1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM C 1363 - Standard Test Method for thermal performance of building materials and envelope assemblies by means of a Hot Box Apparatus.
4. ASTM C 645 - Specification for Nonstructural Steel Framing Members.
5. ASTM C 920 - Specification for Elastomeric Joint Sealants.
6. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
7. ASTM E 84 - Test Methods for Surface Burning Characteristics of Building Materials.
8. ASTM E 96 - Test Methods for Water Vapor Transmission of Materials.
9. ASTM E 119 - Test Methods for Fire Tests of Building Construction and Materials.
10. ASTM E 283 - Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
11. ASTM E 330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

12. ASTM E 331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
13. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
14. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

D. Factory Mutual Global (FMG):
1. ANSI/FMG 4880 Standard for Evaluating Insulated Wall & Roof/Ceiling Assemblies.

E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):
1. Architectural Sheet Metal Manual.

F. Underwriters Laboratories, Inc. (UL):
1. UL 263 - Fire Resistance Tests of Building Construction and Materials.
2. UL 723 - Test for Surface Burning Characteristics of Building Materials.
3. Fire Resistance Directory.
4. UL 1715 Room Corner Test.

1.04 PERFORMANCE REQUIREMENTS

A. Air Infiltration: Maximum 0.06 cfm/sf (0.3 L/s per sq. m) per ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sf (300 Pa), using minimum 10 feet by 10 feet (3050 mm by 3050 mm) test panel that includes horizontal and vertical joints.

B. Water Penetration - Dynamic Testing: No uncontrolled water penetration per AAMA 501.1 at a minimum pressure differential of 15 lb/sf (0.72 kPa) using a minimum 10 feet by 10 feet (3050 mm by 3050 mm) test panel.

C. Horizontal Panel Joint Performance - Static test per ASTM E331 with horizontal seals removed - 1 inch (25 mm) in 10 feet (3050 mm) lengths to simulate seal defects. No uncontrolled water penetration permitted at a pressure of 15 lb/sf (.90 kPa).

D. Pressure Equalization of Horizontal Joinery - Passes the Criteria for a Pressure Equalized Horizontal Joint in accordance with AAMA 508-05, a test method for Pressure Equalized Rain Screen Wall Systems.

E. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, per ASTM E 72:
1. Wind Loads: Determine loads based on uniform pressure indicated on Drawings or calculated per IBC 2003 whichever is more stringent.
2. Deflection Limits: Withstand test pressures of inward and outward wind-load design pressures with maximum deflection of L/180 of the span with no failure.
3. Secondary Framing: Design secondary framing system according to AISI "Standard for Cold-Formed Steel Framing - General Provisions."
4. Provide bearing surface for metal wall panels at the following locations:
   a. Horizontal Panel System: At vertical joints 4 inches minimum (102 mm).
   b. Vertical Panel System: At horizontal stack joints 4 inches minimum (102 mm).

F. Seismic Performance: Comply with ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

1.05 SUBMITTALS

A. Product Data: Manufacturer's data sheets for metal wall panels and accessories.

B. Product Test Reports: Indicating compliance of products with requirements, from a qualified independent testing agency.

C. LEED Submittals: Credit MR 4.1/MR4.2, Manufacturer's Product Data indicating the following:
1. Percentages by weight of post-consumer and pre-consumer recycled content.
2. Indicate total weight of products provided.
3. Include statement indicating costs for each product having recycled content.

D. Cradle to Cradle Certification: Manufacturer to submit evidence of a minimum of a silver level Cradle-to-Cradle certification or an independent sustainability audit that evaluates and validates materials, material reutilization/design for environment, energy use, water usage and social responsibility of the product and manufacturing process.

E. Shop Drawings: Prepared by manufacturer or factory trained authorized dealer. Include elevations showing metal wall panels, and details of each condition of installation and attachment. Indicate coordination dimensions related to structural support system elements provided by others.
1. Include structural data indicating compliance with performance requirements.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

G. Qualification Information: For Installer firm, proof of installer's manufacturer trained field supervisor.

H. Warranty: Submit proposed warranty meeting requirements of this Section.

1.06 QUALITY ASSURANCE

A. Manufacturer/Source: Provide metal wall panel system and panel accessories from a single manufacturer.

B. Installer Qualifications: Experienced Installer with minimum of 5 successful completed projects of similar materials and scope, approved by manufacturer, and employing workers trained by manufacturer to install specified products.

C. Calculations supporting structural performance of the wall panels shall be prepared by a professional structural engineer.

D. Fire Resistance Ratings: Where indicated by design designations, provide metal wall panels tested per ASTM E 119 or UL Standard 263 by a testing and inspecting agency acceptable to authorities having jurisdiction.

E. Fire-Test-Response Characteristics per ASTM E 84 or UL Standard 723:
1. Flame spread index: 25 or less.
2. Smoke developed index: 450 or less.

F. FMG Listing: Class 1 Insulating Wall or Ceiling Panel per FMG 4880.

G. UL Listing for UL 1715 room corner test.

H. NFPA 286 room corner test.

I. NFPA 285 ISMA test.

J. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

K. Pre-installation Conference: Conduct conference at Project site in compliance with Division 01 requirements.

L. Substitutions: No substitution will be considered unless the architect has received a request for approval at least ten days prior to the established bid date. Evidence shall be submitted to demonstrate equivalency to the products and performance levels specified. The written request shall include:
1. A complete description of the substitution, including details of all transition conditions at panel termination points.
2. Independent test reports verifying compliance with the performance requirements.
3. A detailed list of each item that does not fully comply with the specifications.
4. A letter indicating that the substitution is a foamed-in-place panel.
5. A letter stating that the manufacturer or wall systems contractor proposing the substitution will pay additional costs incurred by subcontractors affected by the proposed substitution.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect metal wall panels during shipping, handling, and storage to prevent staining, denting, or other visible damage. Deliver, unload, store, and erect metal wall panels and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.

1.08 WARRANTY

A. Standard Manufacturer's Warranty: Manufacturer shall warrant for a period of one year that the wall system materials will be free from defects. The wall systems contractor shall warrant for a period of one year that the installation workmanship will be free from defects.

B. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal wall panel assemblies that fail in materials and workmanship within five years from date of Substantial Completion.

C. Special Panel Finish Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal wall panels that evidence deterioration of fluoropolymer finish within 20 years from date of Substantial Completion.

D. Special Installer's Warranty: In a form acceptable to the Owner, Installer agrees to repair or replace metal wall panel assemblies that fail in materials and workmanship within two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: CENTRIA Architectural Systems, which is located at: 1005 Beaver Grade Rd. ; Moon Township, PA 15108-2944; Toll Free Tel: 800-759-7474; Tel: 412-299-8000; Fax: 412-299-8317; Email: ppalombo@centria.com; Web: www.centria.com

B. Bidders that are using materials supplied by a manufacturer other than Centria shall list the material supplier/manufacturer of the metal walls panels, provide a sample of the panel including a complete side joint with clip, and provide a letter signed and sealed by a professional engineer registered in the jurisdiction of the project indicating that the proposed products meet or exceed specified requirements. Manufacturers unable to provide this information prior to the time of bid will not be considered.

C. Requests for substitutions will be considered in accordance with provisions of Paragraph: Substitutions.

2.02 FOAMED INSULATION CORE METAL WALL PANELS

A. Panel System Product:
1. CENTRIA, FormaWall Dimension Series 2 (2 inches (51 mm) thick panel).
2. Thermal performance of the wall panels shall be based on tests in accordance with ASTM C236 corrected to 15 mph outside and still air inside. Tests shall include side-joint, standard fastening and integral reveals or profiling. Where reveals exceed the standards, the manufacturer shall provide similar testing to document any adjustments required to the standard conditions.
   a. R value for Series 2 flat panel shall be 14.
3. Panel Sealant/Vapor Seal: Factory-applied non-curing butyl.

B. Steel Sheet Exterior and Interior Facing: Contractor engineered panel meeting requirements indicated in Performance Requirements Article.

C. Face Sheet:
1. Thickness: 22 gage (0.70 mm).
2. Surface: Smooth.

D. Liner Sheet: 26 gage, 0.0179 inch (0.45 mm) G-90 coating, embossed, planked with 0.2 mil primer and 0.6 mil acrylic finish.

E. Panel System Design:
1. Panel Joinery:
   a. Horizontal Panels: Rain screen design with equalized pressure chamber.
2. Panel Width and Length: Refer to the Drawings.
3. Panel Reveal Depth: Horizontal panel reveal depth to be a minimum of 1-3/16 inches (30 mm) for Series 2 panel and 2-3/16 inches (55 mm) for Series 3 panels.
4. Panel Reveal Width: Horizontal panel reveal width to be as shown on Drawings.
5. Profile Faced Panels: As indicated on the Drawings.
6. Segmented Faced Panels: Formed with intermediate, formed joints as indicated on the Drawings.

2.03 MATERIALS

A. Face Sheet: Metallic-coated steel face sheet, coil coated, per ASTM A 755/A 755M, with finish as specified.

B. Face Sheet: Zinc-coated (galvanized) steel face sheet, ASTM A 653/A 653M, G90, structural quality, with finish as specified.

C. Face Sheet: Stainless steel face sheet, ASTM A666, Type 304 architectural grade alloy, 20 gage with bright, non-directional No. 2B polish.

1. Polish: No. 2B, bright, non-directional polish.
   a. Finish: Smooth.

D. Two-Coat Fluoropolymer Finish: Standard fluoropolymer 2-coat system consisting of 0.2 mil primer and 0.8 mil 70 percent PVDF fluoropolymer color coat.
1. Color: 179 Regal White, 181 Slate Gray.

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2.04 ACCESSORIES

A. Metal Wall Panel Accessories: Complete metal wall panel assembly including trim, copings, fascia, parapet caps, soffits, sills, inside and outside corners, jambs, and miscellaneous flashings. Include required fasteners, gaskets, closure strips, and sealants.
1. Material: Aluminum extrusions, 6063-T5 alloy unless noted otherwise on the Drawings.
2. Thermal Break Extrusions: At wall base and head, sill and jamb conditions for windows, doors and other wall openings with no thermal shortcuts.
3. Finish for Exposed Trim and Extrusions: Match panel finish.

2.05 MISCELLANEOUS MATERIALS

F. Sealant: Synthetic non-skinning butyl rubber sealant, as recommended by panel manufacturer, for metal wall panel assemblies to remain watertight.

G. Fasteners: Self-tapping screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal wall panels by means factory-applied coating.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine metal wall panel supports, substrates, and conditions for compliance with requirements for installation tolerances and other conditions affecting work.
1. Verify that structural panel support members and anchorage have been installed within the following tolerances:
   a. Plus or minus 1/4-inch (6.35 mm) in 20 feet (6096 mm).
   b. Plus or minus 1/2-inch (12.7 mm) across building elevation.
   c. Plus or minus 1/8-inch (3.17 mm) within 5 feet (1524 mm) of any change in plane.

B. Correct out of tolerance work and deficient conditions prior to proceeding with metal wall panel installation.

3.02 PREPARATION

A. Install miscellaneous framing and anchorage according to ASTM C 754, metal wall panel manufacturer's written recommendations, and approved shop drawings.

3.03 METAL WALL PANEL INSTALLATION

A. Install metal wall panels and accessories in accordance with manufacturer's recommendations and approved shop drawings.

B. General: Install metal wall panels in orientation, sizes, and locations indicated. Anchor metal wall panels and other components securely in place. Provide for thermal and structural movement.
1. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as approved by manufacturer.
1. Field cutting of metal wall panels is not permitted.
2. Fasten metal wall panels to supports with concealed clips at each joint at location, spacing, and with fasteners recommended by manufacturer. Install clips to supports with self-tapping fasteners.
3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

C. Fasteners for Steel Wall Panels:
1. Exterior: Stainless-steel.

D. Metal Protection: Provide metal wall panel manufacturer's recommended permanent separation material where dissimilar metals will contact each other or corrosive substrates.

E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies.
1. Seal metal wall panel end laps to supports or back-up flashing sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer. Do not install sealant in locations that will interfere with drainage of pressure-equalized panel chambers.
2. Prepare joints and apply sealants per requirements of Division 07 Section "Joint Sealants."

3.04 ACCESSORY INSTALLATION

H. General: Install metal wall panel accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
4. Install related flashings and sheet metal trim per requirements of Division 07 Section "Sheet Metal Flashing and Trim."
5. Install components required for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
6. Comply with performance requirements and manufacturer's written installation instructions.
7. Provide concealed fasteners except where noted on approved shop drawings.
8. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.05 FIELD QUALITY CONTROL

I. Testing Agency: An independent testing and inspecting agency acceptable to Architect to perform field tests and inspections and to prepare test reports.

J. Water-Spray Test: After completing portion of metal wall panel assembly including accessories and trim, test 2-bay area selected by Architect for water penetration, according to AAMA 501.2. Wall areas should be tested as a routine QA procedure. Areas erected by each crew should be checked at various stages of erection.

K. Manufacturer's Field Service: Engage a service representative authorized by metal wall panel manufacturer to inspect completed installation. Submit written report. Correct deficiencies noted in report.

3.06 CLEANING AND PROTECTION

L. Remove temporary protective films. Clean finished surfaces as recommended by metal wall panel

manufacturer. Clear weep holes and drainage channels of obstructions, dirt, and sealant. Maintain in a clean condition during construction.

M. Replace damaged panels and accessories that cannot be repaired by finish touch-up or minor repair.

END OF SECTION 07412

SECTION 07540 – PVC THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Thermoplastic roofing membrane, mechanically fastened to substrate.

B. Thermoplastic roofing membrane, fully adhered to substrate.

C. Preparation of existing roof for recovering.

D. Roof insulation.

E. Prefabricated flashings, corners, parapets, stacks, vents, and related details.

F. Fasteners, adhesives, and other accessories required for a complete roofing installation.

G. Traffic Protection.

1.2 RELATED SECTIONS

A. Section 07600 - Flashing and Sheet Metals: Metal flashing and counter flashing installation and requirements.

B. Section 08800 – Glass and Glazing.

C. Section 15430 - Plumbing Specialties

1.3 REFERENCES

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

B. ASTM C 1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

C. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

D. ASTM C 1396/C1396M - Standard Specification for Gypsum Board.

E. ASTM D 146 - Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing.

F. ASTM D 570 - Standard Test Method for Water Absorption of Plastics.

G. ASTM D 751 - Standard Test Methods for Coated Fabrics.

H. ASTM D 828 - Standard Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus.

I. ASTM D1079 - Standard Terminology Relating to Roofing, Waterproofing, and Bituminous Materials.

J. ASTM D 1204 - Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.

K. ASTM D 2136 - Standard Test Method for Coated Fabrics Low-Temperature Bend Test.

L.ASTM D3045 - Standard Practice for Heat Aging of Plastics Without Load.

M. ASTM D 4434 - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing.

N. ASTM D 5602 - Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens.

O. ASTM D 5635 - Standard Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens.

P. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.

Q. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials

R. ASTM G 154 - Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.

S. UL - Roofing Materials and Systems Directory, Roofing Systems (TGFU.R10128).

T. Factory Mutual Global - Factory Mutual Standard 4470 - Approval Standard for Class 1 Roof Covers.

U. ASCE 7 - Minimum Design Loads For Buildings And Other Structures.

V. NRCA - The NRCA Roofing and Waterproofing Manual.

W. SPRI - Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems.

1.4 SYSTEM DESCRIPTION

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Physical Properties
1. Roof product must meet the requirements of type IV PVC sheet roofing as defined by ASTM D 4434 and must meet or exceed the following physical properties.
2. Thickness: 40 mil (1.0 mm), nominal in accordance with ASTM D 751.
3. Breaking Strengths: greater than 430 lbf. (MD) and greater than 368 lbf. (XMD) in accordance with ASTM D 751, Grab Method.
4. Elongation at Break: greater than 30 percent in accordance with ASTM D 751, Grab Method.
5. Heat Aging in accordance with ASTM D 3045: 176 degrees F for 56 days. No sign of cracking, chipping

or crazing. (In accordance with ASTM D 4434).
6. Factory Seam Strength: greater than 468 lbf in accordance with ASTM D 751, Grab Method.
7. Tearing Strength: greater than 91 lbf. (MD) and greater than 128 lbf. (XMD) in accordance with ASTM D 751, Procedure B.
8. Low Temperature Bend (Flexibility): Pass at minus 40 degrees F in accordance with ASTM D 2136.
9. Accelerated Weathering: No cracking, checking, crazing, erosion or chalking after 5,000 hours in accordance with ASTM G 154.
10. Linear Dimensional Change: less than 0.5 percent in accordance with ASTM D 1204 at 176 plus or minus 2 degrees F for 6 hours.
11. Water Absorption: less than 3 percent in accordance with ASTM D 570 at 158 degrees F for 166 hours.
12. Static Puncture Resistance: greater than 56 lbs. in accordance with ASTM D 5602.
13. Dynamic Puncture Resistance: greater than 474 pdl-ft in accordance with ASTM D 5635.

D. Physical Properties
1. Roof product must meet the requirements of type III PVC sheet roofing as defined by ASTM D 4434 and must meet or exceed the following physical properties.
2. Thickness: 50 mil (1.25 mm), nominal in accordance with ASTM D 751.
3. Breaking Strengths: greater than 472 lbf. (MD) and greater than 366 lbf. (XMD) in accordance with ASTM D 751, Grab Method.
4. Elongation at Break: greater than 31 percent in accordance with ASTM D 751, Grab Method.
5. Heat Aging in accordance with ASTM D 3045: 176 degrees F for 56 days. No sign of cracking, chipping or crazing. (In accordance with ASTM D 4434).
6. Factory Seam Strength: greater than 575 lbf in accordance with ASTM D 751, Grab Method.
7. Tearing Strength: greater than 68 lbf. (MD) and greater than 92 lbf. (XMD) in accordance with ASTM D 751, Procedure B.
8. Low Temperature Bend (Flexibility): Pass at minus 40 degrees F in accordance with ASTM D 2136.
9. Accelerated Weathering: No cracking, checking, crazing, erosion or chalking after 5,000 hours in accordance with ASTM G 154.
10. Linear Dimensional Change: less than 0.5 percent in accordance with ASTM D 1204 at 176 plus or minus 2 degrees F for 6 hours.
11. Water Absorption: less than 3 percent in accordance with ASTM D 570 at 158 degrees F for 166 hours.
12. Static Puncture Resistance: greater than 56 lbs. in accordance with ASTM D 5602.
13. Dynamic Puncture Resistance: greater than 474 pdl-ft in accordance with ASTM D 5635.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Maintenance requirements.

C. Shop Drawings: Indicate insulation pattern, overall membrane layout, field seam locations, joint or termination detail conditions, and location of fasteners.

D. Verification Samples: For each finish product specified, two samples, representing actual product, color, and finish.
1. 4 inch by 6 inch (102 by 150 mm) sample of roofing membrane, of color specified.
2. Sample of roofing membrane with factory weld and T-shaped lap.
3. 4 inch by 6 inch (102 mm by 150 mm) sample of walkway pad.

4. Termination bar, fascia bar with cover, drip edge and gravel stop if to be used.
5. Each fastener type to be used for installing membrane, insulation/recover board, termination bar and edge details.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Installer Certification: Certification from the roofing system manufacturer that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

G. Manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with NRCA ML104 and manufacturer's installation instructions.

B. Manufacturer Qualifications: A manufacturer specializing in the production of PVC membranes systems and utilizing a Quality Control Manual during the production of the membrane roofing system that has been approved by and is inspected by Underwriters Laboratories.

C. Installer Qualifications: Company specializing in installation of roofing systems similar to those specified in this project and approved by the roofing system manufacturer.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for roof assembly wind uplift and fire hazard requirements.

B. Fire Exposure: Provide membrane roofing materials with the following fire-test-response characteristics. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure:
   a. Class A; ASTM E 108, for application and roof slopes indicated.
   b. Class B; ASTM E 108, for application and roof slopes indicated.
   c. Class C; ASTM E 108, for application and roof slopes indicated.
2. Fire-Resistance Ratings: Comply with ASTM E 119 for fire-resistance-rated roof assemblies of which roofing system is a part.
3. Conform to applicable code for roof assembly fire hazard requirements.

C. Wind Uplift:
1. FMG: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's Approval Guide for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
   a. Class 1A-60
   b. Class 1A-75
   c. Class 1A-90
2. Conform to applicable building code for roof assembly wind uplift requirements.

D. Thermal Resistance: Provide overall thermal resistance for roofing system as follows:
1. Minimum U-value, in accordance with ASHRAE 90.1: 0.04.
2. Thickness of thermal insulation specified: 5 inches.
3. Configuration as indicated on the Drawings.

1.8 PRE-INSTALLATION MEETING

A. Convene meeting not less than one week before starting work of this section.

B. Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
4. Review structural loading limitations of roof deck during and after roofing.
5. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
6. Review governing regulations and requirements for insurance and certificates if applicable.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Store roof materials and place equipment in a manner to avoid permanent deflection of deck.

E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.10 PROJECT CONDITIONS

A. Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's specification.

B. Do not apply roofing membrane during inclement weather, or to damp or frozen deck surface or when precipitation is anticipated.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed in the same day.

1.11 WARRANTY

A. Installer Warranty: Warrant the workmanship and proper application of roof system for two years from the date of favorable inspection by the roof membrane manufacturer. Repair any leaks covered under the warranty that occur during this period to the satisfaction of the Owner and the roof membrane manufacturer. All corrective work will be done at no cost to the Owner.

B. Manufacturer Warranty: Provide a no-dollar limit type warranty with provisions for completion of repairs, replacement of membrane or total replacement of the roofing system at the then-current material and labor prices throughout the life of the warranty. Warranty must also meet the following criteria
1. Warranty Period: 15 years from date issued.
2. Include no exclusions for damage caused by ponded water or biological growth, or for incidental or consequential damages.
3. Issued direct from and serviced by the roof membrane manufacturer.
4. Be transferable for the full term of the warranty.
5. Include no additional charges for the warranty.

C. Manufacturer Warranty: Provide a no-dollar limit type warrantee with provisions for completion of repairs, replacement of membrane or total replacement of the roofing system at the then-current material and labor prices for the first ten years of the warranty and then on a pro-rated basis based on the then-current material price during the second 10-years of the warranty. Warranty must also meet the following criteria:
1. Warranty Period: 20 years from date issued.
2. Include no exclusions for damages caused by ponded water or biological growth, or for incidental or consequential damages.
3. Issued direct from and serviced by the roof membrane manufacturer.
4. Be transferable for the full term of the warranty.
5. Include no additional charges for the warranty.

D. Manufacturer Warranty: Warrant that the membrane, material and accessories are free from manufacturing defects at the time of delivery and will not become defective during the term of the limited warranty. Warranty must also meet the following criteria:
1. Warranty Period: 15 years from date issued.
2. Issued direct from the roof membrane manufacturer.
3. Be transferable for the full term of the warranty.
4. Include no additional charge for the warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Duro-Last Roofing, Inc., which is located at: 525 Morley Dr. P. O. Box 3301 ; Saginaw, MI 48601; Toll Free Tel: 800-248-0280; Tel: 989-753-6486; Fax: 800-432-9331; Email: jvanocht@duro-last.com; Web: www.duro-last.com

B. Provide all roofing system components by a single manufacturer, or as approved by membrane manufacturer.

C. Substitutions: Not permitted.

D. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 ROOFING SYSTEM COMPONENTS

A. Roofing Membrane: Duro-Last Specially Formulated Roofing Membrane by Duro-Last Roofing, 1nc. conforming to ASTM D 4434, Type III or IV, fabric reinforced, PVC. Membrane properties as follows:
1. Thickness:
   a. 40 mil (1.0 mm), nominal.
2. Exposed Face Color:
   a. Gray.

B. Accessory Materials: Provide accessory materials as manufactured by the roof membrane manufacturer.
1. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.
2. Prefabricated Flashing: Prefabricated flashings for pipes, curbs, inside and outside corners of same material, type, reinforcement, and color as PVC sheet membrane.
3. Sealants and Adhesives: Caulk, pourable sealant, mastic and adhesives compatible with roofing system.
4. Slip Sheet and Cover Boards: Slip sheet or cover boards, of type required by roof membrane manufacturer for the application.
5. Termination Bars: Standard rigid exterior vinyl bar, 1.5 inches (38 mm) wide with slotted holes 6 inches (152 mm) on center.
6. Edge Detail: Fascia bar and cover, prefabricated Drip Edge, prefabricated Gravel Stop, 2-Piece Compression Metal Edge.
7. Vinyl Coated Metal: 24 gauge, hot-dipped galvanized, grade 90 metal with a minimum of 17 mil of Duro-Last membrane laminated to one side.
8. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate.
9. Two-Way Roof Vents: As recommended by roof membrane manufacturer and installed with a minimum of 1 vent for each 1,000 square-feet (93 sm) of roof area.

C. Coated Glass Fiber Slip Sheet:
1. Number of plies of the coated glass fiber slip-sheet:
   a. Install the number of plies necessary to achieve the required fire classification.

D. Slip Sheet: Duro-Last Nova Rollout Underlayment.

E. Walkways: Provide non-skid, maintenance-free walkway pads in areas of heavy foot traffic and around mechanical equipment. Walkway pads must be as manufactured by roof membrane manufacturer.

2.3 ROOF INSULATION

A. General:
1. Provide preformed roof insulation boards that comply with requirements and referenced standards, as selected from manufacturer's standard sizes.
2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

B. Polyisocyanurate Board Insulation: Complying with ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces. Material as approved by the roof membrane manufacturer and as manufactured by:
1. Apache Products Company.
2. Atlas Roofing Corporation.
3. Celotex Corporation.

4. Dow Chemical Company.
5. Hunter Panels.
6. Koppers, Inc.
7. R-Max, 1nc.
8. U.S. Intec, 1nc.

C. Expanded Polystyrene (EPS) Board Insulation: Material as approved by the roof membrane manufacturer:
1. Density: Minimum 1.5 PCF (24 Kg/m3).
2. Compressive Resistance: Minimum 18 PSI (124 kPa).
3. As manufactured by:
   a. F M R-Control Building Systems.
   b. Avron, Inc.
   c. Benchmark Foam, 1nc.
   d. Certainteed Corporation.
   e. Diversi-Foam Products.
   f. Falcon Foam.
   g. Premier Industries, Inc.

D. Extruded-Polystyrene (XPS) Board Insulation: Material as approved by the roof membrane manufacturer:
1. Density: Minimum 1.5 PCF (24 Kg/m3).
2. Compressive Resistance: Minimum 25 PSI (172 kPa).
3. As manufactured by:
   a. Certainteed Corporation.
   b. Dow Chemical Company.
   c. Owens Corning.
   d. Pactiv Building Products.
   e. T-Clear Corporation.
   f. Premier Industries, Inc.

2.4 ROOF INSULATION ACCESSORIES

A. General: Provide roof insulation accessories approved by the roof membrane manufacturer and as recommended by insulation manufacturer for the intended use.

B. Fasteners: Provide Duro-Last factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane and insulation to substrate in conformance to specified design requirements.

C. Substrate Board:
1. Gypsum wall board conforming to ASTM C 1396/C 1396M. Provide to:
   a. 5/8 inch thick.
   b. Thickness indicated on the Drawings.

D. Coated Glass Fiber Slip Sheet:
1. Number of plies of the coated glass fiber slip-sheet:
   a. Install the number of plies necessary to achieve the required fire classification.
2. Slip Sheet: Duro-Last Nova Rollout Underlayment.

E. Slip Sheet: Duro-Last Nova Rollout Underlayment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that the surfaces and site conditions are ready to receive work.

B. Verify that the deck is supported and secured.

C. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters.

D. Verify that the deck surfaces are dry and free of standing water, ice or snow.

E. Verify that all roof openings or penetrations through the roof are solidly set.

F. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Surfaces shall be clean, smooth, free of fins, sharp edges, loose and foreign material, oil, grease, and bitumen.

D. Ensure that roof deck is structurally sound and in appropriate condition to begin installation of roofing system.

E. Wood Nailers:
1. Provide nailers as indicated on the Drawings and as required by the roof membrane manufacturer.
2. Conform to requirements of Section 06100 - Rough Carpentry.
3. Provide nailers at the entire roof perimeter where insulation thickness is 1 inch (25 mm) or more.
4. Anchor to deck, wall, or existing nailers to resist minimum force of 180 lbf/ft (2627 N/m) in any direction. Space fasteners not more than 18 inches (457 mm) apart.
5. Thickness of nailer shall be such that the top of the nailer is flush with the surface to which the membrane is to be applied.

3.3 INSTALLATION

A. Install roofing system in accordance with the membrane manufacturer's installation instructions.

B. Insulation: Install insulation in accordance with the insulation manufacturers requirements as approved by the roof membrane manufacturer.
1. Insulation shall be adequately supported to sustain normal foot traffic without damage.
2. Insulation materials shall be installed in parallel courses with end joints staggered 50 percent and adjacent boards butted together with no gaps greater than 1/4 inch (6.3 mm).
3. If more than one layer of insulation is used, all joints between subsequent layers shall be offset by 50

percent.

4. Where field trimmed, insulation shall be fitted tightly around roof protrusions and terminations.
5. Tapered insulation boards shall be installed in accordance with the insulation manufacture's shop drawings.
6. No more insulation shall be applied than can be covered with the roof membrane by the end of the day or the onset of inclement weather.

C. Mechanical Insulation Attachment: Use only fasteners, stress plates and fastening patterns accepted for use by roof membrane manufacturer using fastening patterns that meets applicable design requirements.

D. Adhered Insulation Attachment: Use only adhesive acceptable to both roof membrane manufacturer and the insulation manufacturer that meets applicable design requirements.

E. Install fasteners in accordance with roof membrane manufacturer' requirements. Fasteners that are improperly installed shall be removed or corrected.

F. Separation Layer: If required, install recover board or slip sheet directly over the substrate in accordance with roof membrane manufacturer's requirements.

G. Mechanically Fastened Membrane:

1. Mechanically fastened membrane to the structural deck utilizing fasteners and fastening patterns that in accordance with roof membrane manufacturer's requirements.
2. Cut membrane to fit neatly around all penetrations and roof projections.
3. Unroll roofing membrane and positioned with a minimum 6 inch overlap.

H. Fully Adhered Membrane:

1. Fully adhere the membrane to the insulation or acceptable surface using adhesive, tools and techniques required by the roof membrane manufacturer's requirements.
2. Cut membrane to fit neatly around all penetrations and roof projections.
3. Unroll roofing membrane and positioned with a minimum 6 inch overlap.
4. Apply adhesive in accordance with roof membrane manufacturer's requirements.
5. Apply at the required rate in smooth, even coatings without voids, globs, puddles or similar irregularities. Use care not to contaminate the area of the membrane where hot air welding will occur.

I. Seaming:

1. Weld overlapping sheets together using hot air. Minimum weld width is 1-1/2 inches (38 mm).
2. Check welded seams for continuity and integrity by the end of each work day. Repair all imperfections.

J. Membrane Termination/Securement: All membrane terminations shall be completed in accordance with roof membrane manufacturer's requirements.

1. Provide securement at all membrane terminations at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, and other similar condition.
2. Provide securement at any angle change where the slope or combined slopes exceeds two inches in one horizontal foot.

K. Flashings: Complete all flashings and terminations as indicated on the Drawings and in accordance with roof membrane manufacturer's requirements.

1. Base and Wall Flashings:
   a. Do not apply flashing over existing thru-wall flashings or weep holes.
   b. Secure flashing on vertical surfaces before the seam between the flashing and the main roof sheet is completed.
   c. Extend flashing membrane a minimum of 6 inches (152 mm) onto the main roof sheet beyond

the mechanical securement.

d. Use care to ensure that the flashing does not bridge locations where there is a change in direction (e.g. where the parapet meets the roof deck).

2. Penetrations:
   a. Flash all pipes, supports, soil stacks, cold vents, and other penetrations passing through the roofing membrane as indicated on the Drawings and in accordance with roof membrane manufacturer's requirements.
   b. Utilize custom prefabricated flashings supplied by roof membrane manufacture.
   c. Existing Flashings: Remove when necessary to allow new flashing to terminate directly to the penetration.
3. Pipe Clusters and Unusual Shapes:
   a. Clusters of pipes or other penetrations which cannot be sealed with prefabricated flashings or membrane shall be sealed by surrounding them with pourable sealer supplied by roof membrane manufacturer.
   b. Penetration pans shall be installed, flashed and filled with pourable sealer in accordance with roof membrane manufacturer's requirements.
   c. Penetration pans shall not be used where prefabricated or field fabricated flashings are possible.

L. Roof Drains:
1. Coordinate installation of roof drains and vents specified in Section 15146 - Plumbing Specialties.
2. Remove existing flashing and asphalt at existing drains in preparation for sealant and membrane.
3. Provide a smooth clean surface on the mating surface between the clamping ring and the drain base.
4. Taper insulation around the drain to prevent the membrane from bridging and to provide a smooth transition from the roof surface to the drain clamping ring.
5. Use sealant to seal between the membrane and the drain base using constant, even compression from the drain clamping ring.

M. Fascia/Drip Edge/Gravel Stop:
1. Provide fascia bar and cover, drip edge and gravel stop as indicated on the Drawings. Install in accordance with roof membrane manufacturer's requirements.
2. Seal joints between individual sections in accordance with roof membrane manufacturer's requirements.
3. Coordinate installation of metal flashing and counter flashing specified in Section 07620.
4. Manufactured Roof Specialties: Coordinate installation of copings, counter flashing systems, gutters, downspouts, and roof expansion assemblies specified in Section 07710.

N. Walkways: Install walkways in accordance with roof membrane manufacturer's requirements.
1. Provide walkways where indicated on the Drawings.
2. Install at roof hatches, access doors, rooftop ladders and all other traffic concentration points regardless of traffic frequency. Provided in areas receiving regular traffic to service rooftop units or where a passageway over the surface is required.
3. Do not install walkways over flashings or fields seams until field inspections by roof membrane manufacturer have been completed.

O. Water cut-offs: Provide water cut-offs to ensure that water does not flow beneath the completed sections of the new roofing system.
1. Provide water cut-offs on a daily basis at the completion of work and at the onset of inclement weather.
2. Remove water cut-offs prior to the resumption of work.
3. The integrity of the water cut-off is the sole responsibility of the roofing contractor.
4. Any membrane contaminated by the cut-off material shall be cleaned or removed.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's representative shall provide a comprehensive final inspection after completion of the roof system. All application errors shall be addressed and final punch list completed.

3.5 PROTECTION

A. Protect installed roofing products from construction operations until completion of project.

B. Where traffic must continue over completed roofing membrane, protect from damage using durable materials that are not incompatible with membrane.

C. Repair or replace damaged products before Substantial Completion.

END OF SECTION 07540

SECTION 07900 - CAULKING AND SEALANTS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work in this Section.

1.01 DESCRIPTION OF WORK:

A.Work includes providing joint sealers for the following conditions:

1.Interior and exterior joints between walls and door frames.
2.Interior and exterior joints between walls and windows.
3.Joints between built-in equipment/furniture and walls.
4.Other joints as indicated on drawings.

1.02 SYSTEM PERFORMANCES:

Provide joint sealers that have been produced and installed to establish and maintain watertight and airtight continuous seals.

1.03 QUALITY ASSURANCE:

Use only experienced applicators have a minimum of five (5) years experience installing sealants.

1.04 SUBMITTALS:

Submit product data from manufacturers for each joint sealer product required, including instructions for joint preparation and joint sealer application.

1.05 DELIVERY, STORAGE AND HANDLING:

Deliver materials to Project construction site in original unopened containers with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.

1.06 PROJECT CONDITIONS:

Do not proceed with installation of joint sealers where joint widths are greater and/or less than allowed by joint sealer manufacturer for application indicated.

PART 2 - PRODUCTS

2.01 SEALANTS:

A.Paintable Elastomeric Sealant:

Paintable Elastomeric Sealant shall be equal to Dow Corning Trademate Paintable Glazing (meets or exceeds ASTM C 920 Type S Grade NS, Class 25, Use NT and G), and shall be used for joints between: walls and door frames; walls and windows; built-in equipment/furniture and walls; and where sealant shall be paintable.

B.Non-Paintable Elastomeric Sealant:

Non-Paintable Elastomeric Sealant shall be equal to Dow Corning #791 Perimeter Sealant (meets or exceeds ASTM C 920 Type S Grade NS, Class 25, Use NT, M, G, A and O), and shall be used where sealant shall be non-paintable. Color shall match application and/or as selected by Architect.

C.Mildew Resistant Sealant:

Shall be equal to Dow Corning #786 Mildew Resistant Silicone Sealant (meets or exceeds ASTM C 920), and shall be used for perimeter joints of plumbing fixtures with walls and/or floors. Color shall match fixture color and/or as selected by Architect.

2.02 MISCELLANEOUS MATERIALS:

A.Joint Primer/Sealer:

Provide joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

B.Sealant Backer Rod (S-BR):

Compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended by sealant manufacturer for compatibility with sealant.

PART 3 - EXECUTION

3.01 EXAMINATION:

A.Examine joints indicated to receive joint sealers for compliance with requirements for installation tolerances and other conditions that affect joint sealer performance.

B.Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected.

3.02 PREPARATION AND INSTALLATION OF JOINT SEALERS:

A.Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B.Clean out joints immediately before installing joint sealers to assure proper adhesion. Comply with recommendations of joint sealer manufacturers.

C. Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

D. Sealant Backer Rod:

Install sealant backer rod where recommended by manufacturer of sealant and/or where shown on Drawings.

3.03 CLEANING:

Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

END OF SECTION 07900

SECTION 08120 – ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 SECTION INCLUDES

A. Aluminum frame assemblies.

1.02 RELATED SECTIONS

A. Section 06065 – Plastic materials.

B. Section 08710 – Sliding and Folding Door Hardware.

C. Section 08800 – Glass and glazing.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings:
1. Provide elevations indicating rough opening requirements and details for field applied components.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.04 DELIVERY, STORAGE, AND HANDLING

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

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.05 PROJECT CONDITIONS

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

1.06 WARRANTY

A. Manufacturer warrants that the products supplied by it shall be free from material defects in materials and workmanship for a period of five years after shipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: ALMETCO, which is located at: 271 Carr. #21, Río Piedras, P.R. 00927; PO Box 29442, San Juan, P.R. 00929-0442; Tel: (787)-767-7272; Fax: (787)-274-0018; Email: sales@almetco.com; Web: www.almetcopr.com

B. Substitutions: Not permitted.

2.02 DOORS AND FRAMES

A. Product: 6063 T-5 Aluminum Extruded Square Tubes, Sharp Corners, Mill Finish
1. Profile: 1 inch by 1 inch; 1/8 inch thickness.
2. Rail, mounting and adaptors as scheduled or as required. Refer to Drawings.
3. ADA accessible entrance doors shall have 10 inch (254 mm) bottom rail.

2.03 FABRICATION

A. Door stiles and rails shall be tubular sections accurately joined at the corners with concealed shear blocks secured with bolts and screws. No exposed screws shall be permitted unless for hardware installation.

B. Door stiles and rails shall be tubular sections accurately joined at the corners. Corners shall be welded.

C. Doors shall receive manufacturer's standard weather stripping at head, jambs, and stiles.
1. Provide surface weather stripping at bottom of door.
2. Provide concealed weather stripping at bottom of door.

D. Frame:
1. Profile: 1 inch by 1 inch (114 mm) jambs and header.

2.04 MATERIALS

A. Door members shall be extruded aluminum T5 alloy and temper.
1. Major portions of the door stiles shall have .125 inch (3 mm) wall thickness and glazing beads .062 inch (1.5 mm) wall thickness. Screws, nuts, washers, bolts, rivets and other fasteners will be aluminum, stainless steel or other non-corrosive material. Glazing gaskets shall be E.P.D.M. extrusion.
2. Major portions of the door stiles shall have .1875 inch (4.75 mm) wall thickness and glazing beads .062 inch (1.5 mm) wall thickness. Screws, nuts, washers, bolts, rivets and other fasteners will be aluminum, stainless steel or other non-corrosive material. Glazing gaskets shall be E.P.D.M. extrusion.
3. Door leafs shall be prepared to accept glazing as scheduled using square snap in glazing beads.

B. Exposed surfaces shall be free of scratches and other serious blemishes. Finish shall be manufacturers standard.
1. Finish: Clear anodized.

C. Hardware for aluminum doors shall be manufacturer's standard: maximum security lock, push-pulls,

threshold, pivots, and standard exposed or concealed overhead closure as scheduled.

1. Prepared for manufacturers standard push bar and pull handle (hardware to be field installed).
2. 3 point locks will require field drilling of threshold and header bolt holes.
3. All entrances with panic devices installed by the manufacturer shall be provided with a "no-hold open" closer.
4. Configuration: Offset Pivoted Single Entrance.
    a. International 4000 series pivots.
    b. Adams Rite 1850 series maximum security lock, with cylinders.
    c. International 800 series closer (overhead surface applied, medium tension, no hold open). No prep for surface closer is done, shall be field installed.
    d. Surface applied stop (to be field installed after frame installation).
5. Configuration: Offset Pivoted Pair Entrance.
    a. International 4000 series pivots.
    b. Adams Rite 1850 series maximum security lock, with cylinders in the active leaf.
    c. International FB1202 flush bolts in the inactive leaf.
    d. International 800 series closer (overhead surface applied, medium tension, no hold open). No prep for surface closer is done, shall be field installed.
    e. Surface applied stop (to be field installed after frame installation).
6. Configuration: Center Pivoted Single Entrance.
    a. International series 200 overhead concealed closer, 105 degree hold open, with DP pivot.
    b. Adams Rite 1850 series maximum security lock, with cylinders.
7. Configuration: Center Pivoted Pair Entrance.
    a. International series 200 overhead concealed closer, 105 degree hold open, with DP pivot.
    b. Adams Rite 1850 series maximum security lock, with cylinders in the active leaf.
    c. International FB1202 flush bolts in the inactive leaf.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until rough openings have been properly prepared.

B. If rough opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare openings using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Doors and frames shall be installed in their correct locations and set level, square and plumb in alignment with other work and substrates, in accordance with approved shop drawings and accepted industry standards. All joints between framing and substrates shall be sealed to insure a weather tight installation.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. After installation Contractor shall protect exposed aluminum surfaces from damage.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 08120

SECTION 08221 – FIBERGLASS REINFORCED DOOR AND FRAME SYSTEM

PART 1 GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 SECTION INCLUDES

A. Fiberglass Reinforced Plastic (FRP) Doors.

B. Fiberglass Door Frames.

1.02 RELATED SECTIONS

A. Section 07900 – Caulking and Sealants.

B. Section 08719 – Sliding and Folding Door Hardware.

C. Section 08800 – Glass and Glazing.

1.03 REFERENCES

A. ASTM D 523 - Standard Test Method for Specular Gloss.

B. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.

E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

F. SDI 100 - Recommended Specifications for Steel Doors and Frames.

G. UL 10B - Standard for Fire Tests of Door Assemblies.

H. UL 305 - Standard for Panic Hardware.

1.04 PERFORMANCE REQUIREMENTS

A. Door opening assemblies:
1. Maximum flame spread 25 in accordance with ASTM E 84, self-extinguishing in accordance with ASTM D 635.
2. USDA accepted.

B. Fire rated assemblies: Comply with requirements of UL10B, NFPA 252, and ASTM E 152.

C. Fire rated assemblies: Comply with requirements of UL10B, NFPA 252, and ASTM E 152; UL ratings indicated on drawings, with doors and frames bearing rating labels.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings:
1. Plans: Indicate location of each door opening assembly in project.
2. Elevations: Dimensioned elevation of each type door opening assembly in project; indicate sizes and locations of door hardware, and lites and louvers, if specified.
3. Details: Installation details of each type installation condition in project; indicate installation details of glazing, if specified.
4. Schedule: Indicate each door opening assembly in project; cross-reference to plans, elevations, and details.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

F. Closeout: Submit warranty documents specified herein.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing fiberglass doors and frames with a minimum documented experience of ten years.

B. Installer Qualifications: Company specializing in installation of fiberglass doors and frames with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's unopened, undamaged packaging, with manufacturer's labels intact.

B. Inspect and report damage to doors at time of delivery.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. Store door assemblies in on end, to prevent damage to face corners and edges.

1.08 WARRANTY

A. Manufacturer's Warranty: Manufacturer's 15-year warranty against failure due to corrosion from specified environment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Cristalum, which is located at: #1523 El Cinco, 8838 Rd., Río Piedras , P.R. 00926; Tel: 787-751-0123; Fax: 787-765-1872; Web: www.cristalumpuertasyventanas.com

B. Substitutions permitted if approved by the Architect.

2.02 MATERIALS

A. Fiberglass Mat: Glass fiber chopped strand, minimum 1.5 ounces per square foot.

B. Resins: Manufacturer's formulation for fabricating units to meet specified requirements.

C. Anchors: Manufacturer's standard stainless steel expansion anchors for existing openings, and stainless steel masonry tee anchors for new construction.

D. Fasteners: Stainless steel.

E. Glazing: Type specified in Section 08800; factory installed.

2.03 COMPONENTS

A. Non-rated Fiberglass Reinforced Plastic (FRP) Doors:
1. Thickness: 1-3/4 inches (45 mm).
2. Thermal Insulating Value: 'R' factor 11.
3. Construction:
   a. Core: End-grain balsa wood, resin-impregnated.
   b. Door Plates: Molded in one continuous piece, resin reinforced with hand-laid glass fiber mat, nominal 1/8 inch (3 mm) thick, minimum 15 mil gel-coated surface.
   c. Door Edges: Minimum 3 layers resin-reinforced glass fiber mat, nominal 3/8 inch (9.5 mm) thick, machine tooled.
4. Sizes: Indicated on drawings.
5. Finish: Smooth gloss surface, minimum value of 88 in accordance with ASTM D 523.
   a. Color: Gray finish.

B. Fire-rated Fiberglass Reinforced Plastic (FRP) Doors:
1. Thickness: 1-3/4 inches (45 mm).
2. Thermal Insulating Value: 'R' factor 11.
3. Construction:
   a. Core: Fire-resistant mineral core.
   b. Door Plates: Molded in one continuous piece, resin reinforced with hand-laid glass fiber mat, nominal 1/8 inch (3 mm) thick, minimum 25 mil gel-coated surface.
   c. Door Edges: Minimum two layers resin-reinforced glass fiber mat, nominal 1/4 inch (6 mm) thick, machine tooled.
4. Sizes: Indicated on drawings.
5. Finish: Smooth gloss surface, minimum value 88 in accordance with ASTM D 523.
   a. Color: Gray finish.

C. Non-rated Fiberglass Frames:
1. Construction: One-piece pultruded fiberglass reinforced plastic, minimum 1/4 inch wall thickness, jamb-to-head joints mitered and reinforced with FRP clips and stainless steel fasteners; conforming to SDI requirements for performance equivalent to 16 gage steel frames.
2. Frame profile: 5-3/4 inches (146 mm) deep, 2 inches (51 mm) wide face; double rabbeted with 5/8 inch (16 mm) high stop.
3. Sizes: Indicated on drawings.
4. Finish: Satin Co-Extruded finish, with true and consistent color throughout frame thickness.
   a. Color: Gray CO-X Finish.

D. Fire-rated Frames: UL approved, and as follows:
1. Construction: Type 304 stainless steel.
2. Construction: Galvaneal steel, primer finish.
3. Sizes: For door sizes and frame profiles indicated on drawings.

E. Frame Anchors: Types recommended by manufacturer for project conditions.

F. Lites in Fire-rated Doors: UL approved, and as follows:
1. Frames: Type 304 stainless steel..
2. Glazing: Specified in Section 08800.
3. Sizes: Indicated on drawings.
4. Fasteners: Stainless steel screws.

G. Door Hardware: Specified Section 08719.

H. Door Hardware: Supplied by door manufacturer, UL-listed for fire-rated openings, and as follows:
1. Hinges: Location and quantity indicated on approved shop drawings, and as follows:
   a. Type: Full-mortise, ball-bearing stainless steel butts, 4-1/2 inches by 4-1/2 inches (114 mm by 114 mm) template; stainless steel fasteners.
   b. Acceptable product: Fib-R-Dor BB51.
2. Closers:
   a. Type: Standard service.
   b. Acceptable product: International 984.
3. Locksets and Latchsets: Ball knob, exposed surfaces of stainless steel, Grade 2.
4. Push/Pulls: Stainless steel, with beveled edges and brushed finish, size 3-1/2 inches (89 mm) by 15 inches (381 mm); stainless steel fasteners.
5. Exit Devices:
   a. Type: Conforming to UL 305; equipped with pull handle and thumb latch.
   b. Acceptable product: RIM 19-R Series.

2.04 FABRICATION

A. Fiberglass Reinforced Plastic (FRP) Doors:
1. Minimum glass fiber to resin ratio: 30 percent.
2. Mortise for lockset, and recess for strike plate in lock stile.
3. Embed steel reinforcement for hinges in fiberglass matrix; provide for hinge leaf recesses in hinge stile.

B. Fiberglass Frames:
1. Mortise for lock strike, and recess for strike plate in lock jamb.
2. Reinforce for hinges and other indicated hardware.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive work and opening dimensions and clearances are as indicated on approved shop drawings. Do not begin installation until openings have been properly prepared.

B. If opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Acclimate doors and frames to site conditions for a minimum of 24 hours before installation.

B. Do not remove labels from fire-rated doors and frames.

3.03 INSTALLATION

A. Install door opening assemblies in accordance with approved shop drawings, SDI 100, and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.

B. Use anchorage devices to securely fasten sliding door assembly to wall construction without distortion or imposed stresses.

C. Coordinate installation of thermal insulation at shim spaces at frame perimeter.

D. Installation of door hardware is specified in Section 08710.

E. Install door hardware in accordance with manufacturer's printed instructions, using through-bolts to secure surface applied hardware.

F. Site Tolerances: Maintain plumb and level tolerances specified in manufacturer's printed installation instructions.

3.04 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding, and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

3.05 CLEANING

A. Clean surfaces of door opening assemblies and sight-exposed door hardware in accordance with manufacturer's maintenance instructions.

B. Remove labels and visible markings.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.07 SCHEDULE

A. Schedules: Refer to Door Schedule indicated on drawings.

END OF SECTION 08221

SECTION 08350 – FOLDING DOORS AND GRILLES

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK

A. Extent of folding doors is indicated on schedules, drawings and/or as specified herein.
B. Related work described elsewhere:

1. Section 08719 – Sliding and Folding Door Hardware.

1.02 QUALITY ASSURANCE:

A. The material covered by these specifications shall be furnished by a certified manufacturer of proven ability who has regularly engaged in the manufacture and installation of the product.

B. Substitution of any component or modification of system shall be made only when approved by the Architect or Engineer.

C. Manufacturer's qualifications: Experienced in successfully producing fabrications similar to that indicated for this project.

D. In addition to requirements of these specifications, comply with the manufacturer's instructions and recommendations for work.

1.03 SUBMITTALS:

A. Shop Drawings: Submit fabrication and installation shop drawings for each product and process specified as work of this section. Indicate materials, construction, dimensions, locations, tolerances, connections and installation details.

B. Product data: Submit manufacturer's product data for each product and process specified as work of this section. Indicate materials, construction, dimensions, locations, tolerances, physical properties, connections and installation details.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S CONTACT:

SCHWEISS Bi-Fold Doors

P.O. Box 220, Fairfax, MN 55332
Phone: 507-426-8273, Fax: 507-426-7408, Web: www.bifold.com

2.02 MATERIALS:

Bi-Fold Doors shall be as manufactured by SCHWEISS, and of style and height indicated on drawings.

2.03 TECHNICAL INFORMATION

A1-	4	Number of Hinges	A2- 2	Number of Lift Points (Start measuring left to right)
A3-	EQUAL	Location of Lift Points	1st _____ 2nd _____ 3rd _____ 4th _____	
A4-	220-1PH	Electrical System with Up/Stop/Down Switch and Power Unit on the		

Closed Position - Weights for your bi-fold door by Schweiss:

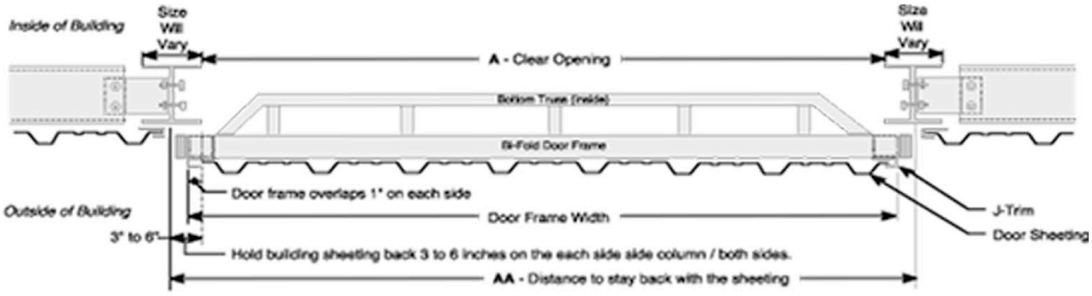
B1-	1319 lbs	Dead weight of your door (lbs.)	
B2-	160 lbs	Exterior Sheeting Weight & Trim (Lbs.)	(29ga. = .82 sq feet --26ga. = .99 per sq ft.)
B3-		Liner Sheeting Weight & Trim (Lbs.)	(29ga. = .82 sq feet --26ga. = .99 per sq ft.) / 2 If Only Bottom Half
B4-		Insulation Weight (Lbs.)	(4" Blanket = .5 sq feet --6" Blanket = .65 per sq ft.)
B5-		Optional - added accessories (lbs.)	
B6-	1479 lbs	Total Dead Weight (lbs.) (Supported by top hinges - ONLY)	

WARNING - Schweiss Manufacture 's the door based on the listed weights above. DO NOT modify the weight of the door.

B7-	3233 lbs	TOTAL WIND LOAD - (Wind Pressure x Door Height x Door Width)
B8-	1213 lbs	Wind Load transferred to each vertical column.
B9-	404 lbs	Wind Load transferred to the header angle / single hinge and bottom truss.

Open Position - Horizontal Component:
When your bi-fold door is opening or is in the wide open position, the door tends to pull away from the building at the hinge line also putting stress on each building column. Schweiss recommends (Lateral) Bracing on the door columns / header into the building. The building manufacturer / contractor / owner is responsible to insure that the buildings structural design is capable of handling all imposed loads. All materials not supplied by Schweiss are the full responsibility of others!!

C1-	1848 lbs	Total Horizontal Force.
C2-	462 lbs	Horizontal Force (lbs.) per Hinge.
C3-	924 lbs	Horizontal Force on each Column (acting at roller location when the door is wide open.)

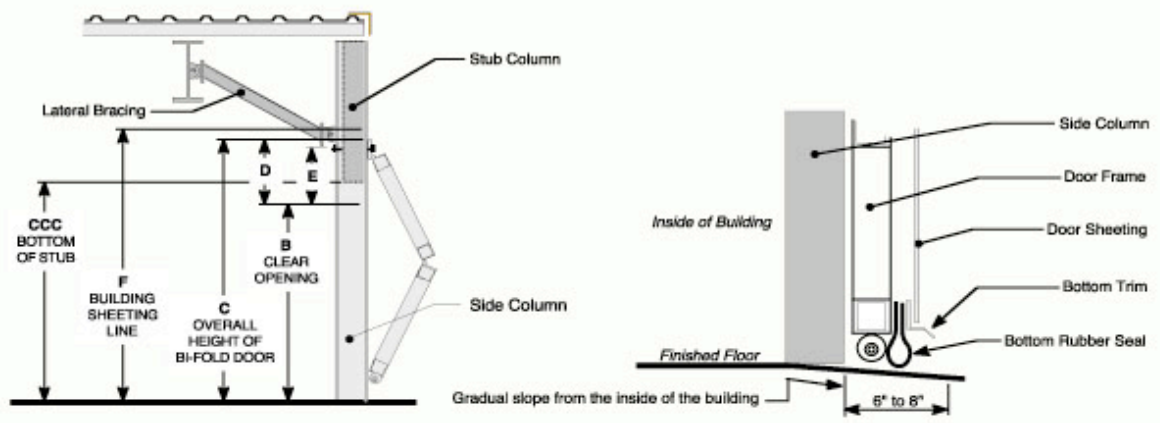


Top view

PART 3 - EXECUTION

Installation specifications

	Inches	Feet & Inches	
A-	192.00"	16'- 0.00"	Clear Opening between side columns or (steel or wood) - finished clear opening.
AA-	202.00"	16'- 10.00"	Total distance to stay back with the building sheeting on the side columns.
B-	96.00"	8'- 0.00"	Clear Opening from bottom truss to finished floor - or total height opening.
C-	120.00"	10'- 0.00"	Distance from finished floor to the very top of hinge - B + D = C.
CCC-	108.00" (Steel Only)	9'- 0.00"	When using stubs to attach your bi-fold door to - the stub columns should hang no lower than 12 inches below the C measurement.
D-	24.00"	2'- 0.00"	Distance from top of clear height to top of single hinges.
E-	23.00"	1'- 11.00"	Distance from top of clear height to center of mounting hole for single hinges.
F-	121.00"	10'- 1.00"	Distance from finished floor to the building sheeting line above the door. Hold the sheeting to this elevation from the finished floor.
H-	119.00"	9'- 11.00"	Distance from the finished floor to the center of single hinge bolt holes.



Recommended Bi-Fold Door Column Data

Building columns supporting bi-fold door lateral and torsional loads shall meet minimum L/240 deflection criteria while the door is in the open, closed or any position. The following criteria shall also be used for recommended minimum flange thickness of wide flange beam columns supporting lateral loads imposed by bi-fold doors.

Recommended Minimum Flange Thickness

0' to 46'	Door Width - Flange Thickness ≥ **3/8"**
47' to 56'	Door Width - Flange Thickness ≥ **1/2"**
57' to 66'	Door Width - Flange Thickness ≥ **5/8"**
67' to 80'	Door Width - Flange Thickness ≥ **3/4"**
81'+	Door Width - Flange Thickness ≥ **1"**

Schweiss is not responsible for the size of columns in your building.
All Materials not supplied be Schweiss are the full responsibility of others!!

Door Span - Allowable Deflection

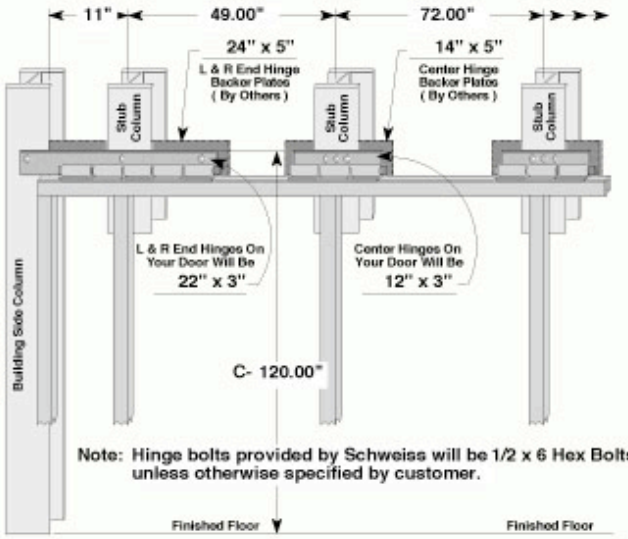
Your building header design must meet standard deflection and strength criteria, both in vertical and horizontal directions to support the bi-fold door in all positions. Make sure your building header does not bow out or away from the building.

Door Span	Allowable Deflection
0' - 50'	1"
50' - 70'	1.50"
Over 70'	2"

Attaching Bi-Fold Door To Your Building

Typical I-Beam Building Side Column With Stub Columns

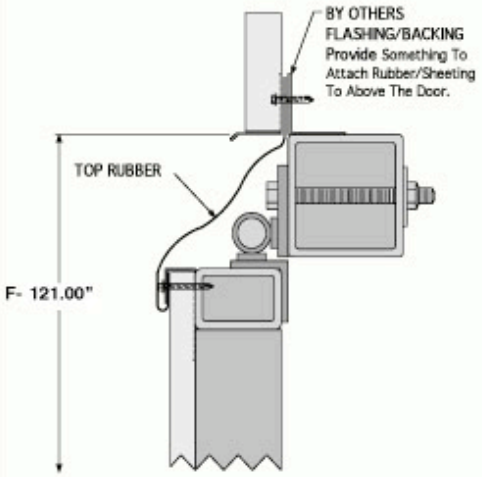
- Bolt Through Side Columns and Stub Columns.
- Hinge Backer Plate Provided By Building Manufacturer/Owner/Contractor.
- Hinge Backer Plate Thickness Determined By Building Manufacturer.
- Recommended Hinge Backer Plate Sizes - See Below...

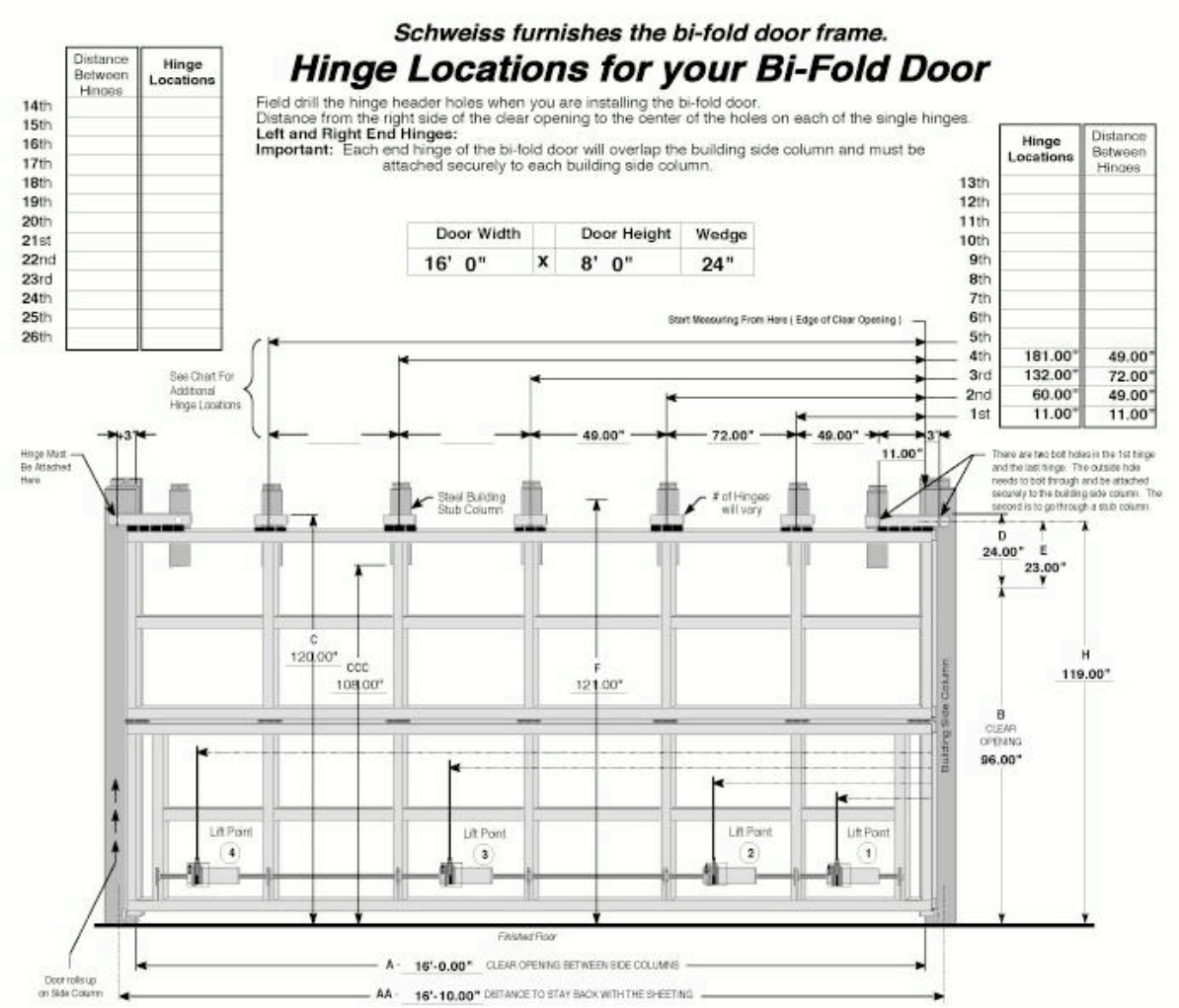


Note: Hinge bolts provided by Schweiss will be 1/2 x 6 Hex Bolts unless otherwise specified by customer.

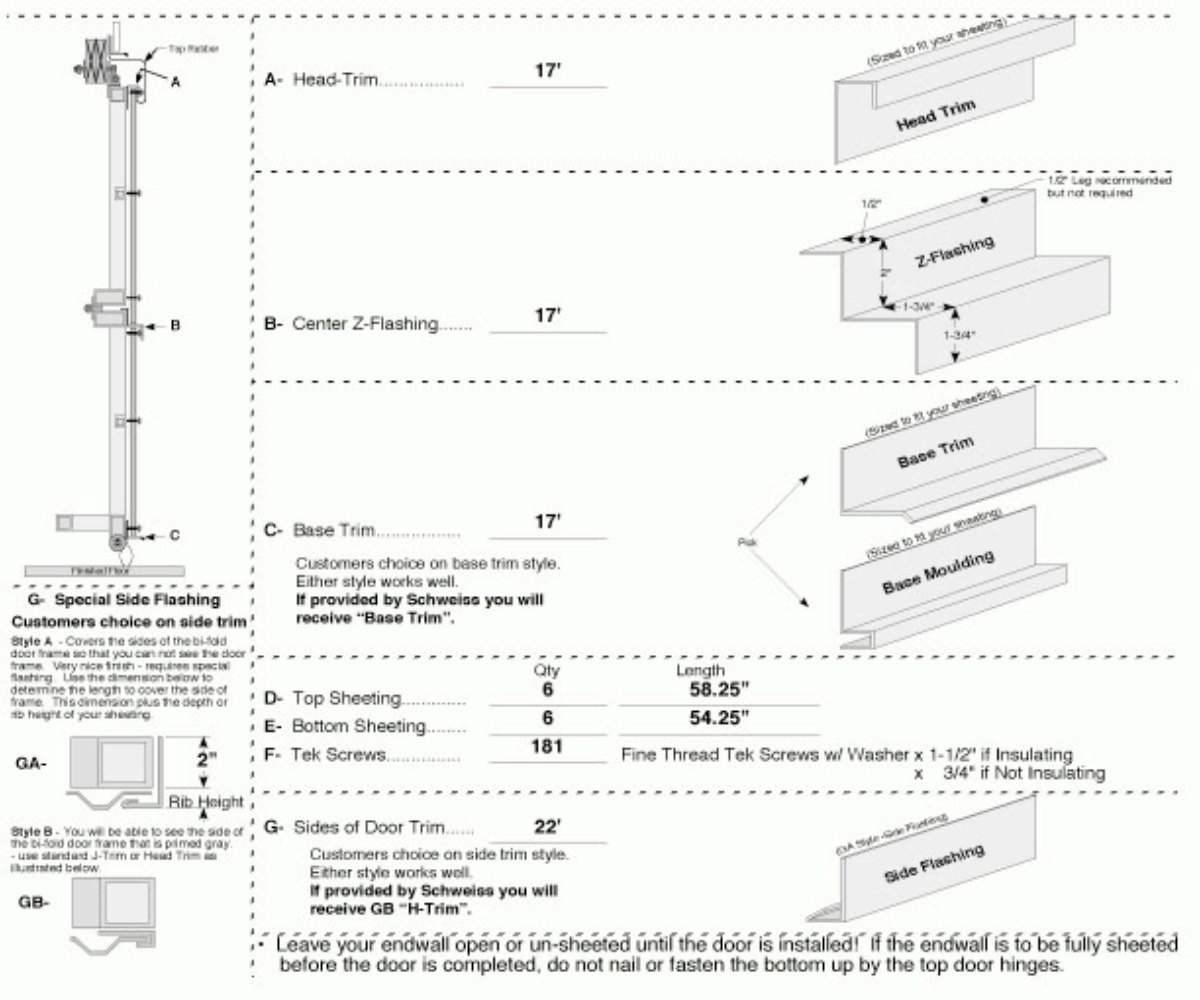
Sheeting Above Your Bi-Fold Door

- **Sheet above door at the height shown below.**
- **Provide proper backing to attach sheeting and door top rubber to at this height.**




Schweiss furnishes the bi-fold door frame.
Hinge Locations for your Bi-Fold Door
Field drill the hinge header holes when you are installing the bi-fold door.
Distance from the right side of the clear opening to the center of the holes on each of the single hinges.
Left and Right End Hinges:
Important: Each end hinge of the bi-fold door will overlap the building side column and must be attached securely to each building side column.
Distance Between Hinges
Hinge Locations
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23rd
24th
25th
26th
Door Width
Door Height
Wedge
16' 0"
X
8' 0"
24"
Start Measuring From Here (Edge of Clear Opening)
See Chart For Additional Hinge Locations
Hinge Locations
Distance Between Hinges
13th
12th
11th
10th
9th
8th
7th
6th
5th
4th 181.00" 49.00"
3rd 132.00" 72.00"
2nd 60.00" 49.00"
1st 11.00" 11.00"
3"
49.00"
72.00"
49.00"
3"
11.00"
Hinge Must Be Attached Here
Steel Building Stub Column
# of Hinges will vary
There are two bolt holes in the 1st hinge and the last hinge. The outside hole needs to bolt through and be attached securely to the building side column. The second is to go through a stub column.
D
24.00"
E
23.00"
C
120.00"
CCC
108.00"
F
121.00"
H
119.00"
B
CLEAR OPENING
96.00"
Building Side Column
Lift Point 4
Lift Point 3
Lift Point 2
Lift Point 1
Finished Floor
A - 16'-0.00" CLEAR OPENING BETWEEN SIDE COLUMNS
AA - 16'-10.00" DISTANCE TO STAY BACK WITH THE SHEETING
Door rolls up on Side Column

SHEETING AND TRIM



SECTION 08719 – SLIDING AND FOLDING DOOR HARDWARE

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 SECTION INCLUDES

A. Straight sliding doors.

B. Multiple panel, straight track folding doors.

1.2 RELATED SECTIONS

A. Section 05500 – Metal fabrication

B. Section 08120 – Aluminum Doors and Frames: Aluminum doors for sliding applications.

C. Section 08719 – Sliding and Folding Door Hardware.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Show layout, components, track mounting and support, anchorage details, and interface with adjacent construction.

D. Component Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Approved by hardware supplier.

1.5 DELIVERY, STORAGE, AND HANDLING

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

B. Store in dry, protected, well ventilated area and protect from damage.

1.6 WARRANTY

A. Provide manufacturer's two-year warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Hafele America Co., which is located at: 3901 Cheyenne Dr. P.O. Box 4000 ; Archdale, NC 27263; Toll Free Tel: 888-437-7477; Tel: 336-434-8136; Fax: 336-434-8159; Email: www.hafele.com/us/4255.asp; Web: www.hafele.com/us

B. Substitutions: Not permitted.

2.2 SLIDING AND FOLDING DOOR AND WALL HARDWARE

A. Hardware for Sliding All-Plastic Doors and Walls: Top track, single or two-wheeled trolleys with high-density nylon wheels or nylon-cladded ball bearing wheels, capacity as recommended by manufacturer for size and weight of door panels; mounting and configuration as indicated on drawings.
1. Opening and Closing Force: Not more than 5.2 pounds force (23 n) to ADA requirement certified by independent testing laboratory.
2. Plastic (3-form) Thickness: two 1/8 inch panels plus framing
3. Top Fittings: Rail full width of panel, requiring cutouts; aluminum, in finish selected by Architect from manufacturer's full range (Junior/GV, Variotec/GV).
4. Bottom Fittings: None.
5. Stops: Wall mounted rubber bumpers; track stop for each panel, with adjustable spring catch.

B. Hardware for Folding Glass Walls: Top track, four-wheeled trolleys with high-density nylon wheels, capacity as recommended by manufacturer for size and weight of door panels; mounting and configuration as indicated on drawings.
1. Suspension Point Location: One edge of each panel; panels hinged to each other; even number of panels; recessed floor guide channel.
2. Plastic (3-form) Thickness: two 1/8 inch panels plus framing.
3. Top and Bottom Fittings: Rail full width of panel, requiring cutouts; aluminum.
4. Floor Guide: Full width aluminum channel recessed in floor.
5. Provide matching mounting hardware for adjacent fixed glass panels and swing doors.
6. Lock on Leading Panel: Bottom rail mounted floor bolt with thumbturn inside.

C. Accessories: Provide all components recommended by hardware manufacturer or required to achieve a complete installation.

D. Fasteners: Provide all fasteners required, of type recommended by hardware manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until support and floor substrates have been properly completed.

B. Verify that structural supports are level and of adequate strength to support the applied loads.

C. Verify opening dimensions prior to fabrication and assembly.

D. Notify Architect of unsatisfactory conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install hardware level, plumb, sure, true and straight.

C. Adjust hardware as necessary to ensure smooth, quiet, and effortless operation and safety.

D. Clean track and hardware surfaces before hanging sliding doors.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion. Replace damaged products that cannot be repaired to original condition.

END OF SECTION 08719

SECTION 08800 - GLASS AND GLAZING

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK:

A. Extent of glass and glazing work is indicated on drawings, schedules and includes, but is not limited to:

1. Vision walls.
2. Windows.

B. Types of glass and glazing include:

1. 3/4" tempered laminated glass.
2. Glazing tape, gaskets, etc.

1.02 SYSTEM DESCRIPTION:

A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

B. Deterioration of laminated glass is defined as the development of manufacturing defects including edge separation or delamination.

C. Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic coating due to normal conditions of use.

1.02 QUALITY ASSURANCE:

A. Glazing Standards:

Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.

B. Single Source Responsibility for Glass:

To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type required.

1.03 SUBMITTALS:

A. Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.

B. Submit samples of each type of glass required. For translucent glass submit samples showing finish proposed for the Architect's approval.

1.04 DELIVERY, STORAGE, AND HANDLING:

Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials. Replace all glass that has been damaged.

1.05 WARRANTY:

Manufacturer's standard warranty, but not less than four (4) year after date of substantial completion.

PART 2 - PRODUCTS

2.01 PRODUCT SPECIFICATION:

Products specified herein refer to particular manufacturer. Equal products of other manufacturers may be submitted by the Contractor for approval by the Architect.

2.02 TEMPERED LAMINATED GLASS:

Tempered laminated glass shall be a two-ply construction consisting of with a 0.090 inch clear PVB interlayer sandwiched between a 3/8" thick Pilkington Optifloat Blue-Green tempered glass exterior pane and a 3/8" thick Pilkington Optifloat Clear tempered glass interior pane. Laminated glass shall meet the current requirements of the ASTM C 1172 "Standard Specification for Laminated Architectural Flat Glass" and shall comply with the Consumers Product Safety Commission 16 CFR 1201 and the safety glass requirement of ANSI Z 97.1. Tempered laminated glass shall be of sizes required to comply with the Contract Documents.

2.03 GLAZING:

Glazing at windows shall be polysulfide, silicone butyl rubber, unless otherwise indicated on drawings or required by the manufacturer of the windows.

2.04 PREFORMED GLAZING TAPES:

Unless otherwise indicated on drawings or required by the manufacturer of the windows, comply with:

A. Compatibility:

Select glazing sealants and tapes compatibility with other materials with which they will come into contact, including glass products and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

B. Suitability:

Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated.

C. Preformed Butyl-Polyisobutylene Glazing Tape:

Provide manufacturer's standard solvent-free butyl-polyisobutylene formulation with a solid content of 100 percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

2.05 GLAZING GASKETS:

Unless otherwise indicated on drawings or required by the manufacturer of the windows, comply with:

A. Lock-Strip Gaskets:

Neoprene extrusions of size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542; black.

B. Dense Elastomeric Compression Seal Gaskets:

Molded or extruded gaskets of material indicated below, complying with ASTM C 864, of profile and hardness required to maintain watertight seal:

1. Neoprene.
2. EPDM.
3. Thermoplastic polyolefin rubber.

2.06 MISCELLANEOUS GLAZING MATERIALS:

Unless otherwise indicated on drawings or required by the manufacturer of the windows, storefronts and entrances, comply with:

A. Compatibility:

Provide materials with proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers:

Type recommended by sealant or gasket manufacturer.

C. Setting Blocks:

Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

D. Spacers:

Neoprene, EPDM or silicone blocks or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application.

E. Edge Blocks:

Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement of glass.

F. Compressible Filler Rods:

Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3 - EXECUTION

3.01 EXAMINATION:

Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION:

Clean glazing channels and other framing members to receive glass immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

3.03 GENERAL:

A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

C. Apply primers to joint surfaces where required for adhesion of sealants.

D. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to

prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.

3.04 GLAZING:

A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.

B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.

D. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

E. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.

F. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

G. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.

I. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by manufacturer.

3.05 REPLACEMENT AND CLEANING:

A. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

B. Wash glass on both faces not more than one (1) week prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

END OF SECTION 08800

SECTION 08950 - INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL SYSTEM

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this section.

1.01 SUMMARY

A. Section includes the insulated translucent sandwich panel system as shown and specified. Work includes providing and installing:

1. Flat (curved) factory prefabricated structural insulated translucent sandwich panels.
2. Aluminum installation system.
3. Aluminum sill flashing.

1.02 SUBMITTALS

A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of components.

B. Submit shop drawings. Include elevations, details, dimensions and attachments to other work.

C. Submit manufacturer's color charts showing the full range of colors available for factory finished aluminum.

1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.
   a. Sandwich panels: 14" x 28" units
   b. Factory finished aluminum: 5" long sections

D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

E. Submit product test reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Test reports required are:
   a. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
   b. Burn Extent (ASTM D-635)
   c. Color Difference (ASTM D-2244)
   d. Abrasion/Erosion Resistance (ASTM D-4060)
   e. Impact Strength (UL 972)
   f. Bond Tensile Strength (ASTM C-297 after aging by ASTM D-1037)
   g. Bond Shear Strength (ASTM D-1002)
   h. Beam Bending Strength (ASTM E-72)
   i. Insulation U-Factor (NFRC-100)

j. NFRC System Certification
k. Condensation Resistance Factor (AAMA 1503)
l. Class 1 Fire Approval (FM 4881) (Optional)
m. Blast Analysis and Testing of Translucent Sandwich Panels Demonstrating Equivalent Performance to 1/4" Laminated Glass per DoD UFC 4-010-01.

F. Submit current documentation indicating regular, independent quality control monitoring under a nationally recognized building code review and listing program.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten (10) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been in successful use for ten (10) years or longer.
2. Panel system must be listed by the International Code Council – Evaluation Service (ICC-ES) which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an approved agency.
3. Quality control inspections and required testing shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with "Acceptance Criteria for Sandwich Panels" as regulated by the ICC-ES.

B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

C. Performance Requirements: The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.

1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver panel system, components and materials in manufacturer's standard protective packaging.

B. Store panels on the long edge, several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.05 WARRANTY

A. Submit manufacturer's and installer's written warranty agreeing to repair or replace panel system work which fails in materials or workmanship within one (1) year of the date of delivery. Failure of materials or workmanship shall include leakage, excessive deflection, deterioration of finish on metal in excess of normal weathering and defects in accessories, insulated translucent sandwich panels and other components of the work. (Contact local representative for extended warranty periods.)

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Kalwall Corporation, tel: (800) 258-9777 – fax: (603) 627-7905 – email: info@kalwall.com

2.02 PANEL COMPONENTS

A. Face Sheets

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
   a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
2. Flammability of interior face sheets:
   a. Flamespread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flamespread rating no greater than 50 (20) and smoke developed no greater than 250 (200) when tested in accordance with UL 723.
   b. Burn extent by ASTM D-635 shall be no greater than 1".
   c. Face sheets shall not deform, deflect or drip when subjected to fire or flame.
   d. Face sheets shall not delaminate when exposed to 200°F for 30 minutes per IBC and NBC (300°F for 25 minutes per UBC and SBC).
3. Weatherability of exterior face sheets:
   a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3.0 CIE Units DELTA E by ASTM D-2244 after 5 years outdoor South Florida weathering at 5 degrees facing south, determined by the average of at least three (3) white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
   b. Erosion barrier: Exterior face shall have a permanent glass erosion barrier embedded beneath the surface to provide long-term resistance to reinforcing fiber exposure. Exterior face surface loss shall not exceed .7 mils and 40 mgs when tested in accordance with ASTM D-4060 employing CS17 abrasive wheels at a head load of 500 grams for 1000 cycles. Sacrificial surface films or coatings are not acceptable erosion barriers.
4. Appearance:
   a. Exterior face sheets: Smooth, 0.070" thick and Crystal-SW in color.
   b. Interior face sheets: Smooth, 0.045" thick and White S-171 in color.
   c. Face sheets shall not vary more than +/- 10% in thickness and be uniform in color.
5. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact equal to 70 (230) ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.

B. Grid Core

1. Thermally broken (aluminum) I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I- beam shall be no less than 7/16". The I-beam grid shall be machined to tolerances of not greater than +/- .002".
2. Thermal break: Minimum 1".

C. Laminate Adhesive

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives."
2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C-297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D-1037.
3. Minimum shear strength of the panel adhesive by ASTM D-1002 after exposure to five (5) separate conditions:
   a. 50% Relative Humidity at 73° F: 540 PSI
   b. 182° F: 100 PSI
   c. Accelerated Aging by ASTM D-1037 at room temperature: 800 PSI
   d. Accelerated Aging by ASTM D-1037 at 182° F: 250 PSI
   e. 500 Hour Oxygen Bomb by ASTM D-572: 1400 PSI

2.03 PANEL CONSTRUCTION

A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking thermally broken (aluminum) I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat sharp edge.

1. Thickness: 2-3/4"
2. Light transmission: 15%.
3. Solar heat gain coefficient: 0.15.
4. U-factor by NFRC certified laboratory:
   a. Complete insulated panel system shall have NFRC certified U-factor of .05.
5. Grid pattern: Nominal 12" x 24" (8" x 20", 12" x 12", other) shoji (reverse shoji, square, staggered).

B. Panels shall deflect no more than 1.9" at 30 psf in 10'-0" span without a supporting frame by ASTM E-72.

C. Panels shall withstand 1200ºF fire for minimum one (1) hour without collapse or exterior flaming.

D. Thermally broken panels:

1. Minimum Condensation Resistance Factor of 80 by AAMA 1503 measured on the bond line.
2. Minimum CRF of 90 at center of grid cell.

E. Panel system shall be a Factory Mutual (FM) tested and approved Class 1 wall system in accordance with FM 4881.

F. Panels shall demonstrate performance equivalent to 1/4" laminated glass under blast loading as specified in the DoD UFC 4-010-01.

2.04 BATTENS AND PERIMETER CLOSURE SYSTEM

A. Closure system: Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.

1. Thermally broken perimeter system shall have a urethane bridge.

2. Perimeter system shall be factory prefabricated “Superbreak” as shown on drawings.
3. Curved closure system may be roll formed.

B. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.

C. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.

D. Finish: Exposed aluminum to be manufacturer’s factory applied finish that meets the performance requirements of AAMA 2604. (Mill)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, supporting structure and installation conditions. Do not proceed with panel erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.03 INSTALLATION

A. Install the panel system in accordance with the manufacturer's installation recommendations and approved shop drawings.

1. Anchor component parts securely in place by permanent mechanical attachment system.
2. Accommodate thermal and mechanical movements.
3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's installation instructions.

3.04 CLEANING

A. Clean the panel system inside and outside, immediately after installation, according to manufacturer's written recommendations.

END OF SECTION 08950

SECTION 09250 - GYPSUM BOARD CONSTRUCTION

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01 DESCRIPTION OF WORK

A.Extent of gypsum board (also referred to as drywall) construction is indicated on drawings, and as specified herein.

B.Types of gypsum board construction include interior walls, ceilings and fascias, screw-attached to steel stud framing members.

1.02 REFERENCES:

The following standards apply to the work in this section, and by reference are hereby made a part of these specifications:

A.ASTM C754 and ASTM C840 for installation of gypsum board ceilings and walls.

B.Gypsum Construction Handbook, 90th Edition.

1.03 QUALITY ASSURANCE:

A.Single Source Responsibility:

Except as otherwise required, obtain gypsum board, framing components, trim accessories and related joint treatment materials from a single manufacturer.

B.Qualifications of Installers:

For the actual installation of gypsum board walls, ceilings and fascias, use only personnel who are thoroughly trained and experienced in the skills and codes required for this work.

C.Fire-Resistance Ratings:

Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

D.Coordination of Work:

Coordinate installation of gypsum board with other work supported by, or penetrating through, ceilings, including light fixtures and HVAC equipment.

1.04 SUBMITTALS:

A.Product Data:

Submit manufacturer's product data for each type of product specified herein. Include copy of manufacturer's current method of installation for each product.

B.Shop Drawings:

Submit shop drawings prepared by Installer for installation purposes, drawn accurately to scale and coordinated with related mechanical, electrical and other work above, penetrating, or connected to ceiling. Show ceiling suspension members, method of anchorage to building structure of hangers, and ceiling-mounted work including light fixtures, diffusers, grilles and special moldings. Drawing scale shall be 1/4" = 1'-0".

1.05 DELIVERY, STORAGE, AND HANDLING:

A.Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B.Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion and other causes. Neatly stack gypsum boards flat to prevent sagging.

C.Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.06 PROJECT CONDITIONS:

Establish and maintain environmental conditions for application and finishing gypsum board to comply with gypsum board manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 PRODUCT SPECIFICATION:

Products specified herein refer to particular manufacturers. Equal products of other manufacturers may be submitted by the Contractor to the Architect for approval.

2.02 GYPSUM BOARD PANELS:

Gypsum board panels shall be US Gypsum Company 5/8" Type X, fire rated, water resistant and, unless otherwise indicated, shall be provided in maximum lengths available to minimize end-to-end joints

2.03 FRAMING COMPONENTS FOR CEILINGS:

A.General:

Ceilings shall have a steel stud framing system and shall comply with ASTM C754 for materials and sizes, and with design requirements established in the drawings and as herein specified.

B.Frame Spacing:

Unless more stringent requirements are recommended to comply with design requirements, steel studs and runners spacing shall be 16" on center.

C.Hanger Wire:

Shall be Unimast Hanger Wire meeting ASTM A641, Class 1 zinc coating, soft temper, 8 gauge, spacing to comply with design requirements.

D.Concrete Inserts:

Inserts designed for attachment to concrete forms and for embedment in concrete, fabricated from corrosion resistant materials, with holes or loops for attachment of hanger wires and capability to sustain, without failure, a load equal to 3 times that imposed by ceiling construction.

2.05 FRAMING FOR WALLS AND PARTITIONS:

A.General:

Steel framing shall comply with ASTM C754 for materials and sizes, and with design requirements established in the drawings and specifications.

B.Frame Spacing:

Unless more stringent requirements are recommended to comply with design requirements, wall steel studs and runners spacing shall be 16" on center.

2.06 SOUND ATTENUATION (INSULATION) PRODUCTS:

Sound attenuation (insulation) blanket shall be equal to Thermafiber 3" SAFB, and shall be provided at walls and ceilings as required in the drawings.

2.07 FASTENERS:

A.Complying with the recommendations of gypsum manufacturers for applications indicated and ASTM C840.

B.Provide screw type fasteners of type, material, size, corrosion resistance, holding power and other properties required to fasten steel framing members securely to substrates and to obtain structural requirements specified in the Structural Drawings and Specifications

2.08 TRIM ACCESSORIES:

Provide corner reinforcements and other trim accessories as manufactured by Unimast for all corner conditions, and install in strict compliance with manufacturer's installation instruction.

2.09 GYPSUM BOARD JOINT TREATMENT MATERIALS:

A.General:

Provide materials complying with ASTM C475, ASTM C840, and recommendations of manufacturer of gypsum board and joint treatment materials for the application indicated.

B.Joint Tape:

Paper reinforcing tape, unless otherwise indicated.

C.Joint Compounds:

Installer has the option of using the setting type or drying type joint compounds, as follows:

1.Setting-Type Joint Compounds:

Factory-prepackaged, job-mixed, chemical-hardening powder products formulated for uses indicated.

2.Drying-Type Joint Compounds:

Factory-prepackaged and premixed vinyl-based products formulated for intended use.

2.10 MISCELLANEOUS MATERIALS:

Miscellaneous materials shall be supplied and installed in strict compliance with manufacturer's installation instruction to obtain the performance specified.

PART 3 - EXECUTION

3.01 EXAMINATION:

Examine substrates to which gypsum board construction attaches or abuts, preset cast-in-anchors and structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF STEEL FRAMING, GENERAL:

A.Install steel framing to comply with structural design requirements, ASTM C754 and with ASTM C840 requirements that apply to framing installation.

B.Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, furnishings and similar construction to comply with details indicated and with

recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook".

C.Unless otherwise required in details or to comply with manufacturer's installation recommendations, isolate framing from building structure to prevent transfer of loading imposed by structural movement as follows:

1.Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetration of structural elements.

2.Where partition and wall framing abuts overhead structure.

3.Provide slip or cushioned type joints as detailed to attain lateral support and avoid axial loading.

D.Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

3.03 INSTALLATION OF FRAMING FOR CEILINGS:

A.Ceiling Anchorages:

1.Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

2.Furnish concrete inserts and other devices indicated, to other trades for installation well in advance of time needed for coordination with other construction.

B.Hangers (Wire and Channels):

Framing system shall be supported with channels and hires, and shall comply with:

1.Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to cast-in concrete inserts or other anchorage devices or fasteners as indicated.

2.Do not attach hangers to underside of concrete slabs with powder-actuated fasteners.

3.Do not connect or suspend steel framing from ducts, pipes or conduit.

4.Keep hangers and braces 2 inches clear of ducts, pipes and conduits.

5.Where hangers attach to channels, reinforce with 12" long stud section secured with two (2) screws.

C.Install suspended steel framing components in sizes and at spacings required to comply with structural requirements, or referenced steel framing installation standard, but not less than:

1.Hangers: 4 ft. on center and 6" of walls.
2.Carrying Channels: 4 ft. on center and 6" of walls.
3.Furring Channels: 16" on center and 3" of walls.

D.Installation Tolerances:

Install steel framing components for suspended ceilings so that cross furring members or grid suspension members are level to within 1/8 inch in 12 ft. as measured both lengthwise on each member and transversely between parallel members.

E.Wire-tie or clip furring members to main runners and to other structural supports.

3.04 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS:

A.Install runners at floors and ceilings where gypsum drywall stud system abuts other construction, or as recommended in standards specified.

B.Install each steel framing and furring member so that fastening surface do not vary more than 1/8" from plane of faces of adjacent framing.

C.Install steel studs and furring in sizes and at spacings indicated to comply with structural design requirements, but not less than 16" on center on exterior walls and 24" on interior partitions.

D.Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings, and frame around ducts penetrating partitions above ceiling.

E.Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.

F.Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section at head and secure to jamb studs.

G.Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

H.Frame openings other than door openings to comply with details indicated, or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

I.Install and finish gypsum board to comply with ASTM C840.

3.05 METHODS OF GYPSUM BOARD APPLICATION:

A.Install gypsum board in accordance with referenced specifications and manufacturer's recommendations.

B.Install gypsum board vertically and provide sheet lengths which will minimize end joints.

3.06 INSTALLATION OF GYPSUM BOARD TRIM ACCESSORIES:

A.Install trim accessories in accordance with referenced specifications and manufacturer's recommendations.

B.Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type

with face flange to receive joint compound.

D.Install metal corner beads at external corners and as otherwise indicated on details.

D.Install edge trim where indicated on wall panels at juncture with ceilings.

E.Install bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

F.Install bead where substrate is kerfed to receive long flange of trim.

G.Install bead where edge trim can only be installed after gypsum board is installed.

H.Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).

3.07 FINISHING OF GYPSUM BOARD:

A.Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B.Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.

C.Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

D.Finish interior gypsum wallboard by applying read-mix type joint compounds, minimum of 3 coats, and sand between coats and after last coat.

E.Finish exterior gypsum soffit board by using setting-type joint compounds to prefill joints, embed tape, and to apply first, fill (second) and finish (third) coats; smooth each coat before joint compound hardens to minimize need for sanding; sand between coats and after finish coat.

F.Paint or apply other finish material specified.

G.Water-resistant gypsum backing board base for ceramic rile shall comply with ASTM C 840 and manufacturer's recommendations for treatment of joints behind tile.

3.08 PROTECTION:

Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION 09250

SECTION 09290 - GLASS REINFORCED CONCRETE (GRC) UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

Drawing and General provisions of Contract, including General Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.02 SUMMARY

A. This section covers all labor, material, accessories, scaffolding and appliances necessary for the complete installation of glass reinforced concrete units. Items not mentioned specifically here, which are necessary to make a complete installation shall also be included.

1.03 SUBMITTALS

A. Shop Drawings: Submit fabrication and installation shop drawings for each product and process specified as work of this section. Indicate materials, construction, dimensions, locations, tolerances, connections and installation details.

B. Product data: Submit manufacturer’s product data for each product and process specified as work of this section. Indicate materials, construction, dimensions, locations, tolerances, physical properties, connections and installation details.

1.04 QUALITY ASSURANCE

A. Manufacturer's qualifications: Minimum of five years experience in the actual production of Glass Reinforced Concrete.

B. Installer's qualifications: Minimum of five years experience in installation of systems of similar complexity to those specified for this project.

1.05 SUBSTITUTIONS

Manufacturers desiring to furnish material other than specified shall submit to the architect, at least 10 working days prior to bid date, all product data as listed above (including copies of all tests and certifications), a 12 x 12 product sample, proof of least five years of GRC product manufacturing experience, and a list of five completed projects with similar product application and size.

1.06 DELIVERY AND STORAGE

A. Reinforced concrete units shall be crated in wooden crates, suitably designed for the specific product. The units shall be cushioned and blocked as necessary, to reduce the susceptibility to freight damage. All crates shall bear the manufacturer's name and a stamp indicating they have been inspected and checked by the Quality Assurance Department. The material is to be warranted against deviation from the shop drawings, by the manufacturer until removed from the crates.

Reinforced concrete units shall be stored on the job in a level area in the manufacturer's crates unit ready for use.

1.07 WARRANTY

A. Submit at the time of the shop drawings, the manufacturer's warranty that the materials furnished herein will not warp or sag for a period of one (1) year when installed in conformance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURER

INNOVATIVE BUILDING SYSTEMS

Caoba 35, San Juan, Puerto Rico 00913 tel: 787-748-4244, fax: 787-293-2613

2.02 MATERIALS: REINFORCED CONCRETE UNITS

A. Shall be IBS pre-fabricated glass reinforced concrete units using multi- directional unlayered spray lay-up procedure. The GRC shall be made from Type III Portland Cement, washed and dried silica sand, potable water, alkali resistant glass fibers complying with PCI-MNL 128, and curing additives.

B. TOLERANCES (FABRICATION)

Shell Thickness: ¼" - 0"/+ ¼"

Dimensional: ± 1/8" per part

Warpage and Bow: ± 1/8" per part

C. PHYSICAL PROPERTIES

Unit Weight (Weight Per Volume): 123.9 lb/ft^3

Compressive Strength (ASTM C39/C109): 9510 psi

Flexural Strength (ASTM C580): 3790 psi

Flexural Strength (MOR) (ASTM C947): +1900 psi

Flexural Strength (PEL) (ASTM C947): +800 psi

Tensile Strength (ASTM D638): 1350 psi

Impact Resistance (IZOD): 9.86 ft-lbs/in^2

Rockwell Hardness (ASTM 785): 57.6

Fuel Contributed (ASTM E84): Zero

Flame Spread (ASTM E84): Zero

Smoke Developed (ASTM E84): Zero

2.03 FABRICATION:

A. Moulds for the reinforced concrete units shall be rigid and constructed of materials that will result in smooth, finished products conforming to profiles and dimensions indicated on the shop drawings.

B. Portland cement, sand, water, chemical admixtures (water reducers, latex bonding agents, accelerators) shall be metered by electronic measuring instruments to insure the highest consistency of the batch mix ingredients. The actual batch mixing process in the creation of the concrete slurry shall be timed to manufacturer's prescribed formulations.

C. Meter glass fiber and concrete slurry rates at spray head to achieve desired mix proportion and glass content. Check in accordance with the standard procedures recommended by PCI-MNL-128.

D. Machine spray in accordance with the manufacturer's standards for multi-directional, chopped fibers.

E. Carefully remove units from moulds and factory repair hollows, voids, scratches, or other surface imperfections. Surface shall be primer ready.

F. Each reinforced concrete unit shall bear a stamp indicating it has been inspected and approved by the manufacturer's Quality Assurance inspector.

2.04 JOINT TREATMENT MATERIALS

A. Monolithic Joints: The monolithic joint shall be finished with joint compound. The joint compound shall be a latex modied cement, tested in accordance with ASTM C900. The bond strength shall exceed 140 psi when tested on the manufacturer's GRC units. **WATER SOLUBLE OR OTHER JOINT FILLERS CAN NOT BE USED**. Should small surface voids require filling, use Synkaloid Exterior spackle.

B. Caulk Joints: See caulking manufacturer's instructions for joint preparation and caulking applications.

2.05 PAINT

A. Primer: The GRC shall be primed by the painting contractor prior to applying the finish coat. The primer will meet the following test requirements established for the coating: Freeze / Thaw Adhesion: ASTM D 3359/2246 - A minimum rating of 4A after 10 cycles shall be required. (The test will demonstrate these adhesion characteristics on both the Glass Reinforced Concrete, and the joint compound.) Sand all surfaces to be primed using a medium grit sandpaper. Blow off all dust with compressed air. Surface should be clean, dry, and free of contaminants. One coat of primer shall be applied to the entire GRC part using a 3/8" nap roller at a spreading rate of 200 square feet per gallon. The primer shall be allowed to cure 12 hours at 75 degrees F. prior to top coating.

B. Top Coating: Finish coating will be applied by the painting contractor, and will be an emulsified acrylic, latex, or water-based epoxy.

2.06 RELATED MATERIALS

A. Fasteners: Bit clips, self drilling, self tapping Tapcon screws, Durock self taping screws.

B. Adhesives: Solvent base construction adhesives: PL Premium PL 400

C. Joint Tape: 2" wide 6 ga. 10 x 10 Leno scrim (Alkali-Resistant) tape

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PART 3 - EXECUTION

3.01 INSPECTION

A. Inspection areas directly adjacent to planned installation for conditions that will prevent proper installation of reinforced concrete units.

B. Inspect parts from crates for variations from dimensions and tolerances shown on the manufacturer's shop drawings. Report any discrepancy to the manufacturer before proceeding.

3.02 INSTALLATION

A. Install reinforced concrete units true, plumb, and level in accordance with the manufacturer's printed installation instructions, and shop drawings.

B. Dead air spaces must by vented.

END OF SECTION 09290

SECTION 09911- EXTERIOR FINISHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A Exterior paints and coatings systems including; paints, stains, transparent coatings, and opaque finishes

1.02 RELATED SECTIONS

A Section 06125- Wood Decking

B Section 06500- Structural Plastics

1.03 REFERENCES

A SSPC-SP 1 - Solvent Cleaning

B SSPC-SP 2 - Hand Tool Cleaning

C SSPC-SP 3 - Power Tool Cleaning

D SSPC-SP 13 / NACE No. 6 Surface Preparation for Concrete

E EPA-Method 24

F OTC-Regulation No. 41

1.04 SUBMITTALS

A. Submit under provisions of Section 01300, Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each paint and coating product should include:

1 Product characteristics
2 Surface preparation instructions and recommendations
3 Primer requirements and finish specification
4 Storage and handling requirements and recommendations
5 Application methods
6 Cautions

C. Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer's color samples available.

D. Verification Samples: For each finish product specified, submit samples that represent actual product, color, and sheen.

1.05 MOCK-UP

Include a mock-up if the project size and/or quality warrant taking such a precaution. The following is one example of how a mock-up on a large project might be specified. When deciding on the extent of the mock-up, consider all the major different types of painting on the project.

A. Finish surfaces for verification of products, colors, & sheens
B. Finish area designated by Architect
C. Provide samples that designate prime & finish coats
D. Do not proceed with remaining work until the Architect approves the mock-up samples

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information:

1 Product name, and type (description)
2 Application & use instructions
3 Surface preparation
4 VOC content
5 Environmental issues
6 Batch date
7 Color number

B. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

C. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not apply coatings under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A Acceptable Manufacturer:
The Sherwin-Williams Company
101 Prospect Avenue NW
Cleveland, OH 44115
Tel: (800) 321-8194
Fax: (216) 566-1392
www.sherwin-williams.com

B Substitutions: Requests for substitutions will be considered in accordance with provisions of Section 016000 Product Requirements.
When submitting request for substitution, provide complete product data specified above under Submittals, for each substitute product.

2.02 APPLICATIONS/ SCOPE

A Use this article to define the scope of painting if not fully defined in a Finish Schedule or on the drawings. This article must be carefully edited to reflect the surfaces actually found on the project. In some cases, it may be enough to use the first paragraph that says, in effect, "paint everything" along with a list of items not to paint, without exhaustively defining all the different surfaces and items that must be painted.

B If the project involves repainting some but not all existing painted surfaces, be sure to indicate the extent of the repainting.

C The descriptions of each system can also be used to further refine the definition of what is to be painted, stained, or clear finished.

D Surfaces To Be Coated:

Wood: Decks
Architectural: Fiberglass

2.03 SCHEDULE

A. Wood Decks, Exterior (including pressure treated lumber)

1. Transparent-Waterborne Alkyd

a. Flat Finish
1st Coat: S-W DeckScapes™ Ext. Waterborne Clear Stain, A15T260
2nd Coat: S-W DeckScapes™ Ext. Waterborne Clear Stain, A15T260
(150-300 sq ft/gal)

B. Architectural Fiberglass (test for adhesion)

1. Latex System

a. Flat Finish
1st Coat: S-W DTM Acrylic Primer/Finish, B66W1
(6 mils wet, 3 mils dry)
2nd Coat: S-W Duration® Exterior Latex Acrylic Flat Coating, K32 Series
(7 mils wet, 2.8 mils dry per coat)

1st Coat: S-W DTM Acrylic Primer/Finish, B66W1
(6 mils wet, 3 mils dry)
2nd Coat: S-W A-100® Exterior Latex Flat, A6 Series
3rd Coat: S-W A-100® Exterior Latex Flat, A6 Series
(4 mils wet, 1.4 mils dry per coat)

2.04 MATERIALS - GENERAL REQUIREMENTS

A. Paints and Coatings - General:
   1 Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
   2 For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.

B. Primers:
   1 Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

2.05 ACCESSORIES:

A Coating Application Accessories:
   1 Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer’s specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

A Do not begin application of coatings until substrates have been properly prepared. Notify Architect of unsatisfactory conditions before proceeding.

B If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C Proceed with work only after conditions have been corrected, and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.

3.02 SURFACE PREPARATION

A Proper product selection, surface preparation, and application affect coating performance. Coating integrity and service life will be reduced because of improperly prepared surfaces. Selection and implementation of proper surface preparation ensures coating adhesion to the substrate and prolongs the service life of the coating system.

B Selection of the proper method of surface preparation depends on the substrate, the environment, and the expected service life of the coating system. Economics, surface contamination, and the effect on the substrate will also influence the selection of surface preparation methods.

C The surface must be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.

D Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry 48 hours before painting. Wear protective glasses

or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.

E. No exterior painting should be done immediately after a rain, during foggy weather, when rain is predicted, or when the temperature is below 50°F, unless products are designed specifically for these conditions. On large expanses of metal siding, the air, surface and material temperatures must be 50°F or higher to use low temperature products.

F Methods:

1 Wood—Exterior
Must be clean and dry. Prime and paint as soon as possible. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.

2 Vinyl Siding, Architectural Plastics, and Fiberglass
Clean thoroughly by scrubbing with a warm, soapy water solution. Rinse thoroughly. Do not paint vinyl siding with any color darker than the original color, unless the product and color are designed for such use. Painting with darker colors may cause siding to warp.

WARNING! Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

3.03 INSTALLATION

A Apply all coatings and materials with manufacture specifications in mind. Mix and thin coatings according to manufacturer's recommendation.

B Do not apply to wet or damp surfaces.

1 Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days.
2 Test new concrete for moisture content.
3 Wait until wood is fully dry after rain or morning fog or dew.

C Apply coatings using methods recommended by manufacturer.

D Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.

E Apply coatings at spreading rate required to achieve the manufacturer's recommended dry film thickness.

F Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G Exterior Woodwork: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 2 weeks.

H Inspection: The coated surface must be inspected and approved by the Architect or Engineer just prior to each coat.

3.04 PROTECTION

A Protect finished coatings from damage until completion of project.

B Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION 09911

SECTION 09912- INTERIOR FINISHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A Interior paint and coatings systems including; paint, stains, transparent coatings, and opaque finishes.

1.02 RELATED SECTIONS

A Section 06400 - Architectural Millwork

B Section 09250- Gypsum Board Construction

C Section 09930- Interior wood

1.03 REFERENCES

A SSPC-SP 1 - Solvent Cleaning

B SSPC-SP 2 - Hand Tool Cleaning

C SSPC-SP 3 - Power Tool Cleaning

D SSPC-SP 13 / NACE No. 6 Surface Preparation for Concrete

E EPA-Method 24

1.04 SUBMITTALS

A Submit under provisions of Section 01300, Submittal Procedures.

B Product Data: Manufacturer's data sheets on each paint and coating product should include:

1 Product characteristics
2 Surface preparation instructions and recommendations
3 Primer requirements and finish specification
4 Storage and handling requirements and recommendations
5 Application methods
6 Cautions

C Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer’s color samples available.

D Verification Samples: For each finish product specified, submit samples that represent actual product, color, and sheen.

1.05 MOCK-UP

Include a mock-up if the project size and/or quality warrant taking such a precaution. The following is one example of how a mock-up on a large project might be specified. When deciding on the extent of the mock-up, consider all the major different types of painting on the project.

A Finish surfaces for verification of products, colors, & sheens
B Finish area designated by Architect
C Provide samples that designate prime & finish coats
D Do not proceed with remaining work until the Architect approves the mock-up samples

1.06 DELIVERY, STORAGE, AND HANDLING

A Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information:

1 Product name, and type (description)
2 Application & use instructions
3 Surface preparation
4 VOC content
5 Environmental issues
6 Batch date
7 Color number

B Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

C Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.07 PROJECT CONDITIONS

A Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not apply coatings under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A Acceptable Manufacturer:
The Sherwin-Williams Company
101 Prospect Avenue NW
Cleveland, OH 44115
Tel: (800) 321-8194
Fax: (216) 566-1392
www.sherwin-williams.com

B Substitutions: Requests for substitutions will be considered in accordance with provisions of Section 016000 Product Requirements.

When submitting request for substitution, provide complete product data specified above under Submittals, for each substitute product.

2.02 APPLICATIONS/SCOPE

A Use this article to define the scope of painting if not fully defined in a Finish Schedule or on the drawings. This article must be carefully edited to reflect the surfaces actually found on the project. In some cases, it may be enough to use the first paragraph that says, in effect, "paint everything" along with a list of items not to paint, without exhaustively defining all the different surfaces and items that must be painted.

B If the project involves repainting some but not all existing painted surfaces, be sure to indicated the extent of the repainting.

C The descriptions of each system can also be used to further refine the definition of what is to be painted, stained, or clear finished.

D Surfaces To Be Coated:

Wood - Walls, Ceilings, Doors, Trim, Cabinet Work, etc.
Wood - Floors-Painted, Stained, Varnished
Drywall- Walls, Ceilings, Gypsum Board, Wood Pulp Board, Plaster Board, etc

2.03 SCHEDULE

A. WOOD- (Walls, Ceilings, Doors, Trim, Cabinet Work, Partitions, Frames [Including Oak, Birch, Poplar, Southern Pine, Douglas Fir, Cedar, Redwood,])

1. Epoxy System (Water Base & Varnished)
   a. Gloss Finish
      1st Coat: S-W PrepRite® Wall & Wood Oil Primer/Undercoater, B49 (4 mils wet, 2 mils dry)
      2nd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V15 Series
      3rd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V15 Series (2.5-3 mils dry per coat)

   b. Semi-Gloss Finish
      1st Coat: S-W PrepRite® Wall & Wood Oil Primer/Undercoater, B49 (4 mils wet, 2 mils dry)
      2nd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V25 Series
      3rd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V25 Series (2.5-3 mils dry per coat)

B. WOOD (Floors-Painted, Stained, Varnished)

1. Acrylic System
   a. Semi-Gloss Finish
      1st Coat: S-W ArmorSeal® Tread-Plex Primer, B90W110 (4.7 mils wet, 2 mils dry)
      2nd Coat: S-W ArmorSeal® Tread-Plex Floor Coating, B90 Series
      3rd Coat: S-W ArmorSeal® Tread-Plex Floor Coating, B90 Series (1.5-2 mils dry per coat)
2. Styrenated Acrylic System

a. Gloss Finish
1st Coat: S-W High Performance Floor Enamel, A32 Series
2nd Coat: S-W High Performance Floor Enamel, A32 Series
(4 mils wet, 1.4 mils dry per coat)

4. Epoxy Systems (solvent base)
a. Gloss Finish
1st Coat: S-W Tile-Clad® HS Epoxy, B62WZ100 Series
2nd Coat: S-W Tile-Clad® HS Epoxy, B62WZ100 Series
(2.5-4 mils dry per coat)

C. DRYWALL (Walls, Ceilings, Gypsum Board, Wood Pulp Board, Plaster Board, etc.)

1. Latex Systems
e. Flat Finish
1st Coat: S-W PrepRite® 200 Latex Primer, B28W200
(4 mils wet, 1.2 mils dry)
2nd Coat: S-W ProMar® 200 Latex Flat, B30W200 Series
3rd Coat: S-W ProMar® 200 Latex Flat, B30W200 Series
(4 mils wet, 1.4 mils dry per coat)

Low Odor - Low VOC Finish
1st Coat: S-W Harmony® Low Odor Interior Latex Primer, B11W900
(4 mils wet, 1.3 mils dry per coat)
2nd Coat: S-W Harmony® Low Odor Interior Latex Flat, B5 Series
3rd Coat: S-W Harmony® Low Odor Interior Latex Flat, B5 Series
(4 mils wet, 1.6 mils dry per coat)

2.04 MATERIALS - GENERAL REQUIREMENTS

A Paints and Coatings - General:
1 Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
2 For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.

B Primers:
1 Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

2.05 ACCESSORIES

A Coating Application Accessories:
1 Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer’s specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

A Do not begin application of coatings until substrates have been properly prepared. Notify Architect of unsatisfactory conditions before proceeding.

B If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C Proceed with work only after conditions have been corrected and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.

3.02 SURFACE PREPARATION

A Proper product selection, surface preparation, and application affect coating performance. Coating integrity and service life will be reduced because of improperly prepared surfaces. Selection and implementation of proper surface preparation ensures coating adhesion to the substrate and prolongs the service life of the coating system.

B Selection of the proper method of surface preparation depends on the substrate, the environment, and the expected service life of the coating system. Economics, surface contamination, and the effect on the substrate will also influence the selection of surface preparation methods.

C The surface must be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.

D Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.

E No exterior painting should be done immediately after a rain, during foggy weather, when rain is predicted, or when the temperature is below 50°F unless the specified product is designed for the marginal conditions.

F Methods

1 Drywall—Interior
Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting.

2 Solvent Cleaning, SSPC-SP1
Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation.

3 Hand Tool Cleaning, SSPC-SP2
Hand Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Before hand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.

4 Power Tool Cleaning, SSPC-SP3

Power Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.

5 Vinyl Siding, Architectural Plastics, and Fiberglass
Clean thoroughly by scrubbing with a warm, soapy water solution. Rinse thoroughly. Do not paint vinyl siding with any color darker than the original color, unless the product and color are designed for such use. Painting with darker colors may cause siding to warp.

6 Wood
Must be clean and dry. Prime and paint as soon as possible. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.

WARNING! Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

3.03 INSTALLATION

A Apply all coatings and materials with manufacture specifications in mind. Mix and thin coatings according to manufacture recommendation.

B Do not apply to wet or damp surfaces.
1 Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days.
2 Test new concrete for moisture content.
3 Wait until wood is fully dry after rain , fog or dew.

C Apply coatings using methods recommended by manufacturer.

D Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.

E Apply coatings at spreading rate required to achieve the manufacturers recommended dry film thickness.

F Regardless of number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.

G Exterior Woodwork: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 2 weeks.

H Inspection: The coated surface must be inspected and approved by the Architect or Engineer just prior to each coat.

3.04 PROTECTION

A Protect finished coatings from damage until completion of project.

B Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION 09912

SECTION 10800 – TOILET AND BATHROOM ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.1 SECTION INCLUDES

A. Towel bars and holders.

B. Dispensers and waste baskets.

C. Toilet paper holders.

1.2 REFERENCES

A. ASTM F 446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 1985 (Reapproved 1999).

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's standard catalog data for each product specified, including dimensions, finish information, details of function, and mounting details.

C. Selection Samples: Manufacturer's standard color fans for selection of colors and finishes.

D. Verification Samples: Submit samples of each product specified, illustrating color and finish.
1. Approved samples will be returned to the Contractor and may be used in the project.

E. Shop Drawings:
1. Locate each specified unit in project.
2. Indicate mounting height of each unit.
3. Include anchoring and fastening details.

F. Installation Instructions: Manufacturer's printed installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Store products in manufacturer's unopened packaging until ready for installation.

1.5 COORDINATION AND SEQUENCING

A. Coordinate installation of blocking, bracing and backing to receive products of this section.

B. Supply installation templates, required reinforcing, and recessed anchorage devices in timely fashion to installers of related work that will receive products of this section.

1.6 WARRANTY

A. Provide manufacturer's standard replacement warranty against defects in materials and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURER'S

A. Acceptable Manufacturer:

Roca Sanitario, S.A.

Av. Diagonal, 513 08029 BARCELONA Teléfono: +34 93 366 1200 Fax : +34 93 419 4501 infosan@roca.net

B. Substitutions: Not permitted.

2.2 TOWEL BARS AND HOLDERS

A. Basic Requirements: Comply with ASTM F 446.

B. Veranda Towel Holder, 500 mm; No. 81575300C

2.3 DISPENSERS AND WASTE BASKETS

A. Soap Dispenser: Nylon, 8-3/16 inches (207 mm) by 2-15/16 (75 mm) diameter. Color as selected from manufacturer's standard range. Capacity 16.9 oz (500ml).
1. No. 988.03.3.. (opaque white container/lid).
2. Veranda Paper Towel Dispenser. Wall mounted. Color as selected from manufacturer's standard range.

B. Rectangular Waste Basket: Container perforated metal, Nylon, 20-5/16 inches (515 mm) by 12 inches (305 mm by 11-13/16 inches (300 mm). Free standing or wall mounted. Color as selected from manufacturer's standard range.

2.4 SHELVES

A. GRC prefabricated shelves.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify that prepared openings are sized and located in accordance with approved shop drawings. Verify that blocking, reinforcement and anchoring devices are the correct type, have been located correctly, and have been installed properly.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install toilet and bath accessories in accordance with manufacturer's instructions. Installation shall be plumb, level and rigidly anchored to substrate.

B. Locate accessories as indicated on the drawings and at heights that are in accordance with Americans with Disabilities Act.

3.4 CLEANING

A. Clean surfaces as required, following procedures and employing cleaning materials as recommended by accessories manufacturer.

3.5 PROTECTION

A. Protect installed products from damage by subsequent construction activities, until completion of project.

B. Field repair of damaged product finishes is prohibited. Replace products that have been damaged by subsequent construction activities.

3.6 SCHEDULES

END OF SECTION 10800

SECTION 11450- RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Residential appliances of the following types:
1. Refrigerators and freezers.
2. Cooking appliances.
3. Venting systems.
4. Microwave ovens.
5. Dishwashers.
6. Waste disposers
7. Clothes care.

1.02 RELATED SECTIONS

A. Section 06400 - Architectural Millwork.

B. Section 06600 - Plastic Fabrications

1.03 REFERENCES

A. ANSI A117.1 - Guidelines for Accessible and Useable Buildings and Facilities.

B. EPA - Energy Star Appliances.

C. Public Law 101-336 - Americans with Disabilities Act.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Model number and selected options for each appliance.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.
5. List of maintenance parts.

C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with referenced standards and the Americans with Disabilities Act as applicable for fixtures for the disabled.

B. Energy Rating: Provide appliances with the EPA Energy Star label where applicable.

C. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to

ensure compatible parts are installed.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 PROJECT CONDITIONS

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

1.08 WARRANTY

A. Provide manufacturer's standard written warranty for each type of appliance specified.

PART 2- PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer:

GE Appliances, which is located at: Appliance Park AP4-109 ; Louisville, KY 40225; Toll Free Tel: 800-626-2000; Tel: 502-452-3346; Fax: 502-452-0620; Email: steven.anderson@appl.ge.com; Web: www.geappliances.com

Gaggenau USA | ovens and cooktops

5551 McFadden Ave., Huntington Beach, CA 92649; tel: 714 901 5360; fax: 714 901 0979; web: www.gaggenau.com

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.02 APPLIANCES

A.Refrigerators and Freezers:
1. Top-Freezer Refrigerators: GE Series, model no. GTH16BBSLWW
2. Appearance: White on white.

B.Cooking Appliances:
1. Cooktops: Gaggenau Modular Cooktop VC 230 glass ceramic cooktop
2. Appearance: Glass and aluminum

C.Venting Systems:
1. Ventilator: Gaggenau VL 051 telescopic swivel ventilation system
2. Appearance: Stainless steel

D.Microwave Ovens:
1. Microwave Ovens: Sharp, model no.230
2. Mounting: Free-standing.

E.Dishwashers:

1. Dishwashers: GE Built-In Dishwashers, Energy Star, model no. PDW8400JWW
2. Appearance: White on white.

F.Clothes Care:

1. Washers: GE Front-Loading Washers, model no. WBVH6240FWW
2. Dryers: GE Dryers, Front-Loading, Electric, model no. DBVH512EFWW
3. Appearance: White on white.

PART 3- EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Coordinate rough-in with appliance sizes and utility requirements.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Assemble appliances and trim and install in accordance with manufacturer's instructions and the following:

1. Securely mount to substrate.
2. Install appliances plumb and level and in proper relationship to adjacent construction.
3. Connect appliances to building utility, supply and waste systems as applicable.

Test for proper operation and drainage. Adjust until proper operation is achieved.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.05 APPLIANCE DATA SHEETS

A. Refer to the manufacturer's data sheets as attached to this Section for required features and additional requirements.

END OF SECTION 11450

SECTION 13630- PHOTOVOLTAIC COLLECTORS

PART 1 - GENERAL

RELATED DOCUMENTS: Drawings and general provisions of Contract Documents, including General and Supplementary Conditions and Division 1 of the Specifications, apply to work of this Section.

1.01- SUMMARY

A. This Section includes photovoltaic collectors.

PART 2 - PRODUCTS

2.01-Photovoltaic Collectors

A. Photovoltaic Collectors are manufactured by SunPower Corporation. Phone: 1-877-786-0123, Email: sales@sunpowercorp.com, Web: www.sunpowercorp.com

B. Model number SPR – 215 - BLK

C. Price per module: $3.92 per watt

2.02-System

A. The system consists of a 35 photovoltaic panel array.

SUNPOWER

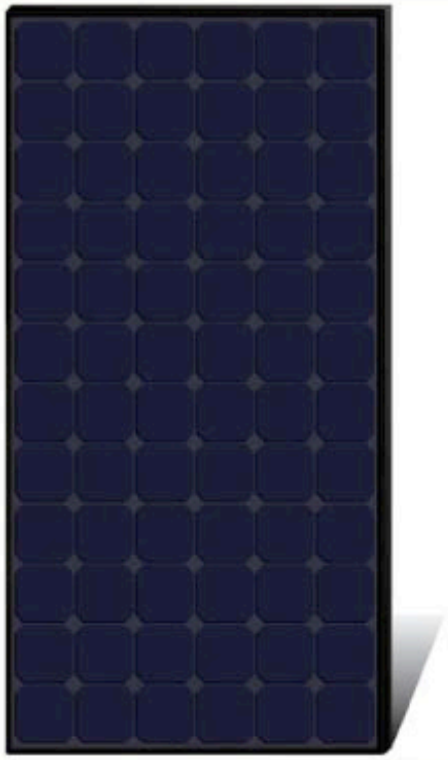
SPR-215-BLK
RESIDENTIAL PV MODULE

The SunPower SPR-215-BLK is designed specifically for on-grid residential systems where a combination of high module efficiency and outstanding appearance is desirable. Utilizing 72 series- connected A-300 solar cells, the SPR-215-BLK delivers industry- leading power density in a unique all-black module package with exceptionally uniform appearance.

SunPower modules—innovative design, proven materials, outstanding performance.

FEATURES & BENEFITS

- All-black module package eliminates harsh reflections and other noticeable cosmetic module features to provide optimum array appearance
- Unique all-back-contact solar cells with conversion efficiency up to 21.5%
- Low voltage-temperature coefficient, exceptional low-light performance, and high sensitivity to light across the entire solar spectrum maximize yearly energy delivery
- Highest quality, high-transmission tempered glass provides enhanced stiffness and impact resistance
- Aerospace style cell interconnects with in-plane strain relief provide extremely high reliability
- Advanced EVA encapsulation system with multi-layer backsheet meets the most stringent safety requirements for high-voltage operation
- A sturdy, black anodized aluminium frame allows modules to be easily roof-mounted with a wide variety of standard mounting systems



SPR-215-BLK RESIDENTIAL PV MODULE
An unequaled combination of power and grace

LISTED UL 1703, Class C Fire Rating

IEC 61215, Safety Class II Certified

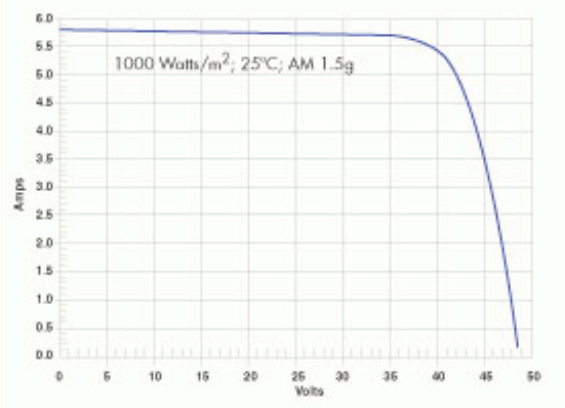
SUNPOWER

SPR-215-BLK
RESIDENTIAL PV MODULE

ELECTRICAL CHARACTERISTICS AT STANDARD TEST CONDITIONS (STC)
STC is defined as: irradiance of 1000W/m², spectrum AM 1.5g and cell temperature of 25°C

Peak Power[1,2]	P_{max}	215W
Rated Voltage	V_{mp}	39.8V
Rated Current	I_{mp}	5.40A
Open Circuit Voltage	V_{oc}	48.3V
Short Circuit Current	I_{sc}	5.80A
Series Fuse Rating		15A
Maximum System Voltage		600V (UL)
		1000V (IEC)
Temperature Co-efficients	Power	-0.38%/°C
	Voltage	-136.8mV/°C
	Current	2.3mA/°C
Module Efficiency		17.3%
PTC Rating		197.6W

IV CURVE

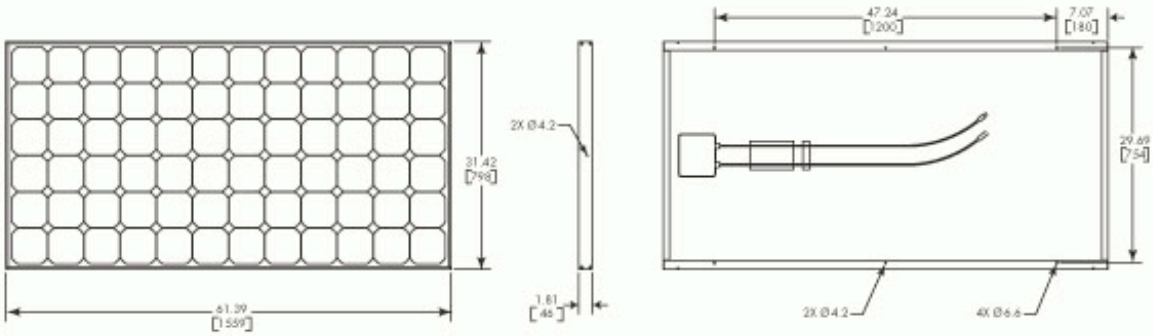


[1] Peak Power Tolerance: +/- 5%
[2] Power guaranteed for 25 years. See SunPower Limited Warranty for details.

MECHANICAL SPECIFICATIONS

Length (mm) x Width (mm)	1559 x 798
Thickness, including junction box (mm)	46
Weight (kg)	15

DIMENSIONS



END OF SECTION 13630

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems
2. Fittings
3. Insulation material for pipes
4. Supports and anchorages
5. Equipment installation requirements common to equipment sections
6. Sleeves
7. Escutcheons
8. Grout

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters

1.04 SUBMITTALS

A. Product Data: For the following:
1. Mechanical sleeve seals.
2. Fittings
3. Escutcheons.

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Copper Support Welding: Qualify processes and operators according to the pertinent regulations.

B. Copper Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Solvent Cements for Joining Plastic Piping when thread is not used:
   1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

2.05 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.06 SLEEVES

A. Galvanized-Steel Sheet: minimum thickness; round tube closed with welded longitudinal joint.

B. Copper Pipe.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

D. PVC Pipe: for piping that goes to the waste tank.

2.07 ESCUTCHEONS

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

2.08 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 28-day compressive strength.
Packaging: Premixed and factory packaged

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: use permitted water flushable flux or lead-free solder alloy to join copper pipes.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according the required regulations.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

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

B. 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.

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

3.05 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 15050

SECTION 15060 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.05 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

1.06 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
   1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
   1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
   2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
   1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
   2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts: minimum compressive-strength insulation, encased in sheet metal shield.
   1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
   2. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
   3. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
   4. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
   5. Material for Hot Piping: ASTM C 552, Type I cellular glass.
   6. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
   7. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
   8. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
   9. Insert Length: Extend beyond sheet metal shield for piping operating below ambient air temperature.

2.02 MISCELLANEOUS MATERIALS

A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

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.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of pipes, requiring insulation.
   3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, if little or no insulation is required.
   4. Pipe Hangers (MSS Type 5): For suspension of pipes, to allow off-center closure for hanger installation before pipe erection.
   5. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes.
   6. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes.
   7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes.
   8. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes.
   9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes.
   10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes.
   11. U-Bolts (MSS Type 24): For support of heavy pipe.
   12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   13. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
   14. Single Pipe Rolls (MSS Type 41): For suspension of pipes, from two rods if longitudinal movement caused by expansion and contraction might occur.
   15. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, from single rod if horizontal movement caused by expansion and contraction might occur.
   16. Complete Pipe Rolls (MSS Type 44): For support of pipes, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
   17. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
   18. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

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.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, if longer ends are required for riser clamps.

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to for heavy loads.
   2. Steel Clevises (MSS Type 14): For piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. C-Clamps (MSS Type 23): For structural shapes.
5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.

G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
2. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

3.02 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

C. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

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

E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

F. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.9.

2. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
3. Insert Material: Length at least as long as protective shield.
4. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.04 METAL FABRICATION

A. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

B. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION 15060

SECTION 15140 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.

1.02 SUBMITTALS

A. Water Samples: Specified in "Cleaning" Article in Part 3.

B. Field quality-control test reports.

1.03 QUALITY ASSURANCE

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

B. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," and NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for combined fire-protection and domestic water service piping to building.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic, potable domestic water piping and components.

D. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Transition Couplings: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Soft Copper Tube: water tube, annealed temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

C. Hard Copper Tube: water tube, drawn temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.02 VALVES

A. Refer to Division 15 Section "Plumbing Specialties" for balancing and drain valves.

PART 3 - PRODUCTS

3.01 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Domestic Water Piping: Use any of the following piping materials for each size range:
1. Hard copper tube,; copper pressure fittings; and soldered joints.
2. Hard copper tube, with grooved ends; copper grooved-end fittings; copper-tubing, keyed couplings; and grooved joints.
3. Hard copper tube,; copper pressure fittings; and soldered joints.
4. Steel pipe; gray-iron, threaded fittings; and threaded joints.
5. Hard copper tube,; copper pressure fittings; and soldered joints.
6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
7. CPVC, Schedule 80 pipe; CPVC, Schedule 80 socket fittings; and solvent-cemented joints.

D. Nonpotable-Water Piping: Use any of the following piping materials for each size range:
1. PVC, Schedule 80 pipe; PVC, Schedule 80 threaded fittings; and threaded joints.
2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.
3. Steel pipe; gray-iron, threaded fittings; and threaded joints.
4. PVC, Schedule 80 pipe; PVC, Schedule 80 threaded fittings; and threaded joints.
5. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.

3.02 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use bronze ball or gate valves for piping and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping and smaller. Use cast-iron butterfly valves with flanged ends for piping and larger.
3. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. PVC ball, butterfly, and check valves may be used with PVC piping.

3.03 PIPING INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service. Refer to Division 15 Section "Plumbing Specialties" for drain valves and strainers.

F. Install water-pressure regulators downstream from shutoff valves. Refer to Division 15 Section "Plumbing Specialties" for water-pressure regulators.

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

I. Perform the following steps before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
   5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.

J. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

K. Check plumbing specialties and verify proper settings, adjustments, and operation.
   1. Water-Pressure Regulators: Set outlet pressure at maximum, unless otherwise indicated.

L. Energize pumps and verify proper operation.

3.04 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.05 ROUGHING-IN FOR WATER METERS

A. Rough-in domestic water piping for water meter installation and install water meters according to utility company's requirements. Water meters will be furnished by utility.

B. Rough-in domestic water piping and install water meters according to utility company's requirements.

3.06 VALVE INSTALLATION

A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping and smaller. Use butterfly or gate valves for piping and larger.

B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping and smaller. Use butterfly or gate valves for piping and larger.

C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.
   2. Install stop-and-waste drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping and smaller and butterfly valves for piping and larger. Refer to Division 15 Section "Plumbing Specialties" for balancing valves.

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Refer to Division 15 Section "Plumbing Specialties" for calibrated balancing valves.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:
   1. Booster Systems: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
   4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for and larger.

3.08 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
   1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Cap and subject piping to static water pressure of above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow standing for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.09 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:
1) Fill system or part thereof with water/chlorine solution with at least of chlorine. Isolate with valves and allow standing for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least of chlorine. Isolate and allow standing for three hours.
c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 15140

SECTION 15150 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes soil and waste, sanitary drainage and vent piping inside the building.

1.02 SUBMITTALS

A. Field quality-control test reports.

1.03 QUALITY ASSURANCE

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

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Cast Iron Soil Pipe and Fittings: Used for pipe buried in or in contact with earth and for extension of pipe to a distance of no more than 5 feet under building floor towards waste water tanks and interior waste and vent piping above grade. Pipe shall be bell and spigot, modified hub, or plain end (no-hub) as required by selected jointing method:

1. Material, (Pipe and Fittings): ASTM A74, C1SP1-301, Service Class.
2. Joints: Provide any one of the following types to suit pipe furnished.
   a. Lead and oakum and caulked by hand.
   b. Double seal, compression-type molded neoprene gasket. Gaskets shall suit class of pipe being jointed.
   c. Mechanical: Meet the requirements and criteria for pressure, leak, deflection and shear tests as outlined in Factory Mutual No. 1680 for Class 1 couplings.
      1) Stainless steel clamp type coupling of electromeric sealing sleeve, ASTM C564 and a Series 300 stainless steel shield and clamp assembly. Sealing sleeve with center-stop to prevent contact between pipes/fittings being joined shall be marked ASTM C564.

2) Cast Iron coupling with neoprene gasket and stainless steel bolts and nuts.

d. Mechanical Grooved Couplings: Shall consist of ductile iron (ASTM A536, Grade 65-45-12), or malleable iron (ASTM A47, Grade 32510) housings, a pressure responsive elastomeric gasket (ASTM D2000), and steel track head bolts. Shall be for use on pipe and fittings grooved to the manufacturer's specifications. Couplings and fittings to be of the same manufacturer.

B. Steel Pipe and Fittings: May be used for vent piping and storm water piping above grade.

1. Pipe Galvanized: ASTM A53, standard weight.

2. Fittings:

a. Soil, Waste and Drain Piping: Cast iron, ANSI B16.12, threaded, galvanized.

b. Sanitary and Exhaust Vent Piping: Malleable iron, ANSI B16.3, or cast iron, ANSI B16.4. All piping shall be of the same kind. Couplings of vent piping may be standard couplings furnished with pipe.

c. Unions: Tucker connection or equivalent type throughout.

d. Mechanical Grooved Couplings: Shall consist of ductile iron (ASTM A536, Grade 65-45-12), or malleable iron (ASTM A47, Grade 32510) housings, a pressure responsive elastomeric gasket (ASTM D2000), and steel track head bolts. Shall be for use on pipe and fittings grooved to the manufacturer's specifications. Couplings and fittings to be of the same manufacturer.

C. Polyvinyl Chloride (PVC): Schedule 40. Shall not be used where waste temperature may exceed 60°C (140°F), such as mechanical equipment rooms, and kitchen, SPD, and sterilizer areas. PVC shall not be used in waste risers due to higher noise than other specified material.

1. Pipe: Shall be manufactured from Type I normal impact resins in conformance with ASTM D2665 and ASTM B16.12.

2. Fittings:

a. Solvent Welded Socket Type: Use solvent cement, ASTM D2564.

b. Threaded Type: Molded threads only. Use tape or lubricant specifically intended for use with PVC plastic pipe.

2.2 CLEANOUTS

A. Same size as the pipe, up to 100 mm (4 inches). Cleanouts shall be easily accessible and shall be gastight and watertight. Provide a minimum clearance of 600 mm (24 inches) for the rodding.

B. In Floors: Floor cleanouts shall have cast iron body and frame with square adjustable scoriated secured nickel bronze top. Unit shall be vertically adjustable for a minimum of 50 mm (2 inches). Cleanouts shall consist of "Y" fittings and 3 mm (1/8 inch) bends with brass or bronze screw plugs. Cleanouts in tile floors shall be provided with square top covers recessed for tile insertion.

C. Provide cleanouts at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be

installed at the base of the stack. Extend the cleanouts to the wall access cover. Cleanout shall consist of sanitary tees. Furnish nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed roughing work, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required by the NPHCC National Standard Plumbing Code.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.3 ROOF DRAINS AND CONNECTIONS

A. Roof Drains: Cast iron with clamping device for making watertight connection. Free openings through strainer shall be twice area of drain outlet. Provide integral no-hub, soil pipe gasket or threaded outlet connection.

1. Flat Roofs: Beehive or dome shaped strainer with integral flange not less than 300 mm (12 inches) in diameter. For insulated roofs, provide a roof drain with an adjustable drainage collar, which can be raised or lowered to meet required insulation heights, sump receiver and deck clamp. Bottom section shall serve as roof drain during construction before insulation is installed.

2. Canopy Roofs: Beehive or dome shaped strainer with the integral flange not larger than 200 mm (8 inches) in diameter. For insulated roof provide a roof drain with an adjustable drainage collar, which can be raised or lowered to meet the required insulation heights, sump receiver and deck clamp. Bottom section shall serve as roof drain during construction before insulation is installed.

3. Promenade Decks: Same as for canopy roofs, except decks shall have flat, round, loose, non-slip, bronze grate set in square, non-slip, bronze frame.

4. Portico Roofs and Gutters: Horizontal angle type drain with flat bottom and horizontal outlet at the same elevation as the pipe to which it is connected. Strainer shall be removable angle grate type.

B. Expansion Joints: Heavy cast iron with cast brass or copper expansion sleeve having smooth bearing surface working freely against a packing ring held in place and under pressure of a bolted gland ring, forming a water and air tight flexible joint. Asbestos packing is prohibited.

C. Downspout Nozzle: The nozzle fitting shall be of brass, unfinished, with internal pipe thread for connection to downspout.

2.4 TRAPS

Provide on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as pipe connected to. Slip joints not permitted on sewer side of trap. Traps shall

correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:
1. Use hubless, cast-iron soil piping and one of the following:
a. Couplings: Heavy-duty, Type 304, stainless steel.
b. Couplings: Heavy-duty, cast iron.
c. Couplings: Compact, stainless steel.
2. PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Cellular-core, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Service class, cast-iron soil piping; gaskets; and gasketed joints.
5. Hubless, cast-iron soil piping and one of the following:
a. Couplings: Heavy-duty, Type 304, stainless steel.
6. Stainless-steel piping, gaskets, and gasketed joints.
7. PVC pipe, PVC socket fittings, and solvent-cemented joints.
8. Cellular-core, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
9. Service class, cast-iron soil piping; gaskets; and gasketed joints.
10. Hubless, cast-iron soil piping and one of the following:
a. Couplings: Heavy-duty, Type 304, stainless steel.
11. Use PVC pipe, PVC socket fittings, and solvent-cemented joints.
12. Cellular-core, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.

C. Underground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:
1. Hubless, cast-iron soil piping and one of the following:
a. Couplings: Heavy-duty, Type 304, stainless steel.
2. PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Cellular-core, PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
5. Hubless, cast-iron soil piping and one of the following:
a. Couplings: Heavy-duty, Type 304, stainless steel.

6. PVC pipe, PVC socket fittings, and solvent-cemented joints.
7. Cellular-core, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
8. Use cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
9. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
10. Hubless, cast-iron soil piping and one of the following:
    a. Couplings: Heavy-duty, Type 304, stainless steel.
11. PVC pipe, PVC socket fittings, and solvent-cemented joints.
12. Cellular-core, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
13. Use cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.

3.02 PIPING INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
    1. Encase underground piping with PE film according to ASTM A 674 or AWWA C105.

F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. 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 and smaller; 1 percent downward in direction of flow for piping 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.

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

J. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.

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

L. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

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

3.03 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods " for basic piping joint construction.

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
   2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than: MSS Type 43, adjustable roller hangers.
      c. Longer Than, if indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Install supports for vertical PVC piping every.

E. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 CONNECTIONS

A. Connect soil and waste piping to waste water tanks installed below the house. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections and larger.

3.06 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 15150

SECTION 15183 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
   1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.

C. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 1.

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX; "Welding and Brazing Qualifications."

B. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Non electrical"; or UL 429, "Electrically Operated Valves."

1.4 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies.

E. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube.

B. Annealed-Temper Copper Tube.

C. Wrought-Copper Fittings: ASME B16.22.

D. Wrought-Copper Unions: ASME B16.22.

E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver)

F. Flexible Connectors: 500-psig (3450-kPa) minimum operating pressure; seamless tin-bronze core, high-tensile bronze-braid covering, and solder-joint end connections; dehydrated, pressure tested, minimum long

2.3 REFRIGERANTS

A. ASHRAE 34, R-410a: Tetrafluoroethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground, within Building: drawn-copper tubing.

3.2 PIPING INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

C. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

D. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

E. Belowground, install copper tubing in protective conduit. Vent conduit outdoors.

F. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

G. Slope refrigerant piping as follows:
1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

H. Install bypass around moisture-liquid indicators in lines larger than.

I. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.

J. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

K. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."

L. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than long.
2. Roller hangers and spring hangers for individual horizontal runs or longer.
3. Pipe rollers for multiple horizontal runs or longer, supported by a trapeze.
4. Spring hangers to support vertical runs.

M. Support vertical runs at each floor.

3.3 PIPE JOINT CONSTRUCTION

A. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.4 FIELD QUALITY CONTROL

A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
   a. System shall maintain test pressure at the manifold gage throughout duration of test.
   b. Fill system with nitrogen to raise a test pressure of or higher as required by authorities having jurisdiction.
   c. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.5 CLEANING

A. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

B. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter-dryer after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to.
4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 15183

SECTION 15430 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following plumbing specialties:
1. Backflow preventers.
2. Water regulators.
3. Trap seal primer valves.
4. Miscellaneous piping specialties.
5. Floor drains.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig

1.3 SUBMITTALS

A. Product Data: Include rated capacities and indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:

1. Backflow preventers and water regulators.
2. Thermostatic water mixing valves and water tempering valves.
3. Water hammer arresters, air vents, and trap seal primer valves and systems.
4. Backwater valves, and floor drains.

B. Field quality-control test reports.

C. Operation and maintenance data for the following:
1. Backflow preventers and water regulators.
2. Thermostatic water mixing valves and water tempering valves.
3. Trap seal primer valves and systems.
4. Grease interceptors.

1.4 QUALITY ASSURANCE

A. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

D. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
   2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.
   3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 BACKFLOW PREVENTERS

A. Available Manufacturers:
   1. Ames Co., Inc.
   2. B & K Industries, Inc.
   3. Cla-Val Co.
   4. CMB Industries, Inc.; Febco Backflow Preventers.
   5. Conbraco Industries, Inc.
   6. FLOMATIC Corp.
   7. IMI Cash Valve.
   8. Mueller Co.; Hersey Meters Div.
   9. Sparco, Inc.
   10. Watts Industries, Inc.; Water Products Div.
   11. Zurn Industries, Inc.; Wilkins Div.

B. General: ASSE standard, backflow preventers.
   1. NPS 2 and Smaller: Bronze body with threaded ends.
   2. NPS 2 ½ and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
      a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
   3. Interior Components: Corrosion-resistant materials.
   4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
   5. Strainer: On inlet, if indicated.

C. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.

D. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and two independent check valves with intermediate atmospheric vent.

E. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; and test cocks with two positive-seating check valves.
   1. Pressure Loss: maximum, through middle 1/3 of flow range.

F. Dual-Check-Valve-Type Backflow Preventers: ASSE 1024, suitable for continuous pressure application. Include union inlet and two independent check valves.
   1. Pressure Loss: maximum, through middle 1/3 of flow range.

G. Double-Check Detector Assembly Backflow Preventers: ASSE 1048, FMG approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; two positive-seating check valves; and bypass with displacement-type water meter, valves, and double-check backflow preventer.
   1. Pressure Loss: maximum, through middle 1/3 of flow range.

2.3 WATER REGULATORS

A. Manufacturers:
   1. Armstrong-Yoshitake, Inc.
   2. BERMAD.
   3. Cashco, Inc.
   4. Cla-Val Co.
   5. Conbraco Industries, Inc.
   6. FLOMATIC Corp.
   7. G A Industries, Inc.
   8. Honeywell Braukmann.
   9. IMI Cash Valve.
   10. Watts Industries, Inc.; Water Products Div.
   11. Zurn Industries, Inc.; Wilkins Div.

B. General: ASSE 1003, water regulators, rated for initial working pressure of minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.
   1. and Smaller: Bronze body with threaded ends.
      a. General-Duty Service: Single-seated, direct operated, unless otherwise indicated.
      b. Booster Heater Water Supply: Single-seated, direct operated with integral bypass.
   2. and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved, interior epoxy coating for regulators with cast-iron body.
      a. Type: Single-seated, direct operated.
      b. Type: Pilot-operated, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.
   3. Interior Components: Corrosion-resistant materials.
   4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.

2.4 TRAP SEAL PRIMER VALVES

A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:

   1. Manufacturers:
      a. E & S Valves.
      b. Josam Co.
      c. MIFAB Manufacturing, Inc.

d. Precision Plumbing Products, Inc.
e. Smith, Jay R. Mfg. Co.
f. Tyler Pipe; Wade Div.
g. Watts Industries, Inc.; Drainage Products Div.
h. Watts Industries, Inc.; Water Products Div.
i. Zurn Industries, Inc.; Jonespec Div.
j. Zurn Industries, Inc.; Specification Drainage Operation.

2. Minimum working pressure.
3. Bronze body with atmospheric-vented drain chamber.
4. Inlet and Outlet Connections: threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type Trap Seal Primer Valves: ASSE 1044, fixture-trap, waste-drainage-fed type, with the following characteristics:

1. Manufacturers:
   a. Smith, Jay R. Mfg. Co.

2. Chrome-plated, cast-brass, minimum, lavatory P-trap with minimum, trap makeup connection.

C. Trap Seal Primer System: Factory-fabricated, automatic-operation assembly for wall mounting with the following:
1. Manufacturers:
   a. Precision Plumbing Products, Inc.
2. Piping: copper, water tubing inlet and manifold with number of outlets as indicated.
3. Cabinet: Steel box with stainless-steel cover.
4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
5. Water Hammer Arrester: ASSE 1010.
6. Vacuum Breaker: ASSE 1001.

2.5 DRAIN VALVES

A. Hose-End Drain Valves: MSS SP-110, ball valve, rated for minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
1. Inlet: Threaded or solder joint.
2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.

B. Hose-End Drain Valve: MSS SP-80, gate valve, Class 125, ASTM B 62 bronze body, with threaded or solder-joint inlet and ASME B1.20.7, garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.

C. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with side drain outlet and cap.

2.6 MISCELLANEOUS PIPING SPECIALTIES

A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.

B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include threaded or solder-joint inlet, of design suitable for pressure of at least; integral or field-installed, nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
   1. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
   2. Finish for Service Areas: Chrome or nickel plated.
   3. Finish for Finished Rooms: Chrome or nickel plated.
   4. Operation for Equipment Rooms: Wheel handle or operating key.
   5. Operation for Service Areas: Wheel handle.
   6. Operation for Finished Rooms: Wheel handle.
   7. Include operating key with each operating-key hose bibb.
   8. Include integral wall flange with each chrome- or nickel-plated hose bibb.

C. Air Vents: Float type for automatic air venting.
   1. Bolted Construction: Bronze body with replaceable, corrosion-resistant metal float and stainless-steel mechanism and seat; threaded minimum inlet; minimum pressure rating at; and threaded vent outlet.
   2. Welded Construction: Stainless-steel body with corrosion-resistant metal float, stainless-steel mechanism and seat, threaded minimum inlet, minimum pressure rating, and threaded vent outlet.

D. Air-Admittance Valves: Plastic housing with mechanical-operation sealing diaphragm, designed to admit air into drainage and vent piping and to prevent transmission of sewer gas into building.
   1. Stack Vent Valve: ASSE 1050, designed for installation as terminal on soil, waste, and vent stacks, instead of stack vent extending through roof, in.
   2. Fixture Vent Valve: ASSE 1051, designed for installation on waste piping, instead of vent connection, for single fixture, in.

E. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting, joined with ASTM C 564, rubber gaskets.

F. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.

G. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

H. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.

I. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

J. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.

K. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

L. Downspout Boots: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.

M. Conductor Nozzles: Bronze body with threaded inlet for connected conductor size, and bronze wall flange with mounting holes.
   1. Finish: Polished bronze.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 15050 for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.

D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.

E. Install draining-type ground and ground post hydrants with of crushed gravel around drain hole.
   1. Set ground hydrants with box flush with grade.
   2. Set post hydrants in concrete paving or in of concrete block at grade.

F. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

G. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

H. Install expansion joints on vertical risers, stacks, and conductors if indicated.

I. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to. Use for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 deg rees.
   3. Locate at minimum intervals of for piping and smaller and for larger piping.
   4. Locate at base of each vertical soil and waste stack.

J. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

K. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

L. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

M. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

N. Install frost-proof vent caps on each vent pipe passing through roof. Maintain clearance between vent pipe and roof substrate.

O. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, or Less: Equivalent to 1 percent slope, but not less than total depression.
      b. Radius,: Equivalent to 1 percent slope.
      c. Radius, or Larger: Equivalent to 1 percent slope, but not greater than total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

P. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
   1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
   2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
   3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
   4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
   5. Coordinate oil-interceptor storage tank and gravity drain with Division 2 Section "Fuel-Oil Distribution."

Q. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

R. Fasten recessed-type plumbing specialties to reinforcement built into walls.

S. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

T. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.

U. Install air vents at piping high points. Include ball, gate, or globe valve in inlet and drain piping from outlet to floor drain.

V. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

W. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Connect plumbing specialties and devices that require power according to Division 16 Sections.

C. Interceptor Connections: Connect piping, flow-control fittings, and accessories.
   1. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
   2. Grease Recovery Units: Connect inlet, outlet, and vent piping; controls; electric power; and factory-furnished accessories to unit.
   3. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
   4. Solids Interceptors: Connect inlet and outlet.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each backflow preventer, trap seal primer system and grease interceptor.
   1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
   2. Refer to Section 15050 for nameplates and signs.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15430

SECTION 15671 - CONDENSING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Air-cooled condensing units.

1.2 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; dimensions; required clearances; methods for assembling components; furnished specialties; accessories; and installation and startup instructions for each model indicated.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

C. Maintenance Data: For each condensing unit to include in the maintenance manuals specified in Division 1.
1. Include a parts list for each condensing unit, control, and accessory; troubleshooting maintenance guide; and servicing and preventive maintenance procedures and schedule.

1.3 QUALITY ASSURANCE

A. Listing and Labeling: Provide electrically operated equipment specified in this Section that is listed and labeled.

B. Fabricate and label refrigeration system.

C. Comply with UL 303, "Refrigeration and Air-Conditioning Condensing and Compressor Units."

1.4 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Section "Roof Accessories."

PART 2- PRODUCTS

PART 2 -

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering condensing units that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide condensing units by one of the following:
1. Condensing Units, Air Cooled,:
a. Daikin Industries
2. Condensing Units, Air Cooled,:
a. Daikin Industries

2.2 CONDENSING UNITS, AIR COOLED,

A. Description: Factory assembled and tested, air cooled; consisting of compressors, condenser coils, fans, motors, refrigerant reservoirs, and operating controls.

B. Compressor: Hermetically sealed and isolated for vibration.
   1. Motor: Include thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

C. Condenser: Copper-tube, aluminum-fin coil.

D. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated fan motor with thermal-overload protection.

E. Accessories include the following:
   1. Low-voltage thermostat and subbase to control condensing unit and evaporator fan.
   2. Precharged and insulated suction and liquid tubing.
   3. Low ambient kit to permit operation down to.
   4. Crankcase heater.
   5. Automatic reset timer to prevent compressor rapid cycle.
   6. Polyethylene mounting base to provide a permanent foundation.

F. Casing: Steel,; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

2.3 CONDENSING UNITS, AIR COOLED,

A. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

B. Compressor: Hermetic or semihermetic compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.
   1. Capacity Control: Cylinder unloading.
   2. Capacity Control: Hot-gas bypass.

C. Condenser: Seamless copper-tube, aluminum-fin coil, with separate and independent refrigeration circuit for each compressor. Include liquid accumulator and subcooling circuit and backseating liquid-line service access valve. Factory test coils at, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen.

D. Condenser Fans: Propeller-type discharge; Include the following:
   1. Permanently lubricated ball-bearing motors.
   2. Separate motor for each fan.
   3. Motors with thermal-overload cutouts.
   4. Dynamically and statically balanced fan assemblies.
   5. Low Ambient Control: Factory-installed damper assembly, fan-speed control, or fan-cycling control.

E. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:
   1. Steel, galvanized or zinc coated, for exposed casing surfaces, treated and finished with manufacturer's standard paint coating.

PART 3- EXECUTION

2.4 INSTALLATION

A. Install condensing units according to manufacturer's written instructions.

B. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

C. Install roof-mounted units on equipment supports specified in Division 7. Anchor unit to supports with removable fasteners.

D. Install units on spring isolators specified in Division 15 Section "Mechanical Vibration Controls and Seismic Restraints."

2.5 CONNECTIONS

A. Connect pre-charged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

B. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories.

C. Connect refrigerant and condenser water piping to water-cooled condensing units. Maintain clear tube removal space.

D. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

2.6 FIELD QUALITY CONTROL

A. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.

B. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
   1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units with new units and retest.

2.7 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Clean units to remove dirt and construction debris and repair damaged finishes.

2.8 COMMISSIONING

A. Verify that units are installed and connected according to specifications.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for physical damage to unit casing.
   2. Verify that access doors move freely and are weather-tight.
   3. Clean units and inspect for construction debris.
   4. Check that all bolts and screws are tight.
   5. Adjust vibration isolation and flexible connections.
   6. Verify that controls are connected and operational.

C. Lubricate bearings on fans.

D. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

E. Adjust fan belts to proper alignment and tension.

F. Start unit according to manufacturer's written instructions.
   1. Complete manufacturer's starting checklist.

G. Measure and record airflow over coils.

H. Check operation of condenser capacity control device.

I. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

J. After startup and performance test, lubricate bearings and adjust belt tension.

END OF SECTION 15671

SECTION 15738 – SLIM-DUCT-BUILT-IN-SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for concealed mounting.

1.2 DEFINITIONS

A. Evaporator-Fan Unit: The part of the air-conditioning unit that contains a coil for cooling (heat rejection for heating operation in heat pump units) and a fan to circulate air to conditioned space.

B. Compressor-Condenser Unit: The part of the air-conditioning unit that contains a refrigerant compressor and a coil for condensing refrigerant (evaporator for heating operation in heat pump units).

1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units of sections of units showing the full range of colors available for units with factory-applied color finishes.

C. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of units and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered.

1.5 COORDINATION

A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 7 Section "Roof Accessories."

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of air-conditioning units that fail in materials or workmanship within specified warranty period.

C. Warranty Period:
   1. Compressor Warranty- Seven years

2. Parts Warranty- Five Years
3. Limited Labor Warranty- One year

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Filters: One set of filters for each unit.
2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Available Manufacturer: Subject to compliance with requirements, manufacturer offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Daikin

2.2 INSIDE ACOUSTIC TILE-MOUNTED, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable panels on front and ends.
1. Insulation: Foil faced insulation ¾" thick 4lb. dual density.
2. Drain Pans: 304 stainless steel, with connection for drain *11/16"* (OD); insulated.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Fan and Motor: Centrifugal fan; resiliently mounted.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
1. Compressor Type: Scroll.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid sub cooler R410A.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

F. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Low voltage with sub base to control compressor and evaporator fan.
   1. Inverter System
   2. Unified On-Of/ Scheduled Timer
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection, including auto setting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units' level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components; larger on each side than unit. Coordinate anchor installation with the base, between three walls.

D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

E. Connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to unit to allow service and maintenance, with a minimum of ten feet's long.

C. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.

D. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.3 FIELD QUALITY CONTROL

A. Installation Inspection: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 COMMISSIONING

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that units are installed and connected according to the Contract Documents.

C. Lubricate bearings, adjust belt tension, and change filters.

D. Perform startup checks according to manufacturer's written instructions and do the following:
1. Fill out manufacturer's checklists.
2. Check for unobstructed airflow over coils.
3. Check operation of condenser capacity-control device.
4. Verify that vibration isolation devices and flexible connectors dampen vibration transmission to structure.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.

2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."

3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

DAIKIN® AC™
absolute comfort™

Submittal Data:
Slim Duct Built-In System
FDXS09DVJU Indoor Unit / RXS09DVJU Outdoor Unit

Job Name: SOLAR DECATHLON 2007 UPR TEAM	Location: WASHINGTON DC.
Purchaser:	
Engineer:	
Submitted To: UPR	For: ☑ Reference ☑ Approval ☐ Construction
Submitted By: JAVIER FIGUEROA - AIRCON	Date: 1/24/07
Unit Designation: Schedule #: BEDROOM UNIT	Model No.: FDXS09DVJU (FanCoil) / RXS09DVJU(Condenser)

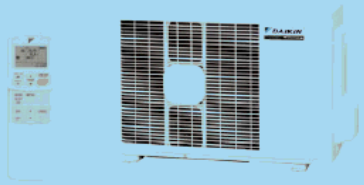
Capacities & Efficiencies:	
Cooling Rated (Min. ~ Max.)	8,500 (4,400 ~ 8,500) Btu/h
Cooling Power Consumption Rated (Min. ~ Max.)	770 (300 ~ 770) W
Seasonal Energy Efficiency Ratio	13.0 SEER
Moisture Removal	2.5 Pt/h
Heating Rated (Min. ~ Max.)	10,000 (4,400 ~ 10,000) Btu/h
Heating Power Consumption Rated (Min. ~ Max.)	950 (290 ~ 1,220) W
Heating Seasonal Performance Factor	7.7 HSPF

Cooling Mode Nominal Conditions:
Indoor: 80°F DB / 67°F WB
Outdoor: 95°F DB / 75°F WB
Pipe Length: 25 ft

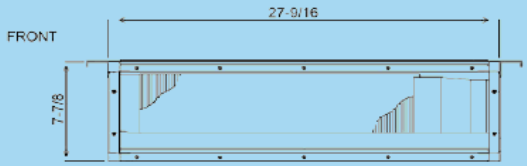
Heating Mode Nominal Conditions:
Indoor: 70°F DB / 60°F WB
Outdoor: 47°F DB / 43°F WB
Pipe Length: 25 ft

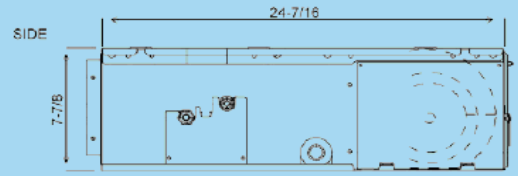
Indoor Unit:	
Power Supply (V/PH/Hz)	208-230/1/60
Cooling Airflow Rate (H/M/L)	305/280/260 cfm
Heating Airflow Rate (H/M/L)	305/280/260 cfm
Running Current (Rated)	.52 Amps
Weight	47 lbs
Sound Pressure Level at 3.3 ft (H/M/L)	35/33/31 dBA
Outdoor Unit:	
Power Supply (V/PH/Hz)	208-230/1/60
Cooling Operating Range (standard)	14°F – 115°F DB
Cooling Operating Range (with optional wind baffle)	0°F – 115°F DB
Heating Operating Range (standard)	0°F – 64°F DB
Minimum Circuit Amps (MCA)	6.1 Amps
Maximum Fuse Amps (MFA)	15 Amps
Starting Current	5.0 Amps
Running Current (Cooling/Heating)	3.7 Amps / 4.1 Amps
Weight	74 lbs
Sound Pressure Level at 3.3 ft	48 dBA
Piping:	
Maximum Height Difference	49 ft
Maximum Length	66 ft
Liquid Piping Connection (OD)	ϕ1/4"
Gas Piping Connection (OD)	ϕ3/8"
Condensate Drain Piping Connection (OD)	ϕ11/16"
Standard Features:	
Compressor Warranty	7 years
Parts Warranty	5 years
Limited Labor Warranty	1 year
Remote Control	
Option:	
Centralized Control/Unified On-Off/Scheduled Timer	

R-410A



FDXS09DVJU





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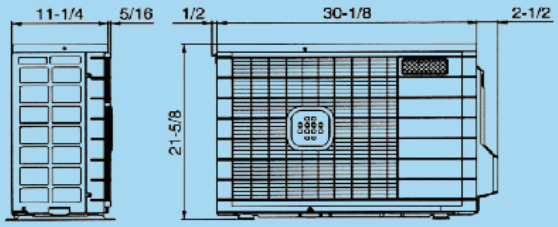

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SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
   2. HVAC equipment quantitative-performance settings.
   3. Existing systems TAB.
   4. Verifying that automatic control devices are functioning properly.
   5. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing."

1.4 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.5 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

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

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Electric-Heating Coils: Measure the following data for each coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.9 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.10 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.12 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, General and Supplementary Conditions are included in this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electricity-metering components.
6. Cutting and patching for electrical construction.
7. Touchup painting.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquid tight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

F. RMC: Rigid Metallic Conduit

1.04 SUBMITTALS

A. Product Data: For electricity-metering equipment.

B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.

B. FMC: Zinc-coated steel.

C. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.

D. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.

E. RMC: Rigid Metallic Conduit

F. Raceway Fittings: Specifically designed for the raceway type with which used.

2.02 CONDUCTORS

A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.

B. Conductors, Larger Than No. 10 AWG: Stranded copper.

C. Insulation: Thermoplastic, rated at 90 deg C minimum.

D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.03 SUPPORTING DEVICES

A. Material: Structural Aluminum acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.

D. Slotted-Steel Channel Supports.

1. Channel Thickness: Selected to suit structural loading.
2. Fittings and Accessories: Products of the same manufacturer as channel supports.

E. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least one surface.

1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

H. Expansion Anchors: Carbon-steel wedge or sleeve type.

I. Toggle Bolts: Stainless Steel springhead type.

J. Powder-Driven Threaded Studs: Heat-treated steel.

2.04 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.

1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
3. Color: Black letters on orange background.
4. Legend: Indicates voltage.

C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.

D. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

E. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

G. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

H. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch, galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.

I. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.05 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

PART 3 - EXECUTION

3.01 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

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

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 RACEWAY APPLICATION

A. Use the following raceways for outdoor installations:

1. Exposed: PVC.
2. Concealed: RNC.
3. Underground, Single Run: RNC.

B. Use the following raceways for indoor installations:

1. Exposed: RNC.
2. Concealed (Walls): EMT
3. Acoustic Roof: LFMC.

3.03 RACEWAY AND CABLE INSTALLATION

A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

B. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

C. Use temporary raceway caps to prevent foreign matter from entering.

D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch.

1. Install conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
2. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.

G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

H. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch (1830-mm) flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

I. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.04 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

A. Feeders: Type THWN insulated conductors in raceway.

B. Branch Circuits: Type THHN insulated conductors in raceway.

3.05 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.

C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.06 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Structural Aluminum materials or nonmetallic, U-channel system components.

B. Dry Locations: Structural Aluminum materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.07 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

K. Install metal channel racks for mounting cabinets, panel boards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceways and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations and of all other fire-rated floor and wall assemblies.

M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the manufacturer's specifications.

3.08 IDENTIFICATION MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Identify raceways and cables with color banding as follows:

1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (8-m) maximum intervals in congested areas.
3. Colors: As follows:

    a. Fire Alarm System: Red.
    b. Control System: Green and yellow.

E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

F. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.
3. Neutral: White.
4. Ground: Green.

3.09 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.

4. Electrical identification.
5. Electricity-metering components.
6. Electrical demolition.
7. Cutting and patching for electrical construction.
8. Touchup painting.

3.010 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.011 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general and supplementary conditions are included in this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver wires and cables according to NEMA WC 26.

1.4 COORDINATION

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

1. Wires and Cables:
   a. General Electric

2. Connectors for Wires and Cables:
   a. General Electric

2.2 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified respectively.

B. Rubber Insulation Material: Comply with NEMA WC 3.

C. Thermoplastic Insulation Material: Comply with NEMA WC 5.

D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.

E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.

F. Conductor Material: Copper.

G. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.

2.3 CONNECTORS AND SPLICES

A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine raceways and building finishes receiving wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

A. Feeders: Type THWN or RHH, in raceway.

B. Branch Circuits: Type THHN, in raceway.

C. Fire Alarm Circuits: Type THWN, in raceway.

3.3 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."

B. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."

F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."

G. Identify wires and cables according to Division 16 Section "Basic Electrical Materials and Methods."

H. Identify wires and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

A. Conductor Splices: Keep to minimum.

B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

C. Use splice and tap connectors compatible with conductor material.

D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.

E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION 16120

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

A. Product Data: For each product specified.

B. Shop Drawings: Legends for receptacles and switch plates.

C. Samples: For devices and device plates for color selection and evaluation of technical features.

D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NEMA WD 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

1. Wiring Devices:

a. Bryant Electric, Inc.
b. GE Company; GE Wiring Devices.
c. Hubbell, Inc.; Wiring Devices Div.
d. Leviton Manufacturing Co., Inc.
e. Approved Equals

2. Wiring Devices for Hazardous (Classified) Locations:

a. Crouse-Hinds Electrical Co.; Distribution Equipment Div.
b. Appleton Electric Co.

3. Multioutlet Assemblies:

a. Airey-Thompson Co.
b. Wiremold.

4. Poke-through, Floor Service Outlets and Telephone/Power Poles:

a. Hubbell, Inc.; Wiring Devices Div.
b. Pass & Seymour/Legrand; Wiring Devices Div.
c. Square D Co.
d. Wiremold.

2.2 RECEPTACLES

A. Straight-Blade and Locking Receptacles: Heavy-Duty grade.

B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

C. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.

1. Devices: Listed and labeled as isolated-ground receptacles.

2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

2.3 PENDANT CORD/CONNECTOR DEVICES

A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SWITCHES

A. Snap Switches: Heavy-duty, quiet type.

B. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.

1. Switch: 20 A, 120/277-V ac.
2. Receptacle: NEMA WD 6, Configuration 5-20R.

C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.

1. Control: Continuously adjustable slide or, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable, toggle, or slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch wire connecting leads.
3. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness.

2.6 WALL PLATES

A. Single and combination types match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: As selected by architect.

3. Material for Unfinished Spaces: Galvanized steel.

2.7 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used Bronze Trim.

2.8 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box unit with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

1. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
2. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
3. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
4. Wiring: Three No. 12 AWG power and ground conductors; one 75-ohm coaxial telephone/data cable; and one four-pair, 75-ohm telephone/data cable.

2.9 FINISHES

A. Color: To be selected by architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

F. Protect devices and assemblies during painting.

G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Basic Electrical Materials and Methods."

1. Switches: Where two or more switches of different phase are ganged, provide box barrieers.
2. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

B. Check TVSS receptacle indicating lights for normal indication.

C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

D. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

SECTION 16246 – BATTERY EQUIPMENT

8G8D

Valve-Regulated, Gelled-Electrolyte Battery

SPECIFICATIONS

Nominal Voltage (V)	12V
Capacity at C/100	265Ah
Capacity at C/20	225Ah
Weight	157 (71.2 kg)
Plate Alloy	Lead Calcium
Posts	Forged terminals & bushings
Container/Cover	Polypropylene
Operating Temperature Range	-76°F (-60°C) – 140°F (60°C)
Charge Voltage @ 68°F (20°C)	
Cycle	2.30 - 2.35 VPC
Float	2.25 - 2.30 VPC
Vent	Self-sealing (2 PSI operation)
Electrolyte	Sulfuric acid thixotropic gel
Resistance	4.0 Milliohms (full charge)
Terminal	SAE

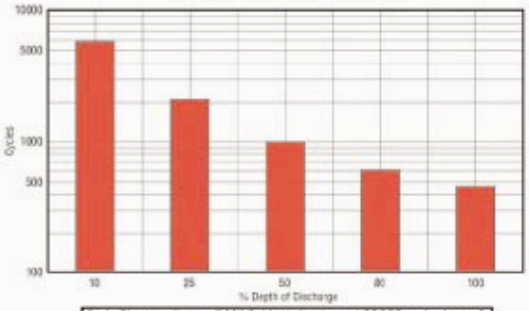
Rated non-spillable by ICAO, IATA and DOT

Made in the U.S.A by East Penn Manufacturing

DIMENSIONS

Length (mm)	20.75 (527 mm)
Width (mm)	11 (279 mm)
Height (mm)	10 (254 mm)

Gel Cycle Life vs Depth of Discharge at +25°C (77°F)
Based on BCI 2-hour Capacity



Cycle Chart applies to all MK Gel batteries (except 8GGC2 cycle chart x 2, 8G24/8G27 with a T872M terminal and 8G31DT cycle chart x .67).

TECHNICAL MANUAL

Valve-Regulated Lead-Acid (VRLA):
Gelled Electrolyte (gel) and Absorbed Glass Mat (AGM) Batteries

EAST PENN Expertise and American Workmanship — *Quality System Certified to ISO 9001*

Introduction

Valve-regulated lead-acid (VRLA) technology encompasses both gelled electrolyte and absorbed glass mat (AGM) batteries. Both types are valve-regulated and have significant advantages over flooded lead-acid products.

More than a decade ago, East Penn began building valve-regulated batteries using tried and true technology backed by more than 50 years experience. East Penn's unique computer-aided manufacturing expertise and vertical integration have created a product that is recognized as the **highest quality, longest lived VRLA battery available from any source.**

East Penn's gel and AGM batteries are manufactured to tough quality standards. East Penn manufactures high power gel and AGM batteries with excellent performance and life.

Applications

VRLA batteries can be substituted in virtually any flooded lead-acid battery application (in conjunction with well-regulated charging), as well as applications where traditional flooded batteries cannot be used. Because of their unique features and benefits, VRLA batteries are particularly well suited for:

Deep Cycle, Deep Discharge Applications

- Marine Trolling
- Electronics
- Sailboats
- Electric Vehicles
- Wheelchairs
- Golf Cars
- Portable Power
- Floor Scrubbers
- Personnel Carriers
- Marine & RV House Power
- Commercial Deep Cycle Applications

Standby and Emergency Backup Applications

- UPS (Uninterrupted Power Systems)
- Cable TV
- Emergency Lighting
- Computer Backup
- Solar Power
- Telephone Switching
- Village Power

Unusual and Demanding Applications

- Race Cars
- Air-transported Equipment
- Off-road Vehicles
- Wet Environments
- Marine & RV Starting
- Diesel & I.C.E. Starting

What is a gel battery?

A gel battery is a lead-acid electric storage battery that:

- is sealed using special pressure valves and should never be opened.
- is completely maintenance-free.*
- uses thixotropic gelled electrolyte.
- uses a recombination reaction to prevent the escape of hydrogen and oxygen gases normally lost in a flooded lead-acid battery (particularly in deep cycle applications).
- is non-spillable, and therefore can be operated in virtually any position. However, upside-down installation is not recommended.

** Connections must be retorqued and the batteries should be cleaned periodically.*

What is an AGM battery?

An AGM battery is a lead-acid electric storage battery that:

- is sealed using special pressure valves and should never be opened.
- is completely maintenance-free.*
- has all of its electrolyte absorbed in separators consisting of a sponge-like mass of matted glass fibers.
- uses a recombination reaction to prevent the escape of hydrogen and oxygen gases normally lost in a flooded lead-acid battery (particularly in deep cycle applications).
- is non-spillable, and therefore can be operated in virtually any position. However, upside-down installation is not recommended.

** Connections must be retorqued and the batteries should be cleaned periodically.*

How does a VRLA battery work?

A VRLA battery is a "recombinant" battery. This means that the oxygen normally produced on the positive plates of all lead-acid batteries is absorbed by the negative plate. This suppresses the production of hydrogen at the negative plate. Water (H_2O) is produced instead, retaining the moisture within the battery. **It never needs watering, and should never be opened** as this would "poison" the battery with additional oxygen from the air. Opening the battery will void the warranty.

What are the differences between gel batteries and absorbed glass mat (AGM) batteries?

Both are recombinant batteries. Both are sealed valve-regulated (SVR) – also called valve-regulated lead-acid (VRLA). AGM batteries and gel batteries are both considered "acid-starved". In a gel battery, the electrolyte does not flow like a normal liquid. The electrolyte has the consistency and appearance of petroleum jelly. Like gelled electrolyte batteries, absorbed electrolyte batteries are also considered non-spillable – all of the liquid electrolyte is trapped in the sponge-like matted glass fiber separator material.

The "acid-starved" condition of gel and AGM batteries protects the plates during heavy deep-discharges. The gel battery is more starved, giving more protection to the plate; therefore, it is better suited for super-deep discharge applications.

Due to the physical properties of the gelled electrolyte, gel battery power declines faster than an AGM battery's as the temperature drops below 32°F. AGM batteries excel for high current, high power applications and in extremely cold environments.

What is the difference between VRLA batteries and traditional wet batteries?

Wet batteries do not have special pressurized sealing vents, as they do not work on the recombination principle. They contain liquid electrolyte that can spill and cause corrosion if tipped or punctured. Therefore, they are not air transportable without special containers. They cannot be shipped via UPS or Parcel Post or used near sensitive electronic equipment. They can only be installed "upright."

Wet batteries lose capacity and become permanently damaged if:

- left in a discharged condition for any length of time (due to sulfation). This is especially true of antimony and hybrid types.
- continually over-discharged, due to active material shedding. This is especially true of automotive starting types.

Our gel cells have triple the deep cycle life of wet cell antimony alloy deep cycle batteries, due to our unique design. The shelf life of a VRLA battery is seven times higher than the shelf life of a deep cycle antimony battery.

How do VRLA batteries recharge? Are there any special precautions?

While our VRLA batteries accept a charge extremely well due to their low internal resistance, **any** battery will be damaged by continual under- or overcharging. Capacity is reduced and life is shortened.

Overcharging is especially harmful to any VRLA battery because of the sealed design. Overcharging dries out the electrolyte by driving the oxygen and hydrogen out of the battery through the pressure relief valves. Performance and life are reduced.

If a battery is continually undercharged, a power-robbing layer of sulfate will build up on the positive plate, which acts as a barrier to recharging. Premature plate shedding can also occur. Performance is reduced and life is shortened.

Therefore, **it is critical that a charger be used that limits voltage.** The charger must be temperature-compensated to prevent under- or overcharging due to ambient temperature changes. **(See Charging Voltage vs. Ambient Temperature chart on page 11.)**

Important Charging Instructions

The warranty is void if improperly charged. Use a good constant potential, temperature-compensated, voltage-regulated charger. **Constant current chargers should never be used on VRLA batteries.**

Can VRLA batteries be installed in sealed battery boxes?

NO! Never install any type of battery in a completely sealed container. Although most of the normal gasses (oxygen and hydrogen) produced in a VRLA battery will be recombined as described above, and not escape, **oxygen and hydrogen will escape from the battery in an overcharge condition** (as is typical of any type battery).

For safety's sake, these potentially explosive gasses **must** be allowed to vent to the atmosphere and **must never be trapped in a sealed battery box or tightly enclosed space!**

Can our VRLA batteries be used as starting batteries as well?

Our VRLA batteries will work in SLI (Starting, Lighting and Ignition) applications as long as the charging voltage is regulated to the appropriate values from the tables on page 11. Many vehicle regulators are set too high for gel batteries; therefore, the charging system may require adjustment to properly recharge a gel battery for best performance and life.

AGM batteries excel in low temperature, high current applications such as cold weather starting.

What do the ratings and specifications signify for this line?

All ratings are **after 15 cycles** and conform to BCI specifications.

CCA = Cold Cranking Amperes at 0°F (–17.8°C)

Cold cranking amperes equal the number of amperes a new, fully charged battery will deliver at 0°F (–17.8°C) for thirty seconds of discharge and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery).

CA = Cranking Amperes at 32°F (0°C)

Same as above, tested at 32°F (0°C).

RC = Reserve Capacity at 80°F (27°C)

The reserve capacity is the time in minutes that a new, fully charged battery can be continuously discharged at 25 amperes and maintain at least 1.75 volts per cell (10.5 volts for a 12-volt battery).

Minutes discharged at 50, 25, 15, 8 and 5 Amperes

Minutes discharged is the time in minutes that a new, fully charged battery will deliver at various currents and maintain at least 1.75 volts per cell. These are nominal or average ratings.

Ampere Hour Capacity at 20, 6, 3 and 1 Hour Rates

Ampere hour capacity is a unit of measure that is calculated by multiplying the current in amperes by the time in hours of discharge to 1.75 volts per cell. These are nominal or average ratings.

EXAMPLE

10 amperes for 20 hours (10 x 20) = 200 Ah @ the 20-hour rate
8 amperes for 3 hours (8 x 3) = 24 Ah @ the 3-hour rate
30 amperes for 1 hour (30 x 1) = 30 Ah @ the 1-hour rate

Therefore, if you have an application that requires a draw of 17 amperes for 3 hours, you would need a 51 Ah battery (@ the 3 hour rate)...(17 x 3 = 51). However, this is 100% of the capacity of this 51 Ah battery.

Most system designs will specify a battery that will deliver a minimum of twice the capacity required. This means the battery will discharge to 50% of its capacity. Using a 50% depth of discharge (versus 80% or 100%) will dramatically extend the life of any battery. Therefore, when helping to specify a battery for a system, choose a battery with at least **twice** the capacity required for best performance. If 50 Ah is required, specify at least a 100 Ah battery.

CHART A

Independent Laboratory Testing BCI 2-Hour Life

Group Size "27" Batteries East Penn Gel and AGM vs. Competitor

This chart compares the cycles run until the battery capacity dropped to 50% of the 15th cycle's capacity (on discharges at the 2-hour rate to a 10.5-volt cutoff).

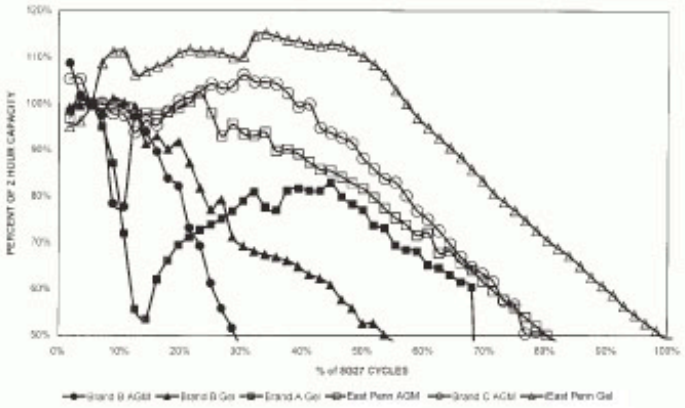


CHART B

Charging Current vs.Charging Time

Shown is the current needed to charge a battery from 0% to 90% state of charge in a given time. Or time required to change a battery from 0% to 90% state of charge at a given current. For example, to charge an 8G8D (curve H) to 90% in 3.5 hours, 100 amperes are required; at 35 amperes, it would take 10 hours

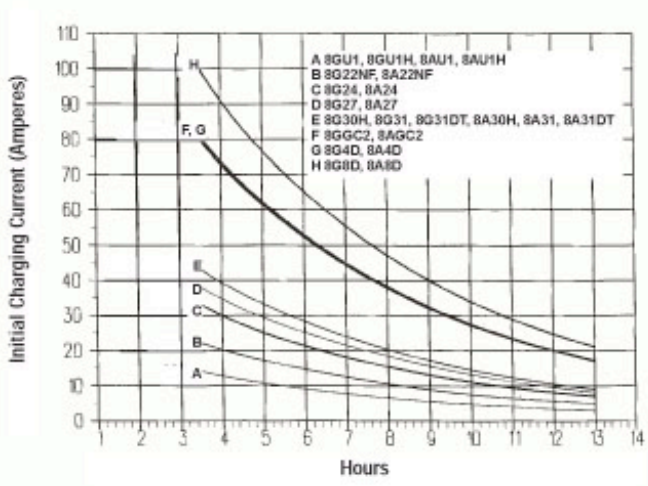


CHART C

VRLA Battery Voltage During Constant Current Discharge

Voltage vs. Percent Discharged

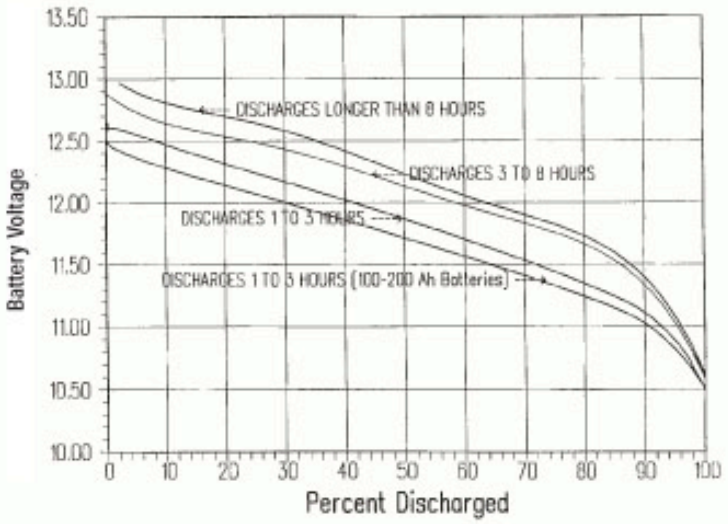
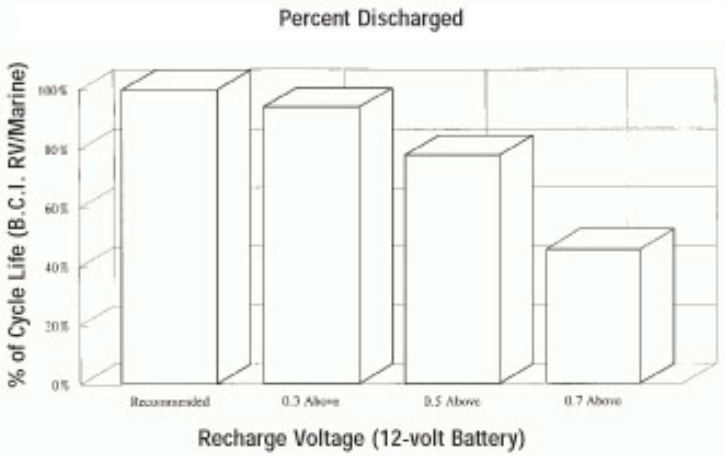


CHART D

Gel Percent Cycle Life vs. Recharge Voltage

This chart shows the effect on life of overcharging a gel battery.
(e.g.: Consistently charging at 0.7 volts above the recommended level reduces life by almost 60%!)



What are the features and benefits that make East Penn's VRLA batteries unique?

East Penn Expertise

East Penn builds VRLA batteries to the highest standards. Our manufacturing process features improved controls using state-of-the art computers and the latest manufacturing technology and equipment. Therefore, the VRLA batteries produced by East Penn consistently meet the highest quality performance and life standards.

Ultrapremium Sealing Valve

A critical feature of any VRLA battery, gelled or absorbed, is the quality of the sealing valve. Not only must the valve keep the cell pressurized and safely release excessive pressure and gas due to overcharging, but it must also keep the cell from being contaminated by the atmosphere. Oxygen contamination will discharge a VRLA battery and eventually ruin the battery.

Our valves are UL recognized and 100% tested after manufacturing. The benefit is **reliable performance and long life.**

Spillproof and Leakproof

A major advantage of VRLA batteries is their spillproof and leakproof feature. However, all VRLA batteries are not created equal in their degree of non-spillability. Some manufacturer's AGM batteries are unevenly filled. Over-saturation of the separators leaves liquid electrolyte that could spill. Under-saturation could lead to premature failure. Some gels do not set properly; they remain liquid and can leak or spill.

Our exclusive gel electrolyte is formulated, mixed and controlled to assure proper "set" in every battery. East Penn's computer-controlled gel mixing and filling equipment ensures homogenization of the mix. This assures a gel battery that will not spill or leak. This feature allows our gel cell to be operated in virtually any position. However, we do not recommend an upside-down orientation.

The AGM filling process assures that each cell is saturated with the maximum amount of electrolyte that can be held by the separators, without leaving excess electrolyte that could spill or leak.

Exclusive Gel Formula

The gelled electrolyte is another critical element in this type of battery. Our gelled electrolyte contains sulfuric acid, fumed silica, pure demineralized, deionized water, and a phosphoric acid additive. The phosphoric acid is a key reason that our batteries deliver **dramatically longer cycle life** than leading gel competitors and 3 times longer cycle life than traditional wet cells.

Exclusive AGM Electrolyte

Our AGM electrolyte contains high purity sulfuric acid and absolutely pure totally demineralized, deionized water to increase battery performance. Since the designs are "acid-starved" to protect the plates from deep discharge, the acid concentration can drop to nearly zero during an extremely deep discharge. Substances that will not dissolve in acid may become soluble when the concentration drops this low. Upon recharge, these dissolved substances crystallize out of the electrolyte, potentially destroying the battery. Our electrolyte prevents these events.

Exclusive Computerized Gel Mixing

Proper gel mixing is critical to life and performance. Consistency in mixing means consistent reliability. We have designed and built the newest, state-of-the-art gel battery manufacturing facility in the world. An example is our proprietary computerized gel mixing operation.

Our exclusive formula is mixed using computer control in every stage of the process. **Computer control delivers superior consistency for gel battery performance that is unequaled.**

Our temperature-controlled process and specially designed equipment assure a homogenous gel. It is important to note that our equipment was designed by our engineers specifically for gel mixing… even down to the contour of the tank bottoms and feed pipe locations. **No other battery manufacturer has comparable equipment.**

Multi-Staged Filling/Vacuuming Operation

Most other manufacturers fill their gel cells in a one step process, vibrating the battery with hopes of releasing most of the air pockets. This system is less than perfect and leaves voids or air pockets at the critical gel-to-plate interface. These voids are non-reactive and reduce overall battery performance.

Our process fills and vacuums each cell several times. This multi-step process assures complete evacuation of air and **complete gel-to-plate interface.** Our computerized process also weighs every battery before and after filling as a check for proper gel levels. The benefit is **more power-per-pound of battery.**

Our AGM topping process assures that the maximum retainable electrolyte quantity is held within the battery separators, without leaving any unabsorbed liquid to spill or leak.

Tank Formed Plates

East Penn is the **only** battery manufacturer that uses tank formation to activate the battery plates. This process **guarantees a fully formed and voltage matched plate.** The extra handling of the plates provides an additional inspection step in the process to verify plate quality.

Ultrapremium, Gel Glass Mat, Double Insulating Separators

Another critical component is the separator, which isolates the positive from the negative plate. The separator must allow maximum charge flow between the plates for maximum performance. Separator failure is a leading cause of warranty claims and customer dissatisfaction.

East Penn uses an **ultrapremium grade separator** in our gel batteries. We believe that this expense (which is 5 to 6 times higher than other types) is worth the benefits of extended life and performance:

- The fiberglass mats embed themselves into the surface of the plates, acting like reinforcing rods in concrete. This extra reinforcement locks the active material onto the plate for longer life and extended performance.
- The ultra-clean separators have no oil contamination or other impurities. Therefore, **resistance is low and battery performance is high.**
- Excellent porosity allows maximum charge flow, which means **more power-per-pound.**
- Superior resistance to oxidation dramatically reduces separator failure, which **extends life.**
- Our separators are **especially suited for gel batteries,** while others use separators designed for flooded automotive batteries.

Ultrapremium AGM glass mat separators

Glass mat separator properties can vary considerably. East Penn uses glass mat engineered to have an ideal balance of properties—i.e. absorbency, compressibility, puncture resistance and electrical resistance. This attention to detail results in high performance and long life.

Exclusive Thru-Partition Weld Seals

One of the causes of self-discharge in batteries is the minute electrical currents that flow between each cell through the partition at the weld area. These currents accelerate the discharge of batteries not in use.

We block these currents by using an **exclusive weld seal** or gasket. This feature **dramatically reduces self-discharge** to less than 3% per month: the lowest self-discharge rate of any battery manufacturer and seven times lower than many conventional batteries!

Exclusive Patented Calcium/Copper Lead Alloy Grids

This exclusive alloy provides **longer shelf life, more power-per-pound and superior corrosion resistance.** By using special grain refiners, we can **dramatically improve performance and life.**

Heavy-Duty Motive Power Style Grid Design

While other manufacturers cut costs by using automotive style grids, we use a high-performance deep cycle grid. This heavy-duty grid design is similar to the grid in a motive power battery.

The hefty "power rods" designed into our grids not only lock the active material onto the grid, but also act as "bus bars" to collect and direct the energy to the terminals. The benefit is **more power-per-pound** of battery for your equipment and **longer battery life.**

Multiple Plate Lug Milling

Shiny, well milled plate lugs are critical to our superior cast-on-strap quality. Each of our plate lugs is automatically milled **to assure the highest quality** strap with no loose or dropped plates. Our lugs are then fluxed and tinned automatically for an **additional assurance of quality.**

Heavier Plate Straps

We use an **exclusive** lead/tin alloy in a unique multi-stage cast-on-strap operation. The result is heavier straps with **outstanding lug-to-strap knit.** This eliminates dropped and loose plates, thereby **improving performance and life.**

Polyester Element Wrap

Another cause of deep-cycle battery failure is "mossing." This phenomenon occurs late in a battery's life, as the positive active material actually grows around the edge of the separator and eventually "shorts" against the negative plate. This ends the battery's service life.

Our AGM separators wrap around the bottom of the plate and are wider than the plates. This makes mossing failures unlikely. To prevent life-shortening mossing in our gel batteries, we use a **special polyester fiber sheet** that is wrapped around the edge of each element, similar to the wrap in an industrial battery. The result is **longer service life.**

Exclusive Forged Posts and Bushings

"Black" posts and oxygen-contaminated batteries are often due to porous lead terminal posts. A battery can lose its critical pressure through tiny pores and fissures in the battery terminals. Pressure loss is harmful to the battery and is evident by black posts, which are caused by sulfuric acid fumes escaping from the battery through and around the lead posts and bushings. These fumes can cause corrosion and can damage sensitive electronic equipment.

These pores and fissures are caused by the industry's method of casting posts and bushings. This method produces tiny air pockets and paths which allow corrosive gas to escape, causing life shortening depressurization, cell dry-out and corrosion damage.

To eliminate this problem, **we use forged terminal posts and bushings,** which are completely solid with absolutely **no porosity.** The benefit is **longer life,** better performance and **no leakage of corrosive gas**…especially important when installed in or near sensitive electronic equipment.

Acid Stratification Prevention

Acid stratification can occur in conventional wet cells. During charge, acid is released at the plate surfaces. During discharge, acid is consumed at the plate surfaces. Since the concentration is not uniform, diffusion (spontaneous mixing by random molecular motions) begins. If this mixing occurred rapidly, stratification would not occur, but it is relatively slow, allowing lighter parts of electrolyte to "float" toward the surface and heavier parts to "sink" toward the bottom.

The top portion of the plates do not perform as well in contact with lower concentration electrolyte. The bottom portion of the plates do not perform as well with the higher concentration, and will corrode prematurely. High voltage "equalization" charging is sometimes used in wet batteries to make gas bubbles that re-mix the electrolyte.

Because the immobilized gel will not "float" or "sink" within itself when a non-uniform concentration exists, it cannot stratify. Therefore, **no high-voltage equalizing charge is necessary.** Simply recharge at the standard 13.8 to 14.1 voltage setting. This means **longer life and consistent performance** in stationary and standby applications.

Electrolyte in an AGM battery is strongly held by the capillary forces between the glass mat fibers, but not completely immobilized. Stratification is possible in extremely tall cells, but cannot occur in batteries of the size covered in this document.

Convenient Carrying Handles

Carrying handles are included on the (gel) 8GU1H, 8G24, 8G27, 8G30H, 8G31DT, 8G31, 8G4D and 8G8D models. Handles are also available on (AGM) 8AU1H, 8A24, 8A27, 8A31DT, 8A4D and 8A8D. **This feature makes carrying, installation and removal easier, more convenient and less time consuming.**

Dozens of Terminal Options Available

Our batteries are delivered with the most popular type of terminal; however, on a special order basis **many terminal options are available.** This gives you total flexibility to specify the **proper terminal for your application**… without making compromises.

Proprietary Case, Cover, and Pressure Vent

We design and mold our own rugged polypropylene cases, vents and covers in our on-site, state-of the-art plastics molding facility. This provides **ultimate control** of our high performance designs, quality and delivery to our manufacturing plant, **assuring you the highest quality** battery and most reliable service.

Environment and Worker Protection

It's nice to know that every possible safeguard was designed into our process to **protect our co-workers and the environment**... special safeguards that are exclusive to East Penn. One benefit is assurance of a consistent source for batteries without fear of governmental interference or delays.

Over 250 Quality Assurance Checks

Hundreds of quality checks are performed to assure total confidence in the performance and life of our batteries.

For example:

- **100% Cycling.** After initial charging, **every battery is discharged and then recharged** at the factory. This allows us to check the performance of the battery and give it a second charge that **equalizes the cells for improved performance and longer life**.

  It's interesting to note that, as a cost-saving measure, we use the current generated during the initial discharge to recharge other batteries in this computer-controlled process.

- **Extended Shelf Stand Test.** Before shipment, every battery is required to stand for a designated period of time. Beginning and ending voltages are compared. This **extra quality assurance step** verifies that the critical pressure control valves are functioning properly.

- **Filling Weight Control.** During this computerized process, batteries are weighed before and after filling. This **assures that the exact amount of electrolyte** is in each battery.

- **Multi-Staged Filling and Vacuuming Process.** Every battery is filled and vacuumed several times during this computerized process. Multi-staged vacuuming **assures complete electrolyte-to-plate interface,** with no power-robbing air pockets.

- **Computerized Polarity Check.** Every battery is checked by computer for proper polarity.

- **High Rate Discharge Test.** Every battery is discharged at approximately twice the rated capacity. A sensitive computer monitors the voltage drop during this discharge to assure that every battery performs as designed.

- **Formed Element Inspection.** Elements are assembled and **charged outside the battery container** in a computerized forming and drying process. This allows visual inspection of every grid, plate, separator, and formed element before being sealed inside the battery, assuring perfect cell elements with longest life and highest performance.

- **Tank Formed Plates.** Voltage matched plates are critical in standby applications. Forming each plate outside the battery assures the **highest quality,** best matched plates in the industry, and also allows a visual check before and during assembly.

State-of-the-Art Technology

Within our newly constructed multi-million dollar VRLA production facility, we have incorporated **state-of-the-art manufacturing processes** that are unmatched by any other battery manufacturer. This major addition allows us to build the **most modern and reliable VRLA batteries in the industry.**

The designs of East Penn's VRLA batteries are always improving. The preceding sections accurately describe East Penn's VRLA products as of the date of publication. East Penn reserves the right to change their processes to improve quality, value or utilize advances in manufacturing technology. Ratings and capacities may change without notice.

How do East Penn's VRLA battery features compare with other types of batteries?

	FEATURE	EPM GEL	OTHER GEL	EPM AGM	OTHER AGM	ALL WET CELLS
1.	EPM Expertise	YES	NO	YES	NO	EPM ONLY
2.	Spillproof and Leakproof	YES	YES	YES	YES	NO
3.	Sealed Valve-Regulated	YES	YES	YES	YES	NO
4.	Ultra-Premium Sealing Valve	YES	NO	YES	NO	NO
5.	Exclusive Gel Formula	YES	NO	NO	NO	NO
6.	Deep Discharge Protection	YES	YES	YES	YES	NO
7.	Exclusive Computerized Gel Mixing	YES	NO	NO	NO	NO
8.	Tank Formed Plates	YES	NO	YES	NO	NO
9.	Multi-Staged Gel Filling/Vacuuming	YES	NO	NO	NO	NO
10.	Ultra-Premium Glass-Mat Dual Insulating Separators	YES	NO	NO	NO	NO
11.	Exclusive Thru-Partition Weld Seals	YES	NO	YES	NO	NO
12.	Exclusive Patented Calcium/Copper Lead Alloy Grids	YES	NO	YES	NO	NO
13.	Heavy-Duty Motive Power Style Grids	YES	NO	YES	NO	NO
14.	Grid Lug Milling, Brushing and Fluxing	YES	?	YES	NO	EPM ONLY
15.	Heavy-Duty Special Alloy Plate Straps	YES	NO	YES	NO	NO
16.	Special Polyester "Moss Guard" Element Wrap	YES	NO	NO	NO	NO
17.	Forged Posts and Bushings	YES	NO	YES	NO	EPM ONLY
18.	Acid Stratification Prevention	YES	YES	YES	YES	NO
19.	Carrying Handles	YES	?	YES	LIMITED	LIMITED
20.	Dozens of Terminal Options	YES	?	YES	?	EPM ONLY
21.	Highest Cycle Life	YES	NO	YES	NO	NO
22.	Highest Performance	YES	NO	YES	NO	N.A.
23.	Shelf Stand Test	YES	?	YES	NO	NO
24.	250+ Quality Assurance Checks w/ ISO 9001 Certification	YES	?	YES	NO	EPM ONLY
25.	State-of-the-Art Technology & Facility	YES	NO	YES	NO	EPM ONLY

Answers to the Most Frequently Asked Questions

NOTE: Before reviewing this section, be sure you understand the difference between gel, AGM, and flooded batteries.

How do we justify the premium price of VRLA batteries to those unfamiliar with this type of battery?

Simply review the advantages, features and benefits, performance, and **impressive life cycle results.** Based upon this and the **lowest cost-per-month or duty cycle** you and/or your customer should have no trouble choosing VRLA batteries.

However, please remember that these batteries are not for everyone or every application. Always be aware of the charging considerations. (See pages 11 & 12.)

What are the advantages and disadvantages of the different types of battery designs?

Gelled Electrolyte Advantages:

- Totally maintenance-free
- Air transportable
- Spillproof/leakproof
- No corrosion
- Superior deep cycle life
- Installs upright or on side (side installation may lose about 10% capacity)
- Very low to no gassing (unless overcharged)
- Compatible with sensitive electronic equipment
- Superior shelf life
- Superior rechargeability (from 0% to 90% in 3½ hours)
- No recharge current limitation @ 13.8 volts
- Rugged and vibration-resistant
- Very safe at sea with no chlorine gas in bilge (due to sulfuric acid and salt water mixing)
- Versatile: Starting, Deep Cycle, Stationary
- Operates in wet environments…even under 30 feet of water
- Will not freeze to –20°F/–30°C (if fully charged)
- Lowest cost-per-month (cost ÷ months of life)
- Lowest cost-per-cycle (cost ÷ life cycles)

Gelled Electrolyte Disadvantages:

- Higher initial cost
- Heavier weight
- Water cannot be replaced if continually overcharged
- Automatic temperature-sensing, voltage-regulated chargers **must** be used
- Charge voltage **must** be limited to extend life (13.8 to 14.1 volts maximum at 68°F)

Absorbed Electrolyte Advantages:

- Totally maintenance-free
- Air transportable
- Spillproof/leakproof
- No corrosion
- Installs upright or on side
- Lower cost than gel cell batteries
- Compatible with sensitive electronic equipment
- Very low to no gassing (unless overcharged)
- Excellent for starting and stationary applications
- Superior for shorter duration/higher rate discharges
- Superior under extreme cold conditions when fully charged
- Superior shelf life
- Superior rechargeability (from 0% to 90% in 3½ hours)
- Rugged and vibration-resistant
- Very safe at sea with no chlorine gas in bilge (due to sulfuric acid and salt water mixing)
- Operates in wet environments…even under 30 feet of water

Absorbed Electrolyte Disadvantages:

- Shorter cycle life than gel in very deep cycle applications
- Automatic temperature-sensing, voltage-regulated chargers **must** be used
- Water cannot be replaced if continually overcharged
- Charge voltage **must** be limited (14.4 to 14.6 volts maximum at 68°F)

Flooded Electrolyte Advantages:

- Lowest initial cost
- Higher cranking amps
- Water can be added (if accessible)
- Excellent for starting applications
- Tolerant of improper recharge voltage
- Certain designs are good for deep cycle applications
- Replacements readily available
- Good under extreme cold conditions when fully charged

Flooded Electrolyte Disadvantages:

- Spillable
- Operates upright only
- Shorter shelf life
- Fewer shipping options
- Cannot be installed near sensitive electronic equipment
- Watering may be required (if accessible)

Why can't VRLA batteries be opened?

VRLA (Valve-Regulated Lead-Acid) batteries, sometimes called SLA (Sealed Lead-Acid) batteries or SVR (Sealed Valve-Regulated) batteries work on a recombination principle. Oxygen gas is produced at the positive plates during charge. The charged negative plates react first with this oxygen and subsequently with the electrolyte. Water is produced and the negative plates are very slightly discharged. Additional charging recharges the negative plates instead of producing hydrogen gas. Since very little hydrogen and oxygen is lost and the water (H_2O) is retained, we say that the gasses have recombined. To work properly, the oxygen produced must be retained in the battery until the reaction is completed. Positive pressure allows the gas to be retained.

If any VRLA (gelled or absorbed electrolyte) battery is overcharged, gas will be vented from the valves. Hydrogen as well as oxygen will be released. If continued, the electrolyte will eventually dry out and the battery will fail prematurely. This is why charging limits are so critical.

In a sealed battery a balance is maintained between the hydrogen, oxygen and charge. If a VRLA battery is opened, or leaks, the negative plates are exposed to extra oxygen from the atmosphere. This excess oxygen upsets the balance. The negative plates become discharged. The positive plates may be subsequently severely overcharged. The battery ***will*** fail prematurely, and the **warranty will be voided.**

Some say calcium grids don't do well in flooded deep cycle applications. Why does East Penn use calcium grids in VRLA batteries for deep cycle applications?

Flooded calcium alloy makes a very efficient, low resistance battery. Therefore, when deeply discharged, the plates release all their available power, eventually causing plate shedding and active material fall-out. In contrast, with flooded antimony batteries, the antimony helps lock the active material onto the grid. Therefore, the plate does not shed as easily, which extends the deep cycle life of the battery when compared to flooded calcium.

Our VRLA calcium alloy battery **(East Penn's exclusive patented alloy)** is also very efficient with low resistance. However, when deeply discharged, the electrolyte is used up before the plates are totally discharged because the battery is "acid-starved." This feature:

- limits the discharge the plates can deliver.
- protects the plates from shedding due to deep discharge.
- extends the life of the battery.

Why do EPM VRLA batteries have longer cycle life than others?

Some of the major features that contribute to our long cycle life are:

- Our patented calcium/copper grid alloy **delivers superior performance** due to the purity of the lead. Copper is added as a "grain refiner." This means that the microscopic grains in our lead grids are odd-shaped, so they retard corrosion and **extend the life** of our grid.
- Our **thicker grids** have more corrosion resistance than thinner grids.
- Our VRLA batteries are protected against deep discharge because they are **"acid-starved."** This means that the battery uses the power in the acid before it uses the power in the plates. Therefore, the **plates are never subjected to destructive ultra-deep discharges.**
- With proper temperature-sensing, voltage-regulated charging (refer to table on page 11) the VRLA battery **never runs out of water.**
- Our gel batteries contain ultra-premium, **glass-mat,** dual-insulating separators which will not break down in service. The glass mat embeds itself into the plate, which **retards life-shortening shedding.**
- Our gel batteries contain polyester element wrap which **retards "mossing"** or active material growth that causes short circuits.
- Our AGM batteries contain separators at the ideal compression and ideal saturation to achieve the best balance between capacity utilization and recombination efficiency.
- Over **250 quality control checks** assure superior performance and long battery life.

Why do EPM VRLA batteries have longer shelf life?

Our calcium/copper lead alloy premium separators and demineralized electrolyte are **ultra-pure.** Impurities in the lead alloy, separators and electrolyte cause tiny currents inside a cell which eventually discharge the battery and shorten its shelf life. **The purer the components, the longer the shelf life.** No one can match East Penn's purity!

Our exclusive **"weld seal gasket"** blocks the minute cell-to-cell currents that cause self-discharge. The better the weld seal, the longer the shelf life. Weld seals are **exclusive** to East Penn VRLA batteries.

Does depth of discharge affect cycle life?

Yes! The harder any battery has to work, the sooner it will fail.

Typical VRLA Battery Cycling Ability vs. Depth of Discharge*

	Typical Life Cycles	
Capacity Withdrawn	**Gel**	**AGM**
100%	450	150
80%	600	200
50%	1000	370
25%	2100	925
10%	5700	3100

** You may experience longer or shorter life based upon application, charging regimen, temperature, rest periods, type of equipment, age of battery, etc.*

As you can see, **the shallower the average discharge, the longer the life.** This is why it's important to size a battery system to deliver at least twice the average power required, to assure shallow discharges.

Follow these tips for the longest life:

- Avoid ultra-deep discharges.
- Don't leave a battery at a low stage of charge for an extended length of time. Charge a discharged battery as soon as possible.
- Don't cycle a battery at a low state of charge without regularly recharging fully.
- Use the highest initial charging current available (up to 30% of the 20-hour capacity per hour) while staying within the proper temperature-compensated voltage range.

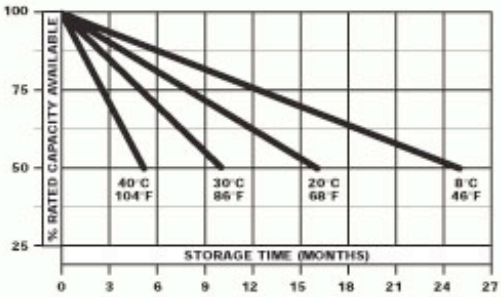
Why can't EPM VRLA batteries be discharged too low?

Our VRLA batteries are designed to be **"acid-starved."** This means that the power (sulfate) in the acid is used before the power in the plates. This design protects the plates from ultra-deep discharges. Ultra-deep discharging is what causes life-shortening plate shedding and accelerated positive grid corrosion which can destroy a battery.

Why does temperature have such a dramatic effect on batteries?

Temperature is a major factor in battery performance, shelf life, charging and voltage control. At higher temperatures there is dramatically more chemical activity inside a battery than at lower temperatures. The following charts graphically illustrate this fact.

Typical Self-Discharge of VRLA Batteries at Different Temperatures



AGM Charge and Float Voltages at Various Temperature Ranges

Temp. °F	Charge Optimum	Charge Maximum	Float Optimum	Float Maximum	Temp. °C
≥ 120	13.60	13.90	12.80	13.00	≥ 49
110 – 120	13.80	14.10	12.90	13.20	43 – 49
100 – 110	13.90	14.20	13.00	13.30	38 – 43
90 – 100	14.00	14.30	13.10	13.40	32 – 38
80 – 90	14.10	14.40	13.20	13.50	27 – 32
70 – 80	14.30	14.60	13.40	13.70	21 – 27
60 – 70	14.45	14.75	13.55	13.85	16 – 21
50 – 60	14.60	14.90	13.70	14.00	10 – 16
40 – 50	14.80	15.10	13.90	14.20	4 – 10
≤ 40	15.10	15.40	14.20	14.50	≤ 4

Gel Charge and Float Voltages at Various Temperature Ranges

Temp. °F	Charge Optimum	Charge Maximum	Float Optimum	Float Maximum	Temp. °C
≥ 120	13.00	13.30	12.80	13.00	≥ 49
110 – 120	13.20	13.50	12.90	13.20	44 – 48
100 – 109	13.30	13.60	13.00	13.30	38 – 43
90 – 99	13.40	13.70	13.10	13.40	32 – 37
80 – 89	13.50	13.80	13.20	13.50	27 – 31
70 – 79	13.70	14.00	13.40	13.70	21 – 26
60 – 69	13.85	14.15	13.55	13.85	16 – 20
50 – 59	14.00	14.30	13.70	14.00	10 – 15
40 – 49	14.20	14.50	13.90	14.20	5 – 9
≤ 39	14.50	14.80	14.20	14.50	≤ 4

What is acid stratification? How do VRLA batteries prevent it?

See page 6 for a detailed explanation of this phenomenon.

How does a battery recharge?

The process is the same for all types of lead-acid batteries: flooded, gel and AGM. The actions that take place during discharge are the reverse of those that occur during charge.

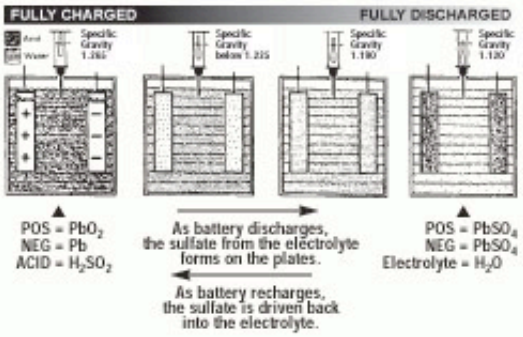
The discharged material on both plates is lead sulfate ($PbSO_4$). When a charging voltage is applied, charge flow occurs. Electrons move in the metal parts; ions and water molecules move in the electrolyte. Chemical reactions occur at both the positive and negative plates converting the discharged material into charged material. The material on the positive plates is converted to lead dioxide (PbO_2); the material on the negative plates is converted to lead (Pb). Sulfuric acid is produced at both plates and water is consumed at the positive plate.

If the voltage is too high, other reactions will also occur. Oxygen is ripped from water molecules at the positive plates and released as a gas. Hydrogen gas is released at the negative plates—unless, oxygen gas can reach the negative plates first and "recombine" into H_2O.

A battery will "gas" near the end of charge because the charge rate is too high for the battery to accept. A temperature-compensating, voltage-regulating charger, which automatically reduces the charge rate as the battery approaches the fully charged state, eliminates most of this gassing. **It is extremely important not to charge batteries for long periods of time at rates which cause them to gas** because they use water, which in sealed valve-regulated batteries cannot be replaced. Of course, no battery should be overcharged for a long period of time…even at low rates using so-called "trickle charges."

In a fully charged battery, most of the sulfate is in the sulfuric acid. As the battery discharges, some of the sulfate begins to form on the plates as lead sulfate ($PbSO_4$). As this happens, the acid becomes more dilute, and its specific gravity drops as water replaces more of the sulfuric acid. A fully discharged battery has more sulfate in the plates than in the electrolyte.

The following illustration shows the relationship between specific gravity readings and the combination of the sulfate from the acid with the positive and negative plates at various states of charge.



How critical is recharge voltage? Why are all VRLA batteries so charge sensitive?

All lead-acid batteries give off hydrogen from the negative plate and oxygen from the positive plate during charging.

VRLA batteries have pressure-sensitive valves. Without the ability to retain pressure within the cells, hydrogen and oxygen would be lost to the atmosphere, eventually drying out the electrolyte and separators.

Voltage is electrical pressure. Charge (ampere-hours) is a quantity of electricity. Current (amperes) is electrical flow (charging speed). A battery can only store a certain quantity of electricity. The closer it gets to being fully charged, the slower it must be charged. Temperature also affects charging.

If the right pressure (voltage) is used for the temperature, a battery will accept charge at its ideal rate. If too much pressure is used, charge will be forced through the battery faster than it can be stored. Reactions other than the charging reaction occur to transport this current through the battery—mainly gassing. Hydrogen and oxygen are given off faster than the recombination reaction. This raises the pressure until the pressure relief valve opens. The gas lost cannot be replaced. Any VRLA battery will dry out and fail prematurely if it experiences excessive overcharge. **Note:** It is the pressure (voltage) that initiates this problem—a battery can be "over-charged" (damaged by too much voltage) even though it is not fully "charged."

This is why charging voltage must be carefully regulated and temperature compensated to the values on page 11.

How long does it take to recharge a fully discharged VRLA battery?

A **specific time is difficult to determine** because recharging depends on so many variables:

- Depth of discharge
- Temperature
- Size and efficiency of the charger
- Age and condition of the battery

See the following Charging Guides for an estimated time based upon the initial charge current the battery accepts.

Typical Charging Time vs. 90% and 100% State of Charge

It will take about 60% of the charge time to bring a VRLA battery from 0% charged to 90% charged. It will take the remaining 40% of the total charging time to put the last 10% of the charge back into the battery.

Charge is a quantity of electricity equal to rate of flow (Amperes) times time (hours), and usually expressed in Ampere-hours (Ah).

0% state of charge is defined as the depth of discharge giving a terminal voltage of 10.50 Volts – measured under a steady load at the 20-hour rate at 80°F. (The 20-hour rate is the 20-hour capacity divided by 20 hours.)

Typically, the charge that must be returned to a VRLA battery to achieve a 100% state of charge is from 105% to 115% of the charge removed.

Charging Guides

Typical Charge Time vs. Initial Charge Current to 90% Full Charge

(Using an automatic temperature-sensing, voltage-regulating charger set at 13.8V. Totally discharged battery at 11.80–12.0 volts.)

	Initial Amperes		
Part No.	13 hrs*	6 hrs*	3½ hrs*
8GU1, 8GU1H, 8AU1, 8AU1H	3	8	15
8G22NF, 8A22NF	5	12	23
8G24, 8A24	7	17	33
8G27, 8A27	8	21	41
8G30H, 8G31, 8G31DT, 8A30H, 8A31, 8A31DT	9	24	45
8G4D, 8GGC2, 8A4D, 8AGC2	17	42	83
8G8D, 8A8D	20	50	100

**approximate*

HOW TO USE THIS CHART: When charger is first turned on, read amps after about one minute. Initial ampere reading will indicate approximate charging time.

EXAMPLE
If an 8G24 reads about 17 ampere charge current when first turned on, the battery will be at 90% in about 6 hours.

IMPORTANT: Always use an automatic temperature-sensing, voltage-regulated charger! Set charger at 13.8 to 14.1 volts at 68°F for gel, or 14.4 to 14.6 volts at 68°F for AGM. Do not exceed 14.1 volts for gel or 14.6 volts for AGM.

How can continual undercharging harm a battery?

In many respects, **undercharging is as harmful as overcharging.** Keeping a battery in an undercharged condition allows the positive grids to corrode and the plates to shed, dramatically shortening life. Also, an undercharged battery must work harder than a fully charged battery, which contributes to short life as well.

An undercharged battery has a greatly reduced capacity. It may easily be inadvertently over-discharged and eventually damaged.

How can you tell if an VRLA battery is fully charged?

By using a voltmeter.

*Open Circuit Voltage vs. State of Charge Comparison**

% Charge	Open Circuit Voltage Flooded	Gel	AGM
100	12.60 or higher	12.85 or higher	12.80 or higher
75	12.40	12.65	12.60
50	12.20	12.35	12.30
25	12.00	12.00	12.00
0	11.80	11.80	11.80

NOTE: Divide values in half for 6-volt batteries.

** The "true" O.C.V. of a battery can only be determined after the battery has been removed from the load (charge or discharge) for 24 hours.*

How can you tell if a VRLA battery has been damaged by under- or overcharging?

The only way is **with a load test.** Use the same procedure you would use with a wet cell battery:

a. Recharge if the open circuit voltage is below 75%.

b. If adjustable, set the load at ½ the CCA rating or three times the 20 hour rate.

c. Apply the load for 15 seconds. The voltage should stabilize above 9.6 volts while on load.

d. If below 9.6 volts, recharge and repeat test.

e. If below 9.6 volts a second time, replace the battery.

What is a float charger? What float voltage is recommended?

This type of charger continually delivers a pre-set voltage to the battery, regardless of charge conditions.

These chargers are used in stationary, emergency back-up power, emergency lighting, and other applications.

The frequency of discharge and temperature will dictate a more exact setting. For example, the more frequent the discharge, the higher the suggested recharge voltage, to **a maximum of 2.35 volts per cell (at 20°C/68°F).**

Our recommended float voltage is 2.25 to 2.3 volts per cell for gel and absorbed models.

What is a thermal runaway?

The appropriate charge voltage depends on the battery temperature (see page 11). A warmer battery requires a reduced voltage. If the voltage is not reduced, current accepted by the battery increases. When the current increases, the heating increases. This can continue in a loop feeding on itself with the battery temperature and charging current rising to destructive levels.

Gel batteries are much less susceptible to thermal runaway than AGM batteries. Batteries may become more susceptible with increasing age. Without a recombination reaction, flooded batteries convert most excess charging energy to gas, not heat. This makes them almost immune from the thermal runaway.

Thermal runaway can be prevented with:

- Temperature compensation monitoring at the battery—not at the charger.
- Limiting charging currents to appropriate levels (see page 11).
- Allowing for adequate air circulation around the batteries.
- Using timers, or Ampere-hour counters.
- Using smart chargers that recognize the signature of a thermal runaway event which will shut the charger down.

How do I know if a charger is "gel friendly" or "AGM friendly"?

Unfortunately, many chargers on the market claim to be gel "friendly" or "OK for sealed batteries", but are not. Some overcharge the batteries, while others may not fully charge the batteries. Some chargers claim to be "smart", Some "smart" chargers do a good job, others do not. The best choice of charger often depends on the application.

Use only "voltage-regulated" or "voltage-limited" chargers. **Standard constant current or taper current chargers must not be used. The voltage must fall in the range of the chart on page 11.** Almost all applications require temperature sensing and voltage compensation. Beware, many chargers measure the ambient temperature which could be significantly different from the battery's internal temperature.

Low frequency current ripple (to about 333 Hz) can be detrimental to sealed batteries depending on the application. On applications where the charger is connected continuously to a float voltage, especially where simultaneous charge and discharge may occur, the level of current ripple must be a consideration.

If you are not sure if a charger is performing properly, follow this procedure:

a. Using a fully discharged VRLA battery (OCV about 11.8V) and a digital voltmeter, record the initial open circuit voltage at the battery terminals.

b. Using an automatic charger as described above, set voltage if adjustable (14.1V for gel, 14.4V for AGM models).

c. Connect and start charging. Record initial on-charge voltage and current .

d. Each hour or so, check and record the on-charge voltage across the battery terminals. Except for occasional, brief "blips" or pulses, the voltage should not exceed the voltage limits noted in "b" above.

e. At the end of charge (when the current is very low or goes to zero) check and record the voltage. Note that the charger may have turned off by then.

f. The disconnected battery should be at 100% or above after a 24 hour rest.

During the charging time, the charger should not have exceeded the limit (except for occasional, brief pulses). This indicates that the charger is working properly.

Keep in mind that the voltage limit is at 68°F/20°C. Charging at higher or lower temperatures will change this limit.
A temperature-sensing charger should always be used, as manual adjustments are never accurate and will damage any VRLA battery.

Do VRLA batteries have a "memory" like ni-cad batteries?

One of the major disadvantages of nickel-cadmium (ni-cad) batteries is that after shallow discharge cycles, the unused portions of the electrodes "remember" the previous cycles and are unable to sustain the required discharge voltage beyond the depth of the previous cycles. The capacity is lost and can only be restored by slowly discharging completely (generally outside the application), and properly recharging. **VRLA batteries do not exhibit this "use it" or "lose it" capacity robbing effect known as memory.**

What is a safe charge rate or voltage setting for outdoor applications with wide temperature fluctuations if a temperature-sensing charger is not available?

NONE! As the chart on page 11 (Effect of Temperature on Recharge Voltage) shows, charging voltage varies widely with temperature. **There is no fixed voltage setting or current that will work.** A temperature-sensing, voltage-regulated charger must be used. Anything else will damage any battery and **cause premature failure!**

Can a VRLA battery be load tested?

Yes. See page 13 (How can you tell if a VRLA battery has been damaged by under- or overcharging?).

Why do some VRLA batteries bulge? Why do some VRLA batteries appear "sucked in"? Are there visual signs of a faulty or plugged pressure relief valve?

To prevent the permanent loss of gases so that recombination has time to take place, each cell can hold up to about 1.5 psi without venting.

Batteries with very large cells, such as the 8G4D, 8G8D, 8A4D, 8A8D and 8GGC2, will bulge somewhat as this normal pressure builds. This is especially true in higher temperatures, because the polypropylene case is pliable. Therefore, **a certain amount of bulge is normal.**

The valves only let gas out, never in. A partial vacuum can form within a sealed battery under various circumstances. Battery temperature and ambient pressure play a role, but predominantly the recombination and discharge reactions are responsible. After charging ends, the recombination reaction continues until most of the oxygen in the battery headspace is consumed. The total volume of the battery components decreases slightly during a discharge. Deeply discharged batteries often have a "sucked-in" appearance. Batteries with large cells may display this appearance even when fully charged.

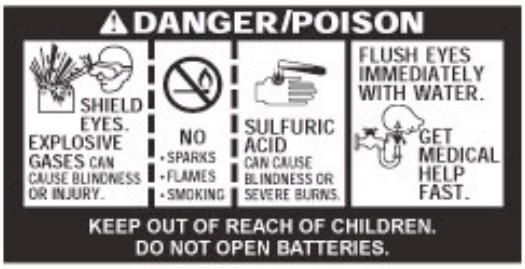
If a battery bulges severely on charge, this is not normal. It is an indication of a blocked valve or an overcharge situation. Such a battery should be removed from service.

A sucked-in appearance can also be normal. A sucked-in battery should be charged, but if it remains sucked-in after charging, the appearance can safely be ignored; however, if only a single cell displays or lacks this appearance a load test would be prudent.

How safe are VRLA batteries? Can they explode?

VRLA batteries are very safe, unless abused. However, as with any type battery, certain safety precautions must be taken.

**ALWAYS WEAR SAFETY GLASSES
WHEN WORKING AROUND BATTERIES!**



CALIFORNIA PROPOSITION 65 WARNING: Batteries, battery posts, terminals and related accessories contain lead and lead compounds and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

Because VRLA batteries normally emit very little to no hydrogen gas, they are safe near sensitive electronic equipment. They do not cause corrosion of surrounding metals. No hydrogen gas means no dangerous explosions... UNLESS SEVERELY OVERCHARGED!

Do not install any lead-acid battery in a sealed container or enclosure. Hydrogen gas from overcharging must be allowed to escape.

DO NOT CHARGE IN EXCESS OF 14.1V @ 68°F - Gel Cells
14.6V @ 68°F - Absorbed

Always use a reliable, temperature-sensing, voltage-regulated, automatic charger.

Because SVR batteries have immobilized electrolyte, they cannot spill or leak, even if punctured. That is why they are approved for air transport by the International Commercial Airline Organization (ICAO), International Airline Transport Association (IATA), and Department of Transportation (DOT) as noted on the label if properly insulated from short circuits.

Also, when protected against short circuits and securely braced/blocked, our VRLA batteries "are not subject to any other requirements of 49 CFR Parts 171-180…." for shipping.

Which way does current flow? On which side should a circuit breaker be installed?

During discharge, electrons progress through the external circuit from the negative post toward the positive post. Inside the battery, positive ions move toward the positive plate by diffusion where they react, leaving neutral molecules in solution. The resulting neutral molecules move back toward the negative plate by diffusion. There are also negative ions in the electrolyte offsetting the positive ion charges. Some travel by diffusion toward both the negative and the positive plates, where they are consumed. During charge, all of the directions reverse.

Although not physically accurate, when designing circuits or making calculations, it is just as valid to consider positive charges moving through the whole circuit. Indeed, this is the convention used to define the direction of current in electronics (known as conventional current).

Proper location of disconnects depends on the application. Vehicles can vary, but in most cases, the negative terminal is treated as ground. The entire chassis is connected to the negative terminal of the battery. The positive side of the circuit is considered "hot." **Switches/circuit breakers should usually be installed on the hot side of a device.** When disconnecting the entire battery from the system with a fusible link or circuit breaker, breaking the connection from the negative terminal to the chassis often works best.

In multiple battery installation, there could be other considerations such as total voltage, multiple voltages, and the effects on other devices.

What do I need to know about installation, especially in salt water marine applications?

Wiring and Waterproofing

ALWAYS WEAR SAFETY GLASSES WHEN WORKING AROUND BATTERIES!

a. Cabling of the approved gauge should be tinned copper. If using untinned copper, allow plenty of spray silicone to "wick" along the strands.

b. Install heat-shrink tubing with a silicone interior; the silicone forms an excellent moisture barrier. Cut the tubing long enough to cover the terminal lug and plenty of the insulated portion of the cable. Slip tubing onto the cable.

c. Crimp on the appropriate terminal.

d. Position the heat-shrink tubing. Heat and inspect.

e. Clean battery terminals and connect. Be sure perfect metal-to-metal contact is made, with no dirt, corrosion, grease or foreign material to interfere with current flow.

f. Always attach the cable connected to the solenoid or starter first. Attach the ground cable last! Tighten snugly, BUT DO NOT OVERTIGHTEN, which will damage the terminals or crack the battery cover. This will destroy the battery and VOID THE WARRANTY.

g. Spray exposed terminals and connectors with several coats of battery terminal corrosion protection spray. (Mask surrounding areas to protect against overspray.)

h. For batteries which may be exposed to very wet environments (e.g. bilge mounted batteries) total encasement of the exposed terminals and connectors is necessary. However, do not block or cover the vents. **Allow ventilation.**

A battery terminal boot should be used. Install the boot on the cable before crimping the terminal. Fill the boot with petroleum jelly and fit over the sprayed connectors (as in "g" above).

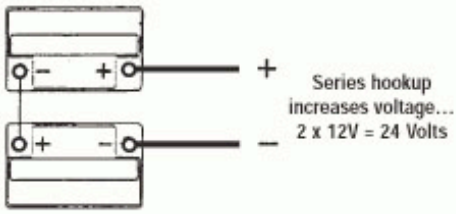
i. Battery charging in a boat requires a charger specifically designed for marine applications. In addition to battery gases, bilges often contain potentially dangerous fuel fumes. Follow all wiring and grounding recommendations of the charger manufacturer for on-board and on-shore connections. **Using a charger not specifically designed for marine applications or failure to follow the marine charger manufacturer's grounding and wiring recommendations could result in major corrosion damage to the hull or prop, and create a serious risk of electrical shock or fire, personal injury or death.**

Battery Installation

Note: In a multi-battery installation, it is often best to replace the entire set of batteries when one battery is weak or has failed.

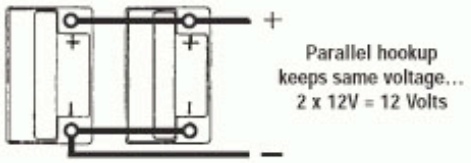
Series

A "series" system increases the voltage, but keeps the battery capacity (cranking amps, amp hours, reserve minutes, and minutes running time) the same. Therefore, two 12-volt batteries connected in series (POS to NEG, NEG to POS) will deliver 24 volts at the same rating as one battery: During recharge, each battery receives the same amount of current: e.g. if the charger is putting out 10 amps, both batteries are getting 10 amps.



Parallel

A "parallel" system increases the capacity available, but keeps the voltage the same. Therefore, two 12-volt batteries with 400 CCA, 110 R.C. and 65 Ah will deliver 12 volts, 800 CCA, 220 R.C. and 130 Ah. (Actually, since each battery's load is lighter, the reserve capacity will more than double.)



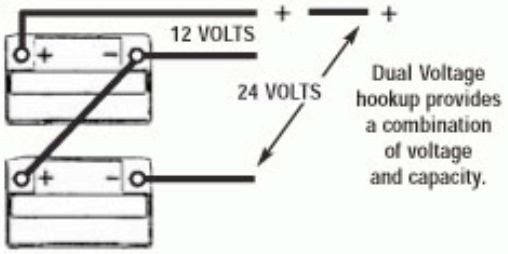
During recharge, the current (amps) is split between the batteries. The battery that is discharged the most will receive more current than the other until both are brought up to full charge.

Series/Parallel

A "series/parallel" system provides a combination of voltage and capacity for special applications. Note: Never mix different types and sizes of batteries in the same bank.

Dual Voltage

The illustration shows an arrangement that would supply 24 volts to a starter and 12 volts to the electronics (or vice versa).



To properly recharge, a sophisticated "battery isolator" should be installed. Otherwise, one battery will be continually overcharged and the other undercharged in a dual-voltage set-up.

IMPORTANT: Do not install any type of battery in a completely sealed box or enclosure. In the event of overcharging, the potentially explosive gasses must be allowed to escape.

UL Recognized Component

QUALITY SYSTEM CERTIFIED TO ISO 9001 ISO/TS 16949

MEMBER OF:

Battery Council International

ABYC AMERICAN BOAT & YACHT CLUB

IBMA INDEPENDENT BATTERY MANUFACTURERS ASSOCIATION

NMMA NATIONAL MARINE MANUFACTURERS ASSOCIATION

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Gel Battery Charging		
STAGE	**END CONDITIONS**	**ERROR**
Bulk Stage I_1 Maintain Current <= 30 A per 100 Ah C_{20} Typically, Constant Current, but Constant Power, or Taper Charge Permitted	End when voltage = 2.30 to 2.35 V/cell (20°C) Max time (h) = 1.2 * DoD (Ah) / Avg. Current (A)	If Max time is exceeded: STOP
Absorption Stage V_1 Maintain Constant Terminal Voltage (Adjusting only for changing battery temperature) Voltage = 2.30 to 2.35 V/cell (20°C)	Without the optional accelerated finishing stage, maintain charge until current acceptance drops by less than 0.10 ampere over a 1 hour period Max Time: 12h With optional accelerated finishing stage end when current = I_2 Max Time: 6h	If Max time is exceeded: Goto next stage If Current exceeds 8 A after dropping below 6 A: STOP
Optional Accelerated Finishing Stage I_2 Maintain Constant Current: 1 to 1.5 A per 100 Ah C_{20}	Charge for 1 to 4 hours based on Ah accumulated in first two stages: <25% of C_{20} – 1 hour 25% to 50% of C_{20} – 2 hours >50% of C_{20} – 4 hours	If Voltage exceeds 2.80 V/cell: Goto next stage
Optional Float Stage V_2 Maintain Constant Terminal Voltage (Adjusting only for changing battery temperature) Voltage = 2.25 V / cell (20°C)	No time limit This step is generally unneeded if (1) zero load is present when device is not in operation, and (2) device duty cycle does not include periods of non-use exceeding 3 months.	

To compensate for battery temperature not at 20°C, subtract 0.005 V/cell for each 1°C above 20°C; add 0.005 V/cell for each 1°C under 20°C.

Applies to East Penn's 8G product line.

SECTION 16442 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, General and Supplementary Conditions are included in this Section.

1.2 SUMMARY

A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panelboards.
2. Distribution panelboards.
3. Transient voltage surge suppressor panelboards.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
3. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
4. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
5. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

E. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: As indicated in the drawings.

G. Maintenance Data: For panelboards and components to include in maintenance manual.

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. General Electric Co.; Electrical Distribution & Control Div.
b. Xantrex Technologies

2.2 FABRICATION AND FEATURES

A. Enclosures: NEMA PB 1, Type 1, to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

F. Bus: Tin-plated aluminum.

G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

L. Split Bus: Vertical buses divided into individual vertical sections.

M. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

N. Gutter Barrier: Arrange to isolate individual panel sections.

O. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch overcurrent protective devices shall be as specified on drawings and schedules.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, as shown with interrupting capacity to meet available fault currents.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
2. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
2. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.7 CONTROLLERS

A. Contactors: NEMA ICS 2, Class A combination controller equipped for panelboard or individual mounting and including the following accessories:

1. Individual control-power transformers.
2. Fuses for control-power transformers.
3. Indicating lights.
4. Seal-in contact.
5. Two (2) convertible auxiliary contacts.
6. Push buttons.
7. Selector switches.

B. Controller Disconnect Switches: Adjustable instantaneous-trip circuit breaker integrally mounted and interlocked with controller.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

INSTALLATION GUIDE

1 Introduction

Thank you for purchasing the Xantrex C-Series Meter Display. The C-Series Meter Display is an optional accessory for the C-Series Multifunction DC controllers C35, C40 and C60. It provides a digital display of the voltage, current, and amp-hour status for the C-Series Multifunction DC Controller.

The C-Series Meter Display comes in two versions:

- the faceplate (DVM/C40), which replaces the front cover.
- the remote (C40R/50 and C40R/100), which can be installed remotely up to 1,000 feet away from the controller.

Figure 1 The Faceplate and Remote

Please note that labeling shown on the product photographs in this guide may not exactly match the unit you purchased.

Read this guide before connecting or using the C-Series Meter Display, and save it for future reference. The main topics in the guide are as follows:

2 Important Safety Information

Misusing or incorrectly connecting the C-Series Meter Display may damage the equipment or create hazardous conditions for users. Read the following safety instructions and pay special attention to all Warnings and Cautions statements in the guide.

Warnings identify conditions that may result in personal injury or loss of life.

Cautions identify conditions or practices that may damage the unit or other equipment.

Warnings and Cautions

WARNING: Explosion Hazard
Do not use the C-Series Meter Display in the presence of flammable fumes or gases. Do not use the C-Series Meter Display in an enclosure containing automotive-type, lead-acid batteries. These batteries, unlike sealed batteries, vent explosive hydrogen gas, which can be ignited by sparks from electrical connections.

WARNING: Shock Hazard
Ensure all power sources are disconnected before proceeding.

Failure to follow these safety guidelines may cause personal injury and/or damage to the C-Series Meter Display. It may also void your product warranty.

Additional Safety Guidelines

Be sure to read, and adhere to, the Safety Guidelines listed in the Owner's Manual for the C-Series Multifunction DC Controller.

3 Features

The C-Series Meters have three features:

- a Liquid Crystal Display (LCD) to show current, voltage, amperage, resettable amp hours and total amp hours,
- an Amp-hour Reset Button, which is also used to illuminate or dim the display, and
- a Light Emitting Diode (LED) to indicate system status.

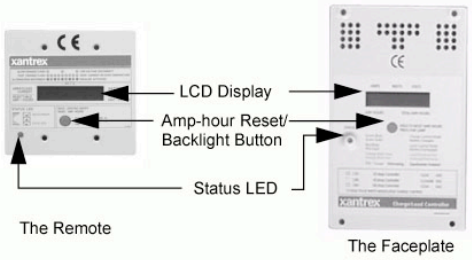


Figure 2 Faceplate and Remote Features

The remote is supplied with either a 50-foot (15 m) or a 100-foot (30.5 m) communications cable. Cable runs up to 1,000 feet (305 m) can be used, but cables exceeding 100 feet are not provided by Xantrex.

The Liquid Crystal Display (LCD)

The LCD on the faceplate or remote provides the following information.

Information Type	Display Value/Range
Current from PV Array or DC Load	0 to 85 amps DC (in whole numbers only)
Battery Voltage	4 to 100 volts DC (in 0.2 volt increments)
Watts	0 to 3,600 watts (volts x amps)
Amp hours	0 to 65,536 Ah; can be reset to 0
Total amp hours	0 to 65,536 Ah; resets to zero when power is disconnected
Status LED	green, red, or orange

Figure 3 LCD Features

The contrast of this display can be adjusted by a potentiometer located on the back on the unit. The potentiometer is a black, round knob on the circuit board next to the jumper pins. See page 9 for the location of this potentiometer.

Amp-Hour Reset and Backlight Button

The amp-hour meter on the faceplate or remote can be reset by two different methods.

Automatic resetting occurs when the C-Series Multifunction DC Controller is first connected and activated and each time it's disconnected from the battery or the meter cable.

To manually reset the amp-hour meter, press and hold the push-button on the front of the meter until the display resets.

This button also activates or deactivates the backlight for the LCD when pressed and released immediately.

LED Status Indicator

The multicolor LED indicates the operating status of the controller. A color-coded label is included on the cover of the controller explaining the status LED's indications. It blinks green, red, or orange depending on the status of the system. The sequence of the flash also changes depending on the operation of the controller at that time.

See page 17 for a basic description of these indications.

See the Owner's Manual for the C-Series Multifunction DC Controller for a more detailed description of the LED indications.

Important: The green and red color of the LED only indicates the particular operating mode and the battery voltage level. It does not indicate whether the charging source is functioning properly.

4 Installation

The following sections describe how to install the C-Series Meter Display. They include detailed instructions for the following steps.

1. **Jumper Installation (Step 1):** Set the voltage setting on the faceplate or remote to match the system voltage by installing the jumper over the appropriate pins. *This step is critical to the proper operation of the unit.*
   See "Jumper Installation (Step 1)" on page 8 for instructions.
2. **Cable Installation (Step 2):** Connect the display to the C-Series controller using the communications cable.
   See "Cable Installation (Step 2)" on page 10 for instructions.
3. **Faceplate/Remote Installation (Step 3):** Determine the location and mounting method for the remote (if used).
   See "Mounting the Remote (Step 3)" on page 14 for instructions.

Jumper Installation (Step 1)

Four sets of jumpers are located on the right side of the circuit board on the back of the faceplate. Three jumpers set system voltage to 12 volts, 24 volts, or 48 volts. The fourth jumper dims the backlight on the display to conserve power and improve accuracy when longer cable runs are used. See Figure 5 for jumper locations.

To enable a selection, carefully slide the jumper over the top of both pins. This is called installing the jumper.

To disable a selection, carefully slide the jumper over only one of the pins. This is called removing the jumper.

Jumper

Jumper Installed
(Jumper is on both pins)
(Selection enabled)

Jumper Removed
(Jumper is only on one pin)
(Selection disabled)

Figure 4 Jumper Positions

To select and set the voltage:

- Install the jumper over the pins that correspond to the voltage of the system. See Figure 5 for the location of the voltage jumpers.

Cable Installation (Step 2)

Connect the display to the controller using the serial communications cable provided. The cable is a six-conductor telephone cable with modular-type connectors (RJ-15). Although any telephone-type cable will work, the cables provided with the displays use stranded and tin-plated wire for better performance and longer life.

The following instructions are illustrated in Figure 6.

To connect the Faceplate to the C-Series controller:

1. Remove the front cover of the C-Series controller by removing the four screws on the front cover of the unit.
2. Remove the LED on the circuit board of the C-Series controller next to the RJ-15 Port just above the BATTERY POSITIVE connector. If the LED must be replaced in the future, it will operate in either orientation, except if replaced incorrectly, the color of the status LED will be reversed.
3. Insert the serial communications cable from the faceplate into the RJ-15 Port.
4. Align the faceplate on the front of the C-Series controller so that the holes for the faceplate match.
5. Secure the faceplate in place using the four screws removed in Step 1.

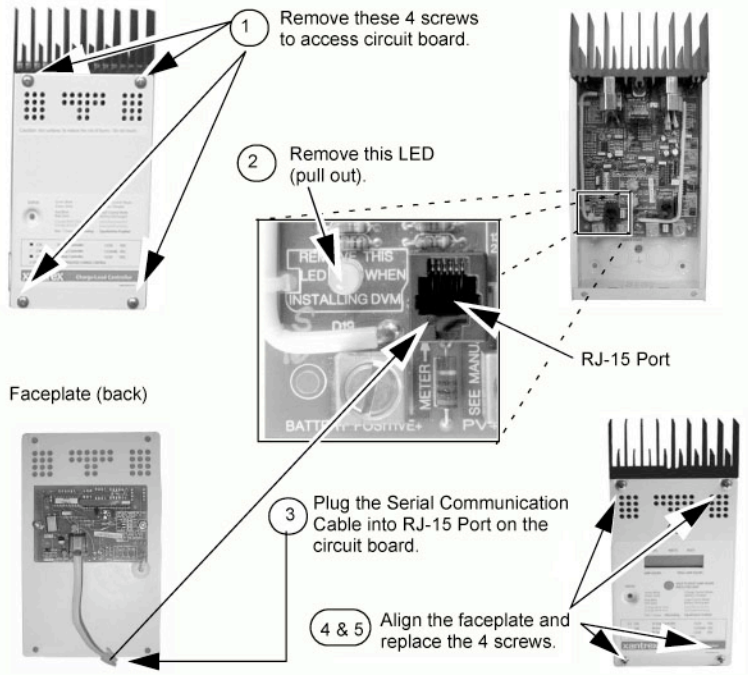


Figure 6 Connecting the Faceplate

To connect the remote:

1. Remove the front cover of the C-Series controller by removing the four screws on the front cover of the unit.
2. Route one end of the serial communications cable (SCC) through a knockout on the controller. Use a strain relief to hold and protect the cable.
3. Plug this end of the yellow cable into the RJ-15 Port on the circuit of the controller.
4. Route the other end of the SCC to where the remote display will be located. Plug this end of the cable into RJ-15 Port on the backside of the remote. Ensure you route it through the mounting surface (i.e., wall or panel) if necessary.
5. Install the remote where desired. Four holes are provided for installing screws or fasteners to secure the display in the mounting surface.
   See "Mounting the Remote (Step 3)" on page 14 for additional information about how to mount the remote.
6. Secure the original faceplate in place using the four screws removed in Step 1.

Important: The LED does *not* need to be removed when using the remote.

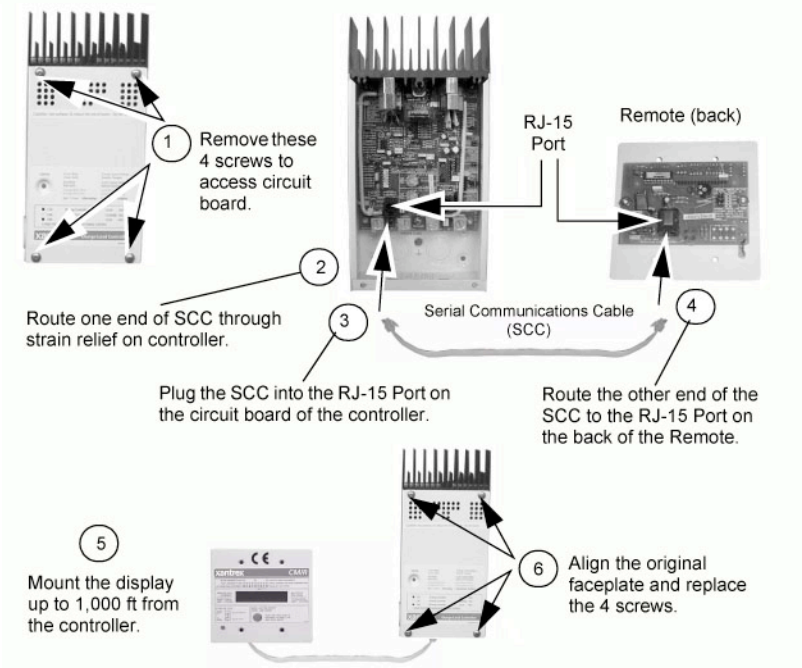


Figure 7 Connecting the Remote

Mounting the Remote (Step 3)

The remote can be permanently installed in a wall or cabinet.

The unit can also be flush-mounted into a rectangular opening in a wall or surface-mounted using a double-gang, non-metallic outlet box.

To flush mount the remote, an opening must be cut in the backing material to allow room for the circuit board, wires, and connectors. Allow at least 1 ½ inch minimum clearance behind the circuit board for the connectors and wires.

Important: Use great care when cutting out the area for the circuit board from the backing material (i.e., wallboard). Ensure there is enough area left to securely hold the screws.

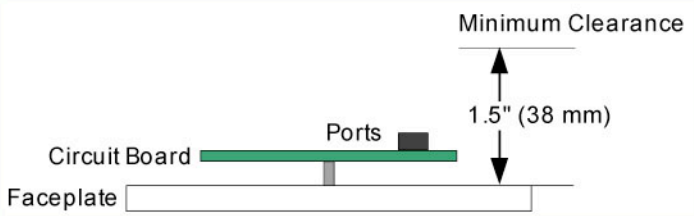


Figure 8 Minimum Clearance for the Remote

5 Operation

Status Indicator

The multicolor LED indicates the operating status of the controller. A color-coded label is included on the cover of the controller explaining the status LED's indications.

- When in Charge Control mode, the LED will be green.
- When in Load Control mode, the LED will be red.
- When an Error Condition exists or the load has been disconnected, the LED will be orange.
- When battery equalization is in process, the LED alternates between red and green.

Important: The green and red LEDs only indicates the particular operating mode and the battery voltage level. It does not indicate whether the charging source is functioning properly.

See the Owner's Manual for the C-Series Multifunction DC Controller for additional information about the LED Status Indicator.

Resetting the Amp-Hour Meter

To manually reset the amp-hour meter, press and hold the push-button on the front of the meter until the display resets.

The meter automatically resets if power is disrupted (for example, DC cable is removed and replaced).

Turning the Display Backlight On or Off

Press and release the Amp-hour Reset button to turn the backlight on or off.

6 Troubleshooting

If using long cable runs on the remote (greater than 100 feet) or if the meter seems inaccurate, remove the jumper located below the voltage configuration pins on the circuit board on the back of the unit. This dims the LCD backlight, reduces power consumption, and improves meter accuracy.

See the Owner's Manual for the C-Series Multifunction DC Controller for additional information about Troubleshooting.

7 Warranty and Return

Warranty

What does this warranty cover? This Limited Warranty is provided by Xantrex Technology, Inc. ("Xantrex") and covers defects in workmanship and materials in your C-Series Meter Display. This warranty period lasts for two years from the date of purchase at the point of sale to you, the original end user customer. Proof of purchase is required to make warranty claims.

This Limited Warranty is transferable to subsequent owners but only for the unexpired portion of the Warranty Period. Subsequent owners also require proof of purchase to validate this warranty.

What will Xantrex do? Xantrex will, at its option, repair or replace the defective product free of charge, provided that you notify Xantrex of the product defect within the Warranty Period, and provided that Xantrex through inspection establishes the existence of such a defect and that it is covered by this Limited Warranty.

Xantrex will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. Xantrex reserves the right to use parts or products of original or improved design in the repair or replacement. If Xantrex repairs or replaces a product, its warranty continues for the remaining portion of the original Warranty Period or 90 days from the date of the return shipment to the customer, whichever is greater. All replaced products and all parts removed from repaired products become the property of Xantrex.

Xantrex covers both parts and labor necessary to repair the product, and return shipment to the customer via a Xantrex-selected non-expedited surface freight within the contiguous United States and Canada. Alaska and Hawaii are excluded. Contact Xantrex Customer Service for details on freight policy for return shipments outside of the contiguous United States and Canada.

How do you get service? If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact Xantrex directly at:

Telephone:	**1 800 670 0707 (toll free North America)** **1 360 925 5097 (direct)**
Fax:	**1 800 994 7828 (toll free North America)** **1 360 925 5143 (direct)**
Email:	**customerservice@xantrex.com**

Direct returns may be performed according to the Xantrex Return Material Authorization Policy described in your product manual. For some products, Xantrex maintains a network of regional Authorized Service Centers. Call Xantrex or check our website to see if your product can be repaired at one of these facilities.

What proof of purchase is required? In any warranty claim, dated proof of purchase must accompany the product and the product must not have been disassembled or modified without prior written authorization by Xantrex.

Proof of purchase may be in any one of the following forms:

- The dated purchase receipt from the original purchase of the product at point of sale to the end user, or
- The dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status, or
- The dated invoice or purchase receipt showing the product exchanged under warranty

What does this warranty not cover? This Limited Warranty does not cover normal wear and tear of the product or costs related to the removal, installation, or troubleshooting of the customer's electrical systems. This warranty does not apply to and Xantrex will not be responsible for any defect in or damage to:

a) the product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment;

b) the product if it has been subjected to fire, water, generalized corrosion, biological infestations, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the Xantrex product specifications including high input voltage from generators and lightning strikes;

c) the product if repairs have been done to it other than by Xantrex or its authorized service centers (hereafter "ASCs");

d) the product if it is used as a component part of a product expressly warranted by another manufacturer;

e) the product if its original identification (trade-mark, serial number) markings have been defaced, altered, or removed.

Disclaimer

Product

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY XANTREX IN CONNECTION WITH YOUR XANTREX PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, TORT, NEGLIGENCE, PRINCIPLES OF MANUFACTURER'S LIABILITY, OPERATION OF LAW, CONDUCT, STATEMENT OR OTHERWISE), INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT REQUIRED UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD STIPULATED UNDER THIS LIMITED WARRANTY.

IN NO EVENT WILL XANTREX BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, COSTS OR EXPENSES HOWEVER ARISING WHETHER IN CONTRACT OR TORT INCLUDING WITHOUT RESTRICTION ANY ECONOMIC LOSSES OF ANY KIND, ANY LOSS OR DAMAGE TO PROPERTY, ANY PERSONAL INJURY, ANY

DAMAGE OR INJURY ARISING FROM OR AS A RESULT OF MISUSE OR ABUSE, OR THE INCORRECT INSTALLATION, INTEGRATION OR OPERATION OF THE PRODUCT.

Exclusions

If this product is a consumer product, federal law does not allow an exclusion of implied warranties. To the extent you are entitled to implied warranties under federal law, to the extent permitted by applicable law they are limited to the duration of this Limited Warranty. Some states and provinces 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 to you. This Limited Warranty gives you specific legal rights. You may have other rights which may vary from state to state or province to province.

Warning: Limitations On Use

Please refer to your product manual for limitations on uses of the product.

SPECIFICALLY, PLEASE NOTE THAT THE C-SERIES METER DISPLAY SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, XANTREX MAKES NO REPRESENTATIONS OR WARRANTIES REGARDING THE USE OF THE XANTREX C-SERIES METER DISPLAY IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

Return Material Authorization Policy

Before returning a product directly to Xantrex you must obtain a Return Material Authorization (RMA) number and the correct factory "Ship To" address. Products must also be shipped prepaid. Product shipments will be refused and returned at your expense if they are unauthorized, returned without an RMA number clearly marked on the outside of the shipping box, if they are shipped collect, or if they are shipped to the wrong location.

When you contact Xantrex to obtain service, please have your instruction manual ready for reference and be prepared to supply:

- The serial number of your product
- Information about the installation and use of the unit
- Information about the failure and/or reason for the return
- A copy of your dated proof of purchase

Return Procedure

1. Package the unit safely, preferably using the original box and packing materials. Please ensure that your product is shipped fully insured in the original packaging or equivalent. This warranty will not apply where the product is damaged due to improper packaging.
2. Include the following:
   - The RMA number supplied by Xantrex Technology, Inc. clearly marked on the outside of the box.
   - A return address where the unit can be shipped. Post office boxes are not acceptable.
   - A contact telephone number where you can be reached during work hours.
   - A brief description of the problem.
3. Ship the unit prepaid to the address provided by your Xantrex customer service representative.

If you are returning a product from outside of the USA or Canada In addition to the above, you MUST include return freight funds and are fully responsible for all documents, duties, tariffs, and deposits.

If you are returning a product to a Xantrex Authorized Service Center (ASC) A Xantrex return material authorization (RMA) number is not required. However, you must contact the ASC prior to returning the product or presenting the unit to verify any return procedures that may apply to that particular facility.

Out of Warranty Service

If the warranty period for your C-Series Meter Display has expired, if the unit was damaged by misuse or incorrect installation, if other conditions of the warranty have not been met, or if no dated proof of purchase is available, your C-Series Meter Display may be serviced or replaced for a flat fee.

To return your C-Series Meter Display for out of warranty service, contact Xantrex Customer Service for a Return Material Authorization (RMA) number and follow the other steps outlined in "Return Procedure" on page 25.

Payment options such as credit card or money order will be explained by the Customer Service Representative. In cases where the minimum flat fee does not apply, as with incomplete units or units with excessive damage, an additional fee will be charged. If applicable, you will be contacted by Customer Service once your unit has been received.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Basic Electrical Materials and Methods."

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform visual and mechanical inspection and electrical tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and notify if there are any disruptions.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

SECTION 16510 - DISCONNECTS (MOTOR AND CIRCUIT)

PART 1 – GENERAL

1.1 DESCRIPTION

This section specifies low voltage disconnect switches.

1.2 RELATED WORK

A. BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. GROUNDING.

1.3 SUBMITTALS

A. Submit in accordance with Section SAMPLES AND SHOP DRAWINGS.

B. Shop Drawings:

1. Include sufficient information, clearly presented, to determine compliance with drawings and specifications.

2. Include electrical ratings, dimensions, mounting, material, enclosure types, fuse type and class.

3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.

C. Manuals:

1. Provide complete operating and maintenance manuals for bolted-pressure switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

2. Identify terminals on wiring diagrams to facilitate operation and maintenance.

3. Wiring diagrams shall indicate internal wiring and any interlocking.

1.4 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Underwriters Laboratories, Inc. (UL):

C. National Fire Protection Association (NFPA):

70-90 National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA):

KS I-90 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

PART 2 - PRODUCTS

2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

A. Quick-make, quick-break type in accordance with UL98, NEMA KS 1 and NEC.

B. Minimum duty rating, NEMA classification Heavy Duty (HD) for 240 volts.

C. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the OFF position.
3. An arc chute for each pole.
4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
5. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
6. Ground Lugs: One for each ground conductor.
7. Enclosures:
   a. Shall be the NEMA types shown on the drawings for the switches.
   b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed.

PART 3 – EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the NEC and as shown on the drawings.

END OF SECTION 16510

SECTION 16511– INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes the furnishings, installation of and connection of the interior lighting.

1.2 RELATED SECTIONS

A. Basic Electrical Materials and Methods

B. Conductors and cables

1.3 SUBMITTALS

C. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include electrical ratings, dimensions, mounting, material, required clearances, terminations, wiring and connection diagrams, photometric data, ballast, lenses, louvers, lamps, and controls.

3. When catalog data and/ or shop drawings for fluorescent fixtures are submitted for approval, photometric data shall be included with submittal, indicating average brightness and efficiency of the fixture.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. Shall conform to the detail drawings, NEC Article 410 and UL- 57.

iolighting.com

line

series .75

10°, 45°, 65°

Application

io lighting's line series .75 is approximately .75" x .75" in cross section. UL listed for dry locations, its low profile housing enables functional luminous intensities from "tight" architectural details such as niches, coves, handrails & casework. Similar to halogen light sources, LEDs are point sources that offer superior definition to three dimensional objects and sparkle to reflective surfaces.

series .75 is a low voltage linear accent luminaire that may be ordered in incremental nominal lengths that range from 6" to 96". Optional beam spreads along the perpendicular axis of the fixture include 10°, 45°, and 65°. For details on the asymmetric beam spread, see dedicated specification sheet. Average rated life for series .75 is 50,000 hours. Lamp lumen depreciation at 50,000 hrs. is 30%.

Light Output

line series .75 is available with two lumen outputs for white light only. Red, green, blue and amber are available in standard output only.

Standard:
- Warm White: 38 lms/ft
- Cool White: 48 lms/ft

High Output:
- Warm White: 127 lms/ft
- Cool White: 145 lms/ft

Refer to light output tables for footcandle values at various distances. IES format files may be obtained from the factory or downloaded from iolighting.com.

Construction

The light weight, yet durable extruded aluminum housing provides recommended heat sink requirements for LEDs. Precision optic is composed of a customized acrylic material that offers very high transmisivity, UV stability, and excellent longevity. series .75 **is UL listed for dry locations only.**

Electrical

Universal 120 or 277 Volt supply required for 24 volt remote driver. 4'-0" 22 AWG, 600 volt TFFN rated power cords are supplied with strain reliefs for both electric feed and connectors (for continous row application).

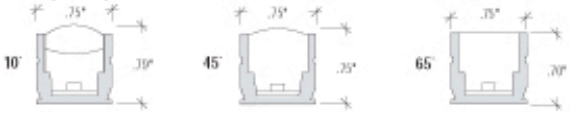
Power Consumption

- standard: 2 w/ft
- high output: 8 w/ft

Finish

Anodized aluminum finish is standard. Custom finishes available upon request.

Beam Spread Options



Power Supply (Driver) Information

Standard Light Output

TYPE	SUPPLIES	REMOTE DISTANCE
24v20w	UP TO 78"	32'-0" (w/18AWG)
24v100w	UP TO 35'-0"	18'-0" (w/18AWG)
	(2) RUNS UP TO 49' WITH (1) RUN NTE 35'-0"	46'-0" (w/14AWG)
		71'-0" (w/12AWG)

High Output

TYPE	SUPPLIES	REMOTE DISTANCE
24v100w	UP TO 12'-0"	18'-0" (w/18AWG)
		46'-0" (w/14AWG)
		71'-0" (w/12AWG)

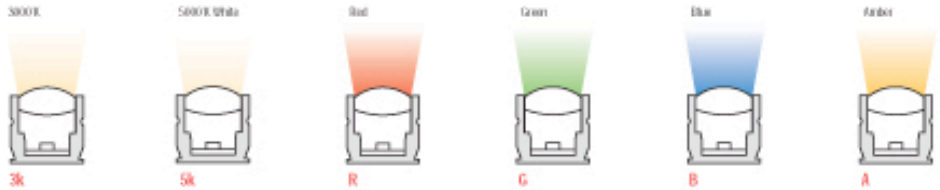
370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

line

series .75

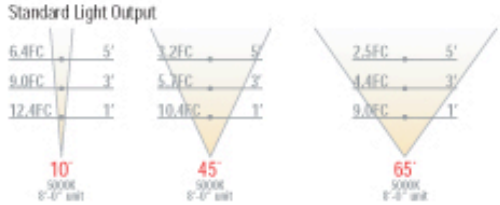
10°, 45°, 65°

Color Options

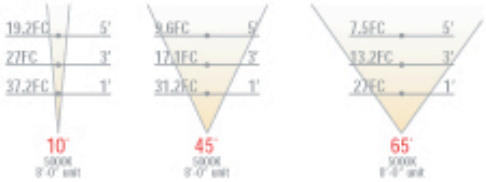


Applications / Light Output

Standard Light Output

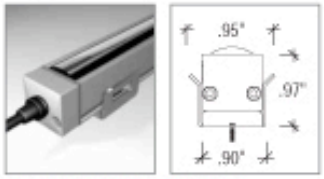


High Output

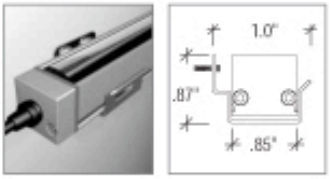


Mounting Options

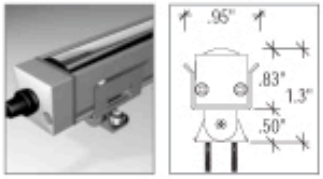
100 surface



101 side surface



102 field adjustable



Electrical End Feed Options

2 end feed

3 right side feed

4 left side feed

5 bottom feed

Order Code

0	03	I	□□□□	□□	□□□	□	□□	□	□	□
io	Line .75	location	Color	Distribution	Mounting	Finish	Length	Electrical Feed	Voltage/Dimming	Driver Enclosure (OPTIONAL)
		Interior only	3k 3000 K 3kHO 3000 K High Output 5k 5000 K 5kHO 5000 K High Output R Red G Green B Blue A Amber	10 10 degree 45 45 degree 65 65 degree	100 Surface 101 Side surface 102 Field adjustable	1 Anodized Aluminum 2 Anodized Custom Color	UNITS (actual) 01 6" (6.15") 02 12" (11.84") 03 18" (17.59") 04 24" (23.15") 05 30" (28.84") 06 36" (34.59") 07 42" (40.15") 08 48" (45.84") 09 54" (51.59") 10 60" (57.15") 11 66" (62.84") 12 72" (68.59") 13 78" (79.84") 14 84" (85.59") 15 90" (91.15") 16 96" (96.84")	2 End feed 3 Right side feed 4 Left side feed 5 Bottom feed FOR CONTINOUS ROW 2-2 Right end feed Left end feed 3-4 Right side feed Left side feed 5-5 Right bottom feed Left bottom feed	1 120v 2 277v 3 120v w/dim 4 277v w/dim 5 other	I Interior Rated N Not Req'd by io Supplied by others

Note: "Actual" length provided includes end feed and non-feed endcaps. Add .27 when electrical feed occurs on both ends (for continous row mounting).

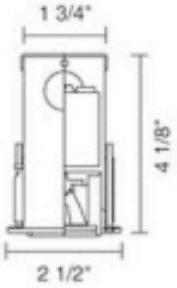
370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

BRUCK.

LEDRA™ 12 WITH J-BOX AND DRIVER

Description:
The LEDRA 12 with J-BOX and Driver is a recessed in ground fixture. Star high brightness LED. Pressure fit mounting hardware allows for no screws to be visible. The small size, long life, lack of UV, rich color options, and cool beam allows for a wide variety of applications. Fixture includes a junction box and a driver. Ledra fixture is dimmable when 2 to 8 fixtures are wired together. When used with LEDRA DIMMING MODULE (70426) & Remote Ledra Drivers (70417 or 70418).

Technical Specs:
Finish: matte chrome
Input voltage: 85~265Vac
Power consumption: 3Watts
Drive current: 700mA
Lumen output: 65 at 700mA
Lamp life: white 70% at 50,000 / blue at 100,000 hrs
Rating: Class II
5500 White / Blue with Luxeon III Star LED
3200 Warm White with Z- Power LED



Part Numbers:

135653/s	white, 10° lens
135653/m	white, 30° lens
135653/fl	white, 45° lens
135653-1/s	warm white, 10° lens
135653-1/m	warm white, 30° lens
135653-1/fl	warm white, 45° lens
135654/s	blue, 10° lens
135654/m	blue, 30° lens
135654/fl	blue, 45° lens

BRUCK.

ARDEN DOWN

Description:
Uni-plug design allows ARDEN DOWN pendant to be mounted on any lighting system or ceiling canopy through the use of an appropriate adaptor, not included. Cable length can be field-cut or specified when ordering. May be specified with Kiss canopy by adding /MP to part number or /MP2 for 2" version.

Technical Specs:
50W Max.
May also be specified with MR16 socket
Lamp not included
GY6.35 socket type

Part Numbers:

220131bz	bronze, white glass
220131ch	chrome, white glass
220131mc	matte chrome, white glass
220132bz	bronze, blue fritted glass
220132ch	chrome, blue fritted glass
220132mc	matte chrome, blue fritted glass
220133bz	bronze, kiwi glass
220133ch	chrome, kiwi glass
220133mc	matte chrome, kiwi glass
220135bz	bronze, papaya glass
220135ch	chrome, papaya glass
220135mc	matte chrome, papaya glass

15774 Gateway Circle Tustin, CA 92780 ph: (714) 259-9959 fax: (714) 259-9969 www.brucklighting.com

MINI MY-T-LITE™

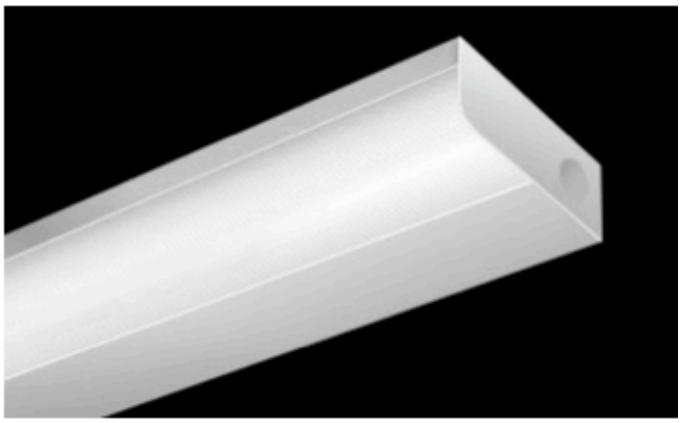
Series **311**

APPLICATIONS

Legion's shallow MINI-MY-T-LITE™ Series 311 utilizes the new energy efficient highlumen output T5 lamps. A high quality, ultra thin and narrow profile specification grade fluorescent luminaire formed of heavy gauge steel, with concealed ballast mounting screws. The low key silhouette design fits virtually anywhere, blending unobtrusively with any decor.

The choice of designers, and specifiers for homes, schools, banks, offices, hospitals etc.

Available in various sizes and wattages. Easily installed and maiantained.



SPECIFICATIONS

CONSTRUCTION: Die formed of heavy gauge steel, rigidly fabricated to insure true and perfect alignment.

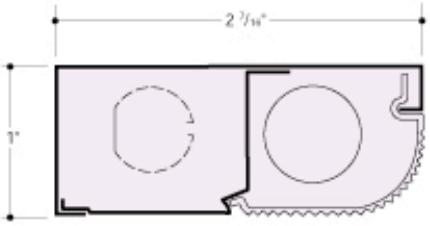
MOUNTING: All Mini-My-T-Lite™ fluorescents can be mounted individually or in continuous rows, knockouts provided at both ends for feed-thru and entry.

ELECTRICAL: Wired with "HES", high performance start hybrid Class "P" thermally protected ballasts, or T5 rapid quick-start 460 MA for 14W, 21W, 28W and 460 MA to 300 MA for 24W, 39W, 54W T5HO Electronic High Power Factor, Class A sound rated, <10% THD (less than 10% Total Harmonic Distortion), FCC Listed for Type 1 for 118 volt 60 Hz operation. Other voltages and frequencies available. CONSULT FACTORY. All electrical components mounted on wiring channel for ease of installation and servicing.

SHIELDING: Lineal ribbed clear prismatic acrylic wrap around plastic standard, destaticized and flexible, easily snaps in and out for relamping.

FINISH: All steel components parts are completely protected against rust and discoloration by an Anchorizing Process and coated with 365° high quality sprayed baked white synthetic enamel for maximum durability, providing a high reflective efficiency.

CERTIFICATION: The Series 311 is U.L. and C.U.L. listed and bears the label of the I.B.E.W./AFL-CIO Local #3.



0800

Section C-Page 99

LEGION® LIGHTING CO., INC.
221 Glenmore Ave., Brooklyn, NY 11207 • Tel: 718/498-1770 • Fax: 718/498-0128
Toll Free Fax: 800/4-LEGION

Series 311

Mini My-T-Lite™

ORDERING DATA

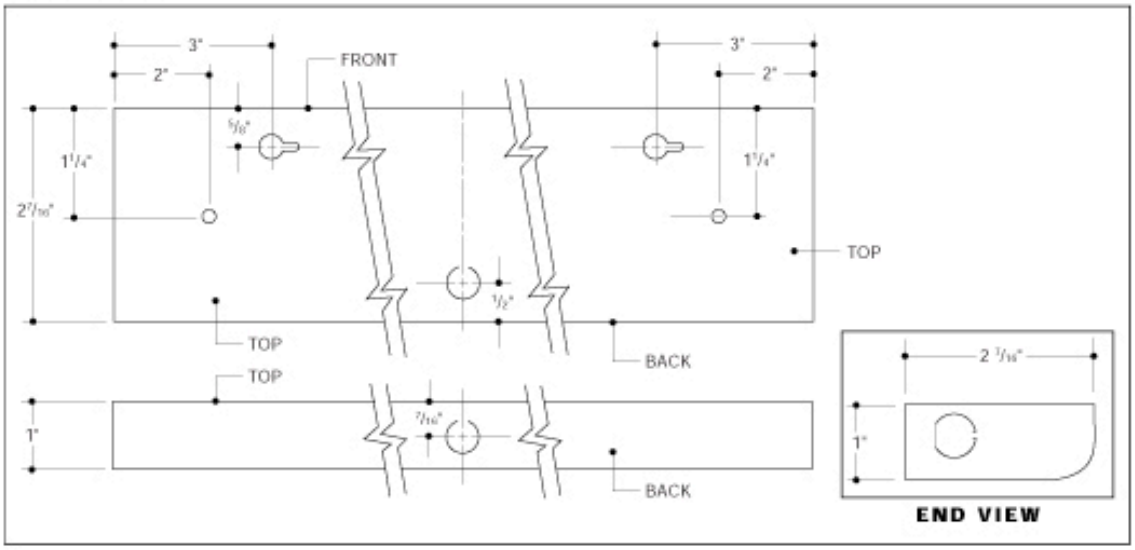
	Catalog No.	No. and Type Lamps	Length	Weight
STANDARD T5	311-8-ACP HES	1-F8T5-PH	12 1/4"	3 1/2
	311-13-ACP HES	1-F13T5-PH	21 1/4"	4 1/2
	311-28-ACP HES	2-F8T5-PH	24 1/2"	7 1/2
	311-8/13-ACP HES	1-F8T5-PH/1-F13T5-PH	33 1/2"	8 1/2
	311-213-ACP HES	2-F13T5	42 1/2"	9 1/2
PENTRON T5	311-114-ACP	1-F14T5	22 9/16"	2
	311-124HO-ACP	1-F24HOT5		
	311-121-ACP	1-F21T5	34 7/16"	3
	311-139HO-ACP	1-F39HOT5		
	311-128-ACP	1-F28T5	46 7/32"	4
	311-154HO-ACP	1-F54HOT5		

Pentron is a trademark of OSRAM SYLVANIA

OPTIONS

Suffix "RSW" after catalog no. for Positive Position Rocker Switch.
Suffix "GCO" after catalog no. for Grounded Convenience Outlet.
Suffix "CP" after catalog no. for 6 ft. cord and plug.
Suffix "GCC" after catalog no. 3/4" greenfield/conduit connector.
Suffix "FB" after catalog no. for Fuse and Fuseholder

BACK PLANS



Information supplied primarily for illustrative purposes, subject to change.
Consult factory for verification and minimum quantity orders.

LEGION LIGHTING CO., INC.

Section C Page 100

BRUCK.

ENZIS TRACK

Description:
The light weight ENZIS TRACK is easily field bendable to achieve any radius or hard angle, eliminating the need for angle connectors or predetermined radius measurements. Two malleable aluminum rods in the flexible track hold the desired shape even when used with suspended cable supports. No tools are required to attach the full array of mounting hardware or fixture adaptors to the track. Enzis track system can be suspended or semi-flush mounted and allows the use of Bruck Uni-Light fixtures and pendants.

Technical Specs:
Material: Plastic extrusion with tin plated copper conductor braiding
Note: Curves and angles made to the track are field adjustable, available in 6 ft. and 12 ft. sections only

Part Numbers:

140006bz	bronze, 72"
140006mc	matte chrome, 72"
140012bz	bronze, 144"
140012mc	matte chrome, 144"

BRUCK.

ENZIS SUSPENSION SUPPORT

Description:
The ENZIS SUSPENSION SUPPORT allows for suspension of track from aircraft cable and may be field shortened (longer lengths available).Standard wood screw provided for ceiling mount. No tools are required to attach the cable suspension to the track. Bruck recommends supports to be placed approximately every 3 ft.

Technical Specs:
Material: brass, matte chrome plated

Part Numbers:

140100bz	bronze, 78"
140100mc	matte chrome, 78"

BRUCK.

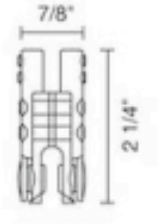
ENZIS POWER FEED

Description:
The ENZIS POWER FEED directly connects to track to deliver low-voltage power from transformer, one set needed per circuit. Recommend placement near center of track run, for use with 8 and 10 gauge power cables.

Technical Specs:
300W max capacity
Power feed cable not included
Material: brass, matte chrome plated

Part Numbers:

140305bz	bronze
140305mc	matte chrome



BRUCK.

ENZIS END CAP

Description:
The ENZIS END CAP, is an end cap for the Enzis track.

Part Numbers:

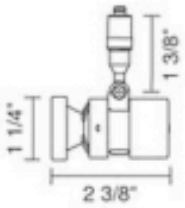
140190bz	bronze
140190mc	matte chrome

BRUCK.

LEDRA™ II

Description:
The LEDRA II is a fully adjustable Uni-Light fixture. Integral AC/DC converter allows fixture to work on all Bruck tracks with standard 12VAC transformers (must meet minimum 20% load). Internal dimming, through integral 32-step switching, controls on each fixture for precise setting. The small size, long life, lack of UV, and cool beam makes the Ledra II ideal for displays, casework, difficult to maintain locations, and applications requiring efficient rich color accents.

Technical Specs:
Finish: matte chrome
Power consumption: 3Watts
Drive current: 700mA
Lumen output: 65 at 700mA
Lamp life: 70% at 50,000hrs
5500 White with Luxeon III Star LED
3200 Warm White with Z- Power LED



Part Numbers:

135711/s	white, 10° lens, 1 3/8" stem
135711bz/s	bronze, white, 10° lens, 1 3/8" stem
135711/m	white, 30° lens, 1 3/8" stem
135711bz/m	bronze, white, 30° lens, 1 3/8" stem
135711/fl	white, 45° lens, 1 3/8" stem
135711bz/fl	bronze, white, 45° lens, 1 3/8" stem
135711-1/s	warm white, 10° lens, 1 3/8" stem
135711-1bz/s	bronze, warm white, 10° lens, 1 3/8" stem
135711-1/m	warm white, 30° lens, 1 3/8" stem
135711-1bz/m	bronze, warm white, 30° lens, 1 3/8" stem
135711-1/fl	warm white, 45° lens, 1 3/8" stem
135711-1bz/fl	bronze, warm white, 45° lens, 1 3/8" stem
135713/s	white, 10° lens, 3 5/8" stem

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BRUCK.

POWER SUPPLY CABLE

Description:
The POWER SUPPLY CABLE is tin-plated and composed of 300 strands of conductive copper wire coated with transparent plastic insulation. Stranded cable improves conductivity and lessens voltage drop in comparison to solid cables. The 10 gauge cable is sufficient for up to 20', the 8 gauge cable can be used when longer runs are necessary.

Technical Specs:
10 or 8 gauge stranded cable
300W max capacity

Part Numbers:

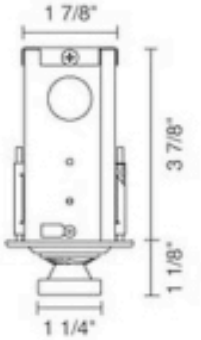
150118	10 gauge, tin-plated, transparent insulated
150121	8 gauge, tin-plated, transparent insulated

BRUCK.

LEDRA™ R WITH J-BOX AND DRIVER

Description:
The LEDRA R with J-BOX and DRIVER is a recessed fixture with a 70° tilt and 360° rotation on fixture head. Pressure fit mounting hardware allows for no screws to be visible. The small size, long life, lack of UV, rich color options, and cool beam allows for a wide variety of applications. Fixture includes a junction box and a driver. Ledra fixture is dimmable when 2 to 8 fixtures are wired together. When used with LEDRA DIMMING MODULE (70426) & Remote Ledra Drivers (70417 or 70418).

Technical Specs:
Finish: matte chrome
Input voltage: 100~240Vac
Power consumption: 3Watts
Drive current: 700mA
Lumen output: 65 at 700mA
Lamp life: white 70% at 50,000
Rating: Class II
5500 White with Luxeon III Star LED
3200 Warm White with Z- Power LED



Part Numbers:

135735/s	white, 10° lens
135735/m	white, 30° lens
135735/fl	white, 45° lens
135735-1/s	warm white, 10° lens
135735-1/m	warm white, 30° lens
135735-1/fl	warm white, 45° lens

basic strip

24
36
48

wall mounted luminaire for direct linear fluorescent lighting particularly suited for bathroom mirror applications.

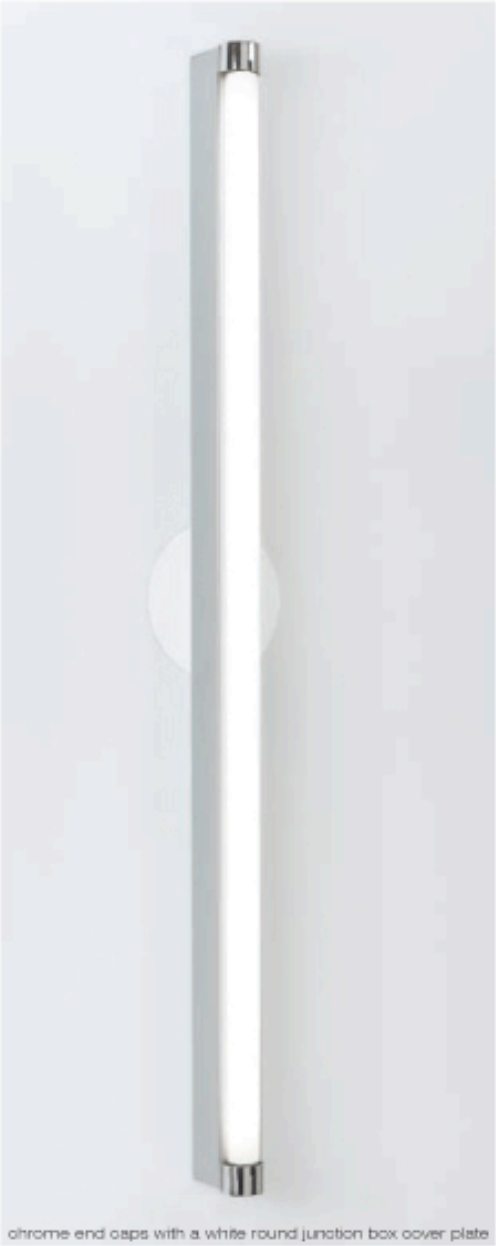
- linear exposed fluorescent lamp.
- body in aluminum extrusion with natural anodized or matte white powder coated finish.
- end caps in chrome, silver, or white finish.
- mounting to standard electrical junction boxes at center of luminaire.
- fixture is supplied with a white powder coated cover plate for mounting on junction boxes and fitting for optional "pigtail" conduit mounting without a cover plate as shown in image on opposite page.

design
ron rezek

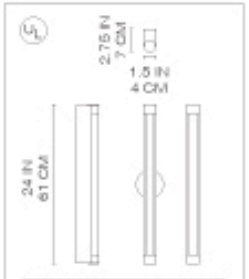

chrome end cap


white end cap


silver end cap


chrome end caps with a white round junction box cover plate

ADA 24



fluorescent source
1X17W(T8,bi-pin)

ADA 36

fluoreacent source
1X25W(T8,bi-pin)

ADA 48

fluoreacent source
1X32W(T8,bi-pin)

PANTAREI 190

ERNESTO GISMONDI • 1994

WALL/CEILING MOUNTED LUMINAIRES FOR DIFFUSED INCANDESCENT, FLUORESCENT AND HALOGEN LIGHTING, SUITABLE FOR OUTDOOR WET LOCATIONS, AS WELL AS INDOOR LOCATIONS.

- BODY CONSTRUCTION IN SOLID DIE-CAST ALUMINUM WITH FRONT CONCEALED HINGED DIFFUSER OPENING FOR QUICK AND EASY RE-LAMPING ACCESS
- BODY TYPES
  - SURFACE MOUNTED
  - FULL LIGHT OR HALF LIGHT
- BODY FINISHES
  - SPECIAL, CORROSION RESISTANT, ELECTROSTATIC POLYESTER POWDER COATING IN BLACK OR WHITE
  - NATURAL POLISHED ALUMINUM WITH CLEAR POLYURETHANE PROTECTIVE COATING WITH NO WARRANTY FOR OUTDOOR APPLICATIONS,AS POSSIBLE NATURAL MUTATIONS OF ALUMINUM MAY OCCUR OVER TIME, DEPENDENT ON LOCAL ATMOSPHERIC CONDITIONS AND MAINTENANCE FACTORS
- DIFFUSERS
  - STURDY, MOLDED, SANDED GLASS WITH INTERNAL RAISED, HONEYCOMBED PATTERN AVAILABLE FOR ALL MODELS AND SUITABLE FOR ALL LIGHT SOURCES.
  - INJECTION MOLDED, IMPACT RESISTANT, OPALINE POLYCARBONATE WITH INTERNAL HONEYCOMB RAISED PATTERN. AVAILABLE FOR FLUORESCENT LIGHT SOURCES ONLY
- WALL/CEILING MOUNTING
  - SURFACE MOUNTING CENTERED TO STANDARD 4" OCTAGONAL JUNCTION BOX

INCANDESCENT SOURCE
- 1X40W (E12/B10W)

COMPACT FLUORESCENT SOURCE
- 1X9W (T4/G23-2)

LOW VOLTAGE HALOGEN SOURCE
- 1X50W/12V (GY6.35)

PANTAREI 190 FULL LIGHT POLY DIFFUSER

PANTAREI 190 HALF LIGHT POLY DIFFUSER

PANTAREI 190 FULL LIGHT

PANTAREI 190 HALF LIGHT

INCANDESCENT

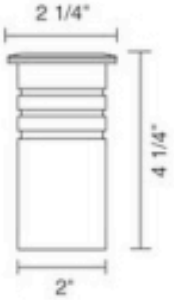
FLUORESCENT

BRUCK.

LEDRA™ 12C

Description:
The LEDRA 12C is a recessed in ground fixture. Pressure fit mounting hardware allows for no screws to be visible. The small size, long life, lack of UV, and cool beam allows for a wide variety of applications. Suitable for wet locations. 18awg wire required to connect Ledra to driver, not included. Ledra fixture is dimmable when 2 to 8 fixtures are wired together. When used with LEDRA DIMMING MODULE (70426) & Remote Ledra Drivers (70417 or 70418).

Technical Specs:
Finish: matte chrome
Power consumption: 3Watts
Drive current: 700mA
Lumen output: 65 at 700mA
Lamp life: white 70% at 50,000 / blue at 100,000 hrs
Rating: Class II
5500 White / Blue with Luxeon III Star LED
3200 Warm White with Z- Power LED



Part Numbers:

135655-1/s/c	warm white, 10° clear lens
135655-1/s/f	warm white, 10° frosted lens
135655-1/m/c	warm white, 30° clear lens
135655-1/m/f	warm white, 30° frosted lens
135655-1/fl/c	warm white, 45° clear lens
135655-1/fl/f	warm white, 45° frosted lens
135655/s/c	white, 10° clear lens
135655/s/f	white, 10° frosted lens
135655/m/c	white, 30° clear lens
135655/m/f	white, 30° frosted lens
135655/fl/c	white, 45° clear lens
135655/fl/f	white, 45° frosted lens
135656/s/c	blue, 10° clear lens
135656/s/f	blue, 10° frosted lens

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BRUCK.

DC DRIVER for LEDRA™ FIXTURES

Description:
The DC DRIVER for LEDRA FIXTURES, supplies constant current of 700 milliamps and powers 2 to 5 Ledra fixtures, not for use with Ledra track. Fixtures must be wired to the driver in series. Features short circuit protection; rated for Class II wiring. Driver may be placed up to 150 feet from fixtures.

Technical Specs:
Operating Temperature: -22° F to 140° F
Input: 100-132VAC
Rating: Class II

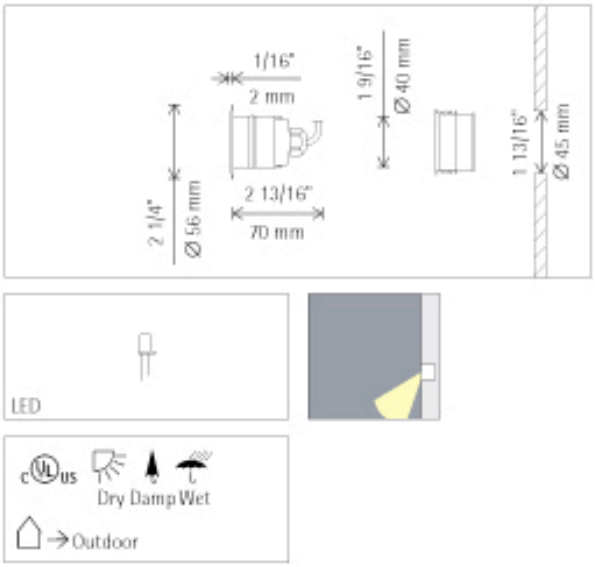
Part Numbers:

70417 17W, for 2-5 fixture

ERCO

LED orientation luminaire

Floor washlight



33768.023 Silver LED daylight white
LED 0.5W 30V DC

Product description
Housing with gasket: stainless steel.
Installation bush with ribs: plastic.
Cable, L 19 11/16" / 500mm.
Upper half of LED in orientation color, lower half of LED for floor lighting white.
Reflector: plastic, aluminum vaporized, silver, frosted.
Cover ring: corrosion resistant stainless steel, with 1/4" / 6mm safety glass. Load 1124lb.wt / 5kN.
Control gear to be ordered separately.
Suitable for wet location (IP68): dust-proof.
Weight 0.35lbs / 0.16kg

ERCO Lighting, Inc.
160 Raritan Center Parkway
Suite 10
Edison, NJ 08837
USA
Tel: +1 732 225 8856
Fax: +1 732 225 8857
info.us@erco.com

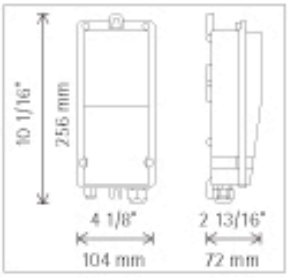
Technical Region: 120V/60Hz
Edition: 11.15.2006
Please download latest version from
www.erco.com/33768.023

ERCO

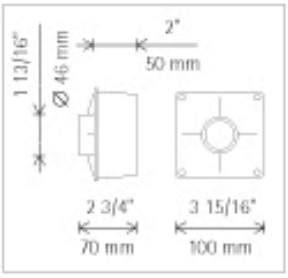
LED orientation luminaire

Accessories

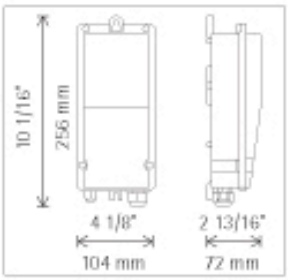
33858.023
Control gear
For max. 10 orientation luminaires.
Input voltage 100V-240V AC, 120V-250V DC.
Output voltage 30V DC.
Adjustable functions: switching and dimming. Gradual flashing and flashing at three speeds.
Suitable for wet location (IP65): dust-proof and water-jet proof.
Weight 1.32lbs / 0.60kg
→Outdoor
Dry Damp Wet



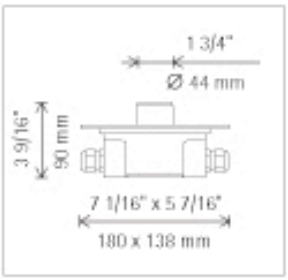
33873.000
Recessed housing
For mounting in plaster.



33859.023
Control gear
For max. 10 orientation luminaires.
Input voltage 100V-240V AC, 120V-250V DC.
Output voltage 30V DC.
24V DC input for emergency power operation.
Adjustable functions: switching and dimming. Gradual flashing and flashing at three speeds.
Suitable for wet location (IP65): dust-proof and water-jet proof.
Weight 1.32lbs / 0.60kg
→Outdoor
Dry Damp Wet



33893.023
Recessed housing IP67
For installation in concrete floors or compressed natural ground with 25mm floor covering.
Cast aluminum, black, double powder-coated.
2 cable entries with IP67 ports.
Through-wiring possible.
Suitable for wet location (IP67): dust-proof and protected against immersion damage.
→Outdoor
Dry Damp Wet

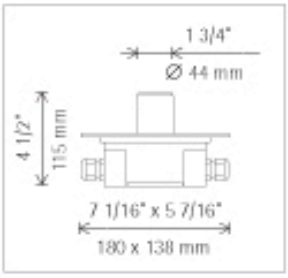


ERCO

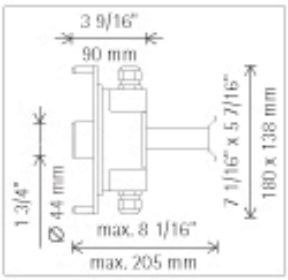
LED orientation luminaire

Accessories

33894.023
Recessed housing IP67
For installation in concrete floors or compressed natural ground with 50mm floor covering.
Cast aluminum, black, double powder-coated.
2 cable entries with IP67 ports.
Through-wiring possible.
Suitable for wet location (IP67): dust-proof and protected against immersion damage.
→Outdoor
Dry Damp Wet



33896.023
Recessed housing IP67
For installation in concrete wall.
Cast aluminum, black, double powder-coated.
2 cable entries with IP67 ports.
Through-wiring possible.
Suitable for wet location (IP67): dust-proof and protected against immersion damage.
Weight 1.65lbs / 0.75kg
→Outdoor
Dry Damp Wet



33876.000
Tool kit
For mounting in cable ducts.

iolighting.com

line

series .75

asymmetric

Application

io lighting's line series .75 is approximately .75" x .75" in cross section. UL listed for dry locations, its low profile housing enables functional luminous intensities from "tight" architectural details such as niches, coves, & casework. Similar to halogen light sources, LEDs are point sources that offer superior definition to three dimensional objects and sparkle to reflective surfaces.

series .75 is a low voltage linear accent luminaire that may be ordered in incremental lengths that range from 6" to 96" nominal. The asymmetric beam spread is optimized for a forward throw distribution. 10°, 45°, 65° distributions also available. See dedicated specification sheet for details. Average rated life for series .75 is 50,000 hours. Lamp lumen depreciation at 50,000 hrs. is 30%.

Light Output

line series .75 is available with two lumen outputs for white light only. Red, green, blue and amber are available in standard output only:

Standard:
- Warm White: 38 lms/ft
- Cool White: 48 lms/ft

High Output:
- Warm White: 127 lms/ft
- Cool White: 145 lms/ft

Refer to light output tables for footcandle values at various distances. IES format files may be obtained from the factory or downloaded from iolighting.com.

Construction

Light weight, yet durable aluminum housing provides recommended heat sink requirements for LEDs. Precision optic is composed of a customized acrylic material that offers very high transmisivity, UV stability, and excellent longevity. series .75 **is UL listed for dry locations only.**

Electrical

Universal 120 or 277 Volt supply required for 24 volt remote driver. 4'-0" 22 AWG, 600 volt TFFN rated power cords are supplied with strain reliefs for both electric feed and connectors (for continous row application).

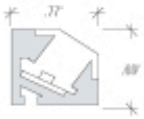
Power Consumption

- standard: 2 w/ft
- high output: 8 w/ft

Finish

Anodized aluminum finish is standard. Custom anodized finishes available upon request.

Beam Spread Options



Power Supply (Driver) Information

Standard Light Output

TYPE	SUPPLIES	REMOTE DISTANCE
24v/20w	UP TO 78"	32'-0" (@18awg)
24v/100w	UP TO 35'-0"	18'-0" (@18awg)
	(2) RUNS UP TO 49' WITH (1) RUN NTE 35'-0"	46'-0" (@14awg)
		71'-0" (@12awg)

High Output

TYPE	SUPPLIES	REMOTE DISTANCE
24v/100w	UP TO 12'-0"	18'-0" (@18awg)
		46'-0" (@14awg)
		71'-0" (@12awg)

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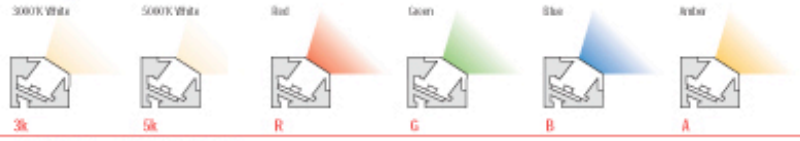
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

line

series .75

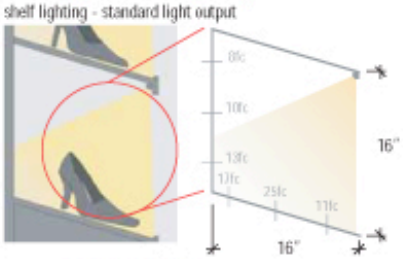
asymmetric

Color Options



Applications / Light Output

shelf lighting - standard light output

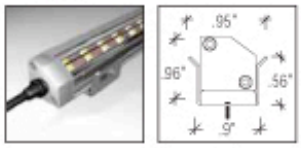


cove lighting

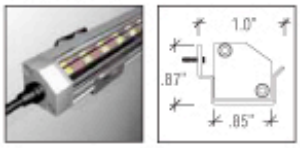
IES format data available at www.iolighting.com

Mounting Options

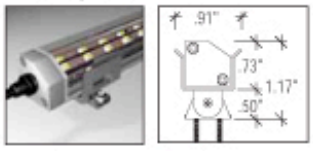
100 surface



101 side surface

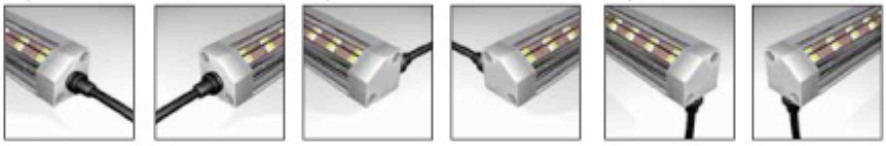


102 field adjustable



Electrical End Feed Options

1 right end feed | 2 left end feed | 3 right back feed | 4 left back feed | 5 right bottom feed | 6 left bottom feed



Order Code

0	03	I	□□□□	□□	□□□	□	□□	□	□	□
io	Line .75	location	Color	Distribution	Mounting	Finish	Length	Electrical Feed	Voltage/Dimming	Driver Enclosure (OPTIONAL)
		Interior only	3k 3000 K 3kHO 3000 K High Output 5k 5000 K 5kHO 5000 K High Output R Red G Green B Blue A Amber	90 Asymmetric	100 Surface 101 Side surface 102 Field adjustable	1 Anodized Aluminum 2 Anodized Custom Color	UNITS (actual) 01 6" (6.15") 02 12" (11.84") 03 18" (17.59") 04 24" (23.15") 05 30" (28.84") 06 36" (34.59") 07 42" (40.15") 08 48" (45.84") 09 54" (51.59") 10 60" (57.15") 11 66" (62.84") 12 72" (68.59") 13 78" (79.84") 14 84" (85.59") 15 90" (91.15") 16 96" (96.84")	1 Right end feed 2 Left end feed 3 Right back feed 4 Left back feed 5 Right bottom feed 6 Left bottom feed FOR CONTINUOUS ROW 1-2 Right end feed / Left end feed 3-4 Right back feed / Left back feed 5-6 Right bottom feed / Left bottom feed	1 120v 2 277v 3 120v w/dim 4 277v w/dim 5 other	I Interior Rated N Not Required by io *Supplied by others*

Note: "Actual" length provided includes end feed and non-feed endcaps. Add .27 when electrical feed occurs on both ends (for continuous row mounting).

END OF SECTION 16511