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NAVFAC PTS-B20 (June 2023)  
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Preparing Activity: NAVFAC SUPERSEDING PTS-B20 (September 2022)  
   
PERFORMANCE TECHNICAL SPECIFICATION  
  
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SECTION B20  
  
EXTERIOR ENCLOSURE  
06/23

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NOTE: This section is intended to be used as a guide and contains requirements that are common to many different types of facilities; however, not all requirements and equipment items will be applicable to all projects. In addition, there may be special requirements for a particular project that are not addressed at all. The RFP preparer may have to incorporate additional information to address these special requirements in this PTS and the corresponding RFP Part 3 ESR. If the RFP preparer chooses to delete building elements that are not required for the project, do not change the remaining Uniformat paragraph designations (A102001). Uniformat designations are unique to the products they are assigned to. However, the subparagraph numerical extensions (example - 1.2 or a,b,c) of the Uniformat designations may change if subparagraphs are deleted.  
   
This guide specification is formatted utilizing Uniformat II, an industry recognized standard, ASTM E 1557. When the RFP preparer chooses to add a paragraph that does not apply to an existing building element already included in the specification, refer to the Uniformat/WBS located on the NAVFAC Design-Build Website for a listing of Uniformat II designations and definitions.  
  
NOTE: The RFP preparer may view or hide the criteria notes in this PTS section by modifying the WORD preferences for "Hidden text". To view the criteria notes, choose "File" then "Option". Click "Display" then check the "Hidden text" box under "Always show these formatting marks on the screen". In the same section, check the box for "Print hidden text" under "Printing options" to print the criteria notes.  
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NOTE: This section consists of the exterior facing of the facility, which includes all vertical and horizontal exterior closure features excluding the roof. (See Section B30, *Roofing*). Load bearing exterior walls are included here and not in Section B10, *Superstructure*. Structural frame elements at exterior such as columns and beams are included in Section B10, *Superstructure*, with only the applied exterior finishes (e.g., paint, stucco) being included here. Finishes to the inside face of walls which are not an integral part of the wall construction are included in Section C30, *Interior Finishes*.  
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**B203006 BLAST RESISTANT DOORS**

Provide blast resistant doors as required by Part 3 of the RFP in accordance with UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.

**B20 GENERAL**

RFP Part 3 including the Engineering System Requirements (ESR) provide project specific requirements. The RFP Part 4, Performance Technical Sections (PTS) provide generalized technical requirements that apply to multiple facility types and include more requirements than are applicable to any one project. Therefore, only the RFP Part 4 requirements that apply to the project and further define the RFP Part 3 project specific requirements are required.

**B20 1.1 DESIGN GUIDANCE**

Provide the design and installation in accordance with the following references. This Performance Technical Specification (PTS) adds clarification to the fundamental requirements contained in the following Government Standards. The general requirements of this PTS section are located in PTS Section Z10, *General Performance Technical Specification*.

Industry standards, codes, and Government standards referenced in the section text that are not found in the [Unified Master Reference List (UMRL)](http://www.wbdg.org/ffc/dod/unified-master-reference) in the [Federal Facility Criteria (FFC)](http://www.wbdg.org/ffc/federal-facility-criteria) at the [Whole Building Design Guide (WBDG)](http://www.wbdg.org/) website, are listed below for basic designation identification. Comply with the required and advisory portions of the current edition of the referenced standard at the time of contract award.

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NOTE: Edit the following list of industry and Government standards to coordinate with the section text additions and deletions. List all industry and Government standards in the following two paragraphs that are indicated in the section text that are not listed in the UMRL.  
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**B20 1.1.1 Industry Standards and Codes**

NATIONAL LUMBER GRADES AUTHORITY (NLGA)

**B20 1.1.2 Government Standards**

Military Handbook 1013/1A, *Design Guidance for Physical Security of Facilities*

UNIFIED FACILITIES CRITERIA (UFC)

|  |  |
| --- | --- |
| UFC 1-200-01 | DoD Building Code (A reference in this PTS section to UFC 1-200-01 requires compliance with the Tri-Service Core UFCs that are listed therein, which includes the following significant UFC(s): UFC 3-101-01, Architecture) |
| UFC 1-200-02 | High Performance and Sustainable Building Requirements |

**B20 1.2 PERFORMANCE VERIFICATION AND ACCEPTANCE TESTING**

Provide verification of satisfactory exterior enclosure system performance via Performance Verification Testing, and by field inspection as detailed in this section of the RFP. Provide special tests and special inspections in accordance with Part 2 Section 01 45 00, *Quality Control*. The cost of all testing is included in the Contract.

**B20 1.2.1 Required Brick Masonry Testing and Field Samples**

a. Where field testing is required, determine masonry strength in accordance with American Concrete Institute (ACI) 530.1.

b. Field Samples: Masonry Panel Requirements - At the job site submit for approval by the Designer of Record, a sample masonry panel minimum 8 feet (2.4 meters) long by a minimum of 4 feet (1.2 meters) high. Actual Sample size will be determined by number of components in the sample wall but provide a span of at least 4 feet (1.2 meters) of uninterrupted brickwork and 2 feet (.6 meters) above wall openings. The approved sample must exhibit the standard for workmanship and materials for the project. The sample panel must include brick coursing, bond, weep holes, flashing, thickness, anchors, joint reinforcing, wall ties, rigid-board insulation, intersection of walls, bond beams, expansion and control joints, and tooling of joints, range of color, texture of masonry, and mortar color; or cold-formed steel framing, insulation, fiberglass-faced gypsum sheathing, air barrier, moisture barrier/vapor retarders, exterior enclosure barrier connections to adjoining construction, sealing of exterior enclosure barrier penetrations, sealant, masonry ties and anchors, and tooling of joints, the range of color and texture of brick veneer, and the color of mortar. Protect the sample panel from damage at the site until masonry work is complete and approved, at which time the panel must be removed from the site. If there are windows or curtain walls in the project which interface with the masonry, a cut-away sample window or curtain wall mock-up must be installed in the masonry field panel, with all accessories, finishes, and trim (see B20 1.2.4 and 1.2.5). Masonry work must match the approved sample.

**B20 1.2.2 Air Barrier Field Sample**

Designate a portion of the project that reveals the various edge, seam, transition, and penetration conditions that the air barrier is exposed to. Determine this location with the Contracting Officer and obtain approval of the sealing methods employed on the project from the air barrier Manufacturer. Leave sample area exposed to view as long as practical to serve as a construction standard and comparison of future air barrier construction on the project. Before construction covers the sample area, provide detailed photographs of the air barrier details for future reference.

**B20 1.2.3 Air Barrier Performance**

Provide air barrier inspection on all projects and air barrier performance testing when required in RFP Part 3, Section B20.

**B20 1.2.3.1 Air Barrier Inspection**

Coordinate all subcontractors that provide part of the air barrier construction to provide an air tight barrier. Review the air barrier prior to being covered by subsequent construction to confirm that the air barrier complies with the following requirements;

a. Prior to applying an air barrier, confirm that the substrate complies with conditions required by the applied air barrier material manufacturer.

b. Air barrier must create a continuous barrier, without gaps, "fish mouths", holes, unsealed seams, or unsealed penetrations.

c. Air barrier components are compatible and capable of being permanently connected to form an air tight barrier.

d. Construction of the air barrier complies with air barrier design as indicated in the Basis of Design and exterior enclosure barrier drawings.

e. Air barrier is installed in accordance with manufacturer's standard details available on the Air Barrier Association of America (ABAA) website named "Air Barrier Materials, Components, Assemblies & Systems" and found at the following web link; <http://www.airbarrier.org/materials/assemblies_e.php>

**B20 1.2.4 Thermal Envelope Performance Testing (Infrared Thermography)**

Where required in RFP Part 3 or B20 1.2.3.2 *Air Barrier Performance Testing*, provide infrared thermal testing and repair as follows (coordinate with air barrier testing):

a. Test the building envelope using Infrared Thermography technology. Complete thermography testing in accordance with the requirements of ASTM E1186 and ISO 6781. The Contracting Officer will witness the testing. Testing must occur just before the building air tightness test. Testing must also occur during the air tightness test so that areas of building air leaks are detected. If the building air tightness test is failed, repeat thermographic testing just before and during subsequent air tightness tests until the air tightness test is successful.

b. Thermographer Qualifications: the lead thermographer must have qualifications meeting requirements in UFGS Section 01 91 19.

c. Thermography Test Procedures: Submit detailed test procedures indicating the test apparatus, the test methods and procedures, and the analysis methods to be employed not later than 60 days after Notice to Proceed.

d. Thermography Test Report: Provide a report. The report must include thermographs in color and a color temperature scale to define the temperature indicated by the various colors. The report must identify the high temperature reading, the outdoor air temperature, the building indoor air temperature, and the wind speed and direction. The report must note any areas of compromise in the building envelope, and must note all actions required and taken to correct those areas.

e. Final Test: Final thermography test report must demonstrate the problem areas have been corrected. Submit the complete test and analysis for review and approval.

**B20 1.2.5 Air Barrier Performance Testing**

Provide air barrier testing and repair as follows (coordinate with infrared thermal testing):

a. Provide a testing plan as a part of the Commissioning Plan and notify the Contracting Officer 7 working days before the testing will take place. Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.  
  
Also coordinate building access during the test with the Contracting Officer. Perform pretest inspection with all parties involved in the test and possible repairs of the building enclosure. Record pretest conditions and utilize pictures to assist in the documentation.

b. Designer of Record (DOR) must utilize UFGS Section 01 91 19, *Building Enclosure Commissioning,* and Contractor must perform testing as described in that specification. Where conflicts exist between the UFGS Section 01 19 19 and this performance specification, UFGS Section 01 91 19 will govern. The air leak flow rate must not exceed 0.25 CFM at 75 Pa per square foot (0.076 cmm 75 Pa per square meter) of building enclosure area including roof or ceiling, walls and floor as provided by the DOR.  
  
Method 1: This test consists of measuring the flow rates required to establish 12 positive and 12 negative building pressures from at least 25 Pa to at least 50 Pa. Take at least 12 bias pressure readings across the building enclosure averaged over 5 seconds each before and after the test. None of these readings must exceed 30% of the minimum test pressure.  
  
Method 2: this test consists of measuring the flow rates required to establish 12 positive building pressures from at least 50 Pa to at least 75 Pa. Take at least 12 bias pressure readings across the building enclosure averaged over 5 seconds each before and after the test. None of these readings must exceed 20% of the minimum test pressure.  
  
The test results must be either pass or fail. Provide the theoretical size of the opening that leaks the same amount as the building enclosure at 75 Pa, to facilitate the search for leaks and repair of the exterior enclosure.

c. Provide infrared thermography to determine air leakage paths if facility fails to retain the required air pressure in the test above. Utilize infrared cameras with a resolution of 0.1 degree C or better.  
  
Perform infrared thermography in accordance with ISO 6781:1983 and American Society for Testing and Materials (ASTM) C1060 and B20 1.2.4 *Thermal Envelope Performance Testing (Infrared Thermography)*. Determine air leakage pathways in accordance with ASTM E1186 *Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems*, and perform corrective work as necessary to achieve the whole building air leakage rate specified.  
  
Modify construction to stop identified air leakage until target is reached. Correct air path leaks at the source of the leak, do not use sealant to close air leakage paths that are required to be opened for maintenance of the facility such as fixtures, switches covers, receptacle covers, access doors, etc.

d. Seal air leaks in the following order of priority:

1. Top of the building. These include attics, roof/wall intersections, penthouse doors and walls, HVAC equipment.

2. Bottom of the building. These include ground floor access doors and inspection hatches, exhaust and air intake vents, service penetrations of enclosure, crawl spaces.

3. Vertical shafts. These include gasket stairwell fire doors, fire hose cabinets and recessed toilet accessories connected to vertical shaft, vertical and horizontal utility penetrations in service rooms, elevator rooms and shafts.

4. Exterior walls. These include weather strip doors and windows, exhaust fans and ducts, service penetrations, electrical receptacles, wall base.

**B20 1.2.6 Required Records for Concrete Wall Panels**

a. Cast-in-place - Submit to DOR mandatory batch ticket information as ASTM C 94 for each load of ready-mixed concrete.

b. Submit to DOR commercial testing results in accordance with PCI MNL-117 and as required in paragraph entitled "Sampling and Testing for Precast"

**B20 1.2.7 Precast Concrete Wall Panel Surface Finish Sample**

Submit to DOR a concrete wall panel sample 12 inches (300 mm) by 12 inches (300 mm) by approximately 1 1/2 inches (38 mm) in thickness, to illustrate quality, color, and texture of both exposed-to-view surface finish and finish of panel surfaces that will be concealed by other construction. Obtain initial approval of color and texture from DOR prior to submission of sample panels.

**B20 1.2.7.1 Manufacturing Plant Sampling And Testing for Precast**

Plant Quality Control - PCI MNL-117 for PCI enrolled plants. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-117 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

a. Aggregate Tests: ASTM C 33. Perform one test for each aggregate size, including determination of the specific gravity.

b. Strength Tests: ASTM C 172. Provide ASTM C 39 and ASTM C 31/C 31M compression tests. Perform ASTM C 143 slump tests. Mold six cylinders each day or for every 20 cubic yards (15 cubic meters) of concrete placed, whichever is greater. Perform strength tests using two cylinders at 7 days and two at 28 days. Cure four cylinders in the same manner as the panels and place at the point where the poorest curing conditions are offered. Moist cure two cylinders and test at 28 days.

c. Changes in Proportions: If, the compressive strength falls below that specified, adjust the mix proportions and water content and make necessary changes in the temperature, moisture, and curing procedures to secure the specified strength. Notify the Contracting Officer of all changes.

d. Strength Test Results: Evaluate compression test results at 28 days in accordance with ACI 214 using a coefficient of variation of 20 percent. Evaluate the strength of concrete by averaging the test results (two specimens) of standard cylinders tested at 28 days. Not more than 20 percent of the individual tests must have an average compressive strength less than the specified ultimate compressive strength.

**B20 1.2.7.2 Acceptable Appearance**

Refer to *Architectural Precast Concrete* by the Prestressed Concrete Institute, in the "Acceptability of Appearance" paragraph for reasons to reject precast panels. Panels in place may be rejected for any one of the product defects or installation deficiencies remaining after repairs and cleaning have been accomplished. "Visible" means visible to a person with normal eyesight when viewed from a distance of 20 feet (6 meters) in broad daylight.

**B20 1.2.8 Window Sample Mock-Up**

a. Provide mock-up of one (1) typical combination window unit to be used within the project and conduct a field mock-up test in strict compliance with American Architectural Manufacturers Association (AAMA) 502 method A and method B. Each opening must be tested to achieve performance of American Society of Civil Engineers (ASCE) 7 calculated requirements (PSF or Kg/m2) for water resistance, which must not exceed .667 % of the products capable water based on AAMA 101/I.S.2. Allowable rates of air leakage for field testing must be 1.5 times applicable AAMA 101/I.S.2 rate for the Product Type and Performance Class.

b. Exhibit transition and interconnection of windows to surrounding materials such as caulking, air barrier, vapor barrier, flashing, flashing end dams, subsill, and fasteners. Obtain DOR approval of materials interconnections prior to being cover by construction

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EXAMPLE NOTE: Performance test at 1.57 PSF (7.66 Kg/m2) allows .30 cfm/ft2, 502B test allows .45 cfm/ft2.   
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c. Opening is to be tested under "Quality Control" testing by a designated independent testing agency.   
  
1) Schedule mock-up installation sufficiently in advance of need to allow adequate time for cure of sealants, testing and reconstruction, if needed, without delaying the project.   
  
2) Build mock-up in building enclosure wall in location selected by Owner and Architect.   
  
3) Modify mock-up construction and perform additional tests as required to achieve specified minimum acceptable results. If corrections are not adequate, construct new mock-up, at written direction of Owner and Architect. Co-ordinate construction of mock-up with other involved trades.   
  
4) Approved mock-ups may become part of completed Work if undisturbed at time of Substantial Completion.   
  
5) Flood test Mock-up window subsill and obtain approval of DOR prior to installing window unit.

**B20 1.3 DESIGN SUBMITTALS**

Provide design submittals must be in accordance with PTS Section Z10, *General Performance Technical Specifications*, Part 2 Section 01 33 10.05 20, *Design Submittal Procedures*, UFC 1-300-09N, *Design Procedures*, UFC 3-101-01, *Architecture,* and UFC 3-301-01, *Structural Engineering*.

In addition, UFGS sections listed below or in the body of the PTS text are to be used by the Designer of Record (DOR) as a part of the design submittal. If the UFGS products or systems are applicable to the project, the DOR must edit these referenced UFGS sections and submit them as a part of the design submittal specification. Edit the specification sections in accordance with the limitations stated in PTS Section Z10, *General Performance Technical Specifications*.

**B20 1.4 CONSTRUCTION SUBMITTALS**

Submit construction submittals in accordance with PTS Section Z10, *General Performance Technical Specifications*. In addition to the Z10 requirements, the Designer of Record (DOR) must approve the following submittals as a minimum;

Shop drawings for reinforcing steel in masonry walls, doors, door hardware, windows, storefront, curtainwall, glazing, paint, exterior enclosure barrier systems, and visible exterior materials.

All structural elements necessary for construction.

**B20 1.4.1 Manufacturer's Verification Inspection Documentation for Galvanized Steel**

Submit manufacturer's verification inspection documentation for all galvanized steel in accordance with ASTM A123, ASTM A 153, and ASTM A 653.

**B20 1.4.2 Field Inspection of Field-erected Concrete Panels**

a. Perform field inspection of panel welded connections. Furnish the services of AWS-certified welding inspector for erection inspections. Welding inspector must visually inspect all welds and identify all defective welds.

b. Notify the DOR in writing of defective welds, bolts, nuts and washers within 7 working days of the date of inspection. Remove all defective connections or welds and re-welded or repaired as required by the DOR.

**B20 1.4.3 Sustainable Construction Submittals**

Submit sustainable construction submittals in accordance with Part 2 Section 01 33 29, *Sustainability Requirements and Reporting*.

**B2010 EXTERIOR WALLS**

Provide exterior wall construction that consists of exterior skin system of non-structural outside face elements with rain-screen back-up wall systems that include; flashing (embedded, exposed, and thru-wall), a water resistive barrier, moisture barrier/ vapor retarder (if required), air barrier, and insulation systems with interior skin system materials to provide a protective finish on the inside face of exterior walls. Provide all components necessary for a shingled water resistive barrier to direct water that would penetrate the wall to be directed to the outside of the wall. Provide exterior enclosure components and barriers in accordance with UFC 3-101-01, *Architecture*.

Design all work to comply with UFC 3-101-01, *Architecture*, and UFC 3-301-01, *Structural Engineering*, and the following requirements:

a. Vapor Pressure and Hygrothermal Analysis - Perform a job specific vapor pressure and hygrothermal analysis in accordance with UFC 3-101-01, *Architecture*. The conclusion of the analysis must indicate if a moisture barrier/ vapor retarder is required, the appropriate locations of needed moisture barrier/ vapor retarder, and anticipated dew-point locations in the exterior enclosure during different critical times of the year.

b. Wind Loads - Provide wind load calculations for exterior cladding in accordance with UFC 1-200-01 and UFC 3-301-01 with comparative analysis of the cladding system to be provided.

c. Water Penetration - No water penetration must occur at a pressure of 8 psf (39 Kg/m2) of fixed area when tested in accordance with ASTM E 331.

d. Insulating Value – Comply with UFC 3-101-01, *Architecture*, for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 90.1 standards to determine the minimum insulating value of the complete wall system.

**B201001 EXTERIOR CLOSURE**

**B201001 1.1 MASONRY VENEER EXTERIOR WALL CLOSURE COMPONENTS**

**B201001 1.1.1 General Requirements**

a. The masonry veneer includes the non-load bearing exterior walls of the structure, and also includes colored mortar, special shapes such as sills, headers, trim units and copings of brick masonry, precast concrete, concrete masonry units, or other approved materials. Tie the veneer to the backup wall system with a system that allows the veneer to move independently of the backup wall system, while being structurally supported. Allow for expansion and contraction of the veneer without cracking the exterior material.

b. Use running bond, tooled concave joints and full head joint weeps at 24 inches (610 mm) on center in the course immediately above the base flashing. Where rowlocks are permitted, slope rowlocks and project not less than 1/2 inch (13 mm) beyond the face of the wall to form a wash and drip. Where required, provide colored mortar conforming to ASTM C270. Provide special shapes where required.

c. Locate expansion/control joints and seal with proper backing material and ASTM C 920 polyurethane sealant, or preformed foam or rubberized expansion joint closure. Conform to UFC 3-101-01 and BIA Technotes 18, 18A. Match joint color of the brick, unless DOR directs otherwise.

d. Conform to ACI 530.1 for masonry veneer installation, including cold weather construction. Antifreeze admixtures are not to be used.

e. Clean the masonry in accordance with manufacturer's instructions and BIA Technote 20.

f. Utilize BIA Technical Notes to design, detail, and construct brick masonry walls. This PTS section amends the BIA documents and takes precedence over similar BIA requirements. Substitute directive language in the place of BIA suggestive language as required in PTS Section Z10, *General Performance Technical Specifications*. The results of these wording substitutions change this document to required procedures.

**B201001 1.1.2 Face Brick**

a. Brick Masonry Appearance - Do not change source or supply of materials after brick manufacturing work has started. Blend all brick to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

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NOTE: Type FBX is the most common type of brick for commercial applications. Always utilize FBX brick when the work requires close dimensional tolerances, such as in stack bond, small exterior piers, short wall segments, and special coursing such as soldiers. Type FBS allows more range of size variations than type FBX, and is commonly used for residential and small commercial buildings. Type FBA brick is manufactured for nonuniformity in size and texture such as hand-molded or tumbled brick. It is used for special architectural effects.  
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

b. Brick Type – Provide brick in accordance with ASTM C216, Grade SW, type FBX. Test rating of ASTM C67 must be "Not effloresced".

**B201001 1.1.3 Split Faced or Ground Faced Masonry**

ASTM C 90. If required, provide split faced or ground faced units, or split-ribbed units or scored-faced units.

**B201001 1.1.4 Cast Stone Trim Units**

a. Cast stone must be the product of a manufacturer regularly engaged in the manufacture of architectural cast stone (precast concrete building unit) products. Meet or exceed the requirements of ASTM C 1364.

b. Trim units of cast stone include sills, fascias, header units, copings and other trim units as required by the approved design.

**B201001 1.1.5 The Wall Cavity**

Comply with UFC 3-101-01, *Architecture* and BIA Technical Notes 21A, 21B, 21C, 28B.

**B201001 1.1.6 Through-Wall Flashing Components**

Provide through-wall flashing over all openings, spandrels, shelf angles, lintels, and built-in structural steel members. Provide through-wall flashing below all openings, parapets copings, sills, and at the base of the wall. Provide a method of weeping water collected by the through-wall flashing to the outside of the wall.

a. Incorporate weep holes to align with through-wall flashing in cavity wall construction as required by UFC 3-101-01, *Architecture*, and BIA Technotes. Install flashing according to BIA Technotes 7, 7A, 7B, 21A, 21B, 21C, 28B, and SMACNA figures 4-1A and 4-1B. Extend metal drip edge flashing beyond the wall plane using a 1/4 inch (6 mm) preformed 45 degree angle turn down.

b. Provide flashing material as required by UFC 3-101-01, *Architecture* and the following: Provide flashing of 7 ounce copper flashing with a 3 ounce bituminous coating on each side or a fiberglass fabric bonded on each side of the copper sheet. Sixteen (16) ounce uncoated copper, 28 gauge Type 302 or 304 stainless steel is also acceptable. 'Flexible membrane flashing, plastic or PVC-based membrane flashing is prohibited. Lap and seal turndown solid metal drip edge flashing to through- wall flashing. Refer to "Flashing" in this section to find requirements for non-through-wall flashing.

c. Incorporate the through-wall flashing in the water resistive barrier and seal joints to flashing to form a shingled effect and direct water to the exterior to the exterior enclosure and away from back-up wall assembly.

d. Where flashing is not continuous, such as at masonry wall opening heads and sills, extend flashing four inches beyond each side of the opening and turn up ends to form a pan and prevent water from reentering the wall cavity.

**B201001 1.1.7 Reinforcing in Veneer Layer**

Reinforcing in the veneer layer must be galvanized in accordance with ASTM A 123/A123M, ASTM A153/A153M, or ASTM A653/A653M, Z275 (G90) coating, and be of sufficient size to eliminate damage to the veneer layer from wind and other live and dead loads imposed on the veneer layer.

**B201001 1.2 CONCRETE EXTERIOR WALL CLOSURE**

**B201001 1.2.1 Precast Concrete Wall Panels:**

ACI 211.1 and ACI 301. PCI MNL-116 or PCI MNL-117. Concrete must have a minimum 28-day compressive strength of 4000 psi (281 Kg/cm2). Air content of plastic concrete must be between 4 and 6 percent air by volume. Provide a dosage of air entraining agent, which will produce 19 plus or minus 3 percent air in a 1 to 4 by weight standard sand mortar in accordance ASTM C 185. Provide aggregate in accordance with ASTM C 33. Seal the panel joints with fully loaded and tooled sealant joints that are properly sized, shaped, and placed against manufacturer approved backing material. Sealant material thickness must not be less than 1/4 inch (6mm).

For rain screen precast panel wall systems with back-up wall construction, provide sealed face joints that allow moisture to be drained from the wall cavity behind the precast panels via weeps. Provide flashing and water/ moisture resistant barriers to direct water from the wall cavity to the outside of the building. Locate weeps where cavity is obstructed such as above through-wall flashing, at head and sill flashing above and below windows, above door flashings, and wall base flashing.

For barrier wall precast panel wall systems without back-up wall construction, provide a two stage drained joint system on all precast panels joints. Design the two staged drained joint system to provide the following;

a. Locate all sealant beads on the exterior side of the backer rod. Align placement of the exterior sealant bead with the exterior surface of the precast panel and space the placement of the interior sealant bead as required below but no less than 3 inches (75 mm) from the face of the panel to the face of the interior tooled sealant bead.

b. Space sealant beads as far apart as possible but provide no less than 1 inch (25mm) clear air space between the exterior seal backer rod and the tooled interior sealant bead.

c. Form minimum of 1/2 inch (12mm) weep holes to facilitate drainage in the vertical sealant joints. Attach a bead of sealant to the interior vertical sealant bead with an outward slope and a drop in height of at least 4 inches (100mm) to form the drainage plane for the weep opening.

d. Locate weeps as necessary to allow complete drainage of water from the two stage air/ vent space. Provide weeps at obstructions in the air/ vent space such as through wall flashing, horizontal panel joints, head and sill flashing above and below windows, above door flashing, and wall base flashing.

Minimize cracking potential of precast concrete elements by implementing expansion and control joints in the precast assembly. Comply with the following;

a. Exposed Aggregates - In addition to the above aggregate, facing mixture aggregate, and aggregate for homogeneous panels with exposed aggregate finish, must be crushed stone.

b. Cement - ASTM C 150.

c. Admixtures - ASTM C 260 for air-entraining admixtures. Other admixtures: ASTM C 494. Certify that admixtures are free of chlorides.

d. Reinforcement - ACI 301.

e. Inserts - ASTM A 47, Grade 32510 or 35018, or may be medium strength cast steel conforming to ASTM A 27/A 27M, Grade U-60-30. Where exposed to moisture, provide inserts hot-dip galvanized after fabrication in accordance with ASTM A 153/A 153M.

f. Embedded Plates - ASTM A 36/A 36.

g. Flashing Reglets - Fabricate of sheet metal, open-type with continuous groove 1-1/8 inches (28 mm) deep minimum by 3/16 inch (5 mm) wide at opening and sloped upward at 45 degrees. Top surface must have toothed lip section to anchor upturned edge of metal snap-lock counter flashing when inserted. Provide stainless steel sheet metal, 0.011 inch (0.28 mm) minimum thickness, ASTM A 167, Type 302 or Type 304, Number 2D finish, soft temper.

h. Clip Angles - ASTM A 36/A 36M steel, galvanized after fabrication in accordance with ASTM A 153/A 153M.

i. Ferrous Casting Clamps - ASTM A 47, Grade 32510 or Grade 35018 malleable iron or cast steel, or ASTM A 27/A 27M, Grade U-60-30, cast steel casting, hot-dip galvanized in accordance with ASTM A 153/A 153M.

j. Threaded Fasteners – Provide galvanized machine bolts, washers and, when required, nuts.   
  
1) Bolts: ASTM A 449, 3/4 inch (19 mm) diameter machine bolts with hexagon head.   
  
2) Washers: American National Standards Institute (ANSI) B18.21.1, medium or heavy lock-spring washers.   
  
3) Nuts: ASTM A 563, Grade C, heavy, hexagon-type nuts.   
  
4) Square Nuts: ASTM A 563, Grade A, plain.

**B201001 1.3 CONCRETE WALL PANEL RESTORATION**

Match the materials, physical and chemical properties, and composition of new concrete of the existing concrete to be repaired, unless samples and testing determine that existing mixtures and materials are faulty or non-performing.

**B201001 1.3.1 Existing Concrete Testing**

Take representative samples of existing concrete from areas of the structure to be repaired at indicated locations. Take samples in accordance with ASTM C 42 and ASTM C 823 and test in accordance with ASTM C 39, ASTM C 42, ASTM C 295, ASTM C 457, ASTM C 856, ASTM C 1218/C 1218M, and ASTM C 642, ASTM C 114, and ASTM C 1084. Evaluate aggregates in the existing concrete in accordance with ASTM C 136 and ASTM C 295. Determine the air content of the existing concrete in accordance with ASTM C 457 and ASTM C 642.

**B201001 1.3.2 Admixtures**

Air entraining admixtures must conform to ASTM C 260, water-reducing or -retarding admixtures must conform to ASTM C 494, and pigments for integrally colored concrete must conform to ASTM C 979 and ASTM C 1017. Admixtures must not contain added chlorides.

**B201001 1.3.3 Aggregates**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: If a specific type or size of aggregate is required for a desired finish, whether it be for a facing mix or the entire thickness, add the additional requirements to the program.  
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Aggregates must conform to ASTM C 33.

**B201001 1.3.4 Cement**

Match cement composition of cement used in existing concrete to be repaired as determined by samples and testing and conforms to the basic requirements of ASTM C 150, Type I or II. Provide cement with non-shrink (shrinkage compensating) properties and conforms to ASTM C 1107, Class B or C, expansive cement type.

**B201001 1.3.5 Pozzolan**

Provide pozzolan to conform with ASTM C 618, Class F, including limit on available alkalis, "Table 2 - Supplementary Optional Chemical Requirements," and uniformity requirements, "Table 4 - Supplementary Optional Physical Requirements."

**B201001 1.3.6 Epoxy Anchor Adhesives**

Use epoxy-resin grout to bond steel anchors to concrete with a 100 percent solids, moisture insensitive, low creep, structural adhesive. The epoxy must conform to ASTM C 881, type IV; grade and class selected to conform to the manufacturer's recommendations for the application. The epoxy adhesive must be conditioned, proportioned, mixed, and applied in accordance with the manufacturer's recommendations, except as otherwise specified herein.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: Some jobs may require the pressure injection of cracks with epoxy-resin grout. In such instances the following paragraphs should be inserted:  
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a. Epoxy-resin grout - Provide a two-component material, 100 percent solids by weight, formulated to meet the requirements of ASTM C 881, Type I or II. Use type I material when materials or atmospheric temperatures are 70 degrees F (21 degrees C) or above. Use type II material when materials or atmospheric temperatures are below 70 degrees F (21 degrees C). Provide epoxy-resin grout with the ability to structurally rebond cracks, delaminations, and hollow plane conditions in concrete; must be insensitive to the presence of water; and must have the capability to penetrate cracks down to 5 mils in width. Materials must have been successfully used in similar conditions for a period of at least five years.

b. Epoxy Injection Ports – Design injection ports for epoxy-resin grout for the intended use as required in this section and made according to the recommendation of the epoxy manufacturer.

**B201001 1.4 OTHER EXTERIOR WALL CLOSURE**

**B201001 1.4.1 Concrete Unit Masonry**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: Use the following paragraph when single wythe, exposed concrete masonry finish is acceptable for the exterior of the building.  
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Masonry walls must comply with ACI 530.1. Load-bearing units: ASTM C90, Non-load bearing- units: ASTM C129, Type I or II. Provide ground face units, split-faced units, or split-ribbed units for exposed exterior walls. Provide water repellent admixture to masonry units where the exterior face of the units will not receive a waterproof coating such as paint. Mortar must conform to ASTM C 270, Type S. Test mortar in accordance with ASTM C 780. Provide water repellent admixture and color additive in mortar for masonry walls that will not receive a waterproof coating such as paint. Do not use admixtures containing chlorides. Provide air entrainment, not to exceed 12 percent, in mortar.

a. Adjustable Anchors for Structural Members - Use adjustable anchors to anchor masonry structural steel columns or beams. Weld the fixed portion of the anchors (steel anchor rods) to the structural steel member. Provide adjustable anchors 3/16 inch (5 mm) diameter steel wire, triangular-shaped. Anchors attached to steel must be 5/16 inch (8 mm) diameter steel bars placed to provide 1/16 inch (1.6 mm) play between flexible anchors and structural steel members.

b. Deformed Bars - ASTM A 615/A 615M, ASTM A 616/A 616M, ASTM A 617/A 617M, or ASTM A 706/A 706M.

**B201002 EXTERIOR WALL BACKUP CONSTRUCTION**

**B201002 1.1 CONCRETE UNIT MASONRY**

Provide concrete unit masonry as described in B201001 1.10.2

Provide water resistive barrier on the cavity-facing wythe of the backup masonry. Coordinate water resistant barrier materials and methods to provide water control and vapor transmission control for the lifetime of the structure. Seal all holes and penetrations in the water resistive barrier and repair any material damaged by other construction operations.

**B201002 1.2 CAST-IN-PLACE CONCRETE SYSTEM**

a. Unless otherwise noted herein, all concrete design and construction must be in accordance with UFC 1-200-01.

b. Provide concrete construction in accordance with ACI 301.

c. Refer to Performance Verification Testing for Cast-in-place field quality control.

d. Concrete construction tolerances must be in accordance with ACI 117.

e. Design for watertight joints, or weeping joints having back-up water penetration protection in precast elements. Minimize cracking potential of precast concrete elements by implementing expansion and control joints in the precast assembly.

f. Joints must include properly sized and placed backing material and fully loaded and tooled sealant joint of no less than 1/4 inch sealant material thickness.

g. Provide a water resistive barrier to protect back-up wall assembly.

**B201003 INSULATION AND VAPOR RETARDER**

Provide insulation, air barriers, water resistive barriers, and moisture barrier/ vapor retarders (if required) in the exterior enclosure to control heat loss/gain, air infiltration/diffusion, moisture infiltration/diffusion, and water infiltration.

Provide insulation, air barrier and water resistive barrier on all conditioned facilities and moisture barrier/ vapor retarders when required by the exterior enclosure vapor pressure and hygrothermal analysis. These barrier materials may be installed separately or combined if different air barrier, moisture barrier/ vapor retarder, and water resistive barrier functions can be consolidated in one material.

Provide exterior enclosure barriers that are durable and designed to last the life of the facility. Seal the continuous air and water resistive barrier in a flexible manner to allow for relative movement of adjacent building enclosure components. Support exterior enclosure barriers to withstand maximum positive and negative air pressure to be placed on the building without displacement or damage and transfer the load to the structure. Permanently seal penetrations, joints, holes, and transitions to adjoining construction in air and water resistive barriers as recommended by the material manufacturer. Do not compromise exterior enclosure barrier integrity at electrical boxes, fixture supports, and fasteners with holes through the exterior enclosure barriers that allow air or water leakage. Do not expose exterior enclosure barriers or retarders to environment conditions longer than is recommended by the manufacturer.

**B201003 1.1 INSULATION SYSTEMS**

Provide vertical and horizontal polystyrene insulation conforming to ASTM C578 or rigid polyisocyanurate board wall insulating products conforming to ASTM C591 or mineral-fiber blanket insulation conforming to ASTM C 665. Wall insulating product must have a minimum R-value as indicated by applicable ASHRAE 90.1 calculations called for in UFC 1-200-02, *High Performance and Sustainable Building Requirements*, and meeting minimum building envelope insulation requirements of UFC 3-101-01 *Architecture* and the energy design of the facility. Seal the joints in rigid insulation within cavity/veneer walls for additional moisture and air infiltration protection.

**B201003 1.1.1 Bituminous Dampproofing**

Bituminous Dampproofing shall be ASTM D449, Type I or Type II bituminous dampproofing on the exterior surface of the interior wythe of masonry in a cavity wall (back-up wall for masonry veneer).

**B201003 1.1.2 Building Paper**

FS UU-B-790, Type I, Grade D, Style 1. Where required, provide over sheathing on wood or metal framed wall construction to eliminate water penetration.

**B201003 1.1.3 Polyethylene sheeting**

ASTM 4397, minimum 6 mil thickness. Provide typically on the interior face of insulated, wood or metal stud wall construction, unless a moisture vapor analysis indicates otherwise. (Poly sheeting on the interior surface of the studs is not recommended for cold, mixed-humid, mixed-dry, hot-humid or hot-dry climates.)

**B201003 1.2 AIR BARRIER**

The building air barrier is a combination of various construction materials/ components that form a continuous air barrier seal on all six sides of a building. Use methods recommended by the manufacturer to seal joints and intersections for air-tightness of materials designated as part of the air barrier. Individual materials used in the continuous air barrier must have an air permeance not to exceed 0.004 cfm/ft2 at a pressure differential of 0.3 inches water (1.56lb/ft2), (0.02 L/s. m2 at 75 Pa) when tested in accordance with ASTM E 2178. If the air barrier is to be field tested, refer to the requirements in the paragraph entitled "Air Barrier Performance Testing" of this section for entire building minimum air permeance. Provide air barrier installation at windows in accordance with ASTM E 2112.

**B201003 1.2.1 Exterior Enclosure Air Barrier Materials**

Refer to Air Barrier Association of America (ABAA) to identify qualified materials with the appropriate performance for the air barrier. Utilize materials from the "ABAA Evaluated Air Barrier Materials" found at the following web link;

<https://www.airbarrier.org/technical-information/evaluated-assemblies-2/>

**B201003 1.3 WATER RESISTIVE BARRIER**

Provide a water resistant barrier to resist bulk water penetration and wind-driven rain that passes the exterior cladding of the facility. Provide vapor permeable water resistant barrier if the water resistive barrier function is combined with other exterior enclosure barrier functions. Integrate water resistive barriers with wall flashing to form a shingled effect and direct water down the outside surface of the water resistive barrier, away from the back-up wall assembly, and out of the wall. Comply with the requirements of ASTM E2256 for mechanical fastened building wrap materials or ICC-ES Acceptance Criteria AC38 for other materials.

**B201003 1.3.1 Exterior Enclosure Water Resistive Barrier Materials**

Refer to Air Barrier Association of America (ABAA) to identify qualified materials with the appropriate performance for the water resistive barrier. Utilize materials from the "ABAA Evaluated Air Barrier Materials" found at the following web link;

<https://www.airbarrier.org/technical-information/evaluated-air-and-water-resistive-barrier-assemblies/>

**B201003 1.4 MOISTURE BARRIER/ VAPOR RETARDER**

Provide a moisture barrier/ vapor retarder to slow or reduce the unintended movement of water vapor in and out of conditioned space, if required by exterior enclosure vapor pressure and hygrothermal analysis. Perform the analysis and provide a moisture barrier/ vapor retarders in accordance with UFC 3-101-01, *Architecture*. Choose the moisture barrier/ vapor retarder permeability as a function of climate, the characteristics of the materials that comprise the assembly, and the interior conditions. Select moisture barrier/ vapor retarders in accordance with ASTM C755.

**B201004 PARAPETS**

Avoid parapets when possible, but when necessary, provide parapets with the same materials as the exterior wall construction, including framing members, anchors, flashings, cants, and accessories. Design parapets to withstand the lateral loads prevailing at the project site and be provided with thruwall flashing below the parapet cap, at structural members, at penetrations, and at the roof level. Provide flashing and scuppers in accordance with SMACNA.

**B201005 EXTERIOR LOUVERS & SCREENS**

If required, provide louvers, which are not an integral part of the mechanical equipment, exterior closures, grilles and screens, storm shutters, and other materials used for a variety of purposes including screening of equipment or as louvers for exterior doors.

Louvers, screens, grilles in must be selected in a color and design that is compatible with the fabric of the exterior architectural character as described below. For frame construction, install in accordance with ASTM E 2112.

**B201005 1.1 WALL LOUVERS**

Provide drainable blade type wall louvers with blade slopes of 45 degrees minimum, but provide wind driven rain rated louvers for wall louvered rooms without a floor drain within the room. Louvers must withstand a wind load of not less than 30 psf (146 Kg/m2), .08 inch (2 mm) thick 6063-T5 or T52 extruded aluminum in a factory-finished color in accordance with AAMA 2605 with a minimum coating thickness of 1.2 mil to match the building facade. Wall louvers must bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500 , 500L (wind driven rain), and AMCA 511. Provide sill flashing with sloped drain pan at base of louver to collect moisture that migrates down the interior face of the louver. This sill flashing must drain water to the outside of the building. Louvers must have bird screens.

**B201005 1.2 SCREENED EQUIPMENT ENCLOSURE**

Design and fabricate support frames to withstand wind loads. Anchor frames securely in place. Provide secondary horizontal steel or aluminum framing for attachment of screen materials. Screen material must be factory finished coating in accordance with AAMA 2605 with a minimum coating thickness of 1.2 mils. Form metal panels from galvanized steel sheet in accordance with per ASTM A 653 or aluminum sheet in accordance with ASTM B 209.

**B201006 BALCONY WALLS & HANDRAILS**

**B201006 1.1 HANDRAILS**

Design handrails and anchorage connections to resist loads in accordance with IBC. Provide steel and aluminum materials in accordance with NAAMM Pipe Railing Systems Manual, with the same size handrail and vertical post. Provide series 300 stainless steel pipe collars. Factory coat all metal railings, except ornamental metals such as brass, bronze, and nickel-silver, with a high performance coating in accordance with AAMA 2605 for aluminum with a minimum coating thickness of 1.2 mils unless otherwise noted. For steel handrails provide finish coating in accordance with UFGS 09 96 00, *High Performance Coatings*.

**B201006 1.1.1 Fiber Reinforced Plastic (FRP) Handrails**

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 NOTE: FRP handrails are only an option for mechanical mezzanine, utility or like construction only.  
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Provide FRP handrails in structural shapes manufactured by the pultrusion process with qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements in accordance with ASCE 7,29 Code of Federal Regulations (CFR) 1910.23, National Fire Protection Association (NFPA) 101. Provide integral UV inhibitors within the resin, synthetic surfacing veil to help produce a resin rich surface, and UV resistant coating for outdoor exposures.

**B201006 1.1.2 Steel Handrails**

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A 53 or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Steel railings must be of 1 1/2 inches (38 mm) nominal size. Railings must be hot-dip galvanized, shop primed shop painted for exterior applications.

**B201006 1.1.3 Aluminum Handrails**

Aluminum railing must be of 1-1/2 inch (38 mm) nominal schedule 40 pipe conforming to ASTM B 429 or 1-3/4 inch (44 mm) square aluminum semi-hollow tube with rounded corners conforming to ASTM B 221. Railings must be coated with a high performance coating or anodized in accordance with AAMA 612, Class I. All fasteners must be series 300 stainless steel.

**B201007 EXTERIOR SOFFITS**

Exterior soffit system assemblies must include trim and necessary accessories including high performance coatings, if required. Installation must be crisp, fit and trim with tight joinery to back-up framing. Design soffits to be field assembled by lapping side edges of adjacent panels and mechanically attaching through panels to galvanized, non-load bearing framing conforming to ASTM A 653 (G60) and ASTM C 645, using concealed fasteners. Provide trim accessories of the same material and finish as the soffit material where soffit abuts other materials.

Use adequate backing material to assure snug joints and even face planes. Where soffits ventilate an attic space, or an otherwise unventilated space, provide a soffit/ridge/louver/ventilator ventilation system with air quantities complying to the IBC. For spaces intentionally not vented, provide sealed soffits to maintain the integrity of the air barrier and insulation barrier.

**B201007 1.1 METAL SOFFIT PANELS**

Provided metal soffit panels factory-formed and factory-finished. Use factory-applied sealant in side laps

**B201008 WALL FLASHING**

Flashing shall be aluminum or stainless steel. Aluminum shall conform to ASTM B 209/B 209M, 0.040 inches (1.27 mm) thick and shall be coated to match the item flashed. Stainless steel shall conform to ASTM A 167, type 302 or 304, 2D finish, fully annealed, dead soft temper. Thickness shall be a minimum of 0.018 inches (0.4572 mm).

**B201009 EXTERIOR PAINTING AND SPECIAL COATINGS**

Apply coatings directly to all non-prefinished surfaces of the exterior construction. Comply with Master Painters Institute requirements for surface degradation analysis, surface preparation, paint and coating selection, paint application restrictions for substrate materials, and paint application.

**B201009 1.1 GENERAL REQUIREMENTS**

Painting practices must comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with Society for Protective Coatings (SSPC) PA 1. SSPC PA 1 methods are applicable to all substrates.

Provide all paint in accordance with the Master Painter Institute (MPI) standards for the exterior architectural surface being finished. The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a more current MPI "Approved Product List"; however, only one list may be used for the entire contract. All coats on a particular substrate, or a paint system, must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Select paint systems for the project in accordance with the MPI Architectural Painting Decision Tree available on the Whole Building Design Guide. Use this interactive MPI Decision Tree website to identify applicable paint system(s) for the project. The MPI Decision Tree identifies paint systems for each interior or exterior coated surface in "Normal" or "Aggressive" environmental conditions and generally lists the applicable paint systems in descending order of performance. The paint system at the top of each substrate list generally indicates the highest performing acceptable coating system.

Choose the "Aggressive" environmental conditions in the MPI Decision Tree for exterior systems that are used in moist humid conditions, abrasive conditions, chemical exposure conditions, or within five miles proximity of the ocean or a body of water. Also use "Aggressive " environmental conditions in interior spaces that are exposed to in moist humid conditions, abrasive conditions, chemical exposure conditions, such as bathrooms, shower rooms, kitchens, chemical storage area, swimming pools, laundry, sanitary areas, commercial kitchens, industrial production areas, and hospital operating rooms provide paint systems that comply with the MPI Decision Tree "Aggressive" environmental conditions.

Comply with the following requirements when determining the appropriate paint or coating system from the MPI Decision Tree:

a. Some of these paint systems are identified with a "NAVFAC Anchor". This "NAVFAC Anchor" indicates the minimum performing system that NAVFAC will accept for that substrate and environmental conditions.

b. When multiple "NAVFAC Anchors" are indicated on a certain substrate and environmental condition, provide the "NAVFAC Anchor" paint or coating system that is most appropriate for the facility use.

c. If only one MPI Decision Tree choice is available for a certain substrate and environmental condition with no indicated NAVFAC preference, provide that sole option for NAVFAC projects.

d. If the MPI Decision Tree provides multiple choices and no NAVFAC preference is denoted**,** refer to the Additional RFP Requirements below to determine level of performance.

e. If the MPI Decision Tree does not identify all paint system applicable to the facility, utilize the *MPI Architectural Painting, Exterior Systems Manual* to identify other appropriate paint systems for the project. Utilize the "Premium Grade" systems and comply with all limitations stated in the MPI "Approved Product List" for each paint product. Products having an MPI VOC Range E3 must be given preferential consideration over lower VOC Ranges. Use higher performing paint systems unless the lower performing paint system can be justified based on a lifecycle cost to include surface preparation, application, disposal, environmental impact, and required recoating cycles. Only use paint products that have been tested for MPI'S "DETAILED PERFORMANCE" or "EVALUATED PERFORMANCE ". Do not use products that have only been tested for "INTENDED USE".

f. If an "Aggressive" environmental condition option is not available in the MPI Decision Tree for a certain substrate, use the "Normal" environmental condition option.

g. Refer to the Additional Exterior Paint and Coating System Requirements below for further system requirements.

Paints and coatings must comply with Master Painters Institute Green Performance Standard GPS-1-12 which is available at the following website; <http://www.specifygreen.com/EvrPerf/EnvironmentalPerformance.html> . Choose paints that provide performance, are environmentally friendly, and that conform to EPA or local environmental regulations, whichever requires the lowest VOC content.

**B201009 1.1.1 MPI Gloss Levels**

Gloss levels must comply with the MPI system of determining gloss as defined in the Evaluation sections of the MPI Manuals. Utilize the performance characteristics of the paint gloss and sheen to categorize paint rather than manufacturers’ description of the product. The MPI Gloss Levels are indicated by the notation G1, G2, G3, G4, G5, G6, or G7. Navy only uses MPI Gloss Levels G2, G3, G5, G6.

The MPI Decision Tree indicates a default gloss level for each paint system, however consider the appearance, anticipated conditions, and need for cleaning when establishing the final gloss level for each coated surface of the project. Comply with the following guidance in choosing the appropriate gloss level.

a. Use G2 "Velvet-like" Flat for ceilings, residential walls away from human contact and low traffic areas.

b. Use G3 "Eggshell-like" in high traffic areas for ceilings and walls, when human contact with the wall is limited, and for dark accent colors.

c. Use G5 Semigloss for walls, doors and trim for high durability and clean ability and when a surface is expected to have routine human contact.

d. Use G6 Gloss only in special situations such as for piping identification or special effects.

The MPI gloss and sheen standard values are in accordance with ASTM D523, and are as follows:

|  |  |  |
| --- | --- | --- |
| **Gloss Level Number** | **Gloss@60 Degrees** | **Sheen@85 Degrees** |
| Gloss Level 1 (G1) - Matte or Flat | Max.5 units | Max.10 units |
| Gloss Level 2 (G2) - "Velvet-like" Flat | Max. 10 units | 10-35 units |
| Gloss Level 3 (G3) - "Eggshell-like" | Max. 10-25 units | 10-35 units |
| Gloss Level 4 (G4) - "Satin-like" | Max. 20-35 units | Min. 35 units |
| Gloss Level 5 (G5) - Semi-Gloss | 35-70 units |  |
| Gloss Level 6 (G6) - Gloss | 70-85 units |  |
| Gloss Level 7 (G7) - High Gloss | More than 85 units |  |

**B201009 1.1.2 MPI System Designations and Table Abbreviations**

The MPI coating system number description is found in either the *MPI Architectural Painting Specification Manual* or the *Maintenance Repainting Manual* and defined as an exterior system

a. EXT - MPI short-term designation for an exterior coating system on a new surface.

b. REX - the MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

c. DSD - the MPI short-term designation for Degree of Surface Degradation as defined in the Assessment sections in the *MPI Maintenance Repainting Manual*. Degree of Surface Degradation designates the MPI Standard for description and appearance of existing condition of surfaces to be painted. This DSD classification is used to determine the proper surface preparation necessary for painting.

**B201009 1.1.3 Surface Preparation**

Comply with the "Exterior Surface Preparation" section of the *MPI Architectural Painting Specification Manual,* or the Exterior Surface Preparation” section of the *MPI Maintenance Repainting Manual*. All suggestive language such as "may" or "should" are deleted from the standard and "must" inserted in its place. Suggestive language such as "recommended" or "advisable" is deleted from the standard and "require" or "required" inserted in its place. The results of these wording substitutions change this document to required procedures. For surface preparation, determine a MPI DSD Assessment of each surface and comply with the MPI Surface Preparation Requirements relating to the assessments. Not-withstanding MPI requirements, clean exterior ferrous metal that is exposed to weather conditions (wind, precipitation, solar degradation, and humidity) to a SSPC SP 10 level (near white).

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. For existing buildings, use MPI *Maintenance Repainting Manual* to determine the coatings that need to be removed. Remove deteriorated or loose coatings before repainting begins. Remove oil and grease prior to mechanical cleaning. Program cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

**B201009 1.2 ADDITIONAL EXTERIOR PAINT AND COATING SYSTEM REQUIREMENTS**

In addition to the MPI Decision Tree, comply with the following paint system requirements:

B201009 1.2.1 Pavement Coatings

a. EXT 3.2 Concrete Horizontal Surfaces

Normal/ Aggressive Condition; Pigmented;

Provide road and parking lot pavement marking in accordance with UFGS Section 32 17 23, *Pavement Markings*.

b. EXT 10.2 Bituminous Coated Surfaces

Normal/ Aggressive Condition; Pigmented;

Provide road and parking lot pavement marking in accordance with UFGS Section 32 17 23, *Pavement Markings*.

B201009 1.2.2 Hot Metal Surfaces (including smokestacks),

a. EXT 5.2 Hot Metal, Up to 205 degrees C 400 degrees F

Normal/ Aggressive Condition; Pigmented

(1) EXT 5.2A - Heat Resistant Enamel

Primer: Intermediate/ Topcoat:

MPI 21 Surface Preparation and numbers of coats in accordance with manufacturers' instructions.

b. EXT 5.2 Hot Metal (Ferrous), Up to 400 degree C, 750 degree F

Normal/ Aggressive Condition; Pigmented;

(1) 5.2C - Heat resistant - inorganic zinc coating

Primer: Intermediate/ Topcoat:

MPI 19 Surface Preparation and numbers of coats in accordance with manufacturers' instructions.

(2) 5.2B - Heat resistant - aluminum finish enamel

Primer: Intermediate/ Topcoat:

MPI 2 Surface Preparation and numbers of coats in accordance with manufacturers' instructions.

c. EXT 5.2 Hot Metal (Non-Ferrous), Up to 593 degree C, 1100 degree F

Normal/ Aggressive Condition; Pigmented

(1) 5.2D - Heat Resistant Coating

New and existing surfaces cleaned bare to SSPC SP 10/NACE No. 2

Primer: Intermediate/ Topcoat:

MPI 22 Surface Preparation and numbers of coats in accordance with manufacturers' instructions.

**B201009 1.3 EXTERIOR CONCRETE MASONRY FINISHES**

New and Existing, previously painted concrete masonry:

a. Latex, System DFT: 11 mils   
  
1) MPI EXT 4.2A-G3/G4 (Low sheen) / REX 4.2-G5; BF:MPI 4, P:MPI 15, I: MPI 15, T: MPI 15

New and Existing Profiled Block (Split Faced Block)

a. Latex System DFT: 11 mils

1) MPI EXT 4.2L-G3/4 (Satin-like) P: MPI 3 I: MPI 15 T: MPI 15

**B201009 1.4 EXTERIOR METAL FINISHES**

**B201009 1.4.1 New and existing steel that has been blast cleaned to SSPC SP 6 & 10:**

a. Alkyd, System (in SSPC Zones 1B and 2A) DFT: 5.25 mils   
  
1) MPI EXT/ REX 5.1D-G5 (Semigloss); P:MPI 79, I:MPI 94, T:MPI 9

b. Waterborne Light Industrial (in SSPC Zones 1B, 3A, 3B, and 3C), System DFT: 8.5 mils   
  
 1) MPI EXT 5.1R-G5 (Semigloss); P:MPI 101, I:MPI 108, T:MPI 163

**B201009 1.4.2 New Galvanized surfaces:**

a. Epoxy P/Waterborne Light Industrial (Use MPI 25 cleaner), System DFT: 4.5 mils   
  
1) MPI EXT 5.3K-G5 (Semigloss); P:MPI 101, I:MPI 161, T:MPI 161

**B201009 1.4.3 Galvanized surfaces with slight coating deterioration, with little or no rusting:**

a. Epoxy P/Waterborne Light Industrial Coating (Use MPI 25 cleaner), System DFT: 4.5 mils   
  
1) MPI EXT 5.3K-G5 (Semigloss); P:MPI 101, I:N/A, T:MPI 163

**B201009 1.4.4 Galvanized surfaces with severely deteriorated coating or rusting:**

a. Epoxy P/Waterborne Light Industrial Coating (Use MPI 25 cleaner), System DFT: 8.5 mils   
  
1) MPI EXT 5.3K-G5 (Semigloss); P:MPI 101, I:MPI 163, T:MPI 163

**B201010 EXTERIOR JOINT SEALANT**

Provide sealant joint design, priming, tooling, masking, cleaning and application in accordance with the general requirements of *Sealants: A Professionals' Guide* from the Sealant, Waterproofing & Restoration Institute (SWRI). All sealant must conform to ASTM C 920.

Joints must include proper backing material for sealant support during application, control of sealant depth, and to act as a bond breaker. Use filler boards, backer rods and bond breaker tapes. Provide priming unless specifically not recommended by the sealant manufacturer. Applied sealant must be tooled. Tooling must not compact sealant too less than the minimum sealant thickness required. Mask adjacent surfaces to control sealant boundaries during sealant application.

**B201011 SUN CONTROL DEVICES (EXTERIOR)**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: For projects located in areas where Sun Control Devices are used, delete the brackets and retain the above heading B201011, the below paragraph and paragraph B201011 1.1 Exterior Sun Screens. For all other projects, delete the referenced paragraphs.  
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

Sun control devices must be manufactured devices to provide sun control on exterior windows and storefronts. Provide sun control devices to withstand the wind loads prevailing at the project site.

**B201011 1.1 EXTERIOR SUN SCREENS**

Exterior sun screens must be of aluminum with 6063-T5/T6 aluminum demountable frame attachment. Screen material must be formed factory finished metal from aluminum sheet in accordance with ASTM B 209. Screen material must be factory finished coating in accordance with AAMA 2605 with a minimum coating thickness of 1.2 mils. Sunscreen must be awning, fin or other type appropriate to the installation.

**B201012 SCREEN WALL**

Screen walls include attached or unattached walls adjacent to the main building. Screen walls must conform to the applicable portions of Section B201001 EXTERIOR CLOSURE.

**B201090 OTHER EXTERIOR WALLS**

**B2020 EXTERIOR WINDOWS**

Provide standard windows in compliance with American National Standards Institute/American Architectural Manufacturers Association/Window and Door Manufacturers Association (ANSI/AAMA/WDMA) 101, Steel Windows Institute (SWI) SWS, UFC 4-010-01, and the design criteria of ASCE 7 for glazed windows to meet the Building Code.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: To comply with minimum antiterrorism (AT) requirements, specify in the project program the options for AAMA HC-60 and 90 psf (439 Kg/m2) below, when facility personnel density is greater than one person per 430 square feet (40 square meters) and minimum AT standoff distances are met. This does not include guard type facilities, single and duplex detached family housing. Those requirements are specified in UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.  
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: If the editor makes adjustments in the minimum residential AAMA LC-25 (38 psf or 185 Kg/m2) or commercial AAMA HC-40 (60 psf - 293 Kg/m2) or HC-60 (90 psf - 439 Kg/m2) windows, adjust the minimum wind pressure to correspond to the modified window performance. Refer to AAMA 101/I.S.2 to identify wind pressures that correspond to the modified AAMA window chosen.  
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

If required, provide windows that meet the requirements of AAMA/WDMA 101/I.S.2. Residential construction must utilize windows that comply with AAMA LC-25 designation unless the wind pressure on the building exceeds 38 psf (185 Kg/m2). Commercial (non-residential) construction must utilize windows that comply with AAMA designation HC-40 (60 psf - 293 Kg/m2) for windows that do not have to meet anti-terrorism requirements, and HC-60 (90 psf - 439 Kg/m2) for commercial windows that are required to meet anti-terrorism requirements, unless the wind pressure or blast pressure on the building exceeds the design pressure for these minimum windows. Determine the wind pressure on the building by converting the ASCE-7 basic wind speed to wind pressure and find the corresponding structural test pressure in the AAMA specific requirements or optional performance tables. If the residential window wind pressure exceeds of 38 psf (185 Kg/m2) or the commercial (non-residential) window wind pressure exceeds 60 psf (293 Kg/m2) or exceeds 90 psf (439 Kg/m2), utilize a higher AAMA designated window complying with the calculated wind pressure. Anti- Terrorism window systems (including connections) must meet the testing requirements of UFC 4-010-01 when tested in accordance with ASTM F1642.

Comply with ASTM E 2112 and with flashing and weather-resistive barrier manufacturers’ recommendations to install windows in framed wall construction. Comply with window flashing details from BIA for masonry back-up and veneer walls. Engineer and install window cleaning access and anchorage to the exterior wall or roof for facilities over three stories tall without interior window cleaning access from pivoting or tilting sash. Provide anchors in accordance with Occupational Safety and Health Administration (OSHA) standard 29 CFR Section 1910.66.

Windows must be provided with sills on the exterior and stools on the interior of the opening. Sills must be special shape or cut unit masonry or precast concrete in masonry exterior construction and extruded aluminum or aluminum-wrapped wood framing or formed metal in other construction. Positively slope sills away from windows. Window stools must be slate or solid polymer for commercial construction and painted wood for residential construction.

**B202001 WINDOWS**

Exterior windows must consist of fixed and operable sash used singly and in multiples. Provide operable sash in spaces occupied by people as a minimum. Include operating hardware, non-corroding framed metal screens for operable sash, and security grilles. Provide jamb support for larger windows where recommended by manufacturer. Metal windows with insulating glass must have thermally broken frames and sash. Provide thermally broken windows and window assemblies where separating conditioned and unconditioned spaces. Provide windows and window assemblies that bear an NFRC energy performance label and meet or exceed current EnergyStar requirements.

Provide glazing in exterior windows in accordance with section B202004 EXTERIOR GLAZING.

**B202001 1.1 STANDARD WINDOW SYSTEMS**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: The type or types of windows to be included in an RFP as Contractor’s options is a critical decision, and must be stated in the project program. Generally, steel or aluminum windows should be used for industrial facilities, aluminum on commercial facilities, aluminum, plastic or wood on light commercial and residential construction.  
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**B202001 1.1.1 Steel Windows**

Conform to SWI SWS. Solid hot-rolled steel shape welded frames and mullions. Provide chemically cleaned and primed galvanized frames with polysteel powder coat finish. Provide glazing beads, steel frame screens with aluminum mesh at operable sashes, hardware and locks, and glazing. Aluminum screens must comply with ANSI/SMA 1004.

**B202001 1.1.2 Aluminum Windows**

Conform to ANSI/AAMA/WDMA 101. Factory finish aluminum windows and provide with aluminum frame screens with aluminum mesh at operable sash, hardware and locks, and glazing. Aluminum screens must comply with ANSI/SMA 1004.

Exposed aluminum surfaces must be factory finished with an AA 45 anodic coating or an AAMA organic coating. Provide a minimum of architectural Class II anodized coating or a baked enamel finish conforming to AAMA 2604 for one- or two-family residential dwelling construction. Provide a minimum of architectural Class I anodized coating or a high-performance organic coating conforming to AAMA 2605 for all other construction. AAMA coatings must have a total dry film thickness of 1.2 mils.

**B202001 1.1.3 Security Windows**

Security windows delay forced entry into the building through the windows. In addition to meeting the requirements of AAMA 101, windows designated "resistance to forced entry" must conform to the requirements of AAMA 1302.

**B202002 STOREFRONTS**

Provide one-story storefront system fabricated from formed and extruded aluminum and glass components for exterior use.

**B202002 1.1 ALUMINUM-FRAMED STOREFRONTS**

**B202002 1.1.1 Performance Requirements**

a. Structural Requirements, as measured in accordance with ANSI/ASTM E330: Wind loads for exterior assemblies must meet or exceed 25 psf (122 Kg/m2) acting inward and 25 psf (122 Kg/m2) acting outward. Design system to withstand this as a minimum and comply with design pressure established within the required ASCE 7 Wind Speed Calculations determined by the overall average opening within the project.

b. Deflection: Maximum calculated deflection of any framing member in direction normal to plane of wall when subjected to specified design pressures for spans up to and including 13’-6" must be limited to 1/175 of its clear span and for spans greater than 13’-6" deflection must be limited to 1/240 + 1/4" of its clear span, except that maximum deflection of members supporting plaster surfaces must not exceed 1/360 of its span.

c. Air Infiltration - Air leakage through fixed light areas of storefront must not exceed 0.06 cfm per square foot of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf (33.84 Kg/m2).

d. Water Penetration - When tested in accordance with ASTM E 331, there must be no water penetration at a pressure of 15 psf (73 Kg/m2) of fixed area.

e. Water infiltration No uncontrolled leakage when tested in accordance with ASTM E331 at test pressure of 10 psf (48 Kg/m2) for system standard and capable of performing within the Design Pressure requirements derived from the ASCE 7 requirements.

f. Provide storefront framing and glazing assembly with an overall thermal transmittance value of not more than 0.40 BTU/hr x ft2 x deg F as determined according to NFRC 100. Provide a thermally broken storefront system where storefront occurs between conditioned and unconditioned spaces. A non-structural thermal break system is not acceptable.

**B202002 1.1.2 Doors And Frames**

Provide doors complete with frames, framing members, subframes, transoms, adjoining sidelights, adjoining window wall, trim, and accessories, as required for a complete installation. Anchors must be stainless steel. Weatherstripping must be Continuous wool pile, silicone treated, or type recommended by door manufacturer. See B203008, EXTERIOR DOOR HARDWARE for hardware requirements.

**B202002 1.1.3 Aluminum Alloy for Doors and Frames**

ASTM B 221, Alloy 6063-T6 for extrusions. ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

**B202002 1.1.4 Fabrication**

a. Aluminum Frames: Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches (300 mm) o.c.. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

b. Aluminum Doors: Doors must be medium or wide stile. Doors must be not less than 1-3/4 inches (44 mm) thick. Minimum wall thickness, 0.125 inch (3.175 mm), except beads and trim, 0.050 inch (1.27 mm). Bevel single-acting doors at lock, hinge, and meeting stile edges. Double-acting doors must have rounded edges at hinge stile, lock stile, and meeting stile edges.

c. Finishes: Provide exposed aluminum surfaces with factory finish of anodic coating conforming to AA45, Architectural Class I or an organic coating conforming to AAMA 2605 with a total dry film thickness of not less than 1.2 mils.

**B202004 EXTERIOR GLAZING**

Provide setting and sealing materials, stops and gaskets as recommended by the glass or acrylic sheet manufacturer.

Provide warranty for insulating glass units for a period of 10 years against development of material obstruction to vision (such as dust or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage. The Contractor is required to provide a glazing warranty for curtain wall glazing written directly to the Government.

Provide warranty for polycarbonate sheet glazing for a period of 5-years against breakage, coating delamination, and yellowing.

Glazing thickness indicated in the following paragraphs is the minimum acceptable thickness. Provide thicker glazing if required by the manufacturer for the given application.

**B202004 1.1 GLASS**

**B202004 1.1.1 Clear Glass**

Type I, Class 1 (clear), Quality q4 (A).

**B202004 1.1.2 Heat-Absorbing Glass**

ASTM 1036, Type I, Class 2 (heat absorbing and light reducing), Quality q3 (select), 1/4 inch (6 mm) thick, with a light transmittance of approximately 45 percent and total solar transmittance of not more than 50 percent for 1/4 inch (6 mm) thickness. Use warm color tint for warm color frames and cool color tints for white and gray frames.

**B202004 1.1.3 Wire Glass**

Type II, Class 1, Form 1, Quality q8 Mesh m1 or Form 2, Quality q7, Finish f1, Mesh m1, 1/4 inch (6 mm) thick. Conform to NFPA 80. Glass for fire-rated windows must be Underwriters Laboratories (UL) listed and must be rated when tested in accordance with ASTM E 163.

**B202004 1.1.4 Laminated Glass**

ASTM 1172, fabricated from two pieces of Type I, Class 1, Quality q3 glass laminated together with a clear 0.030 inch (0.75 mm) thick polyvinyl butyral interlayer. The total thickness must be nominally 1/4 inch (6 mm). Laminated glass used for anti-terrorism window assemblies must be a minimum of 1/4 inch (6 mm) thickness.

**B202004 1.1.5 Insulating Glass Units**

Provide insulated glass using a combination of the interior and exterior glazing materials listed below filled with a thermal resistive gas. The air space must be sized to meet the thermal requirements below but not less than one half inch (12 mm) for non-residential construction and one quarter inch (6 mm) minimum for residential construction.

Provide active solar control glazing by using tinting, maximum thermal resistance, special coatings to meet Energy Star climate zone and window type requirements (including frames), and comply with the performance characteristics below. Provide an active low-emissivity coating on glass surface number 2 (the inside surface of the exterior glass pane).

If the building is located in a heat dominated climate zone, the facility is designed to utilize solar heat gain to augment the HVAC system, and the window overhang design prohibits excessive solar gain; a passive low-emissivity coating may be used to accommodate the design. Design occupied spaces adjoining passive low-emissivity coated glass for comfortable use of the space.

Provide two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances must be as specified in IGMA TR-1200. The units must conform to ASTM E 773 and ASTM E 774, Class A. Provide primary seal, secondary seal, and spacers to eliminate moisture and hydrocarbon vapor transmission into airspace. Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal for a 10-year period following acceptance of the work.

The interior glass pane must be one of the following:

1. Typically ASTM C 1036, Type I, Class 1, Quality q4, minimum 1/4 inch (6 mm) thick;

2. ASTM C 1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 1 (transparent), Quality q4, minimum 1/4 inch (6 mm) thick when required by ANSI Z97.1 or possible human impact is anticipated;

3. ASTM C 1172, laminated glass as specified above, when required by antiterrorism requirements and code requirements for windborne debris.

The exterior glass pane must be one of the following:

1. Typically ASTM C 1036, Type I, Class 2 (tinted heat absorbing or reflective), Quality q4, minimum 1/4 inch (6 mm) thick;

2. ASTM C 1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 2 (tinted heat absorbing or reflective), Quality q4, minimum 1/4 inch (6 mm) thick when required by ANSI Z97.1 or possible human impact is anticipated.

Insulating glass performance for active solar control using low-emissivity coatings:

1. Visible Light Transmission, 66% or lower

2. Outdoor Light Reflectance, 11% or greater

3. Solar Heat Gain Coefficient, .36 or lower

4. Winter U-Value, .35 Btu/square foot x hr x degree F or lower for residential construction and .29 Btu/square foot x hr x degree F or lower for all other types of construction.

**B202004 1.1.6 Tempered Glass**

ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent) or 2 (tinted heat absorbing, Quality q3, 1/4 inch (6 mm) thick.

**B202004 1.1.7 Patterned Glass**

ASTM 1036, Type II, Class 1 (translucent), Form 3 (patterned), Quality q7 (decorative), Finish f1 (patterned one side), Pattern p2 (geometric) 7/32 inch (5.55 mm) thick.

**B202004 1.1.8 Spandrel Glass**

ASTM C 1048, Kind HS or FT, Condition B (ceramic coated), Type I, Quality q5, 1/4 inch (6 mm) thick.

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NOTE: Spandrel glass with adhered backing is required wherever glass spandrels are located above sidewalks, pedestrian or vehicular ramps, paved plazas, entrances not covered by a protective canopy, and other locations where glass could fall onto an area used by the public.  
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**B202004 1.1.9 Spandrel Glass with Adhered Backing**

ASTM C 1048, Kind HS or FT, Condition B (ceramic coated), Type I, Quality q5, 1/4 inch (6 mm) thick and must pass the fallout resistance test specified in ASTM C 1048.

**B2030 EXTERIOR DOORS**

Provide heavy duty insulated exterior steel doors and frames for service access. Door frames must be welded. Corner knockdown door frames are not permitted.

Use heavy-duty overhead holder and closer to protect doors from wind damage. Provide kickplates on the inside face of all exterior doors.

Weather-protect all exterior doors and related construction with low infiltration weatherstripping and sealants. Provide threshold with offset to stop water penetration while maintaining accessibility compliance.

Conform to the design criteria of ASCE 7.

See section B203008, EXTERIOR DOOR HARDWARE, for door hardware requirements. For all installations, provide a recessed key box (Knox Box) approximately 7 inches x 7 inches (175 mm x 175 mm) with 4-3/4 inches (120 mm) solid steel door at primary exterior entry for storage of keys and access cards accessible by the fire department.

**B203001 SOLID DOORS**

**B203001 1.1 FIBERGLASS REINFORCED PLASTIC (FRP) DOORS**

Hardware preparation must be in accordance with ANSI/BHMA A156.115. Doors must be hung in accordance with ASTM E2112.

**B203001 1.1.1 FRP Doors**

Provide door and frame components including, but not limited to, astragals, cores, faces, stiles, rails, heads, jambs, and internal reinforcement, which are FRP structural shapes manufactured by the pultrusion process. Ensure all structural shapes are composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements in accordance with ASCE 7, ICC/IBC and dimensions specified.

Ensure fiberglass reinforcements are a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

Verify resins are of isophthalic polyester with chemical formulation necessary for corrosion resistance, strength and other physical properties as required.

Provide documentation that all pultruded structural shapes are further protected from ultraviolet (UV) attack with:

a. Integral UV inhibitors within the resin.

b. Synthetic surfacing veil to help produce a resin rich surface.

UV resistant coating for outdoor exposures.

**B203001 1.1.2 Accessories**

a. Louvers must comply with SDI 111-C, must be stationary, sight-proof type. Use lightproof louvers if function of room requires darkness. Louver frames must be 20-gage steel with louver blades minimum 24 gage. Cutouts for door lights and louvers are to be manufactured and not field fabricated. Cutouts are to be totally enclosed by internal pultruded FRP stiles and rails as specified and incorporated into the door subframe with the opening completely fused to both door faces.

b. Astragals: Provide an integral heavy pultruded FRP astragal on the stile edge of the inactive leaf for double doors of the same materials as specified for door stiles and rails.

c. Moldings: Provide moldings around glass of exterior doors and louvers. Provide non-removable moldings on outside of exterior doors. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins must interlock at intersections and must be fitted and welded to stationary moldings.

**B203001 1.1.3 Standard FRP Frames**

Provide FRP Door Frame utilizing a high-modulus pultruded structural FRP shape. Fabricate pultruded frame with a wall thickness of not less than 5 mm 3/16-inch. Frames are to be one-piece factory constructed with molded stop. Jambs and header to utilize miter corner connections chemically welded with FRP material ground for a visibly smooth frame face. Post and beam or mechanical fastened corners and joints are not acceptable. Provide sizes and shapes as detailed on the approved drawings.

Provide hardware reinforcement connections utilizing a chemical weld with FRP material at required locations. A minimum pull-out force strength of 1,100 lbs per screw is required for all hardware locations.

**B203001 1.1.4 Anchors**

Provide anchorage devices and fasteners where necessary for fastening fabricated FRP door frame to the adjacent construction-in-place as recommended by the FRP frame manufacturer.

**B203001 1.1.5 Finishes**

Ensure all finished surfaces of FRP items and fabrications are smooth, resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover all glass fibers with resin to protect against their exposure due to wear or weathering. All stiles, rails, heads, jambs, and internal reinforcement are to be integrally pigmented.

**B203001 1.2 STEEL DOORS**

Provide hardware preparation in accordance with American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA) A156.115. Doors must be hung in accordance with ASTM E2112.

**B203001 1.2.1 Steel Doors**

Steel doors must be American National Standards Institute/Steel Door Institute (ANSI/SDI) A250.8, Level 4, exterior, with a physical performance level of, Model 1 or 2.

Doors may be specified to be insulated. Door selection must be specified in the project program according to the following:

a. Doors shall be insulated

**B203001 1.2.2 Insulation Cores**

Provide insulated cores of type specified, and provide an apparent U-factor of .48 in accordance with SDI 113 and must conform to:

a. Rigid Polyurethane Foam: ASTM C591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or

b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or

c. Mineral board: ASTM C612, Type I.

**B203001 1.2.3 Accessories**

a. Provide stationary, sight-proof type louvers which comply with SDI 111-C. Use lightproof louvers if function of room requires darkness. Louver frames must be 20-gage steel with louver blades minimum 24 gage.

b. Astragals: For pairs of exterior steel doors that will not have aluminum astragals or removable mullions, provide overlapping steel astragals with the doors.

c. Moldings: Provide moldings around glass of exterior doors and louvers. Provide non-removable moldings on outside of exterior doors. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins must interlock at intersections and must be fitted and welded to stationary moldings.

**B203001 1.2.4 Standard Steel Frames**

ANSI/SDI A250.8. Form frames with welded corners for installation in exterior walls. Form stops and beads of 20 gage steel. Set frames in accordance with ASTM A250.11.

**B203001 1.2.5 Anchors**

Anchor all frames with a minimum of three jamb anchors and base steel anchors per frame, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage. Mortar infill frames in masonry walls, and infill with gypsum board compound at each jamb anchor in metal frame walls. Only use surface exposed bolted anchors in concrete walls.

**B203001 1.2.6 Finishes**

a. Exterior Doors, Factory-Primed and Field Painted Finish – Doors and frames must be factory primed with a rust inhibitive coating as specified in ANSI/SDI A250.8. Factory prime doors on six sides of the door. Manufacturer's primer and field painting must be compatible with finish system in the paragraph "EXTERIOR PAINTING AND SPECIAL COATINGS".

b. Exterior Doors Galvanized Finish – Must be Commercial Quality, Coating Class A, zinc coating in accordance with ASTM A 591 when facility is located further than 300 feet (91 meters) from the ocean. When facility is located within 300 feet (91 meters) of the ocean, provide G60 galvanized coating in accordance with ASTM A 924/A 924M and ASTM A 653/A 653M.

**B203002 GLAZED DOORS**

**B203002 1.1 ALUMINUM GLAZED DOORS**

See B202002 STOREFRONTS, paragraph titled, "Doors and Frames."

**B203004 OVERHEAD ROLL-UP AND OVERHEAD SECTIONAL DOORS**

Refer to RFP PART 3, Chapter 6 for project specific exterior overhead sectional and roll-up doors system requirements. Do not use exterior roll-up doors as an entrance into conditioned spaces.

**B203004 1.1 OVERHEAD ROLL-UP DOORS**

Provide overhead doors in accordance with Door and Access Systems Manufacturers Association International (DASMA) requirements. Overhead roll-up doors must conform to ANSI/ DASMA 207. Provide overhead roll-up doors with minimum 22 gage thermal insulated slats, however use door weight, pressure, and width to determine if a heavier gauge slat is required. Electric operators must have protected 3-button switches conforming to National Electrical Manufacturers Association (NEMA) MG 1, NEMA ICS 1, and NEMA ICS 2. Galvanize door and sheet metal components in accordance with ASTM A653. Apply painted coat required in RFP Part 3, Chapter 6, over the galvanizing to all components directly exposed to the weather.

**B203004 1.2 OVERHEAD SECTIONAL DOORS**

Provide overhead doors in accordance with Door and Access Systems Manufacturers Association International (DASMA) requirements. Overhead sectional doors must conform to ANSI/DASMA 102 Completely close the door opening in the closed position and make the full width and height of the door opening available for use in the open position. Provide a 3 inch (75 mm) track when required by manufacturers standards, or design pressure and forces on the door, or if the door is equal to or greater than 16 feet (4877 mm) high or wide. Design door storage to allow full use of the space around the door for the activities required in the space. Provide a minimum of 16 inches (400 mm) of headroom for 2 inch (50 mm) tracks, 21 inches (525 mm) of headroom for 3 inch (75 mm) tracks, or a high lift type or vertical lift type. If motorized, provide limit switches to automatically stop doors at the fully open and closed positions. Provide readily adjustable limit switch positions.

Doors must remain operable and undamaged after conclusion of tests conducted in accordance with ASTM E 330 using the design wind load. Form steel door sections of hot-dipped galvanized steel not lighter than 16 gage using a flush surface without ribs or grooves. Sections must be not less than 1 3/4 inches (44.50 mm) minimum panel thickness. Provide maximum insulation value to insulate doors as required to meet energy requirements. Cover interior of door sections with steel sheets of not lighter than 24 gauge to completely enclose the insulating material. Provide galvanized steel tracks not lighter than 14 gauge for 2 inch (50 mm) tracks and not lighter than 12 gauge for 3 inch (75 mm) track. Provide a positive locking device and cylinder lock with two keys on manually operated doors. Form aluminum door panels of 0.050 inch (1.3 mm) sheet aluminum and styles and rails of 6063-T6 aluminum. Galvanize door and steel sheet metal components in accordance with ASTM A653.

**B203004 1.3 OVERHEAD DOOR FINISH**

Finish steel door and components with hot dipped galvanized coating and apply a baked-on primer and topcoat painted finish. If powder coat finish is required in RFP Part 3, Chapter 6, painted system must conform to the following requirements;

a. Outgas Forgiving Primer

b. Film Thickness per ISO 2360 - 2.5-3.5 mils (60-80 µm)

c. Mandrel Bending Test per ASTM D522 - 1/8 inches (3mm)

d. Impact Test per ASTM D2794 - Up to 80 in/lb. Cracking at the perimeter of the concave area

but no cracking pick off

e. Pencil Hardnessper ASTM D3363 - 2H minimum.

f. Color Change per ASTM D2244 - ≤Δe 5.0 (Hunter)

g. Gloss Retention per ASTM D523 - >80%

h. Salt Spray Test per ASTM B117 - 3000 hours

**B203008 EXTERIOR DOOR HARDWARE**

Provide the services of an Architectural Hardware Consultant (AHC), Certified Door Consultant (CDC), or an Electrified Hardware Consultant (EHC) to assist the Designer of Record in preparation of the door hardware schedule and product selection. The hardware consultant must sign and seal the door hardware construction submittal. Provide, as far as possible, door hardware of one manufacturer’s make. All hardware must be clearly and permanently marked by the manufacturer where it will be visible after installation.

**B203008 1.1 HINGES**

BHMA A156.1, size to match door size, but in no case less than 4-1/2 x 4-1/2 inches (114 mm x 114 mm), with non-removable pin and anti-friction bearing hinges. Use two hinges for doors 60 inches (1500 mm) or less in height and one additional hinge for each additional 30 inches (750 mm), or fraction thereof, in door height.

**B203008 1.2 PIVOTS**

BHMA A156.4.

**B203008 1.3 LOCKS AND LATCHES**

Commercial (all construction except family housing) buildings locks and latches must be BHMA A 156.13, Series 1000, Operational Grade 1, Security Grade 2 for exterior building entrances and other high-use doors not requiring exit devices. Use BHMA A 156.2, Series 4000, Grade 1 for all Commercial buildings locks and latches not using Series 1000 hardware.

**B203008 1.4 CARD KEY SYSTEM**

Where required, provide card key type access units. Provide lithium battery powered, magnetic stripe keycard locksets that are ANSI/BHMA A156.13, Series 1000, Grade 1, mortise or ANSI/BHMA A156.2, Series 4000, Grade 1, cylindrical locks, tamper resistant, UL listed with 1 inch (25 mm) throw deadbolt, 3/4-inch (19 mm) throw latch bolt, auxiliary deadlocking latch, and 2-3/4 inch (68.75 mm) backset. The latch bolt and the dead bolt must be operated simultaneously by rotating inside lever. Locks with mechanical override lock cylinders are not acceptable. Locks must be operated only by a correctly encoded keycard. Use of a newly issued keycard automatically re-keys the lock and voids the previous keycard. The lock must re-lock immediately after outside lever is turned and latch retracted. Locks must have memory that is capable of recording up to 140 entries into each room, identification of the keycard used to access the room, the date and time of entry. Entry information of the lock must be retrievable by a data key that can be inserted into the lock and then taken to the front desk printer to display information. Other components that are required for this system at the front desk are a personal or laptop computer, printer and encoder to program each key.

For exit device locks with card key access, provide mortise type, narrow stile exit devices with 24 volt DC, solenoid option for card key exterior access at aluminum storefront doors. Provide mortise type exit devices with 24 volt DC, solenoid option with alarm and remote exterior access for card key access at insulated hollow metal doors. The alarmed exit device must sound when exiting only.

Provide a card key system capable of accepting a minimum of 12 keycard access levels, security auditing and computer interfacing with existing installations management system. Provide a single point of contact customer service representative accessible by telephone with a 10-digit telephone number without additional dialing hierarchies except that a maximum 4-digit extension is permissible. On-site service must be provided within 3 hours from request within the first 12 months of occupancy. Provide a 5-year parts and labor warranty.

**B203008 1.5 EXIT DEVICES**

BHMA A 156.3, Grade 1. Provide on exit doors if it is anticipated that more than 50 people may use a particular door in an emergency exit situation. Touch bars must be provided in lieu of conventional crossbars and arms. Use manufacturer's integral touch bars in aluminum storefront doors.

**B203008 1.6 EXIT LOCKS WITH ALARM**

BHMA A 156.5.

**B203008 1.7 CYLINDERS AND CORES**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: When an extension of an existing system is required, the manufacturer's name and type of locks should be indicated.  
  
Arrow, Best and Falcon make interchangeable cores, which are fully compatible with each other. Corbin, Russwin, Sargent, Schlage, and Yale make locksets, which can receive the interchangeable cores made by Arrow, Best, or Falcon. Corbin, Russwin, Sargent, Schlage, and Yale each make their own interchangeable core system, which are not compatible with any other manufacturer's system. Specify the system, which will best meet the activity's needs without restricting competition.  
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If required, provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores must have seven pin tumblers. Cylinders must be products of one manufacturer, and cores must be the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets must have interchangeable cores, which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

**B203008 1.8 KEYING SYSTEM**

Provide a master key system for the facility, unless more than one tenant/tenant command must reside in a facility, or a grand master keying system, or great, grand master keying system if multiple tenants or buildings are required. The keying system must be an extension of the existing keying system for additions to existing facilities. The keying system must allow for construction interchangeable cores when subcontractors require keys during construction. If required, provide a key cabinet.

The Contractor must coordinate a keying system meeting. The Contractor's Project Manager, Superintendent, Hardware Subcontractor, Electrical Subcontractor (if keying hardware is electric), Designer of Record, Contracting Officer, Public Works Base Hardware Specialist, and the Using Activity must attend this meeting to establish the keying system for the project. This meeting is intended to identify base limitations, the necessary security, and access control within the facility. The meeting must produce a marked up copy of the floor plan indicating the doors to receive locks and the doors to be keyed together, and any master keying or grand master keying.

**B203008 1.9 KEYS**

Furnish one file key, one duplicate key and one working key for each key exchange and for each master and grand master keying system.

**B203008 1.10 LOCK TRIM**

Cast, forged or heavy wrought construction and commercial plain in design.

**B203008 1.10.1 Knobs and Roses**

Knobs and roses must meet test requirements of BHMA A 156.2 and BHMA A 156.13.

**B203008 1.10.2 Lever Handles**

Provide lever handles in lieu of knobs as required by DoD Architectural Barriers Act (ABA) Standards. Lever handles must meet the test requirements of BHMA A 156.13 for mortise locks. All lever handles (mortise or cylinder) must be the freewheeling type.

**B203008 1.11 DOOR BOLTS**

BHMA A 156.16, Grade 1. Provide two flush bolts for each inactive leaf of a pair of doors.

**B203008 1.12 CLOSERS**

BHMA A 156.4, Series C02000, Grade 1, with PT 4C, 1-1/2 inch piston, heavy duty forged arm, full size case. Provide closers for all exterior doors, fire-rated doors, corridor doors, stairway doors, and secure area doors, for non-residential (commercial) construction, as a minimum.

**B203008 1.13 OVERHEAD HOLDERS**

BHMA A 156.8, Grade 1. Provide for exterior doors for non-residential (commercial) construction.

**B203008 1.14 DOOR PROTECTION PLATES**

Kick plates must conform to BHMA A 156.6. Provide kick plates on all doors with closers and all doors leading to corridors or circulation spaces. Provide armor plates on all doors to receive cart traffic. Provide mop plates on all doors in rooms with a mopable floor finish that do not have kick plates.

**B203008 1.15 DOOR STOPS AND SILENCERS**

BHMA A 156.16. Provide silencers, Type L03011, three per single door and four per double door, for doors in hollow metal frames.

**B203008 1.16 THRESHOLDS**

BHMA A 156.21. Provide thresholds with offset to stop water infiltration, while maintaining accessibility requirements.

**B203008 1.17 WEATHERSTRIPPING**

BHMA A 156.22. Air leakage of weatherstripped doors must not exceed 0.5 CFM of air per square foot of door for residential doors, and 1.25 CFM for non-residential doors (unless a more restrictive infiltration level is specified).

**B203008 1.18 RAIN DRIPS**

For all exterior doors that open to the outside, where the door swing area is not covered by an overhang, provide top and bottom rain drips complying with ANSI R3Y535 as a minimum. Greater weather sealing may be required by the geographic location of the project.

**B203008 1.19 FINISHES**

Provide the following hardware finish systems, and match the interior door hardware:

a. BHMA A156.18. Hardware must have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which must have aluminum paint finish, and except steel hinges which must have BHMA 652 finish (satin chromium plated). Hinges for exterior doors must be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish. Exposed parts of concealed closers must have finish to match lock and door trim. Hardware for aluminum doors must be finished to match the doors.