

VA ROSEBURG HEALTH CARE SYSTEM

CORRECT SPD / SURGICAL DEFICIENCIES

FINAL SUBMITTAL, REVISION #1

AUGUST 24, 2012

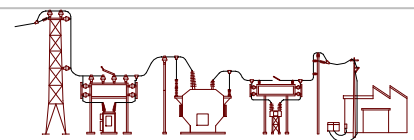
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REVISION #1

* VA Technical Specifications sections listed above and labeled as "Final Submittal, Revision #1" are to replace the Sections previously submitted under submittal labeled "100% Submittal" dated July 10, 2012.

**SECTION 03 30 53
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL**1.1 DESCRIPTION:**

This section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES:

- A. ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS:

- A. ACI SP-66 ACI Detailing Manual
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
 - 117R-06.....Tolerances for Concrete Construction and Materials
 - 211.1-91(R2002).....Proportions for Normal, Heavyweight, and Mass Concrete
 - 301-05.....Specification for Structural Concrete
 - 305R-06.....Hot Weather Concreting
 - 306R-2002.....Cold Weather Concreting
 - SP-66-04ACI Detailing Manual
 - 318/318R-05.....Building Code Requirements for Reinforced Concrete

- 347R-04.....Guide to Formwork for Concrete
- C. American Society for Testing And Materials (ASTM):
- A185-07.....Steel Welded Wire, Fabric, Plain for Concrete
Reinforcement
- A615/A615M-08.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement
- C31/C31M-08.....Making and Curing Concrete Test Specimens in the
Field
- C33-07.....Concrete Aggregates
- C39/C39M-05.....Compressive Strength of Cylindrical Concrete
Specimens
- C94/C94M-07.....Ready-Mixed Concrete
- C143/C143M-05.....Standard Test Method for Slump of Hydraulic
Cement Concrete
- C150-07.....Portland Cement
- C171-07.....Sheet Material for Curing Concrete
- C172-07.....Sampling Freshly Mixed Concrete
- C173-07.....Air Content of Freshly Mixed Concrete by the
Volumetric Method
- C192/C192M-07.....Making and Curing Concrete Test Specimens in the
Laboratory
- C231-08.....Air Content of Freshly Mixed Concrete by the
Pressure Method
- C260-06.....Air-Entraining Admixtures for Concrete
- C494/C494M-08.....Chemical Admixtures for Concrete
- C618-08.....Coal Fly Ash and Raw or Calcined Natural
Pozzolan for Use in Concrete
- D1751-04.....Preformed Expansion Joint Fillers for Concrete
Paving and Structural Construction (Non-
extruding and Resilient Bituminous Types)
- D4397-02.....Polyethylene Sheeting for Construction,
Industrial and Agricultural Applications
- E1155-96(2008).....Determining F_F Floor Flatness and F_L Floor
Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS:

Wood, plywood, metal, or other materials, approved by Resident Engineer, of grade or type suitable to obtain type of finish specified.

2.2 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494.
- H. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).
- I. Reinforcing Steel: ASTM A615, deformed.
- J. Welded Wire Fabric: ASTM A185.
- K. Expansion Joint Filler: ASTM D1751.
- L. Sheet Materials for Curing Concrete: ASTM C171.
- M. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- N. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.
- O. Epoxy for Reinforcing Steel Dowels: Simpson SET High-Strength Epoxy-Tie Anchoring Adhesive, Hilti HIT HY 150, or approved equal.

2.3 CONCRETE MIXES:

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 30 Mpa (4000 psi).
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
30 (4000) ^{1,2}	325 (550)	0.55	340 (570)	0.50

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.

F. Air-entrainment is required for all exterior concrete. Air content shall conform with the following table:

**TABLE I - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in)	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

2.4 BATCHING & MIXING:

- A. Store, batch, and mix materials as specified in ASTM C94.
 1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK:

- A. Installation conforms to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete,

and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.

B. Treating and Wetting: Treat or wet contact forms as follows:

1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
3. Use sealer on reused plywood forms as specified for new material.

C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances:

1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT:

Details of concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3 PLACING CONCRETE:

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of Resident Engineer before placing concrete. Provide screeds at required elevations for concrete slabs.

- B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.
- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.
- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from Resident Engineer.

3.4 PROTECTION AND CURING:

Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by Resident Engineer.

3.5 FORM REMOVAL:

Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.6 SURFACE PREPARATION:

Immediately after forms have been removed and work has been examined and approved by Resident Engineer, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.7 FINISHES:

A. Slab Finishes:

- 1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire

- broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.
2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
 3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
 4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.
 5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
 6. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

Slab on grade & Shored suspended slabs		Unshored suspended slabs	
Specified overall value	F _F 25/F _L 20	Specified overall value	F _F 25
Minimum local value	F _F 17/F _L 15	Minimum local value	F _F 17

3.8 SURFACE TREATMENTS:

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.

- B. Liquid Densifier/Sealer: Use on all exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish.

3.9 APPLIED TOPPING:

- A. Separate concrete topping with thickness and strength shown with only enough water to insure a stiff, workable, plastic mix.
- B. Continuously place applied topping until entire section is complete, struck off with straightedge, compact by rolling or tamping, float and steel trowel to a hard smooth finish.

3.10 EPOXY DOWELS:

- A. Drill and epoxy reinforcing steel dowels into hardened concrete following the instructions of the epoxy product manufacturer.
- B. Special Inspection is required for all epoxy dowel installations.

- - - E N D - - -

SECTION 05 12 50
BUCKLING RESTRAINED BRACES

PART 1 - GENERAL**1.1 SUMMARY**

- A. Section Includes:
 - 1. Furnishing Buckling Restrained Braces (BRB's).
 - 2. Engineering design of BRB's.
 - 3. Qualification of BRB's by uniaxial and subassemblage cyclic testing.
If a pin and collar connection is used the subassemblage test need not be performed.
- B. Related Sections:
 - 1. Section 05 12 00 - Structural Steel: For installation of BRB's and furnishing of connection hardware for BRB's, including loose plates and fasteners.

1.2 REFERENCES

- A. Standards listed below apply where designation is cited in this Section.
Where the applicable year of adoption or revision is not listed below, the latest edition applies.
- B. AISC - American Institute of Steel Construction
 - 1. American Institute of Steel Construction's "Manual of Steel Construction", Thirteenth Edition (AISC)
 - a. "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings", 2005 Edition (AISC 360).
 - b. "Code of Standard Practice for Steel Buildings and Bridges", 2005 Edition (AISC 303).
 - c. "Specification for Structural Joints Using ASTM A325 or A490 Bolts", June 30, 2004 (RCSC).
 - 2. American Institute of Steel Construction: "Seismic Provisions for Structural Steel Buildings", 2005 edition including Supplement 1 dated 2006 (AISC 341).
- C. ASTM - American Society for Testing and Materials
 - 1. A6 - Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use.
 - 2. A36 - Specification for Steel.
 - 3. A500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 4. A325 - Specification for Structural Steel Bolts
 - 5. A490 - Specification for Heat-Treated Steel Structural Bolts, 150 ksi min. tensile strength.
- D. AWS - American Welding Society
 - 1. "Structural Welding Code - Steel", 2006 Edition (AWS D1.1).

2. "Structural Welding Code - Seismic Supplement", 2005 edition (AWS D1.8).

E. JIS - Japanese Industrial Standard

1. G 3136 SN400 B - Rolled Steels for Building Structure.
2. G 3466 STKR 400 - Carbon Steel Square Pipes for General Structural Purposes.

1.3 DEFINITIONS

- A. Buckling Restrained Brace (BRB): Specialty structural brace element consisting of an axial force resisting steel core encased by a system that prevents buckling of the steel core.

1.4 SUBMITTALS

- A. Submit the following in accordance with requirements of Division 1.
1. All requested submittals shall be furnished in English language.
- B. Qualification Testing Report evidencing manufacturer's compliance with Article 2.1D.
1. The Qualification Testing Report shall conform to requirements of Appendix T of the American Institute of Steel Construction "Seismic Provisions for Structural Steel Buildings", (AISC 341-2005).
 2. If project specific testing is required to supplement available test data, include schedule for fabrication of BRB test specimens, description of proposed testing program and name of test facility and schedule for testing and reporting.
- C. Manufacturer's Quality Assurance Plan: Conform to requirements of Article 1.5D, "Quality Assurance".
- D. Engineering Design: Refer to Article 2.1A for design requirements.
1. Design Drawings: Show size and configuration of steel core for full length of BRB. Indicate casing size, thickness and length.
 2. Calculations: Provide design calculations showing the adequacy of proposed BRB's to achieve Performance Requirements specified herein.
 3. Certification: In accordance with Article 2.1A, Design Requirements.
 4. Preliminary Design: At Contractor's option, make an initial submittal of the items listed above, based on assumed material properties, prior to delivery of materials to be employed in work.
 5. Final Design: Submit final drawings, calculations and certifications that include the final dimensions of steel core plates based on results of coupon testing of steel to be employed in Work.
 - a. The Design Engineer shall seal final calculations and required certification.
 - b. Submittal shall be accompanied by the results of coupon testing.
- E. Erection Drawings:

1. Show location and size and of BRB's. Give complete information necessary for fabrication of elements of structural steel frame to receive braces and fabrication of connection plates. Show methods of assembly, including type and size of bolts and/or pins, hole diameter, and preparation and finish of faying surfaces. Identify tolerances for fabrication and erection.
- F. Submit certified material test reports to Testing Laboratory for record purposes.
1. All steel: Tensile tests and chemical analysis. Include trace elements for steel core plates.
 2. Steel Core Plates:
 - a. Coupon test results for each lot of steel used in fabrication showing initial yield, ultimate tensile stress, and ultimate elongation.
 - b. Charpy V-Notch testing for plates 2 inches (50 mm) and thicker.
 3. Welding Electrodes: Include tensile, elongation, and CVN toughness tests. Identify diffusible hydrogen.
- G. Submit Quality Assurance test and inspection reports to Testing Laboratory for record purposes prior to shipping of braces.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Shall have manufactured and successfully tested braces in accordance with Article 2.1D, "Qualification Tests" prior to opening of bids.
- B. Design Engineer Qualifications: Civil Engineer, registered in the State where the project is located, that is knowledgeable with the results of cyclic testing of BRB's and experienced in the design of BRB's based on engineering analysis.
- C. Quality Assurance Plan: The manufacturer shall have a detailed Quality Assurance Plan to evidence that the BRB's being manufactured continue to be the same as those tested. The Plan shall include the following elements:
1. Indicate how the product is to be identified, such that it can be traced back to production quality assurance records.
 2. Include a flow chart of the process by which the product is manufactured, including description of production methods.
 3. List tests for materials, including the applicable recognized standard for each test and the qualifications of testing agency and/or personnel.
 4. Identify manufacturing tolerances for each production process.
 5. In-process quality control, including all points of internal inspection for control and monitoring of the fabrication and assembly process.

- a. Include copies of forms and checklists used to document inspections.
- b. Include required qualifications of personnel performing each inspection.
- c. Identify how inspection reports are reviewed and approved.
- 6. Plan shall also include manufacturer furnished quality assurance for erection, including, at a minimum, attendance at pre-erection conference and a minimum of one visit thereafter to observe installation of braces.
- D. Qualification Testing: Refer to Article 2.1D, "Qualification Tests" for requirements.
- E. Extrapolation of Qualification Testing: All deviations from materials, details of fabrication, and quality assurance controls used for the fabrication of tested prototype braces shall be identified by manufacturer and reviewed by Design Engineer to ensure that production braces meet or exceed the level of quality used in fabrication of prototype braces. Include the following items:
 - a. Weld filler material, including CVN toughness.
 - b. Welding procedures and details, including weld terminations.
 - c. Shape and finish of plate edges at transitions.
 - d. Finish of plate edges, including roughness and treatment of occasional notches.
 - e. Tolerances for flatness and straightness of plates.
 - f. Details of isolation between plates and core at transitions, to accommodate lengthening and shortening.
 - g. Type and thickness of coating materials.
- F. Pre-Erection Conference: Contractor shall schedule meeting with Owner's Representative, BRB-manufacturer, and the steel erector's personnel supervising installation of buckling restrained braces to review installation procedures including handling, fit-up and fastening.

PART 2 PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Design Requirements:
 - 1. Engage a Structural Engineer, licensed in the State where the project is located, to design braces to achieve the Performance Criteria. Design shall be based on detailed examination and understanding of the results of qualifying cyclic tests and interpolation of results to project conditions.
 - 2. Interpolation of test results for different member sizes shall be justified by rational analysis that demonstrates stress distributions and magnitudes of internal strains that are consistent with or less severe than the tested assemblies and

that considers the adverse effects of larger material and variations in material properties.

3. Consider the effect of imposed end rotations.

B. Performance Criteria:

1. Initial "BRB" yield force or area shall be as indicated, within the tolerances specified on the Contract Documents.
2. Braces shall provide for stable cyclic displacement within the ranges required per AISC 341.
 - a. Hysteretic behavior in the non-linear range shall show no sign of degradation or loss of strength.
 - b. Graphs of test results shall show no signs of pinched hysteretic behavior.
3. The portion of the steel core that projects beyond the casing shall provide for stable cyclic loading.
4. Tension and compression shall be resisted entirely by the steel core. The buckling restraining system shall prevent brace buckling and control plate buckling without restraining the steel core from transverse expansion and longitudinal shortening for deformations corresponding to 2 times the design interstory drift.
5. End connections and connection configuration, including gusset stiffeners, must be similar to the tested conditions.

C. Coupon Tests: Perform coupon test results for each lot of steel used in fabrication of steel core areas showing initial yield, ultimate tensile stress, and ultimate elongation. Coupons shall be taken from plates at point of brace manufacture and shall be used as the basis for brace design.

D. Qualification Tests: The design of braces shall be based on results from qualifying cyclic tests. Tests shall consist of at least two successful cyclic tests: one is required to be a test of a brace subassemblage that includes brace connection imposed rotations and the other may be either a uniaxial or subassemblage test. If a pin and collar connection is used the subassemblage test is not be required.

1. Qualification Tests shall conform to requirements of Appendix T of the AISC 341.
2. Qualification tests are permitted to be based on documented full-scale cyclic tests performed for other projects or tests reported in research, provided that there is sufficient basis for extrapolation to project conditions.
3. Extrapolation of previous test results beyond the limitations AISC 341 Appendix T will not be permitted.

2.2 ACCEPTABLE MANUFACTURERS

- A. The following manufacturer's, which have successfully completed qualification testing of braces similar to those required for the project, will be considered acceptable manufacturers, subject to compliance with other requirements of the Contract Documents, including limitations on maximum brace dimensions.

1. STAR Seismic; Park City, UT.
2. Nippon Steel Corporation; Tokyo, Japan

2.3 MATERIALS

- A. Steel Core Areas: JIS G 3136 SN400 B or ASTM A36; except initial yield stress shall be within the tolerances shown on the Contract Documents, as evidenced by coupon testing of plates to be incorporated in work. If the contract documents do not state the initial yield stress it shall be 42.0 ksi with the averages of the coupon tests be between 39 and 46 ksi.

1. Plates 2 inches (50 mm) and thicker shall be supplied with Charpy V-Notch testing in accordance with ASTM A6 Supplementary Requirement S5, or approved equal. The impact test shall meet a minimum average value of 20 ft-lbs absorbed energy at +70 degrees F and shall be conducted in accordance with AISC Specification, or approved equal.

- B. Casing: JIS G3466 STKR 400 or ASTM A500, Grade B.

- C. Welding Filler Material: Meet or exceed CVN toughness and elongation of material used for fabrication of tested assemblies.

1. H16 (diffusible hydrogen), AWS A4.3.

- D. Shop Primer -not required

- E. Debonding Agent: Manufacturer's standard; demonstrated suitable to maintain separation of steel core and grout encasement when subjected to a minimum of 30 cycles of inelastic yielding at 2.0 percent strain; resistant to aging effects for a life cycle of 50 years.

- F. Fill Material: Manufacturer's standard cementitious grout; demonstrated suitable for function as a confining in-fill material by uniaxial or subassemblage qualification testing.

2.4 FABRICATION

- A. Fabricate steel in accordance with Section 05 1200, "Structural Steel".

1. Cut core plates to profile shown on Design Drawings. Conform to tolerances of Quality Assurance Manual, except tolerance on plate width shall not exceed plus or minus 0.2 inches (5 mm).
2. Splices in the steel core are not acceptable.
3. Roughness: After cutting, edges of core plates shall have roughness less than 1000 micro-inches.

4. Gouges and Notches: Occasional gouges and notches less than 0.2 inches (5 mm) deep in edges of core plates may be repaired by grinding to a smooth transition. The length of transition shall be a minimum of 10 times the depth of gouge. The area shall be inspected by MT after grinding to ensure the entire depth of gouge has been removed. Deeper gouges shall be cause for rejection of piece.
- B. The maximum dimensions of the casing of the buckling restrained brace shall be as indicated on the Contract Documents.
- C. Bolted Connections: All holes for bolted connections shall be drilled and burrs removed.
- D. Pin Connections: All holes for pinned connections shall be machined 1/32 in larger than the pin diameter. Pin hole tolerance shall not exceed plus 1/64 in or minus 1/32 in.
- E. Welding: Weld joints using procedures intended to minimize distortion.
 1. Where cruciform plates are terminated in core, pay particular attention to the detailing and finishing of weld termination; meet or exceed qualification tested assembly as minimum standard.
- F. Assembly: Assemble components of the Buckling Restrained Brace in a manner to ensure proper performance of the brace.
 1. Examine steel core areas for straightness prior to coating with debonding agent or pouring with concrete.
 2. Provide end-confining plates to ensure confinement of the fill material while allowing for non-restricting movement of the steel core.
 3. For braces exposed to exterior or corrosive conditions, interior of brace shall be sealed or otherwise protected from moisture/corrosive element infiltration into the interior core region.

2.5 SOURCE QUALITY CONTROL

- A. Testing Laboratory will:
 1. Review Manufacturer's Quality Assurance Plan, mill certificates and results of coupon testing.
 2. Review Manufacturer's quality assurance test and inspection reports.
 3. Observe fabrication and assembly as requested by Owner's Representative.
- B. Contractor shall:
 1. Notify Owner's Representative no less than 30 days before the start of fabrication of the buckling restrained braces, to

allow Owner's Representative to observe fabrication and assembly process.

2. Perform testing and inspection in accordance with approved Quality Assurance Plan and requirements of Contract Documents.

PART 3 EXECUTION

3.1 ERECTION

- A. Braces are erected under Section 05 12 00, "Structural Steel".
- B. Prior to erection, clean faying surfaces of brace to be in contact with bolted connections to remove temporary coatings applied for transport and surface contaminants.
- C. Buckling restrained braces shall not be field cut or altered. Alterations to structural steel components to receive Buckling Restrained Braces shall be as permitted by Section 05 12 00.
- D. No field welding to buckling restrained brace members will be permitted, including attachment of nonstructural components.

- - - E N D - - -

**SECTION 09 06 00
SCHEDULE FOR FINISHES**

SECTION 09 06 00-SCHEDULE FOR FINISHES

VAMC: ROSEBURG

Location: OREGON

Project no. and Name: CORRECT SPD AND SURGICAL DEFICIENCIES

Submission: REVISION 1

Date: August 22, 2012

**SECTION 09 06 00
SCHEDULE FOR FINISHES**

PART I - GENERAL**1.1 DESCRIPTION**

This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

1.2 MANUFACTURERS

Manufacturer's trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer's equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

1.3 SUBMITALS

Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES—provide quadruplicate samples for color approval of materials and finishes specified in this section.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.

B. MASTER PAINTING INSTITUTE: (MPI)

2001.....Architectural Painting Specification Manual

PART 2- PRODUCTS**2.1 DIVISION 05 - METALS**

A. SECTION 05 31 00, STEEL DECKING, SECTION 05 36 00, COMPOSITE METAL DECKING

Finish	Color
Paint (@ exposed Ceilings)	Kelly Moore (Match Walls)

B. SECTION 05 50 00, METAL FABRICATION

Item	Finish
Roof Top mechanical Equipment Screens	Industrial Louvers (Model No. 250 XPI) Stone White (391A454 731A539)
Modular Channel Units	Mill
Channel Door Frames	Paint (where exposed) Kelly Moore, OW205-1 Soap Suds
Edge Guards Angles for Opening in Slabs	Mill
Metal Gratings and Frames	Prefinished Stair Tread Gratings (G 90)
Grating Nose Warning Strip	Prefinished (Epoxy Paint-Yellow))
Aluminum Plate Door Sill	Mill
Steel Ladders	Paint KM-12 (Sierra White)
Aluminum Ladders	Mill
Steel Pipe Railings and Gates (not on Steel Stairs)	Paint KM-12 (Sierra White)
Steel Counter or Bench Top Frame and Legs.	Stainless Steel (Satin No. 4)

C. SECTION 05 51 00, METAL STAIRS

Component	Finish	Color
Newel Posts	Paint (Kelly Moore)	White (Match existing metal window frames)
Guard Rails	Paint (Kelly Moore)	White (Match existing metal window frames)
Handrails	Paint (Kelly Moore)	White (Match existing metal window frames)
Stringers	Paint (Kelly Moore)	White (Match existing metal window frames)
Risers	Paint (Kelly Moore)	White (Match existing metal window frames)
Underside	Paint (Kelly Moore)	White (Match existing metal window frames)
Treads	Pre-Finished	G-90 by Manufacturer

D. SECTION 05 50 00, METAL FABRICATIONS

1. BUILT-IN COUNTER			
Room No. and Name	Component	Material	Finish
Various	Countertop	Stainless Steel	No. 4 Satin
	Vertical Surface(s)	Stainless Steel	No. 4 Satin

2.2 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 45 00, EXTERIOR ALUMINUM FACED COMPOSITE PANELS (INCLUDING PARAPET CAP)

Material	Type	Ext. Finish	Int. Finish	Manufacturer	Mfg. Color Name/No.
Alucobond Plus	Wet Rout and Return	Coil Coated FEVE	---	3A Composites	Bone White - 30

B. SETION 07 53 23, ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING

Color	Manufacturer	Mfg. Color Name/No.
White	Firestone	90 Mil Ecowhite Platinum EPDM

C. SECTION 07 60 00, FLASHING AND SHEET METAL

Item	Material	Finish
Copings (Except Parapets)	Aluminum	Color Anodized - White to Match Existing
Miscellaneous Flashing (Roof)	Aluminum	Color Anodized - White to Match Existing
Miscellaneous Flashing	Stainless Steel	Paint to Match Adjacent Surface

D. SECTION 07 71 00 / 07 72 00, ROOF SPECIALITIES AND ACCESSORIES

Item	Material	Finish	Manufacturer	Manufacturer/Color Name/Number.
Roof Hatch	Aluminum	Mill	Acudor	---
Equipment Support	Galv. Steel	Paint	Greenbeck/York	KM-Sierra White 12
Parapet Copings	Aluminum	Coil Coated FEVE	3A Composites	Bonewhite - 30
Roof Expansion Joint Covers	Extruded Aluminum	Mill	Construction Specialties, Inc.	BRJ-400

E. SECTION 07 92 00, JOINT SEALANTS

Location	Color	Manufacturer	Manufacturer Color
New to Existing Walls	White	Dow Corning	White
Building Expansion Joints	Gray	Dow Corning	Gray
Masonry Sealed Joints	Gray	Dow Corning	Gray

F. SECTION 07 95 13, EXPANSION JOINT COVER ASSEMBLIES

	Material	Finish	Manufacturer	Mfg. Color Name/No.
Floor Component Cover Plate Frame Casket or Sealant (interior only)	Aluminum	Clear Anodized	Construction Specialties, Inc.	GTP-400HD (2-Hour)
	Elastomeric Sealant	---		Gray (Seal)
Wall Component Cover Plate Frame Casket or Sealant (interior only)	Aluminum	Clear Anodized	Construction Specialties, Inc.	ASM-400 (2-Hour)
	Elastomeric Sealant	---		
Ceiling Component Cover Plate, Gasket or Sealant (interior only)	Aluminum	Clear Anodized	Construction Specialties, Inc.	SFC-400
	Elastomeric Extrusion	---		
Exterior Wall Cover Plate Frame Thermoplastic Joint	Aluminum	Clear Anodized	Construction Specialties, Inc.	SF-400
	Elastomeric Extrusion	---		Gray (Seal)

2.3 DIVISION 08 - OPENINGS

A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door	
Component	Color of Paint Type and Gloss
Door (2 nd Floor)	Match Adjacent Wall
Frame (2 nd Floor)	Match Base
Vision Panel Window Frame (2 nd Floor)	Kelly Moore, OW205-1 Soap Suds
Door and Frame (1 st Floor)	Match adjacent existing doors & frames

B. SECTION 08 14 00, WOOD DOORS

Component	Finish/Color
Doors (Stained)	Clear Stain
Doors (Painted)	Match Adjacent Wall
Frames	Match Base

C. SECTION 08 31 13, ACCESS DOORS AND FRAMES

Material	Finish/Color
Steel	Match adjacent surface color
Stainless steel	Satin No. 4

D. SECTION 08 51 13, ALUMINUM WINDOWS

Type	Finish	Glazing	Manufacturer	Mfg. Color Name/No.
Fixed Flush Wall Window	Color Anodized	I.G.U.	Vistawall	4100 Series (KM23 - Swiss Coffee)

E. WINDOW SILLS

Room No. and Name	Material	Finish
Offices/Conference	Solid Surface	Corian Anthracite

F. SECTION 08 63 00, METAL-FRAMED SKYLIGHTS

Item	Material	Finish
Metal Frame	Anodized Aluminum	White (Match existing Skylight)
Polycarbonate Sheets	Exterior Sheet / Interior Sheet	Frosted / Clear

G. SECTION 08 71 00, BUILDERS HARDWARE

Item	Material	Finish
Hinges	Stainless Steel	630
Door Closers	Aluminum	Satin
Closer/ Holder	Aluminum	Satin
Floor Stops	Stainless Steel	630
Door Holders	Stainless Steel	630
Lock/ Latches	Stainless Steel	630
Key Cabinet	Steel	Painted Black
Armor Plates	Metal Plastic	Match Door
Kick Mop Plates	Metal Plastic	Match Door
Door Edging	Steel	652
Exit Device	Aluminum	Satin
Flush Bolts	Stainless Steel	630
Door Pulls	Stainless Steel	630
Push Plates	Stainless Steel	630
Combination Push Pull Plate	Stainless Steel	630
Coordinators	Steel	652
Light Proof Seals	Rubber	Black
Weather Strip	Rubber	Black
Threshold	Aluminum	Mill

H. SECTION 08 80 00, GLAZING

Glazing Type	Manufacturer	Mfg. Color Name/No.
Low-E Coated Glass	Guardian Industries	Light Silver, SNR 43 Clear

I. SECTION 08 90 00, LOUVERS

Item	Manufacturer	Finish
Aluminum	Greeheck	Match Wall Color
Rooftop	See Section 05 50 00	See Section 05 50 00

2.4 DIVISION 09 - FINISHES

A. SECTION 09 24 00, PORTLAND CEMENT PLASTERING

Finish code	Integral	Color	Manufacturer	Mfg. Color Name/No.
---	No	Match Existing	La Habra	Match Existing

B. SECTION 09 30 13, CERAMIC TILING

1. CERAMIC MOSAIC TILE (FT)					
Location	Size	Shape	Collection	Manufacturer	Mfg. Color Name/No.
Floor (Men's)+(H.A.C)	2 x 2	Square	Permatones	Dal Tile	Elemental Tan 6566
Base (Men's)+(H.A.C)	2 x 2	Coved	Permatones	Dal Tile	Elemental Tan 6566
Wall (Men's)+(H.A.C)	2 x 2	Square	Permatones	Dal Tile	Almond 6465
Floor (Women's)	2 x 2	Square	Permatones	Dal Tile	Elemental Tan 6566
Base (Women's)	2 x 2	Coved	Permatones	Dal Tile	Elemental Tan 6566
Wall (Women's)	2 x 2	Square	Permatones	Dal Tile	Almond 6465
Cart Wash / Manual Wash	4 x 4	Square	Permatones	Dal Tile	Almond 6465

2. SECTION 09 30 13, PORCELAIN PAVER TILE (PPT)					
Finish Code	Size	Shape	Pattern	Manufacturer	Mfg. Color Name/No.
Floor	12 x 12	Square	Florenza	Dal Tile	Oliva FZ02
Wall	12 x 12	Square	Florenza	Dal Tile	Oliva FZ02

3. SECTION 09 30 13, PORCELAIN PAVER TILE GROUT		
Finish Code	Manufacturer	Mfg. Color Name/No.
---	Dal Tile	As recommended by Tile Mfr.

4. SECTION 09 30 13, MARBLE THRESHOLDS		
Location	Manufacturer	Mfg. Color Name/No.
Men's Toilet	Dal Tile	Match Tile
Women's Toilet	Dal Tile	Match Tile

5. SECTION 09 30 13, METAL DIVIDER STRIPS		
Size	Material	Manufacturer
Per Application	Brass	---

C. SECTION 09 51 00, ACOUSTICAL CEILINGS

Finish Code	Component	Color Pattern	Manufacturer	Mfg Name/No.
	Exposed Suspension System	Donn DX/DXL	U.S.G.	White
AT	Type III	Radar	U.S.G.	White
AT (SP)	Type III A	Cima Plus	U.S.G.	White

D. SECTION 09 65 16, RESILIENT SHEET FLOORING

Finish Code	Pattern name	Manufacturer	Mfg. Color Name/No.
RSF	Linorette	Armstrong	LP402 Brisbane Blue
WSF	Medintone	Armstrong	H8311 Natural White

E. SECTION 09 65 16, RESILIENT SHEET FLOORING, HEAT WELDED SEAMS

Finish Code	Pattern name	Manufacturer	Mfg. Color Name/No.
---	---	Armstrong	Match Flooring

1. SECTION 09 65 16, CAP STRIPS (WSF)

Finish Code	Manufacturer	Mfg. Color Name/No.
---	Armstrong	Match Flooring

F. SECTION 09 65 13, RESILIENT BASE STAIR TREADS AND ACCESSORIES

Location	Item	Height	Manufacturer	Mfg Name/No.
At RSF	Rubber Base (RB)	4" Inches	Johnsonite	18 - Navy Blue
At CPT	Rubber Base (RB)	4" Inches	Johnsonite	18 - Navy Blue
At C	Rubber Base (RB)	4" Inches	Johnsonite	18 - Navy Blue

G. SECTION 09 68 00, CARPET MODULES (CFT)

1. SECTION 09 68 00, CARPET EDGE STRIP			
Finish Code	Material	Manufacturer	Mfg. Color Name/No.
---	Metal	Shaw	Black
---	Vinyl	Shaw	Match Carpet

H. SECTION 09 68 00, CARPET MODULES (CPT)

Finish Code	Size	Pattern direction	Manufacturer	Mfg. Color Name/No.
CPT	2' x 2'	Expert Tile 59377	Shaw	35410 Knappster

I. SECTION 09 67 23.60, URETHANE RESINOUS FLOORING (RES)

Finish code	Manufacturer	Mfg. Color Name/No.
RES-6A	Dex-O-Tex	413 Speed Way Gray

J. SECTION 09 96 59, HIGH-BUILD GLASED COATING (SC)

Finish code	Manufacturer	Mfg. Color Name/No.
All Rooms or Spaces where (SC) is Scheduled	Kelly Moore	OW205-1 Soap Suds Gloss Level (5)

K. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards

		Gloss @60	Sheen @85
Gloss Level 1	a traditional matte finish-flat	max 5 units, and	max 10 units
Gloss Level 2	a high side sheen flat-"a velvet-like" finish	max 10 units, and	10-35 units
Gloss Level 3	a traditional "egg-shell like" finish	10-25 units, and	10-35 units
Gloss Level 4	a "satin-like" finish	20-35 units, and	min. 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	
Gloss level 7	a high gloss	more than 85 units	

*PAINT COLORS EXCEPT WHERE (SC) IS SCHEDULED

2. Paint Location	Gloss	Manufacturer	Mfg. Color Name/No.
Corridors and Hall	3	Kelly Moore	OW205-1, Soap Suds
Ante Rooms	3	Kelly Moore	OW205-1, Soap Suds
Locker Rooms	3	Kelly Moore	OW205-1, Soap Suds
Toilet Rooms	3	Kelly Moore	OW205-1, Soap Suds
Exit Passage Way	3	Kelly Moore	OW205-1, Soap Suds
Electrical & Mechanical Rooms	3	Kelly Moore	OW205-1, Soap Suds
Vestibule	3	Kelly Moore	OW205-1, Soap Suds
Roof Access	3	Kelly Moore	OW205-1, Soap Suds
Room 132A	3	Kelly Moore	OW205-1, Soap Suds
Offices	3	Kelly Moore	OW205-1, Soap Suds

2.5 DIVISION 10 - SPECIALTIES**A. SECTION 08 90 00, LOUVERS AND WALL VENTS**

Item	Material	Finish	Manufacturer	Mfg. Color Name/No.
Louvers	Aluminum	Color Anodized	Greenheck	White (Match Adjacent Wall)
Vents	Aluminum	Color Anodized	Greenheck	White (Match Adjacent Wall)

B. SECTION 10 26 00, WALL GUARDS AND CORNER GUARDS

Item	Material	Manufacturer	Mfg. Color Name/No.
Vinyl Corner Guards	Vinyl	Acrovyn, SM-20N	930-Blue Silk
Vinyl Wall Guards (Crash Rails)	Vinyl	Acrovyn, SCR-48N	930-Blue Silk
Stainless Steel Wall Guard (Crash Rails)	Stainless Steel	Acrovyn, SCR-1655V	Stainless Steel, Type 304
Stainless Steel Corner Guards	Stainless Steel	Acrovyn, CO-8	Stainless Steel, Type 304

C. SECTION 10 28 00 / 10 14 00 / 11 17 36, MISCELLANEOUS SPECIALITIES

Room No. and Name	Item	Finish	Manufacturer	Mfg. Color Name/No.
---	Mop racks	Stainless Steel	Bobrick	Satin No. 4
---	Package Transfer Box	Stainless Steel	Clean Air Products	Satin No. 4

D. SECTION 10 44 13, FIRE EXTINGUISHER CABINETS

Component	Material	Finish
Cabinet and Door Frame	Baked Enamel	White
Door	Glass	Clear Tempered

E. SECTION 10 28 00, TOILET AND BATH ACCESSORIES

Item	Material (or Type)	Manufacturer	Mfg. Color Name/No.
Combination Paper Towel Dispenser and Disposal	Stainless Steel	Bobrick	B-36903, Satin No. 4
Toilet Tissue Dispenser	Stainless Steel	Bobrick	B-2888, Satin No. 4
Grab Bars	Stainless Steel	Bobrick	B-5806, Satin No. 4
Shower Curtain Rod	Stainless Steel	---	Satin No. 4
Cloths Hooks	Stainless Steel	Bobrick	B-671, Satin No. 4
Towel Bars	Stainless Steel	---	Satin No. 4
Metal Framed Mirror	Stainless Steel	Bobrick	B-293, Satin No. 4
Spherical Mirrors	Quarter Dome	See All	PV18-180 Degree
Spherical Mirrors		See All	PV18-90 Degree

2.6 DIVISION 12- FURNISHINGS

A. SECTION 12 24 00, WINDOW SHADES

Component	Material	Manufacturer	Mfg. Color Name/No.
Integral Venetian Blinds	Aluminum	Kyler Industries	0157 Silver

B. SECTION 12 31 00, METAL CASEWORK

Item/ Type	Finish	Manufacturer	Mfg. Color Name/No.
1. CABINETS	Stainless Steel	---	Satin No. 4

C. SECTION 12 32 00, WOOD CASEWORK

Item Type	Manufacturer	Location	Material	Finish/Color
Exterior Surfaces	Wilsonart	Conference Room	Plastic laminate	D73-60 Pewter
Countertop	Corian	Conference Room	Solid Surface	Anthracite
Interior Surfaces	Wilsonart	Conference Room	Plastic Laminate	Designer White
Shelves	Wilsonart	Conference Room	Plastic Laminate	Designer White

D. SECTION 12 36 00, COUNTERTOPS AND ACCESSORIES

Type	Finish/Color
Methyl Methacrylate	Antracite (E)
Stainless Steel	Satin No. 4

2.7 DIVISION 22 - PLUMBING

A. SECTION 22 40 00, PLUMBING FIXTURES AND TRIM

Item	Color
Water Closet	White Vitreous China
Lavatories	White Vitreous China
Service Sink Corner	Tan Terrazzo

PART III EXECUTION**3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS**

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation

Access Flooring	AF
Accordion Folding Partition	AFP

Acoustical Ceiling	AT
Acoustical Ceiling, Special Faced	AT (SP)
Acoustical Metal Pan Ceiling	AMP
Acoustical Wall Panel	AWP
Acoustical Wall Treatment	AWT
Acoustical Wallcovering	AWF
Anodized Aluminum Colored	AAC
Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE
Brick Face	BR
Brick Flooring	BF
Brick Paving	BP
Carpet	CP
Carpet Athletic Flooring	CAF
Carpet Module Tile	CPT
Ceramic Glazed Facing Brick	CGFB
Ceramic Mosaic Tile	FTCT
Concrete	C
Concrete Masonry Unit	CMU
Divider Strips Marble	DS MB
Epoxy Coating	EC
Epoxy Resin Flooring	ERF
Existing	E
Exposed Divider Strips	EXP
Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Exterior Stain	EXT-ST
Fabric Wallcovering	WF
Facing Tile	SCT
Feature Strips	FS
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT

Fluorocarbon	FC
Folding Panel Partition	FP
Foot Grille	FG
Glass Masonry Unit	GUMU
Glazed Face CMU	GCMU
Glazed Structural Facing Tile	SFTU
Granite	GT
Gypsum Wallboard	GWB
High Glazed Coating	SC
Latex Mastic Flooring	LM
Linear Metal Ceiling	LMC
Linear Wood Ceiling	LWC
Marble	MB
Material	MAT
Mortar	M
Multi-Color Coating	MC
Natural Finish	NF
Paint	P
Paver Tile	PVT
Perforated Metal Facing (Tile or Panels)	PMF
Plaster	PL
Plaster High Strength	HSPL
Plaster Keene Cement	KC
Plastic Laminate	HPDL
Polypropylene Fabric Wallcovering	PFW
Porcelain Paver Tile	PPT
Quarry Tile	QT
Radiant Ceiling Panel System	RCP
Resilient Stair Tread	RST
Rubber Base	RB
Rubber Tile Flooring	RT
Spandrel Glass	SLG
Stain	ST
Stone Flooring	SF
Structural Clay	SC

Suspension Decorative Grids Grids	SDG
Terrazzo Portland Cement	PCT
Terrazzo Tile	TT
Terrazzo, Thin Set	
Textured Gypsum Ceiling Panel	TGC
Textured Metal Ceiling Panel	TMC
Thin set Terrazzo	TST

Veneer Plaster	VP
Vinyl Base	VB
Vinyl Coated Fabric Wallcovering	W
Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF
Wall Border	WB
Wood	WD

3.2 FINISH SCHEDULE SYMBOLS

Symbol Definition

** Same finish as adjoining walls
 - No color required
 E Existing
 XX To match existing
 EFTR Existing finish to remain
 RM Remove

--- E N D---

SECTION 12 24 00
WINDOW SHADES

PART 1 - GENERAL**1.1 DESCRIPTION**

Integral Venetian blinds are specified in this section. Window shades shall be furnished complete, including brackets, fittings and hardware.

1.2 RELATED WORK

- A. Color of exposed parts of venetian blinds, (including tapes and cords):
Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 QUALITY CONTROL

Manufacturer's Qualification: Venetian blind manufacturer shall provide evidence that the manufacture of blinds are a major product, and that the blinds have performed satisfactorily on similar installations.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
1. Venetian blind slats, 300 mm (12 inches) long, including cord and tape, showing color and finish.
- C. Manufacturer's literature and data; showing details of construction and hardware for:
1. Venetian blinds

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced to in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
- AA-V-00200B.....Venetian Blinds, Shade, Roller, Window, Roller, Slat, Cord, and Accessories
- C. American Society for Testing and Materials (ASTM):
- A167-99(R2009).....Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
- B221/B221M-08.....Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- D635-10.....Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
- D648-07.....Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

D1784-08.....Rigid Poly (Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly (Vinyl Chloride) (CPVC)
Compounds

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A167
- B. Cords for Venetian Blinds: No. 4 braided nylon or No. 4-1/2 braided cotton having not less than 175 pounds breaking strength.
- C. Extruded Aluminum: ASTM B221/B221M.

2.2 VENETIAN BLINDS AND SHADES ENCLOSED IN WINDOWS

Shades or blinds inside of windows panes shall be used for manual turn-knob operation..

2.3 FASTENINGS

Zinc-coated or cadmium plated metal, aluminum or stainless steel fastenings of proper length and type. Except as otherwise specified, fastenings for use with various structural materials shall be as follows:

Type of Fastening	Structural Material
Wood screw	Wood
Tap screw	Metal
Case-hardened, self-tapping screw	Sheet Metal
Screw or bolt in expansion shields	Solid masonry
Toggle bolts	Hollow blocks, wallboard and plaster

2.4 FABRICATION

- A. Fabricate venetian blinds to fit measurements of finished openings obtained at site.
- B. Venetian Blinds: Venetian blinds shall have 3/8-inch width horizontal slats positioned within ladder tapes. Multiple blinds in openings are to be of same type and divided at mullions.
 - 1. Head-rails shall fully enclose operating mechanism on three sides and ends.
 - 2. Bottom rails shall be fully enclosed to prevent contact of tapes and sill at underside.
 - 3. Finish concealed metal work of head-rails including concealed mechanism, with one shop coat of paint. Do not paint parts that have non-rusting finish, or parts where motion of friction occurs.

PART 3 - EXECUTION**3.1 INSTALLATION**

A. Venetian Blinds: Support blinds in level position by brackets and intermediate supports that will permit easy removal and replacement of units without damage to blind, or adjacent surfaces. Provide at least two fasteners for each bracket or other support.

1. Install blinds between window unit with steel trim. Mount brackets on trim reveal, flush with face of trim and secure with steel screws.

- - - E N D - - -

**SECTION 12 31 00
MANUFACTURED METAL CASEWORK**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies metal casework and related accessories, including base cabinets, wall cabinets, and full height cabinets.
- B. Items specified in this section:
 - 1. S.P.D. Casework: Including metal casework of the following types:
 - a. Built-in counter (Stainless Steel).
 - b. Casework (Stainless Steel).

1.2 RELATED WORK

- A. Color of casework finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Electrical Components: Division 26, ELECTRICAL.
- C. Anchoring: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

1.3 QUALITY ASSURANCE

- A. Approval by Contracting Officer of proposed manufacturer, or suppliers, will be based upon submission by Contractor certification that, manufacturer regularly and presently manufactures casework specified as one of their principal products.
- B. Installer has technical qualifications, experience, trained personnel, and facilities to install specified items.
- C. Furnish supervision of installation at construction site by a qualified technician regularly employed by casework installer.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
 - 1. Manufacturer's Certificate of qualifications specified and finish on casework.
 - 2. Contractor's Certificate of installer's qualifications specified.
- C. Manufacturer's Literature and Data:
 - 1. Brochures showing name and address of manufacturer, and catalog or model number of each item incorporated into the work.
 - 2. Manufacturer's illustration and detailed description.
 - 3. List of deviations from contract specifications.
 - 4. Locks, each kind
- D. Shop Drawings (1/2 Full Scale):
 - 1. Showing details of casework construction, including kinds of materials and finish, hardware, accessories and relation to finish of

adjacent construction, including specially fabricated items or components.

2. Fastenings and method of installation.
3. Location of service connections and access.

E. Samples:

1. Metal plate, 150 mm (six inch) square, showing chemical resistant finish, in each color.
2. One complete casework assembly, including cabinet(s) with drawers and cupboard.
3. One glazed sliding door with track and pertinent hardware. A complete cabinet may be submitted to fulfill this requirement.
4. Cabinets for subsequent installation may be submitted for above requirements.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A36/A36M-08.....Carbon Structural Steel
 - A167-99(R 2009).....Stainless and Heat-Resisting Chromium Steel
Plate Sheet and Strip
 - A283/A283M-03(R 2007)...Low and Intermediate Tensile Strength Carbon
Steel Plates
 - A568/A568M-09.....Steel, Sheet, Carbon and High-Strength, Low-
Alloy Hot-Rolled and Cold-Rolled, General
Requirements
 - A794/A794M-09.....Standard Specification for Commercial Steel
(CS), Sheet, Carbon (0.16% Maximum to 0.25%
Maximum) Cold Rolled
 - B456-03(R2009).....Electrodeposited Coatings of Copper Plus Nickel
Plus Chromium and Nickel Plus Chromium
 - C1036-06.....Flat Glass
- C. American National Standard Institute:
- Z97.1-09.....Safety Glazing Material used In Buildings
- D. Builders Hardware Manufacturers Association (BHMA):
- A156.1-06.....Butts and Hinges
 - A156.9-10.....Cabinet Hardware
 - A156.5-10.....Auxiliary Locks and Associated Products
 - A156.11-10.....Cabinet Locks
 - A156.16-02.....Auxiliary Hardware
- E. American Welding Society (AWS):
- D1.1-10.....Structural Welding Code Steel

- D1.3-08.....Structural Welding Code Sheet Steel
- F. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-505-06 Series...Metal Finishes Manual
- G. U.S. Department of Commerce, Product Standard (PS):
PS 1-95.....Construction and Industrial Plywood
- H. Federal Specifications (Fed. Spec.):
FF-N-836D.....Nut, Square, Hexagon Cap, Slotted, Castle
Knurled, Welding and Single Ball Seat
A-A-55615.....Shield, Expansion; Nail Expansion (Wood Screw
and Lag Bolt Self-Threading Anchors)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Steel:
1. ASTM A794, cold rolled, Class 1 finish, stretcher leveled.
 2. Other types of cold rolled steel meeting requirements of ASTM A568 may be used for concealed parts.
- B. Structural Steel: ASTM A283 or ASTM A36.
- C. Stainless Steel: ASTM A167, Type 302B.
- D. Plywood:
1. Prod. Std. PS 1, seven ply, interior.
 2. Where both sides are exposed, use Grade AA.
 3. Grade AB for other uses.
- E. Fasteners:
1. Exposed to view, chrome plated steel or stainless steel, or finished to match adjacent surface.
 2. Use round head or countersunk fasteners where exposed in cabinets.
 3. Expansion Bolts: Fed Spec. A-A-55615. Do not use lead or plastic shields.
 4. Nuts: Fed Spec FF-N-836. Type III, Style 15 where exposed.
 5. Sex Bolts: Capable of supporting twice the load.

2.2 MANUFACTURED PRODUCTS

- A. When two or more units are required, use products of one manufacturer.
- B. Manufacturer of equipment assemblies, which include components made by other, shall assume complete responsibility for the final assembled unit.
- C. Constituent parts which are alike, use products of a single manufacturer.

2.3 CASEWORK FABRICATION

- A. General:
1. Welding: Comply with AWS Standards.
 2. Reinforce with angles, channels, and gussets to support intended loads, notch tightly, fit and weld joints.

3. Constructed of sheet steel, except where reinforcing required.

B. Minimum Steel Thickness:

0.89 mm (0.035 inch) (20 gage)	Drawer fronts, backs, bodies, closure plates or scribe and filler strips less than 75 mm (three inches) wide, sloping top, shelf reinforcement channel and shelves. Toe space or casework soffits and ceilings under sloping tops.
1.20 mm (0.047 inch) (18 gage)	Base pedestals, casework top sides, back, and bottom panels, closure scribe and filler strips 75 mm (three inches) or more. Reinforcement for drawers with locks. Tables legs, spreaders and stretchers, when fabricated of cold rolled tubing. Metal for desks; except legs and aprons. Door exterior and interior panels, flush or glazed. Cross rails of base units. Front bottom rails, back bottom rails; rails may be 1.49 mm (0.059 inch) (16 gage) thick. Uprights or posts. Top corner gussets.
1.49 mm (0.059 inch) (16 gage)	Aprons, apron division, reinforcing gussets, table legs, desk legs and aprons, spreaders and stretchers when formed without welding. Toe base gussets, drawer slides, and other metal work. Front top rails and back rails except top back rails may be 1.2 mm (0.047 inch) (18 gage) thick.
1.88 mm (0.074 inch) (14 gage)	Drawer runners door tracks.
2.64 mm (0.104 inch) (12 gage)	Base unit bottom corner gussets and leg sockets.
3 mm (0.12 inch) (11 gage)	Reinforcement for hinge reinforcement inside doors and cabinets.

C. Casework Construction:

1. Welded assembly.
2. Fabricate with enclosed uprights or posts full height or width at front, include sides, backs, bottoms, soffits, ceilings under sloping tops, headers and rail, assembled to form an integral unit.
3. Form sides to make rabbeted stile 19 to 28 mm (3/4 to 1-1/8 inch) wide, closed by channel containing shelf adjustment slots.
4. Make bottom of walls units flush, double panel construction.
5. Make top and cross rails of "U" shaped channel.
6. Provide enclosed backs and bottoms in cabinets, including drawer units.
7. Provide finish panel on exposed cabinet backs.
8. Do not use screws and bolts in construction or assembly of casework, except to secure hardware, applied door stops, accessories, removable

- panels and where casework is required to fastened end to end or back to back.
9. Fabricate casework, except benches, and desks with finished end panels.
 10. Close flush exposed soffits of wall hung shelving, knee spaces in counters, and toe spaces at bases.
 11. In base units with sinks provide one piece, lowered backs.
 12. In base units with doors provide removable backs.
 13. Provide built-in raceways or tubular or channel shaped members of casework for installation of wiring and electric work. Mount junction boxes on rear of cabinets, Electric work is specified in electrical sections of specifications.
 14. Provide reinforcing for hardware.
 15. Size Dimensions:
 - a. Used dimensions shown or specified within tolerances specified.
 - b. Tolerance:
 - 1) Depth: 325 mm (13 inches) in lieu of 300 mm (12 inches), 450 mm (18 inches) in lieu of 400 mm (16 inches), except wall hung units above counter. 525 mm (21 inches) to 600 mm (24 inches) in lieu of 550 mm (22 inches).
 - 2) Width: Minus 25 mm (one inch).
 - 3) Height: 25 mm (one inch) plus or minus for wall hung cabinets and counter mounted cabinets, excluding sloping tops. 25 mm (one inch) plus for floor standing cabinets, excluding base and sloping tops. Full height cabinets shown back to back same height.
 - 4) Manufacturer's tolerance for the same length, depth or height: Not to exceed 1.58 mm (0.0625 inches).
- D. Base Pedestals:
1. Provide adjustable leveling bolts accessible through stainless steel plugs, or notch in the base concealed when resilient base is applied.
 2. Except where flush metal base is shown, provide toe space at front recessed 75 mm (3 inches).
- E. Doors:
1. Hollow metal type, flush and glazed doors not less than 16 mm (5/8 inch) thick.
 2. Fabricate flush metal doors of two panels formed into pans with corners welded and ground smooth. Provide flush doors with a sound deadening core.
 3. Provide sheet steel hinge reinforcement inside doors.
 4. Doors removable without use of tools except where equipped with locks.

F. Sloping Tops:

1. Provide sloping tops for casework where shown.
2. Where ceilings interfere with installation of sloping tops. Provide filler plates as specified.
3. Omit sloping tops or filler plates whenever ceiling material is turned down and furred-in at face of casework.
4. Provide exposed ends of sloping tops with flush closures.
5. Fasten sloping tops with sheet metal screws inserted from cabinet interior; space fastener as recommended by manufacturer.

G. Shelves:

1. Capable of supporting an evenly distributed minimum load of 122 kg/m² (twenty-five pounds per square foot) without visible distortion.
2. Flange shelves down 19 mm (3/4 inch) on edges, with front and bearing edges flanged back 13 mm (1/2 inch).
3. For shelves over 1050 mm (42 inches) in length and over 300 mm (12 inches) in depth install 38 mm by 13 mm by 0.9 mm (1-1/2 x 1/2 x 0.0359 inch) thick sheet steel hat channel reinforcement welded to underside midway between front and back and extending full length of shelf.
4. Weld shelves to metal back and ends unless shown adjustable.
5. Provide means of positive locking shelf in position, and to permit adjustment without use of tools.

H. Undercounter Table, and Suspended Computer Mounting Shelf Frames:

1. Using welded construction.
2. Open frame type with aprons and legs when required.
3. Aprons:
 - a. Channels shaped welded at corners, with leg sockets and reinforcing triangular corner gussets welded in corners.
 - b. Pierce sockets to receive leg bolts and notch gussets to receive legs.
 - c. Upper flange perforated or slotted to receive screws at 200 mm (8 inch) centers, and back channels when installed against wall. Size slots for 6 mm (1/4 inch) anchor bolts.
 - d. Pierce aprons to receive drawer formation, rail at top of drawer opening. Install channel shaped apron division welded at ends, 762 mm 30 inches apart to front and back aprons, or at each side of drawer.
 - e. Fabricate metal components from sheet steel.
 - 1) Use 1.5 mm (0.0598 inch) thick sheet for gussets and channel aprons.
 - 2) Use 1.2 mm (0.0478 inch) thick sheet for other items.

- f. At knee space, provide exposed metal sides and metal closure plate for soffit. Where shown at knee space, provide exposed metal back secured with continuous angle closures at both side.
- 4. Legs:
 - a. Cold rolled tubing or 1.5 mm (0.0598 inch) formed steel.
 - b. Leveling-anchoring device at floor.
 - c. Stud bolt at top for attachment to leg socket.
- 5. Leg Braces:
 - a. Tables and benches not anchored to walls.
 - b. Brace back against front legs near bottom with steel angle, channel or tubular braces.
 - c. Fasten braces together with steel straps.
- 6. Leg Shoes:
 - a. Fit laboratory casework legs at bottom with either stainless steel, aluminum, or chromium plated brass shoes, not less than 25 mm (one inch) in height.
 - b. Fit other legs with a movable molded vinyl shoe 100 mm (four inches) high and coved at bottom.
- I. Suspended computer mounting shelves:
 - 1. Of same construction as counters, except, provide Stainless Steel angles to fabricate shelf support from bottom of counter.
 - 2. Provide side and back closure plates with open front.
 - 3. Provide 2-inch diameter holes on side cover facing work station.
- J. Closures and Filler Strips at Pipe Spaces:
 - 1. Flat steel strips or plates.
 - 2. Openings less than 200 mm (8 inches) wide: 1.2 mm (0.047 inch) thick.
 - 3. Openings more than 200 mm (8 inches wide 0.9 mm (0.359 inches) wide.

2.4 ACCESSORIES

- A. Labels Holders for Doors:
 - 1. Cast or wrought brass or aluminum, 50 mm (2 inch) by 88 mm (3-1/2 inch).
 - 2. Fasten to casework as recommended by manufacturer.

2.5 HARDWARE

- A. Factory installed.
- B. Exposed hardware, except as specified otherwise, satin finished chromium plated brass or nickel plated brass or anodized aluminum.
- C. Cabinet Locks:
 - 1. Where locks are shown.
 - 2. Locked pair of hinged door over 900 mm (36 inches) high:
 - a. ANSI/BHMA A156.5, similar to E0261, Key one side.

- b. On active leaf use three-point locking device, consisting of two steel rods and lever controlled cam at lock, to operate by lever having lock cylinder housed therein.
 - c. On inactive leaf use dummy lever of same design.
 - d. Provide keeper holes for locking device rods and cam.
3. Door: ANSI/BHMA A156.11 cam locks.
- a. Hinged Door up to 900 mm (36 inches) high: E07261.
 - b. Pin-tumbler, cylinder type lock with not less than four pins. Disc tumbler lock "duo A" with brass working parts and case, as manufactured by Illinois Lock Company are acceptable.
4. Key locks differently for each type casework and master key for each service.
- a. Key drug locker inner door different from outer door.
 - b. Provide two keys per lock.
 - c. Provide six master keys per service or Nursing Unit.
5. Marking of Locks and Keys:
- a. Name of manufacturer, or trademark which can readily be identified legibly marked on each lock and key change number marked on exposed face of lock.
 - b. Key change numbers stamped on keys.
 - c. Key change numbers to provide sufficient information for manufacturer to replace key.
- D. Cabinet Hardware: ANSI BHMA A156.9.
1. Door Pulls: B02011.
- a. One for drawers up to 575 mm (23 inches) wide.
 - b. Two for drawers over 575 mm (23 inches) wide.
 - c. Sliding door flush pull, each door: B02201.
2. Door in seismic zones: B03352.
- a. Do not provide thumb latch on doors equipped with three point locking device.
 - b. Use lever operated two point latching device on paired doors over 900 mm (36 inches) high if three point locking or latching device is not used.
3. Cabinet Door Catch:
- a. Install at bottom of wall cabinets, top of base cabinets and top and bottom of full height cabinet doors over 1200 mm (48 inches).
 - b. Omit on doors with locks.
4. Butt Hinges:
- a. B01351, minimum 1.8 mm (0.072 inch) thick chrome plated steel leaves.
 - b. Minimum 3.5 mm (0.139 inch) diameter stainless steel pins.

- c. Full mortise type, five knuckle design with 63 mm (2-1/2 inch) high leaves and hospital type tips.
- d. Two hinges per door except use three hinges on doors 1200 mm (48 inches) and more in height. Use stainless steel leaves for tilting bin doors.
- f. Do not weld hinges to doors or cabinets.
- 5. Pivot hinges: ANSI/BHMA A156.1 A875B.
- 6. Shelf Supports:
 - a. install in casework where adjustable shelves are noted.
 - b. Adjustable Shelf Standards: B04061 with shelf rest B04081.
 - c. Vertical Slotted Shelf Standard: B04102 with shelf brackets B04112 sized for shelf depth.
- 7. Auxiliary Hardware: ANSI A156.16.
- 8. Door silencers: L03011 or L03031.
 - a. Install two rubber bumpers each door.
 - b. Silencers set near top and bottom of jamb.
- 9. Closet Bar: L03131 chrome finish of required length.

2.6 METAL FINISHES

- A. Comply with NAAMM 500 series and as specified.
- B. Stainless Steel: Mechanical finish No. 4 on sheet except No. 7 on tubing.

2.7 ELECTRICAL FIXTURES

- A. Comply with requirements of Division 26 - ELECTRICAL specifications for fixtures, receptacles, wiring and junction boxes required for fixtures and receptacles, included with casework.
- B. Suitable for use with electrical system specified and shown.
- C. Factory install in casework.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Before installing casework, verify wall and floor surfaces covered by casework have been finished.
- B. Verify location and size of mechanical and electrical services as required.
- C. Verify reinforcement of walls and partitions for support and anchorage of casework.

3.2 FASTENINGS AND ANCHORAGE

- A. Do not anchor to wood ground strips.
- B. Provide hat shape metal spacers where fasteners span gaps or spaces.
- C. Use 6 mm (1/4 inch) diameter toggle or expansion bolts, or other appropriate size and type fastening device for securing casework to walls or floor. Use expansion bolts shields having holding power beyond tensile and shear strength of bolt and breaking strength of bolt head.

- D. Use 6 mm (1/4 inch) diameter hex bolts for securing cabinets together.
- E. Use 6 mm (1/4 inch) by minimum 38 mm (1-1/2 inch) length lag bolt anchorage to wood blocking for concealed fasteners.
- F. Use not less than No. 12 or 14 wood screws with not less than 38 mm (1-1/2 inch) penetration into wood blocking.
- G. Space fastening devices 300 mm (12 inches) on center with minimum of three fasteners in 900 or 1200 mm (three or four foot) unit width.
- H. Anchor floor mounted cabinets with a minimum of four bolts through corner gussets. Anchor bolts may be combined with or separate from leveling device.
- I. Secure cabinets in alignment with hex bolts or other internal fastener devices removable from interior of cabinets without special tools. Do not use fastener devices which require removal of tops for access.
- J. Where units abut end to end anchor together at top and bottom of sides at front and back. Where units are back to back anchor backs together at corners with hex bolts placed inconspicuously inside casework.
- K. Where type, size, or spacing of fastenings is not shown or specified, show on shop drawings proposed fastenings and method of installation.

3.3 CLOSURES AND FILLER PLATES

- A. Close openings larger than 6 mm (1/4 inch) wide between cabinets and adjacent walls with flat, steel closure strips, scribed to required contours, or machined formed steel fillers with returns, and secured with sheet metal screws to tubular or channel members of units, or bolts where exposed on inside.
- B. Where ceilings interfere with installation of sloping tops, omit sloping tops and provide flat steel filler plates.
 - 1. Secure filler plates to casework top members, unless shown otherwise.
 - 2. Secure filler plates more than 150 mm (six inches) in width top edge to a continuous 25 by 25 mm (one by one inch) 0.889 mm thick steel formed steel angle with screws.
 - 3. Anchor angle to ceiling with toggle bolts.
- C. Install closure strips at exposed ends of pipe space and offset opening into concealed space.
- D. Paint closure strips and fillers with same finishes as cabinets.
- E. Caulk and seal furniture as specified in Section 07 92 00, JOINT SEALANTS.

3.4 CABINETS

- A. Install in available space; arranged for safe and convenient operation and maintenance.
- B. Align cabinets for flush joints except where shown otherwise.
- C. Install cabinets level with bottom of wall cabinets in alignment and tops of base cabinets aligned.

- D. Install corner cabinets with hinges on corner side with filler or spacers sufficient to allow opening of drawers.
- E. Plug Buttons:
 - 1. Install plug buttons in predrilled or prepunched perforations not used.
 - 2. Use chromium plate plug buttons or buttons finish to match adjacent surfaces.

3.5 PROTECTION TO FIXTURES, MATERIALS, AND EQUIPMENT

- A. Tightly cover and protect cabinets against dirt, water chemical or mechanical injury.
- B. Thoroughly clean interior and exterior of cabinets, at completion of all work.

- - - E N D - - -

SECTION 23 74 13
PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Roof top air handling units including integral components specified herein.
- B. Definitions: Roof Top Air Handling Unit(Roof Top Units, RTU): A factory fabricated assembly consisting of fan, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying, energy recovery (heat pipe), and mixing of air. Design capacities of units shall be as scheduled on the drawings.

1.2 RELATED WORK

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for equipment.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT: Sound and vibration requirements.
- D. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING: Piping and valves.
- E. Section 23 82 16, AIR COILS: Heating and cooling coils and pressure requirements.
- F. Section 23 34 00, HVAC FANS: Return and exhaust fans.
- G. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining.
- H. Section 23 40 00, HVAC AIR CLEANING DEVICES: Air filters and filters' efficiency.
- I. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: HVAC controls.
- J. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Testing, adjusting and balancing of air and water flows.
- K. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT: Types of motors.
- L. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS:
- M. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

1.3 QUALITY ASSURANCE

- A. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air Handling Units Certification

1. Air Handling Units with Housed Centrifugal Fans: The air handling units shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
2. Air Handling Units with Plenum Fans:
 - a. Air Handling Units with a single Plenum Fan shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
 - b. Air handling Units with Multiple Fans in an Array shall be tested and rated in accordance with AHRI 430 and AHRI 260.

C. Heating, Cooling, and Air Handling Capacity and Performance Standards:
AHRI 430, AHRI 410, ASHRAE 51, and AMCA 210.**D. Performance Criteria:**

1. The fan BHP shall include all system effects for all fans and v-belt drive losses for housed centrifugal fans.
2. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
3. Select the fan operating point as follows:
 - a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point.
 - b. Air Foil, Backward Inclined, or Tubular Fans Including Plenum Fans: At or near the peak static efficiency but at an appropriate distance from the stall line.
4. Operating Limits: AMCA 99 and Manufacturer's Recommendations.

E. Units shall be factory-fabricated, assembled, and tested by a manufacturer, in business of manufacturing similar air-handling units for at least five (5) years.**1.4 SUBMITTALS:**

- A. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish a complete submission for all roof top units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.
- B. Manufacturer's Literature and Data:
 1. Submittals for RTUs shall include fans, drives, motors, coils, humidifiers, mixing box with outside/return air dampers, filter housings, and all other related accessories. The contractor shall provide custom drawings showing total air handling unit assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility

- connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc) and rigging points.
2. Submittal drawings of section or component only, will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details; if the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version compatible to AutoCAD version used by the VA at the time of submission.
 3. Submit sound power levels in each octave band for fan and at entrance and discharge of RTUs at scheduled conditions. Include sound attenuator capacities and itemized internal component attenuation. Internal lining of supply air ductwork with sound absorbing material is not permitted. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
 4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute) and 110 percent of design static pressure.
 5. Submit total fan static pressure, external static pressure, for RTU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.
 6. Provide energy recovery (heat pipe) performance data for outgoing and incoming airstreams including CFM, pressure drop, efficiency, temperatures, and BTU. Refer to Air Handling Unit schedule on drawings.
- C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.
- D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.
- E. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

F. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.

1. Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and/or road salt.
2. If not shipped in one (1) piece, provide manufacturer approved shipping splits where required for installation or to meet shipping and/or job site rigging requirements in modular sections. Indicate clearly that the shipping splits shown in the submittals have been verified to accommodate the construction constraints for rigging as required to complete installation and removal of any section for replacement through available access without adversely affecting other sections.
3. If shipping splits are provided, each component shall be individually shrink wrapped to protect the unit and all necessary hardware (e.g. bolts, gaskets etc.) will be included to assemble unit on site (see section 2.1.A4).
4. Lifting lugs will be provided to facilitate rigging on shipping splits and joining of segments. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
- 260-01.....Sound Rating of Ducted Air Moving and
Conditioning Equipment
 - 410-01.....Standard for Forced-Circulation Air-Heating and
Air-Cooling Coils
 - 430-09.....Standard for Central Station Air Handling Units
 - AHRI-DCAACP.....Directory of Certified Applied Air Conditioning
Products
- C. Air Moving and Conditioning Association (AMCA):
- 210-07.....Laboratory Methods of Testing Fans for Rating
- D. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):
- 9-90 (R2008).....Load Ratings and Fatigue life for Ball Bearings
- E. American Society of Heating, Refrigerating and Air Conditioning
Engineers (ASHRAE):
- 51-2007.....Laboratory Methods of Testing Fans for Rating

F. American Society for Testing and Materials (ASTM):

A653/653M-02.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

B117-07a.....Salt Spray (Fog) Testing

C1071-05e1.....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

D1654-08.....Standard Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

D1735-08.....Water Resistance of Coatings Using Water Fog Apparatus

D3359-08.....Standard Test Methods for Measuring Adhesion by Tape Test

E84-10.....Standard Test Method for Surface Burning Characteristics of Building Materials

G. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):

9-90.....Load Ratings and Fatigue life for Ball Bearings

H. Military Specifications (Mil. Spec.):

DOD-P-21035A-2003.....Paint, High Zinc Dust Content, Galvanizing Repair

I. National Fire Protection Association (NFPA):

NFPA 90A.....Standard for Installation of Air Conditioning and Ventilating Systems, 2009

J. Energy Policy Act of 2005 (P.L.109-58)

PART 2 - PRODUCTS**2.1 ROOF TOP AIR HANDLING UNITS**

A. General:

1. Roof top units (RTU) shall be fabricated from insulated, solid double-wall galvanized steel without any perforations in draw-through configuration. Casing is specified in paragraph 2.1.C. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units may be provided subject to VA approval and documentation that structural rigidity is equal or greater than the galvanized steel specified.
2. The contractor and the RTU manufacturer shall be responsible for insuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future

- overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the government.
3. RTUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
 4. The RTU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a local representative at the job site to supervise the assembly and to assure the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation that this representative has provided this service on similar jobs to the Contracting Officer. If a local representative cannot be provided, the manufacturer shall provide a factory representative.
 5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
 6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 1991 Pa (8 inches water gage) or higher.
 7. Corrosion Protection:
 - a. Coil Treatment: Epoxy Immersion Coating-Electrically Deposited:
The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil.

Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:

- 1) Salt Spray Resistance (Minimum 6,000 Hours)
- 2) Humidity Resistance (Minimum 1,000 Hours)
- 3) Water Immersion (Minimum 260 Hours)
- 4) Cross-Hatch Adhesion (Minimum 4B-5B Rating)
- 5) Impact Resistance (Up to 160 Inch/Pound)

- b. Casing Surfaces (Exterior and Interior): All exposed and accessible exterior and interior metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) and 500 hours UV resistance (ASTM D4587).

B. Base:

1. Provide a heavy duty steel base for supporting all major RTU components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 125 mm (5 inch) high 3.5 mm (10 Gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain trap and steam coil condensate return trap as shown on drawings.
2. RTUs shall be completely self supporting for installation on roof curb or steel support pedestals.
3. The RTU bases not constructed of galvanized material shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

C. Casing (including wall, floor and roof):

1. General: RTU casing shall be entirely double wall insulated panels, integral of or attached to a structural frame. Construction shall be such that removal of any panel shall not affect the structural integrity of the unit. Casing finished shall meet salt-spray test as

specified in paragraph 2.1.C.10. All casing and panel sections shall be tightly butted and gasketed. No gaps of double wall construction will be allowed where panels bolt to air handling unit structural member. Structural members, not covered by the double wall panels, shall have equivalent insulated double wall construction.

2. Double wall galvanized steel panels, minimum 51 mm (2 inches) thick, constructed of minimum 1.3 mm (18 gauge) outer skin and 1.0 mm (20 gauge) solid or perforated inner skin to limit wall, roof and floor deflection to not exceed an L/240 ratio when the unit casing is pressurized to (± 1245 Pa (± 5 in. w.g.)). Deflection shall be measured at the midpoint of the panel height. Total housing leakage shall not exceed 1% of rated cfm when the unit casing is pressurized to ± 5 in. w.g. (± 1245 Pa). The outer (skin) and inner panels shall be solid.
3. Blank-Off: Provide blank-offs as required to prevent air bypass between the AHU sections, around coils, and filters.
4. Insulation: Insulation shall be injected CFC free polyurethane foam encased in double-wall casing between exterior and interior panels such that no insulation can erode to the air stream. Insulation shall be 50 mm (2 inch) thick, and 48 kg/m^3 (3.0 lb/ft^3) density with a total thermal resistance (R-value) of approximately $2.3 \text{ m}^2\text{K/W}$ ($13.0 \text{ hr-ft}^2 \text{ }^\circ\text{F/BTU}$). Units with less than 50 mm (2 inch) of insulation in any part of the walls, floor, roof or drain pan shall not be acceptable. The insulation shall comply with NFPA 90-A for the flame and smoke generation requirements. Also, refer to specification Section 23 07 11, HVAC INSULATION.

Table 2.1.C.4

Outer Panel	0.8 mm (22 Gage) Minimum
Inner Panel	0.8 mm (22 Gage) Minimum
Insulation	Foam
Thickness	50 mm (2 inch) Minimum
Density	48 kg/m^3 (3.0 lb/ft^3) Minimum
Total R Value	$2.3 \text{ m}^2\text{K/W}$ ($13.0 \text{ ft}^2\text{ }^\circ\text{F.hr/Btu}$) Minimum

5. The thickness of insulation, mode of application, and thermal breaks shall be such that there is no visible condensation on the exterior panels of the AHU.
6. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to

allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are not acceptable.

7. Access Doors: Provide in each access section and where shown on drawings. Show single-sided and double-sided access doors with door swings on the floor plans. Doors shall be a minimum of 50 mm (2 inches) thick with same double wall construction as the unit casing. Doors shall be a minimum of 600 mm (24 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors for fan section, mixing box, humidifier coil section shall include a minimum 150 mm x 150 mm (6 inch x 6 inch) double thickness, with air space between glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.
 - a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 pound) weight hung on latch side of door.
 - b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inches water gage).
 - c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.
8. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.
9. Roof of the unit shall be sloped to have a minimum pitch of 1/4 inch per foot. The roof shall overhang the side panels by a minimum of

three inches to prevent precipitation drainage from streaming down the unit side panels.

10. Casing finished shall meet ASTM B117, 500-hour salt spray test, using 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no sign of blistering, wrinkling, or cracking, no loss of adhesion, and the specimen shall show no sign of rust creepage beyond 1/8-inch on either side of scratch mark.
- D. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 pounds per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.
- E. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double wall construction, Type 304 stainless steel and have a minimum of 50 mm (2 inch) insulation, and shall be sloped to drain. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.
 1. An intermediate condensate drip pan shall be provided on stacked cooling coils and shall be constructed of type 304 stainless steel with copper downspouts factory piped to main condensate pan. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
 2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
 3. Installation, including frame, shall be designed and sealed to prevent blow-by.
- F. Housed Centrifugal Fan Sections:
 1. Fans shall be minimum Class II construction, double width, double inlet centrifugal, air foil or backward inclined or forward curved type as indicated on drawings, factory balanced and rated in accordance with AMCA 210 or ASHRAE 51. Provide self-aligning, pillow

- block, regreasable ball-type bearings selected for a B(10) life of not less than 40,000 hours and an L(50) average fatigue life of 200,000 hours per AFBMA Standard 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in airstream to assure proper air flow.
2. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide vibration isolators and flexible duct connections at fan discharge to completely isolate fan assembly. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).
- G. Fan Motor, Drive, and Mounting Assembly (Housed Centrifugal Fans):
1. Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in the Specifications Section 23 05 12 (General Motor Requirements For HVAC and Steam Equipment), on drawings and suitable for use in variable frequency drive applications on AHUs where this type of drive is indicated. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications.
 2. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Drive and belts shall be as specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Provide additional drive(s) if required during balancing, to achieve desired airflow.
- H. Plenum Fans - Single and/or Multiple Fans in an Array

1. General: Fans shall be Class II (minimum) construction with single inlet, aluminum wheel and stamped air-foil aluminum bladed. The fan wheel shall be mounted on the directly-driven motor shaft in AMCA Arrangement 4. Fans shall be dynamically balanced and internally isolated to minimize the vibrations. Provide a steel inlet cone for each wheel to match with the fan inlet. Locate fan in the air stream to assure proper flow. The fan performance shall be rated in accordance with AMCA 210 or ASHRAE 51.
2. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC. The fan wheel shall meet or exceed guidelines in AMCA 801-92 for dynamic balancing requirements. The complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).
3. The plenum fans shall be driven by variable speed drives with at least one back-up drive as shown in the design documents. Use of a drive with bypass is not permitted.
4. Multiple fans shall be installed in a pre-engineered structural frame to facilitate fan stacking. All fans shall modulate in unison, above or below the synchronous speed within the limits specified by the manufacturer, by a common control sequence. Staging of the fans is not permitted. Redundancy requirement shall be met by all operating fans in an array and without the provision of an idle standby fan.
5. Fan Accessories
 - a. Fan Isolation: Provide an actuator-controlled damper to isolate the fan not in operation due to failure.
 - b. Fan Airflow Measurement: Provide an airflow measuring device integral to the fan to measure air volume within +/- 5 percent accuracy. The probing device shall not be placed in the airflow path to stay clear of turbulence and avoid loss of performance.
6. Fan Motor, Drive and Mounting Assembly: Fan Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in the Specifications Section 23 05 12

(General Motor Requirements For HVAC and Steam Equipment), on drawings and suitable for use in variable frequency drive applications. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications.

- I. Mixing Boxes: Mixing box shall consist of casing and outdoor air and return air dampers in opposed blade arrangement with damper linkage for automatic operation. Coordinate damper operator with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Dampers shall be of ultra-low leak design with metal compressible bronze jamb seals and extruded vinyl edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings or bronze bushings. Leakage rate shall not exceed 1.6 cubic meters/min/square meter (5 cfm per square foot) at 250 Pa (1 inch water gage) and 2.8 cubic meters/min/square meter (9 cfm per square foot) at 995 Pa (4 inches water gage) Electronic damper operators shall be furnished and mounted in an accessible and easily serviceable location by the air handling unit manufacturer at the factory. Damper operators shall be of same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- J. Filter Section: Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES, for filter requirements.
 1. Filters including one complete set for temporary use at site shall be provided independent of the RTU. The RTU manufacturer shall install filter housings and racks in filter section compatible with filters furnished. The RTU manufacturer shall be responsible for furnishing temporary filters (pre-filters and after-filters, as shown on drawings) required for RTU testing.
 2. Factory-fabricated filter section shall be of the same construction and finish as the RTU casing including filter racks and hinged double wall access doors. Filter housings shall be constructed in accordance with side service or holding frame housing requirements in Section 23 40 00, HVAC AIR CLEANING DEVICES.
- K. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be face or side removable for future replacement thru the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to insure no condensate carry over. Provide factory installed extended supply, return, drain, and vent piping connections. For air handling units serving surgical suites, provide copper fins for all coils. Refer to

Drawings and Section 23 82 16, AIR COILS, for additional coil requirements.

1. Water Coils.

2. Steam Distributing Tube Coils.

L. Humidifier: When included in design, coordinate the humidification requirements with section 23 84 13 Humidifiers. Provide humidification section with stainless steel drain pan of adequate length to allow complete absorption of water vapor. Provide stainless steel dispersion panel or distributors as indicated, with stainless steel supports and hardware.

M. Sound Attenuators: Refer to Drawings, Specification Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT, and Section 23 31 00, HVAC DUCTS AND CASINGS, for additional unit mounted sound attenuator requirements. RTU sound attenuators shall be factory installed as an integral part of RTU.

N. Discharge Section: Provide aerodynamically designed framed discharge openings or spun bellmouth fittings to minimize pressure loss.

O. Electrical and Lighting: Wiring and equipment specifications shall conform to Division 26, ELECTRICAL.

1. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard shall be installed in access sections for fan, mixing box, humidifier and any section over 300mm (12 inch) wide. A switch shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system. Provide single point 115 volt - one phase connection at junction box.

2. Install compatible 100 watt bulb in each light fixture.

3. Provide a convenience duplex weatherproof receptacle next to the light switch.

4. Disconnect switch and power wiring: Provide factory or field mounted disconnect switch. Coordinate with Division 26, ELECTRICAL.

P. Provide heat recovery units of the heat pipe air-to-air type as shown on equipment schedules. Heat pipe shall be manufactured by AHU manufacturer as an integral component. Heat pipe shall transfer heat between outgoing and incoming air streams in counter flow arrangement. A portion shall be provided to isolate the outgoing and incoming air streams; with no cross contamination. Performance data shall be in accordance with ASHRAE

Standard 84-1991 "method of testing air-to-air heat exchangers."

Performance shall be rated in accordance with ARI testing procedures.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof top unit in conformance with ARI 435.
- B. Assemble roof top unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas with paint in accordance with Military Spec. DOD-P-21035A. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air-handling units clean prior to operation.
- C. Install seismic restraints for roof top units. Refer to specification Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- D. Leakage and test requirements for roof top units shall be the same as specified for ductwork in Specification Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class (C_L) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.
- E. Perform field mechanical (vibration) balancing in accordance with Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
- F. Seal and/or fill all openings between the casing and RTU components and utility connections to prevent air leakage or bypass.

3.2 STARTUP SERVICES

- A. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.
- B. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.
- C. An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Owner/Operator training, etc.

3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection,

start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

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**SECTION 26 09 23
LIGHTING CONTROLS**

PART 1 - GENERAL**1.1 DESCRIPTION**

This section specifies the furnishing, installation and connection of the lighting controls.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 24 26 16, PANELBOARDS: panelboard enclosure and interior bussing used for lighting control panels.
- E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Product Data: For each type of lighting control, submit the following information.
 - 1. Manufacturer's catalog data.
 - 2. Wiring schematic and connection diagram.
 - 3. Installation details.
- C. Manuals:
 - 1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
 - 2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COTR.
- D. Certifications:
 - 1. Two weeks prior to final inspection, submit four copies of the following certifications to the COTR:

- a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):
GC-12.....Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):
IESNA LM-48.....Guide for Calibration of Photoelectric Control Devices
- D. National Electrical Manufacturer's Association (NEMA)
ICS-1.....Standard for Industrial Control and Systems
General Requirements
ICS-2.....Standard for Industrial Control and Systems:
Controllers, Contractors, and Overload Relays
Rated Not More than 2000 Volts AC or 750 Volts
DC: Part 8 - Disconnect Devices for Use in
Industrial Control Equipment
ICS-6.....Standard for Industrial Controls and Systems
Enclosures
- E. Underwriters Laboratories, Inc. (UL):
20.....Standard for General-Use Snap Switches
773.....Standard for Plug-In Locking Type Photocontrols
for Use with Area Lighting
773ANonindustrial Photoelectric Switches for
Lighting Control
98.....Enclosed and Dead-Front Switches

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Solid state, with SPST dry contacts rated for 1800 VA tungsten or 1000 VA inductive, complying with UL 773A.
 1. Light-Level Monitoring Range: 1.5 to 10 fc [16.14 to 108 lx], with adjustable turn-on and turn-off levels.
 2. Time Delay: 15-second minimum.
 3. Surge Protection: Metal-oxide varistor.
 4. Mounting: Twist lock, with base-and-stem mounting or stem-and-swivel mounting accessories as required, or built-in as part of the fixture.

2.2 SKYLIGHT PHOTOELECTRIC SENSORS

- A. Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight; with separate relay unit.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
3. Monitoring Range: 1000 to 10,000 fc [10,800 to 108,000 lx], with an adjustment for turn-on and turn-off levels.
4. Time Delay: Adjustable from 5 to 300 seconds, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.3 INDOOR OCCUPANCY SENSORS

- A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
 2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Manual/automatic selector switch.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc [21.5 to 2152 lx]; keep lighting off when selected lighting level is present.
 9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Dual-technology Type: Wall or Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm], and detect a person of average size and weight moving not less than 12 inches [305 mm] in either a

horizontal or a vertical manner at an approximate speed of 12 inches/s [305 mm/s].

3. Detection Coverage: completely covers the area where unit is installed.

C. Dual technology type with daylight saving photoelectric switch: Ceiling or wall mounting, combination PIR and ultrasonic detection methods, field selectable.

1. Sensitivity Adjustment: Separate for each sensine technology.
2. Occupancy Sensor function shall meet dual-technology type indoor occupancy sensors requirements.
3. Ambient light override function monitoring range and time delay shall meet ceiling-mounted photoelectric switch requirements.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Aim outdoor photocell switch according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle photocell turn-on.
- C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.
- D. Set occupancy sensor "on" duration to 15 minutes.
- E. Locate light level sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the scheduled light level at the typical work plane for that area.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for step dimming ballast and switches control. Observe visually for light level change.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

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**SECTION 26 24 16
PANELBOARDS****PART 1 - GENERAL****1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

- A. Section 09 91 00, PAINTING: Identification and painting of panelboards.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.
- D. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.
- G. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Requirements for installing the over-current protective devices to ensure proper equipment and personnel protection.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, shall be clearly presented to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, wiring diagrams, accessories, and weights of equipment. Complete nameplate data, including manufacturer's name and catalog number.

C. Manuals:

1. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets and wiring diagrams.
2. If changes have been made to the maintenance and operating manuals that were originally submitted, then submit four copies of updated maintenance and operating manuals to the COTR two weeks prior to final inspection.

D. Certification: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
2. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturers Association (NEMA):

PB-1-06.....Panelboards

250-08.....Enclosures for Electrical Equipment (1000V
Maximum)

C. National Fire Protection Association (NFPA):

70-Latest EditionNational Electrical Code (NEC)

70E-Latest Edition.....Standard for Electrical Life Safety in the
Workplace

D. Underwriters Laboratories, Inc. (UL):

50-95.....Enclosures for Electrical Equipment

67-09.....Panelboards

489-09.....Molded Case Circuit Breakers and Circuit
Breaker Enclosures**PART 2 - PRODUCTS****2.1 PANELBOARDS**

- A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.
- B. Panelboards shall be standard manufactured products.
- C. All panelboards shall be hinged "door in door" type with:

1. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand-operated latches are not acceptable.
3. Push inner and outer doors shall open left to right.
- D. All panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as scheduled on the drawings or specified herein. Include one-piece removable, inner dead front cover, independent of the panelboard cover.
- E. Panelboards shall have main breaker or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.
- F. Panelboards shall conform to NEMA PB-1, NEMA AB-1, and UL 67 and have the following features:
 1. Non-reduced size copper bus bars with current ratings as shown on the panel schedules, rigidly supported on molded insulators.
 2. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
 3. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys of sizes suitable for the conductors to which they will be connected.
 4. Neutral bus shall be 100% rated, mounted on insulated supports.
 5. Grounding bus bar shall be equipped with screws or lugs for the connection of grounding wires.
 6. Buses shall be braced for the available short-circuit current. Bracing shall not be less than 22,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 22,000 A symmetrical for 277/480 V panelboards.
 7. Branch circuit panelboards shall have buses fabricated for bolt-on type circuit breakers.
 8. Protective devices shall be designed so that they can easily be replaced.
 9. Where designated on panel schedule "spaces," include all necessary bussing, device support, and connections. Provide blank cover for each space.

10. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.
11. Series-rated panelboards are not permitted.

2.2 CABINETS AND TRIMS

Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panelboards shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL 50 and UL 67.
2. Cabinet enclosure shall not have ventilating openings.
3. Cabinets for panelboards may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.

2.3 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

- A. Circuit breakers shall be per UL 489, in accordance with the NEC, as shown on the drawings, and as specified.
- B. Circuit breakers in panelboards shall be bolt-on type.
- C. Molded case circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
 1. 120/208 V Panelboard: 22,000 A symmetrical.
 2. 120/240 V Panelboard: 22,000 A symmetrical.
 3. 277/480 V Panelboard: 22,000 A symmetrical.
- D. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 A frame or lower. Magnetic trip shall be adjustable from 3x to 10x for breakers with 600 A frames and higher. Factory setting shall be HI, unless otherwise noted. Re-adjust breaker trip setting in the field, based on the approved protective device study as specified in Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY.
- E. Breaker features shall be as follows:
 1. A rugged, integral housing of molded insulating material.
 2. Silver alloy contacts.
 3. Arc quenchers and phase barriers for each pole.
 4. Quick-make, quick-break, operating mechanisms.

5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.
8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where indicated.
10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the circuit breakers are being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. Install a printed schedule of circuits in each panelboard after approval by the COTR. Schedules shall be printed on the panelboard directory cards, installed in the appropriate panelboards, and incorporate all applicable contract changes. Information shall indicate outlets, lights, devices, or other equipment controlled by each circuit, and the final room numbers served by each circuit.
- D. Mount the fully-aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78 in [1980 mm]. Mount panelboards that are too high such that the bottom of

the cabinets will not be less than 6 in [150 mm] above the finished floor.

- E. Rust and scale shall be removed from the inside of existing backboxes where new panelboards are to be installed. Paint inside of backboxes with rust-preventive paint before the new panelboard interior is installed. Provide new trim and doors for these panelboards. Covers shall fit tight to the box with no gaps between the cover and the box.

3.2 ACCEPTANCE CHECKS AND TESTS

Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:

1. Visual and Mechanical Inspection

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical, electrical, and mechanical condition.
- c. Verify appropriate anchorage and required area clearances.
- d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
- e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
- f. Clean panelboard.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

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**SECTION 26 27 26
WIRING DEVICES****PART 1 - GENERAL****1.1 DESCRIPTION**

This section specifies the furnishing, installation and connection of wiring devices.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlets boxes.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.
- C. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the COTR: Technical data sheets and information for ordering replacement units.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

- B. National Fire Protection Association (NFPA):
70-Latest Edition.....National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA):
WD 1.....General Color Requirements for Wiring Devices
WD 6Wiring Devices - Dimensional Requirements
- D. Underwriter's Laboratories, Inc. (UL):
5.....Surface Metal Raceways and Fittings
20.....General-Use Snap Switches
231.....Power Outlets
467.....Grounding and Bonding Equipment
498.....Attachment Plugs and Receptacles
943.....Ground-Fault Circuit-Interrupters

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall be listed by Underwriters Laboratories, Inc., and conform to NEMA WD 6.
 - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
 - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.
- B. Duplex Receptacles: Hospital-grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.
 - 1. Bodies shall be ivory in color.
 - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be unswitched.
 - 3. Duplex Receptacles on Emergency Circuit:
 - a. Bodies shall be red in color.
 - 4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box.
 - a. Ground fault interrupter shall be consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliamp) on the load

side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second.

- b. Ground Fault Interrupter Duplex Receptacles (not hospital-grade) shall be the same as ground fault interrupter hospital-grade receptacles except for the "hospital-grade" listing.

5. Safety Duplex Receptacles:

- a. Bodies shall be gray in color.

- 1. Shall permit current flow only while a standard plug is in the proper position in the receptacle.

- 2. Screws exposed while the wall plates are in place shall be tamperproof type.

6. Duplex Receptacles (not hospital grade): Shall be the same as hospital grade duplex receptacles except for the "hospital grade" listing and as follows.

- a. Bodies shall be brown phenolic compound supported by a plated steel mounting strap having plaster ears.

C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.

D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2.2 TOGGLE SWITCHES

A. Toggle Switches: Shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles shall be ivory in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.

- 1. Switches installed in hazardous areas shall be explosion proof type in accordance with the NEC and as shown on the drawings.

- 2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.

- 3. Ratings:

- a. 120 volt circuits: 20 amperes at 120-277 volts AC.

- b. 277 volt circuits: 20 amperes at 120-277 volts AC.

2.3 WALL PLATES

- A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.
- B. Color shall be ivory unless otherwise specified.
- C. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD 6.
- D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- E. Wall plates for data, telephone or other communication outlets shall be as specified by VA Medical Center.
- G. Duplex Receptacles on Emergency Circuit:
 - 1. Bodies shall be red in color. Wall plates shall be red with the word "EMERGENCY" engraved in 6 mm, (1/4 inch) white letters.

2.4 SURFACE MULTIPLE-OUTLET ASSEMBLIES

- A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.
- B. Shall have the following features:
 - 1. Enclosures:
 - a. Thickness of steel shall be not less than 0.040 inch [1mm] steel for base and cover. Nominal dimension shall be 1-1/2 by 2-3/4 inches [40 by 70mm] with inside cross sectional area not less than 3.5 square inches [2250 square mm]. The enclosures shall be thoroughly cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer finish.
 - 2. Receptacles shall be duplex, hospital grade. See paragraph 'RECEPTACLES' in this section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
 - 3. Unless otherwise shown on drawings, spacing of the receptacles along the strip shall be 24 inches [600mm] on centers.
 - 4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
 - 5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.
 - 6. Bond the strips to the conduit systems for their branch supply circuits.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.
- C. Outlet boxes for light shall be mounted on the strike side of doors.
- D. Provide barriers in multigang outlet boxes to separate systems of different voltages, Normal Power and Emergency Power systems, and in compliance with the NEC.
- E. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- F. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades. In addition, check for exact direction of door swings so that local switches are properly located on the strike side.
- G. Install wall switches 48 inches [1200mm] above floor, OFF position down.
- H. Install convenience receptacles 18 inches [450mm] above floor, and 6 inches [152mm] above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- I. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.
- J. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
- K. Test GFCI devices for tripping values specified in UL 1436 and UL 943.

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**SECTION 26 29 21
DISCONNECT SWITCHES**

PART 1 - GENERAL**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of low voltage disconnect switches.

1.2 RELATED WORK

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES 600 VOLTS AND BELOW: Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.
- F. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Motor rated toggle switches.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, and fuse types and classes.
 - 3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.
- C. Manuals:
 - 1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the COTR two weeks prior to final inspection.

2. Terminals on wiring diagrams shall be identified to facilitate maintenance and operation.
3. Wiring diagrams shall indicate internal wiring and any interlocking.
- D. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the COTR:
 1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
 2. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Electrical Manufacturers Association (NEMA):
 - FU 1-07.....Low Voltage Cartridge Fuses
 - KS 1-06.....Enclosed and Miscellaneous Distribution
Equipment Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA):
 - 70-Latest Edition.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
 - 98-04.....Enclosed and Dead-Front Switches
 - 248-00.....Low Voltage Fuses
 - 977-94.....Fused Power-Circuit Devices

PART 2 - PRODUCTS

2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

- A. In accordance with UL 98, NEMA KS1, and NEC.
- B. Shall have NEMA classification General Duty (GD) for 240 V switches and NEMA classification Heavy Duty (HD) for 480 V switches.
- C. Shall be HP rated.
- D. Shall have the following features:
 1. Switch mechanism shall be the quick-make, quick-break type.
 2. Copper blades, visible in the OFF position.
 3. An arc chute for each pole.
 4. External operating handle shall indicate ON and OFF position and have lock-open padlocking provisions.
 5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable to permit inspection.
 6. Fuse holders for the sizes and types of fuses specified.
 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 8. Ground lugs for each ground conductor.

9. Enclosures:

- a. Shall be the NEMA types shown on the drawings for the switches.
- b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R, indoor wet locations shall be NEMA 4 and hazardous locations shall be explosion-proof.
- c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

2.2 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but without provisions for fuses.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches in accordance with the NEC and as shown on the drawings.
- B. Fusible disconnect switches shall be furnished complete with fuses.
Arrange fuses such that rating information is readable without removing the fuse.

3.2 SPARE PARTS

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the COTR.

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**SECTION 26 56 00
EXTERIOR LIGHTING**

PART 1 - GENERAL**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of exterior luminaries, and supports.

1.2 RELATED WORK

- A. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for exterior light supports and luminaries.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- D. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- G. Section 26 09 23, LIGHTING CONTROLS: Controls for exterior lighting.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, luminaires, lamps, and accessories. Include electronic photometric files in IES format, or provide link (URL) to manufacturer's website that contains photometric data for each specific fixture used, excluding wallpack fixtures.

- C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the COTR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement lamps, ballasts, and parts.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:
1. Certification by the manufacturer that the materials are in accordance with the drawings and specifications.
 2. Certification by the contractor that the complete installation has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Aluminum Association Inc. (AA):
AAH35.1-06.....Alloy and Temper Designation Systems for
Aluminum
- C. American Concrete Institute (ACI):
318-05Building Code Requirements for Structural
Concrete
- D. American National Standards Institute (ANSI):
C81.61-09Electrical Lamp Bases - Specifications for
Bases (Caps) for Electric Lamps
- E. American Society for Testing and Materials (ASTM):
A123/A123M-09Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
A153/A153M-09.....Zinc Coating (Hot-Dip) on Iron and Steel
Hardware
B108-03a-08Aluminum-Alloy Permanent Mold Castings
- F. Illuminating Engineering Society of North America (IESNA)
HB-9-00.....Lighting Handbook
RP-33-99.....Lighting for Exterior Environments
LM-5-96.....Photometric Measurements of Area and Sports
Lighting Installations
LM-72-97.....Directional Positioning of Photometric Data

LM-79-08.....Approved Method for the Electrical and
Photometric Measurements of Solid-State Lighting
Products

I. National Electrical Manufacturers Association (NEMA):

C78.43-07Electric Lamps - Single-Ended Metal-Halide
Lamps

C78.1381-98.....Electric Lamps - 70-Watt M85 Double-Ended
Metal-Halide Lamps

C136.3-05For Roadway and Area Lighting Equipment -
Luminaire Attachments

C136.17-05Roadway and Area Lighting Equipment - Enclosed
Side-Mounted Luminaires for Horizontal-Burning
High-Intensity-Discharge Lamps - Mechanical
Interchangeability of Refractors

ICS 2-00 (R2005)Controllers, Contactors and Overload Relays
Rated 600 Volts

ICS 6-93 (R2006)Enclosures

J. National Fire Protection Association (NFPA):

70-Latest EditionNational Electrical Code (NEC)

K. Underwriters Laboratories, Inc. (UL):

496-08Lampholders

773-95.....Plug-In, Locking Type Photocontrols for Use
with Area Lighting

773A-06Nonindustrial Photoelectric Switches for
Lighting Control

1598-08Luminaires

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be in accordance with NEC, UL, ANSI, and
as shown on the drawings and specified.

2.2 LUMINAIRES

- A. Per UL 1598 and NEMA C136.17. Luminaires shall be weatherproof, heavy
duty, outdoor types designed for efficient light utilization, adequate
dissipation of lamp and ballast heat, and safe cleaning and relamping.
- B. Incorporate ballasts in the luminaire housing, except where otherwise
shown on the drawings.
- C. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with
prismatic refractors, unless otherwise shown on the drawings. Use heat

and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

- D. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking-type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61 and UL 496.
- E. Pre-wire internal components to terminal strips at the factory.
- F. Bracket-mounted luminaires shall have leveling provisions.
- G. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- H. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
- I. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.3 LAMPS

- A. Install the proper lamps in every luminaire installed.
- B. Lamps shall be general-service, outdoor lighting types.
- C. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381.

2.4 METAL HALIDE CORE AND COIL BALLASTS

- A. Shall be pulse start, linear reactor type for 277 volt luminaires and constant-wattage autotransformer (CWA) type for other voltage luminaires (if not otherwise specified).
- B. Ballasts shall have individual overcurrent protection in each ungrounded supply conductor.
- C. Power factor shall be not less than 90%.
- D. Ballast shall have an allowable line voltage variations of $\pm 5\%$ for linear reactor type and $\pm 10\%$ for CWA, with a maximum 20% lamp wattage regulation spread.
- E. Ballast shall have a minimum starting temperature of -40° F [-40° C].
- F. Lamp current crest factor shall be 1.8 or less, in accordance with lamp manufacturer recommendations.

2.5 METAL HALIDE ELECTRONIC BALLASTS

- A. Ballast shall be low-frequency electronic type, and shall operate pulse start and ceramic metal halide lamps at a frequency of 90 to 200 Hz square wave.
- B. Ballast shall be labeled Type '1' outdoor, suitable for recessed use, Class 'P'.

- C. Ballast shall have auto-resetting thermal protector to shut off ballast when operating temperatures reach unacceptable levels.
- D. Ballast shall have an end of lamp life detection and shut-down circuit.
- E. Lamp current crest factor shall be 1.5 or less.
- F. Ballasts shall comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
- G. Ballast shall have a minimum ballast factor of 1.0.
- H. Input current THD shall not exceed 20% for the primary lamp.
- I. Ballasts shall have ANSI C62.41, category 'A' transient protection.
- J. Ballasts shall have power factor greater than 90%.
- K. Ballast shall have a Class 'A' sound rating.

2.6 EXISTING LIGHTING SYSTEMS

- A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Install lamps in each luminaire.
- C. Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment, including luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.3 ACCEPTANCE CHECKS AND TESTS

Verify operation after installing luminaires and energizing circuits.

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